The AIRCRAFT YEAR BOOK

For 1942

ACCA

LEADING THE NATION INTO FLIGHT

HARRISON BRAND, JR.

AIRCRAFT YEAR BOOK FOR 1942

U. S. Army photo

U. S. ARMY PARATROOPS

The
AIRCRAFT YEAR BOOK

(Registered U. S. Patent Office)

For 1942

TWENTY-FOURTH ANNUAL EDITION

HOWARD MINGOS
Editor

Published by the

AERONAUTICAL CHAMBER OF COMMERCE
OF AMERICA, INC.

30 Rockefeller Plaza New York

MANUFACTURED COMPLETE BY
THE COLONIAL PRESS INC., CLINTON, MASS.

TABLE OF CONTENTS

ILLUSTRATIONS

AIRPLANE DESIGN DRAWINGS

U. S. Navy photo

ABOARD A U. S. NAVY AIRCRAFT CARRIER

Fighters and bombers warming up on the flight deck before take-off.

CHAPTER I

THE WAR IN THE AIR

Air Force Strength Proves Dominant Military Factor—The German Campaigns—The British and Russians Strike Back—The War Spreads to Asia—Treachery Enables Japan to Take Advantage of the Element of Surprise—United Nations Prepare for Decisive Aerial Victories.

As this 24th annual edition of the Aircraft Year Book goes to press early in April, 1942, World War II has spread to all continents, and now at last among all the peoples trying to save our civilized way of life there is the awful realization that air power, superior air power, can dominate any military situation on land or sea. That lesson should have struck home two years ago when the German legions ravished most of Europe with their superior air power; and it should have been a self-evident truth when they failed to annihilate England because her heroic, amazingly efficient Royal Air Force managed to maintain superior strength at home and either shot down the Germans or drove them helter-skelter back to their own sties. Such was the lesson, the bitter lesson, of the war up to a year ago.

The British were doing fairly well in North Africa for several months, their advance against the Axis armies paced by American pursuit planes and bombers, along with the few British machines they thought they could spare from other far-flung outposts of the Empire. But they underestimated Axis air strength again. Pausing only long enough in April to blast the Yugoslavian armies into oblivion with their heavy bombers and attack planes, the Germans went on into Greece and took that gallant nation before the end of the month. Then they flew at the throats of the British in Libya again. Crete was supposed to be the scene of a last stand opposition to the Axis thrust to the East. The Germans flew in their air forces on May 21, contemptuously using gliders for army transport in defiance of the

BELL AIRACOBRA OVER ENGLAND

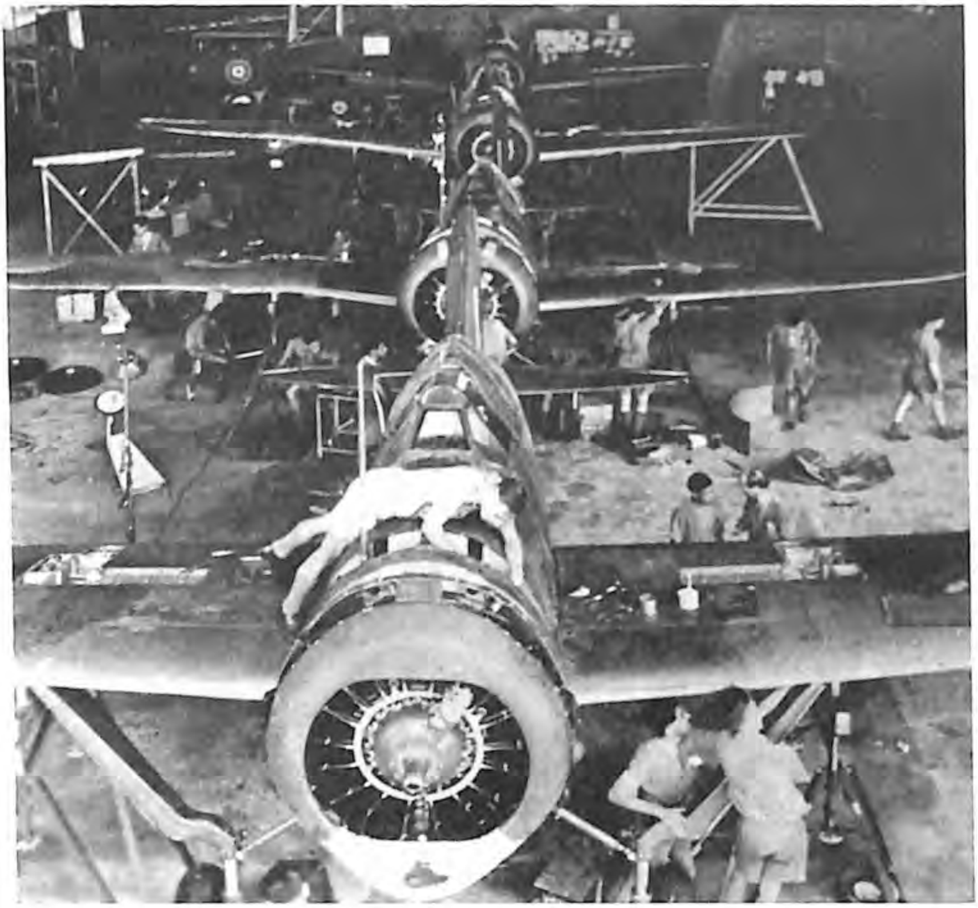
One of the hundreds of Bell high firepowered pursuit planes on guard against German attack.

British R. A. F. and Empire troops, and while the Royal Navy squadrons were ranging the neighboring seas. Crete was in German hands by June 1, a pitiful example of the effectiveness of superior strength in the air. And in those two months of successful campaigning against Yugoslavia, Greece and Crete, the Axis had forced the British to keep full strength at home by raiding London. At the same time the Axis air forces were showing increased strength in Libya. The British, too, had managed to show air strength, on May 18 when they forced the Italians to surrender in Ethiopia, also on May 27 when, with the aid of an American Consolidated Catalina flying boat, they sank the battleship Bismarck, and again on May 31 when they settled the uprising which had menaced their oil supplies in Iraq. However small by comparison with Axis air victories, these achievements of the British also were convincing.

Hitler's characteristic invasion of Russia without warning on June 22 was accompanied by the greatest display of air force in history. It ranged across a front of 2,000 miles from the Arctic to the Black Sea, falling upon the border strongholds and blowing them up before the Russians knew they were in the war. This German treachery, because of the element of surprise, enabled the aerial invaders to swoop down and take a stupendous toll in Soviet flying personnel and their planes before they could get into the air and defend themselves—enough to delude Hitler into believing for weeks, as he boasted, that he had destroyed the Russian air force. He had

FROM THE NOSE OF A FLYING FORTRESS

A view duplicated many times in the war. Boeing B-17E Flying Fortresses in flight above the clouds. Photo taken through the nose of a B-17E with another flying ahead. Note the bombardier to the left, and the small ship on the water far below. A reflection of the bombardier's face may be seen in the sighting window.



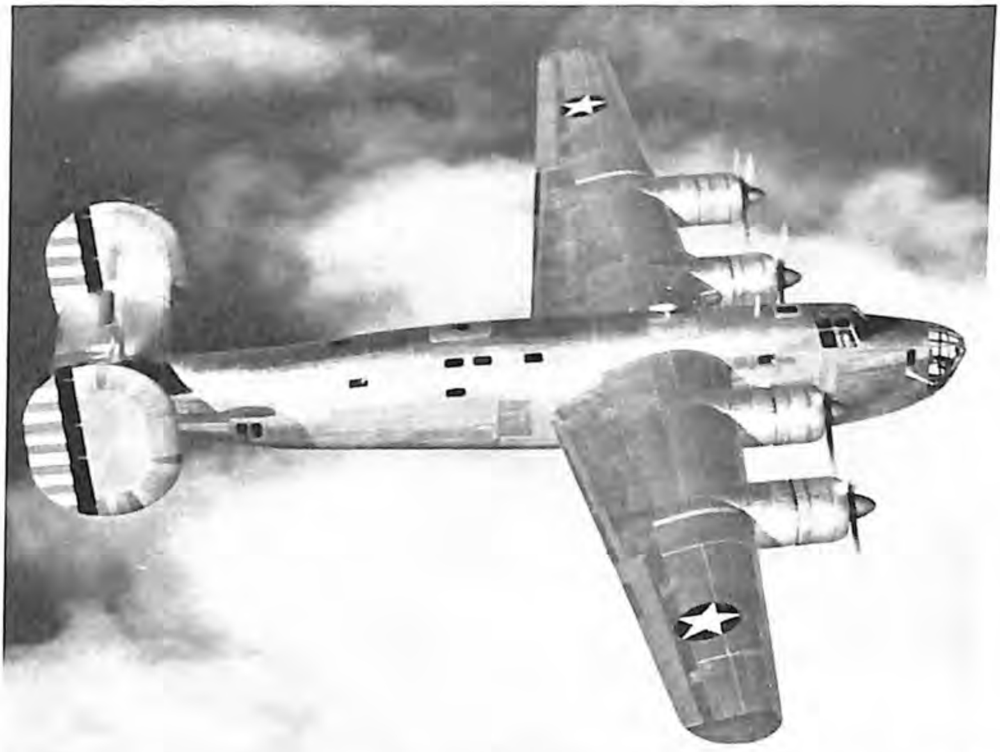
BREWSTERS AT SINGAPORE

Putting Brewster Buffalo fighters in flying condition before the battle. They were repeatedly mentioned in dispatches for the devastating work.

crippled it, yes, and both the United States and Britain had to rush forth all possible reinforcements, but the long established Soviet policy of building up air power as rapidly as Russian resources permitted had given them a remarkable reserve. This, with augmented shipments from their allies, helped the Soviet air forces to punish the Germans continuously during the Winter of 1941-42.

It was a known fact in Army circles that the gallant stand by Greece had been the one thing to upset the German timetable. Hitler had to settle with Greece before he could attack Russia. The Greek resistance so delayed the Germans that they went into Russia several weeks late; and Winter caught their air forces and armies before they could complete the first season's phase of the campaign against the Soviet.

Yet all this, and all that had gone before, was only the beginning of the world catastrophe. In the light of what was to follow, it is difficult to realize that not until August 1, 1941, did the United States ban shipments of aviation fuel to Japan, to be followed 18 days later by the establishment of a bomber ferry service across the South Atlantic and across Africa to the Near East. This helped the British to launch a great offensive in Libya on November 19. Then, on December 7, while her emissaries actually were negotiating settlement of mutual problems with the American Government in Washington, Japan struck without the slightest warning and according to the most infamous of the Axis precepts for starting a war—by way of the air, on the same day against American Army and Navy bases,



U. S. Army photo

THE ARMY AIR FORCES CONSOLIDATED BOMBER

The B-24, four-engine long-range fast bomber which the British R. A. F. named Liberator.

FOR FIGHT AND FRIGHT

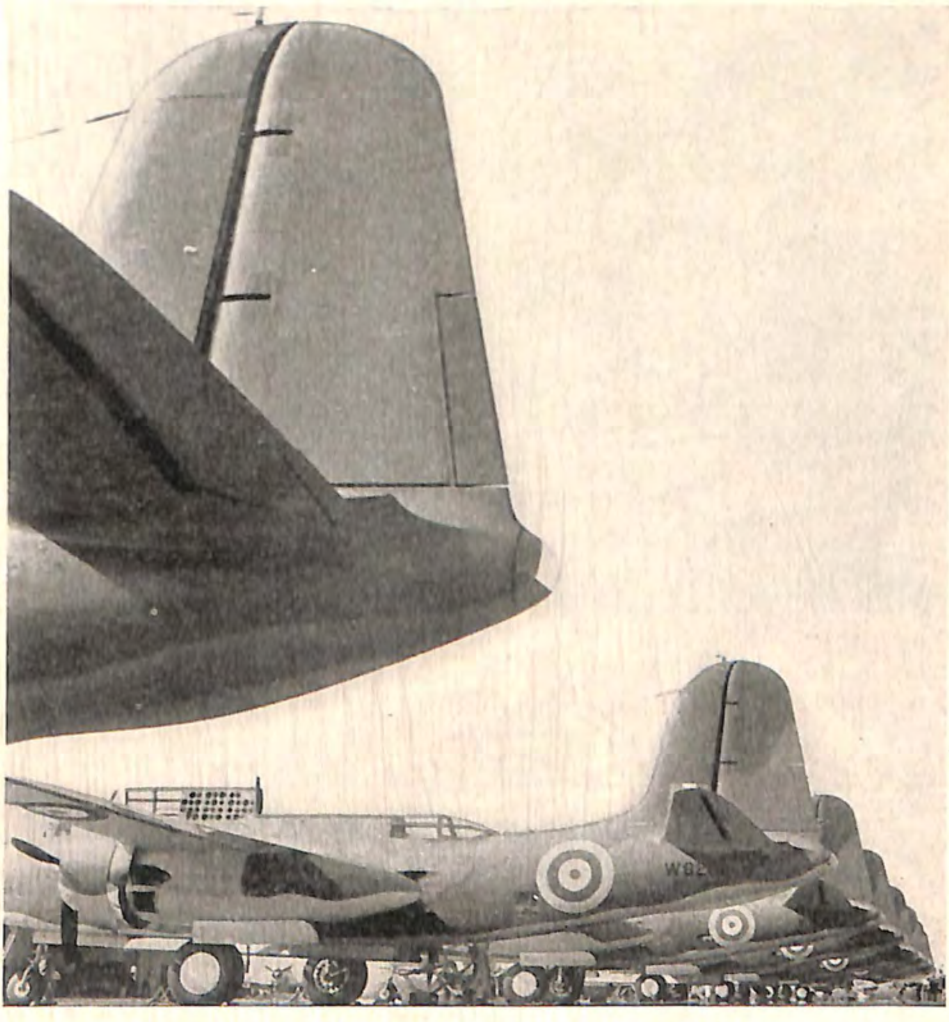
R. A. F. pilots in the African campaign painted a squadron of Curtiss Tomahawks to look like sharks.

and neighboring civil communities at Pearl Harbor in Hawaii, Manila in the Philippines, Wake and other islands, and against the British in Hong Kong and Malaya.

"The Japs dominate the air! Their bombers blast an open road for their surface forces!" This simple explanation came out of the Southwest Pacific hour by hour as those benighted spawn of Nippon swept away nearly all resistance. Two days after Pearl Harbor, a British admiral took out from Singapore two of the greatest battleships in His Majesty's Navy, the "Prince of Wales" and the "Repulse." They went forth seeking battle without any aerial escort, and in less than 15 minutes after Japanese torpedo planes let go at them, these leviathans of Britain's naval supremacy sank from sight beneath an oily sea; and the Japs went on their way to one victory after another, taking Hong Kong, Manila and about 40 per cent of the Philippine domain, driving General Douglas MacArthur and his American-Filipino army into an almost hopeless defense on Bataan Peninsula. MacArthur had been forced to give up Manila to save it from destruction by the overwhelmingly powerful and ruthless Japanese air forces.

Malaya went the same way, and finally Singapore—all softened for the kill by Jap bombers, even as other squadrons bearing the insignia of the rising sun held American and British fighters at bay in the skies over Burma; and by sheer numerical supremacy wore out the resistance of the gallant Dutch and other flyers of the United Nations in the Netherlands East Indies.

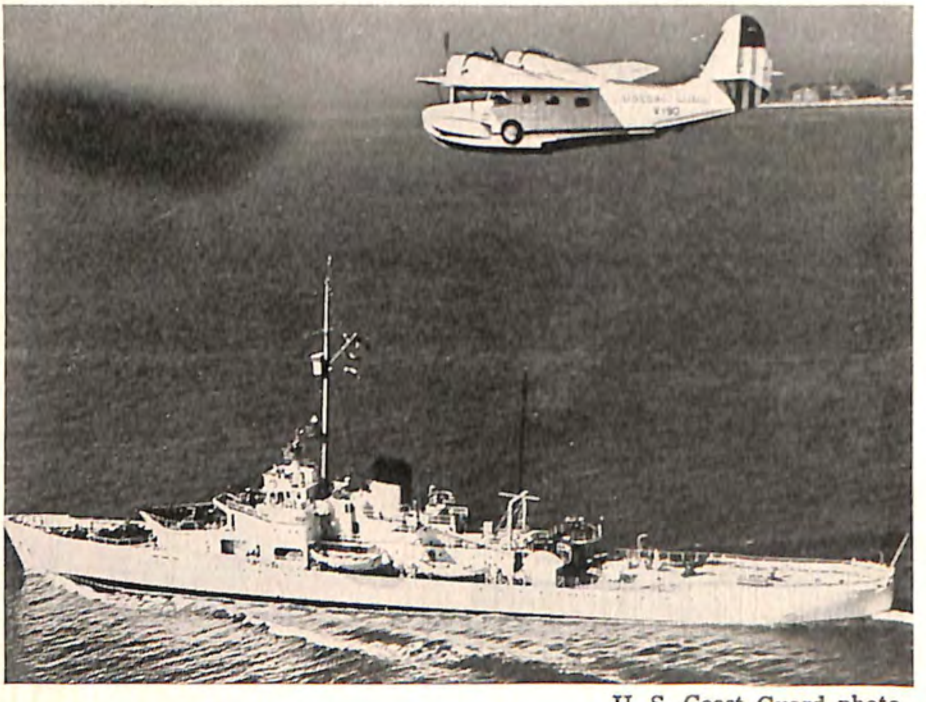
It was numerically stronger air power supported by surface forces on land and sea, well-coordinated and operating with devilish precision and persistence—the result of preparedness in the air—it was this stronger air power that carried Japan to one victory after another



MASS PRODUCTION OF DOUGLAS BOMBERS

The huge assembly line of bombers moves outside the Douglas plant for the final touches in order to speed up production.

during her first four months of easy conquest. At last the United Nations knew that if they were to save what was left and have a chance of regaining that which had been taken so easily, they must do it with superior air force strength, a dominantly superior air power which only the United States could provide.



U. S. Coast Guard photo

GUARDIANS OF THE COASTS

A U. S. Coast Guard Grumman amphibion and the cutter "Spencer" leaving port on patrol duty.

CHAPTER II

U. S. AIR POWER TO DETERMINE VICTORY

American Air Strength Needed Throughout the World—Our Fateful Responsibility—Preparing the Most Destructive Force in the History of Warfare—Official Reports of Superior Performance of American Planes—The Harter Report—The Mac Leish Report—The Results of Long Range Planning by the Army and Navy Air Forces in Cooperation with the Aircraft Manufacturers—Frightful Surprises Promised the Enemy.

AS this is written early in April, 1942, the United States has been at war only about four months, yet it is already apparent that American air power must be built up for action on all fronts, over all continents and all seas, if the United Nations are to emerge victors from a conflict that now grips the whole world. There is no question about it. Planes, flyers, maintenance crews and a continuous flow of air force supplies in rapidly increasing volume must be provided in order to blast out the enemy everywhere. Everywhere that he has gained a foothold must be the ultimate scene for aerial warfare carried on largely with American equipment operated and kept serviceable by Americans. In every quarter the enemy must be driven back from lands he now occupies, largely by force of his own air strength acquired over long years of fiendish toil in preparing this holocaust, while non-aggressive peoples lived comfortably in the fancied security of peace. Only the maximum of effort here in the United States can provide the air power required to restore that peace.

China must have American planes, flyers, service crews and a steady stream of supplies. So must the Pacific islands, Australia, New Zealand, India, North and South and Central Africa. So must Russia, the Near East, and above all, England, and ultimately Norway, Free France and others now craving American help in expelling the invaders.

THE LOCKHEED BOMBER POOL

Hundreds of these Lockheed Hudson bombers have been finally tested, inspected and serviced here outside the factory for flyaway delivery to the British Royal Air Force.

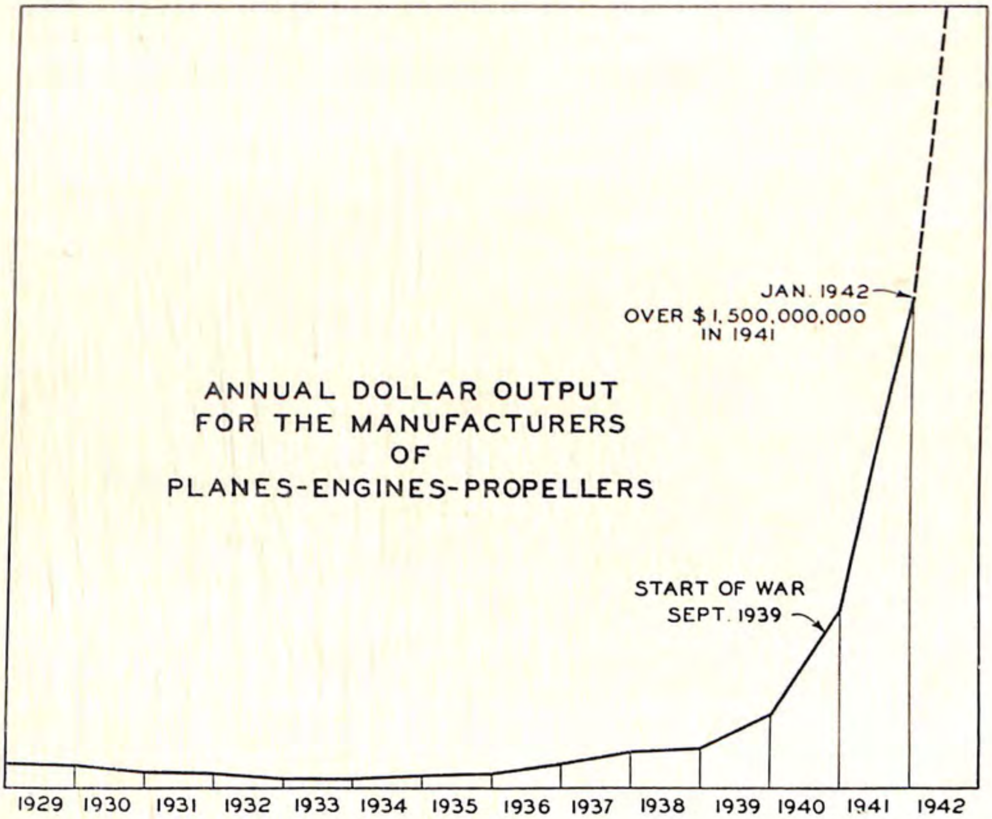
All armies that we and our allies send against the enemy from now on must have some of our air power. Even the British will continue to need this help from us because they will not have enough air force strength of their own, not even in the British Isles. All this must be convoyed, and every convoy should have air protection. All supply lines must receive the same kind of protection, on both land and sea, protection against attack from the air. They must be guarded both going and coming, while taking out personnel, munitions, foods and the thousand and one other things needed in a campaign, and guarded equally as well while bringing into the United States the raw materials so vital to this, the greatest of arsenals.

The entire Western Hemisphere must be safeguarded by our air power—all our far-flung bases in all our neighboring seas, all the coastlines, the islands off every shore. Still that is not all. Our surface Navy must have more air force than the enemy can possibly bring up for attack at any one place, at sea or in port, throughout the world. At the same time, our striking air forces must be numerically superior on every mission everywhere. And finally, our

American air forces must be built up to a strength which will enable them to take home to the enemy, in every lair where this evil spawns, the ceaseless, devastating attacks with thousands of tons of high explosive bombs that must obliterate eventually his arsenals and his home defense, in some cases inevitably annihilate his people on the ground, and win the war.

No nation in history has been confronted with such a stupendous task, such fateful responsibility. And only history can record the outcome. All that we can do here is to set down some of the work to date and outline briefly what is in progress for the near future development of our air power.

Thousands of aviators? The program early in 1942 called for more than a hundred thousand for our Army and Navy air forces. For the Army Air Forces, the program then under way demanded 30,000 trained pilots a year and 10,000 bombardiers and navigators, with the figures to be doubled as quickly as facilities could be provided. The program for 100,000 airplane technicians and mechanics a year was to be tripled. The Navy plan called for 30,000 trained



THE MARTIN B-26 BOMBER

With all the latest features demanded in combat, it has great fire power, power-driven turrets, self-sealing fuel tanks and protective armor. It has two Pratt & Whitney 1,850 h.p. engines and Curtiss four-blade automatic electric full feathering propellers 13½ feet in diameter. Its gross weight is 26,625 pounds. Used by the Army Air Forces.

aviators and a proportionate number of crew members, besides a huge force of mechanics. The two branches combined were on their way toward an aerial army of about two and a half million men, with possibilities of increasing it before the end of the war.

Setting up facilities for this mass training and establishing operations bases for the air forces was a gigantic task in itself, as Chapter VI, on training, shows in considerable detail.

Planes? President Roosevelt in his message to Congress on January 6, 1942, set the goal. He said that the program called for 60,000 planes, including 45,000 combat, in 1942, and 125,000, including 100,000 combat, in 1943. The 1941 output had been approximately 20,000. In official circles it was believed that the President's program would be modified to reduce the 1942 output to about 45,000 planes of all types, in order to permit retooling of some factories for mass production of newer models, thereby avoiding too much obsolescence in service planes. A production of 45,000 planes in 1942 would be a miracle of industrial accomplishment, even with an industry accustomed to being credited with having performed such miracles in the past.

On December 4, 1941, Colonel John H. Jouett, president of the Aeronautical Chamber of Commerce of America, in his annual report stated:

"The aircraft manufacturers of the United States this year are turning out several thousand more military planes than the most optimistic of Government officials dared to hope for 12 months ago when they called upon the industry to speed up its output which even then was breaking all records. Our output of nearly 20,000 military planes this year is more than eight times the production two years ago, in 1939. The dollar volume of more than one and a half billion dollars in production of planes, engines and propellers in 1941 is about triple that of last year. The production rate is rising month by month. Our engine plants have now reached a monthly production rate of nearly six million horsepower, 12 times the monthly rate at the outbreak of the war in late 1939.

"That has been accomplished by experienced management expanding plant facilities and training the thousands of new employes so essential to increased production. During the last year our plant space has been increased from more than 25,000,000 square feet to nearly 46,000,000 square feet, not counting that now under construction and which will be in operation within the next six months. Our airplane, engine and propeller plants have increased employes from over 193,000 a year ago to about 390,000 at the present time. We are supplying the air forces of the United States, Britain and other governments with more than 30 different types of combat aircraft.

PRODUCTION FOR WAR

Part of the B-25 medium bomber assembly floor at one of the North American Aviation plants.

THE NEW REPUBLIC P-47 THUNDERBOLT

Turbo-supercharging equipment for operations at unusually high altitudes and the huge Pratt & Whitney Twin Wasp 2,000 h.p. engine with heavy armor and armament contributed to the fighting qualities of this new interceptor for the Army Air Forces.

They are in service on all continents and in all war zones. Their performance and reliability in action is the subject of a steady stream of laudatory official reports flowing back here from those who use them. The vastly increased output and the fine performance make this year's achievement of our manufacturers an industrial miracle.

"The 1941 record, however, is only part of the story. It has been our first year of real production for defense. During the next two years our industry, its subcontractors and other companies which are preparing to produce aircraft equipment, will be called upon to deliver much more than a hundred thousand planes. You will recall that when President Roosevelt in his defense message of May 16, 1940, said that he would like to see the industry able to turn out 50,000 planes a year, it seemed a fantastic figure in view of the past both here and abroad. We now have every reason to believe that an annual production rate of 50,000 planes will be reached sometime in 1942. Moreover, not all these planes will be frozen models. Our manufacturers even now either have in the design stage or are actually experimenting with no less than 40 new models of military aircraft. If the production rate is not developed as stated here or new models are not produced to maintain our superiority in the air, it will not be the fault of the aircraft industry; it will be due to other circumstances beyond our control."

Further evidence of the gigantic task undertaken by the aircraft industry and its ability to supply the necessary equipment was supplied by the Subcommittee of the House of Military Affairs Committee, with Congressman Dow Harter of Ohio, as chairman. After an investigation of several months, the Harter Committee made public its report early in February, 1942. Of certain aspects of the aircraft program, the report stated:

"When Germany was building up her air force beginning in 1934, our Army Air Corps had less than 1,450 planes and 1,500

VOUGHT-SIKORSKY PRODUCTION

Assembly lines of Kingfisher OS2U-3 Navy observation scout planes at the Vought-Sikorsky Aircraft plant.

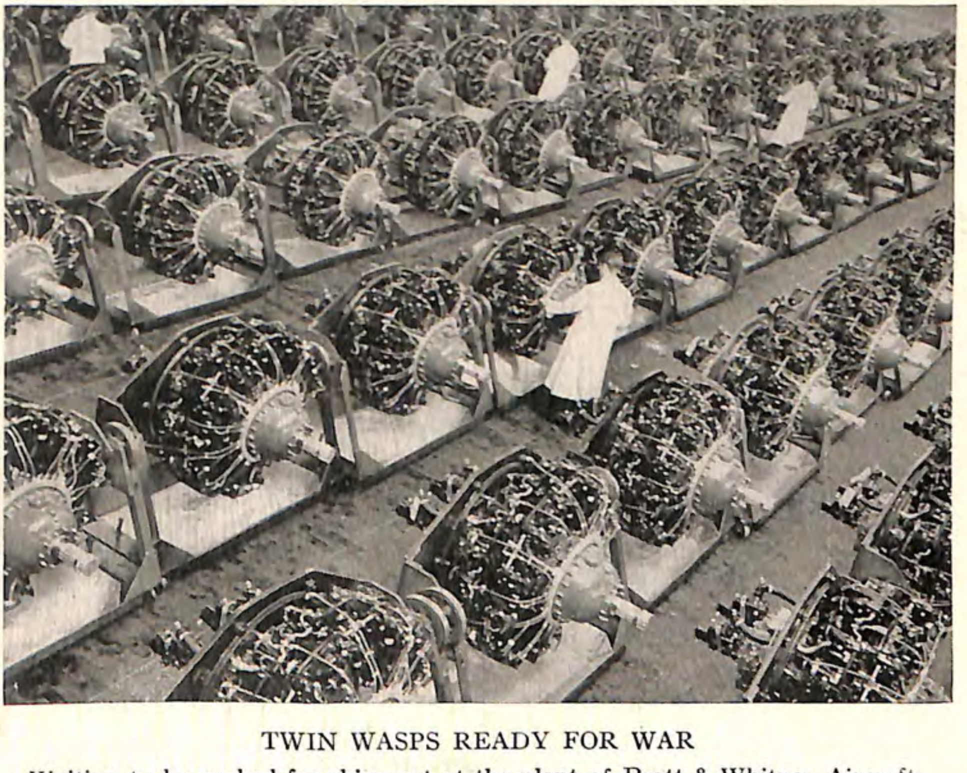
VULTEE VANGUARD PURSUIT

Loading machine gun bullets in one of the Vanguards sent to China.

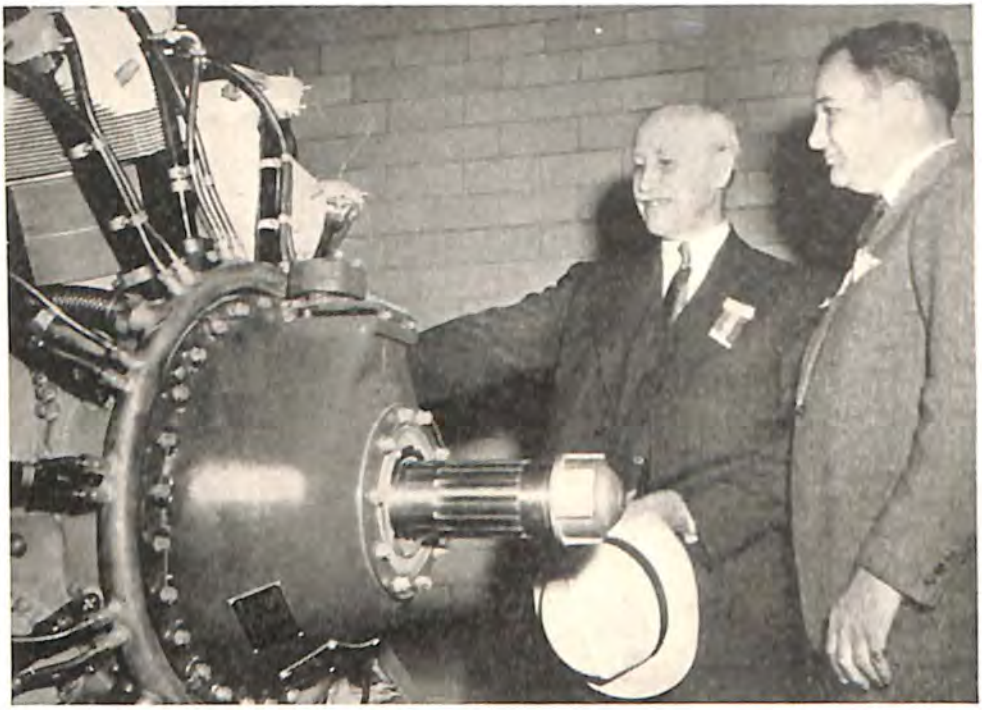
officers, four years later it had 1,773 planes and 2,079 officers. It will be remembered that our goal and authorized strength of the Army Air Corps was 2,140 planes. This was never reached and it was not until passage of the Act of April 3rd, 1939, that Congress authorized any considerable increase in Army airplane strength. That Act authorized a strength of 5,500 Army planes. When one considers the insignificance of the volume of business going to aircraft manufacturers in the United States during the period from 1930 to 1938 inclusive, he realizes immediately that it was not a mass production business and that planes were very much a 'tailor-made' proposition. Jointly the airplane manufacturers of this country enjoyed during that period annual business consisting of two to three hundred of the larger type commercial planes and a few hundred each of Army and Navy military types. Suddenly with our own expanded program in 1939, together with the large orders that came from the French and British and then neutral nations, including Norway, the Netherlands and the others, the industry was called upon to make the most drastic expansion that could be conceived. This entailed the building of thousands of feet of additional floor space, acquiring and installing of additional tools, increases in managerial and supervisory personnel, which was a terrific job, and the training of thousands of workmen. In 1939 the airplane manufacturers of this country employed fewer than 30,000 people, by the end of 1940 our airplane, engine and propeller plants had increased the number of employees to nearly 200,000 and in December of 1941 double that number was employed in the industry or about 390,000.

"The aircraft industry itself was faced with a tremendous problem in finding the necessary skilled personnel needed to operate the vastly expanded plants. In order to accomplish this it was learned that individual manufacturers had evolved a program of training inexperienced people. This was done by establishing night schools in cooperation with local school authorities where instruction could be given to prospective employees. The instructors in these schools were provided by the companies and in this way a large reservoir of skilled workmen was created during the period of expansion of the industry. The beneficial results of the first experiments along this line have justified using this program throughout the industry, and have made possible the enormous development and growth which has taken place. The further utilization of this procedure will make possible the still further expansion which will be necessary to achieve the production schedules of 1943.

"This Special Committee has visited many of the great aircraft manufacturing plants of this country. We have observed shop methods in small plane factories and in those where four-engine bombers and other types of planes are manufactured. Tremendous strides



TWIN WASPS READY FOR WAR
Waiting to be packed for shipment at the plant of Pratt & Whitney Aircraft.



THIS IS ALL WRIGHT

Orville Wright (left) who with his brother Wilbur invented the airplane, and Guy W. Vaughan, president of Curtiss-Wright Corporation, inspect a Wright engine at the company's new plant in Cincinnati.

have been made in the use of tools and machinery in the building of airplanes, and approved methods of mass production where possible have been introduced and assembly lines somewhat similar to those in the automotive industry have been installed to facilitate and speed up the production of planes.

"As is now generally known, the War Department has not been content to depend solely upon the expanded facilities of the aircraft industry itself but many of our prominent manufacturers with great experience in the production of civilian merchandise and with known reputations for managerial ability have been called upon to produce airplane parts and huge assembly plants have been created into which these parts are being and will be fed, so that the flow of finished aircraft will continuously increase. All in all, this Special Committee finds the aircraft manufacturers have been made up of forward looking business men who have had tremendous problems confronting them during the last several years, but who have surmounted most obstacles and are performing a most important and patriotic service to their country. Some mistakes have been made, which is only natural, but the industry when requested to do a job has proceeded to perform it in the most approved American fashion.

"Without disclosing the actual production figures of military aircraft today, you can grasp the tremendous strides that have been made in two years when we know that our output of military airplanes of all types in January, 1940, numbered 265. In August, 1941, we produced more planes than we did during the entire first six months of 1940. In December, 1941, we produced about three times the number of planes that we produced during the same month in 1940."

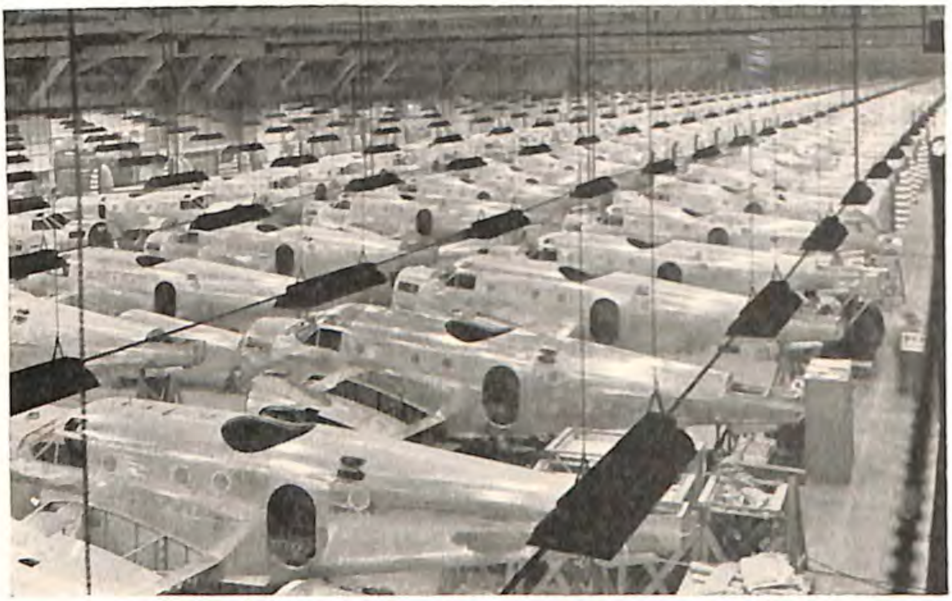
From many other official sources there were reports of a most encouraging kind about the increased production and the fine performance qualities of our airplanes. In January, 1942, in response to a request from President Roosevelt, the Federal Office of Facts and Figures issued its first "Report to the Nation," popularly named the MacLeish report after Archibald MacLeish, able director of that bureau. The report stated: "We now have four types of combat planes better than anything yet produced abroad, so far as is known. . . . American bomber types now in mass production are superior to those built anywhere else in the world. Still better models are on the way."

No small part of the credit for the excellent production capacity of the industry at this stage of the conflict must be given Lieutenant General Henry H. Arnold, Chief of the Army Air Forces, and Rear Admiral John H. Towers, Chief of the Bureau of Aeronautics of the Navy. There is a long record of their farsightedness in planning with manufacturers, their designers and production managers, for

U. S. Army photo

THE CESSNA AT-8

With two Jacobs engines, it was one of a fleet used by the U. S. Army Air Forces in multi-engine training.



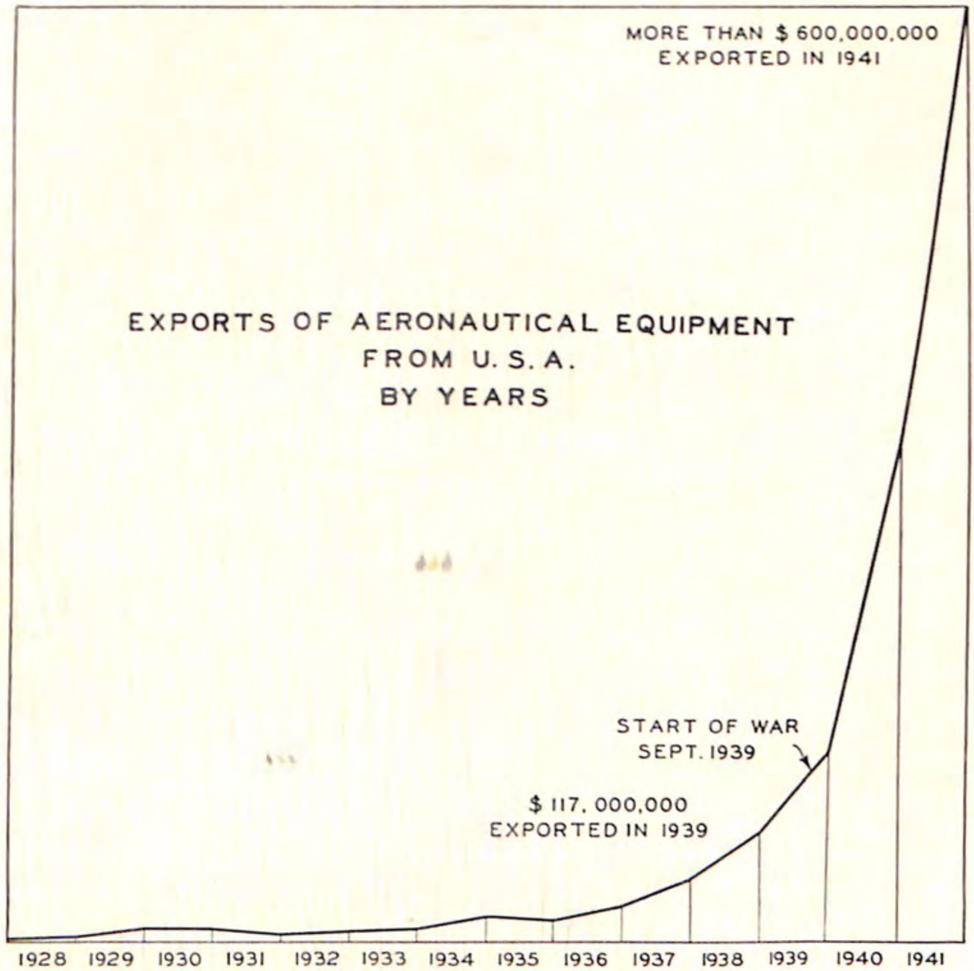
ACRES OF BEECHCRAFT ADVANCED TRAINERS

Final assembly department of Army trainers in the plant of Beech Aircraft Corporation.

the day when the whole industry would be called upon to go into full-out schedules. The industry, in fact, has been doing considerable "war mobilization" planning with the War and Navy Departments over a period of 20 years. As a result of this long-range planning, there are many new developments under way, not experimental but rather, actually in production and promising soon to give the enemy one jolt after another. It is no idle boast that Hitler's hordes and the Japs have some frightful surprises coming to them.

Part of the speed-up progress can be attributed to the eminently successful standardization of parts and installations which has been carried on by the industry and the Army and Navy. It has saved time in production of these parts by limiting the number of different shapes and sizes.

As a result of long-range planning, too, aircraft experts for many months have been training the artisans of other industries, the motor car plants for example. They have been in the aircraft plants learning the intricate and different methods of aircraft manufacture, while the aircraft people have been in the auto plants assisting in converting them into adequate factories for airplane parts. The results of more than 30 years of design, engineering research and development, as well as the "know-how" of aircraft construction



FRONT VIEW NORTHROP "FLYING WING"

One of the "mystery" planes under development in 1941.

THE FAIRCHILD PT-19A
Army trainer powered by a Ranger engine.

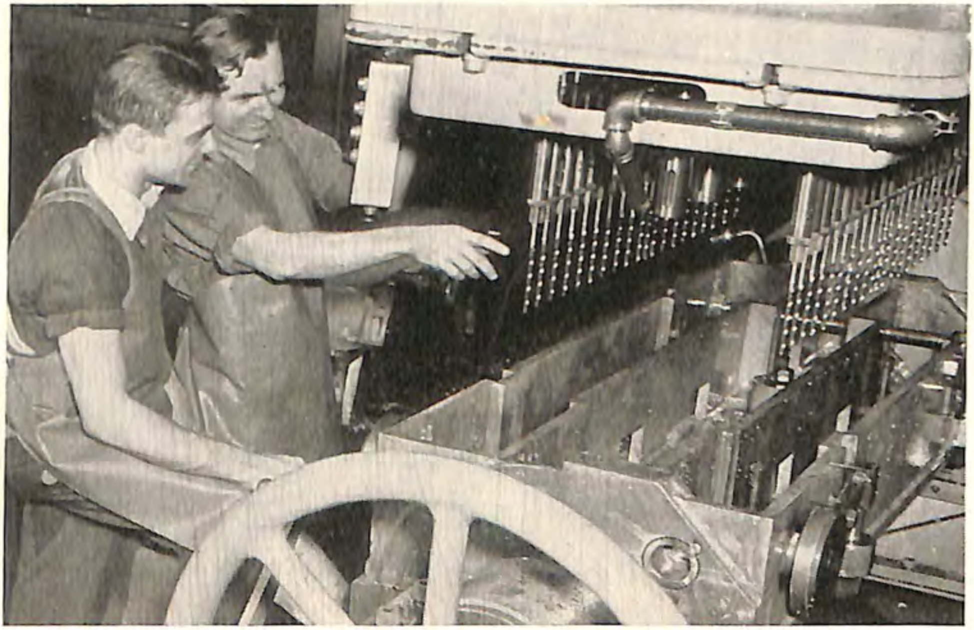
are being placed at the disposal of the motor car and allied industries for their use in contributing to the production program.

Another factor in placing the aircraft companies well out in front in the production race has been their plant training programs, carried on since orders for warplanes first commenced arriving from Europe, as mentioned in the Harter report.

The progressively extensive needs of the British, Russians, Chinese and Dutch for American equipment could not have been foreseen; and it accounts for the relatively small number of planes possessed by our own air forces as we entered the war. As the tempo of the war increased the demands from abroad, larger numbers of planes were sent overseas to the other air forces. The American services received only a very small per cent of the number built and delivered. That is one reason, and possibly the only valid reason, why our own air forces could not use much effective striking power as soon as war was forced on the United States. It was not through lack of foresight on the part of the air forces themselves.

The long-range bomber program is a fine example of planning years before the war. Today, American four-engine bombers—the Boeing Flying Fortress and the Consolidated Liberator—are years ahead of anything that the enemy can produce; and they will retain their lead in performance through all possible refinement. The work of all manufacturers, insofar as censorship restrictions permit, is described in detail in the last chapter of this volume, along with general items of development in progress which should have considerable influence on the improved performance of aircraft before this war ends.

Activities of the Army and Navy air forces, the vitally important work of other Federal bureaus dealing with aeronautics, the great training programs, the manner in which this generation of private flyers now becomes part of civilian defense, the place of the air transport industry in the war effort, and some activities of the



LEARNING TO MAKE ALLISON ENGINES

An operator explains to a trainee how a multiple spindle drill press drills and counter-drills 42 holes at one time in the crankcase.

aeronautical societies and associations—all are described in these pages, along with the activities of the manufacturers, because they make up our air power.

A RYAN V FOR VICTORY

Ryan PT-21 primary trainers with Army Air Forces cadets at Ryan School of Aeronautics.

CHAPTER III

THE U. S. ARMY AIR FORCES

Unprecedented Expansion—Spectacular Progress—Superior Equipment—The MacLeish Report—Report of Secretary of War Stimson—General Arnold's Description of War Preparations—Reorganization of the Air Forces—The Combat Command—The Ferrying Command—New Air Base Program—Results of the 1941 Maneuvers—Paratroops—Glider Plans—The Work at Wright Field.

ON January 14, 1942, the MacLeish report to the nation from the Federal Office of Facts and Figures stated: "At present the Air Forces form the second largest branch of the Army. By mid-year Air Force strength will have passed the 750,000 mark, and will be expanding rapidly. Through wide revisions in the requirements, approximately 2,000,000 more men are expected to become eligible for the Air Forces. . . . In performance, our Army Air Corps can be credited with spectacular progress. Our new achievements in performance were accomplished not with specially built power units but with engines in regular production. . . . American bomber types now in mass production are superior to those built anywhere in the world. Still better models are on the way."

The above statements made after America's entry in the war supplemented the comments of Secretary of War Henry L. Stimson in his report for the fiscal year 1941. He said in part: "The functions of modern air power which have been developed and demonstrated during this war have vitally affected previously approved methods of warfare. They have been carefully studied by our own Army and have powerfully affected our plans and organizations. Fortunately our own Air Corps has kept itself in the forefront of this development even before the recent startling disclosures of the

U. S. Army photo
TAKING ON A LOAD OF LIGHT BOMBS

conflict itself. American construction has been in the van of the progress which is now making possible a striking arm of extreme mobility and phenomenal range. The development of our flying fortresses, which have just demonstrated their supreme characteristics over Germany, was begun by the American Air Corps in 1934.

"The recently demonstrated effectiveness of air power as against sea power in the confined limits of the Mediterranean has suggested revolutionary possibilities for the defense of American interests in the similar seas of the southwestern Pacific. It has also suggested the enormous powers of a hemispheric defense which, radiating out from the manufacturers and training grounds of the United States and taking advantage of our now existing ocean and continental bases, may strike at and ward off aggressive hostile sea power long before it is able to approach our shores.

"Acting in well-trained cooperation with our ground forces, our shorter ranged dive and attack bombers are supplementing and expanding in warfare of rapid movement the demolition and counter-battery work formerly the exclusive role of our heavy artillery. And, guided by the carefully worked out detection systems of home defense which are now being installed throughout our seacoast states, our swift interceptors and fighting planes are planning to defend our large cities from approaching enemy bombers."

To cope with the tremendous problem involved in the rapid expansion of Army aviation, the War Department on June 22, 1941, announced the creation of the Army Air Forces, to be organized into (1) The Headquarters Army Air Forces, (2) the Air Force Combat Command, (3) the Air Corps, and (4) all other air units. Major General (now Lieutenant General) Henry H. Arnold was made Chief of the Army Air Forces, retaining also his position as Deputy Chief of Staff (for Air), an appointment dating from October 25, 1940.

In April, 1941, Robert A. Lovett was appointed Assistant Secretary of War for Air, an office which had been vacant since 1934. Since December, 1940, Mr. Lovett had been working as a special assistant to the Secretary of War, and in his new post, he was rightly regarded as a key figure in the air armament program.

The Headquarters Army Air Forces included the Chief of the Air Forces and a separate Air Staff, organized on conventional

U. S. Army photo

U. S. ARMY PARATROOPS IN TRANSPORT

U. S. Army photo

NEW BOEING B-17E FLYING FORTRESS

Latest of a long line of famous long-range four-engine bombers, this 1941 model is the largest and most powerful bomber in quantity production.

General Staff lines, with a Chief of Air Staff, Secretaries, Air Adjutant General, Air Inspector, and special divisions for personnel (A-1), air intelligence (A-2), operations and training (A-3), materiel and supply (A-4), air war plans, budget, statistics and public relations branch. The main purpose of the Air Staff was to prepare the essential overall plans for the Army Air Forces, and this setup obviously gave Army aviation a considerable measure of autonomy within the War Department framework.

The Army Air Forces was composed of two main branches, the Air Force Combat Command and the Air Corps. The Air Force Combat Command was the striking force in United States air power, and was headed up from June to December by Lieutenant General Delos C. Emmons, with headquarters at Bolling Field, Washington, D. C. After General Emmons' transfer to head up all Army air and ground forces in the Hawaiian Department following our entry in the war, the commanding officer of the Air Force Combat Command was Major General Carl Spaatz, former chief of the Air Staff.

The Air Force Combat Command was a logical outgrowth of the GHQ Air Force, created in 1935 to fill a definite role in our national defense team—a powerful, mobile, striking force, available for any contingency. The Combat Command was divided into four complete air forces covering the entire continental United States. They could operate independently or as one air force with the land or sea forces. Each air force consisted of four major elements, the Bomber Command for destroying hostile objectives, the Interceptor Command for defense, the Support Command for close cooperation with ground troops, and the Base Command for maintenance of flying equipment in the field.

The Air Corps, with Major General Walter R. Weaver as Acting Chief in the absence of Lieutenant General George H. Brett, who had become Deputy Supreme Command (for Air) of the Allied Forces in the Southwest Pacific, could be regarded as the arsenal of the Air Forces from which flying equipment and trained personnel were drawn. The Chief of the Air Corps also was responsible for research and development of military aircraft and allied equipment, for all major maintenance, and for ferrying planes from the factories.

U. S. Army photo

PREPARING FOR A HIGH ALTITUDE FLIGHT

An Army pursuit pilot is "oxygenated" before taking off on a flight several miles above the earth's surface.

CLOSE-UP OF BELL AIRACOBRA

The insignia on the cabin door of this Bell Aircraft Airacobra shows that this cannon-carrying fighter plane is in the 31st Pursuit Group of the U. S. Army Air Forces.

To carry out these vast and varied activities the Chief of the Air Corps had an Executive Assistant, who in turn had assistants for Administrative Planning and for Technical Planning; Adjutant General; Judge Advocate General; Fiscal Officer and Inspector General; also Assistant Chiefs of the Air Corps for Procurement Services (Materiel); Supply and Maintenance Services (Air Service Command Buildings and Grounds Division); Ferrying Services (Ferry Command); Training Services (Flying Training Command and Technical Training Command); and Army Air Traffic Services. As part of this new organization of the Army Air Forces, the War Department also created an Air Council to review periodically and coordinate properly all major aviation projects of the Army.

Under the heading of "all other air units" as contained in the War Department announcement, we may place the interesting developments in connection with the Army Air Forces overseas. These were not included under the Air Force Combat Command which covered the continental United States only, but were attached to the regular Army forces in the various outlying departments and defense bases and commands. As illustrating the increasing recognition of the importance of air power in modern warfare, it may be noted that in the following areas high ranking air officers with wide experience in other branches of the Army were placed in command of all Army forces, air and ground, in the respective areas. This was in line with the most advanced military strategy as developed abroad. Lieutenant General Frank M. Andrews had the Caribbean Defense Command; Major General Gerard C. Brant, Newfoundland Base Command; Lieutenant General Delos C. Emmons, Hawaiian Department; Major General Henry C. Pratt, Trinidad Defense Command; Major General James E. Chaney, Commanding United States Army Forces, British Isles. In some of these cases a unified command with an Admiral of the Navy in charge was set up.

On March 2, 1942, the War Department announced that the President had approved a reorganization of the War Department and the Army, effective March 9, 1942. The new streamlined organization provided under the Secretary of War and the Chief of Staff a War Department General Staff, a Ground Force, an Air Force and a Services of Supply Command, all with headquarters in Washington. In addition, such number of oversea departments, task forces, base commands, defense commands, commands in theaters of operations and other commands as might be necessary in the national security were provided.

Under that set-up, Lieutenant General Henry H. Arnold became Commanding General, Army Air Forces, dropping his former titles of Chief of the Army Air Forces and Deputy Chief of Staff for Air. The functions, duties and powers of the Commanding General, Air

CONSOLIDATED'S MASS PRODUCTION

One of the Consolidated Aircraft Corporation's yards showing the famous four-engine Liberator bombers and Catalina flying boats receiving finishing touches out-of-doors.

THE CURTISS P-40F WARHAWK

Latest of a long line of pursuits which have been mentioned in dispatches repeatedly from the war theaters in Africa and Asia.

Force Combat Command, and of the Chief of the Air Corps were transferred to the jurisdiction of the Commanding General, Army Air Forces.

Major General Joseph T. McNarney, who was associated with Lieutenant General Frank M. Andrews in the organization of the GHQ Air Force in 1936, was made Deputy Chief of Staff, second to General Marshall, on March 9, 1942.

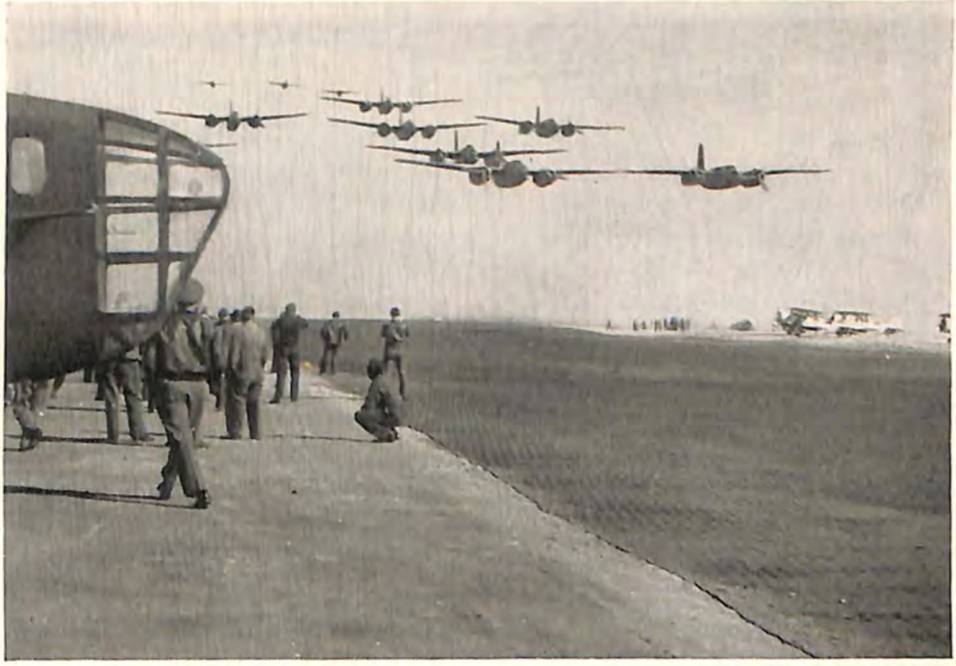
With the elimination of the Air Corps as such and the Combat Command, the streamlined organization consisted of an Air Staff as outlined previously in this chapter, a series of numbered Air Forces (such as the 1st, 2nd, 3rd and 4th in the continental United States), and several specialized commands (including the Technical Training Command, Flying Training Command, Ferrying Command, as previously described). Operations were in the hands of a group of Operations Officers (such as Air Adjutant, Fiscal Officer and Public Relations Officer) and a newly created Director of Military Requirements (with six assistants, including Director of Air Defense, Director of Bombardment) and Director of Technical Services (with five assistants, including Director of Communication, Director of Traffic Control and Director of Technical Inspection).

The best way to evaluate the tremendous expansion already under way in the Air Forces early in 1942 is to see the picture as it existed a few years ago. In October, 1941, General Arnold in an off the record address at West Point, subsequently revised for release, made these interesting comparisons: "Before the emergency, say about the time of the Munich Pact, September, 1938, we had roughly 2,000 officers and 20,000 enlisted men, at a time when the German Luftwaffe was training an air giant of a million officers and men. We had one small-output training center, composed of Randolph and

Kelly Fields, at San Antonio, Texas, which graduated three classes a year, usually less than 100 pilots in each class. We had about 1,000 combat type airplanes compared with a total of 2,500 today, a total built up in spite of heavy diversion of planes abroad. We had a handful of planes outside the continental United States as against 800 combat types in foreign service units today.

"We had less than 20,000 enlisted men as against more than 180,000 today. We had two or three hundred aviation cadets as against the more than 10,000 now in training. We had about 2,000 officers as against a present strength of nearly 17,000.

"During 1940 and 1941, expansion was piled on expansion like plywood until we are now embarked upon a program which calls for the training of 30,000 pilots, 10,000 bombardiers and navigators and 100,000 mechanics and technicians per year to man an organization of 84 expanded groups, which, if we meet our objective, will give us an ultimate strength of 41,000 officers and 600,000 enlisted men, including auxiliary personnel from other branches of the Service—or over four times the strength of the whole Army a short time ago.



U. S. Army photo

THE MARSTON STRIP

Douglas A-20A attack bombers landing on one of the portable runways developed by the Army Air Forces.

MORE EAGLES WITH WARPAINT

Lockheed P-38, Lightning, pursuit planes on flyaway delivery to the U. S. Army Air Forces.

"Now as to equipment. In the heavy bomber field American types are vastly superior to any such planes produced elsewhere in the world. The [Boeing] B-17, even in its original form in 1935, represented a long head start over any of the heavy bombers of foreign nations. The Air Corps' championing of the long-range multi-engine type has been amply vindicated, and has enabled it to go into large production without drastic changes. The ceiling and speed have been raised to more than 35,000 feet and over 300 miles per hour, respectively, through the use of turbo-superchargers. Armor, leak-proof tanks, power-driven turrets and tail guns have been incorporated to make them even better fighting machines than they were.

"The four-engine Consolidated B-24 bombers have made an impressive record with our Air Corps Ferrying Command, and as the "Liberator" with the R.A.F. Coastal Command, where it has been found so maneuverable, in spite of its size, that it has been used as a fighter against German bombers, fighters and submarines. New versions of the Boeing and Consolidated heavy bombers will have truly startling performance.

"Likewise in the medium and light bomber fields we are producing at least one model of each type which is generally rated above similar types of foreign manufacture. The North American B-25 and the Martin B-26, in the medium bomber field, are superior to any foreign medium bomber in range, speed and load abilities. In the light bomber field, the A-24 Dive bomber and A-20 Attack bomber, both made by Douglas, are superior to any enemy planes in their class, according to Army tests. The A-20 (export DB-7B) is so fast that the British use it as a night fighter under the name of "Havoc." Combining the best features of the attack plane and a light, fast bomber, the A-20 is designed for use with ground troops, speeding ahead to bomb hostile ammunition dumps, bridges, troop concentrations and larger obstacles than demand the use of dive bombers.

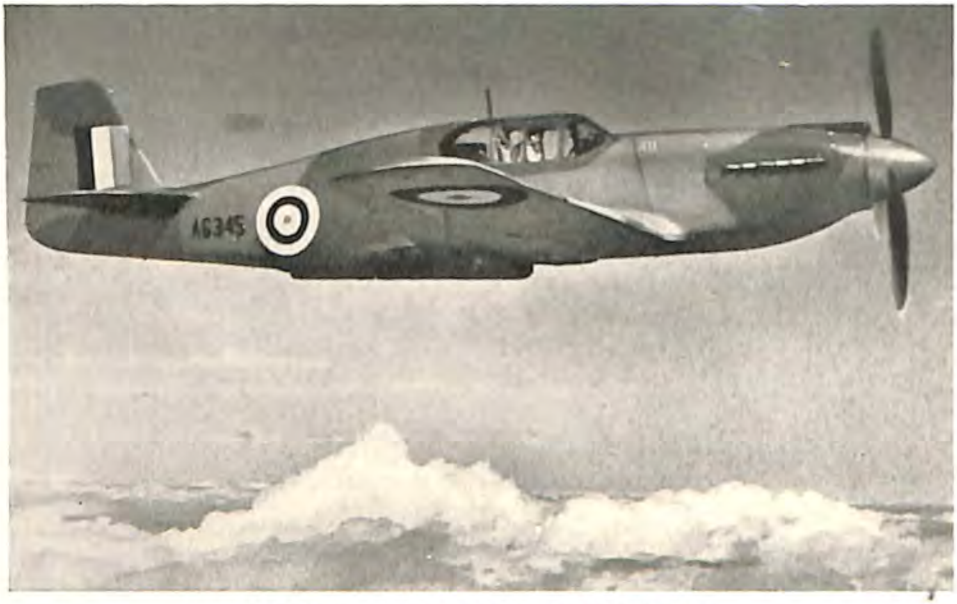
"In the pursuit-fighter class we have long realized that a differentiation was required between high altitude interceptors, medium altitude anti-bomber fighters, and heavy fire power ground troop and anti-tank aircraft. These types have frequently caused confusion among commentators who have overlooked their specialized functions.

"Before the expansion we had an experimental order for 13 Curtiss P-40's, a first class fighter. Modifications were necessary in the original P-40, and we have incorporated them into the later versions of the P-40 series and our other fighter planes—armor plate, leak-proof tanks, more rugged landing gear for unprepared fields, and, especially, greater fire power.

"Thousands of P-40's have been built and delivered to pilots in our squadrons and to the British, who have found them superior to the Hurricane fighters. The P-40B's and P-40C's (Tomahawk) and P-40D's and P-40E's (Kittyhawk) have given an excellent account

MARTIN ARMY BOMBERS

One of the main B-26 assembly lines in the plant of the Glenn L. Martin Company.



NORTH AMERICAN PURSUIT P-51

It is powered by the Allison engine, and used by the U. S. Army Air Forces and the R. A. F.

of themselves against the Luftwaffe in the Middle East, and in other theaters of war.

"Our other medium altitude fighter is the Bell P-39 Airacobra, which is being produced at a satisfactory rate. In actual operations the P-39, as a type, is demonstrating itself as superior to the newest versions of the Spitfire and Messerschmitt 109 in the medium altitude field.

"In the high altitude class we are getting good production on the Lockheed P-38 twin-engine interceptor, a type which in high speed tests against other pursuits or in combat activity against bombers leads both the Hurricane and the Spitfire. Eclipsing this, however, is the new single-engine Republic P-47B high altitude fighter."

A further indication of the tremendous expansion of the Army Air Forces is found in the amount available for obligation in the fiscal year ended June 30, 1941, as compared with the year before. The 1941 figure was $3,892,769,570 as against $243,931,388 for the year ended June 30, 1940. Of this huge total, approximately $3,425,000,000 was for airplanes, spare engines and parts. As an indication of how this figure was dwarfed by the total for our first war year, it may be noted that from July 1, 1941, to January 31, 1942, the total for airplanes, engines and parts is over $12,600,000,000.

The setup for air combat groups showed a corresponding increase. In 1940 the goal was set for 24 groups, a total which was raised to a 54-group expansion program, announced January, 1941, to be attained by the end of the year. In October, 1941, however, Secretary Stimson announced a new goal of 84 Combat Groups. After the entry of the United States in the war, the sights were raised further still, but no definite announcement was made as to the number of groups. The Air Forces training program is described in Chapter VI.

THE REPUBLIC THUNDERBOLT'S TRIO

Standing in front of the Curtiss propeller, first four-blade propeller to be used on an American fighter type plane are left to right Hart Miller, Republic vice president and director of military contracts, Alexander Kartveli, Republic chief engineer and designer of the Thunderbolt, and Major Russell Keillor, Air Corps factory representative.

THE VULTEE O-49 VIGILANT
Used by the Army Air Forces for observation liaison.

General Arnold frequently emphasized the need of a coordinated program for the air forces so that the number of pilots, the number of mechanics, the number of airplanes and the bases for operating those airplanes would be available at the same time. In a recent testimony before a Congressional Committee he said: "We are expanding some of our present fields, and we are also building new fields. When you are flying, and particularly when you are carrying out training, there comes a time when the air gets saturated with airplanes, beyond which you have the danger of collisions and a high accident rate. So rather than go through any such unfortunate situation as that, we prefer to build new schools where we will not have that overlapping in the air.

"In general, most of our fields will be located in the central part of the United States. However, we must have a certain number of our combat fields on the coasts for combat purposes. Along the Atlantic coast we are trying to have our bases so located that, in case of threat, we can concentrate the necessary number of combat planes in any locality, whether it be the Boston locality, New York, Philadelphia, Washington, or wherever it may be."

In the continental United States, construction, enlargement and improvement of air bases during 1941 was carried on at a breathtaking speed under the direction of the Air Corps Building and Grounds Division, in cooperation with the Corps of Engineers.

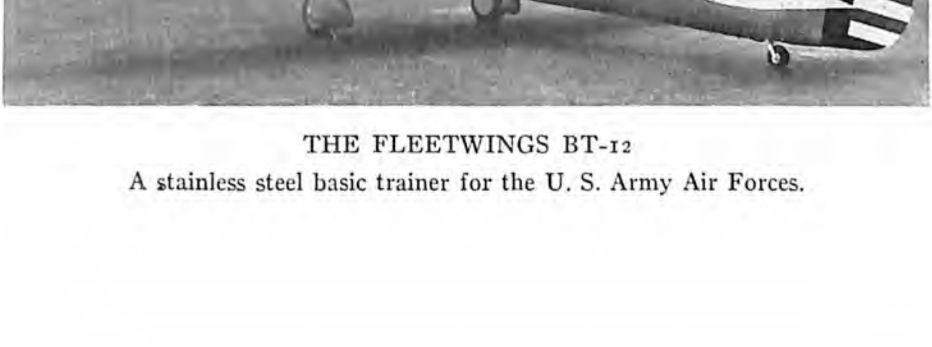
In its role of defender of the entire Western Hemisphere, a national policy of the highest importance, the United States needs other air bases as outposts. Fueling, repair and supply stations in the Atlantic, the Pacific, the Caribbean, South America and Alaska are being rapidly built up, some in our own possessions, others by long-term lease from England, and still others in close cooperation with Latin American countries.

After our entry in the war, other strategically located overseas bases in the British Isles, Africa and Asia were rushed to completion.

The engineers of the Army Air Corps have made a great contribution to aerial warfare with the development of a portable steel landing mat which could be installed as a usable military airport in two or three days, and repaired within a few minutes after bombing. When joined together, the panels formed a continuous runway 150 feet wide and 3,000 feet long, and were capable of being used by all types of military airplanes, from the newest and fastest fighter planes to the heavy bombers. Hailed by General Arnold as "the year's greatest achievement in aviation," the steel landing field was installed and tested at Marston, N. C., during the large-scale Army maneuvers in the late fall of 1941, hence the term "Marston strip."

In addition to this specific Army development, the War Department announced on November 27, 1941, that the Army Air Forces would cooperate in the construction of "Flight Strips" along highways. This project, fostered for over 10 years by Lieutenant Colonel Stedman S. Hanks, Air Corps Ferrying Command, was authorized by the Defense Highway Act of 1941. Their use as emergency landing fields and also for the dispersion of military aircraft was regarded as of the highest importance by leading air officers. Both of those aids in connection with the air base situation are definitely in the air war strategic plans for defense of the country, speeding delivery of warplanes, and offensive operations overseas.

In order to expedite the delivery of military aircraft under lend-



THE FLEETWINGS BT-12

A stainless steel basic trainer for the U. S. Army Air Forces.

PIPER J-3 FOR THE ARMY
The Army Air Forces call it L-59.

lease on June 5, 1941 the Secretary of War established the Ferrying Command under the Chief of the Air Corps, with Colonel (now Brigadier General) Robert Olds in command. During the first six months of its operation over 1,000 American-built bombers were flown by Air Corps Ferrying Command pilots from the factories to Montreal or Newfoundland, where they were turned over to ATERO pilots who flew them across the Atlantic, or to Miami, where Pan American Airways took them over for delivery to Africa via Brazil and the South Atlantic. The Ferrying Command did more than 3,000,000 miles of flying in the first six months.

Included among the types of bombers delivered were the Lockheed Hudsons, Boeing fortresses, Consolidated Liberators, and Consolidated Catalinas, all of which had an excellent range.

General Arnold gave a vivid description of the activities of the Ferrying Command as follows: "Do you remember the difficulties encountered by the Air Corps when it carried the mail in 1934? We are doing a somewhat similar job with our Air Corps Ferrying Command, but on a much vaster scale and with much more success and greater efficiency.

"There were cogent reasons why the Air Forces undertook the project of transporting airplanes from the factories to their points of departure from our shores. Obviously the British couldn't spare the pilots to do it. We could. Our pilots, starved for equipment as they were, needed the training in navigation, weather and radio flying that a coast-to-coast ferrying service would give them—and on the latest, hottest equipment.

"We are also running a Trans-Atlantic service, from Washington to Scotland. Six Consolidated B-24 [Liberator] bombers are used, and on each trip new crew members receive training as pilot, co-pilot, navigator, radio operator, aerial engineer and gunner. Radio operators must be specially trained in British secret codes in order that they can properly identify anti-aircraft locations, balloon barrages and danger areas when they enter the combat zone. The B-24 is fast enough to cross the water in 8½ hours at 55 per cent power, and fortunately it is faster than Nazi planes normally operating over Scotland.

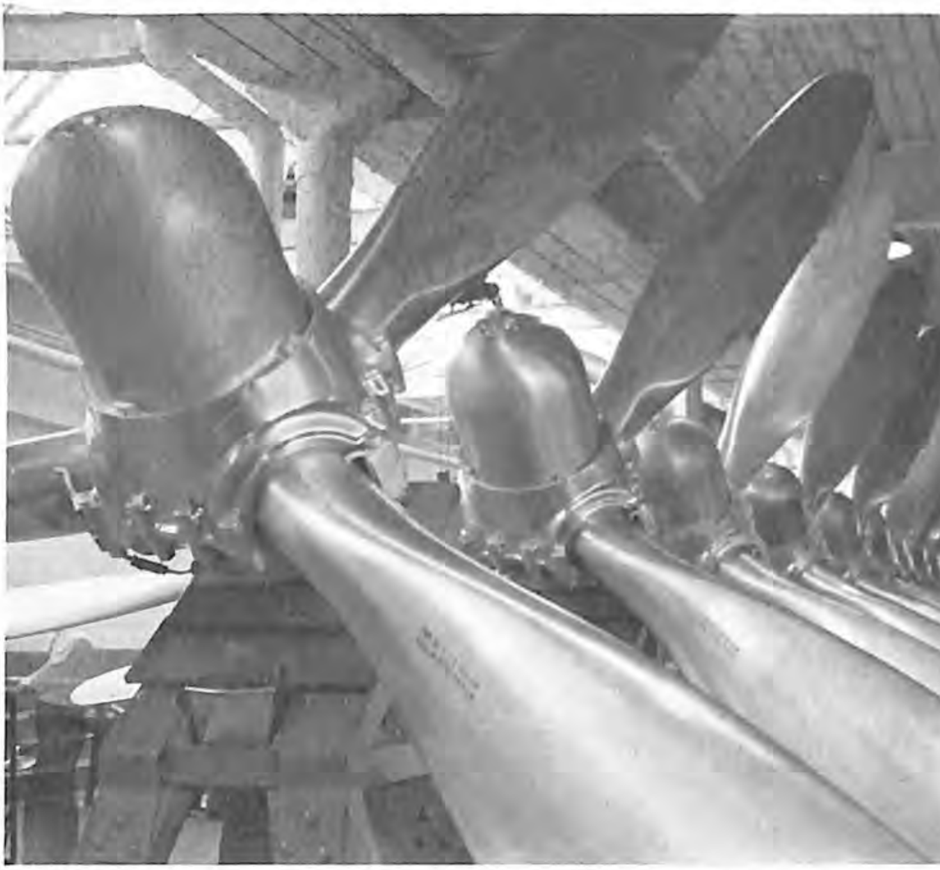
"We must be prepared to fly across the North Atlantic or to follow a southern route to Cairo, or to transfer operations via Alaska to Russia. Or jump from Hawaii across the South Pacific to Singapore, the Dutch East Indies or Australia. In fact the Air Corps Ferrying Command is prepared to operate, and is operating around the world. Its navigators are studying globes—not maps—and they will take a bomber to Tibet or Troy if you give them 48 hours notice."

In the autumn of 1941 units of the newly created Army Air Forces received their "baptism of fire" under the most realistic possible conditions in connection with the large-scale Army maneuvers in Louisiana during September and in the "battle of the Carolinas" in November. The Air Forces, through the Air Corps and the Air Force Combat Command, played a major role in the training of more than a half million officers and men of the expanding armies in the tactics and technique of joint air-ground operations.

In describing the part aircraft played in the first phase of the war games, General Emmons said that almost 850 Army, Navy and Marine Corps planes took part. The planes consumed about 4,000,000 gallons of gasoline, flew about 40,000 hours and covered

THE TAYLORCRAFT L-57

Army "grasshopper" plane with 65 h.p. Continental engine.



HAMILTON STANDARD HYDROMATIC PROPELLERS
Awaiting shipment from the plant.

some 8,000,000 miles between 3,000 and 4,000 missions. Had they been carrying real bombs and firing real bullets they would have dropped some 10,000,000 pounds of bombs and shot approximately 7,500,000 rounds of ammunition.

Except for a spectacular demonstration of precision bombing from an altitude of 15,000 feet by 12 Boeing B-17 Flying Fortresses, heavy bombers did not take part in the maneuvers as such. The North American B-25 and Martin B-26 medium bombers did effective work, and the Douglas A-20-A attack bomber turned in a top-notch performance in fast, low flying bombing and strafing operations. The Douglas A-24 dive bomber, similar to the SBD "Dauntless" of the Navy, received its first tryout in the Louisiana maneuvers, and in performance characteristics proved superior to the German Ju-87 "stuka".

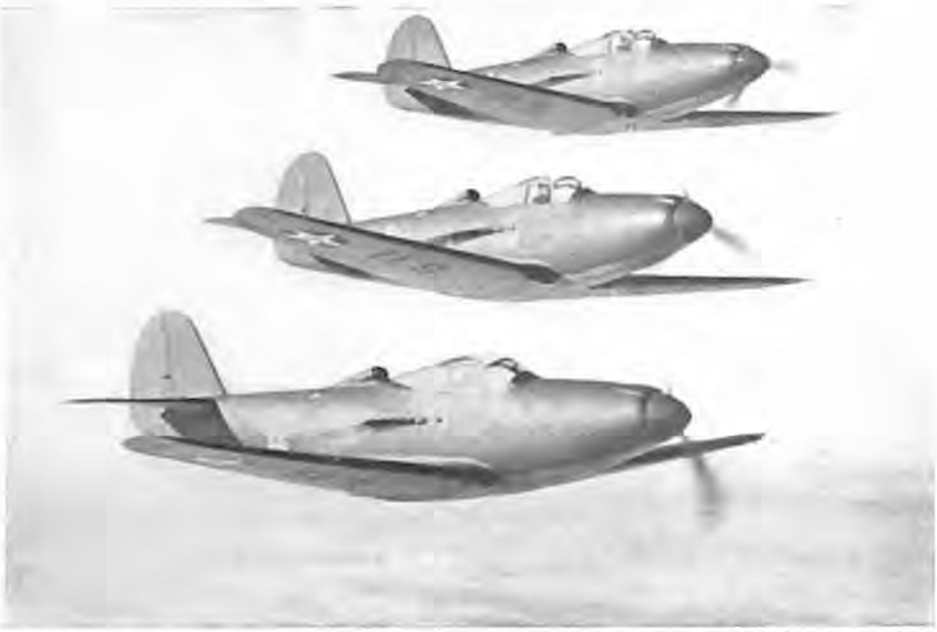
In the pursuit-fighter class advanced models of the Curtiss P-40 series were used, Bell P-39 Airacobras, Republic P-43 Lancers (precursor of the high-powered P-47 Thunderbolt fighter) and the Lockheed P-38 twin-engine interceptor. All these planes came through with flying colors.

In addition to these combat types a large number of North American O-47 and Stinson O-49 observation planes were used. The Louisiana maneuvers saw the first "grasshopper squadron" using regular light planes for close liaison work. This proved so successful that the use of several types of light planes was greatly extended during the Carolina maneuvers.

Mr. Lewin B. Barringer, Glider Specialist, Air Staff, reported: "The glider development of the Army Air Forces is making steady progress. The first of our experimental troop gliders has been successfully test flown at Wright Field. Several different designs of these big gliders will be put through static and flight tests before the

COMPLETING CURTISS PROPELLER BLADE

Wearing safety goggles and a nose and mouth protector, an expert uses an electric high-precision machine to give a perfect finish to a Curtiss electric propeller blade.



U. S. Army photo

BELL AIRACOBRA PURSUITS

In active service with the Army Air Forces.

present experimental program is complete. We shall then know from comparative evaluation which designs of these motorless craft will be used for production to supply transportation for our air-borne troops."

The training of Army Air Corps officers in glider operation was initiated during the first week of June, 1941, under War Department contract at two civilian schools, the Elmira Gliding Area Soaring Corporation, Elmira, N. Y., and the Lewis School of Aeronautics, Lockport, Ill. Early in January, 1942, a new glider training school for officers of the Army Air Forces was opened at 29-Palms, Calif., a desert community 60 miles from Palm Springs. On account of the favorable weather conditions it was expected that glider training would be concentrated in the new civilian-contract school, the 29-Palms Air Academy, where several hundred glider pilots could be trained during 1942. The students were trained power-plane pilots, and received an average of 30 hours of instruction in gliders of the two-place TG-1 (Schweizer) and TG-2 (Frankfort) types. The training included several hours of dual glider towing by powered aircraft, instruction in different types of glider launching—by automobile, winch, and airplane tow—and experience in spot landings, because absolute precision is far more important in the landing of powerless aircraft than is necessary for powered aircraft. A thorough understanding of weather is an important adjunct to glider training, as a highly developed weather-consciousness is essential to glider operations.

The employment of parachute troops in "vertical envelopment" of enemy lines and defenses is usually credited to Russia, the idea then being borrowed and further developed with outstanding success by the Nazis. It so happens, however, that the United States Army was the first to make experiments with paratroops, at Chanute Field, Ill., in April 1928. In line with the spectacular development of this technique in World War II, the United States Army organized its first battalion of 500 paratroops during the winter of 1940-41 at Fort Benning, Ga., under the command of Major William M. Wiley. Known as the 501st Parachute Battalion, the air infantry's work had progressed so well that this specialized force was being greatly expanded. Demonstrations of their activity were among the highlights of the Louisiana and Carolina maneuvers.

On December 17, 1941, the 38th anniversary of the Wright brothers' first flight, in the atmosphere of a world fully awakened to the capabilities of the airplane in war and in commerce, the Collier Trophy for 1940 was awarded to men who have accomplished "outstanding success in high altitude flying by the development of the turbo-supercharger."

FAIRCHILD PT-19 ARMY TRAINERS
On the line at Spartan School.

HIGH ALTITUDE PILOT

A member of the Boeing Flying Fortress testing crew in high altitude gear, with BLB oxygen mask, flying suit and parachute.

Vice President Henry A. Wallace, on behalf of the National Aeronautic Association and acting for President Roosevelt, made the presentation at the Capitol to Dr. Sanford A. Moss, scientist, of the General Electric Company, and to the United States Army Air Corps, represented by Major General Walter R. Weaver, Acting Chief of the Air Corps.

The turbo-supercharger has made possible the eminently successful performance of the high-flying four-engine Boeing B-17D bombers, the fast Lockheed P-38 interceptor, the Republic P-43 "Lancer" and P-47 "Thunderbolt" fighters, and other high-altitude planes which have demonstrated their efficiency.

Most of this development took place at Wright Field, "nerve center of the Air Corps." There is no better place to finish this survey of the progress of the United States Army Air Forces in 1941 than to have a glance at Wright Field.

During the last half of 1941 the Wright Field's Experimental Division increased its active research projects by 15 to 18 per cent, mainly as a result of (1) Ever-increasing number of new plane models. (2) Development of troop-carrying gliders and air-borne task force transport equipment. (3) Development of special weapons, especially those in fire power. (4) Increasing engineering problems in developing mass production methods and the omission of the extended service test phase. (5) Increased development on power plants, such as supercharging, extension shafting, dual rotation propellers and gearing. (6) Application of new metals, alloys, materials, plastics and manufacturing and fabricating processes.

FOR HIGH ALTITUDE FLYING

At the plant of the Firestone Steel Products Company, where beverage containers were made in peacetime, high pressure oxygen cylinders are now made for protection of pilots at high altitudes.

Brigadier General O. P. Echols, Assistant Chief of the Air Corps for Procurement, gave an example of the kind of work carried on at Wright Field, and incidentally one of the many reasons for increased cost of airplanes. He said: "Of major importance is the need of fire control installations which permit the aiming of all guns installed on an airplane from a single centralized control point. These installations for the long-range bomber have added $50,000 to the cost of each airplane."

SPERRY ALL WEATHER LABORATORY

Sperry aviation equipment is tested here in temperatures as low as 35 degrees below zero.

CHAPTER IV

THE U. S. NAVY AIR FORCES

Magnitude of Naval Aviation's War Task—The MacLeish "Report to the Nation"—Rear Admiral Towers Reports on the Vast Preparedness Program—New Squadrons Organized—Aircraft Ordered for Hundreds of Warships—New Developments—Improved Performance of Naval Aircraft.

AS American participation in the war entered the fourth month of 1942, the Navy's air forces were fighting in many zones of conflict and patrolling vast areas over both the Atlantic and Pacific. The long range vision, the knowledge of the vital importance of Air Power which the able officers of Naval Aviation had displayed by preparing to the utmost for the gigantic task ahead had shown most gratifying results in the heroic achievements of Navy flying personnel in raging battles far overseas and, too, much nearer home where time and again they encountered enemy prowlers of the sea and prevented them coming dangerously close to our coasts. A generation of flying men in the U. S. Navy had devoted their careers to preparations for this war effort. In his annual report for the fiscal year 1941 Rear Admiral John H. Towers, Chief of the Bureau of Aeronautics of the Navy, described in considerable detail how these preparations were progressing. The report of Admiral Towers supplied much background information to supplement that given in the MacLeish "Report to the Nation" on January 14, 1942.

"When Japan struck," stated the MacLeish report, "we had 17 battleships, and 15 more being built. We had seven aircraft carriers, and 11 more being built. We had 37 cruisers, and 54 more being built. We had 171 destroyers, with 193 more being built. We had 113 submarines, and 73 more being built.

"That is by no means the whole story of the Navy's progress in 1941. By November 1941, the Navy had commissioned 25 new combatant ships. It had added 2,000 planes to its hangars and its aircraft

BREWSTER SB2A-1 DIVE BOMBER
The Buccaneer, powered by a 1,600 h.p. Wright Cyclone engine.

carriers. Its new chain of overseas bases extended far into both oceans, and it had enrolled some 5,000 new officers and more than 12 times as many men.

"In those 10 months 345 new combatant ships of many kinds were under construction, as well as 96 auxiliary vessels, 243 mine craft, 225 patrol boats, and other floating equipment generally overlooked in accounts of battles at sea, but essential if the men-of-war are to go into action.

"Where were they being built? At shipyards up and down both coasts and as far inland as the Great Lakes, where even submarines are born. At the beginning of the year, 72 private yards were building ships for the Navy. By November there were 133 yards—not including the Navy's own 86 yards.

"The air is as important to the Navy as the sea. The Navy's plane complement of 15,000 has been increased. Before the war entered the shooting stage the Navy—and the Marine Corps—had more than 5,000 pilots. Thousands more were in training. It is interesting to note here that last July the rate of enlistment for naval aviation training was eight times the rate in May, 1940. A greater rush was to come.

"The Navy alone has 34 air stations. In Jacksonville and at Pensacola the Navy has in operation two of its greatest new training stations. A third is in Corpus Christi, Tex. The Corpus Christi Station shows what Americans can do when they decide to put their backs into an effort. In just 10 months a flat, desert area of sand and scrub was turned into a modern city, a city with miles of streets and runways, a city of permanent buildings with leagues of water mains and power lines, a city with one purpose—to help build an air fleet for our Navy.

"All this expansion of air and sea forces has led to a vast increase in naval shore establishments.

"American sailors and marines are now serving in Newfoundland; they are serving at Bermuda; they are serving at Great Exuma Island in the Bahamas; they are serving at Antigua, Jamaica, St. Lucia, and Trinidad in the Caribbean, and in British Guiana in South America. In the Pacific our sailors and marines hold a far-flung bastion of bases protecting us from would-be invaders from Asia.

"A great deal of work has gone into the development of those overseas bases. As Secretary Knox pointed out, what we gained in the destroyer trade with Britain was not bases but the right to build bases. Defenses against attack from the air and attack by sea had to be installed. Dockyards, coast artillery, barracks, lines of supply for guns, food and coal, workmen to do the building were needed. Nearly half a billion dollars was spent in developing our bases last year.

"The Navy's task today is twofold—it has the greatest battle of its life on its hands, and it also has a tremendous defensive patrolling job to carry out. The Navy, like the rest of us, is at war with Germany in the Atlantic, with Japan in the Pacific, with Italy in the Mediterranean. At the same time, it must police with Britain the sea lanes from Iceland to the bulge of South America and, with the British, Dutch, and Australian Navies, the vast Pacific as far as Singapore. Fighting ships which might otherwise be used to attack the Japanese Navy must serve as two great mobile arcs of steel guarding all our continental coastline. They must see that German ships do not menace the routes to and from the eastern ports of South and Central America. They must keep Japanese ships clear of the Western

U. S. Navy photo

THE U. S. S. CARRIER "HORNET"

U. S. Navy photo

CONSOLIDATED PB2Y-2 CORONADO

Long-range four-engine patrol bomber for the U. S. Navy.

Hemisphere from the Straits of Magellan to the Northern Bering Sea. This is a naval problem without parallel in history.

"Long before Pearl Harbor, the Navy's ability to give and take severe blows had been shown in the waters between America and Europe, in the months when it was obeying the President's command to shoot first.

"The Navy and the Marine Corps entered the war with an unprecedented peacetime strength. Their complements of fighting forces are being increased with a speed that can be matched by no other nation on earth at this time. The Navy's ultimate strength rests soundly on the resources, the spirit, and the capacity of this country to carry to completion a plane and shipbuilding program years before we thought it could be done."

Issued some weeks before the Navy aviation program was expanded to an objective of 25,000 planes and 30,000 pilots, the annual report of Admiral Towers for the fiscal year 1941 showed how the program had developed step by step with dwindling hopes that America might remain out of the war. Parts of his report follow:

"The Naval Aeronautic Organization was authorized by Congress during the past year to increase its complement to 15,000 airplanes. This directive became effective on July 19, 1940, and since that date the Bureau of Aeronautics has directed its efforts toward the early consummation of this program. An orderly plan was established to augment the plan already prescribed in order to procure the additional airplanes required over and above the 10,000-airplane program previously authorized by Congress.

"A parallel training and base facilities program was established in order to support the increased number of airplanes authorized for naval operations. The training program was immediately stepped up with existing facilities and on March 18, 1941, a directive was issued for the additional shore stations required. As a result of high priority given to their construction, new training stations were well along toward completion at the close of the year. Details on new stations and facilities for naval aviation appear elsewhere in this report."

The Naval Aviation training program is described in Chapter VI.

"The Destroyer-British-Base Trade Agreement, accomplished by the President of the United States during the year," Admiral Towers reported, "will greatly extend the operating area of naval aircraft. With bases established on the sites acquired, it will be possible for patrol planes to keep under surveillance vast off-shore ocean areas, thus extending the outer defenses of the United States far to the east in the Atlantic.

"Several new squadrons were established during the past year but the full force of the expansion program will not become effective until next year. However, the primary training squadron organization was increased to take the student load as it progressively increased.

"Two in-shore patrol squadrons were organized with six airplanes

THE MARTIN FLYING BOAT "MARS"

Designed and built for the U. S. Navy by the Glenn L. Martin Company, the "Mars" is powered by four 2,000 h.p. engines and is capable of flying to Europe and back without stopping. It has sleeping quarters for a crew of 13. It could carry 150 men fully armed. The space in the hull is equivalent to a 16 room house.

CURTISS SB2C-1 HELLDIVER

One of the U. S. Navy's latest dive bombers, the SB2C-1 is for aircraft carrier use.

assigned to each. The aircraft units for the 'Washington,' 'North Carolina,' 'Curtiss,' 'Albemarle,' 'Tangier,' 'Pocomoke,' 'Barnegat,' and 'Biscayne' were organized and equipped.

"The aircraft complement of battleships and carriers was rapidly replaced during the past year with new and more modern equipment which reflected lessons learned during the first year of the present war. Innovations included better performance, armor plate, heavier armament, self-sealing gasoline and oil tanks, and oxygen equipment.

"These ships were acquired during the year for the support of naval aircraft: three aircraft tenders, the 'Curtiss,' 'Albemarle,' and 'Pocomoke'; one aircraft escort vessel, the 'Long Island'; and eight destroyers which were converted to the patrol-plane-type tender.

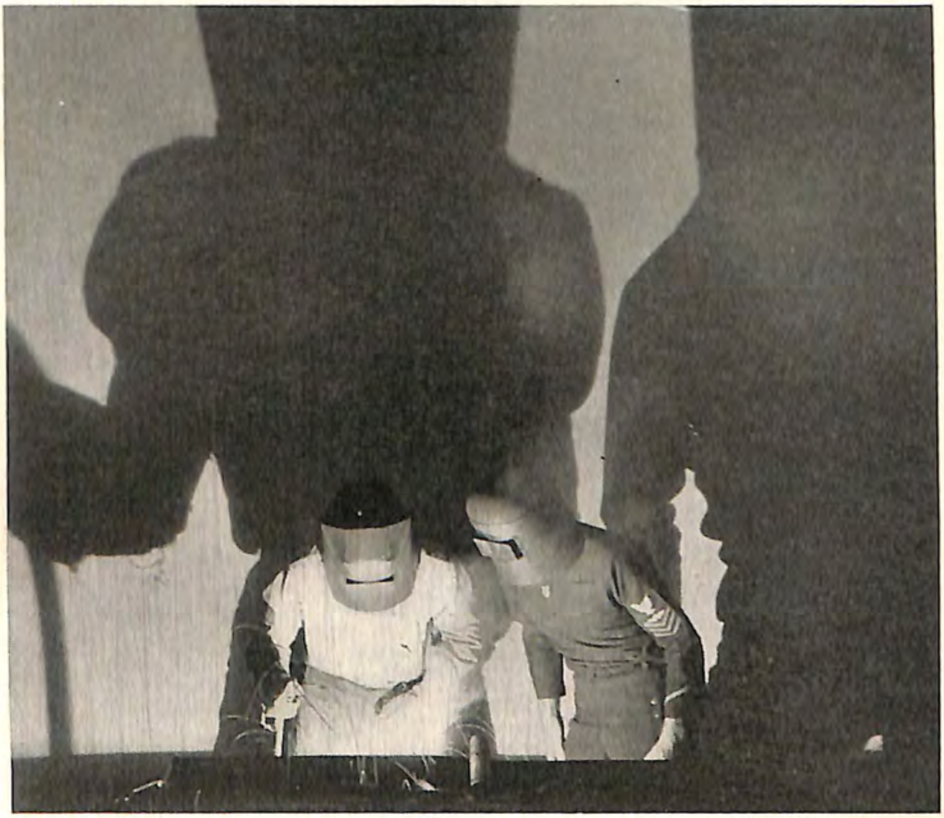
"Two plastic training airplanes are being purchased in order to study the material under test and to determine its serviceability in operation. Continued effort will be made to increase range, performance, armament, and defensive qualities of naval aircraft by experiment and research. A step in this direction was the establishment of test units at San Diego and Norfolk to relieve operating units of this load and to improve current test procedure.

"Deliveries of two training-type airships were effected and six patrol-type nonrigid airships are on order. Funds for 21 additional patrol-type airships were included in pending supplemental estimates.

"Allocation of funds by the President as of June 30, 1941, totals $199,123,668.00. Expenditure of allocated funds is as follows:

For aircraft and aeronautical material	$158,668,218.00
For equipage of vessels	2,100,000.00
For facilities and equipment	37,000,000.00
For agriculture, industrial and other commodities, and articles	1,350,000.00
For administrative expenses	5,450.00

"Naval aircraft assigned to the Fleet participated in all Fleet problems and tactical exercises during the year, including joint Army and Navy exercises in the Caribbean and Hawaiian areas. Constant operations and training were conducted in both areas with emphasis being placed on the practical testing and development of ideas and methods currently being used in the European conflict. The expansion



U. S. Navy photo

THE NAVY'S "MEN OF MARS"

An enlisted student learning electric arc welding from an instructor in a Navy school.

U. S. Navy photo

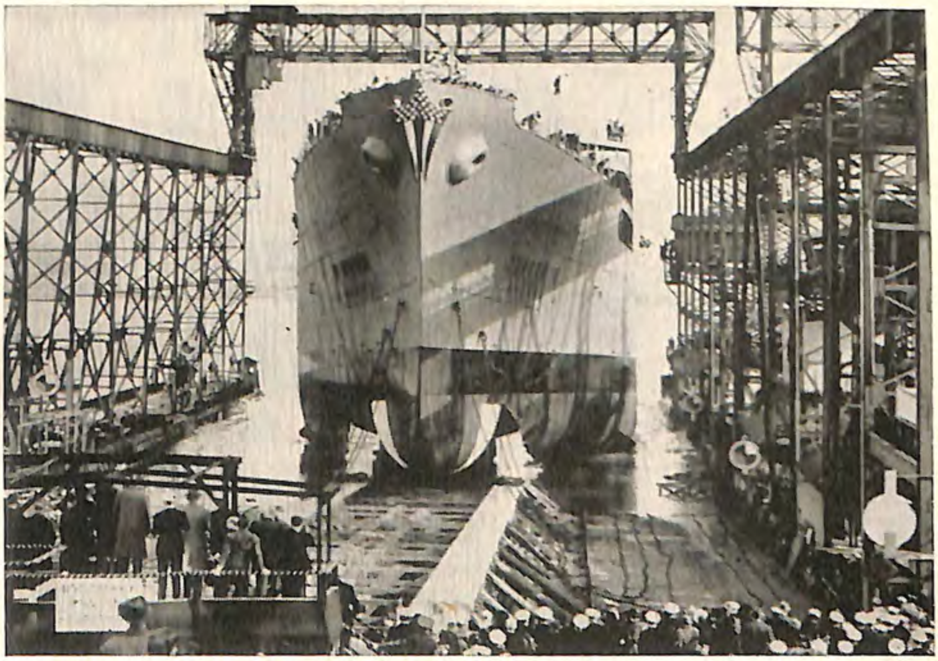
NAVY GRUMMANS IN FLIGHT

They are fighters stationed in the West Coast area.

of the Atlantic Fleet, organization of the Support Force, acquisition of bases on British territory, and increasing demands on the neutrality patrol resulted in a relocation and reorganization of both aircraft and supporting facilities. The North Atlantic was added to the list of those areas in which naval aircraft now conduct routine operations. A total of about 1,226,900 hours was flown during the year; this is more than 50 percent greater than that of last year.

"The scale of flight operations incident to delivery of new and overhauled airplanes to both service and training units increased tremendously during the year. Approximately 2,750 such flights were made, most of them being transcontinental. It is considered most desirable to afford operating personnel an opportunity to visit manufacturers' plants when acquiring new equipment, and this continues to be done as often as possible. However, in order to speed up deliveries of new airplanes and decrease the time a pilot is away from his home station to a minimum, the first Training Test and Acceptance Units were formed at San Diego and Norfolk. The functions of these units are intended to include taking delivery of the airplanes from the manufacturer, conducting thorough inspection and test of the structure and engine units, installing certain items of Government-furnished material, such as automatic pilot equipment and armament, compensating compasses and calibrating radio equipment; in short, doing everything necessary to have the airplane in a 'ready-for-operation' status when the squadron ferry crew arrives. So well has this plan worked out in the delivery for service of patrol planes that it is now intended to establish three more such units, one at New York, one in the Los Angeles area, and another in the Middle West, to take delivery of all service airplanes except trainers.

"Lessons taught in the current conflict abroad are being constantly analyzed and studied. Considerable revision of technique concerning the use of oxygen equipment has been occasioned during the year. Other developments, such as special recognition and locating devices, practical lessons in the field of armor and armament, the application of glider warfare to national defense, the training and use of parachute troops, and the increasing importance of aerial photographic reconnaissance are being thoroughly considered. The value of dive-bombing, first introduced by the U. S. Navy, is, unfortunately, being demonstrated abroad, to the detriment of the Allied cause. Developments in this field continue. The U. S. Army Air Corps requested and its representatives were given a series of demonstrations in dive-bombing at Norfolk during the year, in addition to lectures and actual



THE U. S. S. SPERRY

The Navy's new submarine tender named in honor of the late Elmer A. Sperry, inventor of the Sperry Gyro and other aviation precision instruments, and a pioneer in submarine construction.

NAVY BEECHCRAFT JRB-1
A special observation and utility transport.

flights in dive-bombing planes. Further collaboration with the Army, including the assignment of Navy airplanes to the first Air Corps Dive Bombing Training Detachment at Orlando, Florida, and the detail of experienced naval aviators to them as instructors, is currently in progress.

"On June 30, 1941, there were 1,577 naval aviators and 609 naval aviation pilots on duty in the Aeronautic Organization, while a total of 3,467 student pilots of the Navy and Marine Corps were in training in the heavier-than-air craft and six were in training in lighter-than-air craft. There were 1,512 Naval Reserve officers of the class A-V(N) on active duty, and 3,104 aviation cadets in training at naval air stations. There were 1,829 Naval Reserve aviators of all classes on active duty, and 335 Naval Reserve officers on duty in a non-flying status.

"There has been an increase of 48 per cent in the number of pilots in the Aeronautic Organization of the Navy during the fiscal year 1941. A comparison of total pilots available June 30, 1941, and June 30, 1940, is shown below.

	Total Pilots as of June 30, 1941		Total Pilots as of June 30, 1940	
	HTA	LTA	HTA	LTA
Regular U.S.N.	1,577	19	1,104	10
Naval Reserve A-V (N)	1,512		903	
Naval Reserve other than A-V (N)	317		120	
Enlisted Navy (NAP)	609		587	
Regular Marine Corps	296		193	
Marine Corps Reserve AVC	117		76	
Marine Corps Reserve other than AVC	40		28	
Enlisted Marine Corps	52		45	
Regular U.S.N. (retired)	5		3	
Total Pilots	4,525	19	3,059	10

"On June 30, 1941, there were 47,168 enlisted personnel on duty in the Naval Aeronautic Organization. Of these, 11,213 were aviation ratings. Comparative figures for aviation ratings on duty June 30, 1940, and June 30, 1941, are as follows:

	1940	1941	Increase
Aviation Machinist's Mates	4,456	7,467	3,011
Aviation Metalsmiths	1,152	1,919	767
Aviation Carpenter's Mates	76	...	...
Aerographers	157	240	83
Photographers	189	297	108
Aviation Ordnancemen	748	1,290	542
Totals	6,778	11,213	4,435

"The First Marine Aircraft Group conducted training and tactical exercises with the First Marine Division at Guantanamo Bay, Cuba, and participated in Fleet landing exercises in the San Juan-Culebra Area. Marine Scouting Squadron Three, St. Thomas, V. I., was temporarily assigned to and operated with the First Marine Aircraft Group during Fleet landing exercises. All tactical squadrons completed the prescribed gunnery exercises. The training of Marine Corps Aviation personnel is proceeding satisfactorily.

"The Government is now beginning to realize returns on experi-

BOEING NAVY TRAINERS—N2S-1

BETTER THAN ANY GERMAN STUKA

Douglas A-24 dive bombers with the U. S. Army Air Forces, similar to the Navy SBD-3 Dauntless.

mental investments in its ability to specify many features in future production aircraft which are direct and important contributions to improved performance, reliability, and operating effectiveness and versatility of all combat types of naval aircraft.

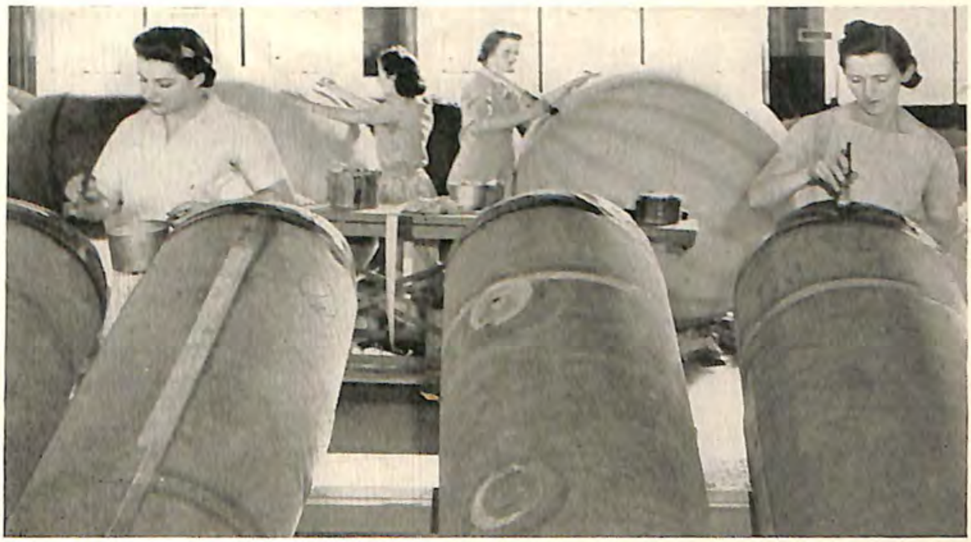
"The production program for the next two years has been crystallized around experimental aircraft which have been made possible by the increased appropriations of the last two years. It was necessary in some cases to premise production on the prototypes prior to flight testing. The designs were so advanced, however, that the general characteristics were established, the only element of risk being necessity of minor changes. The policy of procuring two airplanes to each promising experimental design, when economical, has been adopted in order to accelerate testing and to provide insurance against serious delay in case of accident or loss.

"An outstanding design of scout-dive bomber reached the stage of flight tests during the year. New contracts were awarded for several types, particularly fighters and scout-bombers. The development of patrol-bombers continued satisfactorily, as did that of other combat aircraft, particularly in increased and improved armament. Actual construction of several promising variations of high-lift devices for carrier-based aircraft was initiated.

"The rapid and enormous expansion in the aircraft industry in the past year has fully demonstrated the present need for standardization of materials and equipment used in the production of Army and Navy aircraft. Through the Permanent Working Committee of the Aeronautical Board, this activity has proceeded at a greatly accelerated rate. In standardization of aircraft instruments, protective coatings, metals, batteries, generators, hydraulic systems, and other items are being diligently prosecuted.

"The scarcity of certain aircraft materials has necessitated increased activity in the development of suitable substitutes. The anticipation of the situation by the Bureau of Aeronautics approximately two years ago has resulted in the consummation of carefully planned programs from the laboratory through the service test stage with the result that satisfactory substitutes for certain materials of which there is a shortage have been developed and are in use. Cotton webbing has completely replaced linen webbing and has been adopted for parachute harnesses. Synthetic rubbers of various types are being introduced at an increasing rate as a substitute for natural rubber. Synthetically produced silk fabrics have been investigated and found to be satisfactory as substitutes for imported parachute silk.

"Plastics are being studied to determine their possible aircraft applications, and in some instances their use has been authorized



FLOTATION BAGS

These Goodyear bags are installed while deflated in warplanes and are inflated with compressed carbon dioxide to provide buoyancy and keep the planes afloat if forced down on water.

U. S. Navy photo

VOUGHT-SIKORSKY SCOUT BOMBER

The Navy scout bomber Vindicator, VS-SB2U-3 land plane, powered by a Pratt & Whitney Twin Wasp Junior engine and Hamilton Standard constant speed propeller.

for certain aircraft non-structural components. The Bureau of Aeronautics has not yet found structural materials which can be used under production conditions as general substitutes for the highly satisfactory high-strength aluminum alloys from which present-day aircraft are constructed. The unusual properties of these alloys, the facilities available, and the established procedures in the aircraft industry for processing them in production, make their replacement in aircraft by other materials extremely hazardous. This bureau does not feel that it should jeopardize the safety of personnel or aircraft and possibly decelerate production by introducing untried structural materials in aircraft. A complete study of this problem is nevertheless actively underway. Also, investigations are being made with a view toward widening specification tolerances for impurities in certain aluminum alloy specifications in order to permit the use of secondary aluminum wherever practicable.

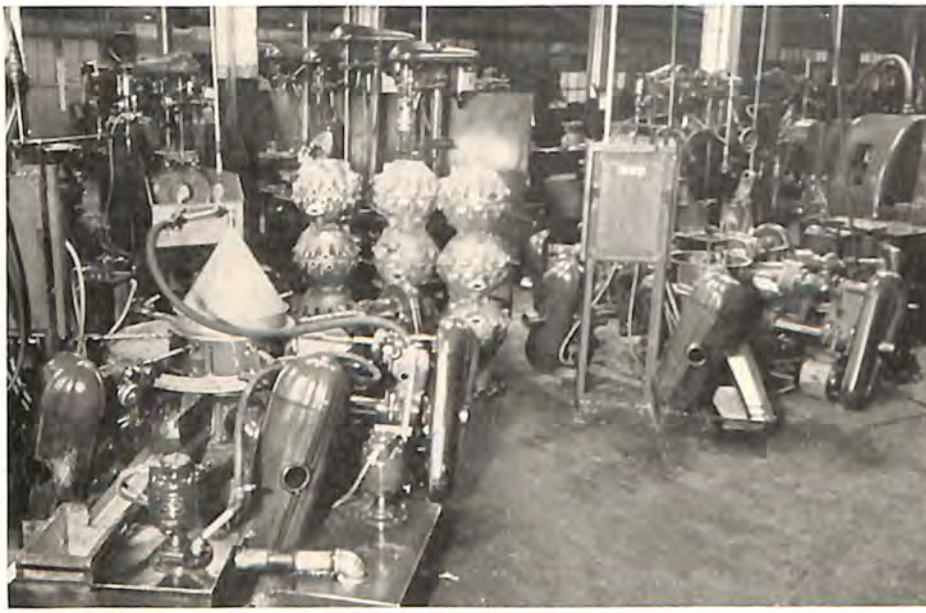
"Unsettled conditions abroad have necessitated expediting developments of certain equipment known to be essential in combat. Chief among these has been the development of self-sealing fuel and oil tanks. As the result of excellent cooperation obtained from a number of manufacturers, under the guidance of the Bureau, there have been developed, tested, and placed in production at least three highly satisfactory self-sealing tank materials. Tanks of this type are now being installed in combat aircraft. The Bureau's tests indicate that these materials are superior to those available abroad.

"Heating systems which have been developed are now being installed in certain types of naval aircraft. Oxygen equipment, reported to be far superior to equipment heretofore available, has been developed, service-tested and is now being manufactured in quantity and supplied to operating units. The Bureau has maintained close cooperation with the National Defense Research Council, sound studies of various types of naval aircraft resulting in the accumulation of valuable data which will be used as a basis for specifications controlling soundproofing of naval aircraft. Various designs of life rafts have been developed and are being used not only for emergency purposes but for general servicing of flying boats and other uses.

"A system of aircraft camouflage has been devised, tested and adopted for all Fleet aircraft.

"During the past year the application of aerodynamic and hydrodynamic test data has continued to result in gratifying improvements in the performance of flying characteristics of naval airplanes. As in past years, routine tests have been conducted at the Washington Navy Yard wind tunnels but the limitations of present equipment at the yard has made it necessary for the Bureau to depend on the

RYAN ST3-S SEAPLANE
For Naval pilot training.



FOR JACOBS AIRCRAFT ENGINES

Appropriately named the "Octopuses" by the shop crew, these machines incorporate specially designed fixtures, each with seven horizontally mounted Delta drill heads for drilling the 14 tappet guide holes and tappet guide hold-down screw holes in the front cases. Heads are cam operated, but indexing, raising and lowering of inner portion of fixture is performed by air.

facilities of the National Advisory Committee for Aeronautics for the investigation of many specific design problems. The Bureau highly appreciates the cooperation of this committee in investigations despite interference with valuable basic research work.

"Research and design development have been instrumental in improving high-lift and lateral control devices, flying boat hull lines, and stability and control characteristics.

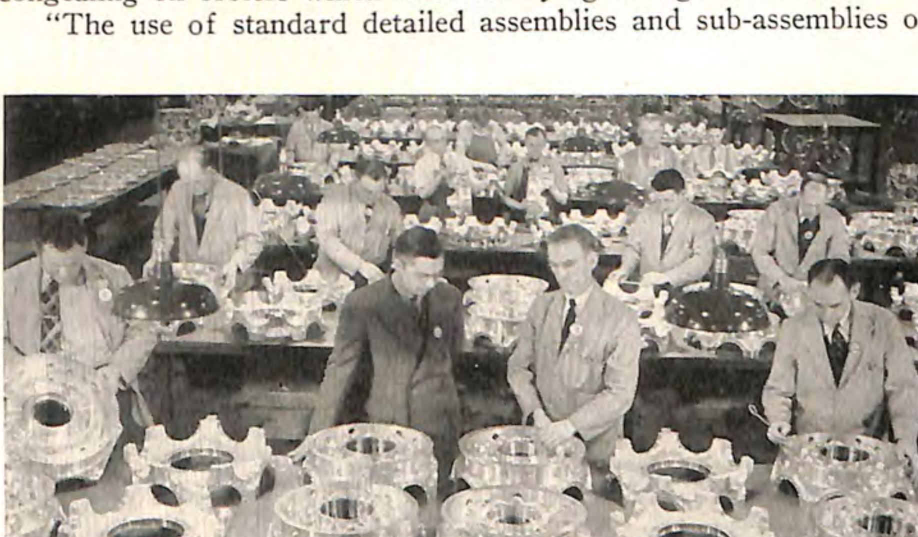
"Advances in aircraft armament, spurred by the hostilities abroad, have continued at an increasing pace. In cooperation with the Bureau of Ordnance, which has primary cognizance of aircraft armament material, the Bureau of Aeronautics has continued to foster such modernization and improvement of armament installations in existing Fleet aircraft as is practicable; in new aircraft to incorporate new designs in gun and bomb installations; to increase generally the fire power and effectiveness of armament installations; to provide protection for personnel, fuel, and oil; and to develop new and more effective weapons such as aircraft turrets, remote control for guns, and continuous ammunition supply for guns.

"The improvement and development of equipment accessories for use on naval vessels for the launching, arresting, and operation of aircraft has shown marked progress in keeping with the increasing requirements. Aircraft equipment has been provided on the two new battleships 'North Carolina' and 'Washington,' commissioned on April 9 and May 15, 1941, respectively, and for one escort vessel, aircraft, the 'Long Island,' which was commissioned on June 2, 1941. Aircraft equipment has been authorized and is being manufactured for 15 battleships, 46 cruisers, six destroyers, and 12 aircraft carriers.

"During the past year many new engine manufacturing plants quite widely distributed have been placed in production to keep up with the defense needs. This has placed an increased work load on the parent organizations, depriving experimental work to some extent of materials and personnel. Although experimental work has been slowed, individual improvement in essential factors such as fuel economy, weight, frontal area, and reliability has continued. So far, the Navy adherence to the aircooled radial engine design has been shown to be sound, in view of the excellent results obtained in actual combat work and the ease with which production of this type of engine was stepped up.

"The outstanding features of the year were the advent of the pressure carburetor, high altitude fuel systems, oil systems, and non-congealing oil coolers which facilitate flying at high altitudes.

"The use of standard detailed assemblies and sub-assemblies of



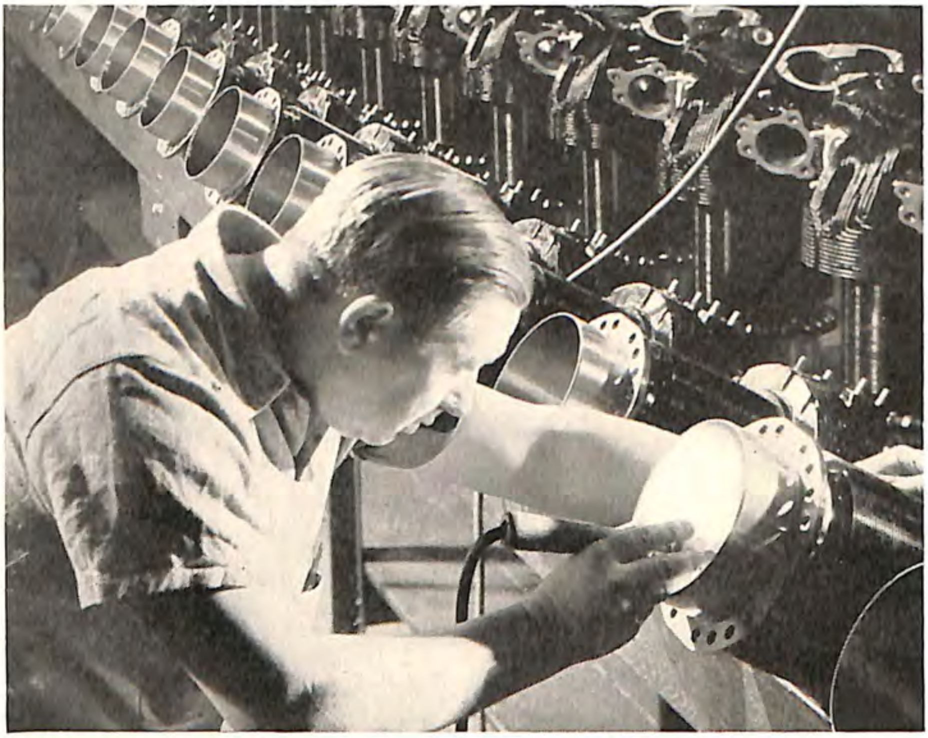
INSPECTING DOUBLE WASP CRANK CASES
At the Pratt & Whitney Aircraft engine plant.

accessories and controls has been promoted to secure increased production and quick installation. There are available starters which are capable of handling with ease the biggest engines now contemplated.

"Auxiliary power plants, due to the extensive use of electricity aboard the planes for armament and other purposes, have had their output increased nearly 100 per cent. With the expansion of Naval aviation has come a wider geographical spread of operating units, which requires these units to operate over wide temperature ranges with a degree of reliability equal to that of the main engines.

"During the fiscal year 1941 as compared to 1940, hours flown in the Fleet increased 12 per cent and ashore 60 per cent, for a combined increase of 30.5 per cent. The large increase in flying hours ashore was the result of the augmented training program.

"During the fiscal year 1941 as compared to 1940, the total number of airplanes overhauled increased 7.2 per cent, engines 11.5 per cent, and minor overhaul and repairs 35 per cent."



INSPECTION OF WRIGHT ENGINE CYLINDERS

A powerful light ray aids inspectors in their careful examination of the bore of Wright Cyclone cylinder barrels for detection of possible scratches.

CHAPTER V

TRAINING AND EDUCATION

Giant Training Programs Follow Our Entry in the War—Air Force Training Programs of the Army and Navy—U. S. Trains Pilots of the United Nations—The Civilian Pilot Training Program—Vocational Training—The Aircraft Industry Trains an Army of Workers—Educational Work of the Schools.

THE day was December 19, 1941. The place was one of the U. S. Army Air Forces advanced flight training schools. It was early morning. Grim-visaged aviation cadets paced the flying line, impervious to everything but the sleek training planes being warmed up. To one side stood a group of officers and civilians. An officer spoke:

"Look at that formation flying up there! Cadets never flew with such precision in so short a time!"

Another officer spoke:

"It's amazing! They've taken new interest since war started! Nobody gets lost on cross-country flights anymore!"

America's entry into total war intensified training everywhere. There never could be too many trained airmen—pilots, bombardiers, navigators, gunners and other specialists, not forgetting the surface personnel—all important in the program to "keep 'em flying." Training had become a more complex problem, too, with faster planes and more of a machine to handle on countless missions. At the beginning of 1942, the United States was embarked on a steadily expanding program to build up the greatest flying force in the world, greatest as to both superiority and numerical strength.

The U. S. Army Air Forces was inducting trainees at a rate permitting annual production of 30,000 pilots. One year previously, an induction rate permitting output each year of 12,000 pilots had been reached. This 12,000-a-year rate itself represented the realiza-

U. S. Army photo

TRAINING FOR THE ARMY AIR FORCES

Student pilots at one of the training centers march to their planes for the start of daily flying practice.

tion of a then-unprecedented expansion, following as it did a 2,750-a-year program. And—as the 30,000-a-year-rate was reached, a plan to double this program was being formulated.

The Army Air Forces had approximately 35,000 flying officers and aviation cadets in January, 1942. Training was being conducted at 82 schools. This compared to 13,000 officers and cadets and 46 schools a year previously. By February of 1942, the training expansion task had grown so vast that the separate Flying Training Command was formed to centralize the job. This Training Command was charged solely with direction of training, under the Air Corps, which was itself a part of the Army Air Forces. Responsibility for establishing the training schools remained with the Air Corps, which was the overall training and procurement branch of the Air Forces. The chief of the new Training Command was Major Gen. Barton K. Yount, a pioneer in the Air Corps training system. His job was to train 30,000 pilots in 1942, with the sights for 1943 about to be trained on a much larger goal. Thousands of new officers were to be trained and rushed to the combat commands, the "shootin' half" of the Air Forces, with all possible speed.

By February, 1942, the Army Air Forces had in operation 42 primary flight training schools, 18 secondary training schools and 22 advanced training schools. Forty-five of the primary and secondary training centers were civilian schools under contract to the War Department.

Indicative of the importance of the navigator, the bombardier, the observer, and the gunner was the fact that 13 institutions were devoted exclusively to their schooling. Here was specialist training unheard of in World War I when the second and only man in the airplane, other than the pilot, combined all the functions of aerial war except flying—but combined them in a loose and lazy sort of way, having control, usually, of not more than one .30 caliber manually operated machine gun, and perhaps a small fragmentation bomb. World War II, demanded that thousand upon thousand of these

U. S. Army photo

LEARNING TO USE OXYGEN

A flying cadet in U. S. Army Air Forces training prepares for high altitude work.

BEECHCRAFT ARMY NAVIGATION TRAINERS

An all-metal low-wing monoplane carrying a crew of five. It is powered by two Pratt & Whitney 450 h.p. engines.

specialists be trained to handle highly-developed, intricate equipment, including multi-gun power-driven turrets swung hydraulically or electrically in all directions against the terrific wind pressures set up by 300 to 400 m. p. h. speeds. Modern bombers demanded crews of from three to nine, including pilot, co-pilot, navigator, bombardier, radio operator, gunner—in many cases more than one of each. Equipment demanded specialists in each field. The pilot, navigator and bombardier were the three musketeers of the air.

Fortunately for the program, the civilian owned and operated schools were available to help train military aviators. It had been an experiment only two years previously. In 1942, however, it had proved eminently successful. Use of civilian flying schools by the Air Corps had the great advantage of utilizing the long experience and facilities of the leading commercial schools, and brought about a decentralized training program in a way which permitted rapid expansion, as was demonstrated fully. This expansion was carried on more rapidly and at substantially less cost than could have been done, if executed directly by the Army.

The schooling of fighting pilots in 1942 took 30 weeks, 10 weeks each in a primary, secondary and advanced training center. A little over a year before, the time required was one year, but the emergency demands for pilots forced extension, decentralization and intensification of the training system. The country's private flight training schools played a meritorious part in making this possible, by taking over all the primary and some of the secondary training from the Air Forces, thus relieving the pressure on the Army-operated training centers. The success with which the big training job was being

READY FOR THE U. S. ARMY AIR FORCES
North American AT-6A advanced trainers.

AERONCA CHIEFS AND TRAINERS
Ready for delivery outside the Aeronca plant.

accomplished was evidenced by the fact that, despite the almost unbelievable expansion in pilot training activities, the accident rate actually decreased.

Much heterogeneous, but necessary, training was being supervised by the Air Forces. Two air lines ran training courses for Army pilots in flying multi-engine aircraft. In June, 1941, the Air Forces established the Ferrying Command, headed by Brigadier General Robert Olds. The Ferrying Command flew newly completed warplanes from factories to Air Forces bases and to ports whence they were shipped or flown abroad to go into service with America's allies. Four weeks special training was given Air Forces pilots before they undertook ferrying work. Before the year was out, 100 ferrying pilots were being turned out each month. The Ferrying Command flew over 3,000,000 miles during 1941.

Another type of pilot training was scheduled by the Army in 1942. Following demonstrations during field maneuvers, the Field Artillery decided to equip the artillery components of one infantry division and one corps artillery brigade with airplanes, pilot-mechanics and maintenance mechanics. These planes were the light craft that became so well known as "grasshoppers" and their adoption represented a triumph for the lighter plane industry, which had gained the Army's permission for the field maneuvers demonstrations. Company pilots, operating the "grasshoppers," performed such feats of liaison, communication and fire directing that the artillery was "sold." An intensive training course, stressing low altitude flying and take-offs and landings in limited space, was planned. The "flying observation post," to direct fire on pre-arranged targets and to spot targets of opportunity, probably had become a fixture with the artillery. Achievements of the "grasshoppers" confirmed the claims of the light plane industry, which had held for years that their products had a definite place in the military scheme. Before the year 1941 was out, orders were placed for Piper, Taylorcraft and Aeronca planes.

Air Forces training was intensive, but thorough. The newly appointed aviation cadet was assigned to an Aircrew Replacement Center. Upon arrival, he took a complete physical examination for flying duty. If he passed this he was given further mental and psychological examinations for the purpose of determining for which type of Aircrew training he was best qualified. Upon the basis of these tests, the aviation cadet was selected for either bombardier, navigator or pilot training. If he failed to pass the flying duty examination, or if later on was eliminated from any of these types of aircrew training, he was allowed to pursue some other type of ground duty training, such as, armament, engineering, meteorological, etc. If for any reason he was ineligible for this, he was relieved and sent to one of the Air Corps Replacement Training Centers (Technical) for training in a technical school for enlisted men.

The Replacement Center, a fairly-new idea (they were called Manning Depots by the British), provided a short military orientation course. The recruit got his innoculations, took up ground drill, customs of the service, and other basic military subjects. By this means, when an aviation cadet entered his flight training course he could concentrate entirely on learning to fly, and on technical ground school subjects.

After leaving the Pilot Replacement Center the prospective mili-

THE BEECHCRAFT AT-10

A transitional trainer for multi-engine bomber pilots of the Army Air Forces.

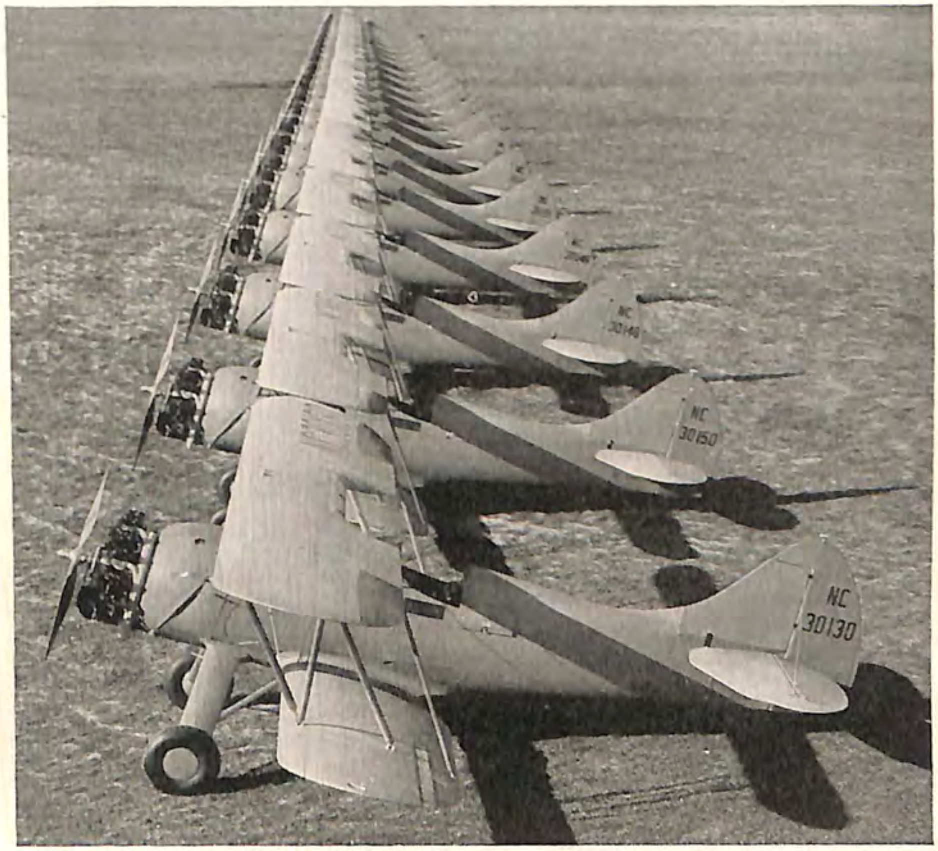
BOEING ARMY TRAINER

One of the PT-13-B trainers for the U. S. Army Air Forces. It is powered by a Lycoming engine.

tary flyer proceeded to one of the civilian flying schools and took his elementary flying training course of 10 weeks. This included 60 hours of actual flying training (an average of 28 dual and 32 solo), 140 hours of academic instruction including 30 hours of meteorology. In the flight instruction the aviation cadet learned to fly such primary training ships as the Stearman biplane and Ryan and Fairchild monoplanes, with average top speed of 125 miles per hour. At the end of the 10 weeks he was supposed to be proficient in all fundamental maneuvers in primary trainers. A recent class of 146 members flew an aggregate of 3,866,100 miles without a fatality. Each member chalked up some 26,480 miles, further than around the world at the equator. No other country could spare aviation gasoline for that amount of training flight, but it was deemed essential to good pilotage by the Army Air Forces and the United States had the gasoline.

Basic flying training, the secondary stage, covered advanced maneuvers, spins, forced landings, formation flying, night flying, instrument flying, etc. The ground school sessions included radio code, air navigation, weather observation, airplane and engine operation, etc. Airplanes used in the basic training program included such 450-h.p. ships as the Vultee BT-13 and BT-15, and North American BT-14, with top speeds of 170 miles per hour, some 60 instruments, full radio equipment, landing light apparatus for night flying, etc.

In the advanced or third stage of pilot training, the cadet learned to use the airplane as a weapon of war. There were two distinct courses. Advanced single-engine pilot training taught combat proficiency in single-engine military aircraft. Advanced twin-engine pilot training taught combat proficiency as pilot of two-engine military aircraft. In the 10 weeks necessary to complete advanced single-engine pilot training, cadets first covered the broad scope of pilotage of single-engine advanced training military aircraft, then trained as combat pilots of fighter type aircraft, and then qualified in basic duties common to junior officers of the Air Forces. Of the 237 air-ground hours in single-engine pilot training, some 118 hours were consumed in classrooms and laboratory work, while 79 hours actually were spent in the air. An additional 80 hours were evenly divided between military training and athletics. During the flying, aviation cadets



WACO UPF-7 TRAINERS

A week's production of trainers sold to flying schools under the CPT program, outside the factory of the Waco Aircraft Company, Troy, O.

THE FAIRCHILD PT-26

The Canadian version of the Fairchild PT-19 standard Army elementary trainer.

underwent transition from the relatively simple basic airplanes to the more complex training ships such as the North American AT-6 (also widely used by the British as the Harvard and Yale advanced trainers) and also some transition on available combat types, such as the P-35 and P-36. After assignment to squadrons in the Combat Command they were ready to step into the newest single-engine fighter planes, such as the Curtiss P-40, Bell P-39 (Airacobra), and the Republic P-43 (Lancer).

In single-engine advance training there was also plenty of practice in formation flying, navigation and ground and aerial gunnery.

Ground school instruction covered such subjects as armament, tactics and technique of air fighting, squadron duties, maintenance engineering, anti-aircraft, signal communications, etc. Some 45 different textbooks and many special Air Forces circulars provided material for study.

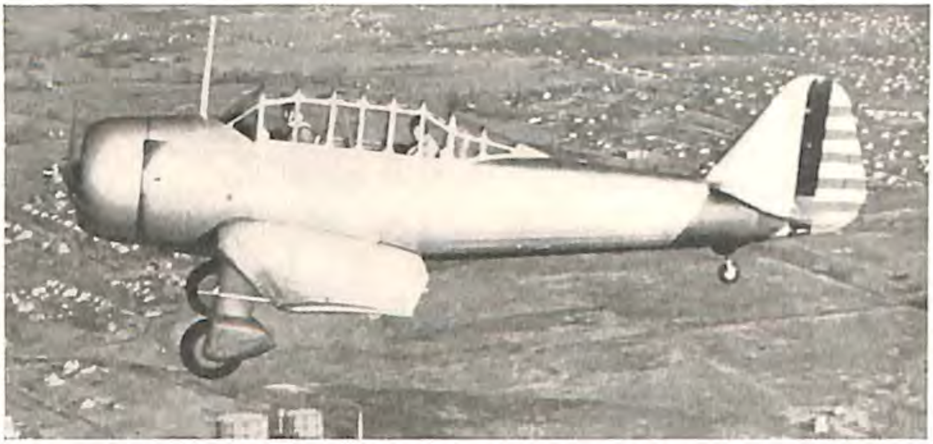
Twin-engine pilot training was also a 10 weeks course and covered 247 air-ground hours, with 121 hours for hangar and laboratory work, 70-78 hours of actual flying and 20 hours each for military training and athletics. Most of the time in the ground school was set aside for study of armament and gunnery after students were thoroughly familiar with equipment and technical operations instruction. Technical orders and shop practice, as well as tactics and technique of bombardment aviation, were studied along with the theory of bombing, duties of squadron officers, maintenance engineering, employment of aviation in the Army, bombing trainer study, radio and dead reckoning air navigation, combat orders, signal communications, tactical fire and reconnaissance aviation, and search operations.

In the allotted 70-78 hours flying time in twin-engine pilot training, the cadet gained transition on advanced two-engine jobs by Beechcraft, Cessna and Curtiss, and on bombers, including the Douglas B-18A and Lockheeds. Night flying, advanced formation drills and instrument flying were practiced, both in training airplanes and bombing aircraft. After this training the flying officer was assigned to a Bomber Command squadron and took the new medium bombers into the air—the North American B-25 and Martin B-26. After considerable experience on these, some of the twin-engine pilots were assigned to squadrons using B-17 and B-24 heavy four-engine bombers.

Aviation cadets training to become the other officer members of the aircrew—bombardier and navigator—concentrated on highly technical subjects. For a long time the term "flyer" was applied to the pilot only. More recently, however, it was recognized that all members of the aircrew in military aircraft must be classed as military flyers. The pilot's duties, including the take-off, the management, direction of the airplane in flight and the return of it safely to earth have remained little changed. The duties and functions of the other members of the aircrew—the bombardier, navigator, aerial engineer, gunner, radio technician—have grown steadily year after year with the advent of new equipment requiring an ever-increasing dependence, for successful flight missions, on a multiple crew of superior individuals trained in perfect team play and coordination. To

CURTISS SNC-1 COMBAT TRAINER

Delivered in quantity to the Navy air forces. The SNC-1 is powered by a Wright Whirlwind engine.



FLEETWINGS ARMY BASIC TRAINER

The BT-12 in flight, first stainless steel military plane on record.

operate the new sky battleships, as well as thousands of medium two-engine bombers, a tremendous number of aircrew members were needed.

During 1941 the bombardier entered the news with all the importance which was his just due. He was the man who carried the ball. He operated the bomb sight; at just the precise moment released the tremendously important air weapon, the bomb. He was also trained as an observer and as a gunner so that he could take his place in protecting the airplane. His special studies included the theory, practice and use of our bombsight, meteorology and practice in reading weather maps.

Without a trained and able navigator an airplane could not reach the desired objective. The navigator was trained to locate his position by the stars, by radio, by dead-reckoning and by ordinary recognition of land marks. At night, and during blackouts, his job was difficult, but U. S. navigators were able to do their job. The navigator was also trained in observation and gunnery. He was trained to report on everything he saw, and to be able to protect the airplane when called upon to do so. His course included the science and art of navigation by pilotage, dead-reckoning, radio navigation, celestial navigation and how to use each method in conjunction with the others. He also studied meteorology and practice in weather observation.

The accomplishments of the aircraft manufacturing industry in meeting the mushrooming demand for training planes of all kinds could not be overemphasized. Wartime restrictions precluded disclosure of detailed figures but monthly trainer production was increased about 100 per cent in 1941. These training planes, acknowledged by aeronautical experts to equal or surpass any in the world, rolled off assembly lines at the factories of Fairchild, Ryan, Spartan, Stearman, North American, Vultee, Curtiss, Beech and Cessna. Several new models, including the Fleetwings stainless steel basic trainer, were scheduled for delivery early in 1942.

Early 1942 saw an expected revision of requirements for entrance into training as bombardiers, navigators and pilots. In 1941, the requirements had been relaxed to permit enlisted men with high school educations to receive flight training, with non-commissioned rank awaiting them upon graduation. But by the end of 1941, it became obvious that the requirement of two years of college for eligibility to commissioned rank must be abolished, if sufficient candidates were to be obtained for training. So a uniform simplified test replaced the college credits requirement, and eligibility was extended to married men. In addition the minimum age limit of 20 was reduced to 18. The maximum age limit of 26 was retained. The reduced age limit applied to ground as well as air officers. Through the revision in requirements, approximately 2,000,000 more men became eligible for commissions in the Air Forces. The new tests did not emphasize detailed academic knowledge or studies but were concerned with the applicant's proficiency and ability to comprehend subjects with which he would be confronted in training texts and manuals. Results of the revision in eligibility requirements were seen immediately. Soon after the revision was announced, 700

THE INTERSTATE S-1A-90F

A tandem trainer powered by a 90 h.p. Franklin engine.

BEECHCRAFT NAVIGATION TRAINER

It is equipped for simultaneous training of three student navigators in celestial, dead reckoning and radio navigation.

applicants applied for training in the Air Forces in a single city in one day.

The successful aviation cadet, upon graduation, received the rank of Second Lieutenant, a uniform allowance of $150, and, on completion of active duty, a bonus of $500 for each year of his active service. During his training, he received $75 a month, plus $1 a day subsistence, lodging, clothing, equipment, medical care and a $10,000 life insurance policy.

The pilot training program in progress and about to be undertaken by the Army Air Forces was equalled by the Naval pilot training program announced early in 1942. The Navy, while it had always maintained what was considered to be both the best and the largest Fleet Air Arm in the world, nevertheless never had been called upon to train and maintain a force numerically comparable with that of the Army. However, Pearl Harbor and subsequent events in the Pacific changed all theretofore normal precepts of the amount of naval air power necessary in modern warfare.

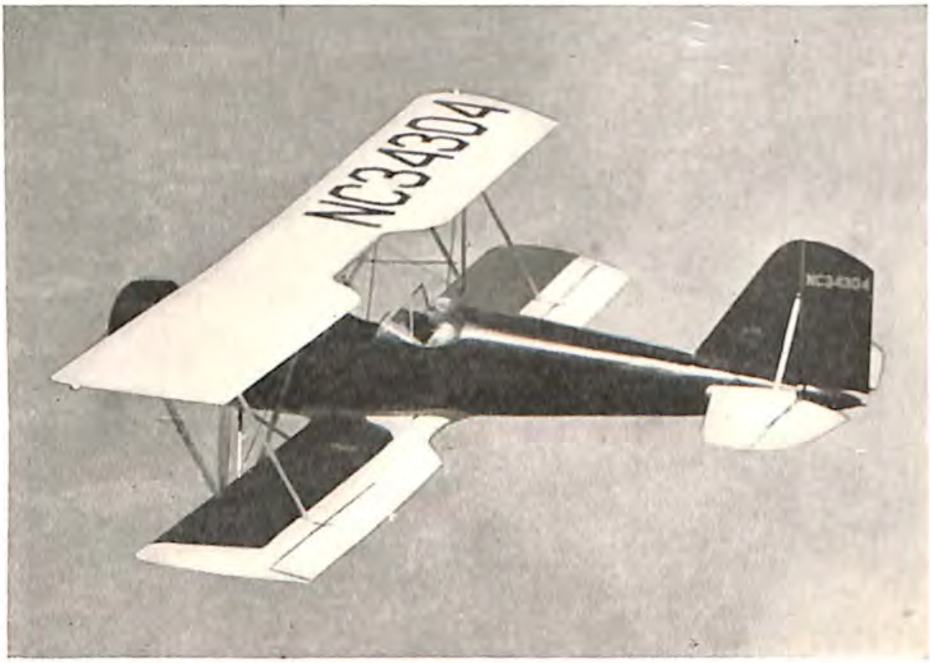
The Navy's pilot training program had been expanded until at the beginning of 1942 the Fleet Air Army had about 12,000 pilots and trainees, double the number of a year before—and was aiming at a pilot force of approximately 17,000. In early 1942 the Navy was turning out about 600 pilots monthly, an annual production of more than 7,000. This program suddenly was revised to contemplate 30,000 pilots in 1942, an increase of more than 300 per cent. In other words, the Navy High Command decided it needed nearly as many pilots as the Army for the aerial armada projected by the President.

To school its pilots under the new program, the Navy retained its old training framework, but expanded it greatly, introducing a significant innovation. Facilities of four large universities, one each in the East, the West, the Midwest and the South, were leased for the duration of the war. Each was to become an "Annapolis of the Air." At these universities, Naval pilot candidates were to go through a rigorous, three-months toughening process aimed, according to the official announcement, "at making our sea hawks the strongest, most daring and most determined type of airmen in the world." This stage in the training—one of the innovations—was to cover four phases: (1) Proper physical conditioning (2) Indoctrination in naval history and customs (3) Military drill and seamanship (4) Training in communications, ordnance and other specialties.

Lieut. Commander Tom Hamilton, former head football coach at the Naval Academy and himself a Navy flyer, was named to direct the physical training activities at the universities. Other leading coaches and physical education authorities were called upon to help Commander Hamilton whip into shape the 2,500 trainees to be inducted monthly under the new program. Secretary of the Navy Knox said that the preliminary three-month toughening process would be "the most strenuous in the history of American military training." He said the trainees would learn to march "up to 40

CURTISS TWIN-ENGINE TRAINER

The AT-9 advanced trainer produced by Curtiss-Wright for U. S. Army Air Forces multi-engine pilot training.



THE MEYERS TRAINER

It is powered by a 145 h.p. Warner engine.

miles from sunup to sundown, and will be set to such heavy labor as ditch-digging, wood-chopping and land-clearing, and will be extensively schooled in such realistic self-defense arts as advanced jujitsu, boxing and rough-and-tumble fighting."

"The program is a challenge to patriotic young American men who are proud of their ability to take it," said Secretary Knox. "This training will be hard, but the time for pulling punches has passed."

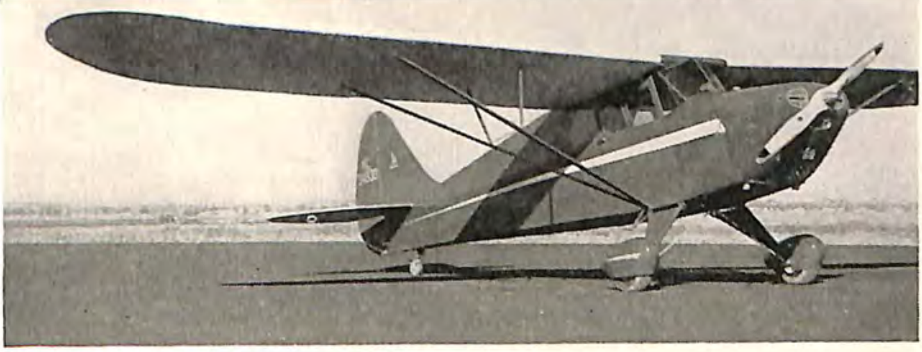
Secretary Knox, adding that he expected the airmen turned out under the new program to become the leaders in postwar aviation, declared that it would be in operation by May 1, 1942, or sooner.

Following the three-months preliminary course, the usual Naval flight training, which was in process throughout 1941, was to be undergone by the "new style"—Fleet Air candidates. It was through this system that the Navy was turning out 600 pilots monthly when the expansion was announced. This training comprised 30 days of flight school at one of 16 elimination centers, with the successful candidates moving on to one of the Navy's four huge advanced flight centers at Pensacola, Jacksonville and Miami, Fla., and Corpus Christi, Tex. At these stations six months of advanced flight training, if successfully completed, turned out a full-fledged Naval aviator ranked as an Ensign. Upon graduation the pilot was selected for duty in one of the three specialized branches into which the training program was divided—patrol plane, seaplane (operating from cruisers and battleships) and carrier-type planes. During the advanced training, Naval cadets, in addition to becoming pilots, received instruction in engine construction, radio operation, celestial and dead reckoning navigation, gunnery, warfare tactics and aerodynamics.

Introduction of the three-months preliminary course was to lengthen from seven to 10 months the full training period for pilots, but the vastness of the facilities at the existing elimination and advanced centers was expected to permit monthly output of 2,500 airmen without further expansion.

The year 1941 saw inauguration of programs of training for British, Chinese and Latin American military pilots in the United States. Largest by far among these programs was the British. Supervised by the Army Air Forces, the British program utilized 11 Army schools—five civilian and six Air Forces—to turn out pilots at an annual rate of 4,000, in addition to 1,000 navigators. This program supplemented huge British pilot training activity in Canada.

The Civilian Pilot Training Program, supervised by the Civil Aeronautics Administration, in 1941 continued to set records as the largest and most successful program of its kind in history. The program, which had its inception in 1939, turned out 40,000 pilots in 1941 and the first two weeks of 1942, bringing its total output during existence of the program to nearly 70,000. During 1941 CPTP graduated 6,000 secondary (CPT advanced) pilots and on January 15, 1942, had 3,000 secondaries in training. In addition, 6,000 instructor refresher courses were given during 1941.



THE INTERSTATE CADET

Model S-1A, a tandem trainer with 65 h.p. Continental engine.

NORTH AMERICAN SNJ-3

A Pratt & Whitney Wasp-powered scout trainer with the U. S. Navy.

The program, which is operated uniquely in that none of the training is given by the CAA, all of the work being farmed out to civilian schools, was participated in by 550 ground schools and 600 flight centers. About 500 colleges included CPTP courses in their curricula. The course comprised both ground and flight training and in the elementary stage took the student up through 35 hours of flying, at which time he was eligible to take a test for his private pilot's license. Chiefly through CPTP, the number of licensed private pilots in the United States increased during 1941 from 63,000 to 100,000, with approximately 75,000 students in training throughout the country early in 1942.

The CPTP was a gigantic reservoir of military pilot candidates during 1941. As 1942 opened, 10,000 CPTP graduates were in the air services, 7,000 were awaiting the call to military flight training, and 7,000 more were in the armed services in other than flying capacities.

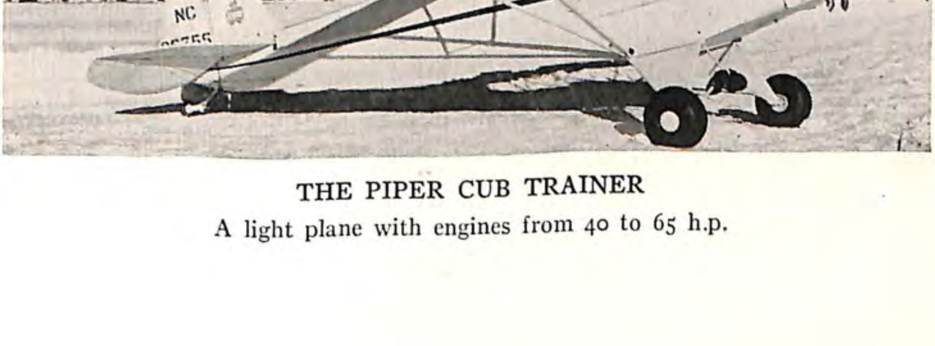
CPTP started out to be purely what its name implies—a Civilian Pilot Training Program. But the national emergency, and then the war, affected a radical change. Candidates for CPTP training were asked to sign a pledge that they would enter the American air services if their country needed them. The pledge apparently was unnecessary. Thousands who entered CPTP before the pledge was required nevertheless volunteered for the air services upon graduation. On January 1, 1942, more than 30 per cent of all the young men seeking enrollment in the air services were CPTP graduates, with some 35,000 CPTP students still in college, where they were deferred from military service.

The year 1941 proved that CPTP was a vast reservoir of good military pilot material. Out of every 100 CPTP graduates who entered the air services, only seven failed to graduate. The rate of attrition among non-CPTP aviation cadets was much higher. In addition to supplying the air services with so many thousands of pilot candidates, CPTP in 1941 supplied 254 instructors for civilian schools giving Army flight training, 63 instructors to Canadian flying schools, and 163 instructors to the air lines, where for the most part they became commercial pilots to help keep those defense-vital means of transportation at a high standard of efficiency and a high frequency of operations.

This training was not costly, either. A private pilot was produced for \$375; a secondary pilot for \$870 additional. The Government rented no classrooms, bought no airplanes, hired no instructors. These were provided and maintained by the colleges and flight contractors.

Numerous changes were made in the CPTP during 1941 better to integrate the program with those of the Army and Navy. The armed forces were consulted on each step in the program's development. As a result, CPTP, which during its early days had been somewhat suspect by the air services as to its worth, became the object of praise by those services. No conflict in equipment requirements was experienced, because CPTP for the most part used the so-called light planes, only a relatively few of which were ordered by the armed services.

The safety record of CPTP was amazing, students having flown



THE PIPER CUB TRAINER

A light plane with engines from 40 to 65 h.p.

U. S. Army photo

BOEING PT-18 ARMY TRAINER

It is powered by a Jacobs engine.

during 1941 four and a half million miles per fatality, equal to 180 times around the world. Best yardstick of safety, however, was the low rate of life and accident insurance premiums on student pilots.

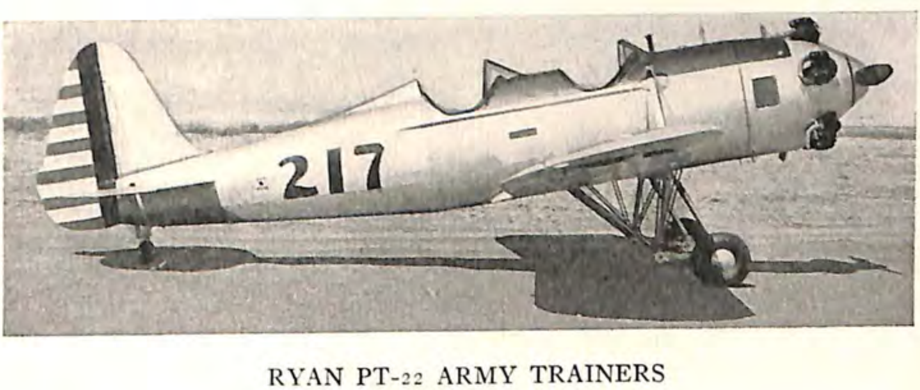
In CPTP America finally embraced the movement credited with having made possible Germany's sweeping military successes—national aviation indoctrination of youth. In this country the development was founded on peaceful precepts, but it has been forced by the war to assume, temporarily, a military character. When the United States belatedly introduced civilian pilot training, it was too late to prevent the present world conflagration, but the program's complete success was seen as a possible keystone on which future peace could be built and assured. Certainly, the program, which American ingenuity and resourcefulness had in such a short space of time made the greatest of its kind in history, assured to aviation a successful future in this country. Assistant Secretary of Commerce Robert H. Hinckley, who as Chairman of the former Civil Aeronautics Authority, founded CPTP, on January 13 made the pungent statement that "one of our biggest Pearl Harbors" was lack of aeronautical training in American schools.

"We must make ourselves a nation of fliers," Mr. Hinckley declared. "It does no good to be air conscious with a flock of enemy planes overhead—you will soon be unconscious."

One of the most serious problems facing the defense program, and particularly the aircraft industry, as 1942 opened, was the training of an industrial "army" to stand behind the man behind the gun. When President Roosevelt voiced his stirring appeal for 185,000 military planes in 1942 and 1943, the problem was intensified many-fold. The aircraft industry had been forced to train tens of thousands of workers during the last two years. Vocational training by the Government had helped, but the industry had to shoulder the principal burden of procuring and training additional hundreds or thousands.

On January 1, 1941, about 193,000 persons were working in the industry. A year later, this number had been increased to more than 400,000. Prospects at that time—January, 1942—were that at least 200,000 more employes would be needed. Came Mr. Roosevelt's message, and the estimate rocketed to 1,400,000. How was the mountainous task of training these new thousands of workers to be accomplished? Where were they to be found? The answer to the first question was to be found in the training achievements of the industry during 1941. As to the second question, about 4,000,000 workers in civilian goods industries early in 1942 were faced with loss of their jobs as the Government ordered curtailment of production of such commodities as automobiles, washing machines and refrigerators.

The labor training job of 1941, which was to be carried on in 1942 on an incredibly larger scale, was unprecedented. When the year began, the reservoir of skilled aircraft labor had been drawn dry. Only green hands were available. These green hands the aircraft industry took and sent to schools for pre-employment training. These schools, set up by State and local educational systems, were supported with Federal funds. The aircraft companies prepared curricula, furnished instructors, and in many cases furnished materials. On conclusion of pre-employment training, the worker, trained to perform a simple repetitive function, went to work. He was placed, along with several fellows, at the side of a "leadman," an experienced workman. The "leadman," in addition to performing



RYAN PT-22 ARMY TRAINERS

RYAN TRAINERS FOR DEFENSE

A corner of the Ryan Aeronautical Company's plant at San Diego, Calif., showing construction of Ryan S-T trainers.

his own work, supervised the efforts of the newcomers. When one of these became proficient, he was set to another task, under another "leadman." In this way, the new hand was encouraged to progress as far as possible. Picking up the skills one by one, many thousand employes in time became skilled, or semi-skilled. These workers then were offered sparetime schooling, by the companies in more advanced subjects, such as blueprint reading. When they completed this "in service" training, they received better jobs, and in time many became "leadmen" and even sub-foremen or foremen, whereupon they themselves took a hand in carrying on the vast training program.

This system of "up-grading" the green workers, was originated by the aircraft industry in the early stages of the "battle of production" and became one of the most significant industrial developments of the century. As described, the aircraft industry faced a shortage of all-round, skilled aircraft builders. The art of building airplanes admittedly was unique, different. What to do? The industry studied the problem, decided the only solution was to "divide up a skilled worker" into his component skills, then teach one skill each to as many workers as necessary to produce one composite artisan. Thus was broken a "bottleneck" which threatened to bog down the defense program before it had fairly started.

With the "up-grading" technique perfected by early 1942, a new problem arose to plague the aircraft and other defense industries. A large majority of the aircraft industry's "second army" of defense were of prime military age, 20 to 35, and were subject to the Selective Service Act. Local Selective Service Boards, up until actual entry of the United States in the war, had followed a strict policy of deferring essential defense workers from military service. After Pearl Harbor, however, it became necessary immediately to mushroom the American armed forces into the world's greatest army. To do this, many thousands of defense workers had to be called to arms. A new labor "bottleneck" arose to harass industry. The solution appeared to be women. Joint studies by the industry and the Government revealed the fact that women were being employed successfully as production workers in England. They had been employed in the American aircraft industry in certain capacities, such as inspection, for which they were particularly well suited, for some time, but in early 1942 it became obvious that their employment must be multiplied many times over.

As early as June, 1941, the Aeronautical Chamber of Commerce of America, trade association of the aircraft industry, had published and interpreted the results of a Labor Department survey on the subject of employment of women in the aircraft industry, and advised the industry to begin setting up training programs for women. The survey showed that 25 to 33 per cent of all the jobs in aircraft plants could be filled by women, and said that "in an emergency some women make good on any job if adequately trained." It recalled that, in

ST. LOUIS AIRCRAFT PT-LM-4
A training plane with Ranger engine.

CURTISS 22B COMBAT TRAINER

It is powered by a 420 h.p. Wright Whirlwind engine.

1918, 23 per cent of the employes in 40 airplane factories were women. It listed 24 different functions that women could perform in an aircraft factory. Stating that the predominating job in airplane assembly is riveting, the survey declared that "not all, but a large proportion of the work of this kind might be done by women, and the training of girls as riveters appears to offer definite possibilities as a source of labor for an industry rapidly expanding its working force."

That was six months before the new labor supply bugaboo took form. By the time it materialized, the industry and the Government were well on the road to smashing it—through the employment of women. A dozen factories had hired and trained hundreds of women. One company announced it contemplated a working force in the near future of which 40 per cent would be women.

The important part played by the Government in the aircraft labor training program must not be overlooked. Government aid to prospective workers helped the industry to score outstanding successes in recruiting and whipping into shape an industrial army which was destined to be equally as important as the armed forces in the ultimate destruction of Axis aggression. Through Federal financial aid and encouragement, 1,200 public vocational and trade schools, 155 colleges and universities and 10,000 public school shops were drawn into the training effort for all defense industries. When the United States entered the war, these institutions were put on a

24-hour-day, seven-day-week basis. During the 17 months up to January, 1942, that the Government had participated in the training drive, over 700,000 workers for defense were enrolled, including 133,000 WPA workers.

Among the many Government agencies participating in the training effort were the U. S. Office of Education, the National Youth Administration, the WPA, and a special Labor Supply Division of the Office for Emergency Management. Fiscal administration of training headed up in the Office of Education, which granted funds to the thousands of schools which made their classrooms available for defense training.

The work of the country's private aircraft vocational training schools must not be underestimated. (These activities are described in detail later in this chapter.) These institutions performed highly commendable service in turning out hundreds of the well-rounded aircraft artisans who were so badly needed as supervisory personnel in the aircraft industry. These were the men who could afford, or who somehow managed to afford, a year's training before entering lucrative employment. These schools during the year encountered difficulties as increasingly attractive, and certainly necessary, offers of free Government training had their effect on private enrollments which entailed outlay of what to many was a substantial sum of money. This inevitable conflict was adjusted through cooperative effort by the Office of Education, the Aeronautical Chamber of Commerce of America, and its School Committee. Late in 1941, Senator McCarran of Nevada and Representative Randolph of Virginia, introduced bills in Congress providing for a Civilian Mechanics Training Program to parallel the Civilian Pilot Training Program. House hearings were held, with Senate hearings called for early in 1942.

SOUTHERN AIRCRAFT BM-10

A two-place trainer with a 225 h.p. Continental engine.

THE SPARTAN NS-1

A two-place trainer produced by the Spartan Aircraft Company at Tulsa, Okla., and powered by a 220 h.p. Lycoming engine.

An impending shortage in maintenance and service mechanics for the country's air services, and for the British and other foreign air services, which were receiving large numbers of U. S.-built warplanes, loomed early in 1942. Authorities estimated that the shortage might approach 50,000 by the middle of 1942. This potentially perilous situation was taken under study by Federal authorities. It was hoped that early action would result. The private aircraft schools appeared to be the chief source of supply for this needed type of worker. Particularly keen was the need for assembly and maintenance mechanics abroad, where foreign technicians, because of differences between United States and overseas military airplane specifications, were finding it difficult to assemble and service American aircraft.

The Army itself carried on a huge mechanic training program in 1941. Thousands upon thousands of technical experts were needed to keep the thousands of warplanes turned out by the aircraft industry in fighting trim. An annual Army output rate of 100,000 of these flight crew members was reached early in 1942, with early expansion of even this huge number contemplated. The bulk of these workers were enlisted men, with officers being trained to supervise their labors. The non-flying members of the Army Air Forces totaled about 200,000 early in 1942. Included were the flight crew members, the "men behind the pilots." In December, 1941, nearly 175,000 more of these men were needed for the half-million-man Air Forces then contemplated, with orders doubling the Air Forces due early in 1942; and a goal of 2,000,000 in 1943.

Flight crew members were being trained early in 1942 at 14 civilian schools under contract to the War Department and at five technical schools operated by the Air Corps Technical Command. They were being offered a choice of 19 courses which ranged from eight to 26 weeks in length. From this curricula were pouring the mechanics, machinists, welders, metal workers, weather observers, instrument technicians, radio operators, bombsight maintenance specialists, and other classified specialists so vital to the operation of an air force in modern warfare.

Vocational aircraft training in the Navy was administered by the Bureau of Navigation. In peacetime, this training of mechanics and other maintenance personnel was carried out through an apprentice system in the Naval Aircraft Factory and other Naval manufacturing establishments. Advent of the emergency, however, forced an immediate expansion of that program, an expansion which had been repeated and repeated again. The bulk of the new Naval aircraft vocational training was carried on in 1941 at the Naval Trade Schools at Jacksonville, Fla., Norfolk, Va., and San Diego, Calif. Vocational training was expanded at Naval Air Stations wherever possible, and courses were begun in civilian universities and trade schools.

The country's private flight and vocational training schools were doing a fine job for the military services in 1942, as well as continuing the work of training pilots for the Government's Civilian Pilot Training Program, which had become a great reservoir of military pilot candidates. A year before when it had been found that the success of the huge expansion in the air services made necessary by the emergency would depend on the ability of the private schools to take over a large part of the training, most of these institutions were operating on a small scale. Their proprietors met the call for expansion eagerly and capably, rapidly enlarged their facilities without

THE SWALLOW LT65 TRAINER

TAYLORCRAFT TANDEM TRAINER

lowering standards, and soon were turning out large numbers of pilots ready for specialized combat training, and hundreds of plane factory workers and plane mechanics.

A looming shortage of well-trained mechanics to service and maintain the thousands of warplanes being turned out by the aircraft industry, early in 1942 called attention to much unused capacity in the private mechanics schools. It was believed that the Government would move rapidly to increase participation of these institutions in mechanic training so that the American air war effort on all fronts would not fail for lack of the indispensable repair and maintenance man.

Among private flight and vocational schools with records of achievement early in 1942 were:

Academy of Aeronautics, LaGuardia Field, Jackson Heights, New York, made steady progress in student enrollment, increased faculty and enlarged facilities in the airplane, engine, designing, accessories and metal departments. A modern heat-treating laboratory was installed. Advanced welding and riveting classes were organized. Intricate mockups for instruction in hydraulics, engine induction and instruments were designed and installed. A new engine test house was built to house six engines and adjoining classrooms. The two-story dormitory, completed early in 1941, was used to capacity as quarters for enlisted men from the Army Air Corps, trained in groups through the year under a curriculum providing 22 weeks of instruction in aviation mechanics for each group.

The Aeronautical University of Chicago had an enrollment of more than 300. Engineering students were eligible for free flight training. During 1941, 37 completed the CPTP course with an average of 41 hours per student.

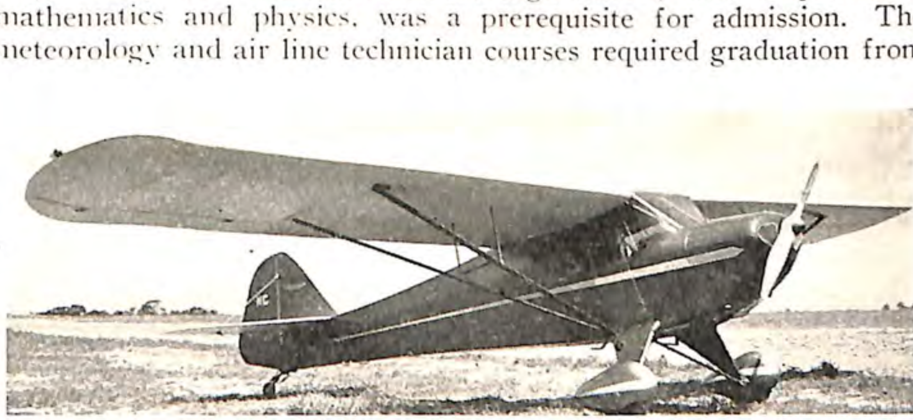
The Baltimore School of Aeronautics gave a complete course from primary through secondary and also cross-country, night and instrument flying.

Aero Industries Technical Institute, Los Angeles, Calif., was geared closely to the personnel requirements of the aviation industry through changes in management and curriculum. Many new facilities were added, including a large, new instrument laboratory. Advanced training programs in the production sciences were instituted to meet the aircraft industry's developing need for production engineers. Development of a military training sailplane was begun. The new plane was being engineered for mass production. In 1941, more than 1,500 aircraft plane employes were upgraded; employes of Canadian aircraft firms were trained. More than 1,500 mechanics and engineering graduates were placed in aviation employment.

Alabama Institute of Aeronautics entered its fourth year of operations in February, 1942. Students from the University of Alabama were being trained as part of the Civilian Pilot Training program, and, in addition, the school had a detachment of pilots in training for the Army Air Forces.

Aviation Institute of Technology, Inc., Long Island City, N. Y., was one of the private schools which had suspended all civilian activities for the duration of the war to train airplane and engine mechanics for the Army Air Forces. The Institute was training enlisted men in these capacities in groups of 480, the courses being telescoped and intensified to increase output.

Boeing School of Aeronautics, Oakland, Calif., a division of United Air Lines, where average enrollment was 225 students, included eight career courses in its program, with instruction in 35 major subjects. Graduation from high school, with emphasis on mathematics and physics, was a prerequisite for admission. The meteorology and air line technician courses required graduation from



TAYLORCRAFT SIDE-BY-SIDE TRAINER

TIMM AEROMOLD TRAINER PT-220C

Fuselage, wings and tail surfaces are built of plastic bonded plywood by the Timm aeromold process.

an accredited college of engineering. Length of the courses varied from one year for the air line mechanics course to two years for the aeronautical engineering and the air line operations and engineering courses. The school had 35 instructors, and reported graduate placement at 100 per cent. In addition to the regular commercial program, Boeing School built barracks and shops of sufficient size to carry on a program for the training of an average of 700 Air Corps mechanics.

Cal-Aero Academy, a training base at Ontario, Calif., for Army Air Corps cadets, was enlarged several times so the 350-acre plant could accommodate many hundred cadets. Completion of an engine repair and maintenance plant at Cal-Aero during the year permitted all repair, overhaul and maintenance on the Army Stearman and Vultee training ships to be accomplished at the field. The school had 25 permanent buildings.

California Flyers School of Aeronautics, Inglewood, Calif., continued to train air line pilots, flight instructors, aeronautical engineers and master mechanics and had instituted training of mechanics for the Army Air Forces. This phase of the school's activities was enlarged greatly in the early months of the year. The school plant, which had grown to include four large structures and a fleet of 20 planes, was enhanced by acquisition of a huge motor testing stand.

The Curtiss-Wright Technical Institute, Glendale, Calif., training base for civilian mechanics and engineers established in 1929, passed the 2,000-mark in enrollment during 1941. Like all comparable schools, the advent of free, short-term public school courses had its effect on Curtiss-Wright Tech, but to a minimum degree, and with a noticeable upswing back to normalcy late in the year as students realized the desirability of career-training over job courses. The Army Air Corps continued to maintain a large mechanics training detachment at Curtiss-Wright Tech, with several hundred enlisted men constantly under instruction. As civilian enrollment increased in both master mechanics and aeronautical engineering courses and Army requirements gave promise of a similar increase, plans were completed for expansion to triple facilities. Practically every graduate stepped into instant employment at nearby factories, if he so desired.

Dallas Aviation School at Love Field, Dallas, Tex., had more than 350 students. The same management operated a primary and basic training detachment for flying cadets in the Army Air Corps at Fort Worth and Brady; an aircraft mechanic's school for enlisted men at Dallas and a primary, basic and advanced training detachment for British R. A. F. cadets at Terrell.

Embry-Riddle School of Aviation, Miami, Fla., had six divisions, necessitating an operations staff of 1,200. In Miami were the technical school and the land and seaplane bases. At Arcadia were Carlstrom and Dorr Fields, and in Clewiston, Riddle Field. The three fields were turning out military pilots. Carlstrom and Dorr were operating under the Army's Southeastern Air Corps Training Center, while Riddle Field trained British pilots—one of the six all-British training schools in the United States. The Technical School was housed in a huge, million-dollar hotel, product of Miami's boom days, which was converted into administrative offices, dormitories, class and work rooms. It met the urgent need for skilled mechanics, supplying Intercontinent Aircraft Corporation in Miami, Carlstrom, Dorr and Riddle fields, and aviation factories in other sections of the country. During 1942 the school planned to play an

AT CAL-AERO ACADEMY

An Army Air Corps basic training class at one of the leading private flying schools.

AT CURTISS-WRIGHT TECHNICAL INSTITUTE

Part of the student body at the Glendale, Calif., school listens to an address.

important part in the training of Latin-American youths who were studying to become pilots, aeronautical engineers, air line and instructor mechanics under Government scholarships. The first contingent of 526 students to be instructed in the United States were at work at Embry-Riddle. These mechanics, upon graduation, were to return to their homes and pass their new knowledge on to other students there.

Casey Jones School of Aeronautics, Newark, N. J., filled its civilian classes to capacity, as it had done for more than two years. During 1941 efforts were devoted largely to obtaining and installing additional equipment and facilities for the extensive expansion of the Army Air Corps mechanics training program in which the school was participating. Anticipating an expanding program after the first of the year the school took over an additional building. More space for housing facilities was obtained in a nearby hotel for about one hundred students from Central and South America. To take care of the feeding of the students, a new cafeteria was opened. A three story building was equipped with sleeping accommodations for several hundred enlisted men. The school employed about 200 instructors.

Lakeland School of Aeronautics, Lakeland, Fla., was giving primary flight training to British students for the R. A. F. The school was under supervision of the Southeast Air Corps Training Center of the Army Air Forces. Facilities for training were expanded to accommodate a large increase in the number of students arriving every five weeks. A new auxiliary air field was established, while three other auxiliary fields were enlarged. The school plant also included two large barracks, mess hall, hangars and a fleet of Continental-powered Boeing trainers.

The Lewis School of Aeronautics, Joliet, Ill., shifted during 1941 its entire emphasis to collegiate study of aviation subjects exclusively.

Lincoln Aeronautical Institute and its affiliate, Lincoln Airplane and Flying School, Lincoln, Neb., were preparing, on request of the Army Air Forces, to train larger numbers of Army students in ad-

U. S. Navy photo

NAVY AVIATION CADETS

Future Naval aviators examining a patrol bomber at the Pensacola school.

U. S. Army photo

TRAINING PARATROOPS

Showing parachute soldier leaving the ship, while others stand ready to follow him.

vanced airplane and engine maintenance. Purchase of an airport, with hangar, and construction of a second, larger hangar, had prepared the schools for their new assignment. During additions to the plant, the schools continued all training activities, including aeronautical engineering, airplane and engine mechanics, commercial pilot and flight instructor training. The flying school was participating in all phases of the C. A. A.'s Civilian Pilot Training Program.

Lodwick Aviation Military Academy, Avon Park, Fla., was giving primary flight training to cadets of the Army Air Forces with the possibility of doubling the size of classes. An unusual aspect of this school, which began operations under War Department contract in October, 1941, was its "barracks" which prior to that date had been a winter resort hotel, which the school took over. Cadets had available hotel rooms with private baths, water front view, spacious lobby, facilities for swimming, basketball and tennis. A former country club, adjacent to the "barracks" was converted into a ground school. Cadets were transported to the air field, and to four auxiliary fields established by 1942, in 36-passenger buses. Two large steel hangars and a large fleet of trainers were among the school's equipment.

The Luscombe School of Aeronautics, West Trenton, N. J., in April, 1941, set up a branch in Dallas, Tex., to supply aircraft sheet metal workers to the rapidly growing aircraft industry, particularly in Texas, Oklahoma and Kansas. This School devoted its efforts entirely to training young men in aircraft sheet metal work, including precision layout, aircraft metal forming and all types of aircraft riveting. The school at West Trenton continued to major in Government approved courses leading to both airplane and engine mechanics' licenses, and graduates found ready employment in all fields of aviation.

Mira Loma Flight Academy at Oxnard, Calif., formerly a branch of Cal-Aero Academy at Ontario, acquired a new name and new facilities during the year. With the expansion of the Army Air Corps training program, the management erected a complete training base comparable to the parent field at Ontario. Capable of accommodating several hundred cadets, the Oxnard plant was unique in its bungalow barracks, dozens of four-room, eight-cadet cottages built in typical California style around a central patio parade ground.

Missouri Aviation Institute, Kansas City, Mo., devoted facilities to training mechanics for the Army Air Forces. A cantonment especially erected for the purpose housed and fed the Army men. The institute, three years old and combining airplane and engine mechanics

LYCOMING TRAINING SCHOOL

Machine operators and assembly men in classes which are held 24 hours a day.

THE HOWARD TRAINER
Commercial students taking off at the Dallas Aviation School.

and sheet metal schools, had trained more than 3,000 civilians for the aircraft industry before devoting itself to training Air Forces mechanics.

New England Aircraft School, East Boston, Mass., greatly expanded its facilities during 1941 as increased enrollments in all courses made more space and equipment imperative.

The aviation ground school and teacher-training courses carried on by the School of Education of New York University expanded facilities so that the fullest program could be given, including extensive work in trouble shooting on aircraft engines. Since the summer of 1940, 1,021 registrants took advantage of this training, of which number 310 were CPTP students preparing for entrance to the Army or Navy air forces. Others were preparing for positions as ground school instructors, public school teachers, and for commissions as teachers in the various armed services.

Ohio Institute of Aeronautics, Columbus, O., was training students to take their place in the national war effort through its courses in aircraft and aircraft engine mechanics.

Parks Air College, East St. Louis, Ill., passed another milestone in its fourteenth year of educational progress when a new library building was erected and opened for student and faculty use. The school continued to offer four courses in the commercial school, aeronautical engineering, maintenance engineering, professional piloting and aviation operations. Each course required two years for completion with the exception of aeronautical engineering which required two and one-quarter years. Enrollment at Parks throughout the year was at a capacity figure of 330 commercial students. Cooperating with the U. S. Army Air Corps, Parks also trained 200 aviation cadets in primary flight training, such training taking 10 weeks. Eighty-six instructors, specialists in their field, composed the faculty personnel. Approximately 15 per cent of the graduates received appointments in the Army or Navy Air Forces.

Polaris Flight Academy's new mile-square War Eagle Field at Lancaster, Calif., came into existence as an exclusive Royal Air Force training base with the passage of the lend-lease law. In a record-breaking construction program, a complete training base for several hundred youths from Britain rose in 60 days where sage brush of the desert previously stood. Like American flight training fields at Ontario and Oxnard, Calif., War Eagle Field provided two-men rooms, baths, luxurious public quarters, lawns and landscaping. There were large hangars and repair and maintenance facilities. Numerous runways insured safe training. Polaris gave primary, basic and advanced training to the cadets sent here from England,

ACADEMY OF AERONAUTICS

Students on repair projects in the metal department of the school at LaGuardia Field, N. Y.

CASEY JONES SCHOOL OF AERONAUTICS

Students at work on final assembly in the engine department at the Newark, N. J., school.

returning them home with only operational instruction ahead of them.

Rising Sun School of Aeronautics, Philadelphia, Pa., discontinued commercial training to place all its facilities at the disposal of the Army Air Forces, for which it was training large numbers of mechanics.

Robertson Aircraft Corporation, Robertson, Mo., operated a Government-approved primary and advanced flying school at Lambert-St. Louis Municipal Airport, in addition to operating Civilian Pilot Training programs at several bases throughout Missouri.

Roosevelt Aviation School, located on Roosevelt Field, Mineola, N. Y., entered 1942 with the experience of 15 years of teaching young men and women both flying and mechanics. In 1941 hundreds of Roosevelt School graduates were employed in some branch of aviation and the demand was still growing—growing so fast that it was impossible at times to meet the demands of the industry for Roosevelt graduates. The civil school averaged about 500 students, and a corps of 200 to 225 men from the Army Air Corps constantly was being trained in mechanics as a part of the defense program. The school specialized in a master airplane and engine mechanics course which prepared for the test given by the Civil Aeronautics Administration for the aircraft and aircraft engine certificates of competency.

Ryan School of Aeronautics, San Diego, Calif., gave instruction to pilots, mechanics and engineers for positions in the aircraft industry. In 1941, Ryan had one of the most rapid expansion periods in all its history. Supplementing its residence training courses, Ryan offered specialized home-study instruction through the affiliated Ryan Aeronautical Institute, which was organized during the year. Texts for the Ryan correspondence courses were written by leading industry authorities, all men with long practical experience in aviation. Courses of study offered included aeronautical drafting and engineering, stress analysis, aircraft power plants and aircraft construction and maintenance. In spite of free training courses in sheet metal work, aircraft mechanics and piloting offered by the Government to stimulate the defense program, the commercial training division of the Ryan School continued to expand. With the accelerated pilot training program of the Air Corps getting into full swing, officials of the Ryan School, which had been training Army primary pilots for two and a half years, during 1941 directed the completion of an even further expansion of training facilities at its base school at San Diego and at its branch school at Hemet, Calif. Supplementing its other work in the pilot training field, Ryan during 1941 also conducted a secondary CPT program.

Safair, Inc., Readington, N. J., completed a very successful year as distributors of the Piper Cub line and flight instructors to the

AT ROOSEVELT AVIATION SCHOOL

A section of the overhaul and repair depot at the Roosevelt Field, Long Island, N. Y., school

STEWART TECHNICAL SCHOOL

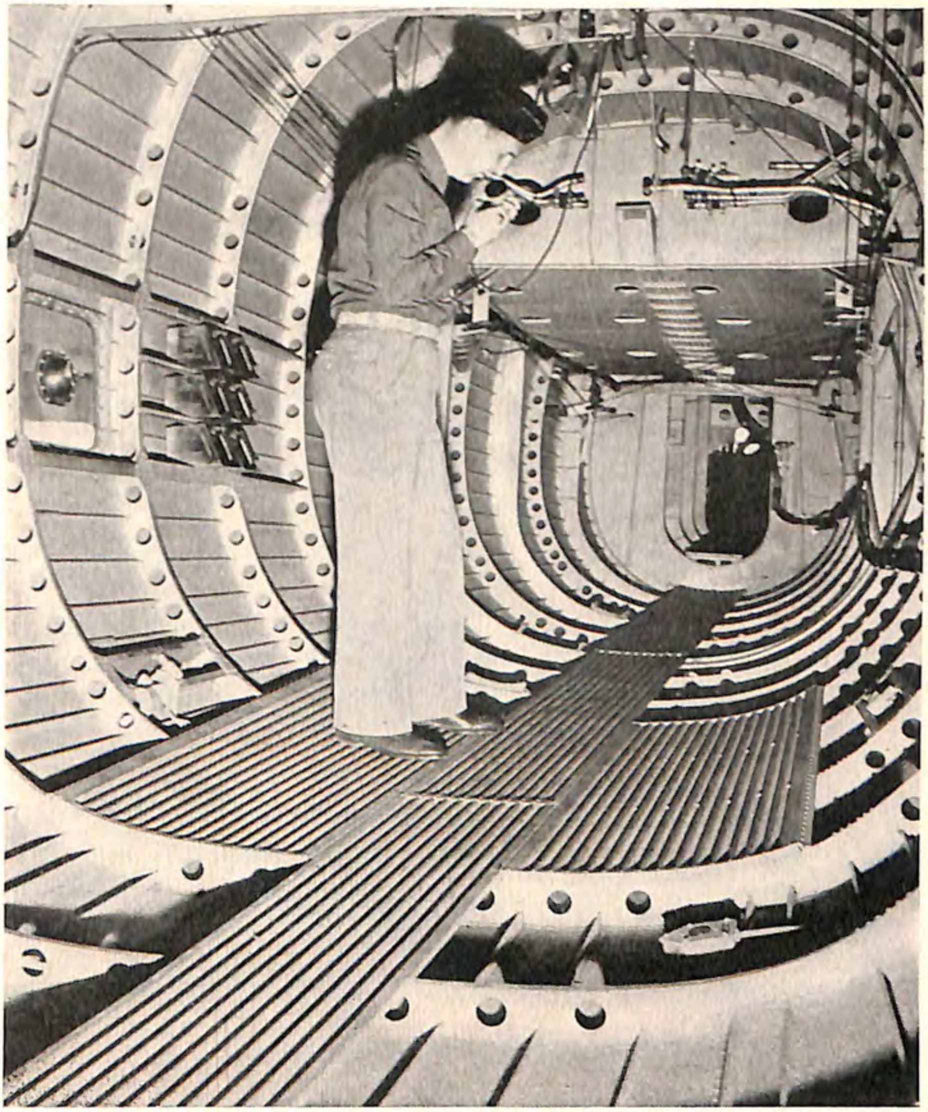
Trouble-shooting and testing engines in the aeronautics department of the school in New York City.

civilian governmentally controlled CPT program for New York University and various other colleges. Defense activity on Long Island and eastern coastal points necessitated Safair's removal from Hangar B, Roosevelt Field, to the Solberg-Hunterdon Airport at Readington, N. J., in April, 1942. For the convenience of the public, a New York City showroom was maintained where the entire Piper line was on display and arrangements for flight courses could be made.

Spartan School of Aeronautics, Tulsa, Okla., lengthened its classroom work-week in order to supply trained aviation technicians for war work. While the new policy permitted larger output of graduates, the school's standards were not lowered. The new six-day week schedule was not applied to the large Army Air Forces training program, which was carried on at Muskogee and Miami, Okla., as well as at Tulsa.

Stewart Technical School of New York, N. Y., completed its twelfth year specializing in aeronautics. Government-approved aircraft and aircraft engine mechanic courses were offered, as well as its long established course in aeronautical drafting, including detail design. Graduates of all the courses were reported as doing exceptionally well in the industry. A number of airplanes were repaired in the school's Government approved aircraft repair station by the students under the direction of licensed instructors. As usual, this aircraft repair station was operated solely for the students' benefit, and not as a source of revenue for the school. Applicants for admission had to have a high school education.

E. W. Wiggins Airways, Inc., operating at Boston and Norwood, Mass., and Providence and Newport, R. I., trained over 600 CPT students in 1941 and was preparing for even more extensive opera-



IN THE DOUGLAS B-19 BOMBER

An officer talking over the plane's Western Electric intercommunications and radiophone system during flight.

tion. Under Government contract, the company gave refresher instruction to 161 private and commercial pilots. Government approved mechanics courses were given to 100 students in aircraft, engine and welding work. The new plant included two hangars. The company operated over 100 airplanes.

LOCKHEED HUDSONS OVER ENGLAND

CHAPTER VI

U. S. GOVERNMENT CIVIL AVIATION

Work of the Federal Bureaus—The Civil Aeronautics Administration—Civil Aeronautics Board—Division of Exports and Defense Aid—Division of International Communications—Federal Communications Commission—Fish and Wildlife Service—Geological Survey—National Advisory Committee for Aeronautics—U. S. Coast and Geodetic Survey—U. S. Coast Guard—U. S. Forest Service—U. S. Public Health Service—U. S. Weather Bureau—War Production Board.

THE entry of the United States into a full-out shooting war found the Federal Bureaus in a fair state of preparedness. Despite the problems imposed by censorship and the desire on the part of all to withhold from the enemy any military information of value, these bureaus were able to provide the following interesting accounts of their activities.

Civil Aeronautics Administration

The year 1941 was one of national preparation for just such an attack as materialized on December 7. The important role of the Civil Aeronautics Administration in these efforts was spotlighted by the series of rapid-fire CAA actions taken immediately after the outbreak of war.

Pilot licenses suspended, provision made for reinstatement under proper safeguards, flight plans ordered filed with the CAA on all flights of more than 10 miles from base, the plan then to be cleared by the CAA with Army Interceptor Command . . . the reserve of 40,000 CAA-trained pilots called upon by the Administrator to fulfill

CPTP STUDENTS CHECK PLOTTED COURSE

Advanced trainees at the Lincoln Airplane and Flying School, Lincoln, Neb. They are using Meyers' trainers.

their pledge of offering their services to Army and Navy aviation when needed . . . these and other moves placed the facilities of civil aviation in full coordination with the war effort.

These activities climaxed a year of intensive work by the CAA for the continued development of civil aviation as a factor in national readiness. Its programs of airport construction, pilot training, safety regulation and airways construction and operation were guided by this purpose.

A further step, aimed at bringing aviation training into the primary and secondary schools, was also under way at the beginning of 1942. It was described by Robert H. Hinckley, Assistant Secretary of Commerce for Air, as follows:

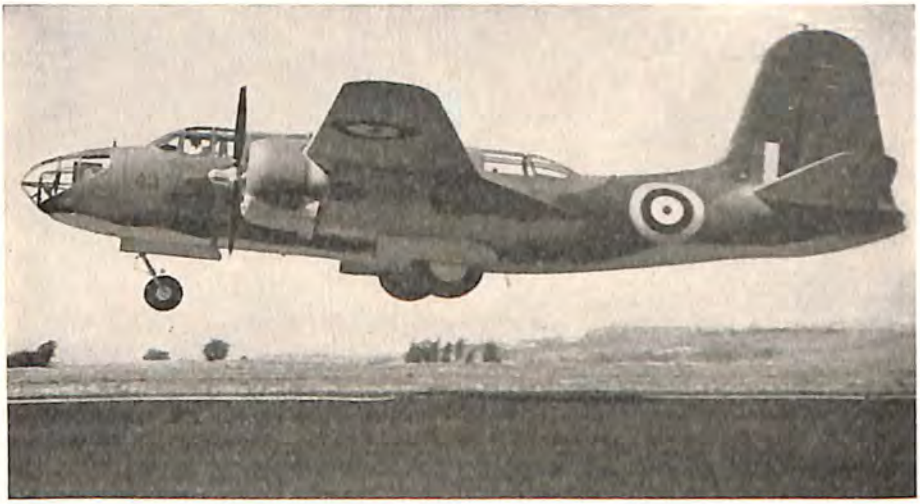
"The main handicap to mass flying, all along, has been that travel in three dimensions is an awesome thing to two-dimensional people. I can remember that solid geometry seemed much more difficult than plane geometry. The air is a strange new element to man. And it will be taken in stride, as a matter of course, only by people who have learned the principles of flying in their youth and have applied those principles in actual practice. After that the fearful mystery is gone. Flight is then a matter of some principles in physics, like a change in the temperature.

"I call this process the 'air-conditioning' of people, to get away from the weak terms 'air-conscious' and 'air-minded.' Those terms are as obsolete today as the word 'defense.' What good is it to be 'conscious' of a swarm of enemy airplanes overhead? Pretty soon you will be unconscious. But if you are 'conditioned' to flying, then you are in a state of fitness to do something about it—to participate in it.

"We must have whole generations of people who are air-conditioned. For three years we have approached this education at the college level. That was a sound beginning, as our present wartime needs prove. But the principles of flight, and their practical application, must be taught to the youngsters in our high schools, and even

FOR THE FAR PACIFIC WAR

General L. H. Van Oyen, head of the Netherlands East Indies Air Force, inspecting one of the new Brewster dive bombers under construction for his squadrons in the plant of the Brewster company.



DOUGLAS BOMBERS FOR BRITAIN

One of the famous DB-7B attack bombers which is making history with the R. A. F. on many fronts. At home in England the R. A. F. used it as a night fighter, and appropriately have named it Havoc.

in the grades. The practical application, in primary schools, would be with model planes. In the high schools it would include gliders.

"I speak of this here because the educators of the United States are becoming alert to this need of aviation very rapidly. In the Department of Commerce we have studied very carefully the program through which, during the last eight years, Germany has been conditioning her young people from the sixth grade up toward participation in aviation. To best that competition in our own free way, we have brought together a group of prominent educators as an advisory committee on aviation to the Civil Aeronautics Administration. This committee is crystallizing its studies into a proposed program for the 'air-conditioning' of young Americans on a mass scale both in the high schools and the upper grades.

"We see this program as a very important preliminary to the pilot training program now conducted by the CAA at the college level. We know that the only way such a program in the primary and secondary schools can be launched rapidly and effectively is through the enthusiastic participation in it of local school authorities. The educators on our advisory committee believe that local school authorities, when the situation is presented to them, will see at once the importance of and the need for such a program. To that end, in the traditional democratic way, this committee of educators proposes to call early in

1942 a series of regional conferences with State and municipal school officials to outline our proposals and to gather local advice and comment which might further strengthen the program.

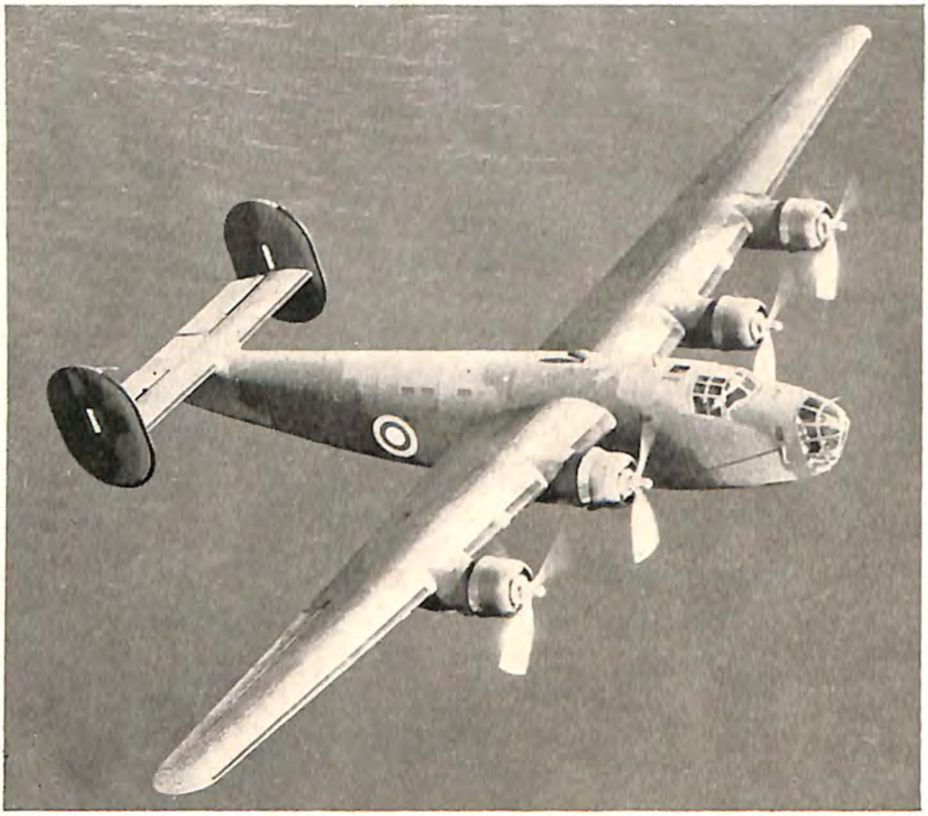
"In this we have a three-fold purpose; first, to win the shooting war; second, to win the commercial war for air supremacy which will follow it; and third, to guarantee the security of our people against a recurrence of the awful situation we face now. This guarantee, I believe, can be accomplished by making ourselves a nation of flyers so advanced in the air that no aggressor would dare to threaten us."

Because of enlarged pilot training activity, air line travel, and aircraft production, there was a 50 per cent increase in the work load of CAA inspectors during 1941. They made 50,000 examinations of planes and 200,000 of pilots, instructors, mechanics, and other aviation personnel seeking CAA certificates. In order to give prompt service, 625 qualified men in the industry were designated flight examiners and 125 aircraft inspection representatives.

With the outbreak of war, CAA inspectors also faced the task of examining for reindorsement the certificates of nearly 200,000 pilots and student pilots. Inspectors concerned with safety of air carrier operations flew a total of 1,546,752 miles, as service was extended to Africa and other distant points. After careful checks, 55 approval certificates were issued for new types of aircraft, engines, propellers and appliances; and 174 for new models added to old type approvals. The Aviation Medical Division of Safety Regulation conducted approximately 172,500 physical examinations.

MARTIN BRITISH BOMBER

The 187B-1, Baltimore, built in quantity for the R. A. F. It is powered by two 1,600 h.p. Wright Cyclone engines.



CONSOLIDATED'S LAND BOMBER FOR BRITAIN
The B-24 four-engine long-range bomber. The R. A. F. named it Liberator.

The CAA policy of decentralization was given even wider effect in order to keep up with the increase of activity during 1941. An eighth regional office was established in Anchorage, Alaska, in addition to the seven other regional centers in the United States.

Civil Aeronautics Board

The Civil Aeronautics Board appoints its personnel and performs its functions independently of the Secretary of Commerce. The Board, however, is technically within the framework of the Department of Commerce, which provides purely housekeeping facilities for it. Work of the Board falls within three main categories:

1. Economic regulation, including issuance of certificates of public convenience and necessity, fixing of air mail rates, regulating of

passenger and property rates, passing upon mergers and consolidations, and the performance of various other related economic regulatory duties.

2. The prescribing of safety standards, rules, and regulations, and the suspension and revocation of various safety certificates (including pilots' certificates) after notice and hearing.

3. The independent investigation and reporting of aircraft accidents of all types.

Extension and speeding up of air carrier service routes both at home and abroad, in the interests of the national defense, and promulgation of important defense safety regulations formed the major activities of the Board. Approval on the basis of a temporary certificate was given to Pan American Airways for an air route across the South Atlantic between Miami, Fla., and Leopoldville, Africa, via Belem and Natal, Brazil; and other extensions granted on the Pacific and into Canada. United States flag lines in Latin America were materially increased in number and time schedules cut, as the Board worked in cooperation with countries there to eliminate axis-controlled air carriers. Early in 1942 the Board granted a certificate to American Export Airlines for non-stop service between New York and Foynes, Eire.

In these connections, the Board authorized extensions of Pan American Airways Pacific routes between the original points San Francisco, Calif., and Manila, P.I., to Singapore, Straits Settlements, for a five year period; amended the San Francisco-Auckland route to include a stop at Suva, British Crown Colony of Fiji, authorized acquisition of control of Pan American Airways-Africa and Pan American Air Ferries by Pan American Airways to assist the movement of ferry aircraft between the United States and the Middle East; authorized Pan American Grace Airways to operate a weekly non-

CURTISS PLANES IN JAVA

Pilots of the Royal Netherlands East Indies Air Force and their Curtiss 21B interceptors.

A VOUGHT-SIKORSKY FOR THE R. A. F.

The Chesapeake scout bomber, powered by a Pratt & Whitney Twin Wasp Junior engine and Hamilton Standard constant speed propeller.

stop service between Cali, Colombia, and Guayaquil, Ecuador, and another between Talara and Lima, Peru. When Peru took over Lufthansa Peru, and Bolivia eliminated Lloyd Aero Boliviana, Panagra was authorized immediately to begin operations along a new transcontinental route extending from Lima, Peru, via Cochabamba, Sucre, Vallegrande, Santa Cruz, Concepcion, San Ignacio, San Jose, Robore, and Puerto Suarez, Bolivia and Corumba, Brazil, where it made contact in September with a new extension of Panair do Brazil which carried the service on to Rio de Janeiro.

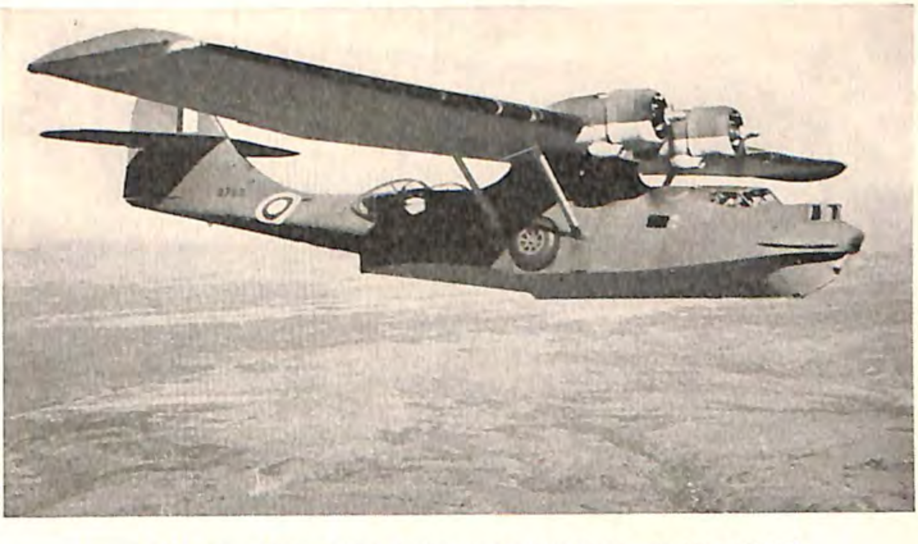
American Airlines was granted local operating rights between Toronto, Canada and Buffalo, N. Y., between Windsor, Canada, and Niagara Falls, N. Y., and Western Air Lines was granted service between Great Falls, Mont., and Lethbridge, Alberta, Canada, where it connected with the interior Canadian route to White Horse, Yukon Territory, and so with Pan American Airway's route into Alaska. Foreign air carrier permits were granted to Cia Mexicana de Aviacion, affiliated with Pan American Airways, allowing it to continue service between Los Angeles, Calif., and Mexico City and to Trans Canada Air Lines for non-stop service between Toronto and New York. The Trans Canada decision stemmed from the principles of reciprocity set up in the Canadian-American Air Transport Arrangement of 1939.

Certificates and amendments to certificates started more than 8,000 miles of new routes and route extensions, both domestic and foreign. Because of this large increase in route mileage, tariff filings jumped some 225 per cent over those of 1940 and there was a substantial addition in the number of operating schedule filings, which reflected the expansion in the number of local and non-stop flights made by the carriers.

Immediately after the American declaration of war, the Board suspended hearings and pre-hearing conferences on pending new route applications with the exception of those important to national defense. Rate cases were being continued, however, with plans under development for shortening the procedure in order that "the immediate and maximum attention of the carriers and their personnel and of the Board and other Government agencies concerned may be available for emergency demands." Working closely with the Army and Navy as the great growth in military flying developed new problems, the Board issued the following important safety and defense regulations:

1. Requiring all aircraft of over 10,000 pounds gross weight to be equipped after January 1, 1942, with an altitude recording device.

2. Following recommendations of the Interdepartmental Air Traffic Control Committee composed of representatives of the Army, Navy, Civil Aeronautics Administration and the Board, regulations were promulgated for traffic control to facilitate movement of military aircraft and ensure safety on the Federal Airways; i.e., all aircraft operating without two-way radio and a sensitive altimeter must fly below 3,500 feet altitude; specified altitudes must be maintained



ONE OF CANADA'S CONSOLIDATED PATROL SHIPS
The Consolidated 28-5 AMC amphibion.

THE GRUMMAN MARTLET I

This is the GB 36-A fighter with the R. A. F. It is powered by a 1,200 h.p. Wright Cyclone engine.

by all aircraft flying between 3,500 feet and 17,000 feet; flight plans must be filed if a flight is contemplated through a United States Airways Traffic Control Center; all altitudes above 17,000 feet were reserved to military aircraft alone, except specially authorized commercial operations or civil flights for aeronautical development.

3. Imposition of prompt and severe penalties for pilots violating regulations covering restricted areas.

4. Federal certification of all planes and pilots.

5. Requirements of identification of pilots and planes; filing of plans for all flights; examination of pilot identification by owners of planes before permission to use is granted; clearance for flights by police officers or other qualified representatives; sealing of cameras carried in aircraft and inspection of all cargo and baggage under strict control.

6. Permission for air carriers to fly off the Federal Airways if proper direction-finding devices are used.

7. Higher ceiling minimums and restriction of flight under icing conditions.

8. Certification of pilot ratings on the horsepower of their planes instead of on a gross weight basis.

9. Elimination of spiralling to landings on airports.

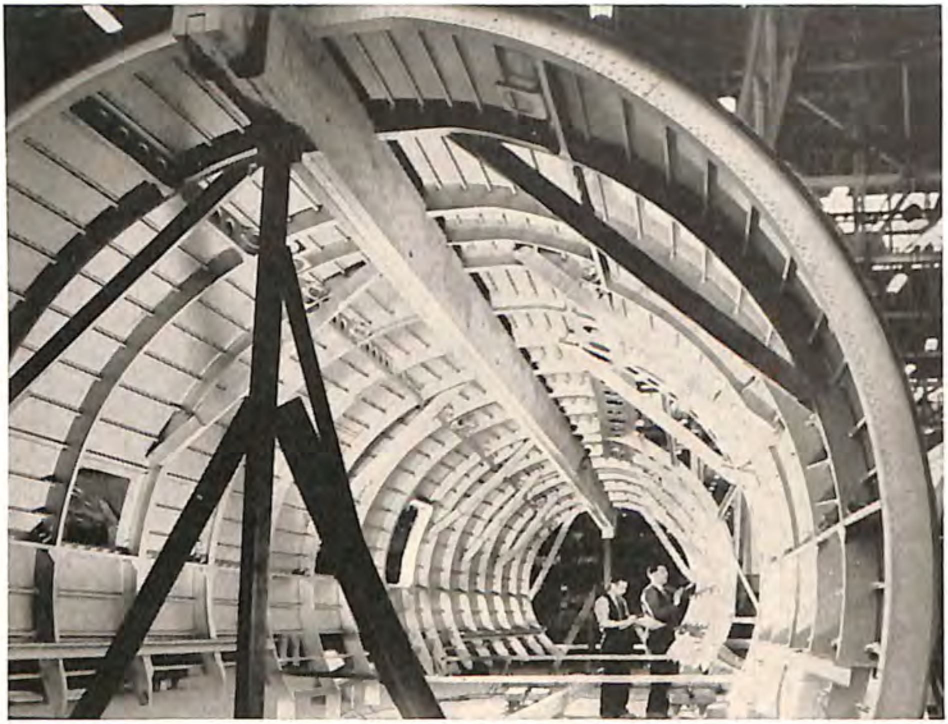
Important technical studies were being carried on by the Safety Bureau of the Board. Over 5,500 accident reports of all types had been handled and official investigation made of 824 serious accidents, including 28 public hearings, of which 11 concerned air carrier accidents.

Division of Exports and Defense Aid

Section 12 of the Neutrality Act approved November 4, 1939, required that every person engaged in the manufacture, exportation or importation of any of the arms, ammunition or implements of war listed in the President's Proclamation of May 1, 1937, should register with the Secretary of State. In addition, each export and import shipment of such articles had to be licensed by the Secretary of State, who would issue licenses only to applicants duly registered under the Neutrality Act to export or import, as the case may be. Prior to October 7, 1941, administration of these registration and licensing provisions was vested in the Division of Controls, Department of State. On that date, however, the Division of Controls was abolished, and these functions were transferred to the newly created Division of Exports and Defense Aid. The following articles of aeronautical character were included in the President's Proclamation of May 1, 1937, and were therefore subject to the jurisdiction of the Division: aircraft of all kinds, aircraft engines, propellers, propeller blades, fuselages, hulls, wings, tail units and under-carriage units. Component parts of aircraft other than those enumerated were subject to government control in respect to exportation, pursuant to the Export Control Act approved July 2, 1940. This control was exercised by the Office of Export Control, Board of Economic Warfare, although prior to September 15, 1941, the Division of Controls in the State Department issued licenses under the provisions of this latter Act. Effective as of January 20, 1942, aircraft parts, equipment, or

FAIRCHILDS FOR CHILEAN AIR FORCE

A trainer powered by a Warner engine.



STARTING A CURTISS C-46 TRANSPORT

Inspectors checking the upper forward section of the fuselage of one of the troop and cargo transports for the U. S. Army Air Forces.

accessories other than those listed in the President's Proclamation of May 1, 1937, could be exported only on general or individual licenses issued by the Office of Export Control. The exportation of complete aircraft and of aircraft parts, equipment and accessories listed as arms, ammunition and implements of war in the President's Proclamation remained subject to the requirement of a license issued by the Division of Exports and Defense Aid. Excepted from this requirement were those aircraft and aircraft parts which were authorized by the Office of Lend-Lease Administration.

The necessity of coordinating foreign aviation needs with our own requirements of national defense resulted in the system of Purchase Negotiation Reports. These were requests for preliminary clearance on the contract of purchase of new aircraft or certain component parts, such as complete engines and propellers. Purchasers of aircraft for exportation to any of the South and Central American countries or to any neutral country of Europe had to communicate with the embassy or legation of such country in Washington to secure the presentation by it to the State Department of a purchase negotiation report. These purchase negotiation reports were cleared by the Division of Exports and Defense Aid. Purchase negotiation reports relating to the purchase of planes or parts to be exported to countries other than European neutrals and South and Central American countries were submitted to the Office of Lend-Lease Administration for appropriate action.

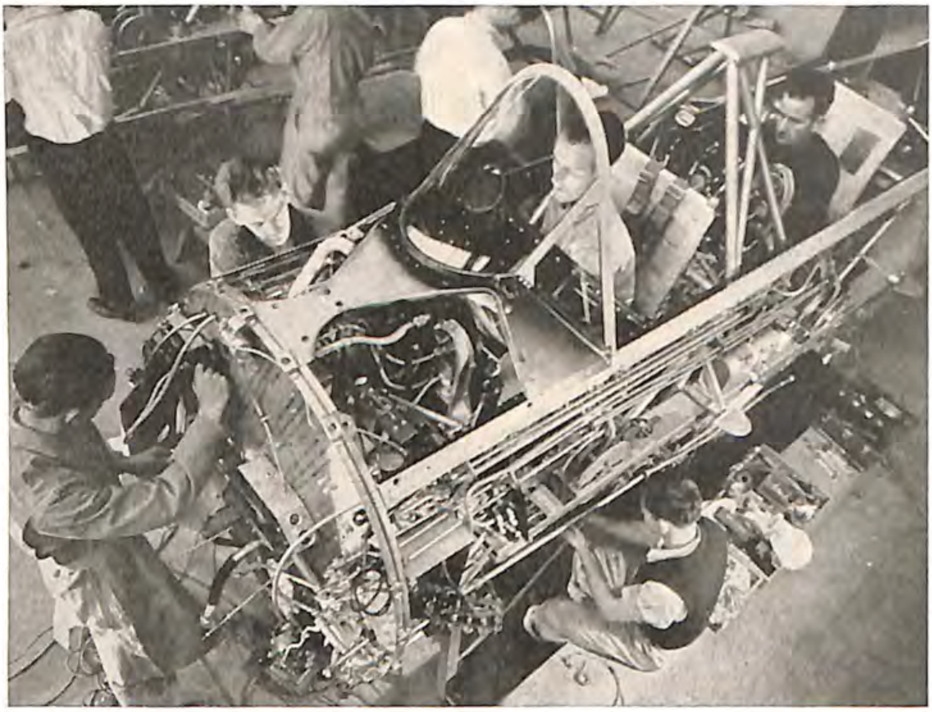
Division of International Communications

The Division of International Communications of the Department of State was created on August 19, 1938, in order more effectively to meet the steadily increasing problems which confront the United States in the field of international communications. In establishing the Division, the Secretary of State defined its duties as follows:

"The Division is charged with the initiation of the policy action of the Department and with the elaboration and carrying into effect of comprehensive and coordinated programs of activities involved in the international aspects of aviation, radio, motion pictures, telegraph, cable, and shipping; with assisting in the preparation and interpreta-

DOUGLAS OUTDOOR PRODUCTION

A-20A attack bombers being completed for the U. S. Army Air Forces outside the plant at night.



BUILDING A TRAINER

A North American AT-6A advanced trainer in the early stages of assembly.

tion of treaties in this field; with the drafting or reviewing of all correspondence with foreign governments and their missions in this country, American Diplomatic and Consular Officers, Government Departments, and all other correspondence pertaining to international communications activities; with maintenance of liaison with other Government Departments and agencies in international communications matters falling within the field of joint interest and authority; and with collaboration with foreign missions in Washington."

The functions of the Aviation Section include the negotiation of international agreements on such subjects as air navigation, the operation of air transport services, the reciprocal issuance of airman certificates and the reciprocal recognition of certificates of airworthiness for export, as well as agreements on various phases of international air law. The Aviation Section is in charge of the technical work connected with participation in international aviation conferences and in the activities of international aeronautical organizations such as the International Technical Committee of Aerial Legal Experts (CITEJA) and the Permanent American Aeronautical Commission

(CAPA). The Aviation Section makes arrangements for flights of United States civil and military aircraft over foreign countries and for flights of foreign civil and and military aircraft over the United States, and is charged with certain other miscellaneous duties pertaining to various phases of international aviation.

Federal Communications Commission

War conditions intensified the already complicated situation with respect to aviation communications. The new importance of radio to military and civilian flyers was reflected in the increased demands for space in the radio spectrum. The Federal Communications Commission allocated frequencies for the use of aircraft, and licensed such equipment. Government craft used frequencies assigned by the President, upon the advice of the Interdepartment Radio Advisory Committee. All radio range stations and many marker stations, localizer stations, also a few airport control stations and aeronautical stations, were under supervision of the Civil Aeronautic Administration. In 1942, 18 transport companies, utilizing six domestic radio

MORE BOMBERS FOR BRITAIN
Assembly line of the famous Lockheed Hudsons.

NOSE SECTIONS OF THE MARTIN B-26
On the way to final assembly.

chain communications systems, operated over routes to knit more closely the United States. The general growth of non-government stations in the domestic service was reflected in Commission licenses for the last two years:

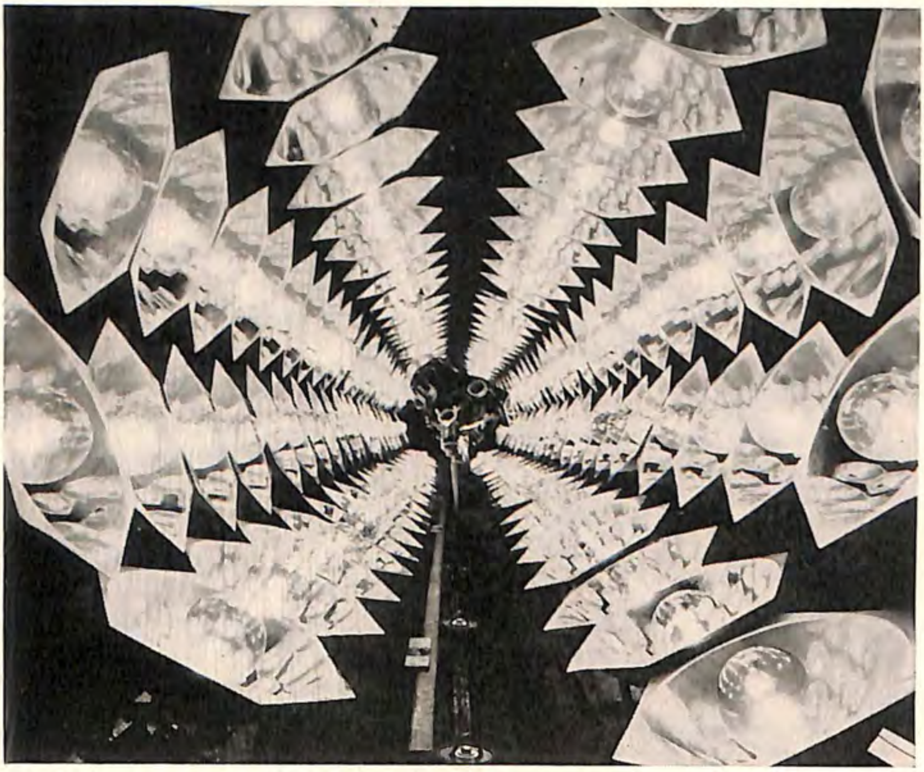
Type of Station	June 30, 1940	June 30, 1941
Aircraft	1,294	2,140
Aeronautical	345	438
Aeronautical fixed	141	210
Airport control	82	75
Flying school	13	25
	1,875	2,888

The increasing number of stations made it desirable to stagger the expiration date of station licenses. It also was found advisable to make ship radiotelephone and radiotelegraph frequencies available to aircraft. The volume of domestic and international air travel required reassignment of certain frequencies allocated to chain aviation systems.

At major terminal points, such as New York, Philadelphia, Chicago, Los Angeles and other centers, the problem of airport traffic control involved critical use of radio, especially during periods of low ceilings that require instrument flights and blind landings.

Of the total landing places, approximately 25 per cent were municipal airports, 20 per cent were commercial landing fields, and the balance were military or miscellaneous Government and a few private fields. Airport radio control stations were being installed at major points, and many were being changed over to the ultra high frequencies then available for airport control purposes.

The ultra high frequencies available for airport control stations were set up on a long-range assignment plan designed to meet the progressive use and future needs of aviation service, particularly the needs of non-scheduled flyers. It was desirable that as many points as possible use a single frequency and the number of additional frequencies necessary for point-to-point flying be limited to a minimum. In cooperation with the Civil Aeronautics Administration, the frequency assignment plan was developed so the majority of airports could be assigned a single frequency. With few exceptions, any one of the cross continent civil airways might be flown by the use of no more than four frequencies. Under such a system, the simplest type of fix-tuned receiver could be used in the aircraft installation. Air-



JACOBS ENGINE PRODUCTION

Freshly painted cylinders traveling on a conveyor through a battery of 350-watt infra-red lamps for drying and baking the enamel. This six minute trip does a better job than 8 to 15 hours of air drying.

REPUBLIC SPEEDS PRODUCTION

Parallel production lines at the huge new plant of Republic Aviation Corporation.

ports not located on any of the civil airways or having no frequency designation under the assigned plan were to be the subject of individual study.

Though the private flyer had been relatively slow to realize the importance of two-way radio, the number of aircraft stations licensed to non-scheduled flyers had doubled. With the installation of this equipment, the pilot had communication facilities with airport control stations and the benefit of the complete radio air navigational aids maintained by the Government. Indications were that the Civilian Pilot Training Program would produce a large number of private owners of aircraft educated in the use of radio transmitters.

Flying school station licenses were issued to applicants desiring radio communication facilities for the instruction of student pilots in flight. There were 25 stations of this class at the close of the fiscal year. That type of station proved beneficial in the Civilian Pilot Training Program. Of the four frequencies available for this service, one (39,060 kilocycles) was set aside for soaring societies for use in connection with glider activities.

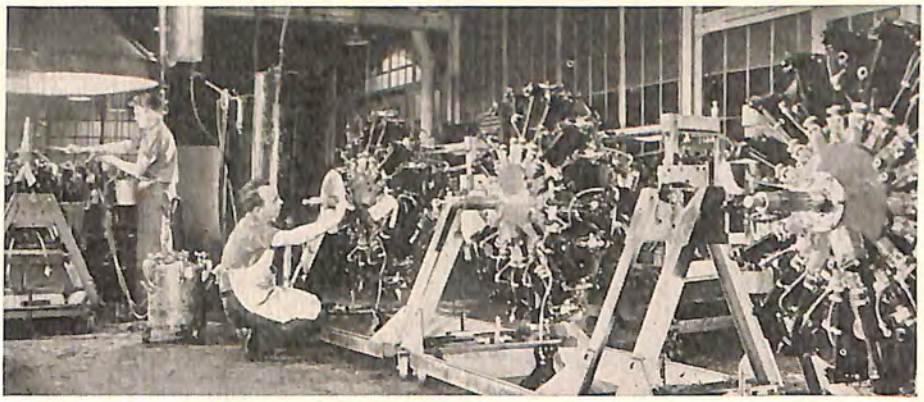
Notwithstanding the war and curtailment of scheduled commercial aviation service to the North European sector, progress was made in new routes, extended routes, and better service to other parts of the world. The radio frequencies designated for intercontinental routes at the International Telecommunications Convention (Cairo revision), were used in a coordinated system of communication essential for the safe operation of transport aircraft. There was a total of 284 terminals and 191 ground stations serving these international routes.

At the close of the fiscal year a study was being conducted of the communications necessary for all international routes in order to plan for their expansion and to assure that frequencies in adequate numbers would be available to carry the increasing communication requirements.

Fish and Wildlife Service

The use of airplanes for patrolling the vast hunting, fishing and trapping areas in Alaska to spot violations, in 1941 added materially to the effectiveness of the law enforcement duties assigned to the Fish and Wildlife Service, U. S. Department of the Interior. The Alaska Game Commission, the Service's operating agency in the Territory, purchased two new planes, a 165 h.p. Fairchild and a 90 h.p. Monocoupe, both with two-way radio communication. The Commission then owned five planes, three Fairchilds and two Monocoupes. The Monocoupes operated on wheels, skiis and floats. In March the plane stationed at Fairbanks was flown 3,500 miles in the Lower Yukon, Koyukuk and Kotzebue areas, during which period an alien who had been operating for several years under a resident fur-dealer's license was apprehended and taken to Nome where he was fined $1,000 and his furs forfeited.

Airplanes of the Commission and of five commercial companies were used in the patrol of the Alaska fisheries in the 1941 season, covering about 10,700 miles in a total of 103 hours. Commission planes operated on 14 days while chartered service was employed on 24 days. Fishery investigations in the Bristol Bay area required 38 days of airplane service, and included transportation of personnel and freight, collection of biological data, and a survey of spawning areas.



LYCOMING ENGINES
Preparing for shipment.

PRATT & WHITNEY INSPECTION

After initial testing all parts of the engine are laid out on one of these benches for minute inspection.

Total flying time was about 148 hours, and nearly 16,000 miles were traversed.

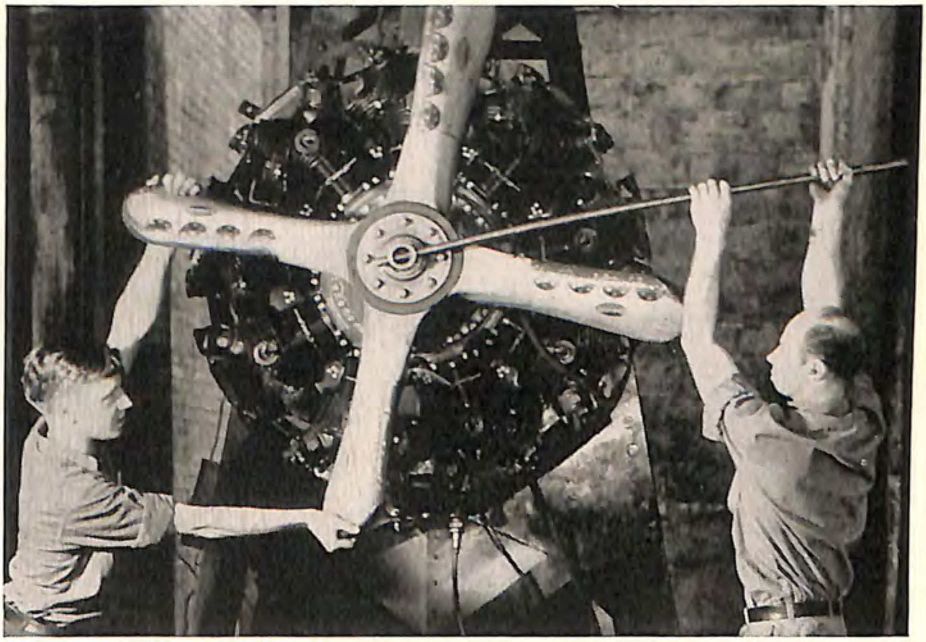
During the annual inventory of North American waterfowl, airplanes were used extensively. They covered the entire Atlantic coast from southern Maine to Key West; the area from Pensacola, Fla., to the mouth of the Rio Grande; sections of the Mississippi River; and portions of the Pacific Coast.

Aerial surveys were employed in reconnaissance of prospective wildlife refuge areas. By viewing an extensive marsh area from the air, the choice areas were located through observation of bird concentrations and the condition of vegetation. Aerial photography also proved to be effective in preparation of base maps essential for refuge planning and future management.

Geological Survey

Aerial photographs were used more extensively by the Geological Survey in its mapping activities of 1941 than in any other year in its history. Several hundred thousand square miles were covered by the airplane pictures procured by the Geological Survey for mapping in the continental United States and Alaska. As conditions and requirements in the States and in the Territory differ widely, the methods applied and the results obtained also differed greatly.

Applying a technique all their own, engineer specialists in the Alaskan work used the combined vertical and oblique aerial photographs to prepare, rapidly and at low cost, small-scale maps of extensive areas that could not have been mapped by ordinary ground methods except through slow, laborious processes and an enormous outlay of money. As a matter of fact, it would not have been practicable, under Alaskan conditions, to send ground parties into some areas to map them by ground methods, yet maps of the region were essential if safe transportation routes were to be established. Such maps are not only indispensable to the Geological Survey's work but are perhaps in even greater demand by other agencies of the Federal Government interested in the development of the Territory. Aside from their use as an aid to mapping, aerial photographs also served a direct use to the Alaskan field geologist in his specialized work. Taking the photograph itself, the geologist can see at a glance many of the significant features that might easily escape his notice in trudging through swamp or forest, or perhaps clinging precariously to a mountainside he is attempting to scale. The airplane picture is regarded as a tool of inestimable value in every phase of the Survey's work in Alaska.



WRIGHT ENGINES FOR ARMY TANKS

A Wright Whirlwind 9 engine being prepared for a test run before installation in a U. S. Army's 28-ton M-3 tank.

BREWSTER'S LONG HISTORY

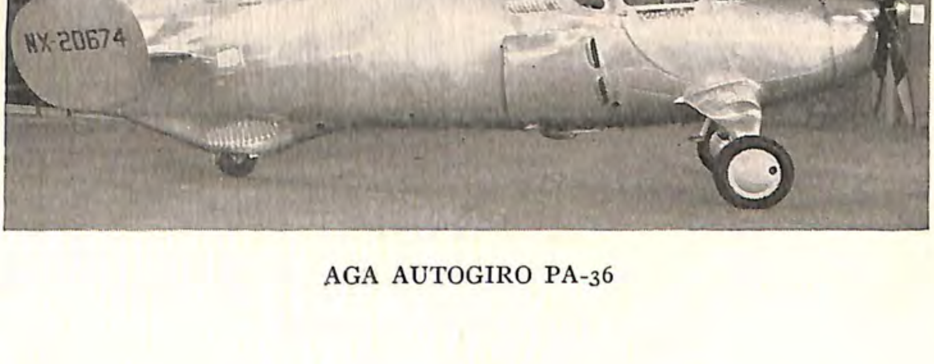
A new Brewster combat plane and the 50-year old carriage made by the Brewster company which started in business in 1810.

In the States, where larger-scale maps are required, different methods are followed. The type of camera employed is governed by the character of the area to be mapped, the relative difficulty of expanding control surveys in the area, and the equipment that is available for use in converting details on the photographs into a map where the same details are to be shown, as nearly as practicable, in their correct position and mutual relation. Precise single-lens cameras of comparatively short focal length and a wide angle of field have proved to be very effective and are now being used extensively on mapping projects. Stereoscopic plotting devices are employed in both planimetric and topographic mapping to the extent that the increasing equipment of the Survey will permit. However, the stereoscopic equipment now available is inadequate for the volume of work required by the Survey's expanded mapping program. Consequently, graphical methods are still employed extensively in the compilation of planimetric details from aerial photographs. Line maps are prepared on the mean scale of the contact prints, showing as many details of culture, drainage and woodland as can be identified definitely. These line maps are reduced, by means of photography, from the compilation scale to the field scale, on which the maps are to be completed by planetable methods, and prints are made in light blue on regular map sheets. These are used in the field as planetable sheets to complete topographic mapping by the addition of contours and other details that could not be identified on the photographs. Aerial photographs of areas, for which the preliminary publication of maps without contours is contemplated, are usually interpreted in the field in advance of their compilation, and the details that were not shown or were not readily apparent are added to furnish complete information for the compiler. Stereoscopic plotting devices and methods are used for developing both planimetric and topographic maps. Maps so developed are sent to the field after compilation for the addition of any necessary details, such as civil boundaries, names of physical and cultural features, and other details that were not readily identifiable on the photographs.

During 1941, 29 geologic field parties in the States used aerial photographs as bases for geologic mapping, and one party used the photographs in the preparation of topographic maps with the aid of a stereo-comparagraph. Of the total, photographs for 14 projects were furnished during 1941, and those for 14 other projects had been procured from other Government agencies. Field mapping of geologic details is usually done on contact prints with vertical control obtained by planetable methods or from a topographic map if one is available. The geologic data are later transferred from the contact print to a mosaic, to a planimetric map constructed from the photographs, or to a topographic base map when available.

National Advisory Committee for Aeronautics

As a Government bureau, charged by law with scientific research in the problems dealing with the development of aircraft, the National Advisory Committee for Aeronautics on January 12, 1942, made public its 27th annual report, which was of unusual interest because of the need for maintaining supremacy of American aircraft in the war. "Against a background of fallen nations, the airplane looms as



AGA AUTOGIRO PA-36

N. A. C. A. photo

IN THE N. A. C. A. PROPELLER RESEARCH TUNNEL

Model of a Vought-Sikorsky at the Langley Laboratories.

the instrumentality that has changed previous concepts of military power and the course of history," the report stated; and continued: "In the emergency created by this situation, the United States is expending unprecedented sums for the production of aircraft, on the effectiveness of which the security of the nation may largely depend. Vast quantities of aircraft alone seem insufficient unless their performance is at least equal to those they may be called upon to oppose. It has been possible, due to close collaboration with the Army, Navy and aircraft industry, to incorporate the results of a great deal of the Committee's work in current production aircraft, thus making them more effective military weapons.

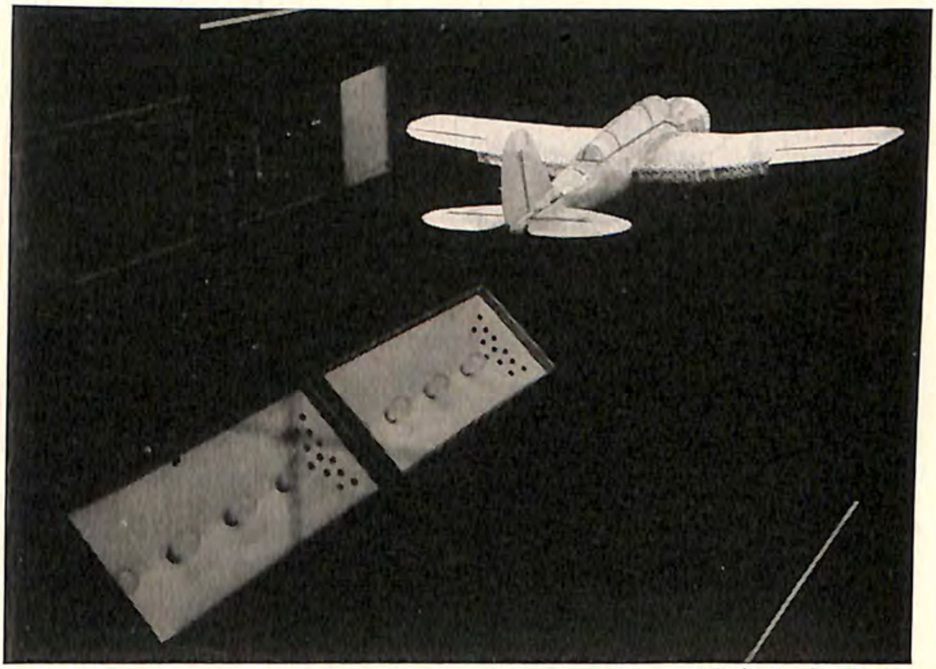
"Only continued scientific research can give the nation assurance that its aircraft will be kept at least the equal of those of any other nation. In order to develop aircraft to their full potentialities, both in peace and in war, scientific research must be prosecuted with vigor and imagination.

"As the threat of war grew grave in 1938 and the pace of armament accelerated, the Committee surveyed its research needs in anticipation of greatly increased responsibilities. The Committee restudied the research facilities which would be needed to work effectively upon a great variety of problems of the airplane, its power plant and its equipment; and proposed a program for the construction of additional and improved wind tunnels to investigate large airplane models at speeds in excess of current military requirements and for greatly increased facilities for power-plant research.

"The Congress provided funds, first, to increase the research facilities at Langley Field, Va., and to provide an electric generating plant to permit operation of wind tunnels at all hours of the day; second, to establish a new aerodynamic research station, now known as the Ames Aeronautical Laboratory, at Moffett Field, Calif.; and third, to establish a separate station for fundamental research on aircraft engine problems. This station is now under construction at Cleveland, O.

"The Committee placed in operation during the last year at the Langley and Ames laboratories new wind tunnels, representing an expansion of more than 100 per cent in the wind tunnels devoted to urgent defense problems, and is proceeding with construction of other wind tunnels, representing another 100 per cent increase over those available a year ago. The regular and supplemental appropriations for the Committee for the fiscal year 1942 provide also for a substantial increase in personnel.

"The Committee's ability to meet its growing responsibilities has thus been materially aided through the provision of a more adequate staff and better research facilities. At the same time it has had the effective support and cooperation of representatives of the Government agencies concerned with aeronautics and of a large number of experts from the industry and from private life. These experts have



N. A. C. A. photo

N. A. C. A. 12-FOOT FREE-FLIGHT WIND TUNNEL

THE AERONCA O-58-A

Purchased by the Army Air Forces for certain kinds of observation work.

served on technical subcommittees charged with the planning of detailed research projects.

"The desired characteristics of the naval and military types of aircraft now included in the national defense program are such that both fundamental and specialized research are necessary to realize the performance required. A speed of 400 miles per hour and as much more as is practicable is an obvious necessity. The factors involved include not only clean aerodynamic design, but the discovery of new principles and facts whose application in design leads to real improvements. It is not enough merely to increase the horsepower and to smooth the surfaces.

"It was necessary to develop a new wing section of low-drag type, to obtain accurate data in a low-turbulence wind tunnel of its lift and drag, to determine the effect of various types of flaps for increasing lift, and the action of normal and other lateral control devices. It was also essential to reexamine the method of cowling and cooling both aircooled and liquid-cooled engines at high air speeds. Special cowlings were required to handle the air needed to cool the engine, the oil radiator, the intercooler and, in the liquid-cooled type, the radiator. This work was based on theoretical analysis and proved in wind-tunnel and flight tests.

"Propellers of usual design are inefficient at extreme speeds. New propeller blade sections and new plan forms for the blade have had to be developed to keep the losses under those conditions to a minimum. Again theoretical studies and wind-tunnel tests together were necessary to arrive at a practical solution.

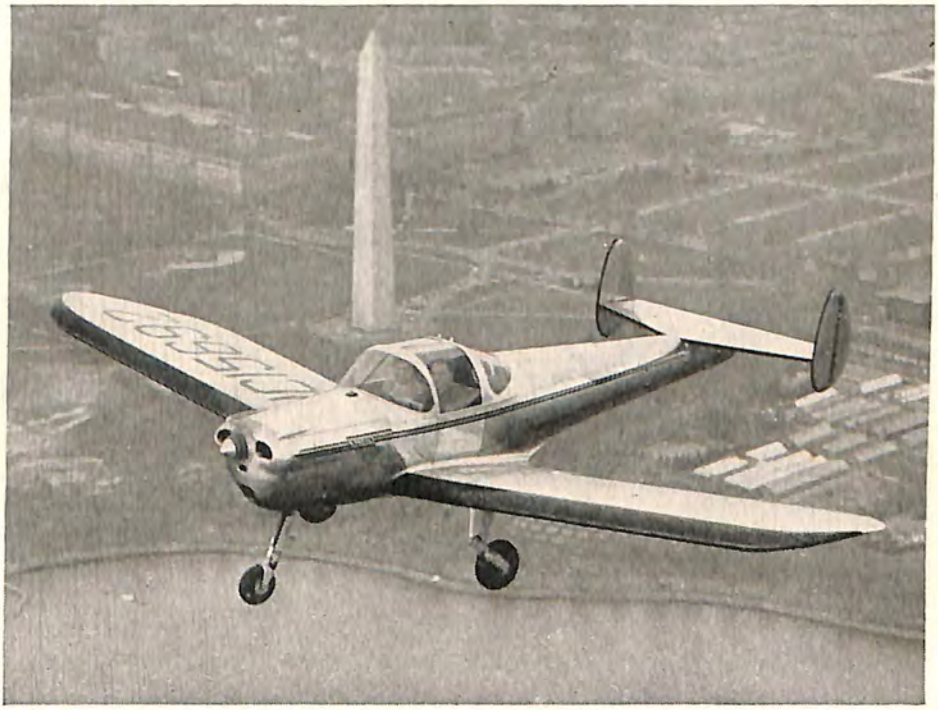
"At high speed the airplane is subject to compressibility effects.

The wing, the fuselage, the propeller and other parts must be designed to eliminate compression waves as far as possible. This requires testing in a high-speed wind tunnel.

"Altitude requirements have been much increased. They demand better supercharging equipment and better cooling of the engine and the intercooler at high altitudes.

"In planning the design of a new military airplane special model tests are necessary to determine its spinning characteristics. Where the design is of a radically new form tests are also made in the free-flight tunnel to be assured that the design will have adequate stability and control.

"The Committee initiated its present program of expansion of research facilities in 1938. Through the support of the President and the Congress since that time, the Committee has been able to place in operation during the last year seven wind tunnels of major significance, and a structures research laboratory, all now fully engaged on urgent problems relating to the defense program. The new wind tunnels at Langley Field are a 20-foot free-spinning tunnel, a stability



ERCOUPE MODEL 415C

The two-place private owner plane produced by Engineering and Research Corporation on a flight over Washington, D. C.

FOR HARD-HITTING PURSUIT SQUADRONS

This is the Airacobra, manufactured by the Bell Aircraft Corporation, in British war paint. The liquid-cooled Allison engine which powers this fighter plane is located behind the pilot and furnishes power to the hollow hub propeller by means of a 10 foot drive shaft. The plane is armed with a cannon and light and heavy machine guns.

tunnel, a two-dimensional tunnel and a 16-foot high-speed tunnel. At Moffett Field the new tunnels so far placed in operation include a 16-foot high-speed tunnel and two 7-by-10-foot high-speed tunnels. There are under way at Moffett Field a low-turbulence high-speed tunnel, a supersonic tunnel, and a full-scale tunnel.

"An aircraft engine research laboratory is under construction at Cleveland, O. This will include special equipment for research on engines and accessories, propellers, fuels and lubricants; an ice tunnel for the study of problems of ice formation in flight; and a novel, high-speed engine-research wind tunnel to operate under conditions of temperature and density existing at high altitudes.

"There is also under construction at Langley Field a second seaplane towing tank, a seaplane impact basin, an electric power-generating plant, an additional shop building and extensions to the Flight Research Laboratory and to the service and administration buildings.

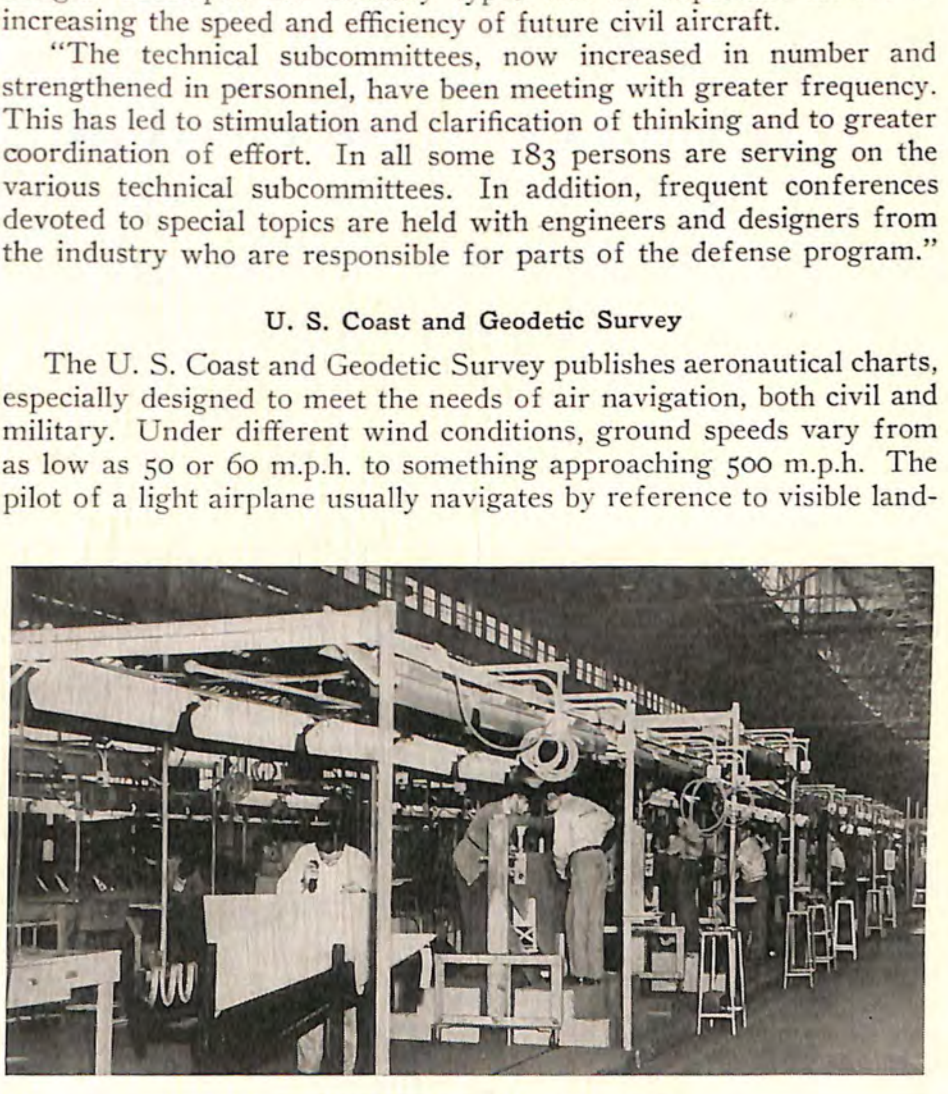
"In the present emergency the Committee, with the special approval of the Congress, has increased its use of available research facilities in educational and scientific institutions and in the National Bureau of Standards. The work so done supplements that of the Committee's own laboratories; and the Committee's research contracts enable scientists of special qualifications to work upon problems of national importance which they would otherwise lack the means to investigate.

"With the exception of dive-bombing problems and problems incident to armament installations, practically all the research of the Committee is directly applicable to civil types of aircraft. Improvements in large two- and four-engine airplanes of the bombing type will undoubtedly be reflected in transport airplanes of tomorrow. New and improved engine installations, wing forms and propeller designs developed for military types will be important factors in increasing the speed and efficiency of future civil aircraft.

"The technical subcommittees, now increased in number and strengthened in personnel, have been meeting with greater frequency. This has led to stimulation and clarification of thinking and to greater coordination of effort. In all some 183 persons are serving on the various technical subcommittees. In addition, frequent conferences devoted to special topics are held with engineers and designers from the industry who are responsible for parts of the defense program."

U. S. Coast and Geodetic Survey

The U. S. Coast and Geodetic Survey publishes aeronautical charts, especially designed to meet the needs of air navigation, both civil and military. Under different wind conditions, ground speeds vary from as low as 50 or 60 m.p.h. to something approaching 500 m.p.h. The pilot of a light airplane usually navigates by reference to visible land-



FLEETWINGS FINAL ASSEMBLY

Coast and Geodetic Survey photo

THE U. S. COAST AND GEODETIC SURVEY NINE-LENS AERIAL CAMERA
Being hoisted into a Coast Guard plane.

marks, and requires all possible detail. Pilots of fast ships are concerned only with the most prominent landmarks, and a small-scale chart showing few details is satisfactory for them.

To meet these varying needs, three principal series of charts are now completely available, as follows: (1) Sectional charts, covering the entire United States in 87 sheets at a scale of 1:500,000, or about eight miles to the inch; (2) Regional charts, covering the United States in 17 sheets at 1:1,000,000, or about 16 miles to the inch; and (3) Radio direction finding charts of the United States in six sheets at 1:2,000,000, or 32 miles to the inch. Eight charts of Alaska at a scale of 1:1,000,000, and a number of auxiliary charts are also issued, and research in improved methods of air navigation is carried on. "Practical Air Navigation" (C.A.B. No. 24) is prepared and revised in this Bureau for the Civil Aeronautics Administration.

During 1941, five United States sectional charts were again flight-checked in part, and considerable flight-checking was carried out in Alaska. This means the charted areas were flown over by trained observers from the Bureau, and the details of the charts checked and corrected from the air. Photographic surveys were made along the coasts of the United States and Alaska using the large nine-lens camera, developed by the Coast and Geodetic Survey. Planes and flight personnel for this work were furnished by the U. S. Coast Guard and the U. S. Army Air Corps.

The many changes in the aids to navigation along the Federal Airways System in the United States, together with the wealth of new mapping material resulting from the accelerated program of topographic surveys and air photo projects, required frequent revisions to provide charts adequate for safe air navigation. To care for these needs, the Bureau's personnel was greatly increased during 1941.

U. S. Coast Guard

Aviation activities of the U. S. Coast Guard entered upon a new phase on November 1, 1941, when the Coast Guard, by Executive Order, became a part of the Navy, subject to the orders of the Secretary of the Navy. The organization, built up primarily for such peacetime functions as enforcement of maritime law, rendering assistance, and the patrol and reconnoitering of large areas, thus took on additional military duties, while to a certain extent it continued its older functions. The change was not an abrupt one, for during the period of national defense which preceded the declaration of war, Coast Guard planes and air stations had engaged to a large extent in patrol work having a military significance. In a sense Coast Guard aviation was experiencing a return to a more fully military status, for the origin of aviation activities in 1920 was due to the fact that Coast Guard

GRUMMAN WIDGEON

A four-five place amphibion powered by two 200 h.p. Ranger engines. The U. S. Coast Guard used numbers of these ships as the J4F-1.

U. S. Coast Guard photo

COAST GUARD MERCY ERRAND

A stretcher case leaving a U. S. Coast Guard plane at Elizabeth City, N. C.

officers, trained as aviators, had seen much active service during the first World War, and that after the armistice surplus Navy equipment had been secured for peacetime use.

Perhaps more important in the present war than its planes were the Coast Guard aviation personnel and air stations. The aircraft were restricted to certain definite activities, for they were designed for non-combatant peacetime duties, where desired characteristics were quite opposite to those of many military types of planes. In sea and short patrol work, however, Coast Guard personnel and equipment should excel, because of their years of familiarity with every mile of coastline of continental United States, and practical experience gained through hundreds of landings along open beaches, on inlets and coves, and on the open sea itself.

Usefulness of Coast Guard aircraft and personnel in war time was predicated upon the development of this air arm in peacetime. While the Coast Guard's aviation branch was a small one compared with the Army and Navy air forces, equipment and personnel was deemed adequate for the tasks in hand. Training for the Coast Guard officer began at the Coast Guard Academy at New London, Conn., where the courses designed to fit the needs of a nautical service also included certian fundamentals required by the air officer. Commissioned an ensign, and with three years of sea duty behind him, the young officer if air minded, might apply for aviation duty. Preliminary examinations successfully passed, he was sent to a Coast Guard air station for short preliminary indoctrination training. The Naval Air Station at Pensacola was his ultimate destination, where he received the same flight training given to Navy and Marine Corps student officers.

Assigned to a Coast Guard air station the new aviation officer had behind him the successful completion of the flight training, plus four years at the Coast Guard Academy. He took up flying as a profession under the usual conditions prevailing within the service. Outstanding features of operations at all Coast Guard air stations were the constantly recurring emergency calls, the delivery of hurricane warnings, the locating of missing craft, spotting of disabled vessels, occasional removal of injured persons from ships at sea, and assignments to law enforcement work of a land and maritime nature.

There was constant training in the coordination of plane movements with those of floating units of the Coast Guard. In many searches, the plane was the reconnoitering instrument in cooperation with the sur-

READY FOR FULL-OUT WAR

Lockheed P-38 Lightning Pursuits being prepared for flyaway delivery to the Army Air Forces.

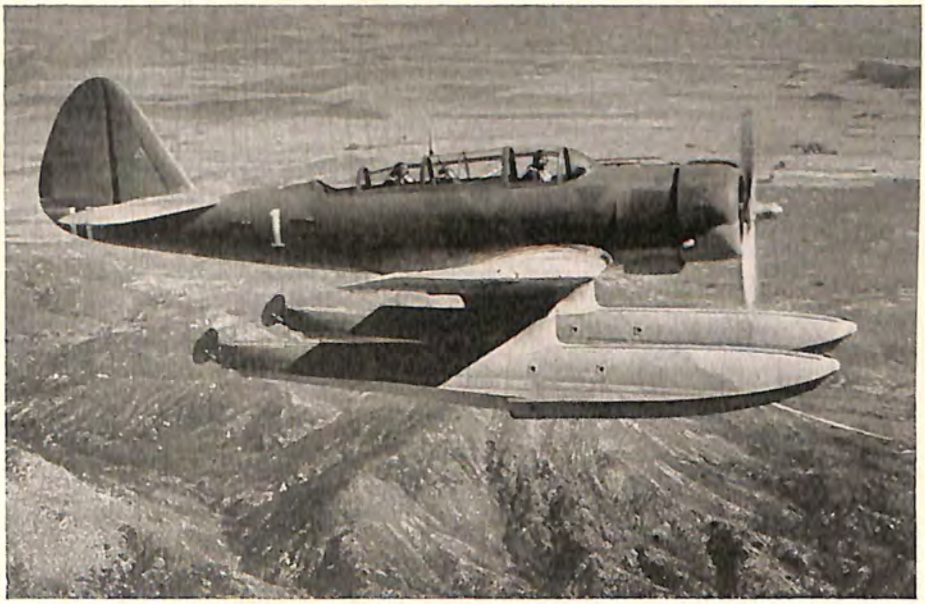
BOEING FLYING FORTRESS B-17E

On flyaway delivery from a plant of the Boeing Aircraft Company.

face craft. The importance of communications was at all times before the aviation officer, for he frequently was engaged in practical problems where he set out with little or no information, and had to rely on orders and information received en route from a number of sources.

Back of the Coast Guard planes was the small but effectively located network of Coast Guard air stations, their sites selected with a view to plane coverage of the entire coast and the placing of aircraft close to points where there was normally most maritime and assistance activities. Most air stations of the Coast Guard were so located that both land and seaplanes could be operated from them. None were located directly upon the open coast, but upon some body of water affording adequate shelter for the take-off and landing of seaplanes. The typical layout included a concrete ramp of adequate dimensions, with mooring buoys, guiding lights and other facilities required by seaplanes. This ramp was directly connected to the paved space in front of the hangar. Each air station was practically a self sustaining unit, complete with facilities for the maintenance and operation of aircraft, and barracks for the personnel assigned. The normal maintenance facilities of an air station were developed at each of the Coast Guard units to a point where operations could be carried out in an effective and economical manner. The Coast Guard also maintained at Elizabeth City, N. C., and San Diego, Calif., facilities and trained personnel for the major overhaul of its aircraft. Personnel of the stations included the usual non-rated grades, and petty officers qualified in aviation specialties, including enlisted pilots. Commissioned aviators and aviation pilots, as before stated, were trained at Pensacola, but were also fully qualified for transfer at any time to the strictly nautical branches of Coast Guard work.

The effective state of Coast Guard aviation on our entry in the war was not achieved overnight; but was the result of long years of striving and the overcoming of apathy and other seemingly insurmountable difficulties. When the Coast Guard first took an active interest in aviation and secured its first plane such equipment was looked upon solely as a new tool with which to accomplish long established duties. Planes transcended the limitations of land equipment and sea craft. In certain cases they enormously reduced the time of travel. They provided excellent observation points. The tasks, however, on which they were employed, were the same as those assigned to cutters and shore units, and the drawbacks quickly became apparent. Planes could render little or no direct assistance to vessels at sea, they could not make arrests or seizures, and the possibilities of direct rescues were curtailed seriously by the difficulties of landing



NORTHROP N-3PB PATROL BOMBER

It is powered by a Wright Cyclone engine and equipped with Edo floats.

VOUGHT-SIKORSKY OS2U-3

The Navy Kingfisher scout plane, with Pratt & Whitney Wasp Junior engine and Hamilton Standard constant speed propeller.

and take-off and the limited carrying capacity of planes. The persistent efforts of Coast Guard aviation personnel to overcome the natural handicaps of planes in their highly specialized duties and the gradual development of an operating technique which would result in a close and effective coordination of air, land and sea craft, in the work of a sea police force, have been most commendable.

Early in 1942, the country was divided into 18 Coast Guard districts. Such a district could embrace territory equal to two or more States, could include a half dozen seagoing cutters, a considerable number of smaller patrol craft, perhaps twenty or more lifeboat stations, as well as the network of navigational aids such as lighthouses and lightships and the ships and other plant required for their operation. The district commander was coordinating officer for a considerable aggregation of ships, aircraft, stations and personnel. The communications system formed the connecting links, and included telephone lines, both Government and commercially owned, the commercial telegraph system, and a series of radio stations, on shore, aboard ships and in planes. Thus thousands of points throughout the area covered by the Coast Guard had a rapid and reliable means of communicating with district headquarters at all times.

In immediate control of the operations of each air station was its commanding officer, a Coast Guard aviator. In him was vested the authority to carry out well defined duties of a routine nature. As notification of emergencies came to him, through any of the mediums of communication, official or otherwise, he had further authority to act immediately in accordance with previously formulated policy, and through the communication system of obtaining substantiation of his actions or additional instructions through the district commander. Immediate readiness to act was secured at all times through the advisory routing of all dispatches likely to affect the station in question.

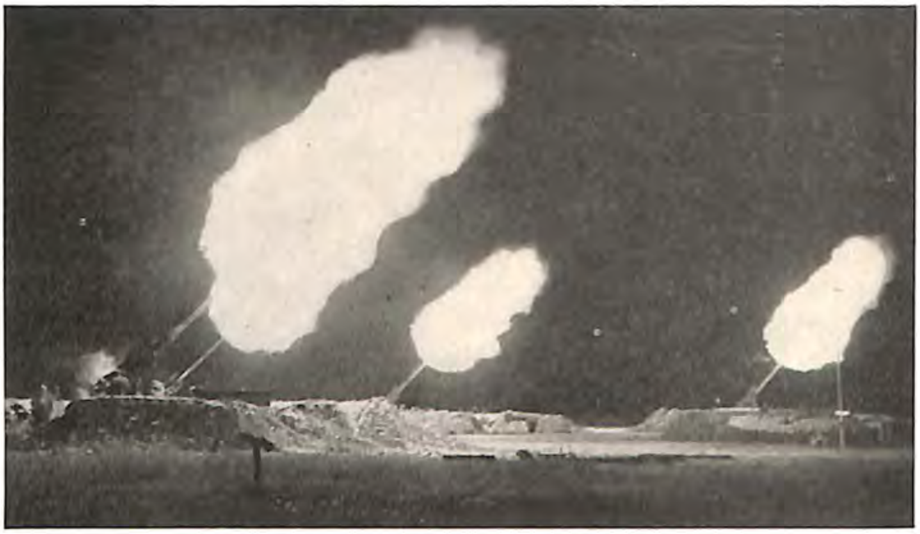
While conditions had changed and much of the administrative procedure was modified to meet the needs of coordinated operation under the Navy, the basic principles of Coast Guard air station operation continued unaltered.

U. S. Forest Service

National defense was the keynote for Forest Service aerial activities during 1941. The research, advisory and consultative program of the Department of Agriculture's Forest Service was shifted almost entirely to projects contributing directly to the prosecution of the war. One of the most important fields of research looked to improvement of the utility of wood for propellers, spars, wing coverings and fuselages for aircraft; substituting wood for critical metals. Army training planes were manufactured of wood and plywood, and certain parts of combat planes also employed those materials. Plans and designs were far along looking to the wider use of wood for combat planes.

NAVY BEECHCRAFT GB-2

A personnel transport similar to the commercial Beechcraft D17S.



BRITISH ANTI-AIRCRAFT GUNS IN ACTION

Of special interest was the Forest Service experiments with the molding of resin-bonded and impregnated plywood into wings, fuselages and other plane parts. The method of impregnation fused several layers of plywood into a solid piece, which could be worked into desired shapes under special treatment. It reduced shrinkage and swelling of the wood and improved its strength and toughness. The Forest Service was represented on a committee reporting to the War Production Board on the supply of aircraft spruce. Early in 1941 the Army arranged for integration of Forest Service fire lookout stations and facilities in air-raid warning plans. Selected stations were made suitable for year-round occupancy and manned by trained forest observers as needed. For several years, Forest Service lookout stations on the West coast had participated in trials of the Army's aircraft detection network, and induction of the national forest facilities into the defense system was relatively easy. Forest Service telephone and radio communications were utilized in these nets.

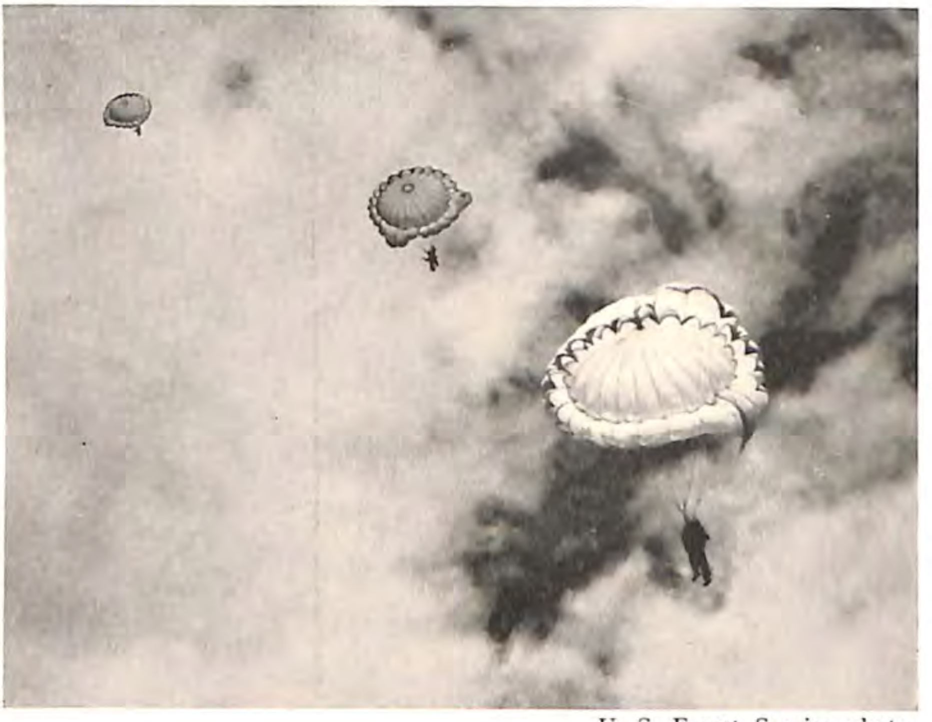
A general intensification of forest fire control measures was made necessary by the war situation, as it was essential that forests and forest products industries be kept producing materials vital to war needs, and that strategic facilities of all kinds in and near forest areas be protected. Looking to possible need for special forest protection techniques arising from present-day methods of aerial warfare, the Forest Service assigned picked men to a special training course with the Chemical Warfare Service of the Army. The training covered modern methods of chemical warfare defense, particularly the protection of lives and property against gas and incendiary bombing. Steps were taken to adapt to forest protection the techniques of defense against the new methods of aerial warfare.

During the 1941 fire season the Forest Service expanded its program of parachute jumping to back-country forest fires, first demonstrated under actual fire conditions in 1940. Activities in 1941 were on a larger scale. The Forest Service established headquarters in the Northwest, in mountainous terrain, where three eight-man squads of jumpers, placed at strategic points, served certain remote forested zones in Washington, Montana and Idaho. A project leader trained the men to act in three capacities: (1) as individual smoke jumpers; (2) as a squad unit; (3) as a 25-man crew. Thus the smoke-jumper force was organized to meet varying types of fire emergencies in back-

U. S. Forest Service photo

FOREST FIRE FIGHTERS USE PARACHUTES

For years some of the hard-fighting crews of the U. S. Forest Service have used parachutes to reach fires in our national forests. Two jumpers prepare to go up.



U. S. Forest Service photo

PARACHUTING TO A FOREST FIRE

Smoke eaters of the U. S. Forest Service dropping into the danger spot in a national forest.

country areas. A Forest Service parachute jumper designed a special static line, attached to the parachute and connected with the plane, which automatically pulled the rip cord as the jumper leaped. Trainers reported that the static line eliminated the most difficult phase of training, because with this device a jumper no longer had to concentrate on pulling his rip cord at the proper split second. Use of the static line removed the possibility that the jumper might "freeze" and fail to open his "chute."

The Forest Service found planes valuable for taking a game census. The fourth annual count of the Jackson Hole, Wyo., elk herd was made in 1941. Five days, with a total of 26½ hours of flying time, were required to count the herd, largest in the nation. Cost of the seven-passenger Travelair plane used was divided equally among the Forest Service, Fish and Wildlife Service, and the Fish and Game Department of Wyoming. The aerial game reconnaissance covered about a million acres, extending from the village of Alpine near the Wyoming-Idaho border eastward to Togwotee Pass on the Continental Divide.

Cooperating with the Army, the Forest Service undertook the preparation of maps covering nearly 5,000 square miles for the national defense mapping program. Aerial photographs were being used in the preparation of planimetric maps to form as a base on which contours could be added by a combination of ground surveys and photogrammetrical methods. Trained surveying and map-making personnel of the Forest Service were mobilized from several national forest regions for the project. The Forest Service also aided the Army in the procurement of lookout towers for use by the Army Air Corps as observation posts on bombing target ranges at Army training posts.

U. S. Public Health Service

Medical officers of the Public Health Service found rapid air transport to be of great service in their duties of investigating and aiding in the suppression of epidemic diseases and in giving medical service to American seamen, either by sending a doctor to ships which had no medical officer aboard or by transporting the patient to one of the Public Health Service marine hospitals. The Public Health Service constantly was concerned, however, with aircraft in connection with the administration of quarantine laws to prevent the introduction into the United States of dangerous diseases and disease carriers, both human and insect.

Chief among the quarantine problems incident to air commerce with foreign areas was the danger of the importation of cases of yellow fever and certain types of malaria, as well as insect vectors of those diseases. Other diseases such as cholera, plague, smallpox, typhus fever and dengue also caused concern. The maximum incubation periods of those diseases varied from five days to two weeks. With the average flight traveling time of a day or two from infected areas, a traveler very easily might become infected before embarka-

READY FOR WAR SERVICE

North American B-25 medium bombers awaiting flyaway delivery.

U. S. Public Health Service photo

QUARANTINE INSPECTION FOR AIR TRAVELERS

Officers of the U. S. Public Health Service examining passengers arriving at a port of entry from Latin America.

tion and not come down with the disease until some time after reaching the port of destination.

The rapid expansion of airplane service to the United States and the increased incidence of some of the quarantinable diseases, especially yellow fever, in foreign countries not only required greater vigilance on the part of quarantine officers, but also made necessary the development of more effective precautionary measures. During 1940 and the first part of 1941, aircraft disinsectization bases were established at Barranquilla, Colombia, and Maracaibo, Venezuela, and inspection bases at Kingston, Jamaica, and Port-au-Prince, Haiti. On request, Public Health Service officers aided in the establishment of these bases, but they were maintained by the respective countries.

Early in 1942, the Public Health Service revised regulations and pertinent information relative to quarantine measures applicable to aerial navigation, for the use of quarantine officers, airways personnel and others concerned.

The fundamental principles of aircraft quarantine were essentially comparable to those of maritime quarantine except for the additional element of danger which the speed of air travel has introduced. These included careful medical inspection of airplane passengers and crews, supplemented by medical surveillance of persons arriving from infected foreign areas until the incubation period of the suspected or possibly imported disease had passed. Disinsectization of aircraft had become an exact and effective procedure, which, if carefully done, would for all practical purposes exclude mosquitoes and thus eliminate two of the most serious threats associated with air transport.

A large number of the air line flight personnel on southern routes had been immunized against yellow fever, smallpox and typhoid fever. Pan American Airways routinely sprayed its planes with insecticide before arrival in the United States. The various quarantine measures so far had proved successful.

An index to the expansion of air travel to the United States from foreign ports, and especially to the increase in the number of persons carried per plane, during the last 10 years was found in the records of the quarantine officers regarding arrivals at airports of entry. In 1931, a total of 4,469 planes carrying 25,351 persons ar-

REPUBLIC P-43 LANCER

With Pratt & Whitney Twin Wasp engine and Curtiss electric propeller.

GLENN L. MARTIN PATROL BOMBER

One of the PBM-1 patrol bombers in Navy service. It carries a crew of seven and is powered by two Wright Cyclone 1,350 h.p. engines.

rived from foreign countries at airports of entry in the United States and Alaska. During 1941, there were 6,242 planes carrying 96,610 persons—an increase of 39 per cent in the number of planes and of 281 per cent in the number of persons carried.

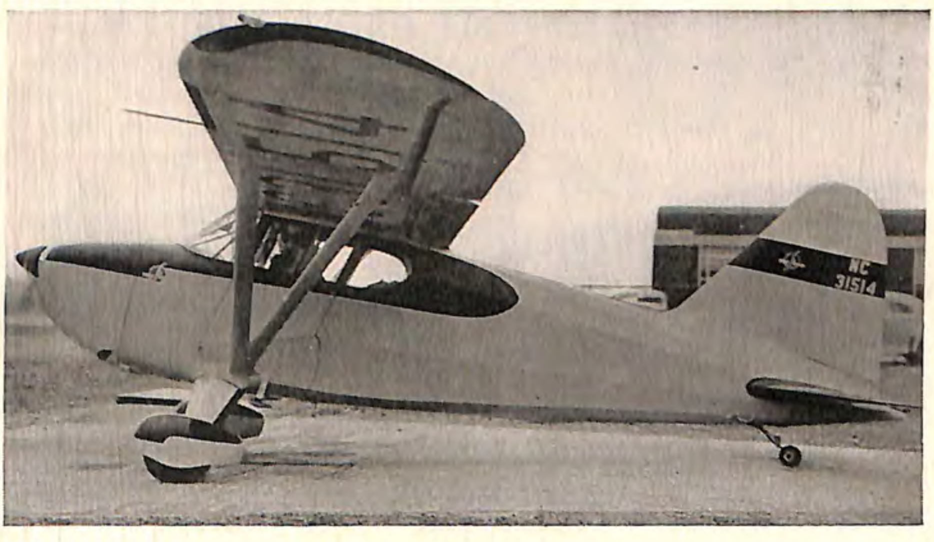
In view of the development of transoceanic air service, though temporarily restricted by the war, and with the prospect of mechanical advances in aeronautical engineering resulting from the exigencies of war, air travel, both continental and international, promised to expand rapidly when peace and the free commerce of nations should again prevail. Because of the increase in disease in many of the nations at war, that development was bound to necessitate greater vigilance on the part of the quarantine officers of the Public Health Service, to protect the United States against imported infections that might develop into epidemic form.

U. S. Weather Bureau

On January 1, 1942, there were 875 weather reporting stations contributing directly or indirectly to the airway weather service in the United States and its possessions, and operated by the U. S. Weather Bureau. Of this total there were 501 stations furnishing reports at hourly intervals, besides 83 3-hourly reporting stations, 77 stations reporting each 6 hours, and 214 airway stations reporting under certain specified conditions or upon request. Included in these totals were 29 new hourly-reporting stations established during 1941 and 11 new airway stations established in Alaska. Also, in addition to increased activity at a number of other stations in the latter territory, 25 stations in the United States which had formerly reported each 6 hours were required during 1941 to furnish reports at 3-hourly intervals, and a number of airway stations were set up to provide increased service for new air routes. There were 14 forecast centers in the United States, plus 3 in Alaska and 1 in Honolulu, which prepared airway forecasts every 6 hours, day and night, for all the important air line terminals and for the entire territory over which regular scheduled flight was maintained. In addition to the regular forecasts, special trip forecasts were issued to pilots upon request, and a forecast service for transoceanic flights was in operation at New York and San Francisco. Forecast service at two of these 18 stations was started in 1941. Denver was assigned limited airway forecasting duties on December 19; and airway forecast service at Anchorage, Alaska, was rapidly expanding as additional personnel arrived there near the end of the year.

The 1941 increase in quantity of observational data, in number of stations, and in forecast service available, continued the service-expansion program which accompanied the growth of air traffic in 15 years. During this period new observational techniques were evolved; advances were made in the physical theories underlying the science of meteorology; and operating procedure was improved and standardized.

The theory of air-mass-analysis, developed in Norway during the first World War, became the accepted theoretical approach to forecasting in 1941. This theory provides a general explanation of the mechanism of weather changes based directly on accepted physical



THE STINSON VOYAGER

A three-place private owner plane with 90 h.p. Franklin engine.

THE PIPER CUB CRUISER

A three-place utility light plane, with Continental or Lycoming engine, produced by Piper Aircraft Corporation, Lock Haven, Pa.

principles; and its use enables the forecaster to obtain a more precise picture of the forces acting in the atmosphere, and thence to predict the resulting changes with a greater degree of certainty. Air-mass-analysis stresses the three-dimensional aspect of atmospheric activity; and to realize the benefits inherent in the theory, improved methods for measuring conditions in the upper air have been developed.

Recording instruments attached to kites were originally used to obtain records of conditions above the earth's surface. This method, necessarily cumberous and restricted to low altitudes was replaced early in the development of aviation by airplane soundings. Airplanes, however, frequently were unable to take off in adverse weather when reports were most essential; also, the altitudes they could attain were insufficient for the observation of conditions at the great heights required. During the 1920's experiments were begun with balloon-carried radio transmitters, forerunners of the modern radiosonde. This instrument combined elements for measuring temperature, humidity, and pressure, with a small high-frequency radio transmitter. The temperature and humidity elements were variable resistors which, in effect, modulated the high frequency emission of the transmitter. The entire instrument, including radio, battery, and measuring devices, weighed slightly less than two pounds and was carried aloft by a rubber balloon inflated with helium to a diameter of approximately 6 feet. The average height attained by these soundings was approximately 50,000 feet, and the radio signal was recorded at the ground throughout the flight, providing a complete record of the temperature, pressure, and humidity conditions through which the balloon had passed. While the number (29) of radiosonde stations operating in the United States was still decidedly insufficient, the twice-daily simultaneous observations from these stations contributed very substantially to the meteorologist's knowledge of the continuously changing structure of the troposphere in which aircraft operate. Five new radiosonde reporting stations were established in 1941, increasing the Weather Bureau network to a total of 40 stations. Twenty-nine were located in the United States, seven in Alaska, one at Swan Island in the Gulf of Mexico, one at San Juan, Puerto Rico, and two on ships at sea.

To supplement the upper air data received from the radiosonde stations there were a total of 150 stations making four pilot balloon observations daily. These observations were made to determine the velocity and direction of the wind at various levels above the ground. To obtain this information, the flight of a small balloon, inflated with helium and rising at a known ascensional rate, was observed through a theodolite. The elevation and azimuth angles were measured at regular intervals, and from these measurements the wind velocity and direction at any elevation were readily computed. Observations with larger balloons, with a higher ascensional rate and capable of reaching greater heights, were recently instituted at some stations with good results.

In addition to a dense network of reporting stations, the weather

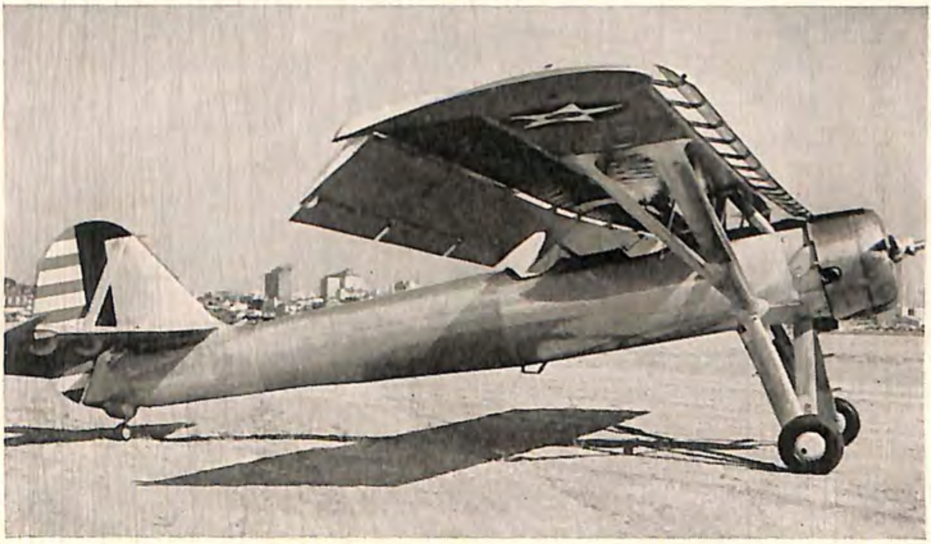
THE LUSCOMBE 8A
It is Continental-powered.

DOUGLAS C-47 ARMY TRANSPORT
The Air Forces version of the DC-3 transports in air lines service.

service required an efficient communication system. The weather is continually changing, not only from day to day but from hour to hour, so that the time-interval between observations and receipt of reports at forecast centers must be kept at the minimum. A highly efficient teletype network was maintained by the Civil Aeronautics Administration primarily for this purpose. Weather reports from hundreds of stations all over the United States were collected and transmitted to central forecasting stations at hourly intervals, and were received within a few minutes after the observations were taken. In 1941, although the teletype system operated 24 hours a day and transmitted information automatically at the rate of 60 words a minute, it proved unable to handle the steadily increasing flow of weather reports. So a new circuit, 26,000 miles in length with teletype drops at 171 stations, was put into operation to transmit weather information exclusively. The new system permitted the transmission of many reports formerly excluded through lack of facilities.

The Weather Bureau was a public service institution created for the express purpose of collecting and disseminating information on the weather to the general public. With the outbreak of war on December 7, however, it became necessary to subordinate all other activities to the single dominant aim of winning the war. Weather is a vital factor in practically every phase of modern warfare. It may decide the outcome of a submarine attack on a convoy; it governs the operation of aircraft; and it may be the deciding factor of an entire campaign. It is therefore imperative to prevent the enemy from gaining any clear picture of large scale weather phenomena existing over this hemisphere.

Upon the insistence of military authorities, broad restrictions were placed on the dissemination of weather information. Radio broadcasting of weather reports, except in emergencies, was banned; access to Weather Bureau offices was subject to restriction; and weather maps and current reports were handled as confidential material. A limited amount of temperature and precipitation data, and general short-period forecasts for restricted areas, were still published in the newspapers; but they contained no specific information on pressure, wind, cloudiness, or precipitation-areas, and it was believed that control of communication channels could prevent even this small amount of published information from falling into the hands of the enemy. Although specific forecasts and detailed reports could not be given the public, the Weather Bureau furnished confidential advices to interests engaged in essential war work and to a limited extent also to private interests under conditions satisfactory to military authorities. Private flyers, for example, could be given enough information to file a flight plan; flood predictions were indicated by



THE RYAN DRAGONFLY

An experimental short-range plane produced for the Army Air Forces to low-speed specifications.

CURTISS O-52 PHOTO-LIAISON

A two-place high wing monoplane for small field operations.

river gage-heights without reference to the spread of rainfall; hydroelectric engineers were consulted directly on regulation of waterheads in power dams; and other significant meteorological advices—for transportation, agriculture, industry, and particularly aviation—continued to be provided within the limits of military safety.

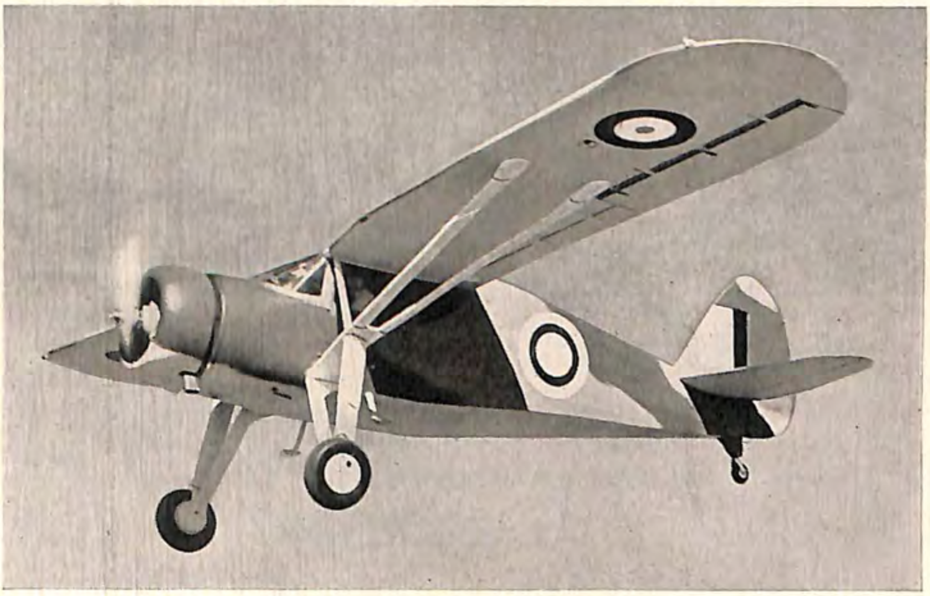
War Production Board

The first and controlling job of the Aircraft Branch of the War Production Board, formed in January, 1942, was to render assistance to military services in all matters pertaining to production. Although its overall functions had remained substantially the same, the Branch had been a part of three major organizations since the beginning of the defense effort in June, 1940. A start was made with the National Defense Advisory Commission, a board that had no real power and did not get very far in surmounting the organizational problems involved, although a good start was made in setting programs and arranging for expansion. Early in January, 1941, the Office of Production Management was formed, and the Aircraft Branch took over many of the personnel from the old NDAC. When the OPM was superseded by the War Production Board, a similar shift of personnel of the Aircraft Branch was made.

The "board of directors" for all aircraft activity in Washington was the Joint Aircraft Committee. This Committee included eight men; two representing the Army Air Corps, two the Navy Bureau of Aeronautics, two the British Air Commission, and two the Aircraft Branch of the War Production Board. This Committee had jurisdiction over all matters pertaining to the allocation and standardization of aircraft in the war program. It met regularly every week. The standardization work was handled by a subcommittee which determined, with the approval of the military services, the items derived from British war experience that should be incorporated in our plans. The subcommittee also standardized the equipment built in a given factory from which the output was going to two different consumers, thus greatly facilitating production.

In the matter of allocations, the programs that were established by the Army Air Corps or the Navy, or by the defense aid organization, were formed into an approved schedule of deliveries for the industry to follow.

There were several sections of the Aircraft Branch. One was a Production Planning Section. It had charge of preparing detailed schedules based on approved programs, a function pertaining to the future. It also had charge of analyzing the past output so as to develop the parameters on which production capacity could be based. It had an equipment and materials group, and through the scheduling unit located at Wright Field, Dayton, O., which reported to it, equipment and materials were allocated to the aircraft industry. This scheduling unit included one representative from the Army, one



THE FAIRCHILD C-61

A development of the private owner 24, it was used by the U. S. Army and R. A. F, for personnel and light cargo transport.

THE CESSNA AIRMASTER

It is powered by either a 145 h.p. or 165 h.p. Warner engine.

from the Navy, one from the British and one from the War Production Board. It was a guiding committee which settled policy matters in connection with this distribution of equipment and materials. The actual survey work was carried out by the Production Survey Branch which was part of the Industrial Planning Section of the Materiel Division, Army Air Corps, at Wright Field.

The Aircraft Branch of the War Production Board also had a priorities section. Formerly, priorities of all branches of the defense effort were handled in one priorities division of OPM. In the summer of 1941 this authority was delegated to the various branches dealing with a particular product, so that the Aircraft Branch handled its own priorities on an allocation basis, supplemented by preference ratings.

Under that Priorities Section, there was a Civilian Aircraft Committee composed of representatives of Government departments and civilian organizations dealing with civilian aircraft matters. It received from the air lines their equipment needs. It then made out a program and, after getting approval from the Joint Aircraft Committee, determined the allocation of the equipment approved to the various air lines. Under the latest plan approved by this group, deliveries were to start in the summer of 1942 and be at a sufficient rate to permit the air lines to carry out their defense functions efficiently.

Another group in the Aircraft Branch was the Manufacturing Section dealing with tools, facilities and other manufacturing problems. It had men in the field visiting the aircraft and subcontracting factories for the purpose of ascertaining and assisting in correcting difficulties. It assisted in determining the need for new facilities and the best manner of getting them. It cleared all Army and Navy aircraft contracts for the War Production Board. The problem of tools was a severe one. It consisted of trying to get tools, when they were needed, from a supply which was inadequate. It meant that

QUANTITY PRODUCTION OF PURSUIT PLANES

Constant motion is provided these two Airacobra assembly lines at one of Bell Aircraft Corporation's plants. A drag chain is recessed into the floor and fuselage dollies are hung to the chain, moving slowly from station to station as work progresses.

the tools unit of the Manufacturing Section had been one of the most active departments in the Aircraft Branch.

In addition to these sections, there were production and engineering specialists dealing with the aircraft industry. In this group were specialists concerned with particular types of airplanes; or parts of airplanes such as the airframe, the engine, the propeller or the equipment; or who handled the coordination of standardization matters. These men served more or less in the capacity of project engineers. They were trouble shooters and expediters. They also handled engineering problems when they arose, although the WPB had no definite engineering responsibilities, these being assumed by the technical branches of the military services.

The Aircraft Branch made a number of important studies, and the reports dealing with requirements of basic materials served as a basis for determining necessary expansion. Probable deliveries of aircraft were determined and, in general, the Branch's schedules coincided with the actual deliveries of almost all the companies, often more closely than those of the companies themselves.

U. S. Navy photo

U. S. NAVY PATROL BOMBER CATALINAS

Consolidated PBY flying boats in echelon formation.

CHAPTER VII

U. S. AIR TRANSPORT ACTIVITIES

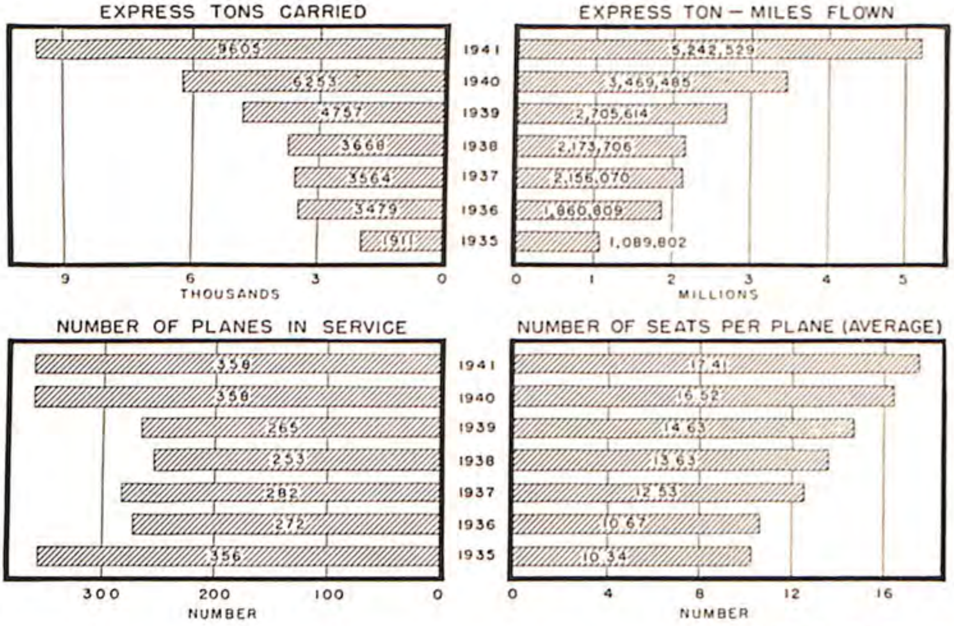
The Nation's Air Lines Prove Their Worth in Speeding Up the War Program—Increase in Safety of Air Travel—Growth of Passenger Traffic, Air Mail and Air Express—The Postmaster General's Report—New Developments in Pick-up Service—Work of the Major Air Lines.

WITH passenger miles of the domestic air lines at one billion four hundred thousand as compared with but slightly over a billion in 1940, the air transport lines of the United States had their greatest year in 1941. Mail and express loads showed increases of about 30 per cent. Air express was up 40 per cent over 1940. War shipments of one kind or another predominated.

A survey made during the middle of 1941 showed that over 80 per cent of the business travel was directly applicable to the defense program. All the 365 planes used in domestic service were of the modern multi-engine type as manufactured by Douglas, Lockheed and Boeing. Average speeds increased to well over three miles a minute. More efficient utilization of equipment brought the average use of air liners per day to about nine hours as compared with five hours only a few years before.

When the A-10 Government priority rating, granted the lines for repair and maintenance materials, no longer met the need, they were given an A-3 rating for such products, thus enabling them to maintain equipment in accordance with their usual high standards.

The acceleration of the arms program created a vital demand for speed in transport of persons and things; and this was reflected in the increased traffic. In 1941, some 4,500,000 passengers were carried as against 3,185,278 in 1940. Distances flown increased from 119,517,263 miles in 1940 to about 150,000,000 miles in 1941. The fatality rate dropped from 3.05 passengers to 2.20 per one hundred million passenger miles.



C. A. A. Graph

SEVEN YEARS OF DOMESTIC AIR CARRIER PROGRESS

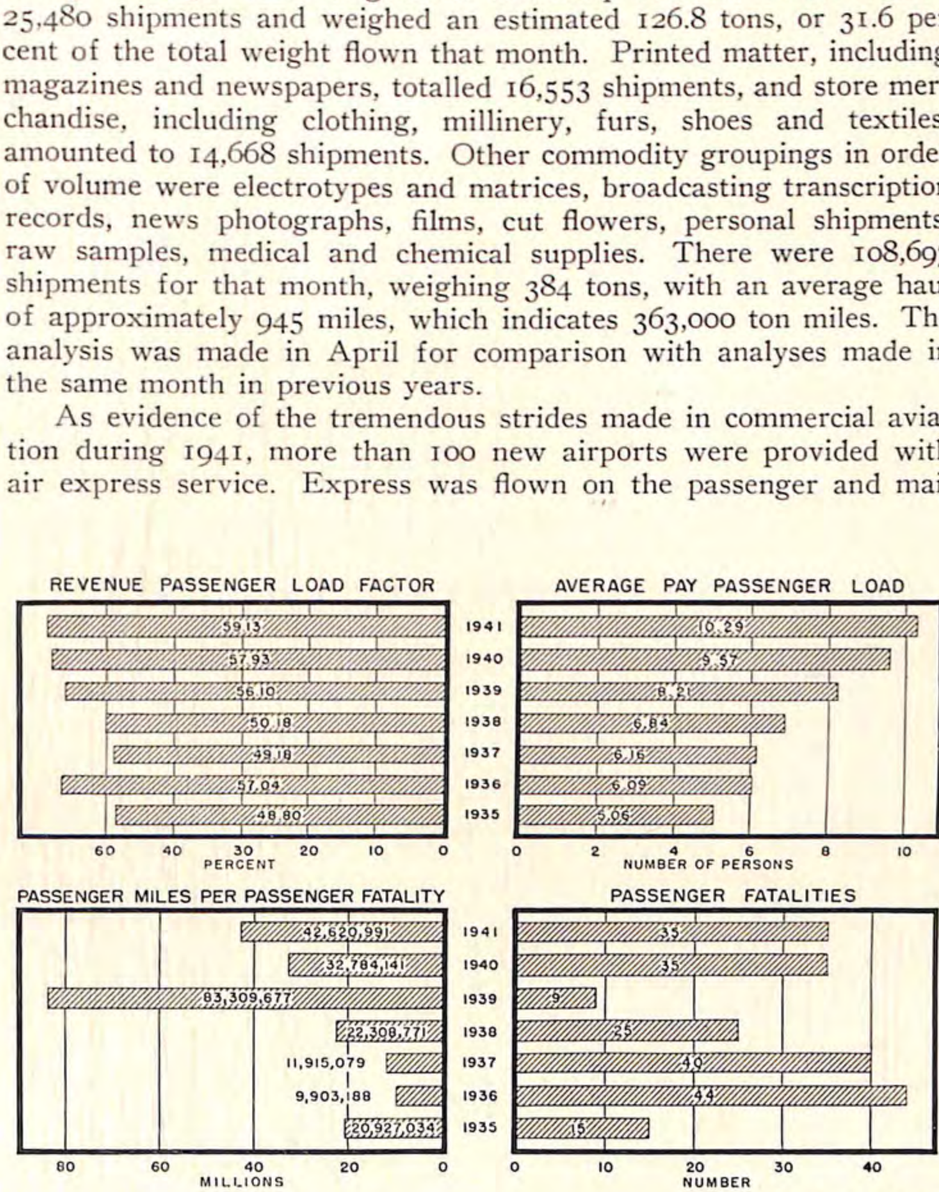
Growth of Air Express

Air express celebrated its 14th anniversary in 1941 by becoming a business of over four million dollars. It aggregated more than 1,311,000 domestic shipments weighing approximately 11,000,000 pounds. Shipments were 21 per cent higher than in 1940. Revenue increased more than 42 per cent. Poundage was up more than 48 per cent. Air-rail shipments, which either start, finish or go part-way by rail, increased 32.4 per cent over 1940. Gross revenue from air-rail shipments gained 56 per cent in 1941. December, 1941, for example, broke all-time monthly records for revenue and shipments. Increased mileage of domestic airways, creation of two new domestic lines and installation of new airports contributed to the growth of the service.

In addition to domestic shipments, there were 143,173 international air express shipments in 1941 as compared to 109,396 in 1940, an increase of 30.8 per cent. Gross revenue was up 56 per cent, largely because of increased business with Latin America and the opening of new services. Air express from the United States reached the European continent for the first time in September, 1941, with service to Lisbon, wartime gateway to the Old World.

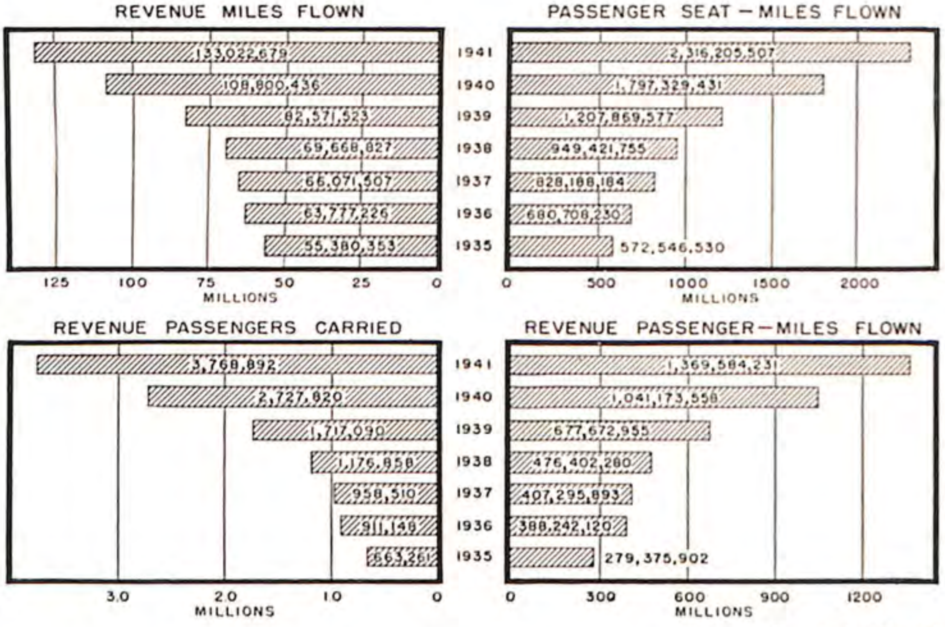
During the month of April, 1941, the Railway Express Agency made a commodity analysis of air express shipments. Heavy industry forwardings, including machinery, aeronautical, automobile, electrical and rubber goods, hardware and implements and oil industry loadings, were the greatest revenue producers. These totalled 25,480 shipments and weighed an estimated 126.8 tons, or 31.6 per cent of the total weight flown that month. Printed matter, including magazines and newspapers, totalled 16,553 shipments, and store merchandise, including clothing, millinery, furs, shoes and textiles, amounted to 14,668 shipments. Other commodity groupings in order of volume were electrotypes and matrices, broadcasting transcription records, news photographs, films, cut flowers, personal shipments, raw samples, medical and chemical supplies. There were 108,697 shipments for that month, weighing 384 tons, with an average haul of approximately 945 miles, which indicates 363,000 ton miles. The analysis was made in April for comparison with analyses made in the same month in previous years.

As evidence of the tremendous strides made in commercial aviation during 1941, more than 100 new airports were provided with air express service. Express was flown on the passenger and mail



C. A. A. Graph

SEVEN YEARS OF DOMESTIC AIR CARRIER PROGRESS



C. A. A. Graph

SEVEN YEARS OF DOMESTIC AIR CARRIER PROGRESS

planes which averaged 325,000 miles daily over 45,000 miles of airways to and from more than 370 airports.

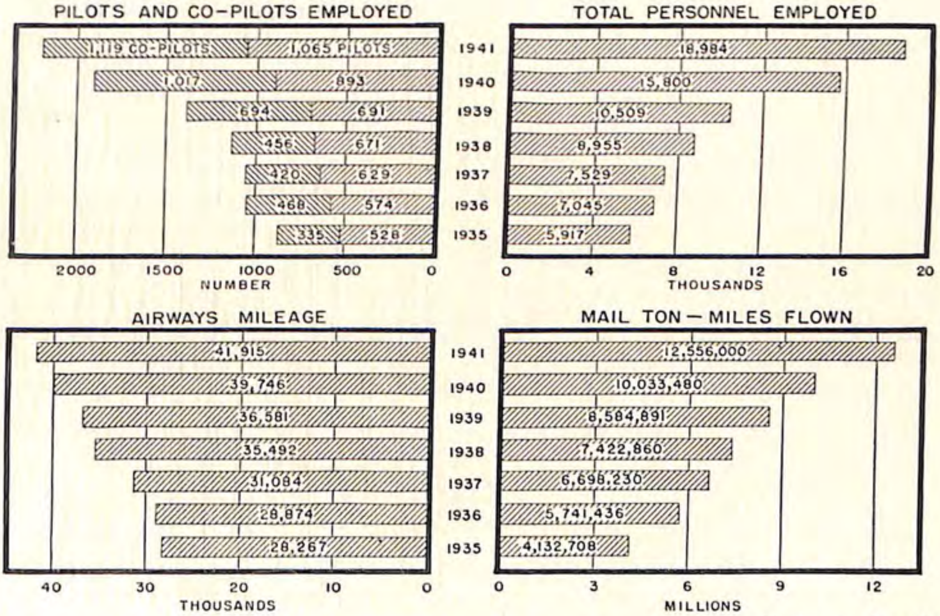
In addition, the Railway Express Agency provided coordination of air-rail service along the 230,000 miles of railway arteries to more than 23,000 offices of the company. About 30 per cent of all air express shipments either start, finish or go part way by rail to expedite movement. Many of the 57,000 express company employees were utilized in the combined services, and 12,000 motor vehicles were available to participate in the pickup and delivery operations and transfer to and from airports to patrons' premises. To facilitate service further, Railway Express had an agreement with Western Union whereby calls to any W. U. office would bring a messenger to pick up light, low-valued air express packages. There was no extra charge for the service.

Air express established more records in 1941. The longest shipment on record, a package of samples, was routed 18,000 miles—three-quarters of the way around the world to Alexandria, Egypt. The package moved by transport and clipper planes on American lines, then was transferred to British Imperial planes to reach its destination.

The importance of air express as a dependable, super-swift means of international transportation was exploited strikingly by Time magazine during 1941. Beginning in May the magazine issued an International Air Express edition for Latin-American countries. Air express delivered the editions to all points in South America within six days—a three weeks saving in time over ordinary means. Magazines reached the news stands in Cuba and New York at the same time.

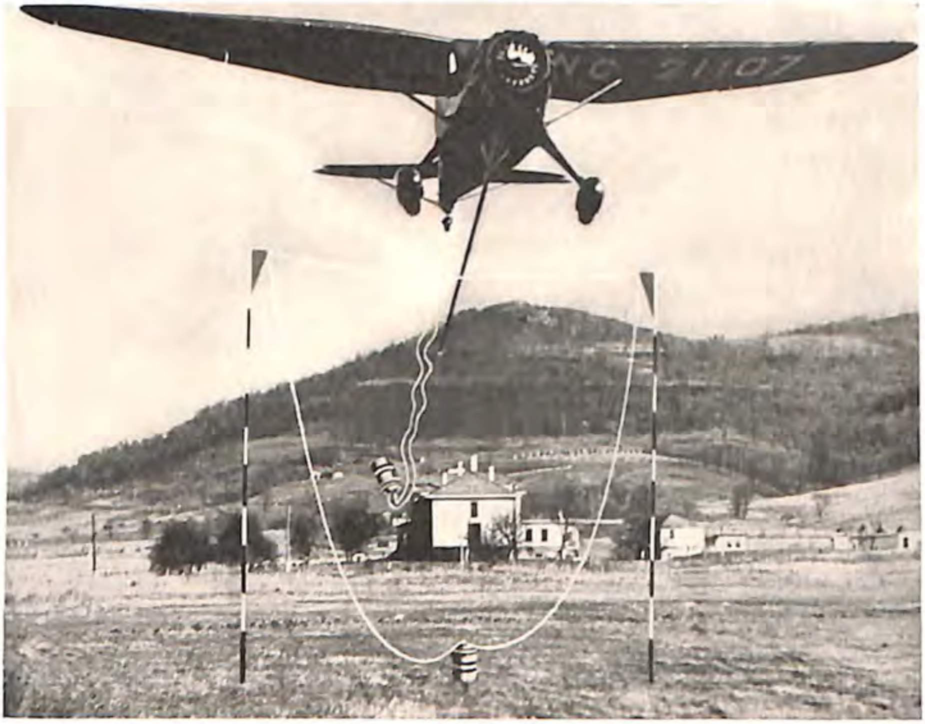
While the bulk of air express business was heavy industry, there were some astounding entries on the waybills. There were porpoise milk and stuffed lizards, bananas and queen bees, mummies and manikins, snowballs and musical cakes. A model of a battleship was flown to the President at Hyde Park, N. Y., cheese from the East Indies went to the exiled Princess Juliana of the Netherlands in Ottowa, and a knitted British flag rode a clipper en route to Queen Elizabeth in London.

Because of fluctuations in air traffic, the Express Agency, with its contract air lines, early in 1942 was experimenting with special rates in an effort to capitalize on unused available capacity. Flow of traffic was appreciably greater from East to West and North to South, and there were four well defined traffic peaks coming approximately in March, June, October and December, with corresponding



C. A. A. Graph

SEVEN YEARS OF DOMESTIC AIR CARRIER PROGRESS



STINSON RELIANT PICK-UP PLANE

Operated by All American Aviation on its air mail pick-up routes.

valleys. Lower commodity rates on newspapers, flowers and fish were initiated to attract more business and balance traffic loads. It permitted Dungeness crabs from Pacific waters to become a Chicago specialty, while California roses were sold in midwestern towns, and New York morning papers were read the same day in Miami.

Air Pick-up Service

Since the transition of the air pick-up service from an experimental operation under the Post Office Department to a permanent operation under the Civil Aeronautics Board, the system by which this unique service is conducted has undergone a complete transformation mechanically. All American Aviation, Inc., operators of the service, reported that the new system greatly simplified the whole air pick-up operation, increased its efficiency and economy and made faster schedules possible. The air pick-up service was in daily operation on five routes operated by All American Aviation, Inc. They radiated from Pittsburgh to 111 cities and towns in six States, Pennsylvania, West Virginia, Kentucky, Delaware, New York, and

Ohio. The total length of the routes was 1,386 miles. The average was 275 miles. Each served about 20 station points between which the average distance was 16 miles, although some were less than 10 miles apart. Service to all points was provided by two flights a day, one in the morning and one in the evening, both being timed to give every community trunkline connections that afforded overnight service to and from every other air line point in the country, thus providing air mail and express service comparable to that received by cities on the trunklines. A fleet of nine planes was employed in the operation, six being in daily use. Each plane was manned by a crew of two—a pilot and a pick-up man. An average of 165 pick-ups and deliveries was made daily.

Communities along the pick-up routes ranged in population from 588 to 120,000. Forty-six station points had no airports. At those places, the air pick-up stations were located on hill-tops, meadows and public parks. A pick-up station could be established wherever the approaches were reasonably free from obstacles for a reasonable distance in opposite directions. Where a town had a suitable airport, the local air pick-up station was usually located on it, which permitted landings for exceptionally heavy loads. Pick-ups were made at intervals of from five to 22 minutes, and schedules were maintained at an average speed of 110 m.p.h. which compares favorably with the time made on some of the shorthaul schedules of the trunklines. Air pick-up lines were strictly "feeder" lines. They functioned in a sphere where an air line could not be operated by conventional methods. Consequently, the service was an adjunct of the main lines, extending the scope of their service and feeding them additional traffic from new and potentially rich territory, which they could not practically or effectively tap with their own service.

In the development of All American's new pick-up system, the three units comprising the system—the mechanism in the airplane,

BEECHCRAFT C-45A PERSONNEL TRANSPORTS
Camouflaged planes at the Beech factory ready for flyaway delivery to the Army Air Forces.

FOR HIGH ALTITUDE BOMBER TEST

Expert pilots and aerodynamics specialists of the Boeing Aircraft Company enter a Flying Fortress for a test flight. They have been using oxygen on the ground in preparation, and inside they will attach their masks to the ship's oxygen supply.

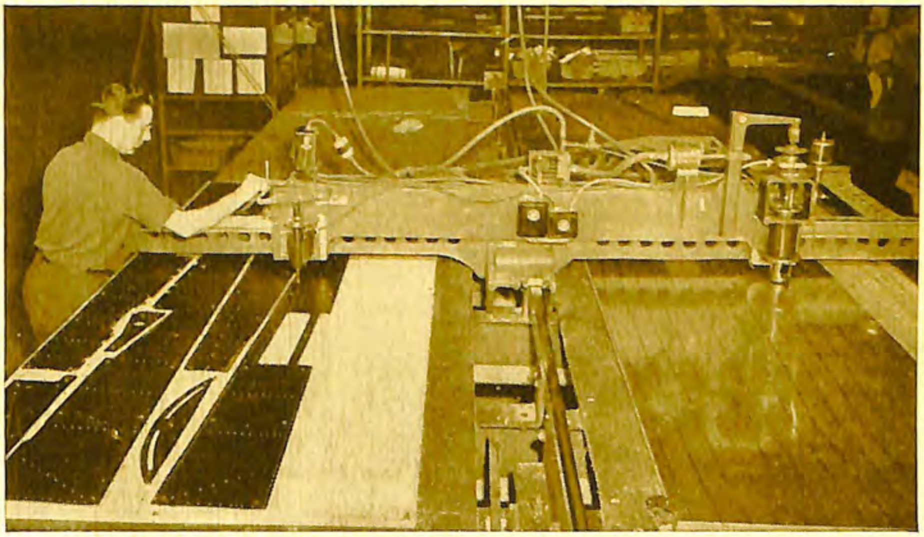
the ground station and the transfer equipment—were entirely changed. The pick-up mechanism in the plane consisted of a winch with an electric drive, a 40-foot rope cable, a 15-foot arm or boom which retracted into the bottom of the ship when not in use, a device for releasing the cargo in making regular deliveries, and parachutes for delivering fragile or unusually heavy articles.

The new ground station was portable. It comprised two sectional poles, which were 20 feet high and were erected 20 feet apart. Each pole had three sections, two of which were aluminum, the third or top part being bamboo. The poles were painted in wide bands of international orange and white to improve visibility. Standard station equipment also included two smudge pots which were lighted when visibility was poor. Pilots found these pots very helpful in locating stations and making contacts in bad weather.

The ground station was erected before each flight simply by putting the poles together and sticking them in their ground sockets. These sockets had lids to protect them from snow, ice and dirt. When dismantled, the station poles, two transfer units, one a spare, and other ground equipment were stored in a weatherproof, locked box on the station site. About three minutes were required to assemble the station for a pick-up, and it could be dismantled and stored in the same time.

The transfer unit by which pick-ups were made and the mail and express transferred from the ground to the plane and vice versa, was a loop of light, strong rope to which the container was attached by a ring in its nose. When the station was rigged for a pick-up the top of the loop was stretched between the tips of the poles with the container resting on the ground.

The flying technique remained essentially the same. In approaching the station for a pick-up and delivery, the pilot leveled off in much the same manner as he would in making a landing, except that his speed was much greater—anywhere between 110 and 130 miles an hour. The pick-up boom was lowered, and the delivery container trailed behind it on its own transfer loop, the air drag preventing fouling. Just before making the pick-up, the pilot



SPEEDING UP PRODUCTION

This is the pantagraph router with which Bell Aircraft Corporation daily turns out thousands of Airacobra parts. On the left a workman may be seen tracing templates. On the right, a cutting tool produces accurate copies of the patterns from sheets of aluminum alloy.

CURTISS C-55 ARMY CARGO TRANSPORT

Numbers of these planes were being built for the U. S. Army Air Forces by the Curtiss-Wright Corporation.

tripped a release and the delivery container dropped to the ground. At almost the same moment, the arm with the pick-up hook resting at the lower end, struck the transfer rope suspended between the two station poles and the rope slid down the arm into the hook, disengaging the hook and pick-up rope from the arm and setting the energy absorbing mechanism on the plane in motion. The winch or drum to which the pick-up rope was attached commenced revolving at high speed, and simultaneously the rope itself paid out rapidly; but this lasted only for a split second, and the action was stopped quickly but smoothly by an automatic control. This operation absorbed the shock of contact to such an extent that it was hardly perceptible.

At the time of contact, the plane was about 30 feet above the ground. After the pick-up was made, the container was automatically pulled into the plane through the hatch in the bottom where it was opened by the pick-up man, the mail sorted and the container prepared for delivery at the next station. This container was built for hard usage. It had a reinforced fibre nose, and a heavy rubber skirt sheathed the canvas bag holding the mail and express. Up to January, 1942, not a single letter had been lost or damaged. The container had a dimensional capacity of 8 by 8 by 17 inches, and the equipment was licensed for a maximum load of 50 pounds for a single pick-up. Heavier loads had been picked up in tests.

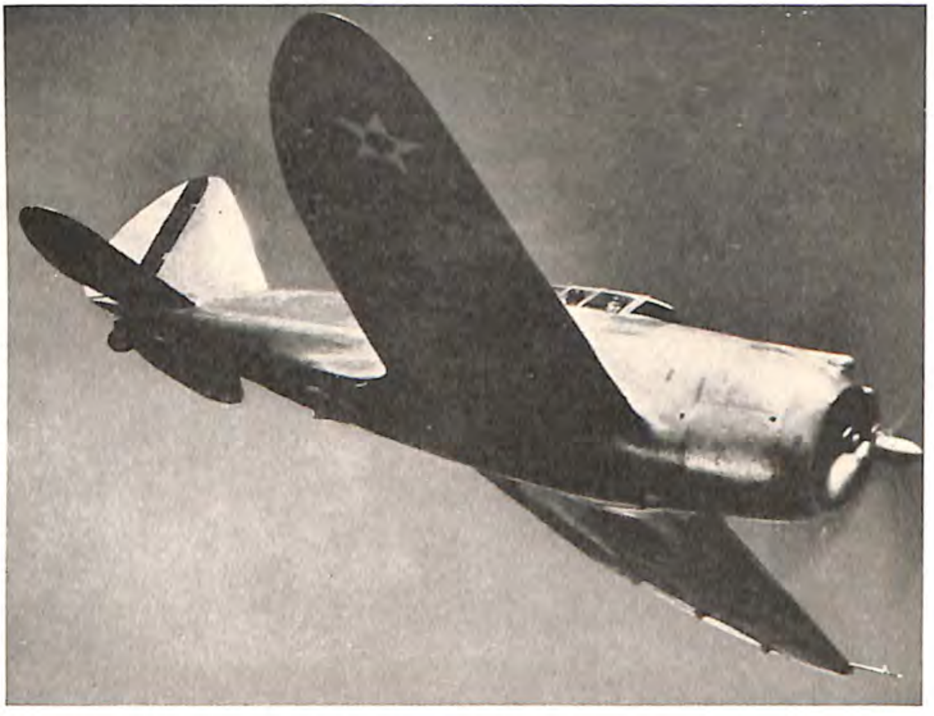
The Post Office Department designed a special pouch expressly for the pick-up service in which the mail for each station was placed and the pouch labeled according to its destination. This greatly simplified the handling of the mail aboard the plane as the pick-up man had only to sort the pouches and not the mail itself. Special messengers were employed to transport the air mail and express between the local Post Office and the air pick-up station.

Report of the Postmaster General

Postmaster General Frank C. Walker in his report for the fiscal year 1941 stated that postal expenditures showed that out of every dollar spent, $.202 went for transportation of the mails, including $.127 for railway transportation, $.024 for domestic air mail and $.02 for foreign air mail.

The report also stated: "At the close of the fiscal year 1941, there were in operation 43,411 miles of domestic air mail routes as compared with 37,943 miles at the close of the previous fiscal year. A total of 74,297,154 miles of service was performed as compared with 59,177,525 miles of service in 1940. The total cost for the fiscal year 1941 was approximately $20,300,000 as compared

BREWSTERS IN JAVA
A squadron of Buffalo fighters at an airport near Batavia.



REPUBLIC LANCER IN FLIGHT

These P-43 interceptors are in Army Air Forces service. They are high altitude planes with 1,200 h.p. Pratt & Whitney Twin Wasp supercharged engines.

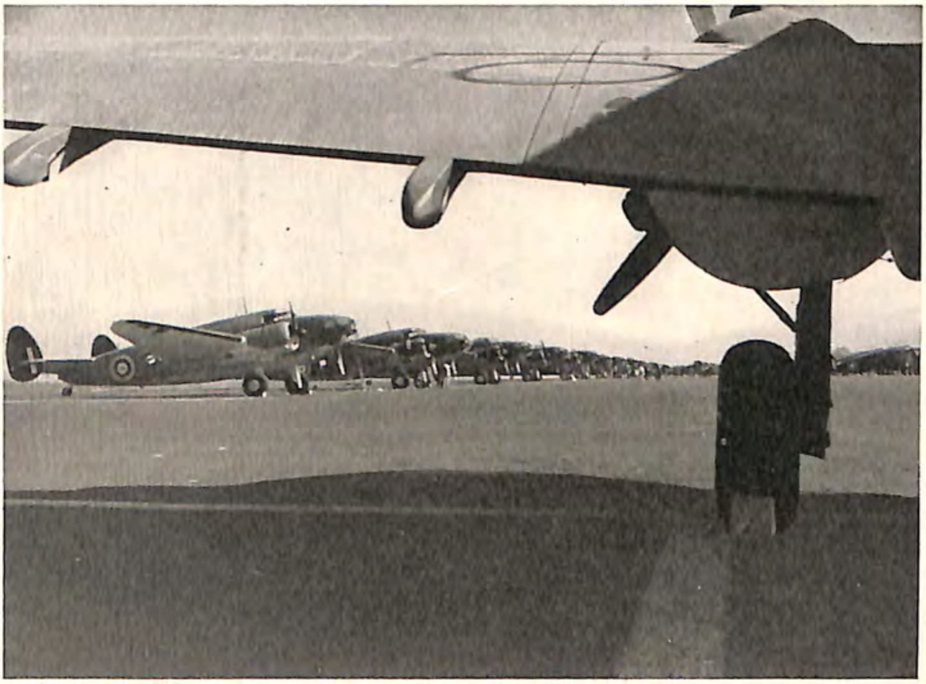
with $18,855,306 for the fiscal year 1940. The growth of the domestic air mail service is reflected in the increase of 19 per cent in the volume of mail transported. Service was established on 13 new domestic routes serving an additional 53 cities with direct air mail supply." (See Appendix for details concerning the operation of the domestic air mail service.)

"The expansion of the war in Europe has resulted in further disruption of the mail service to transatlantic countries by surface transportation. The service to certain ports in Africa, Asia, Australia and New Zealand operated with less frequency and regularity, due largely to the withdrawal of a number of faster steamships serving those countries. There was no change in the frequency or regularity of the service to South Africa and to Central and South America.

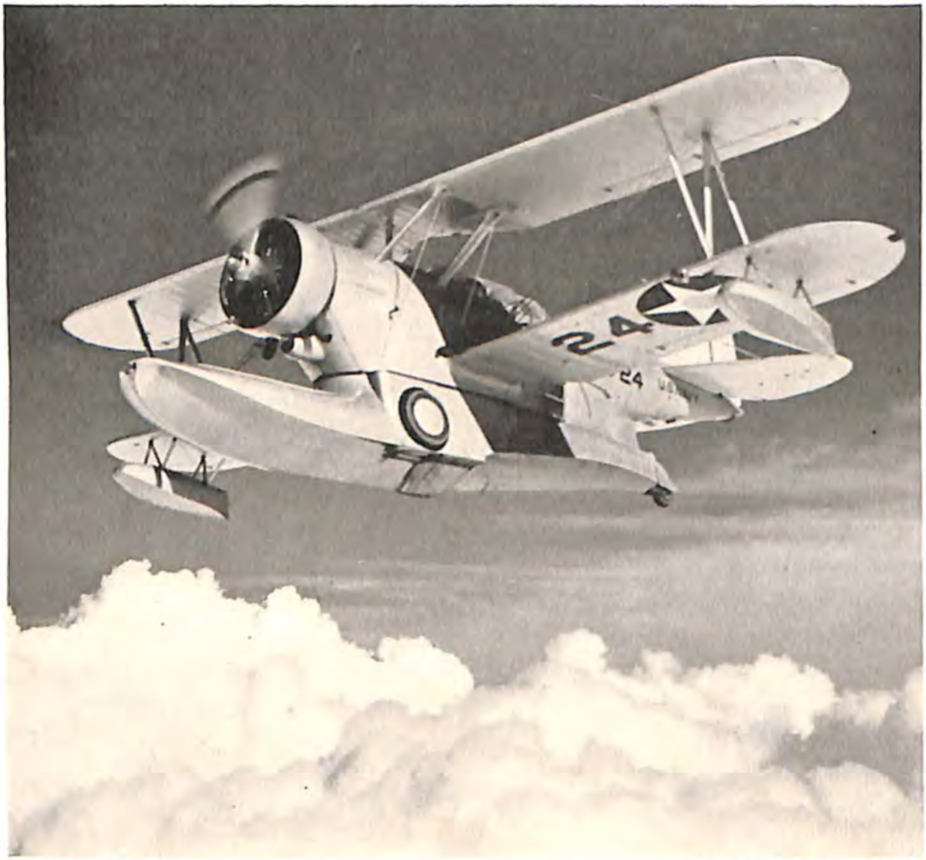
"The foreign air mail service suffered little interruption and, in some cases, was improved by extension of routes or by additional trips. The length of the foreign air mail routes was 49,706 miles at the close of the fiscal year 1941, and the mileage flown on a pay basis was 8,235,585 miles, representing an increase of almost 40 per cent over the previous fiscal year. The air mails dispatched during the year on the foreign routes to Mexico, Central and South America, and the West Indies, increased 32 per cent and the mails received therefrom increased 34 per cent over the weights carried during the previous year." (See Appendix for statement of the mileage and cost of foreign air mail service, appropriations, rates of payments to carriers, service scheduled and performed and volume of mail transported during the fiscal year 1941.)

American Airlines

American Airlines in 1941 continued to make operations records. The 4,000,000th passenger was carried on November 3, marking the first time any air transport company reached that figure. It was noteworthy that 10 years were required to carry the first million, and only 10 months for the fourth million. The routes of American Airlines touched at many of the most important centers of defense



LOCKHEED HUDSONS ON THE LINE
Ready for flyaway delivery to the British R. A. F.



U. S. Navy photo

GRUMMAN J2F-2 IN FLIGHT

One of the utility planes with the Navy air forces.

industries and a large part of the increases in passenger, mail and express traffic could be traced to the speed-up in businesses connected with defense. All possible service was given to industrial cities, and especially to the nation's capital. The completion of the new Washington National Airport greatly facilitated handling the tremendous number of passengers arriving and departing on Government business. New schedules were added on all routes into Washington, from New York, Chicago and Los Angeles.

Service was started, or reinstated after airport improvements, at five cities in this country and two in Canada. In the fall of 1941, schedules were set up for New Haven, Bridgeport, Roanoke, and Niagara Falls, and earlier in the year the Flagships made their first landings at Toronto and Windsor, Ont., Canada. Baltimore also opened a new and larger field with more daily trips. The Chicago airport was considerably enlarged and double runways put in commission. The New York to Boston and the transcontinental routes had more trips added. American Airlines at the beginning of 1942 operated 25 flights daily each way between New York and Boston, and there were six trips each way between New York and Los Angeles.

Traffic increased steadily. In 1941 American Airlines carried 1,202,816 revenue passengers, an increase of 38.1 per cent over 1940. The passenger mile figure came to 409,400,652 for an increase of 40.6 per cent over 1940. The load factor also increased, reaching 69.4 per cent, indicating that more efficient use was made of equipment on hand.

Industrial activity also was reflected in the tremendous increase of 40.6 per cent in air express pound miles flown. Fairly large shipments were carried, most of them having some connection with the defense effort. In many cases long production delays were avoided by rapid air delivery of vital replacement parts.

Throughout the system, travel was fairly heavy on week ends and holidays, but passenger traffic became predominantly business,

WASPS, TWIN WASPS AND DOUBLE WASPS

Pratt & Whitney engines on the assembly floor; Double Wasps at the right, Wasps in single line at left and Twin Wasps at rear of the line.

NORTH AMERICAN B-25 BOMBER

It is powered by two 1,600 h.p. Wright Cyclone engines.

Government and military, with speed in transportation rapidly becoming more important to the defense effort toward the end of the year.

As the defense effort curtailed the acquisition of the normal amount of new transport equipment, the American Airlines maintenance departments employed many more mechanics, undertook to train more men in the company's apprentice school, and revised the overhaul procedures so that no ships were out of service on week ends when they were needed most. One ship went into the shop every day for a 24-hour service with engine change. Each week two ships were in for three days each—servicing that took place after each 3,500 hours of flight time. Each week one ship was in for a complete six day overhaul. Besides allowing better use of equipment by avoiding the previous three week overhaul period, this plan also aided in keeping up good maintenance by more frequent work on each airplane.

The development program of the company during 1941 was mostly toward improvement and refinement rather than expansion. No new types of equipment were added, but many improvements in the Douglas DC-3 transports on hand were tested and adopted.

The most important improvements included the development and adoption of automatic windshield wipers, and the installation on all ships of the Sperry automatic visual direction finder. Flight tests were made toward standardization of fuels, and improvement of engine lubrication was studied and put into practice. An improved technique in the dynamic balancing of propellers was adopted. Many other projects were under way.

Expansion was chiefly in the direction of plant improvement. Several new stations were opened, and some construction was required at each of them, and at other stations the increase in passenger traffic required increased facilities. It was possible to keep an adequate stock of materials for maintenance. The air transport industry was awarded an A-3 priority rating for materials vital to safe and efficient operation, and the purchasing department exercised this right upon occasion.

Considerable progress was made in communications. More tests were made in ultra high frequency radio, and service tests were conducted on the new Sperry Flight-ray equipment. Radio messages totaled 1,443,648. The private line teletype messages increased to 4,683,071—a 43 per cent rise over 1940. Between airplanes and ground stations, 99.82 per cent of the radio contacts were completed, evidence of reliability of equipment and the conquest of static.

American Airlines on April 22, 1941, received the National Safety Council's special award for having operated a billion passenger miles without fatality or serious injury to any passenger or crew member.

American Export Airlines

On February 10, 1942, the Civil Aeronautics Board issued to American Export Airlines a certificate, signed by President Roosevelt, authorizing passenger, mail and express air service between New York and Foynes, Eire. This certificate, permitting operation of a non-stop service between the two terminals, was deemed necessary to the best interest of national defense, and was conceived as a much

THE REARWIN 8135T

VOUGHT-SIKORSKY FLYING BOAT

The VS-44A "Excalibur" for American Export Airlines, powered by four Pratt & Whitney Twin Wasp engines and Hamilton Standard Hydromatic propellers. It carried a crew of 11, 16 overnight passengers and cargo of mail and express.

needed supply and communications line between the United States and American forces overseas. The certificate permitted American Export Airlines to make intermediate stops for refueling, and other emergency purposes, at Bermuda, Horta, in the Azores, and Lisbon, Portugal.

Equipment for the service was to be the giant, four-engine Flying Aces, built by Vought-Sikorsky. The Flying Ace "Excalibur," first unit of this fleet, was christened January 17 at Stratford, Conn. The day after its maiden flight it was flown south to undergo test flights. On its long non-stop test run to the south, and in shorter routine flights, the "Excalibur" demonstrated the outstanding performance characteristics included in the builder's guarantee. Test engineers reported that it had exceeded the builder's estimates, with respect to speed, water characteristics, ease of handling, maneuverability in the air and in other particulars.

Two additional sister ships were nearing completion early in 1942, and all three aircraft were scheduled for service in a few months.

Early in 1941, American Export Airlines signed a long-term lease with the City of New York for a transatlantic operating base, consisting of a giant hangar and offices at LaGuardia Field, New York. This base, scheduled for completion during the Spring, 1942, was equipped with all necessary facilities for handling maintenance, repairs and operations. American Export Airlines had spent five years building an extensive organization preparatory to operating transatlantic service. In addition to the flying personnel, the company organization included an executive staff, operations staff, maintenance crews, communications and meteorological staffs and technicians for both foreign and domestic operations.

In 1939 the company ran a series of round-trip survey flights between New York and Europe, covering the northern, southern, and combination routes. The twin-engine Consolidated PBY flying boat employed in these surveys, was used by American Export Airlines to make numerous additional survey flights, and to train its crew.

In October, 1940, the meteorological division of American Export Airlines, placed meteorologists aboard each of the American Export Lines "Four Ace" passenger steamships operating in transatlantic service between New York and Lisbon. American Export Lines was the parent company of American Export Airlines.

Delta Air Lines

Delta Air Lines, which had been serving the South for 17 years, early in 1941 acquired a fleet of new Douglas DC-3 transports, replacing the DC-2 model. Two new routes were opened, the Atlanta, Ga.—Knoxville, Tenn.—Cincinnati, O., route and that between Atlanta, Augusta and Savannah.

The headquarters of Delta were shifted from Monroe, La., to Atlanta on March 1, with the completion of a combined general office building and maintenance shops at the Atlanta Municipal Air-

U. S. Navy photo

VOUGHT-SIKORSKY NAVY SCOUT BOMBER

The SB2U-3 with Edo floats.

CONSOLIDATED PBY-5 CATALINA

One of the great armadas of patrol boats in U. S. Navy and British war service.

port. At the beginning of the year applications for several new routes were pending with the Civil Aeronautics Board.

Early in 1942 Delta started hiring women, where feasible, to fill vacancies created by the induction of personnel into the armed services. Several training classes were conducted for the new women employes, who were engaged for vacancies in the traffic, reservations, and operations departments throughout the system, in some instances taking over positions theretofore held only by men.

Eastern Air Lines

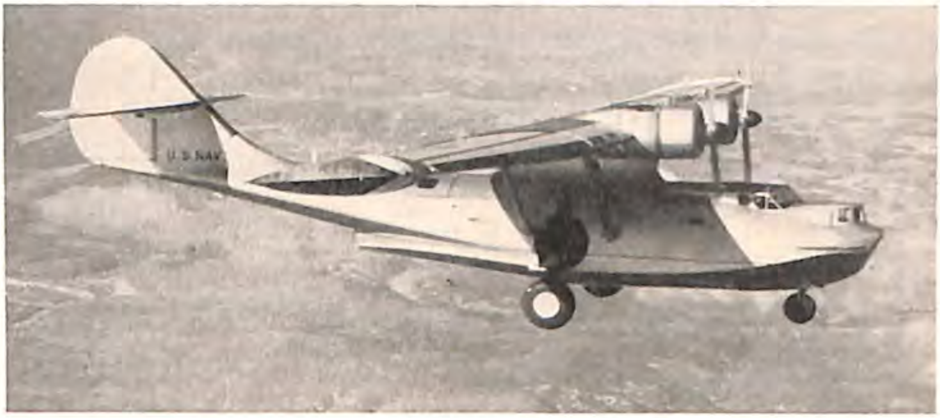
In 1941, Eastern Air Lines extended its route mileage from 5,649 to 5,971, an increase of six per cent. On March 1, the company inaugurated service to Brunswick, Ga., (Sea Island) on its New York-Miami run. On May 10, direct air passenger service was inaugurated between Louisville, Ky., Evansville, Ind., and St. Louis, Mo. Significance of the new service: Evansville received two flights daily to St. Louis; one direct flight to Louisville, Indianapolis and Chicago. For the first time Chicago, Indianapolis and Louisville were connected by direct air service with Evansville, an important manufacturing city. Eastern Air Lines on October 31, was awarded a contract to serve Atlantic City, as an additional stop between New York and Washington. At the end of the year, Eastern Air Lines' equipment included 35 Douglas DC-3 21-passenger transports, five Douglas sleepers and three Stinson Reliant pilot instrument training planes, a total of 43 in all. The company was officially granted 11 new Douglas DC-3 transports to be delivered during 1942.

At the beginning of 1942, Eastern Air Lines personnel totaled 2,280, a 17 per cent increase over the previous year, when 1,946 employes were listed. The payroll for the year 1941 totaled $4,731,652.06. This represented a 21 per cent increase over the previous year's figure of $3,916,968.76. Growth in the four classifications of Eastern Air Lines personnel during 1941 were: maintenance, from 603 to 653, an eight per cent increase; operations, from 544 to 690, an increase of 27 per cent; executive, from 74 to 84, an increase of 14 per cent and traffic, from 332 to 401, a 21 per cent increase. An estimated 482,000 revenue passengers were carried during the 12 months of 1941. It represented an estimated increase of 39 per cent over the 346,593 revenue passengers carried during 1940. During the year of 1941, an estimated $11,000,000 passenger revenue was earned. It represented an estimated 31 per cent increase over the 1940 figure of $8,371,485 passenger revenue.

Hawaiian Airlines

Hawaiian Airlines, Ltd., formerly Inter-Island Airways, began its 13th year of operations on November 11, 1941, by adding three 24-passenger Douglas DC-3 transports to its fleet of 16-passenger Sikorsky amphibions, marking the first time land planes were used

LOCKHEED COMMERCIAL TRANSPORT
One of the Lodestars in service on National Airlines.



CONSOLIDATED AMPHIBION PATROL BOAT

It has wing tip floats and a three-wheel landing gear.

by the company on its routes, which were practically all over water. Since the service started between the islands of the Hawaiian group, 250,000 passengers were carried without accident. The planes flew in excess of 33,000,000 overwater passenger miles.

Six months prior to addition of the DC-3s, schedules were doubled, each of the six major islands of the archipelago being served by at least two flights daily. The Sikorsky S-43 amphibions were used on the shorter runs, with the Douglas DC-3 planes scheduled over the longer, heavier traffic route southward from Honolulu to the islands of Maui and Hawaii, a distance of 229 miles.

Traffic showed a substantial increase during 1941 when approximately 45,000 passengers were carried, as compared to 28,000 in 1940. Increased schedules and tremendous national defense construction throughout the Islands were partially responsible for the increase.

All commercial airports throughout the Territory were being improved and enlarged under CAA specifications, with work proceeding under double shifts. The great Keehei international sea and land plane base on the outskirts of Honolulu was under construction, with dredging practically completed. Air service to the western coast of Hawaii Island was anticipated in 1942, as construction was ready to start on a new airport at Kailua. New terminal buildings were to be opened by Hawaiian Airlines early in 1942 at Hilo, Molokai, Lanai, Upolu Point and Port Allen, with new radio equipment to be installed by June.

Operation of America's most westerly domestic air mail line differed from that of most mainland air services. Although all scheduled stops were on land bases, most of the flying was over-water, 235 miles to the southeast via the islands of Lanai, Molokai, Maui and Hawaii, and 135 miles northwestward to the island of Kauai.

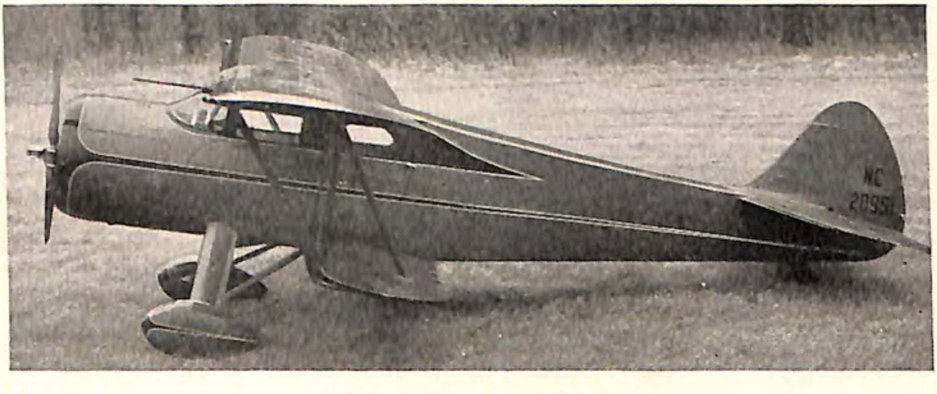
Mid-Continent Airlines

During the summer of 1941, two additional Lockheed Lodestars were added to the Mid-Continent fleet of aircraft. A rise in the demand for service necessitated the addition of several more flights daily between the major cities on Mid-Continent's system, and more comfortable and convenient service was accorded the air traveling public.

At Minneapolis a new hangar and shops building was completed, to serve as the main overhaul and maintenance base.

During 1941 the company launched another route expansion program and made application with the Civil Aeronautics Board for three major routes, designed to give direct service between Canada and the Gulf.

Mid-Continent filed applications with the CAB in November for eight pick-up and feeder routes, which would serve over 150 smaller communities in Oklahoma, Kansas, Missouri, Nebraska, Iowa, South Dakota and Minnesota, serving as feeders for the present trunk-line systems operating in the Great Plains area. Under that type of service, no passengers would be carried, and the planes in making their pick-ups would do so without landing. Specially designed equipment would be used to bring the mail and express from the ground into the aircraft. If granted, these routes would



THE WACO MODEL E

A private owner plane available with five different engines. The Waco is manufactured by Waco Aircraft Company, Troy, O.

THE BOEING 314 CLIPPER

These 42-ton all metal flying boats, were operated over both the Atlantic and Pacific oceans by Pan American Airways in 1941.

cover 4,302 miles, and the routes would be traveled each day. Although no definite type of aircraft has been designated for use on such routes, it was thought that smaller aircraft than transports would be used. The planes would be able to carry a substantial payload, however. According to priorities allocations, Mid-Continent was to receive seven new airplanes in 1942. Contracts with Lockheed Aircraft Corporation called for seven Lodestars.

Pan American Airways

Eclipsing all previous years in its 14 years of existence in the matter of expanding, developing and maintaining American flag routes in the international air transport field, Pan American Airways in 1941 expanded its route mileage from 69,464 to 88,478 miles. Chief expansion in this record development was the establishment of a new intercontinental route from the United States to Africa by way of South America, incorporating regular air line operations across the South Atlantic, long the exclusive operating stronghold of European air lines; establishment of a new direct air link between the United States and Singapore and the placing in service of a new transcontinental air line across South America comparable in length to the longest transcontinental domestic air line in the United States. All that was achieved in the 341 days of peace in 1941.

In the 24 days of war of that year, America's international air transport system, represented by Pan American Airways, began to prove on a hitherto undreamed of scale the value of its construction and building, began to write a history of performance and service which could not be fully told, for military reasons, until the world was again at peace. One such performance, however, typically significant and formally passed by the censor was termed the outstanding airplane flight of the year. This was the routine transfer immediately after the start of war in the Pacific of the Pacific Clipper from Pan American's Pacific Division to the company's Atlantic Division, a 24,686-mile flight, from Auckland, N. Z., around the world to LaGuardia Field, New York.

In the 1941 days of war and peace combined, the planes of the Pan American Airways System flew 231,100,000 passenger miles and carried approximately 375,000 passengers on its regularly maintained, regularly operated 88,478 miles of international airways serving 62 countries and colonies of the world.

The annual report of the CAB stressed the increasing importance of American flag planes in international air transport, pointing out that the European war had demonstrated the indispensability of Pan American services as a medium of communication between nations. The report stated that while surface transport overseas was sharply curtailed, international air service of the United States met the demand for essential travel and mail between the continents. "Most important," the report stated, "has been operations of the U. S. flag services into Latin America, which proved a continuing expression of the good neighbor policy."

In 1941 Pan American Airways provided for the first time twice

PAN AMERICAN CLIPPERS

Three Boeing flying boats in Pan American's Atlantic service in port at Horta, Azores.

daily air service from its aerial gateway at Brownsville, Tex., to and through Mexico City to the Canal Zone and daily service to the same and other Latin American points from Los Angeles, Laredo on the Texas border, and Miami.

Only in the smallest measure did the battle of the Atlantic, resulting from the European conflict, affect the transatlantic operations of Pan American. The most important effect was the abandonment as a result of the passage of the Neutrality Act in the early stages of the war, of Foynes, Ireland, as a transatlantic Clipper terminal. At the year's close, immediately after Congress had amended that Act, Pan American applied for and received authority to resume using Foynes as a transatlantic terminal.

The following table shows the growth of the Pan American Airways System in 1941:

	Jan. 1, 1941	Jan. 1, 1942
Total Miles of Routes	69,464	88,478
Countries and Colonies Served	53	62
Aircraft in Operation	144	162
Passengers Carried (12 mos.)	1,621,000	1,995,000
Passenger Miles Flown (12 mos.)	663,900,000	895,000,000
Employees	6,500	8,750

A week after the United States entered the war, the Atlantic Clipper, "routine and on schedule," settled on the waters of New York's Bowery Bay and taxied to Pan American's marine base at LaGuardia Field to complete the 500th crossing of the Atlantic Ocean by Pan American Airways since service was inaugurated in May, 1939. Of those 500 crossings, 472 had been made on the New York-Lisbon run, 26 on the New York-Foynes, Ireland run, two on the New York-Leopoldville, Belgian Congo, route.

Statistically, the year had been phenomenal. Passenger miles flown, the most indicative air line figure, jumped from 13,000,000 in 1940 to 23,600,000 in 1941, an 80 per cent increase. Miles flown by the giant Clippers of the Atlantic fleet had risen to 1,200,000 from 500,000 in 1940. And passengers carried on all transatlantic routes during the year totaled some 10,000. Phenomenal, too, were the figures on the operations side of the ledger. New routes, new services, had upped operating route mileage a full 360 per cent from 3,890 to 17,961.

The first new route placed in operation in 1941 was the westbound Clipper course inaugurated in February. Flight experience gained through the first winter of transatlantic flying had shown that head winds as high as 50 m.p.h. were prevalent over the westbound course from Lisbon and Horta in the Azores to Bermuda.

These winds caused numerous delays, required the Clippers to carry a larger load of fuel, and thus sacrificed much of the payload ordinarily available in the milder summer months. To circumvent these head winds, a new route was charted across the South Atlantic via Bolama, Africa, and Natal, Brazil. This four-continent air line closely followed the track of the old-time sailing Clippers and took advantage of steady, year-round prevailing winds. Success of the four-continent course was borne out by the statistical summary of the three months it operated. The route was suspended on May 1 with the return of normal summer conditions over the more direct northern route. Transatlantic passengers carried in both directions totaled 471 compared with 286 in the corresponding 1940 period, or an increase of 64.3 per cent. Passenger miles (3,500,000) were up 199 per cent, mail loads up 111 per cent, from 1940 figures.

With the return to the direct New York-Lisbon route for the summer season, the transatlantic service settled down to normal operations—if operating an air line across the world's major trade route in time of international strife can be called normal. The second anniversary of transatlantic air mail service was observed on May 20, 1941.

Intensive schedules maintained during the spring and early summer months began to loosen the passenger "bottleneck" at Lisbon which had existed almost since the start of hostilities in 1939. Droves of refugees, government and other officials on their way to the United States, had been jamming existing steamship facilities and had placed a tremendous burden on the transatlantic Clipper fleet. But marked regularity of flight operations, together with ever-tightening government restrictions, did much to reduce the backlog of travelers.

Then, on September 28, with cargo space at last available, the Dixie Clipper, veteran of many a "first," added another to her log by carrying the first load of transatlantic air express from the United States to Europe. Among the items in the initial cargo: a knitted Afghan consigned to Queen Elizabeth; a batch of clippings and photographs; various parcels containing chocolate, cigarettes, flashlights, many another hard-to-get-in-England trinket. Thereafter, regular shipments contained scores of varied items, chiefly medicinal supplies, clothing, films and foodstuffs.

Biggest transatlantic news of the year was President Roosevelt's announcement on August 18, just after his historic meeting at sea with Prime Minister Churchill, that Pan American Airways would shortly undertake a new defensive mission, would establish between the United States and Africa a new line of communication to sup-

A BOEING STRATO-CLIPPER

Four-engine land transports with an altitude-conditioning system. This automatic cabin-supercharging system maintains comfortable low-altitude atmospheric conditions for passengers and crew during upper level flights of 14,000 to 20,000 feet.

plement an air ferry service between the two continents also to be Pan American-operated. Less than three months later, months that represented years of work in previous development of transoceanic lines of similar length and magnitude, the new service was ready.

Base facilities had been arranged for and installed, including Pan American's long-range radio direction finders and station-to-station facilities for 24-hour communication between the giant Clippers and ground bases along the route. Hundreds of new personnel had been hired, taught and carried to distant new ports of call. New fuel supplies and spare part stocks had been set up, and many another complicated problem tackled and overcome.

On November 10, after the 9,000-mile air track was ready, the Capetown Clipper, latest in the series of 42½-ton Boeing 314A flying boats left LaGuardia Field, N. Y., on the first leg of a 20,139-mile route-proving flight, and finally landed at Leopoldville, Belgian Congo, on November 16. Aboard were three CAA observers, transatlantic Manager John C. Leslie, 16 pilots bound for Africa to fly the routes of Pan American Airways—Africa, Ltd. After two weeks of flying (a route-proving flight adheres to no set schedule), the Capetown Clipper's glistening hull again touched home waters, and landed at LaGuardia Field, on November 26.

Then on December 6, the same Clipper, with a load of philatelic and other contract mail tucked away in her hold, company personnel and government passengers on board, inaugurated the first American-flag air mail service between the United States and Africa. Thus, for a country which the very next day was plunged into war, was established still another vital defense line for mail and express.

Though the last three weeks of 1941 had suddenly overshadowed Pan American's Western Hemisphere operations during the preceding 49 weeks of peace, year-end figures showed that the year would go down as by far the greatest of the 14 in the company's history. Each of the four areas of Pan American's services to Central and South America had turned up one remarkable increase after another, and had reached a crescendo in the very week that war burst upon the Americas.

On the front line of America's eastern defenses, the Pan American operations out of Miami were largely devoted to increasing co-operation with the military forces and governments of countries engaged in building up those defenses. While no new routes were established, the operations department, in spite of the difficulties of obtaining additional flight equipment, increased frequencies and shortened flight times so that miles flown went up 40 per cent from 4,019,074 to 5,815,000, while passengers carried increased 20 per cent from 89,650 to 107,580. The relatively small increase in passenger traffic was largely explained by the 63 per cent increase in express from 579,000 pounds to 950,000 pounds. Major part of this express movement represented material, spare parts and other equipment necessary to the development of Caribbean defense bases.

Services on all routes had increased, in some cases by 100 per cent or more. Into and out of Miami, first schedule to be increased was the trans-Gulf Miami-Merida run which was raised from a once-a-week to a thrice-weekly basis, with new Douglas DC3A transports replacing twin-motored flying boats. This shift to land planes was continued when at mid-year the DC3A started flying between Miami and Nassau, giving the Bahamas the best summer service in history—five round trips a week.

Schedules serving Puerto Rico, Trinidad and the east coast of South America were adjusted several times during the year, and at the close, totaled eight trips in each direction between Miami and San Juan. Service to the islands between Puerto Rico and Trinidad—Virgin Islands, Antigua, Martinique, Guadaloupe—had been doubled. Weekly round trips from Miami to the north coast of South America were increased from two to three between Miami and Barranquilla, Columbia, from one to two between Miami and Maracaibo, Venezuela.

Along the east coast of South America the vital hemisphere communications trunk route had four flights weekly in each direction, three between Trinidad and Rio de Janeiro by way of Belem and Barreiras, the fourth serving the Guianas and Brazil's coastal cities. Below Rio three weekly schedules connected with Buenos Aires by way of Porto Alegre and a fourth by way of Sao Paulo and Asuncion.

Pan American's trunkline operations from the Texas border through Mexico, Central America, Panama and along the north coast of South America to Trinidad concentrated during 1941 on a vast modernization of ground equipment. Thus this sector was ready for the almost instantaneous use of its facilities by the United States Army in the emergency following December 7. But operating statistics indicated that this area also enjoyed a boom in its normal operations.

On March 1, the Brownsville-Guatemala-Canal Zone-Trinidad trunkline was placed on a daily basis. In December, the second daily Brownsville-Mexico City service was extended, providing two flights daily all the way from the Texas border to the Canal Zone. Also the Miami-Barranquilla run had its services increased from twice to thrice weekly, and, with Venezuela's oil-producing areas booming, the Maracaibo-Haiti-Miami weekly service was doubled.

On the Coastal-Caribbean routes, miles flown during the year rose from 2,400,700 to 3,275,000, up 35 per cent, while passenger traffic increased 20 per cent from 40,000 to 48,000, and express more than doubled, 52 per cent from 498,000 to 756,000 pounds.

Pan American's wholly-owned nationalized subsidiary CMA (Compania Mexicana de Aviacion) had an equally remarkable year. In February, Douglas DC-3 planes were first placed on the Mexico City-Merida run, and shortly thereafter service on this route went from a weekly to a thrice weekly basis, with direct connections to Havana and Miami. In September, daily service was opened on a new 470-mile line running north from Mexico City to Monterey. In December, this line was extended to Nuevo Laredo on the Texas border, thus establishing a new port of entry into the United States.

At the beginning of 1942, preliminary studies were under way on an extension south of Mexico City via Oxaca and other intermediate points to Tapachula on the Guatemalan border. Meanwhile, service from Mexico City to Los Angeles, Calif., previously thrice weekly, was placed on a daily basis.

Development of Panagra's routes on the west coast of South America took on a comet-like tempo in 1941. Late in 1940, preliminary development of Ecuador's domestic air service together with the fourth weekly schedule extension from the Canal Zone to Guayaquil, Ecuador, had prepared the way for a 1941 mileage increase of approximately 50 per cent. As a result of its new trans-Bolivian services, Panagra helped establish an all-American transcontinental route from Arica, Chile, to Rio de Janeiro (via Panair do Brasil), and through Asuncion, Paraguay, to Buenos Aires, Argentina (via the "River Plate diagonal"). In December, after a fourth weekly schedule had been extended through to Buenos Aires, the spectacular trans-Andean Santiago-Buenos Aires route was put on a daily basis.

Statistics of Panagra's 1941 operations showed these increases in route mileage and frequencies over 1940:

Revenue miles flown—from 1,530,000 to 2,267,000 (48 per cent).

Mail carried (U.S. and Foreign)—from 112,000 to 157,500 pounds (40 per cent).

Revenue passengers carried—from 14,660 to 29,600 (102 per cent).

Express pounds carried—from 170,000 to 466,000 (170 per cent).

But figures alone do not reveal the commercial and political value of Panagra's operations in 1941. In the interest of greater hemisphere commercial development, Panagra early had recognized the vital importance of its services to defense and had cooperated steadily with local government efforts to eliminate the Nazi control of South American air transport. On its own, Panagra anticipated with new frequencies and schedules the necessity of maintaining uninterrupted, ever-increasing communication between the Americas. Cooperating with United States agencies, Panagra contributed both equipment and personnel, training and operation, to the rapid development of all-American air service in its territory. Result: during 1941 some 6,600 miles of air lines were freed from German control and replaced by American operated air lines.

Pan American's nationalized operating subsidiary in Brazil, Panair do Brasil, concentrated during 1941 on President Vargas' program to open up, through aviation, his country's vast interior States. Thus Panair in December could point to four new routes which together had increased the company's mileage by 3,515 and brought the year end total to 9,382 route miles.

With the new route to Goyania, Panair's domestic network reached all but two of the capitals of Brazil's 20 States. Late in

TWIN WASPS AFTER OVERHAUL

At United Air Lines base in Cheyenne, Wyo., these Pratt & Whitney Twin Wasp engines are overhauled after every 700 hours of flying.

December, one of those capitals (Cuyaba in Matto Grosso) was about to receive weekly service from Corumba. And early in 1942, Panair was waiting for permission from Brazil's CAB to open routes in northeastern States of the republic which would include the last remaining State capital (Terezina in Piaui), adding some 2,500 miles to Panair's network.

In 11 months and six days of peace, Pan American's Pacific operation achieved new highs in all departments and carried more mail, passengers, and express than ever before. The year was ushered in by the "diaper schedules," occasioned by Navy orders that wives and children return from the Far East to the United States. For weeks every incoming Clipper brought children. On some schedules the youngsters outnumbered the adults, and inevitably proved to be excellent travelers.

The year furnished countless new examples of the speed and convenience offered for certain types of cargo shipped by transpacific Clipper. Surveying the air express business, Pan American found that in the transpacific service Clippers averaged 300 individual shipments per trip, flew some 12,000 ton-miles of air freight weekly. Shipments of gold from New Zealand became routine items in the manifests—gold bullion being a "natural" for air express because of its value and relatively small bulk and weight.

During 1941, the volume of transpacific Clipper-borne mail grew until normal loads were in the neighborhood of 1,500 pounds, with peaks running up to 3,000 pounds per departure. After the initial 1935 transpacific mail load of 1,837 pounds, mail volume had dropped off to a few hundred pounds per departure.

Prior to August 10, 1941, the mainland-Hawaii sector of the transpacific operation was a bottleneck. Longest (2,402 miles) flight in the service, it was over the route with highest traffic potential. Since the longer the flight, the more the fuel load and the less the revenue load, the U. S.-Hawaii sector required sea-air combinations (steamer to Honolulu, air beyond), to meet traffic demands.

With delivery of new equipment by the Boeing Aircraft Company it became possible to offer additional service on this part of the ocean. In order to make the most use of available equipment and serve traffic needs to utmost capacity, a rather complex schedule was set up, with some departures and arrivals on the direct San Francisco-Honolulu route, others on a San Francisco-Los Angeles-Honolulu route, with three round trips every two weeks in addition to the through North and South Pacific schedules. Total effect: three round trips weekly between California and Hawaii.

Of outstanding significance because of the economically-important area it brought into the network of Pan American Airways, was the extension to Singapore, from Manila on the North Pacific route. In effect, the Singapore extension closed the gap between the United States and all the East Indies and India, through connections with the British (BOAS) and Dutch (KNILM) air lines. It was operated at first by routing one North Pacific Clipper to Hong Kong, the next to Singapore. Later, the Sikorsky S-42 "Myrtle", with the official name "Hong Kong Clipper" inaugurated a twice-weekly shuttle between Manila and Hong Kong. Through schedules were routed to Singapore, with connection at Manila for Hong Kong.

From the start, the Singapore extension served a special role in the lend-lease program. Of many traffic movements connected therewith, one which may be mentioned as typical was that of health and sanitation technicians who traveled to Burma to fight malaria-bearing mosquitoes, thus to protect Chinese laborers working on the new railroad across Burma.

The romance of the South Seas again came into the picture when Pan American added Suva, capital of the Fiji Islands, to its South Pacific route. Primarily an operating expedient—to break up a long flight sector into two parts, provide an opportunity to refuel and thus increase pay load—the arrangement also included an optional fuel stop at Palmyra Island.

Transcontinental & Western Air

The year 1941 marked the greatest single year of development in the air transport industry and particularly in the history of

Transcontinental & Western Air, which reported the heaviest volume of traffic on record during the 12-month period.

Significant among the year's developments, both for TWA and the rest of the air transport industry, were: Re-gearing of air line operations to conform to the current war emergency; Completion of the first full year of operation of the high-altitude, four-engine Boeing Stratoliners, which definitely established the future growth of four-engine land plane operation in commercial air service; announcement of the development of a long-range, four-engine transport plane that will carry 57 passengers and a crew of seven.

With passenger, air mail and air express movements reaching record highs in 1941, TWA was filling a wartime role of service to both the civil and military forces. TWA also was training four-engine flight crews for the Army Air Forces at Albuquerque, N. M.

TWA had 3,097 employes. Preliminary statistics for 11 months showed that a total of 326,066 TWA passengers flew a total of 188,503,235 revenue passenger miles, an average of 578 miles per passenger and a passenger increase of 36.02 per cent over the corresponding period of 1940. In the same period, the line operated 18,126,269 revenue miles. Air express loadings showed an even greater increase. Preliminary figures for the first 11 months of 1941 revealed a 73 per cent increase, an advance of from 1,030,738 pounds in 1940 to 1,786,614 in 1941. An increase in air mail poundage of 32 per cent was noted for the 11 months period, preliminary figures indicated a gain of from 4,396,059 to 5,822,853 pounds.

The 57-passenger airplane was to be a new type land transport. Forty were on order from the Lockheed Aircraft Corporation in Burbank, Calif. The first plane was scheduled for flight test early in 1942.

The new transport, equipped with four 2,500 h.p. Wright engines, was designed for a range in excess of 4,000 miles, with a top speed of 350 miles an hour. At 47½ per cent of maximum power, it promised to cruise at 283 miles per hour, bringing Los Angeles within 8½ hours of New York, and any capital in the western hemisphere within 16½ hours of the United States. Supercharged cabin and engines would permit operations up to 30,000 feet with low altitude comforts.

In the field of new route development, TWA joined with the New York, New Haven & Hartford Railroad in applying for an air line route from New York to Boston. The application, filed under the corporate title of TWA-New England, Inc., sought permission from the Civil Aeronautics Board to serve the intermediate New England points of Bridgeport, New Haven, New London, Hartford, Danbury, Bristol, New Britain, Meriden and Waterbury, Conn.; Providence and Newport, R. I., and Pittsfield, Springfield, Worcester, New Bedford, Fall River, Taunton, Brockton and Attleboro, Mass.

Three more cities were added to the TWA system during the year. In addition, TWA was authorized by the CAB to purchase the former Marquette Airlines, whose route TWA had been operating under a leasing arrangement. The Marquette route, absorbed in TWA's system, extended from St. Louis to Detroit, via Cincinnati, Dayton and Toledo.

In 1941, the company completed a program of re-equipping its entire fleet of Douglas transports with a new and more powerful type of Wright Cyclone engine. The new engines developed 1,200 horsepower, or 100 horsepower more than the former type, and provided a greater margin of reserve power. Other technical advances included the installation on all planes of an improved type of Bendix Radio Transmitter and receiver units, new Sperry direction finding equipment, and a new type of de-icer for propellers, windshields and carburetors. In addition, approximately 2,000 miles of teletype circuits were added to the company's vast private communications system. The national emergency did not affect the supply of spare and replacement parts necessary to maintain the high safety standards of the air lines. Such supplies had a high priority rating. Standards for the maintenance of equipment actually increased in the last two years, as evidenced by increase in personnel in the TWA maintenance department. In 1939, TWA employed 18 maintenance workers for every airplane in service; while at the beginning of 1942, the number was 25.

United Air Lines

With national defense traffic as a contributing factor, United Air Lines recorded 1941 as the busiest year in the company's 15 year history. Revenue passenger miles flown in the year totaled approximately 272,000,000 for a gain of 22 per cent over the 222,331,118 flown in 1940. Revenue airplane miles reached an estimated total of 26,275,000 for a 13½ per cent increase over the 23,174,931 of the preceding year. Estimated mail-ton miles were 3,605,000 and express ton-miles, 1,500,000 for increases of 24 and 37 per cent, respectively, over the 1940 totals. Approximately 9,143,000 pounds of air mail and 4,086,000 pounds of air express were carried over United's coast-to-coast and border-to-border system.

From the start of 1941, United Air Lines' operations reflected the increasing reliance of business and industry on air transportation

FAST WARTIME TRANSPORTATION

Official documents and vitally important defense shipments go the fastest way. United Air Lines takes on a huge load for night delivery across the continent.

speed for the accomplishment of national defense activities. United's transcontinental and Pacific Coast routes, closely linking many of the country's major cities, industrial centers and military establishments, were used for a steadily mounting volume of passenger and cargo traffic identified with the defense effort. Such movements increased sharply at the end of the year with the outbreak of actual war in the Pacific.

To accommodate defense and other traffic, United flew the most extensive schedules in its history, accounting for the operation of as many as 85,000 miles daily at the peak of the season. Included were 14 daily flights between Chicago and New York, nine daily round trips from coast to coast, 14 daily round trips between San Francisco and Los Angeles, five daily round trips the length of the Pacific Coast and numerous additional inter-city schedules. These operations were accomplished with a total of 68 twin-engine transports as compared with 69 which were available in 1940. United had, as of July, 1941, 39 Douglas DC-3, 15 Douglas DST, and 14 Boeing 247-D transports.

During 1941, the company released five planes in service and five on order to the Government for defense aid. Thus, expenditures for new airplanes, engines and propellers totaled only about $750,000, although the company's inventory of materials and supplies for operating and maintenance purposes reached an all-time high. Prior to the national emergency United Air Lines had budgeted approximately $8,000,000 for new equipment, including four-engine planes. United Air Lines' assistance to defense was not confined to the movement of passengers and cargo. The company's large research and development departments cooperated extensively with Government authorities; hundreds of skilled aviation mechanics were produced for the Army Air Forces under a contract with United's Boeing School of Aeronautics.

New, highly trained pilot personnel for the growing requirements of air commerce were turned out during 1941 from the United Air Lines pilot training school at Tracy, Calif. More than 100 men were graduated and became United co-pilots between June and November. Enrollment of another 100 student pilots was begun. United also increased its own mechanic training activities, and encouraged all its personnel to participate in home study courses of the Boeing School of Aeronautics.

The important national defense production centers of Youngstown, O., and South Bend, Ind., as well as Salem, Ore., were added

A MILLION MEALS IN THE AIR

Here is one of the United Air Lines eight commissary kitchens where meals are prepared for service to passengers on the planes.

WHY AIRPLANES ARE EXPENSIVE MACHINES

High performance and the maximum of safety factors in American aircraft require thousands of man hours of labor. Photo shows a crew at work on the two longitudinal beams that form the fuselage of a Bell Airacobra. The light dots are rivets.

as stops on the United system during the year. Services also were resumed into Toledo, O., and Newark, N. J., following airport improvements at those cities.

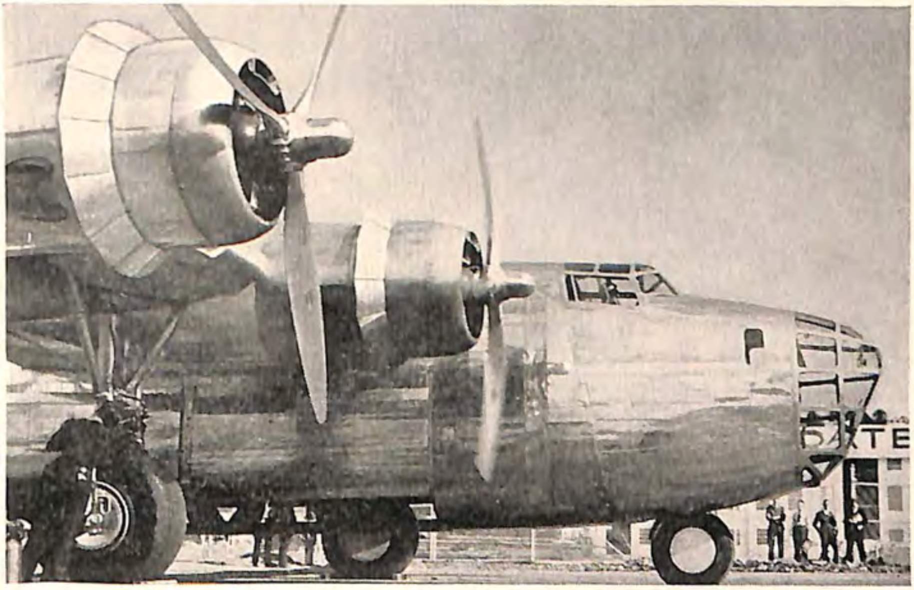
During the year hearings were held on United Air Lines' applications to operate between Boston and Hartford and Cleveland, linking New England directly with the company's coast-to-coast route; to operate between Toledo and Washington, also linking Washington with United's transcontinental route; and to include Visalia, Merced, Modesto and Stockton as intermediate points on the company's Pacific Coast route. Other applications of the company pending at the close of the year included those of United to fly between Des Moines, Kansas City and Denver and between Denver, Grand Junction, Las Vegas and Los Angeles.

United Air Lines continued its large-scale research and development program during 1941, bringing out numerous innovations of benefit to the entire industry and looking forward to the post-war development of air transportation. New construction of United in the year included a $900,000 western operations headquarters and maintenance base at San Francisco and the addition of a $350,000 wing to the company's general headquarters building in Chicago. Considerable work also was done in redesigning and redecorating traffic offices and passenger terminals along the company's system. United Air Lines employed 3,500 persons.

Western Air Lines

Western Air Lines reported outstanding gains in passengers, mail and express for 1941 and looked forward to playing an important part as a defense carrier in 1942. Passengers in 1941 were 69,813, an increase of 49.11 per cent over 1940 with 46,819 passengers. Revenue passenger miles were 22,829,191, a 46.73 per cent increase over 15,601,831 in 1940. Mail poundage climbed to 1,288,792 from 951,451 pounds in 1940, a 35.46 per cent increase. Express pounds showed a 44.98 per cent gain of 821,189 as compared with 566,427 in 1940.

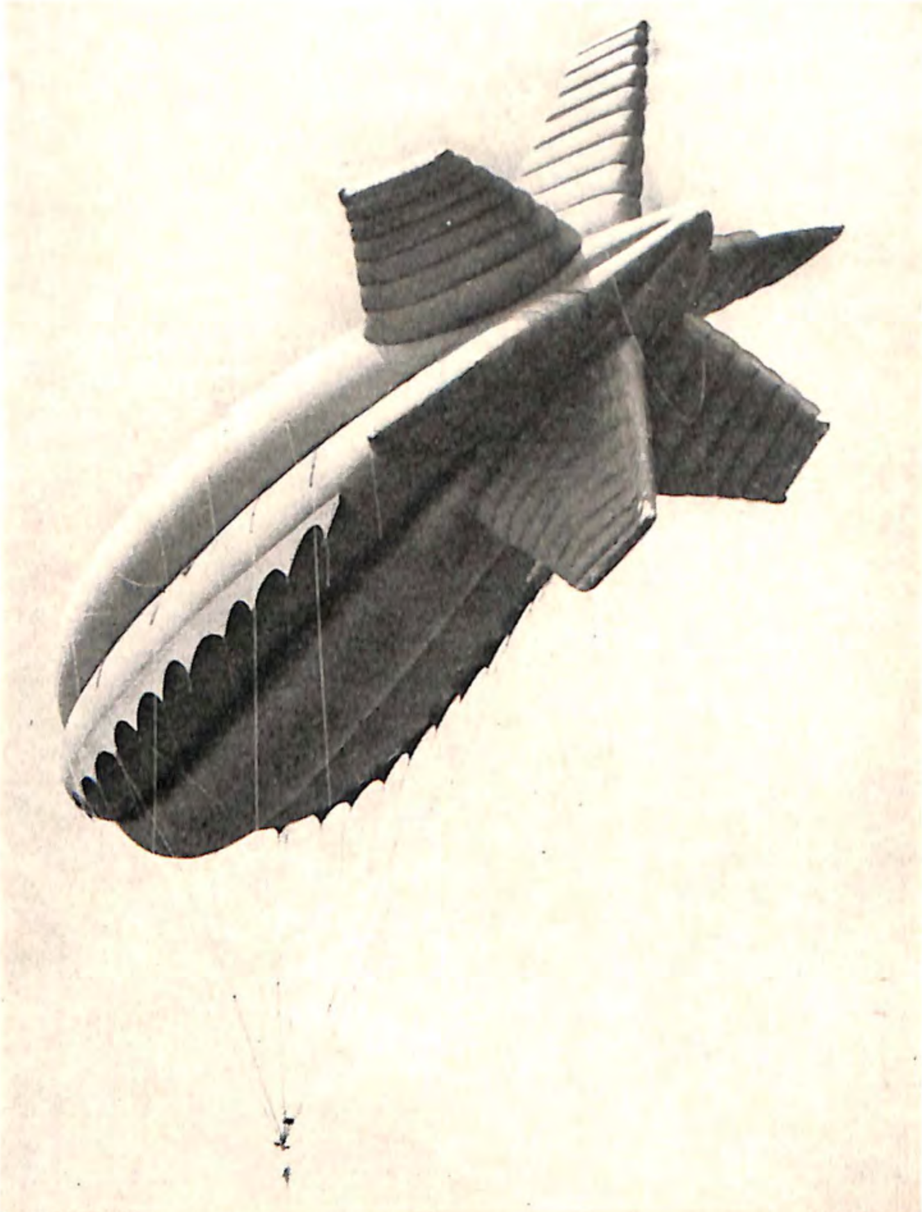
Outstanding highlights of 1941 included a detailed flying and engineering study of a new route to serve the all-important defense area of Alaska. Submitted to the Civil Aeronautics Board, Western Air proposed daily service over an inland course free from poor flying conditions and possible enemy attacks.



CLOSE-UP OF CONSOLIDATED B-24 BOMBER

Showing tricycle landing gear and two of its four Pratt & Whitney Twin Wasp engines and Hamilton Standard propellers.

Other events included inauguration in June of service to Lethbridge, Alberta, Canada, completing a border-to-border system.



GOODYEAR BARRAGE BALLOON

One of the high altitude six-lobe, six-fin Strato-Sentinels for air raid protection.

CHAPTER VIII

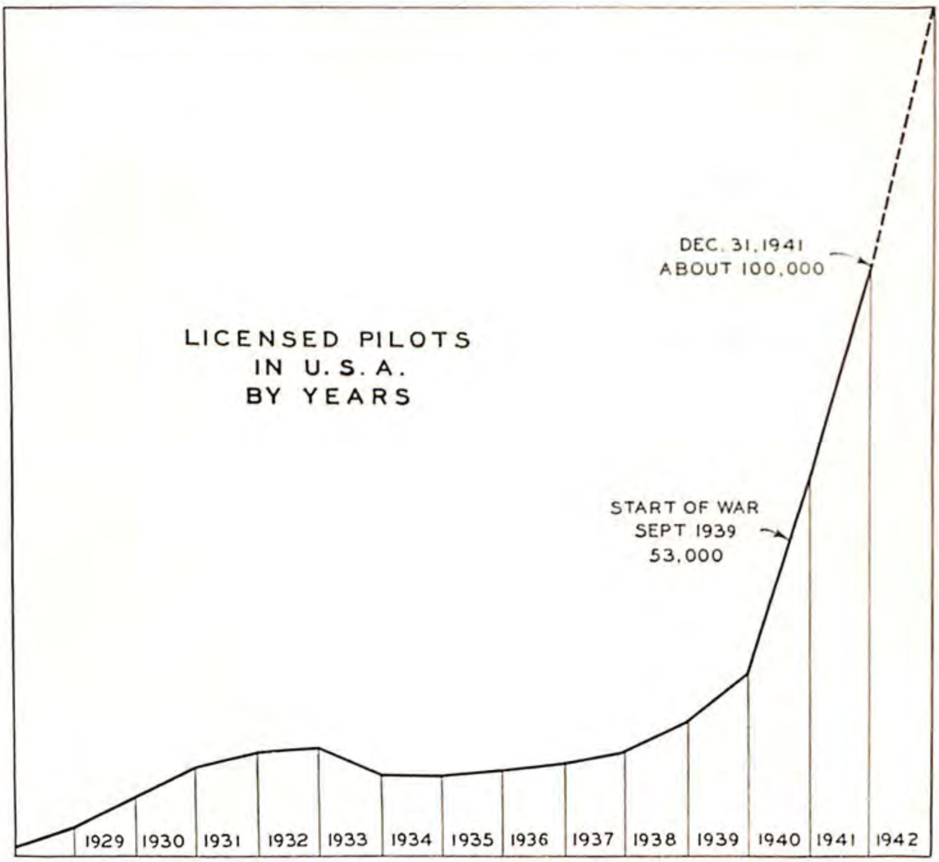
PRIVATE FLYING—CIVILIAN DEFENSE

Private Pilots Recognized As Important in War Effort—The Civil Air Patrol—Results of Civilian Pilot Training Program—Hostilities Involve Sacrifices for Private Owners—Light Planes Adopted for Military Service—Trends in Latin America.

AMERICA'S private flyers—the "blood, sweat and tears" band which waged the good fight, and often the last-ditch fight, for American aviation through the pioneering years—taxied their thousands of much kidded "putt-putts" stoutly into Uncle Sam's service as 1942 sent the United States into war and a determined fight for salvation of a decent and free civilization.

Overcoming the widely held opinion that their equipment and their flying background could be of little assistance in World War II, the "little" band of "cornfield" pilots, suddenly found to be no longer little or cornfield, brought a realization of their importance to an air-conscious country. It was this air-consciousness that America's private flyers had been seeking for years to spread among the nation's youth.

"The year 1941 was the greatest in the history of American aviation," stated Robert H. Hinckley, Assistant Secretary of Commerce for Air, as the year ended. In the case of private flying, the Secretary's statement was one that had been proved only after a year of intense effort to avert total elimination of private flight activities. The year had seen private flying abolished in every other belligerent country. As 1942 opened, the United States was the only fighting country in the world that had not grounded all its private flyers—and all portents pointed to these pilots acquiring increasing stature in the defense scheme as time went on. But the fight against opinion had been hard.

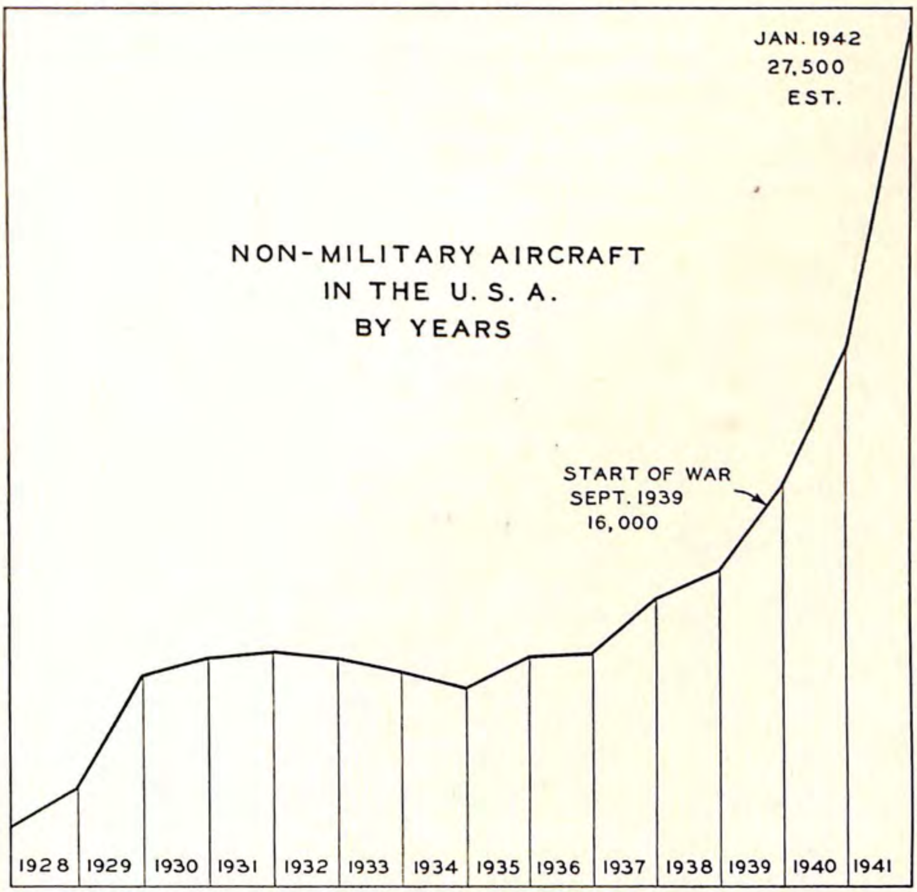


Early in the year, the country's 63,000 pilots and 17,000 airplanes had been faced with a flight moratorium, as expanding military operations and an increasing shortage of materials for new planes and repairs to existing aircraft threatened disaster for the lighter plane industry and a second dodohood for the private flyers. Priority was rearing its ugly head. Ceiling was becoming zero, visibility ditto.

Led by the Aeronautical Chamber of Commerce of America, the National Aeronautic Association and numerous individuals from the private flying field, a campaign was begun to convince the Government that properly directed private flying was as essential an adjunct to national defense as the air lines and other fields of aviation. The innumerable defense-related functions that could be performed best by private flyers were publicized—pipeline patrol, anti-pollution patrol, ambulance service, transport of key defense personnel and dozens of other activities. The Government was convinced, the lighter plane industry received priorities for materials with which to build ships for these defense-related activities, and priorities were granted for repair and maintenance of the thousands of private planes which were swinging into line to back up the military air forces. No new planes were to be sold except for defense-related uses.

At the beginning of 1942, the 63,000 licensed pilots of 12 months ago became 100,000 licensed pilots (with 75,000 students in training); and 17,000 planes became 25,000 in a year. After December 7th, the beginning of the war, the future again darkened for private flying. A country at war needed a reminder that private flying could be made "the first line of civilian defense."

All civilian flying, save scheduled air line, was grounded. Before private pilots could take the air again, extensive formalities had to be undergone, and properly so. Citizenship and patriotism had to be proved. Licenses had to be reinstated. An extensive system of



THE CESSNA T-50

A two-engine personnel transport.

flight clearances was established. And, even when all these requirements were fulfilled, private flying was limited to areas adjacent to the take-off airfield. All this, and much more, was necessary to assure against espionage and sabotage. Cameras were taboo in planes, or had to be securely locked in luggage compartments. Planes had to be dismantled in such a way as to prevent their theft by saboteurs. Again, the future of private flying became most uncertain.

Meanwhile, however, the pilots had been preparing for M-day. They had laid the groundwork for the Civil Air Patrol, a nationwide organization of private flyers and ground helpers who were shortly to relieve the military of many flight functions so that the front-line fighting pilots could arrive more quickly where they would do the most good. To the CAP were flocking what was to total an "air force" of a quarter of a million men and women; a force of 250,000 which was to include old and young, boys and girls and their fathers and mothers, many of the men disabled in prior military service, or otherwise, to an extent which kept them out of a fighting cockpit.

With them these flyers were bringing their own airplanes into service, while the lighter plane industry stood ready to build new thousands of ships, if they were given the minimum of critical materials and labor with which they could expand production quickly to a rate of 25,000 a year. The question of providing planeless CAP pilots with ships at Government expense was being considered as the CAP was perfected. Its organization was proceeding quickly, along military lines, with U. S. Army Air Forces officers assigned to regional commands in each of the nine Army Corps Areas.

Forty-eight wing commanders, most of them with prior military experience, were hand picked, one for each State. Chief peril to what promised to be a gloriously successful service record for CAP was the fact that the lighter plane industry, holding few military orders, might disintegrate, thus precluding procurement of equipment replacements for the Civil Air Patrol.

A regular Army officer was placed in command of the CAP. He was Major General John J. Curry, of the Army Air Forces. General Curry emphasized to his new "command" that the United States was the only belligerent country in which private flying was still functioning, and added, trenchantly, "We have got to organize and discipline civilian aviation or we won't have it here, either." The response was sensational. Private flyers swamped CAP headquarters in Washington with a torrent of applications which was stemmed only when a force of 60 clerks was made available to handle them.

Quickly the new "first line of civilian defense" prepared for duties, which included flight testing alertness of air raid spotting systems; aiding searchlight practice; courier duties; reconnaissance; towing aerial gunnery targets; patrolling highways, searching for lost aircraft; aiding interceptor machine-gun practice; aerial ambulance work; returning ferry pilots to aircraft factories and, perhaps most important, maintenance of a night and day shore patrol, thus relieving long-range military planes for distant scouting and combat work.

The fact that civil flying was being permitted in the United States during wartime was no accident. It stemmed from inception in 1938 of the Civilian Pilot Training Program (see Chapter VI, Training and Education). As war clouds rolled up, CPTP graduates answered the call for thousands of additional fighting pilots and the

VULTEE AT-19 RELIANT

Used by the British Naval air forces for navigation training.

PIPER CUB COUPE J-4

CPTP curricula were shaped to school pilots along quasi-military lines. As 1942 brought actual conflict to the United States, CAP was enabled to draw, from this quasi-military CPTP, thousands of pilots with a knowledge of discipline and a feeling of responsibility, both vital if the new organization was to be built into a real "first line of civilian defense."

As CAP led the way in establishing the private flyer's place in the defense scheme, the comprehensive, rigid restrictions imposed on M-day were relaxed successively. Brigadier General Donald H. Connolly, who for 18 months had been Administrator of Civil Aeronautics, was called to active duty and named Army Air Forces Liaison Officer in charge of all civilian aviation. Under General Connolly's leadership, the importance of private flying was certain to be recognized and its continued existence assured. Coincident with General Connolly's appointment, new regulations for civil aviation were announced. In short, they stated that U. S. civilian pilots "who have proved their citizenship and loyalty may, beginning February 15, continue many of their pre-war flying activities under a system of controls designed to protect the nation, themselves, their airports, and their planes against saboteurs, and to hold their craft ready for service in any possible military emergency."

In the new regulatory set-up, the key officers were a Registrar and a Clearance Officer, appointed by and responsible to the management of every airport. Said the official announcement:

"They (the Registrar and Clearance Officer) must have the approval of and be designated as such by the (Civil Aeronautics) Administration. They will be responsible for checking pilot credentials, checking the aircraft for proper registration, and issuing flight clearances. Subject to the new regulations, pilots will be free to fly as usual if the Registrar and Clearance Officers are continuously informed as to their whereabouts and activities. Local flying will be permitted in areas designated for that purpose in the vicinity of airports, and excluding areas over which local restrictions may be imposed for military reasons."

Pleasure and industrial flying were to be permitted. Approval of flight plans by the Clearance Officer was to allow trips beyond local areas or to other airports. To prevent sabotage, 24-hour guards were to be mounted at airports. Aircraft, however, under the new regulations, had to be dismantled completely when hangared, because it had been found that earlier regulations, calling for removal of a key part, such as the distributor, could be circumvented by watchful saboteurs. These gentry, it was decided, could determine what part a particular plane owner habitually was taking home with him, and by procuring a duplicate, could steal the ship and take off to sabotage a national defense project.

The new regulations were worked out by the CAA in conjunction

LUSCOMBE PRIVATE OWNER PLANES

Outside the factory in West Trenton, N. J.

THE STINSON VOYAGER

with the armed forces. Said Charles I. Stanton, Acting CAA Administrator, "Our prime objective was to 'keep 'em flying'. We worked on the theory that every pilot and every plane in the nation is an asset in the total war effort."

With first the national emergency and then the full-out war effort to absorb their full attention and energies, the country's private flyers readily and rapidly forsook and cancelled the many outstanding, annually-scheduled civilian aviation exhibitions, contests, and other events. The great winter "Aerolympics" at Miami, which had been held for 13 straight years, was one of the leading gatherings of this kind which bowed out due to the war. This event in 1940 had seen 1,400 private pilots, all flying planes powered by 80 h.p. or less, flock in from every corner of the country to constitute striking proof that popular air travel had come into its own.

Many private flying organizations suspended operations as their officers and members turned their full energies to prosecution of the war.

Many other sacrifices in the interests of national defense were made cheerfully by private flyers during the year. Not the least among these was the relinquishment to the War and Navy Departments of nearly 300 aircraft for use in connection with military and naval activities. These craft were of certain specific types which the services needed badly, and which could be manufactured only at the expense of vital military plane production.

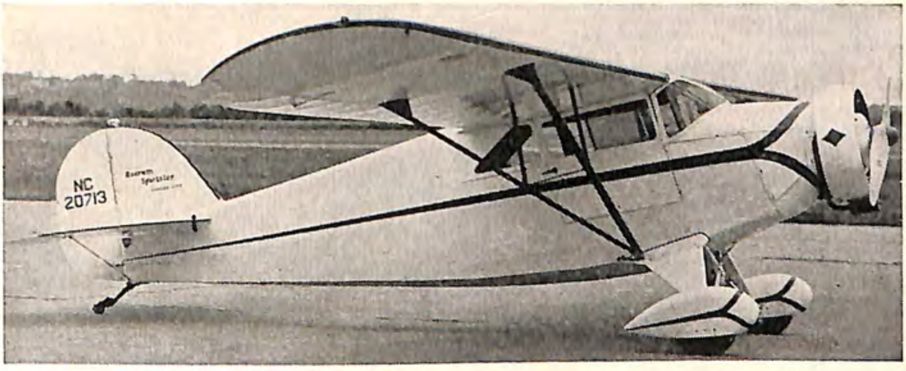
When Secretary Hinckley declared 1941 aviation's greatest year, one of the proofs he offered was the fact that insurance rates for the Civilian Pilot Training Program, lodestar of private flying, had been lowered during the year for the sixth time since the program's inception. CPT-ers during the year piled up a safety record never before equalled, flying more than 6,200,000 miles per fatality.

Women played no small part in the newly-important functions of private flying. General Curry made it clear shortly after the CAP was formed, that every one of the country's 3,000 women flyers who enrolled would be utilized to the fullest.

"There will be absolutely no discrimination in the Civil Air Patrol, and each member is to be accepted and assigned to duties strictly upon the basis of his or her experience and record of performance," said General Curry. "This has been the policy of the CAP from its inception as a part of the Office of Civilian Defense. There must be no doubt in the minds of our gallant women flyers that they are needed and, in my opinion, indispensable to the full success of the CAP. A great part of the progress made in organizing civilian aviation under the Civil Air Patrol has been due to the volunteer help given by women flyers—members of the Women Flyers of America and the Ninety Nines."

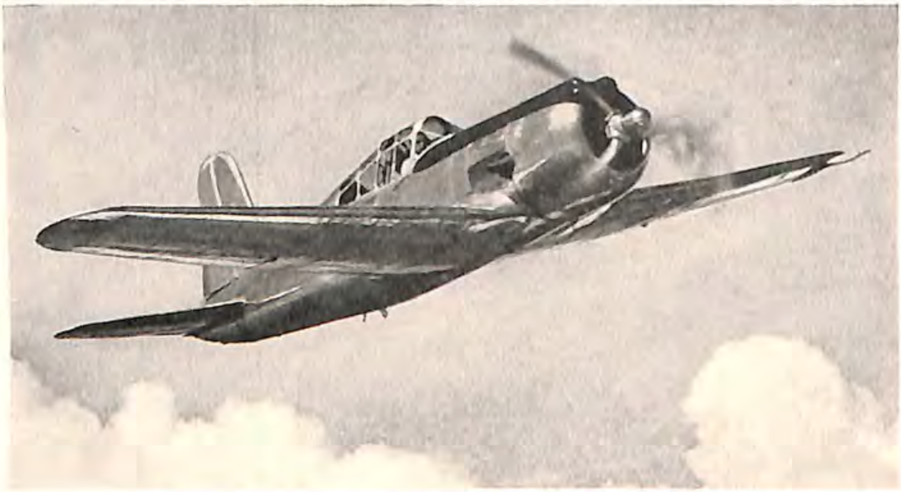
Early in 1942 women flyers were being organized to undertake flight functions auxiliary to the military, functions which the women of England had successfully performed, such as ferrying warplanes from factories to Air Forces stations.

Interest in the advancement of private flying as a defense measure was not confined to the United States alone during 1941. Realizing the significance of aviation in South and Central America, the U. S. Government and private interests gave material encouragement to



REARWIN SPORTSTER

It is powered by a 70 h.p. Ken-Royce or 90 h.p. Warner engine.



VULTEE PURSUIT IN FLIGHT
The Vanguard on a test flight.

surveys in the republics to the South, directed toward facilitating the organization of flying groups. All authorities concerned became doubly convinced during the year that the present, as well as the future, of the South and Central Americas depend on aviation, because of the rugged terrain which apparently was to be conquered, thoroughly and eventually, only by the flying machine.

In Latin America, the chief need was discovered to be primary flight training for civilian pilots. While many of the South and Central American republics had taken initial steps toward instituting military flight training, little had been done to encourage the average air-minded citizen. Campaigns were launched to get these people into the air, and popular support for the campaigns was sensational. Individuals and clubs made liberal financial contributions, and the U. S. Government cooperated by releasing for export light training planes. It was officially realized that thus the peoples of Latin-America would become better fitted to utilize for their defense the military equipment that the United States hoped to make available to them as soon as the more pressing needs of its own fighting airmen, and those of Britain, China, Russia and the Dutch were filled. It was hoped that this activity would inspire the formation of a Latin-American Civil Air Patrol in 1942.

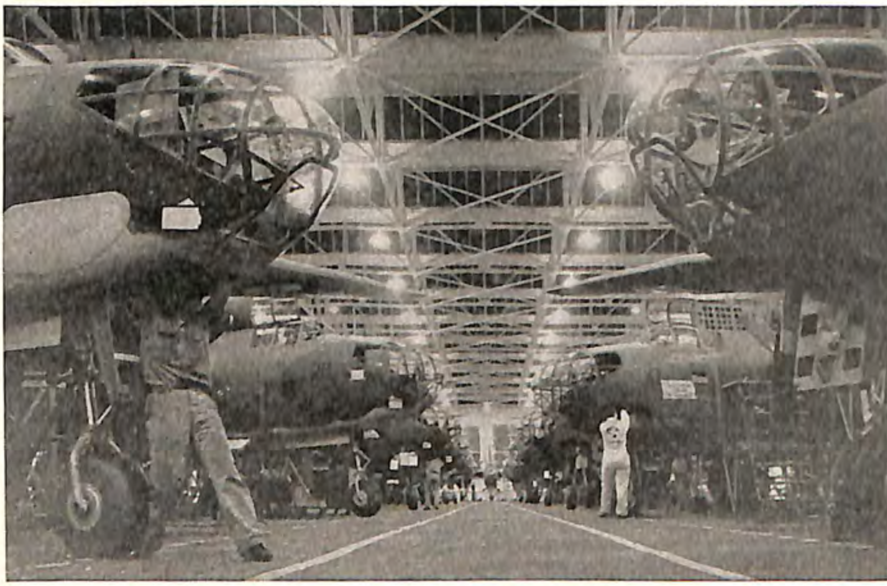
While 1941 was a time of trial for private flyers and their lighter planes, a time during which the future of private flight was heavily clouded on at least two occasions, the new year of 1942 brought crystallization and appreciation of the true value of the team—private pilot and light plane. Official Government orders were prepared which incorporated blanket authorization of manufacture and sale of lighter planes for the Civil Air Patrol, the Civilian Pilot Training Program and for State Air Guards which had the approval of the National Guard Bureau of the War Department. In addition, the War Production Board (Aircraft Branch) was to be empowered to issue specific authorizations for sale of lighter planes for execution of other needful functions, as well as for ample maintenance of safe flying conditions through adequate repair facilities. All civil aircraft, even the lightest, was to be recognized officially as being of essential defense importance. This recognition was to assure civilian aircraft owners of their opportunity to keep in flying trim.

All of these developments were of greatest importance because they meant that, in war's aftermath, the light plane was to be the backbone of private flying and a tremendously vital factor in the broad field of aviation. This vista was becoming clearer day by day as (1) industrial and Government planners stated irrevocably that the future of the world and civilization was to be largely dependent on aviation and (2) production thought in the aircraft industry centered toward three chief post-war trends, i. e., the transport plane, the cargo plane and the light plane.

The early bird of the middle thirties who spoke of the 100,000 flyers certain to traverse American skies one day, saw his prediction borne out by the end of 1941, by which time he had raised his estimate to 1,000,000 or more, with few dissenters. Military and scientific developments by early 1942 had reduced the speculation to—not how

THE CULVER LFA
It is powered by an 80 h.p. Franklin engine.

many flyers, but how soon? The plane of the near future also had become an item of great interest. The war was beginning to answer this question as the year 1942 brought full-out hostilities. From the conflict, with its consequent technical advances, authorities foresaw private craft undreamed of five years ago—two, three and four-place "family planes" which would sell for popular prices. Many aircraft companies, building at top speed for defense, nevertheless had an engineering eye trained on the clear skies of peace of the future.



NIGHT WORK ON DOUGLAS BOMBERS

One of the mass production lines turning out the DB-7B Havoc attack bombers for the R. A. F.

CHAPTER IX

AIRPORTS AND AIRWAYS

The Nation's Airports and Airways Are Prepared for War—Increase in Number of Landing Fields for Heavy Transports and Bombers—Government Agencies Cooperate in Development Program—States Take More Active Interest with Record Enabling Legislation—Growth of the Federal Airways Systems—Wartime Regulations for Private Flying.

THE Civil Aeronautics Administration's first airport program got underway in 1941, with 385 defense landing areas designated for construction or improvement by a board including the Secretaries of War, Navy and Commerce. Funds of about $140,000,000 were involved in this project, with Congress considering a request from the President for an additional $57,865,300. As a result, at the beginning of 1942, the nation's airports numbered 2,484, of which 1,086 were municipal, 930 were commercial, 283 were intermediate airways emergency, 38 Navy, 77 Army, 40 miscellaneous and 30 private. A total of 662 of the fields were lighted for night operations.

At the same time there were 362 seaplane bases and anchorages, 21 of them lighted. The total included 59 bases, 267 anchorages, 21 Navy, 11 U. S. Coast Guard, one Marine Corps and three Army.

Airports showed a gain of 282 and seaplane bases and anchorages a gain of 46 during the 12 months of 1941. Texas led all States in the number of airports and landing fields with a total of 207. California was next with 194, and Michigan third with 125. (Complete list by States will be found in the Appendix.)

Improvement of the airport picture was also noticeable in the fact that there were 64 Class 4, or topnotch airports, against 23 in 1940, while the number of Class 1 airports, those with minimum

THE LOCKHEED HUDSON BOMBER

facilities, dropped from 1,641 to 1,501. Class 4 airports were suitable for operations of both heavy bombers and air line transports.

Meanwhile, however, the usual program of airport construction which had been made possible by allotments from the Work Projects Administration and other Federal agencies, as well as contributions from local sponsors, continued during 1941. As directed by the Civil Aeronautics Act, each such airport project, before approval by the WPA authorities, was first certified by the Administrator, following study, recommendations, and approval from an aeronautical standpoint, as reasonably necessary in air commerce or for the national defense.

During the calendar year 1941, the Administrator issued 490 Certificates of Air Navigation Facility Necessity authorizing the expenditure of approximately $107,000,000 in Federal funds, including WPA, PWA, NYA, CCC, and War Department (Civil Projects). In addition, approximately $23,000,000 in CAA funds and $46,000,000 in sponsors' pledges were involved in these projects.

The year 1941 witnessed an unprecedented volume of State legislation designed to correct deficiencies in State airport laws and otherwise facilitate the development of municipal airports and the Federal airport development programs according to a survey by the Civil

Aeronautics Administration. During 1941 there were passed 42 acts designed to provide municipalities and other political subdivisions with the basic authority to develop airports, to cure defects in, or further implement, existing airport development enabling legislation.

Statutes also were enacted which provided for administrative action by an agency of the State Government in the field of airport development. Ten States adopted acts authorizing State agencies to acquire land and construct and operate airports on it. Another State passed an act which provided that the aviation gasoline tax refund, if unclaimed for four months, could be used to construct flight strips adjacent to public highways. Three other States passed legislation directing their aviation bodies to encourage and promote the development of airports and the establishment of air navigation facilities. In addition, a number of statutes were enacted providing for State assistance, financial and other, to political subdivisions in the development of municipal airports. These included five acts which authorized the four new State aeronautics commissions created in 1941 to assist the political subdivisions of the State in the development of their airports, as well as several authorizing use of State owned or controlled lands for municipal airport purposes.

In reviewing Federal airport aid, the survey went back to October 9, 1940, date of the passage of the First Supplemental Civil Functions Appropriation Act, which contained an appropriation to the Administrator of Civil Aeronautics of $40,000,000 for public airport development. Passage of this act, the review stated, heralded a new day for municipal airports, for by it, Congress for the first time recognized the vital place of the municipal airport in civil aeronautics and in the national defense.

British Air Ministry photo

NORTH AMERICAN TRAINERS WITH R. A. F.

The British named them Harvard. They credited them with having trained thousands of the best pilots in the R. A. F.

THE BREWSTER BUFFALO

Developed from the Navy shipboard fighter, the Buffalo was in service with three air forces of the United Nations, the U. S. Navy, R. A. F. and Netherlands East Indies Air Forces.

The survey further indicated that a large number of recent airport legal developments were connected with or incidental to the operation of the CAA airport programs made possible through this act and two subsequent appropriations.

Since October 9, 1940, $140,477,750 has been appropriated and 385 airports and airport sites have been selected by the Administrator of Civil Aeronautics for development, and approved by an Approval Board consisting of the Secretaries of War, Navy, and Commerce as necessary for national defense.

Another action of Congress during the year affecting civil airport development was the amendment of the Act of May 24, 1928, authorizing lease of public lands for public airport purposes, by changing the limitation on the area that may be leased for any particular airport from 640 acres to 2,560. As a result, in those States where public lands are still available, it is now possible for a city, other public agency, or private person to lease as much as four sections of such lands for development as a public airport.

Of the 42 airport enabling acts mentioned, 24 contained provisions expressly granting political subdivisions the power to acquire land for airport purposes by the several usual methods. In addition, the need for speed in the acquisition of lands required for airport development, particularly in the national defense program, resulted in several enactments amending State condemnation laws to provide a more expeditious condemnation procedure than that previously in effect. This further increased the number of States which, like the Federal

Government, had a condemnation procedure permitting the taking of possession of the property to be condemned for airport purposes without awaiting determination of the amount of the award. Likewise, it reduced the number of States in which national defense airport projects might be delayed because of inability of a public body to obtain immediate possession of the land to be developed, as several such projects were delayed in the past.

Airport financing received considerable attention during 1941 in the State legislatures. A major portion of the cost of developing municipal and other public airports was borne by the Federal Government in connection with WPA and CAA airport programs. But most of the cost of constructing hangars, administration buildings, and other structures and facilities, and all the cost of acquiring the necessary land, had to be borne by the municipality or other political subdivisions. To provide a means of meeting these capital expenses, 19 acts were passed authorizing the political subdivisions empowered to establish airports to sell long-term bonds. All these 19 authorized such borrowing to finance the acquisition of land and 15 to defray the costs of the airport construction or development as well.

A significant development in airport financing was the enactment of State legislation designed to permit political subdivisions to raise funds for airport purposes notwithstanding existing constitutional or

GIRLS IN AERONCA PLANT
The covering department; rib stitching.

THE LOCKHEED P-38 PURSUIT

statutory limitations on their power to tax and borrow. This legislation included three acts authorizing issuance of bonds secured only by a lien on the airport revenues or the airport property, and therefore not constituting general obligations of the political subdivisions issuing them; two creating new political subdivisions for the sole purpose of establishing airports, known as "airport districts"; 19 authorizing joint action in the development of an airport by two or more political subdivisions, of which two provide for the creation of Government corporations called "airport authorities", to act on behalf of the political subdivisions collaborating; three authorizing particular cities or counties to borrow in excess of their statutory debt limits; two authorizing the levy of airport taxes in certain cases in excess of maximum tax limits; and one act enabling cities and counties to appropriate funds for airport purposes in excess of their annual budgets.

Much progress was made toward the protection of airport approaches through airport zoning. The CAA and the National Institute of Municipal Law Officers encouraged the adoption of effective State and local zoning legislation. Although the CAA did not attempt to promote any particular airport zoning legislation, it made available copies of two drafts of possible zoning legislation to all persons expressing interest in the subject. As a result of these efforts to acquaint public officials with the need for airport zoning, 11 acts were adopted during the year. This brought to a total of 23 the States having legislation on the subject.

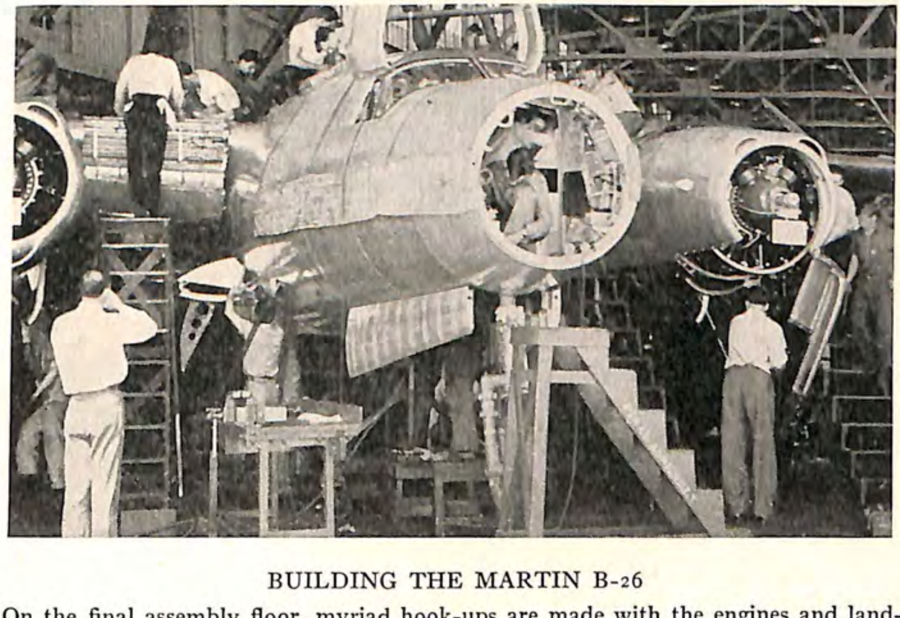
To serve the mounting volume of commercial and military traffic, the Federal Airways System was extended and improved. At the end of 1941, there were in operation 32,487 miles of lighted airways, equipped with radio course signals (known as radio ranges), communications and weather-reporting facilities, and emergency landing fields.

Traffic along those routes was separated and otherwise controlled from 14 CAA centers, which recorded 1,628,400 aircraft operations during the year, a gain of 45 per cent over 1940. New control centers at Memphis and Jacksonville were completed during 1941, with seven additional centers planned for 1942, at San Antonio, Tex.; Boston, Mass.; Kansas City, Mo.; Denver, Colo.; Albuquerque, N. M.; Minneapolis, Minn., and Great Falls, Mont.

The growing volume of traffic occasioned a ruling during 1941 that all craft flying the airways above 3,500 feet must be equipped with two-way radio. Another step to insure safe movement of aircraft during the emergency was the passage of legislation authorizing the CAA to establish or take over operation of control towers at airports where there was both civilian and military flying. The work was already under way.

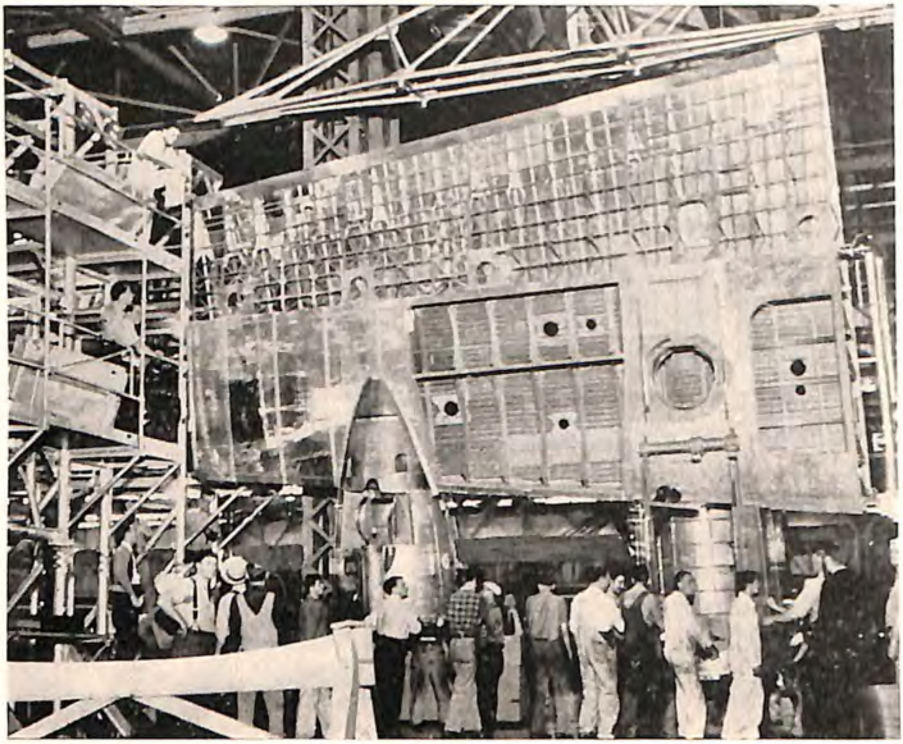
To improve weather-reporting service, an additional 24,000 miles of teletype lines were leased, bringing the total to 55,790 miles, in addition to the 10,360 miles used exclusively for traffic control.

Ultra-high-frequency radio ranges, which transmit with virtually no interference, were put into operation along the New York-Chicago



BUILDING THE MARTIN B-26

On the final assembly floor, myriad hook-ups are made with the engines and landing gear already installed.



BOEING HEAVY PRODUCTION

A massive inboard wing section is lifted by overhead crane from one of the jig lines in the Boeing Aircraft Company plant. Engine nacelles and landing gear support may be seen on the lower, leading edge section of this wing panel. One of these panels is attached to either side of the all-metal, cylindrical fuselage of a B-17E Flying Fortress. Wing tips, ailerons, flaps, and miscellaneous equipment are added before attachment to the fuselage on the final assembly floor.

airway as a service test system. Instrument landing systems operating in the U-H-F band were being installed at Washington and Atlanta, with five more being manufactured for use at New York, Cleveland, Chicago, Kansas City, and Los Angeles.

Defense regulations for the control of private flying were issued by the Civil Aeronautics Board. Although civil pilot certificates were suspended on December 8, 1941, by the Administrator of Civil Aeronautics, grounding all civil pilots except those operating scheduled air carrier aircraft, provisions later were made for the reinstatement of those certificates after determining that each applicant was a citizen of the United States and after investigation of his character and loyalty to the United States. For this reason the Board issued the new regulations having as their purpose the control of civilian flying both for the protection of such flying and for the prevention of sabotage and espionage by civil aircraft.

The regulations ordered owners of aircraft not to permit any other person to operate them unless the owner actually had examined the pilot certificate of the person desiring to use the aircraft and had secured proper identification. After January 8, 1942, all pilots were required to carry identification cards containing their fingerprints, picture and signature. In addition, before taking off from any airport, a pilot had to present his pilot certificate and identification card to the police officer or other authorized person at the airport and secure clearance for his proposed flight. In doing so, he also had to file a statement identifying the aircraft and setting out a detailed plan of his flight.

The carriage of baggage, cargo, and cameras in aircraft other than those on established air lines also was restricted. Baggage and cargo could be carried only if it first had been searched thoroughly

CURTISS FINAL ASSEMBLY

Acres of plant space are covered by pursuit planes nearing completion.

by the pilot or by someone he designated, and cameras could not be made accessible to passengers.

On June 16, 1941, the Washington National Airport was placed in operation, approximately two and one-half years from the time construction was begun. During the rest of the year, almost 300,000 air line passengers enplaned or deplaned at the airport, and scheduled air carrier operations reached a high of 192 daily in the month of September.

Spectator interest remained very high and up to the first of December over 2,225,000 persons visited the airport, with some 400,000 passing through the turnstiles onto the observation terrace.

VOUGHT-SIKORSKY HELICOPTER

Latest version of the VS-300 experimental helicopter simplified to include but one auxiliary control rotor and one main lifting rotor. Igor Sikorsky is at the controls.

CHAPTER X

MISCELLANEOUS ACTIVITIES

Aeronautical Chamber of Commerce of America—Aircraft Owners and Pilots Association—Institute of the Aeronautical Sciences—Manufacturers Aircraft Association—National Aeronautic Association—National Aircraft Standards Committee —National Intercollegiate Flying Club—Society of Automotive Engineers

THE full-out war effort received considerable impetus in many ways from the activities of the more important national aviation organizations as described in the following pages from special reports which they submitted for this book.

Aeronautical Chamber of Commerce of America

Entry of the United States in World War II found the Aeronautical Chamber of Commerce of America with a background of more than 21 years of service as the trade association of the aircraft manufacturing industry in the United States and its official spokesman on all matters of concern to the industry as a whole. As the war effort expanded the aircraft industry, the Chamber's activities increased in volume and intensity, requiring reorganization to meet the ever-increasing demands on all departments. Representing group opinion on all matters, as developed by the industry members on the Board of Governors, Executive Committee and committees of specialists which included accounting, public relations, engineering, airplane technical, engine technical, export, finance, light plane and engine, mechanics schools, materials procurement and other branches, the Chamber acted in liaison capacity before all the Government bureaus in Washington where the Chamber headquarters were maintained. At the same time it had branches in New York and Los Angeles. In his annual report to members, Col. John H. Jouett, president of the

THE TAYLORCRAFT PLANT

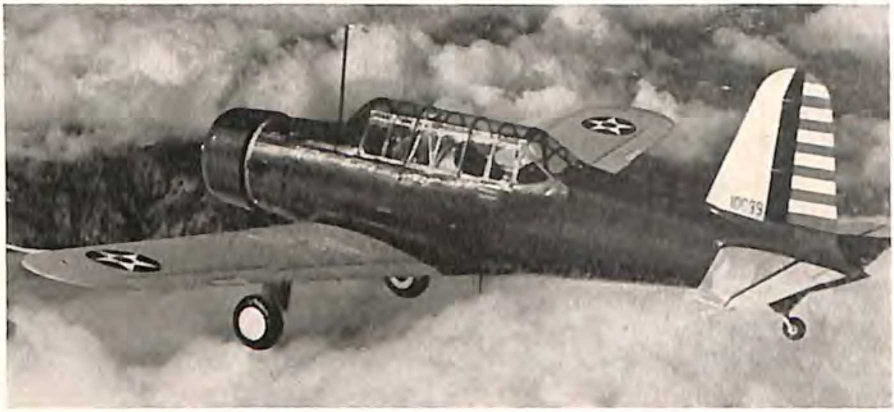
Showing the Taylorcraft L-57 reconnaissance and liaison "grasshopper" planes under construction for the Army Air Forces.

Chamber stated: "The Chamber and its staff maintain constant contact with Government bureaus and officials dealing with aviation; and they look to the Chamber as a clearing house of information and an intermediary on all matters of interest to the industry as a whole. Today the cooperation between the Government and the Chamber is more extensive than ever; and more generally effective. Keeping its members informed as to the trends in legislation has always been an important activity of the Chamber. During 1941 this service has been constant because Congress has been in continuous session. We have made sustained efforts to inform our members promptly as to the progress of bills through the legislative mill; and the meaning of all measures introduced has been interpreted in 110 bulletins during the last 12 months, bills dealing with selective service, amortization, taxes, appropriations, lend-lease, C.A.A., profit limitation and labor. The Chamber also has responded to an unusually large number of inquiries from Congressional committees and individual members seeking factual information about our industry. Expansion of the industry to meet the requirements of the war program and the impact of the program on all industry have combined to create labor problems. In cooperation with the Government bureaus concerned, and at the request of the officials in charge, the Chamber on many occasions acted in a liaison capacity in bringing together industry groups in efforts to affect some form of stabilization. A special project in this connection was undertaken in July and August, 1941, with a special study seeking the adoption of a uniform method of job classification throughout the industry. Southern California members already had devised their own system of job classification. This and the effort currently being completed in the East and Middle West will undoubtedly result in a uniformity of thought and practice which should pave the way for the adoption of the aircraft industry index for escalation and other purposes. Studies in the fields of labor contracts and labor relations are being carried on continuously.

"The Public Relations Committee of the Chamber recommended expansion of activities in supplying the public with information con-

VULTEE WOMAN WELDER

She is making an aluminum weld on an oil tank.



VULTEE VALIANT BT-15

One of the large number of basic trainers used by the Army Air Forces. It was powered by a 440 h.p. Wright Whirlwind engine.

cerning the industry's participation in the war program. The Executive Committee approved the proposal to supplement the Chamber's normal public relations activities—which deal with all branches and problems of the industry—by creating an Aviation News Committee and issuing to the press and other media a clipsheet of news about the industry. This medium has been distributed twice a month as Aviation News Features and sent to nearly 3,000 newspapers, writers, columnists and others. The Aircraft Year Book, which is published by the Chamber, receives hundreds of commendatory letters from Government officials and members of Congress.

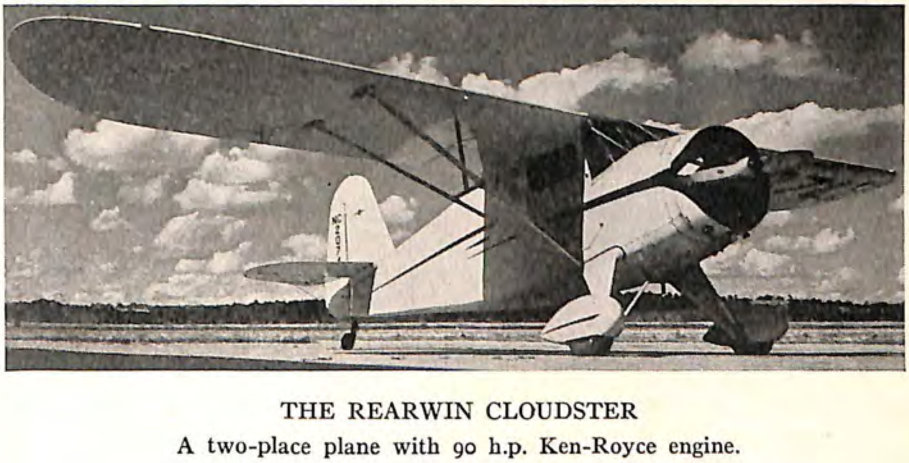
"In 1941 the Chamber answered an average of 52 publicity and public relations inquiries a day by telephone, letter and personal interviews with aviation writers, newspaper editors, columnists, Government officials and others interested in aviation material. A total of 41 public relations bulletins and 21 questionnaires were sent out. Meanwhile, opportunities for the Chamber to provide specific information multiplied with the development of the war program and the widespread interest in the industry's contribution to it.

"The multiplicity of laws, regulations and rules controlling export of aeronautical equipment, and the creation of several new Government agencies dealing with exports under the various phases of the defense program brought into the offices of the Chamber many new problems of concern to the entire industry. A total of 159 bulletins covering export control, lend-lease and other matters were issued. The Aeronautical Export Directory was continued and kept up to date within the limits imposed by military restrictions.

"The manufacturers of light planes were confronted by the possibility that priority curbs and other restrictions soon would put them out of business. Group effort on the part of these manufacturers working through the Chamber resulted in recognition by the Government bureaus that this branch of the industry should be preserved because its products were useful in the defense program. The result was that in 1941 the light plane manufacturers turned out about 7,500 planes as compared to 6,583 the previous year.

"The evolution of preference, priorities and allocations as these procedures were developed by the O.P.M. and S.P.A.B. became one of the most important problems with which the Chamber had to deal. Hundreds of individual cases related to aircraft production were handled. The Chamber was the clearing house for all priority problems affecting the industry. A total of 126 bulletins on the subject were sent to members; invariably days or even weeks before the same information explaining the orders of O.P.M. were sent out to its own agents in the field. To acquaint its members with priorities problems the Chamber organized committees in different sections. These meetings were well-attended by company purchasing agents and priorities specialists, as well as Government officials. The statistical work of the Chamber has been carried on despite severe handicaps, such as restricted military information and confusion in various departments as to how much information the Chamber should collect and release.

"The Chamber has centered its technical activities on several important objectives. The Aeronautical Board commissioned the Chamber to process industry recommendations on Army and Navy airplane specifications and requirements. Similar recommendations were submitted earlier in the year on engine specifications. These recom-



THE REARWIN CLOUDSTER

A two-place plane with 90 h.p. Ken-Royce engine.

VULTEE FINAL ASSEMBLY

Women are employed here, installing fittings and brackets on the mechanized assembly line.

mendations eliminated the expense of the industry's taking deviations on engine specifications, and also prevented delays in production resulting from individual company problems. A project dealing with flight loading conditions at extremely high speeds was presented to the Air Corps and the National Advisory Committee for Aeronautics. The Chamber's technical staff cooperated with the Army-Navy-Civil Committee on Aircraft Design Criteria and was the industry's liaison in dealing with changes in aircraft design requirements. Another important activity was the standardization work in cooperation with the National Aircraft Standards Committee, the Society of Automotive Engineers and other groups. In the cooperative development of an improved and practical set of flight requirements for transport planes, the technical staff served as coordinating agent. The fire control study undertaken by the C.A.A. had the cooperation of the Chamber's technical staff which also represented the members in all problems concerning C.A.A. regulations. A program seeking to devise means whereby the existing mechanics training schools could be employed in the defense training program was developed under Chamber sponsorship and presented to the Federal bureaus concerned. A total of 114 releases relating to technical subjects were sent out during the year. A total of 20 meetings of a technical nature were held or sponsored by the Chamber, and its staff representatives took part in 27 others.

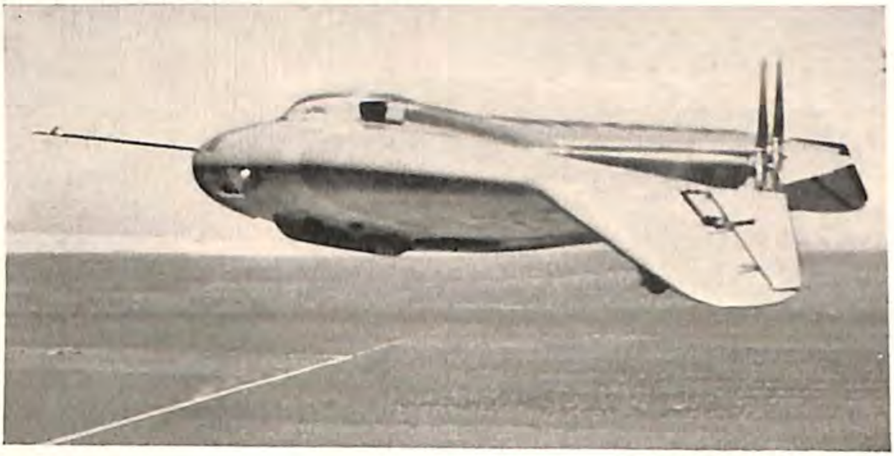
"In 1941, 25 organizations joined the Chamber, which started 1942 with 49 airplane companies, 11 engine companies and 67 accessories companies. School membership increased from 13 to 21. Membership included 195 organization members and 73 individual or affiliate members. The Aeronautical Chamber has a more diversified membership and is faced with more diversified activities and problems than the trade association of any other industry in the country."

Aircraft Owners and Pilots Association

The Aircraft Owners and Pilots Association with more than 7,000 members, the roles restricted to pilots and plane owners, was the only national association composed exclusively of non-scheduled pilots. In the field of civic service the foremost problem faced by AOPA was that of coordinating civil aviation with the war effort. From its

MASKED WOMEN AT VULTEE

They are putting finishing touches on canopies in one of the paint shops.



THE NORTHROP "FLYING WING"

successful experience with its "Air Guard", AOPA was able to sell to Government officials the idea of organizing a national Civil Air Patrol, sponsored directly and officially by the Army and Navy. In order to protect the interests of the non-scheduled pilot. AOPA was represented at many hearings in Washington and elsewhere on various proposed changes in regulations, procedures and facilities sponsored by the Civil Aeronautics Administration and sister bodies such as the ATA, the ALPA and the Aeronautical Chamber of Commerce of America.

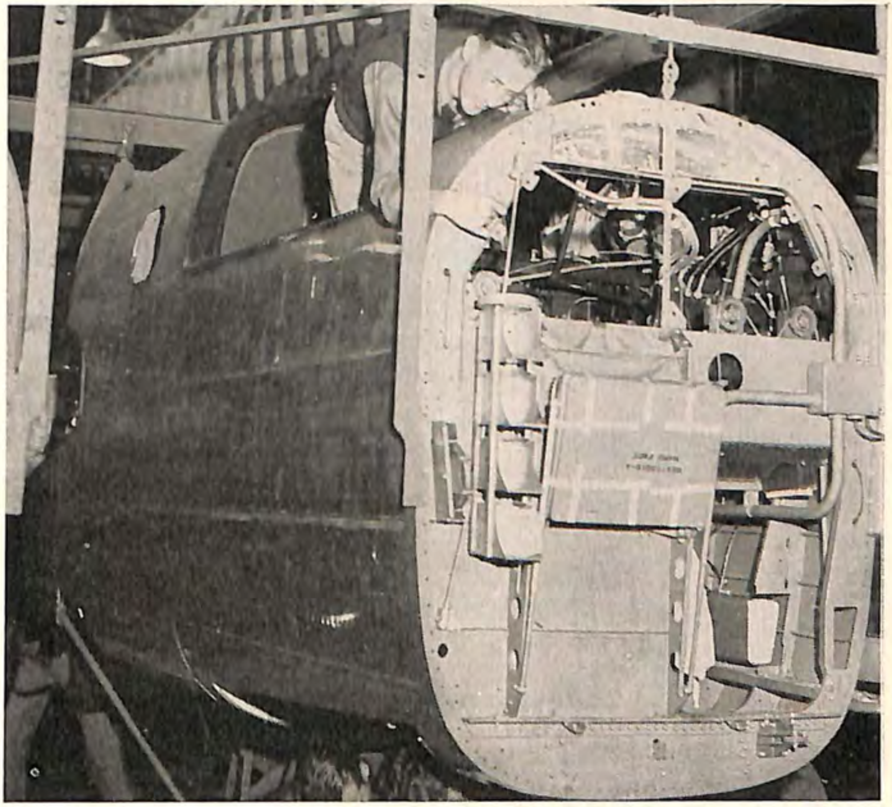
Probably the most popular activities among AOPA members were the various AOPA sponsored flights, including flights for aquatic events in the summer and Eskimo parties in the winter, breakfast flights on short days and dinner flights on long days.

The AOPA continued to service individual members' problems, such as legal difficulties, airport closures, hangars, high lines and routes. It instituted many new services, including airport rating service, a consumers research for aeronautical products, such as radios, propellers and fire extinguishers, and placement service. Throughout the country the many local AOPA units were assisting in handling local problems confronting members.

Institute of the Aeronautical Sciences

The 10th anniversary of the Institute of the Aeronautical Sciences was observed at its honors night dinner in New York on January 27, 1942. The Daniel Guggenheim Medal for 1941 was presented to Juan T. Trippe, President of Pan American Airways

System, "for the development and successful operation of oceanic air transport". Institute awards conferred for 1941 included The Sylvanus Albert Reed Award to Dr. Theodore von Karman, director of the Daniel Guggenheim School of Aeronautics, California Institute of Technology, "for the development of a satisfactory theory of the influence of curvature on the buckling characteristics of aircraft structures". The Octave Chanute Award for scientific achievement by a pilot was awarded to Melvin N. Gough, senior test pilot of the N.A.C.A., "for his outstanding contributions to fundamental research in aeronautics as conducted on airplanes in actual flight". The Lawrence Sperry Award for young men went to Ernest G. Stout, engineer in charge of Aerodynamics and Flight Test, Consolidated Aircraft Corporation, "for his contribution to the experimental determination of the hydrodynamic stability of model flying



NORTH AMERICAN BOMBER CONSTRUCTION

A forward fuselage section of the B-25 bomber receives sub-assemblies as it moves along an overhead conveyor.

BOMBERS ARE INTRICATE MACHINES

This is the mass of wiring and tubing in the leading edge of a Martin B-26 wing.

boats and seaplanes". The John Jeffries Award for the advancement of aeronautics through medical research was conferred on Major Harry G. Armstrong, M. C., School of Aviation Medicine, Randolph Field, "for his basic studies on the physiological and psychological effects of flight at high altitude and the description of a number of clinical entities involved, establishment of the Army Aero Medical Research Laboratory and contributions to the literature of aviation medicine". The Robert M. Losey Award in recognition of outstanding contributions to the science of meteorology as applied to aeronautics was given to Dr. Horace R. Byers, Institute of Meteorology, University of Chicago, "for his research in air mass analysis and its applications in synoptic and aeronautical meteorology."

At the 10th annual meeting in New York, January 28-30, 1942, 65 technical papers and reports were presented at sessions on structures, power plants, radio and instruments, design, materials, rotating wing aircraft, physiologic problems, aerodynamics, air transport and meteorology. The meteorological sessions were held in cooperation with the American Meteorological Society.

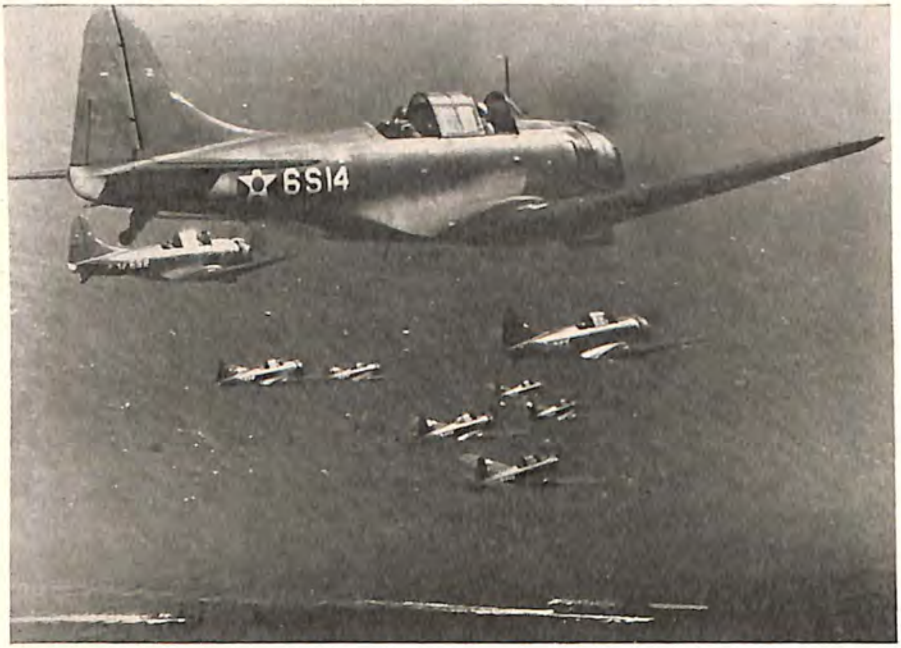
Institute membership increased to a total of 4,158. Of that number 944 were student members organized in student branches at 41 schools and colleges. Eight local sections of Institute members were organized in aeronautical centers, and local meetings were held throughout the year. The annual Wright Brothers Lecture was presented in New York on December 17, 1941, by Prof. R. V. Southwell of Oxford University. His subject was "New Pathways in Aeronautical Theory".

The Institute's total assets increased from $1,000 in 1933 to $101,000 for the fiscal year ending September 30, 1941. In addition, several libraries were operated by the Institute, as was the Aeronautical Index compiled by the Work Projects Administration, and also the collections in its Aeronautical Archives. These assets were further increased in 1941 by three gifts. Paul Kollsman added to the gift that he and The Square D Company had already made to establish The Paul Kollsman Library by a gift of $25,000 setting up a $65,000 fund to continue the support of the lending library service supplied by the Institute. Sherman M. Fairchild made a donation of $25,000 to be used for the publication of important technical reports. R. H. Fleet gave $10,000 for which a special use was to be assigned.

With the cooperation of the aircraft manufacturers in the Los Angeles area, the Institute established the Pacific Aeronautical Library in Hollywood, lending books to aviation company libraries and maintaining a reference collection for individual readers.

COMPLETING A BELL AIRACOBRA

Once the Airacobra fuselage has been completed at Bell Aircraft Corporation's plants, wings are attached and the fighter plane is ready for flyaway delivery.



U. S. Navy photo

DOUGLAS NAVY DIVE BOMBERS

SBD-3 Dauntless planes, officially rated among the world's best, returning to their nest aboard a Navy aircraft carrier.

The Institute's Journal of the Aeronautical Sciences continued to publish reports on research work. The Aeronautical Review Section of the Journal provided members with a comprehensive digest of new aeronautical books, magazine articles, trade releases, news of the aviation industry and technical bibliographies.

Manufacturers Aircraft Association

The primary function of the Manufacturers Aircraft Association since its organization during the first World War in 1917 has been to administer the various patent cross-license agreements and license contracts under which the aircraft manufacturing industry of the United States has operated for 25 years. Reports of the patents were received and patent licenses granted, including licenses to the United States Government, provided for by the terms of such agreements. The Association also served as a collecting and disbursing agency for the payments required to be made in accordance with the provisions of such agreements and contracts, and in addition, it developed a specialized procedure which enabled arbitration proceedings to be conducted in connection with claims for compensation on patents reported by members, and in the settlement of the relatively few disputes in regard to such matters. Payments on the original patents having expired, the only royalty payments currently required were those resulting from the appraisal of new patents issued to member companies.

During 1941 a total of 98 airplane patents were reported by members of the Association, and practically all aircraft manufactured in the United States were licensed under the 1,215 patents owned or controlled by members, thereby continuing to carry out the original policy of making licenses on the same terms available to all manufacturers desiring to enter the field. As in the past a further important objective of the cross-license plan, namely, the prevention of wasteful patent litigation within the industry, was attained, no suits for patent infringement having been filed under any of the patents coming within the operation of the Cross-License Agreement. The contract relationship between the Association and the United States Government, which enables the War and Navy Departments to obtain licenses on the same terms as members of the Association, also was continued.

As a necessary incident to the administration of the Cross-License Agreement and in order to supplement the other services rendered to

MASS PRODUCTION OF LOCKHEED PURSUITS

The assembly line of the P-38, Lightning, pursuit planes for the Army Air Forces at the plant of the Lockheed Aircraft Corporation.

ANOTHER BELL AIRACOBRA FACTORY

An overall view of one of the Bell Aircraft Corporation's plants which are now mass producing P-39 cannon-carrying Airacobras for the air forces of the United States and Great Britain.

members, the Association had the foresight to acquire during a 20-year period a private library devoted to engineering research and technical developments in aeronautics. Well over three hundred volumes of books and periodicals were acquired during 1941, either by purchase or by gifts from various companies and individuals. In addition, a complete file of aircraft patents issued in the United States, and as many as were obtainable from Great Britain, France and Germany was maintained by the Association, including an extensive classification and indexing system, which was unique from the point of view of research in the patented art, and was peculiarly adapted to the needs of the members in connection with engineering problems.

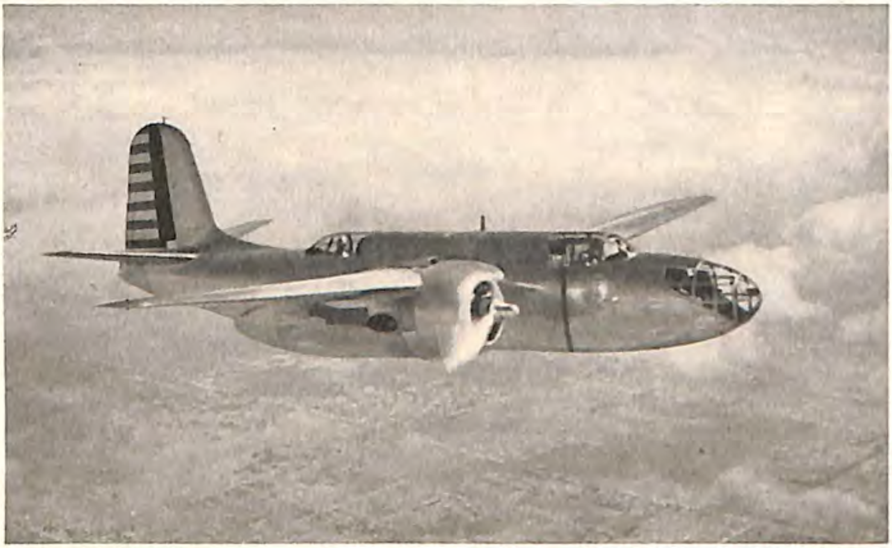
The Association's Patent Research Division was organized shortly after the adoption of the amended Cross-License Agreement. The services rendered by this Division were developed and expanded until it comprised one of the most important functions of the Association. The publication of a comprehensive digest of all aircraft patents and such British patents as were available, including abstracts of the specifications and official drawings, kept members informed regarding patented developments in the United States and foreign countries. The Patent Research Division also advised members of the Association insofar as practicable regarding the trend of technical development in the United States and other countries, with a view to minimizing infringement claims, and as a basis for the possible acquisition of patents, licenses and design rights. The facilities of the Division also were available in connection with the preparation and filing of patent applications on inventions which would otherwise be the subject of abandonment by member companies but eventually might have considerable value to the membership from a defense standpoint. The result was that wasteful patent litigation was largely avoided and advancement of the art encouraged by making the important technical progress available to all aircraft manufacturers in the United States.

Submissions of outstanding developments by all inventors in the field of aviation were given careful consideration and called to the attention of the membership, or kept on file so as to be readily available in case of inquiry. Some inventors were disposed to file complete data such as blueprints, photographs and experimental and test records in regard to their patented inventions, so as to be assured that the Association members have some indication of the real nature of constructive improvements offered for purchase or license. This was of advantage to inventors because the Association thereby understood the terms which would be acceptable to the respective patentees. At the same time, no submission of a confidential nature was solicited or received from others than members of the Association.

A further important service rendered in connection with nonmember patent owners was the substitution of friendly arbitration proceedings for costly court litigation. Accordingly, as in the case of the elimination of patent litigation between members as a result of the operation of the Cross-License Agreement, the Association suc-

AT THE FAIRCHILD AIRPLANE PLANT

Women at work on trainers.



THE EAGLE PUTS ON ITS WAR PAINT

The Douglas A-20 attack bomber in mass production for the U. S. Army Air Forces.

ceeded in establishing a somewhat similar situation as regards the relationship with non-member patent owners desiring to make worthwhile inventions available to the aircraft industry.

Advantages of the Cross-License Agreement to the industry, the Government and the public were manifold. By continuing to make important technical progess available to all manufacturers, the Association encouraged engineering development and research, resulting in a position of world leadership without interference from wasteful litigation or hardship due to any monopolistic tendency within the aircraft industry. Membership in the Association was not restricted in any respect. No qualified applicant was refused the right to acquire licenses under the terms of the agreement. There never were any withdrawals from the Association, except in the case of companies which either went out of business or ceased the manufacture of aircraft.

A direct effect of operations under the Cross-License Agreement was that there was no price fixing within the aircraft industry, no regulation or control of markets, nor any other restriction in regard to the sale of products. Patents of lesser consequence which might have been grouped for the purpose of controlling certain aspects of the manufacturing processes were licensed free of charge. Inventions of a more basic character, which otherwise might have been held by individual companies to dominate the industry, or withheld for the purpose of preventing competition, were made available at rates of royalty permitting unlimited use by every member of all inventions coming within the operation of the agreement.

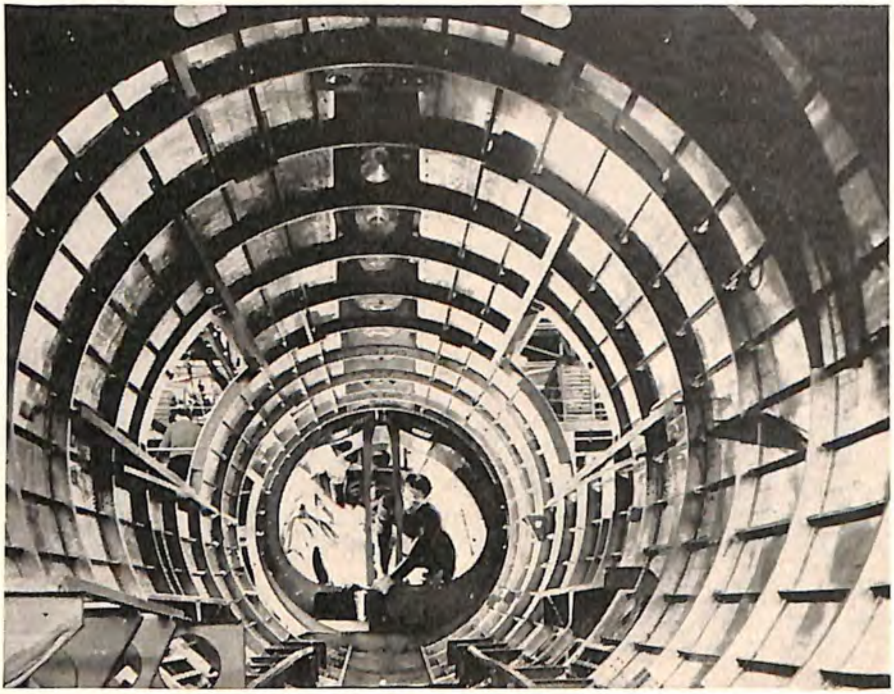
Early in 1942 the equivalent of many years of normal research and development were being crowded into the war effort. The most advanced ideas for the improvement of military models were made available to all manufacturers through the facilities of the Association.

National Aeronautic Association

The National Aeronautic Association in 1941 dealt with the civil side of air power by forming a united front among groups representing the several components of civil aviation and by launching programs to aid the military and civil defense forces. It campaigned for the formation of civil air defense units, set up by NAA groups in many areas under State sanction to mobilize private planes and pilots, and for a national Civil Air Patrol which was organized on the outbreak of war by the Office of Civilian Defense. While private pilots were grounded in other warring countries, they were carrying on in the United States under the patrol for many wartime duties. The headway of civil aviation thus was maintained for rapid expansion after the war.

NAA continued to pursue its regular programs of public education aimed at the development of airports and ground facilities for civilian pilot and mechanic training, and the general advancement of all phases of aviation. The organization was built up geographically with a National Councilor in each State, a growing number of active chapters, and with a 50 per cent gain in membership at large during 1941. The Association's monthly magazine, National Aeronautics, was developed to service NAA activities. The weekly NAA Wash-

BREWSTERS IN THE FAR EAST
A squadron of Buffalo fighters preparing for battle.



BOEING FLYING FORTRESS CONSTRUCTION

Mechanics installing a bracket for the retractible tail wheel of a Boeing B-17E Fortress.

ington Newsletter, started at the beginning of 1941, gained circulation. The affiliated women's Ninety-Nine Club maintained a newsletter and included over one-third of the licensed women pilots. A monthly publication also was issued by the NAA Academy of Model Aeronautics. There were special bulletins by the National Intercollegiate Flying Club Division.

Air Youth of America was consolidated as a new division of NAA, thus greatly expanding the Association's junior program. The National Aviation Training Association voted to affiliate with NAA. Other active affiliates in 1941 were the Soaring Society of America and the Air Reserve Association. The divisions and affiliates were designed to form a ladder of activities whereon young people entering aviation might progress from model building step by step to careers in aviation under a program integrated both nationally and locally.

The Collier Trophy for 1940 was awarded to Dr. Sanford A. Moss, engineer of the General Electric Company, and to the U. S. Army Air Corps for "outstanding success in high-altitude flying by the development of the turbo-supercharger".

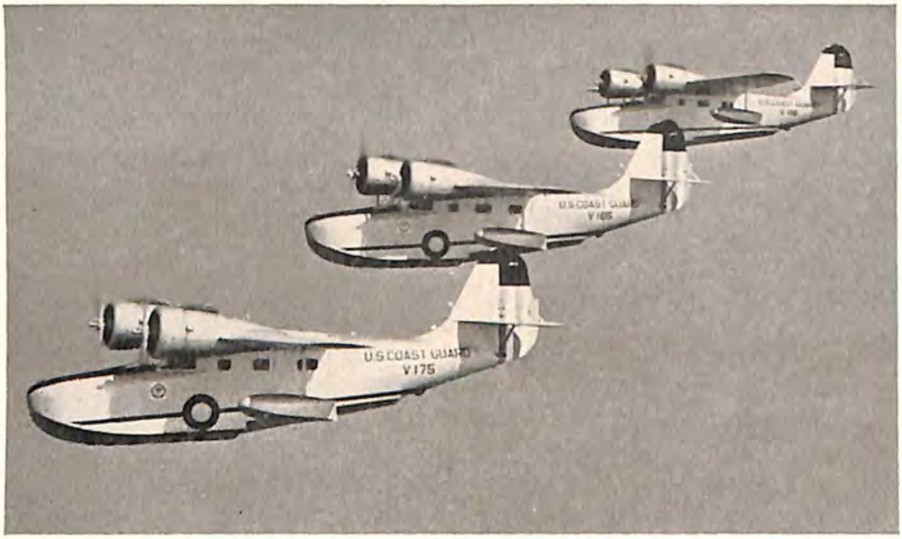
Several air shows were held under NAA sanction, under F.A.I. rules, administered by the NAA Contest Board. The offices of the Federation Aeronautique Internationale, governing body for sporting aviation throughout the world, came under Nazi domination with the German occupation of Paris. As U. S. representative of F.A.I., NAA repudiated the seizure and offered other member countries its facilities to safeguard records for the duration of the war.

National Aircraft Standards Committee

Aircraft manufacturing companies for many years employed standards engineers to establish standards on hardware components recurring in their aircraft designs. That activity was normally carried on in conjunction with the drawing room manual and a form of standard shop procedure manual which described various forms of fabrication processes utilized in that particular company's production line. The standards so established, in each case, augmented existing Army-Navy standards, and resulted from a definite need for the part in that company's designs. In 1940, it became apparent that many

A FLYING FORTRESS TAKES SHAPE

Joining the forward and aft sections of a Boeing B-17E four-engine bomber on the final assembly floor of the Boeing Aircraft Company's plant.



GRUMMAN JRF-2 AMPHIBIONS

On duty with the U. S. Coast Guard. They are powered by Pratt & Whitney Wasp Junior engines.

large companies were duplicating their efforts in establishing similar standards. This was undesirable for the customer because it resulted in a higher cost of the finished product and at the same time the various company standards, although utilized for the same purposes, differed just enough between companies to prevent interchangeability.

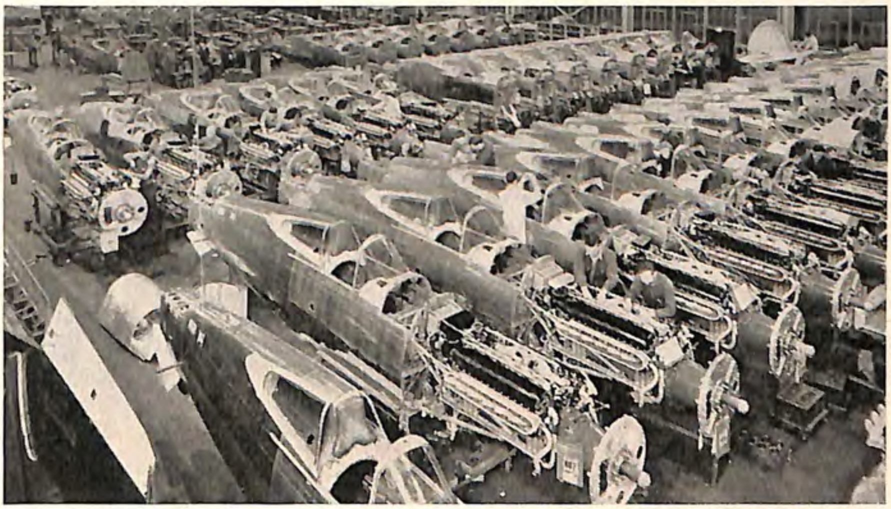
To solve their problems the aircraft companies formed separate standards committees in the eastern and western parts of the United States to establish inter-company standards. These committees were formed independently on both coasts. The two committees functioned separately for some time. Finally, a national organization was formed to coordinate the needs of the eastern and western companies, and to eliminate the duplicate standardization being established by the two committees. The National Aircraft Standards Committee was established on November 7, 1940.

On February 28, 1941, the NASC was given responsibility for the standardization of airframes, power plant installation and the various systems and installation problems encountered in aircraft production.

In order to help focus the work of the Committee on standards considered to be most important to the defense program, an Executive Board was organized, consisting of an engineering executive from an East and a West coast aircraft company, the chairmen of the eastern and western divisions and the presiding national chairman. The office of the national chairman was established in Washington, D. C., in which a Secretary handled the greater part of all routine correspondence.

The work of the standards committee was carefully coordinated with the Aeronautical Board (Army and Navy) to make sure that no duplication existed between standards program of the Services and that of NASC. If the Aeronautical Board was found to be working on a project paralleling that contemplated by NASC, the NASC program was deferred, and all material available to NASC immediately was turned over to the Aeronautical Board to assist it in processing its standard. If the Aeronautical Board decided that the Services were not interested in establishing an "AN" standard on the subject in question, it might then be reinstated on NASC's projects list. If an established NASC standard, through popular usage, was considered a suitable subject for "AN" standardization, the NASC standard was cancelled upon establishment of the duplicate "AN" standard in order to prevent the possibility of confusion which might arise as a result of two parallel sets of standards.

The NASC also formed a committee structure through which the Army and Navy were able to obtain industry coordination on any standards problem quickly and efficiently. An important fact was that during the emergency NASC was organized to assist and



CURTISS WAR PRODUCTION

Output of pursuits increased steadily at the plants of the Curtiss-Wright Corporation.

U. S. Army photo

NORTH AMERICAN BASIC COMBAT

The Army BC-2, with Pratt & Whitney Wasp engine.

to augment the Aeronautical Board in its work, and in no way was to be considered a competitive agency promulgating the wholesale duplication of existing Government standards.

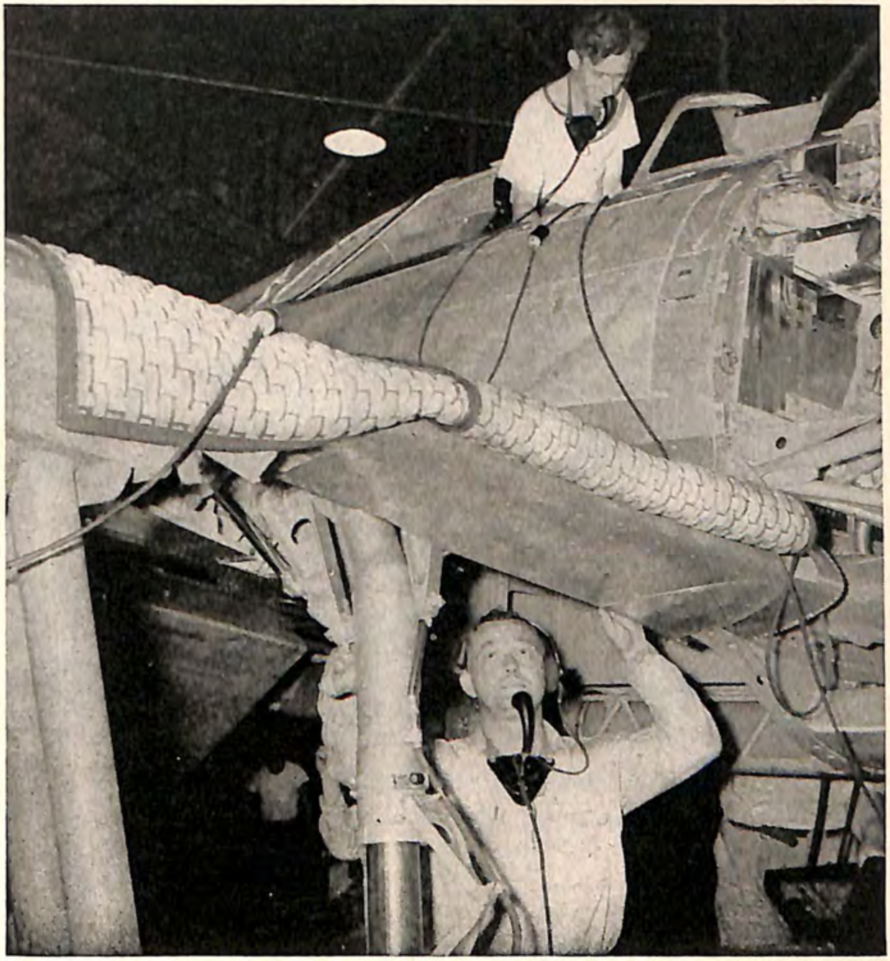
National Intercollegiate Flying Club

The National Intercollegiate Flying Club, a division of the National Aeronautic Association, was organized in 1934 to promote and advance collegiate flying. An annual Intercollegiate Flying Conference is held each spring and later in the year the National Intercollegiate Air Meet attracts contestants from all parts of the United States. The location and events of each annual air meet are decided by delegates to the annual conference. Regional and sectional air meets also are sponsored by the club. Through these contests, and the exchange of club ideas and by other group activities, the N.I.F.C. acts to publicize and promote college flying.

The Loening Trophy for the 1940-1941 school year was won by the University of Michigan Flying Club, whose 27 members logged approximately 1,570 hours, a number of which included instrument and cross-country flying, between March 31, 1940, and April 1, 1941. The Seventh National Air Meet of the NIFC was held at Middletown, O., June 18-20, 1941, by the Ohio State University Flying Club's "A" Team which accumulated a total of 121.6 points in the bomb dropping, precision landing and spot landing events. The University of Michigan's "A" Team was a close second and the "A" Team from the University of Detroit placed third. Twenty-one flying clubs from 16 colleges and universities participated. Individual high point scorer with a total of 150 points was Earl Rottmayer of the University of Michigan, and feminine high point scorer, with a total of 91 points was Dolly Heberding of Ohio State University.

Society of Automotive Engineers

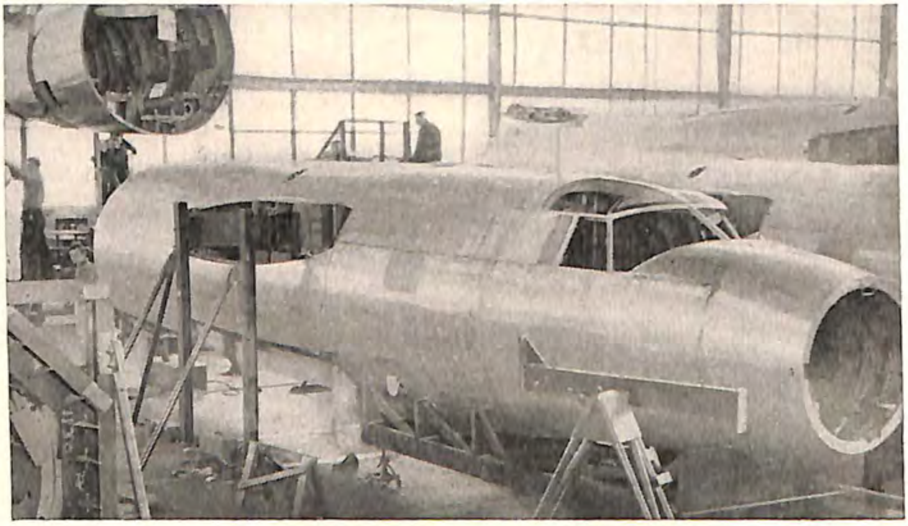
The Society of Automotive Engineers was active in aeronautic work through its aeronautic standards, its large-scale aeronautic



TIME-SAVERS IN PRODUCTION

The telephone line in action here is one of the world's shortest, but it is helping speed production of military aircraft. The two workmen, busy on a P-43 Lancer pursuit plane in the Republic Aviation Corporation plant, are equipped with a phone hook-up which permits them to talk to each other, even though one man is inside the fuselage and the other outside. Prior to this assembly line innovation, the man inside had to crawl to the nearest opening to communicate with his fellow workman.

meetings and its technical aeronautic papers in the SAE Journal, activities which accompanied the growth of the aircraft industry. During 1941 the SAE expanded its aircraft standardization functions to include the coordination for the aircraft industry of a broad aeronautical standardization program. Covering the fields of aircraft engines, propellers, accessories and equipment, and materials and processes for aircraft and aircraft engines and accessories. Within 10 months after the program's inception, 42 aeronautical standards were approved. A large number of the 7,500 members of the Society were connected directly or indirectly with the aircraft industry. In 1941, the aircraft groups heard 74 papers on a variety of aeronautical subjects delivered before the SAE national and sectional meetings.



MARTIN BOMBER CONSTRUCTION

A tail section goes on in the splicing fixture with nose already in place.

CHAPTER XI

THE AIRCRAFT MANUFACTURING INDUSTRY

Manufacturers of Planes, Engines and Accessories in Full-Out War Production—Expansion of the Industry—Its Contribution to the War Effort in Design and Construction—Development of Subcontracting—A Statement of Principles—Work of the Individual Companies

THE manufacturers of aeronautical equipment were in full-out war production which was being accelerated month by month, limited only by the allocation of materials which the Government had deemed critical and which were required by all defense industries. No better description of the aircraft industry program could be found than that expressed in a reaffirmation of principles made by the industry on March 14, 1942. It follows:

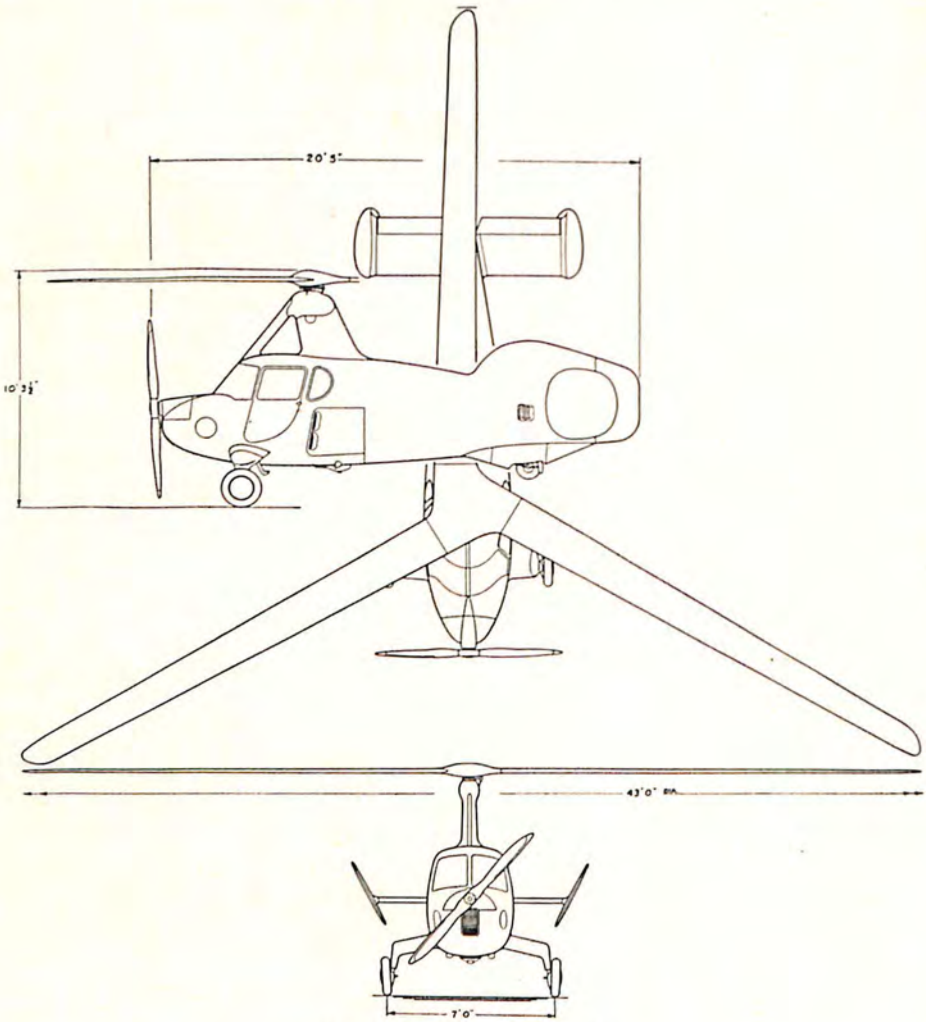
A Statement of Principles

"The American aircraft industry, still under the guidance of those who gave man wings, and backed by countless thousands of loyal men and women along production lines across the country, makes this solemn statement of principles:

"To our fellow Americans, and to fighters for freedom everywhere, we pledge our every material resource, our every ounce of energy to the great task entrusted to us.

"To the thousands of pilots now fighting for democracy, and to the legions of fledglings still to come, we rededicate ourselves to providing the finest equipment that aeronautical science can produce, and in such numbers as to enable them to sweep the skies.

"Given the materials with which to build, we shall carry the battle of production through to final victory."

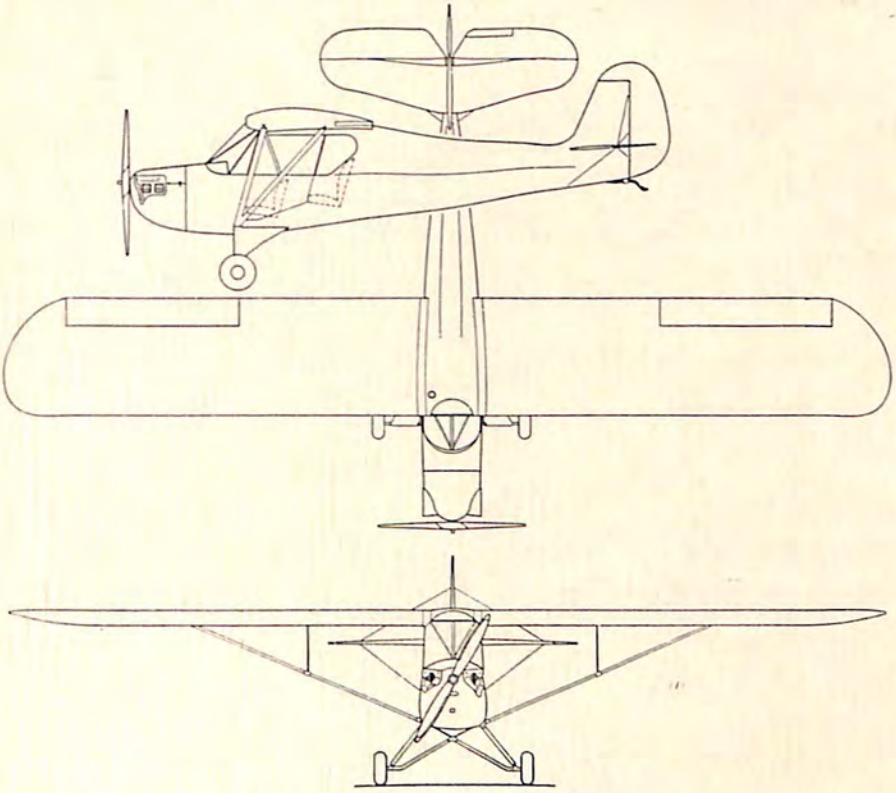


AGA PA-36 AUTOGIRO

A two-place cabin autogiro powered with a Warner Super Scarab 165 h.p. engine

Manufacturers of Aircraft

AGA Aviation Corporation, Willow Grove, Pa., was the new corporate name for the Pitcairn-Larsen Autogiro Company. In 1941, it had in production the PA-36 Whirlwing autogiro, a 2-place machine with 175 h.p. Warner Super-Scarab engine, a rotor disc area of 1,452 sq. ft. and a gross weight of 2,050 lbs. Top speed was stated to be 121.7 m.p.h., cruising at 102 m.p.h., range 350 mi.

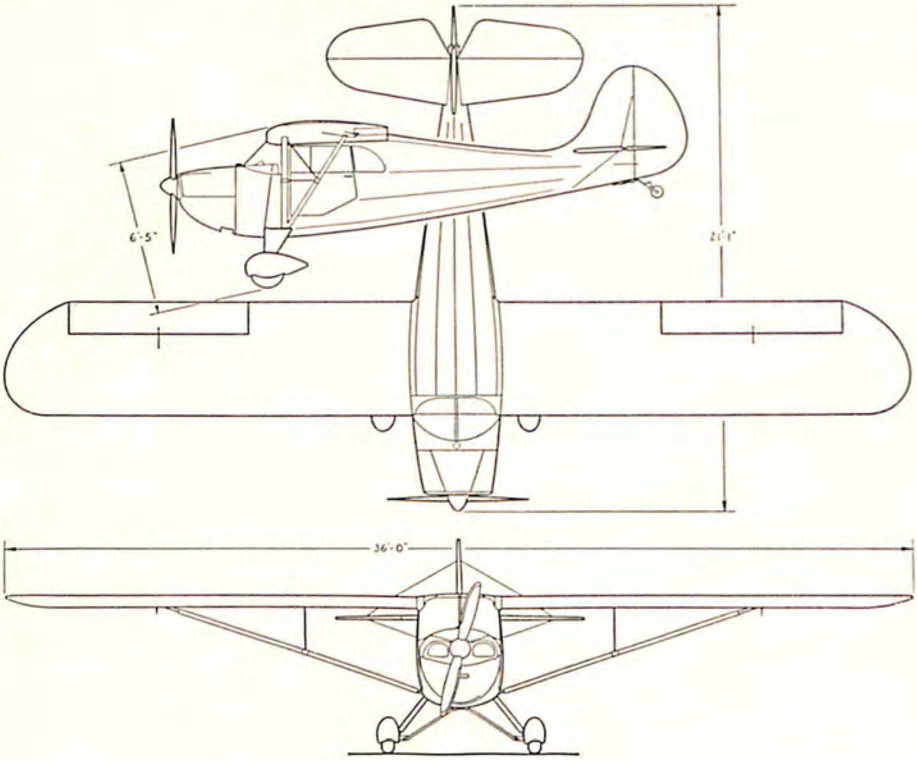


AERONCA DEFENDER TRAINER

This two-place tandem trainer is offered with a choice of Continental, Franklin or Lycoming engines.

Aeronca Aircraft Corporation, Middletown, O., increased its production approximately 28 per cent in 1941. This was due largely to the demand for the Aeronca Super Chief and a new tandem training ship that was designed, engineered and produced as the Aeronca Defender. The Aeronca Super Chief, a 2-place side-by-side high-wing monoplane, was popular with sportsmen pilots and with airport operators who believed that this type of airplane was desirable for training pilots. During the year, many changes in the way of improvements were made on the Chief. Improved brakes were designed, cowling was modified and general interior improved.

Late in 1941, the new Defender trainer was announced. It was designed around the former tandem trainer with the following improvements added: A wider fuselage, improved interior, heavier construction, balanced controls, addition of muffler and improved type



THE AERONCA SUPER CHIEF

A two-place plane for the private owner powered with either a Continental or Lycoming 65 h.p. engine.

cowling. In addition to these main changes, a number of other improvements were made to increase the pilot's comfort. The introduction of the Defender was followed by an initial order from the War Department for a military version of this ship to be used in aerial observation and courier work. Equipped with 2-way radio, along with a few minor changes, these standard Defender trainers, known to the Army as the O-58-A airplanes, were used in extensive military maneuvers in the South and West. Piloted by U. S. Army Air Forces pilots, these ships performed yeoman service in the duties assigned to them and were immediately recognized as valuable contact units.

Plans were made to expand plant facilities with an increase of personnel.

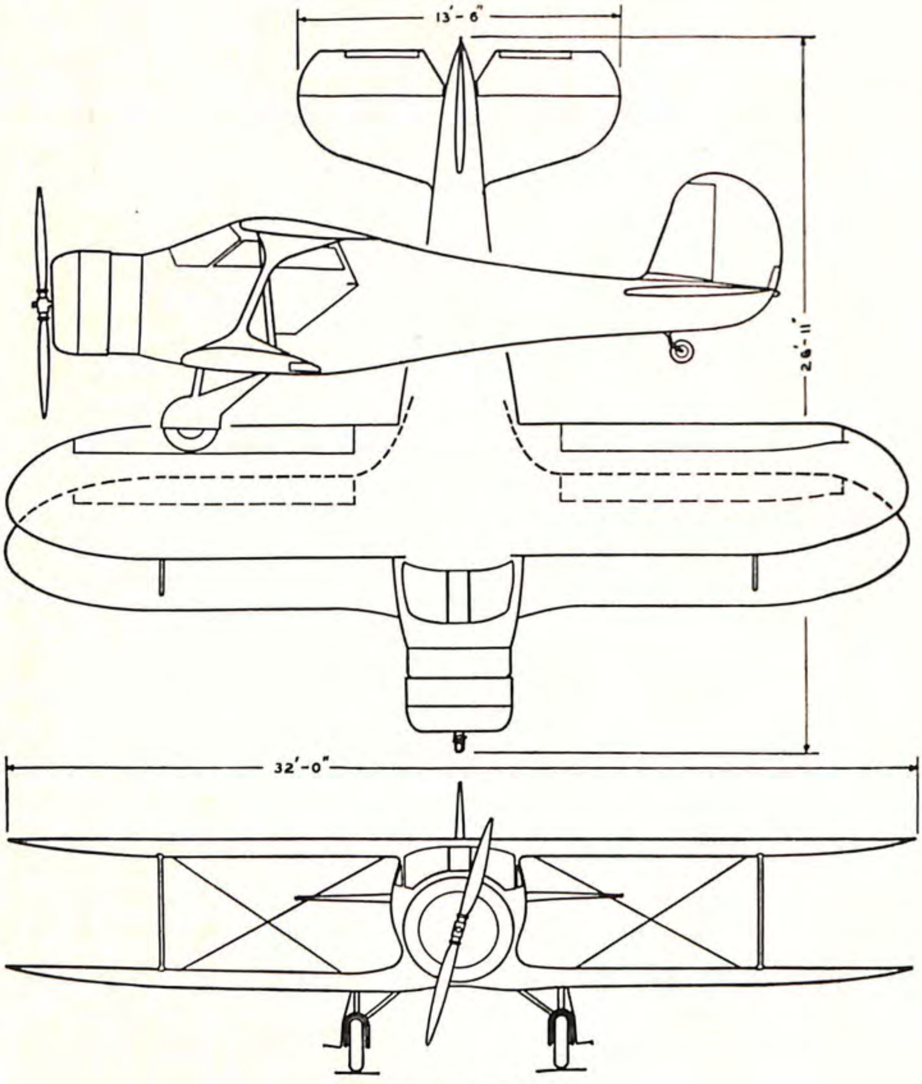
Beech Aircraft Corporation, Wichita, Kans., concentrated on large-scale production of Beechcrafts for the U. S. Army Air Forces and the Navy Bureau of Aeronautics. Types produced were chiefly adaptations of the Beech commercial Model 18 all-metal twin-engine monoplane and the Model 17 single-engine biplane. To expedite production, appropriate expansions of facilities and personnel were undertaken, and the company's extensive sub-contracting program was further enlarged.

Characteristics of the previous commercial Beechcraft were retained in the military versions. Low wing loading and landing speed, high cruising speed, retractable landing gear and tail wheel, large aileron-type trailing edge flaps for safe small-field operation, and extensive use of heat-treated structural members of high strength-weight ratio were basic design features of all types. Negative wing stagger continued to characterize the single-engine Beechcraft biplane.

All-metal twin-engine Beechcrafts were produced for the Army Air Forces in three versions, the C-45A personnel transport, AT-7 navigation trainer and the AT-11 bombing trainer. The C-45A personnel transport had passenger accommodations similar to those of a commercial air liner, and carried de-icers and anti-icing equipment. The War Department described the AT-7 navigation trainer as follows: "The airplane is an all-metal, low-wing monoplane with retractable landing gear and twin rudders. It is powered by two Pratt and Whitney 9-cyl. 450 h.p. engines, and carries a crew of five. This is the first training airplane procured solely for training student navigators. It is equipped with a chart table, a periodic compass and stabilized drift sight for each of three students, and a celestial navigation dome for sextant readings."

The AT-11 bombing trainer was described by the War Department as follows: "The low-wing all-metal monoplane AT-11 advanced trainer will be used for the specialized training of bombardiers and gunners. It is equipped with flexible guns and bomb racks for

A NAVY BEECHCRAFT
The JRB-2 personnel transport.



BEECHCRAFT D-17

A five-place private plane with a choice of either a Pratt & Whitney or Wright engine both rated at 450 h.p.

the instruction of a crew of three or four men, depending upon the instructional mission. The AT-11 has a wing span of approximately 47 ft., a length of 35 ft., retractable landing gear and twin tail. Power is delivered by two radial, 9-cyl., 450 h.p. Pratt and Whitney engines which operate two two-blade propellers having a diameter of approximately 8 ft."

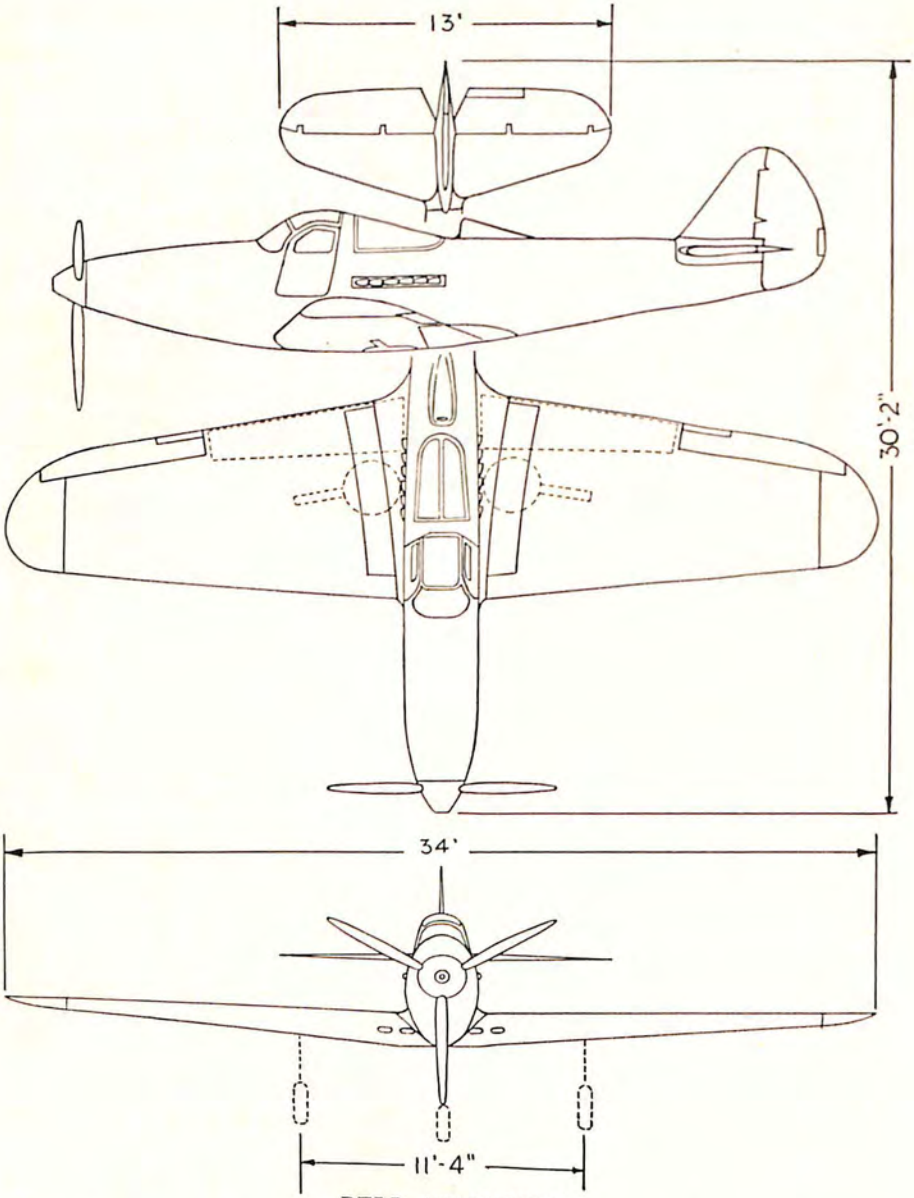
For the U. S. Navy Bureau of Aeronautics, production proceeded on two versions of the basic all-metal twin-engine design. The JRB-1 utility transport was distinguished by a streamlined extension of the cockpit enclosure, to provide maximum visibility in all directions for special observation purposes. The JRB-2 personnel transport was equipped with special accommodations for passengers, similar to the Army's C-45A transport. Also in production was the GB-2 light personnel transport, a single-engine biplane similar to the commercial Beechcraft biplane.

Production also went forward on a new model twin-engine Beechcraft advanced trainer for the Army Air Forces, designed for pilot instruction on multi-engine aircraft. Wood was used extensively in its construction, to speed production and release scarce materials for use in combat planes. Its official War Department description was: "The AT-10, an advanced training airplane, is a low-wing monoplane with a conventional retractable landing gear. The fuselage is wood monocoque construction except for the pilots' compartment which is of metal construction. Two 280 h.p. 9-cyl. radial engines, each equipped with a two-blade propeller, power the airplane. This new transitional training airplane with the pilot and student seated side by side is equipped with a full complement of training instruments, including an automatic pilot."

Bell Aircraft Corporation, Buffalo and Niagara Falls, N. Y., directed all its efforts to the production of ever-increasing quantities of its interceptor-pursuit, the Airacobra, designated P-39 by the U. S. Army Air Forces. When the President, at the outbreak of war, December 7, asked for all-out, full-time production in the war effort, Bell Aircraft was one of the first to answer with a 24-hour day, seven-day week production schedule.

The Airacobra, designed and manufactured by Bell Aircraft, purposely was designed around a 37 mm. cannon firing either explosive or armor piercing shells. The cannon was mounted in the nose and fired directly forward through the hollow propeller hub. Other armament included light and heavy machine guns installed in the fuselage and wings. The engine was mounted behind the pilot, and the propeller was powered by means of an extension driveshaft from the engine, beneath the pilot's compartment to the propeller in the nose, the same principle used in surface ships, and automobiles. The latest improvements included more and heavier armor plate and leak resistant fuel tanks and an improved Allison engine.

As the air forces of the United States and Great Britain called for more and still more Airacobras, Bell Aircraft, in the middle of 1941, swung into real mass production. In May, a new assembly

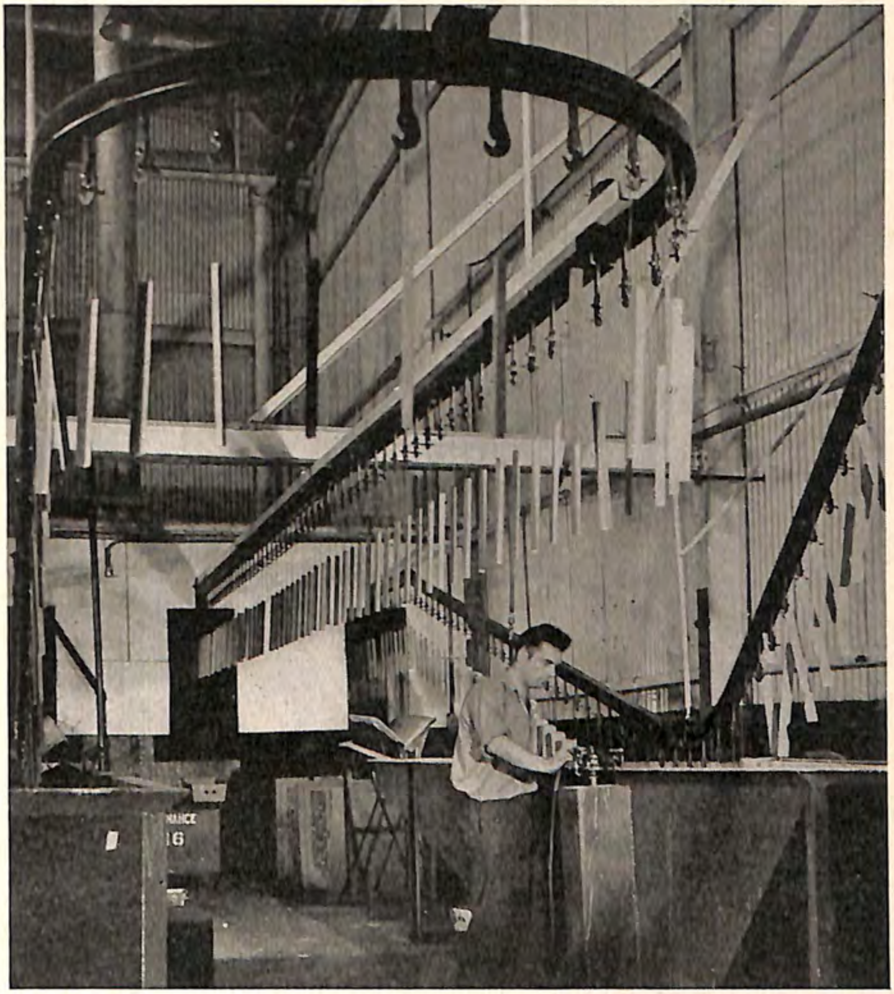


BELL AIRACOBRA

This single-seat interceptor fighter is powered with an Allison engine.

plant had been completed, and by midsummer was in full operation. Early in 1942 the company's production was carried on in several plants. A further large expansion of production space was initiated in October, 1941, and was ordered rushed to completion when America entered the war.

Employees were added at a greater rate, proportionately, than floor space was acquired. The company realized that not enough men would be available to meet future needs, and within a matter of days women workers were being employed for production departments. That program was gradually expanded, and women were engaged in light assembly, electrical work and fabric attachment.



SAVING TIME IN PRODUCTION

With this conveyorized paint dipping equipment, Bell Aircraft Corporation can double-dip paint thousands of small Airacobra parts each day.

Bell Aircraft's assembly lines featured straight line production, with sub-assemblies flowing into the final assembly line at the proper points. At the new assembly plant, drag-chain conveyor lines were built into the floor and carried wheeled dollies down the line as various operations were performed. Another production improvement adapted to aircraft industry needs was an overhead conveyor system to carry parts and materials to fabrication departments and the assembly lines. Nearly a mile long, this conveyor daily delivered tons of parts and materials. Another conveyor was used to "double-dip-paint" small parts instead of spraying them.

Redesign of about 30 per cent of the Airacobra to enable 100 per cent lofting was one of the first steps taken by Bell Aircraft to achieve mass production. This required making a template or pattern for each one of the 9,000 parts that made up this fighter plane. As a result of this method a workman could take the pattern for any part, and easily make the piece to match it.

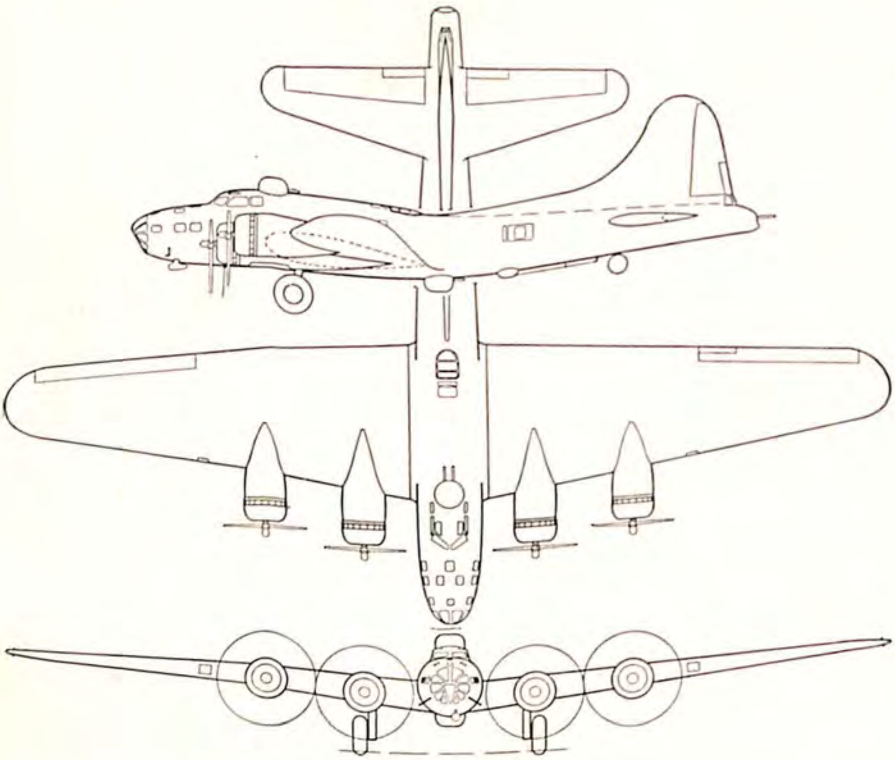
Bell Aircraft pioneered in the development of a flush riveting technique suitable for mass production of high performance aircraft. It involved an improved method of dimpling and the development of a new machine to turn out 400,000 rivets a day, resulting in an 80 per cent reduction in rejections. A pantograph router was developed which traced a template on one table and accurately cut complicated parts out of aluminum alloy sheets on another table. The handwork required to sew the fabric covering to the control surfaces of the Airacobra threatened to become a serious bottleneck until Bell Aircraft engineers developed a simple device to force a thin retainer strip into a channel in a rib extrusion to hold the fabric in place. This device was made available under license to other manufacturers in the industry, as were other Bell Aircraft developments. The Farnham Spar Cap Milling Machine, also developed by Bell Aircraft engineers, cut the time needed to mill wing spar cap extrusions to five per cent of former time requirements.

Boeing Aircraft Company, Seattle, Wash., continued and greatly increased production of its famous Flying Fortress four-engine, long-range bombers during 1941. Early in 1941 the last of the model B-17D Flying Fortresses were completed. A group of the B-17C models named "Fortress I's" by the British, were delivered across the Atlantic to the R. A. F., where they won immediate acclaim in many actions. Germany got her first taste of the effectiveness of this substratosphere heavy bomber when an R. A. F. Fortress squadron scored hits on the battleships Scharnhorst and Gneisnau in the harbor of Brest, from high altitudes never before used in warfare. Flying at 35,000 ft., the Fortresses were almost out of sight and hearing of the ground, and were out of effective reach of both anti-aircraft fire and intercepting Nazi pursuits.

Even more important than the spectacular part these ships were playing in the European war was the introduction, in September, 1941, of the new B-17E Flying Fortress, described by the War Department as "bigger and more deadly" than any of its predecessors in the notable Boeing Flying Fortress series. This new ship was not a lone experimental model but the first of a huge production series that early in 1942 was rolling off enlarged production lines in steadily increasing volume. A record in testing was accomplished with the first B-17E when the ship was rolled from the plant, had a complete engine and ground test and took to the air on the same day. For the quantity production of this airplane, Boeing had installed in one of its plants alone some $10,000,000 worth of the most modern prduction machinery obtainable, as well as assembly jigs, dies, machine fixtures and handling fixtures, all specially designed for rapid production. The Boeing tooling department, working under forced draft, in 12 months designed and manufactured some 40,000 such jigs and tools, to fit the requirements of the new volume production.

MASS PRODUCTION OF HEAVY BOMBERS

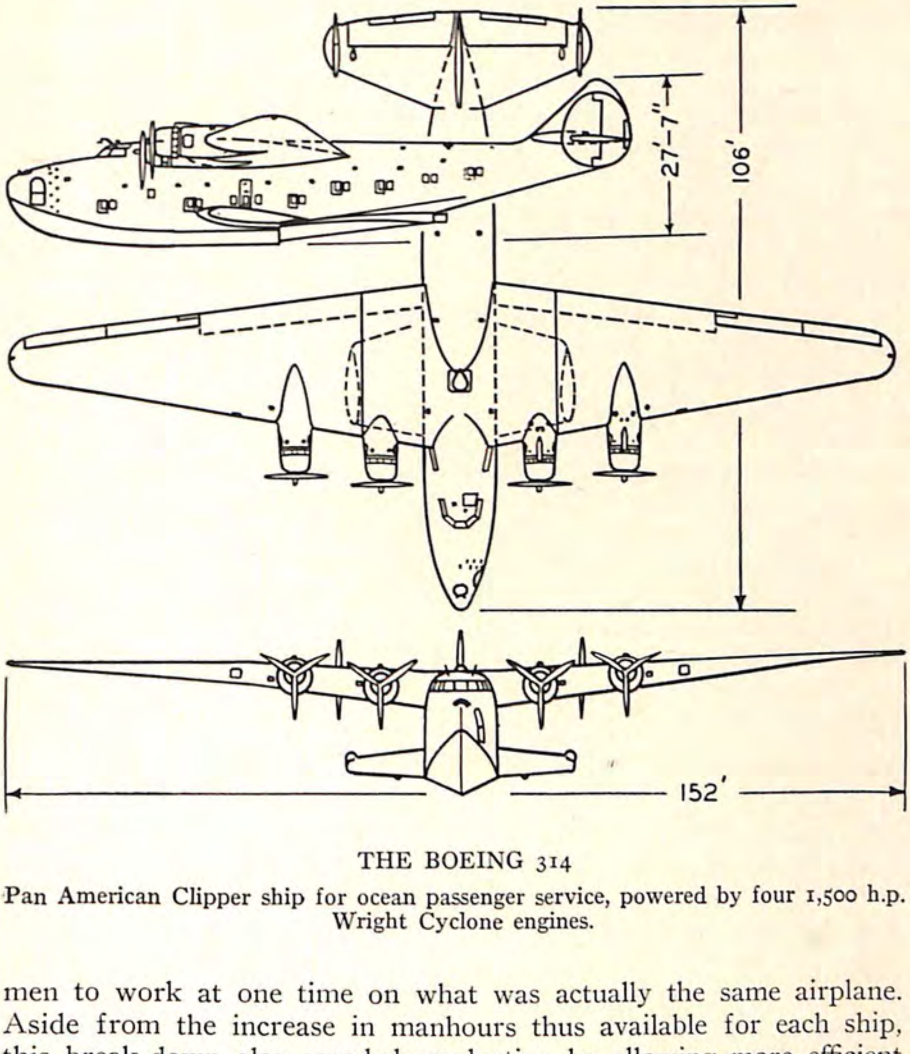
One of the Boeing Aircraft Company's plants showing assembly of the B-17E Flying Fortresses.



BOEING B17E FLYING FORTRESS

In 1941, there was created a unique "production pool," in which Boeing, Douglas and Vega cooperated in the manufacture of completely assembled, identical B-17 airplanes. Boeing-designed tools, jigs and dies were made available to the other manufacturers in this "patriotic cooperative."

With the advent of true mass production in the aircraft industry, the new Flying Fortress was broken down into many separate units to facilitate subcontracting and more efficient assembly. Subcontractors and suppliers in virtually every part of the United States were shipping everything from small bolts and nuts to completed outer wing panels and engine nacelles to the final assembly plant. Earlier Fortresses had been built more or less as complete units in one jig assembly line. In the new B-17E, through the use of newly designed tools and breakdown jigs, the fuselage had been broken up into three main sections, which in turn were a combination of many smaller sections assembled in minor break-down jigs. Each of the three main fuselage sections was assembled in a separate jig, enabling many more



THE BOEING 314

Pan American Clipper ship for ocean passenger service, powered by four 1,500 h.p. Wright Cyclone engines.

men to work at one time on what was actually the same airplane. Aside from the increase in manhours thus available for each ship, this break-down also speeded production by allowing more efficient use of available space. Each of these main fuselage jigs was duplicated many times, with dozens of copies of each. From these jigs, completed body sections flowed in orderly succession on installation cradles on tracks to a joining position. After joining the body sections, the bodies were mounted on specially designed assembly jacks on the final assembly floor. Through the use of these jacks, each completed fuselage could be lowered to floor level for final reaming of wing terminals and installation of the hundreds of small items necessary to these huge planes. After completion of wing installation, the electric jacks raised the fuselage to a position high enough to permit installation of the wheels and tail assembly. The entire process was planned toward the end of producing in quantity.

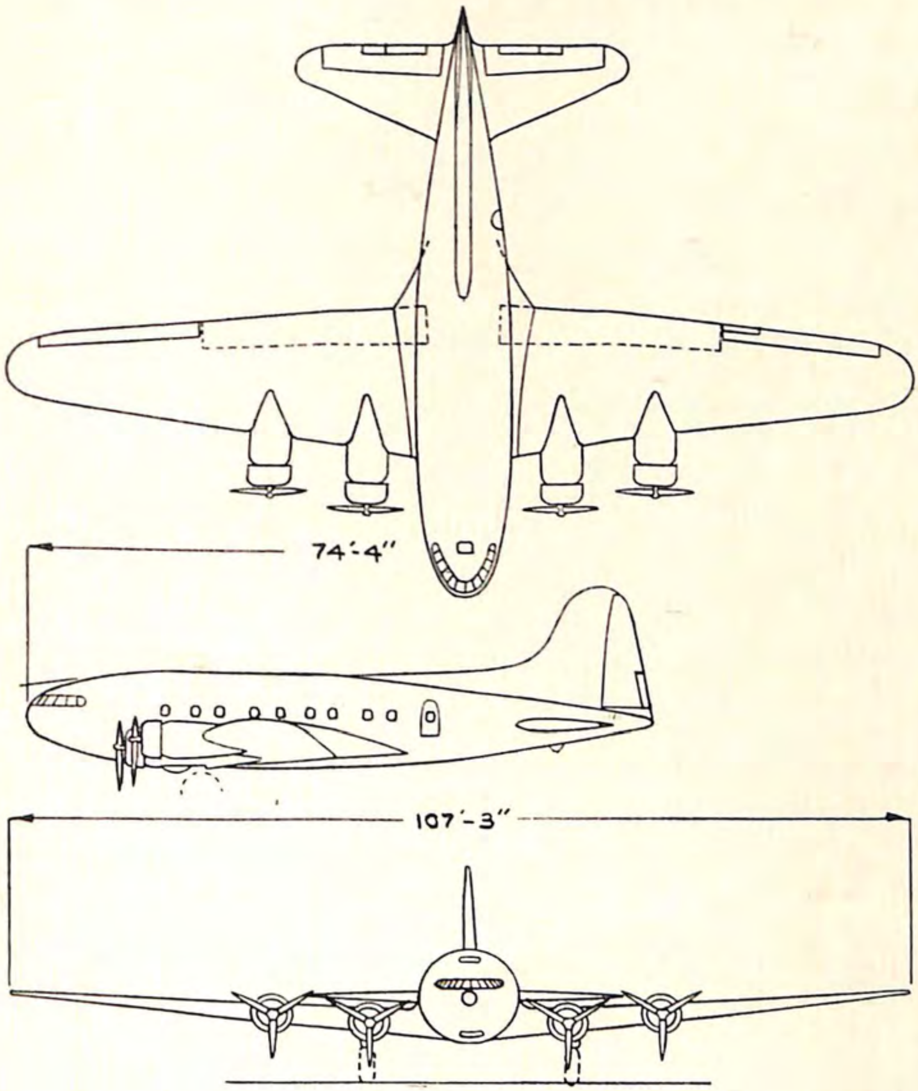
Boeing installed millions of dollars worth of the most modern heavy machinery available. Huge hydraulic draw presses and multiple-action mechanical presses now do the work of the old drop hammers, and would in time eliminate hammers for all but special experimental work. The largest press in use, a 5,000-ton monster, could do the work of a whole battery of drop hammers. As an example, one of the new multiple-action mechanical presses could turn out four parts per minute, where the drop hammer required an average of 30 minutes, for just one of the same parts. The switch-over to heavy presses has not been an overnight process by any means. The use of this type of equipment in the automotive industry had been in connection with sheet steel, an easily worked metal, whereas the airplane industry was working with aluminum alloys and stainless steel. Further, airplane parts must be formed accurately and with infinitely finer tolerances than automotive factories have used.

One Boeing designed and built machine, which was in use in other plants as well, was the circumferential hydro-punch, an ingenious gadget that punched circumferential stiffeners with a dozen or more holes and trimmed the ends in one easy operation. This process which by old methods meant punching out each hole one at a time, had been speeded up by this hydro-punch. Boeing turned out more of these stiffeners in one day than old methods could produce in a month.

In the matter of "skinning" the broad wings of the Flying Fortress, another interesting automatic machine was designed. Sheet Alclad (aluminum alloy) came to the plant in long sheets. To speed production these sheets were automatically spot-welded together to form a covering panel for one whole inboard wing section. In operation, this machine resembled more than anything a huge sewing machine, automatic in operation, which made neat rows of spot-welds and permanently fastened several sheets of aluminum alloy together.

The B-17E Flying Fortress was basically the same B-17 type as had been used by the Army Air Forces and the R. A. F., but was considerably modified to incorporate latest developments in aerial fighting. In place of the original vertical tail, a new tail surface design, including a long dorsal fin extending almost half way forward on the body, was used and in place of the knife point fuselage a deadly new tail "stinger turret" was housed in the end of the ship. Previous gun emplacements were augmented by power-driven heavy calibre turrets on both top and bottom of the long cylindrical fuselage.

The first weeks after America's entry in the war saw Boeing Flying Fortresses in action. Captain Colin Kelly's heroic bombing of



THE BOEING STRATOLINER

A 38-place transport for substratosphere operations. It is powered by four Wright Cyclone engines of 1,100 h.p. each.

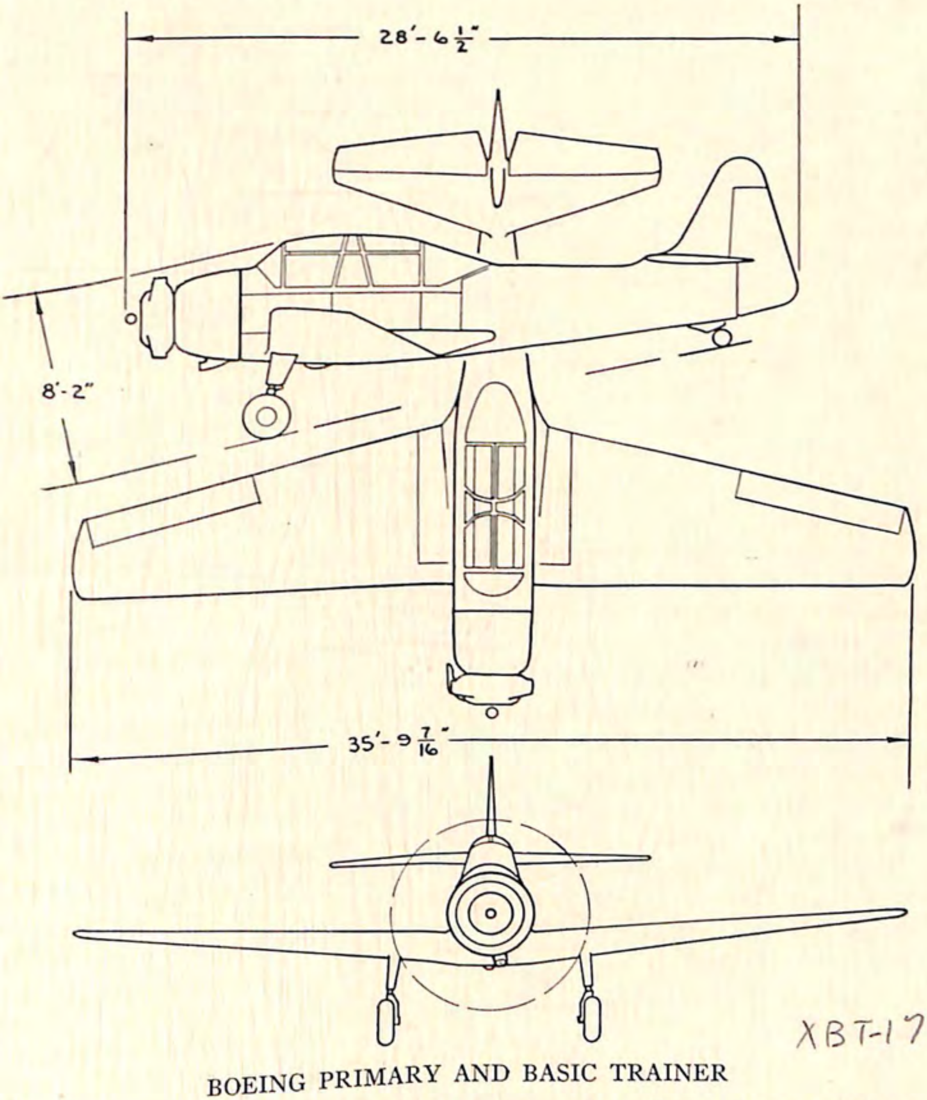
the Japanese battleship "Haruna" was accomplished with a B-17, and later dispatches told of many additional aerial missions carried out by these four-engine bombers. A House Military Affairs subcommittee reported February 1, 1942, for instance, that "within the past two weeks the U. S. Air Force on six assigned missions, using from three to nine B-17 airplanes each, destroyed 13 enemy airplanes, two lighters, two transports and one tanker, and damaged one battleship, one cruiser, one transport and a tanker, losing a total of only three planes."

Other military aircraft built by Boeing during the year included a large number of Douglas-designed DB-7B's, known in the R. A. F. as "Boston III's." Two Wright Cyclone 14's, of 1,600 h.p. each, powered these fast, all-metal light bombers.

The Boeing Company continued its extensive strato-chamber research, and early in 1942 completed a new cold room for the testing of full size aircraft components. Capable of maintaining a temperature of minus 70 degrees F., this room also was connected to the newly enlarged strato-chamber, part of which now could be reduced not only in pressure to simulate high altitudes, but could be used as well for testing under combined low pressure and low temperature conditions. Regulation of humidity also was possible in this newly enlarged chamber. These two chambers were helping immeasurably in the testing of new equipment for the Flying Fortresses, which early in 1942 were the only substratosphere bombers in service anywhere in the world.

The fleets of four-engine Boeing Stratoliners and Strato-Clippers in service with TWA and Pan American Airways respectively, continued to give high speed service in "above the weather" flights across the continent and to South America. These ships remained the only cabin-supercharged commercial airplanes in service anywhere in the world. Carrying 33 passengers and a crew of five, the Stratoliner and Strato-Clipper were basically similar in design and appointments. Four 1,100 h.p. Wright Cyclones powered these all-metal low-wing ships, which had a top speed of 250 m.p.h. The body diameter was 11½ ft., giving the cabin a width slightly greater than that of a modern streamlined railway train. The overall length was 74 ft. 4 in., wing span 107 ft. 3 in., and overall height 20 ft. 9½ in. Weight empty was 30,000 lbs., gross weight 45,000 lbs. Night accommodations were provided for 25 passengers, with 16 upper and lower berths plus 9 individual reclining chairs.

Take-off distance of the Stratoliner and Strato-Clipper (Models 307-B and S-307) when equipped with 1,100 h.p. Wright Cyclone GR-1820-G105-A engines was 927 ft., rate of climb with four engines 1,200 ft. per min., with three engines 600 ft. per min., and with two engines 113 ft., per min. Service ceiling was 24,000 ft. with four engines, 16,350 ft. with three, and 7,950 ft. with two engines. The maximum range with reduced payload (17 passengers and baggage) was 2,340 mi. Automatic cabin supercharging in the ships

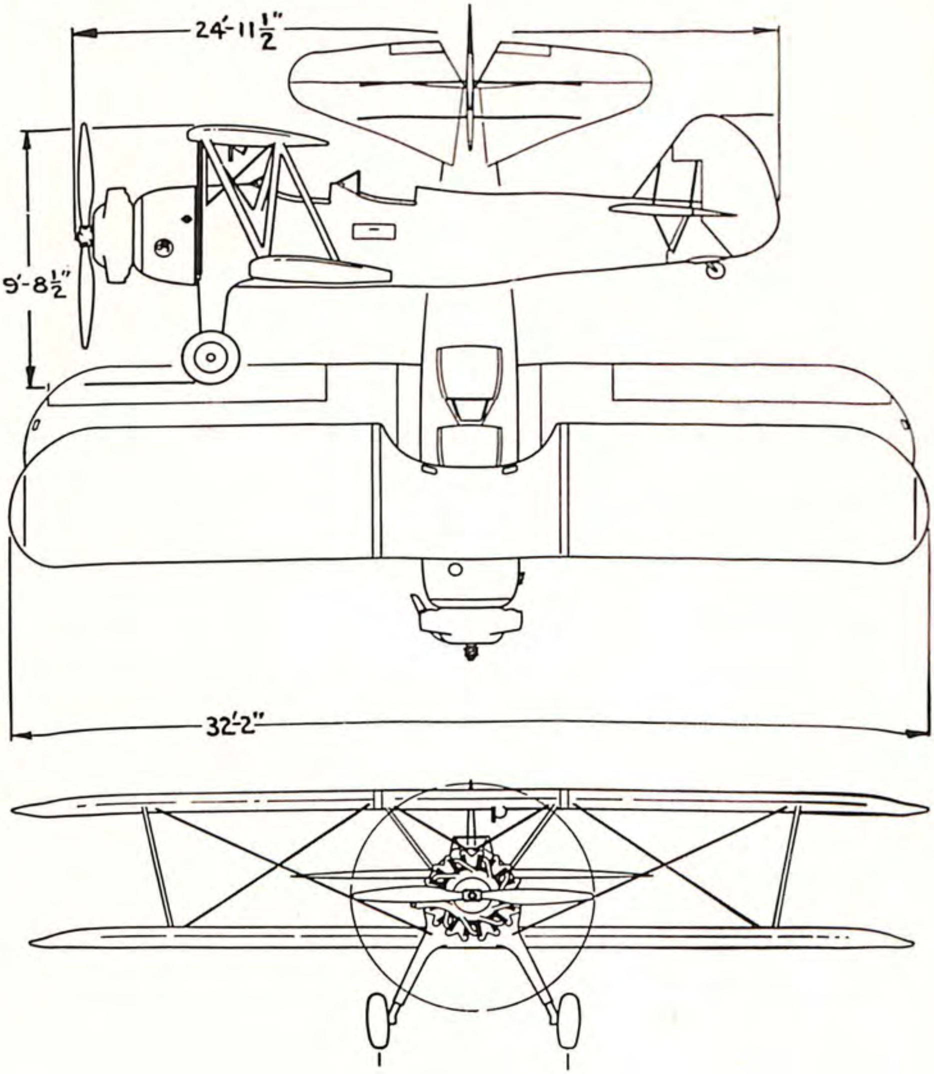


BOEING PRIMARY AND BASIC TRAINER

Model 90 is powered by a Lycoming 225 h.p. engine. The 91 is powered by a Pratt & Whitney 450 h.p. engine.

maintained comfortable low-altitude atmospheric conditions for passengers and crew during upper level flight, at altitudes of from 14,000 to 20,000 ft.

With the completion of an additional six Boeing Model 314-A Clippers during 1941 the fleet of these 42-ton flying boats in world-wide service was doubled. Pan American Airways used nine of these



BOEING TRAINER PT-13B

The PT-13B has a Lycoming engine. The PT-17 has a Continental 220 h.p. engine. The PT-18 has a Jacobs 225 h.p. engine.

Boeings on their Atlantic, Pacific and African service. Three of this last series of six were re-sold to British Overseas Airways for Empire communications service, and it was, in fact, one of these ships in which Prime Minister Winston Churchill flew back to England after his historic visit with President Roosevelt in Washington. The

314-A's delivered several months ahead of schedule during 1941 were basically similar to the first six Clippers delivered, but had larger engines, a new laminar flow type propeller, increased fuel capacity and innovations in interior design and arrangement. The first six Pan American Boeing Clippers were modified into 314-A's during 1941, with the addition of new engines and greater gas capacity.

Boeing Model 314-A's and 314's in service with Pan American Airways at the end of 1941 included the Atlantic Clipper, Pacific Clipper, American Clipper, Yankee Clipper, Dixie Clipper, California Clipper, Honolulu Clipper, Anzac Clipper and Capetown Clipper.

Construction and delivery of Army and Navy primary trainers from the Midwest plant of the Boeing Company continued throughout 1941 in record quantities. PT-17's and PT-18's for the Army, powered by Continental R-670 and Jacobs R-775 engines respectively, were going into service in many Army primary training schools. The new Navy primary schools at Jacksonville and Corpus Christi, Tex., were getting, in addition to other new Navy flight training centers, increasing numbers of N2S-2 and N2S-3 trainers, basically similar to the Army PT-17 and PT-18 except for minor modifications.

Brewster Aeronautical Corporation, Long Island City, N. Y., placed in operation a new plant, as it went into production on two new long-range dive-bomber models. They were the Brewster Buccaneer SB2A-1 for the U. S. Navy; and its export counterparts the Brewster Bermuda, being built in quantity for the Royal Air Forces of Great Britain and the Netherlands East Indies. Both the Buccaneer and the Bermuda were two-place aircraft each powered with a 1,700 h.p. Wright Cyclone 14 engine. The Navy Buccaneer differed from the export, its counterpart, in that it was designed for operation from aircraft carriers, whereas the Bermuda was designed for landbased operation. It was disclosed officially that both had a range of approximately 2,500 mi. and were capable of carrying a 1,000 pound bomb. A distinctive feature of the design was the enclosure of the bomb load entirely within the fuselage with the resultant elimination of drag which would be encountered if bombs were carried externally in racks suspended beneath the belly of the ship. The internal enclosure of the bomb load was introduced in the SBA-1 developed by Brewster for the U. S. Navy in 1935.

Both the Buccaneer and the Bermuda were equipped with braking flaps to slow speed in dives on targets, bullet-proof fuel and oil tanks, armor plating for pilot protection and bullet-proof windshields.

During 1941, the company completed delivery of Brewster Buffalo single-place, single-engine fighters, powered with 1,100-1,200 h.p. Wright Cyclones, to the U. S. Navy and the Royal Air Forces of

THE BREWSTER BERMUDA

Great Britain and the Netherlands East Indies. The Buffalo, named by the British for the water buffalo of the Far East, saw service on practically all the foreign fighting fronts and received high praise from both British and Dutch pilots for its speed, fire-power and maneuverability. Buffalos were used initially for the protection of the British Isles during the early raids on London and later were employed by the R.A.F. in Libya and at Singapore.

In both the latter sectors, they outperformed superior forces of German Messerchmitts of the 109 and 110 types, coming off victorious against odds as high at times as 5 and 10 to 1. Press dispatches from Singapore particularly praised the ease of handling of the stubby little ships and their ability to "turn inside" enemy aircraft. Similar reports came frequently from Java and other points in the Dutch East Indies where the Buffalo was used in combat.

Developed originally as a shipboard fighter for the U. S. Navy, the Buffalo was equipped for export use with four .50 cal. machine guns, two installed in the wing and two firing through the propeller. Speed was about 350 m.p.h. Bullet-proof tanks and windshields as well as armor for the pilot were standard equipment.

In addition to producing the Buccaneer, Bermuda and Buffalo models, the Brewster Company continued to produce outer wing panels, wing-tip floats and braces for a prime contractor. A production problem involving the backing-up of rivets and the inspection of rivets in the wing panels was ingeniously solved by the employment of 15 midgets whose small size enabled them to work with ease in cramped quarters which quickly tired normal-sized men. The subcontract for the wing panels was the only remaining vestige of the previous nature of that type of business in which the company had engaged. At one time subcontracting constituted approximately 90 per cent of the company's production. The sole remaining subcontract comprised less than 10 per cent of sales. Brewster's own experience as a subcontractor stood it in good stead in cooperating with the Government's desires in placing its Buccaneer and Bermuda models in production. Approximately 45 per cent of these models are furnished by outside vendors.

The new factory was strictly an assembly plant. Its modernity was attested to by the fact that all arrangements had been made for extensive employment of women on the sub-assembly and assembly lines. Early in 1942, several hundred women were employed and others rapidly being trained for sub-assembly and production line jobs.

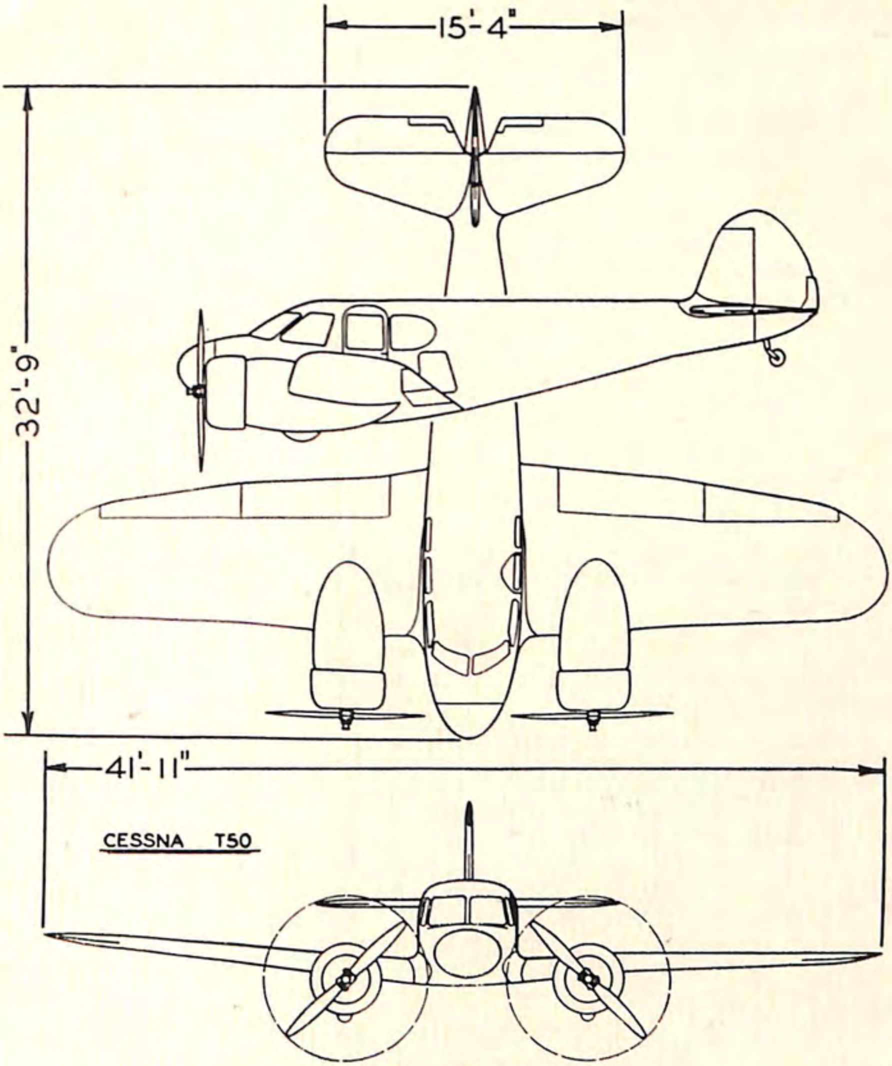
Brewster pioneered among manufacturers in the construction of a modern airport adjacent to its plant by becoming the first of the nation's aircraft manufacturers to employ the soil-cement process in the construction of runways. This process involved the use of approximately 10 to 15 per cent cement mixed with the soil, and enabled the company to effect a saving of upward of 40 per cent in cost over conventional macadam or concrete. Equally as important was the saving in time. The new airport with three runways of about 3,000 ft. each in length was built in the unusually fast time of five months from the day the grading operations were started. The normal time for building an airport of this type was a year or longer. Following the completion of the hard surfacing, the fertile top-soil, stripped off during grading operations, was replaced between the runways and a fine grade of grass seed sown. The field resembled a huge park lawn, transversed by the runways.

AT ONE OF BREWSTER'S PLANTS
Combat planes leaving the assembly line.

To train both men and women for work at the new assembly plant, the Brewster company cooperated with a local high school in the establishment of training courses. Obtaining funds both from the State of Pennsylvania and the Federal Government, the school system set up courses on a 24 hour-a-day, round the clock basis.

Production of aircraft in the modern era was the third successive phase of transportation in which Brewster had engaged since the original company was founded. The company was a continuation of a manufacturing enterprise started in 1810 by James Brewster of New Haven, Conn. The original product was carriages which were built continuously from 1810 to the early part of this century. From 1826 on, most of the manufacturing activities of the company were carried out in New York City. In 1907, the company switched its production to the manufacture of automobile bodies, and in 1920 entered the aircraft field with the start of work on a Navy contract for seaplane floats. About the same time the company built the famous Cigarette IV, first all metal motorboat which won the President's Cup race in 1924. In 1932, the aircraft division of Brewster was purchased by James Work, now chairman of the board, and three associates. They organized the Brewster Aeronautical Corporation. Some of the carriages on which the original reputation of the company was built were still in daily service near Central Park in New York.

Cessna Aircraft Company, Wichita, Kans., was in production on military contracts and continuing its program of expanding plant facilities. In the commercial field, Cessna continued production of the C-145 and C-165 Airmaster models, as well as the Cessna T-50 twin-engine model. The C-145 Airmaster was a 4-place cabin high-wing monoplane with wing, tail surfaces and landing gear of full cantilever construction. Its gross weight was 2,450 lbs. and it was powered with the 145 h.p. Warner Super Scarab engine. The C-145 had a cruising speed of 151 m.p.h. at optimum altitude and was available with a range of from 525 to 785 mi. The C-165 model of the Airmaster was similar to the C-145 except that it was powered with the 165 h.p. Warner Super Scarab engine. Gross weight remained the same, cruising speed was increased to 157 m.p.h. at optimum altitude, with a range of from 485 to 725 mi. Take-off and climb were improved by the increase in horsepower. The 4-place Airmaster had a span of 34 ft. 2 in., length 24 ft. 8 in., and gross weight of 2,450 lbs. The Cessna T-50 Twin cabin monoplane was manufactured as a twin-engine trainer for both the U. S. Army and the Royal Canadian Air Force. The commercial T-50 was powered by two Jacobs L4MB engines, rated at 225 h.p. each with 245 h.p. available for take-off. The T-50 carried 5 persons



CESSNA T-50

A twin-engine personal transport, carrying five, and powered with two Jacobs engines of 225 h.p. each.

and baggage, with a range of from 750 to 1,000 mi. Stated cruising speed was 191 m.p.h. at optimum altitude of 7,500 ft. with 75 per cent power output. The T-50 featured a continuous cantilever wing of spruce construction and a fuselage welded from chrome molybdenum steel tubing, both fabric covered. Cessna claimed that this construction lent itself admirably to easy maintenance and repair as well as rapid, economical construction. The T-50 had a span of 41 ft. 11 in., length 32 ft. 9 in., and gross weight of 5,100 lbs. The T-50 was also available as a military airplane, a trainer, ambulance, personnel transport or photographic airplane.

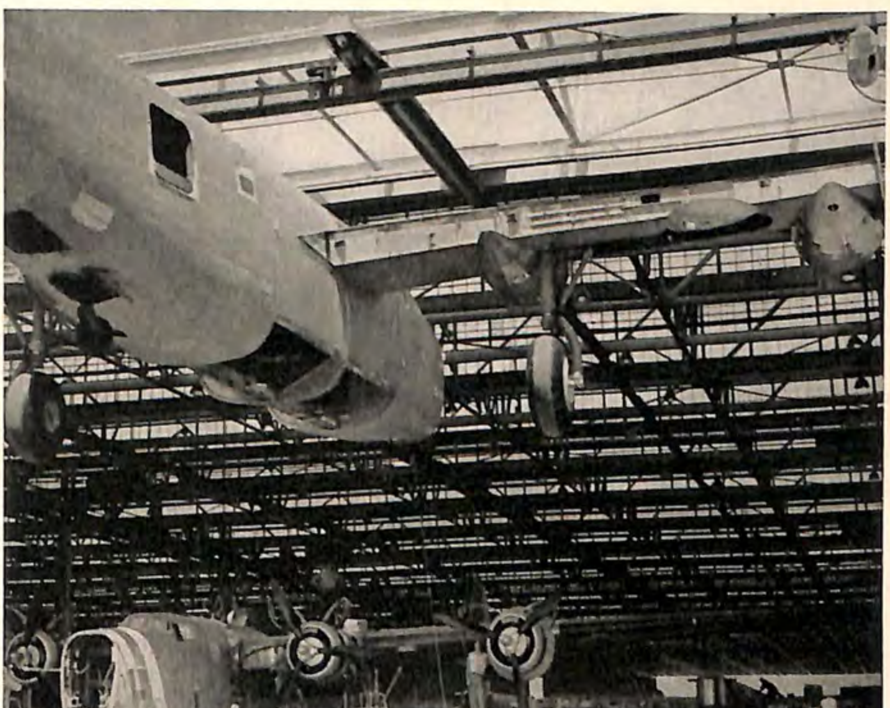
Consolidated Aircraft Corporation, San Diego, Calif., early in 1942 was expanding, at a progressive rate of speed, production of the 4-engine long-range B-24 Army bomber and long-range Navy patrol bomber flying boats. Mechanized assembly lines for these warplanes were to speed up mass production in both the old and new plant space at San Diego. At the same time Consolidated was to manage and operate a huge blackout plant in the Midwest, where the B-24 bomber was to be assembled from parts turned out by motor car companies and other non-aviation subcontractors. The number of Consolidated employees had increased by tens of thousands in a few months period, and other thousands were being hired and trained by the company.

The 4-engine B-24 Army bomber was used by both the U. S. Army Air Forces and the R. A. F. The British named it Liberator. The Consolidated 4-engine PB2Y was supplied to the U. S. Navy in numbers. It was known as the Coronado, and was a long-range Navy patrol bomber. The Consolidated 2-engine Navy patrol bomber was known as the Catalina.

On the B-24 production line the assembly of the fuselage was riveted to the wings and the airplane was completed while on the line. Even the work platforms moved along with each plane. Other conveyor lines were installed for assembling the fuselage nose segments and for putting them together into a single nose assembly. The same type conveyor lines were operating for the wing center section and the fuselage tail assembly.

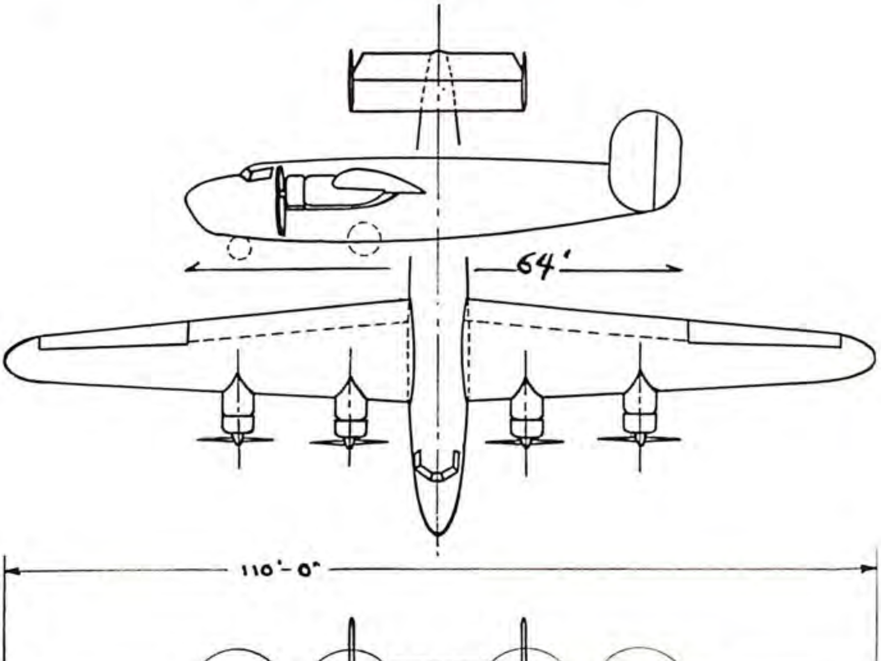
The twin-motored Catalinas and the four-motored Coronados also were subjected to assembly line treatment, but the final stages of their assembly were accomplished with the nearly completed planes rolling on their own beaching gear. One of the biggest contributing factors in the speed-up of Consolidated land bomber production was the streamlining of the assembly of the nose section. With the exception of the wing, the nose section was the most important part of the bomber. In it were concentrated most of the vital installations in the plane. There thousands of separate parts connected and intersected. Previously, the nose section was assembled as a shell and the "insides" put in on the final assembly line. This meant that in order to get any kind of production at all, a large crew of men had to crowd into the limited space of the nose and make the many installations. That was changed, and output jumped encouragingly. The nose shell was assembled as before, but instead of being riveted together, it was merely fastened temporarily in a kind of "fitting" operation. Then the shell was taken apart and the two sides, the top and the floor were sent down separate assembly lines. Here at various stations the nose section installations were made. Only a few parts were put on at each station, but when each panel reached the end of the line and the section was riveted together permanently, the nose was a complete assembly. Lost time due to crowding and waiting was eliminated. The installations were made out in the open where there was plenty of space and better and faster inspection was possible. Sub-assemblies were fed in from departments on either side of the lines, and whole units were fitted into the nose rather than just individual parts or installations.

An example of the sub-assemblies was the control pedestal. In the past, this panel was assembled inside the nose section, but under the



SPEEDING UP WAR PRODUCTION

View of one of Consolidated Aircraft Corporation's assembly lines showing the huge fuselage of a B-24 Liberator four-engine bomber moving steadily forward on a monorail conveyor.



CONSOLIDATED LIBERATOR B-24

This long-range bomber carries a crew of six to nine and is powered by four Pratt & Whitney engines of 1,200 h.p. each.

new system it was assembled completely in a sub-assembly department on a jig that was an exact duplicate of the final panel. All the wiring was attached and all that remained was for the entire panel to be fitted to the nose floor as it moved down the line.

Corners were cut in the work of wiring the airplane, too. Previously all wire was enclosed in metal conduits to protect radio wiring against interference. By the new method the wiring was merely padded where it passed a bulkhead. This not only saved considerable time but it was found that when a bullet pierced the conduits it almost always shorted out the wires. Under the new method when a bullet passed through the wires it only parted the several strands and rarely damaged the circuit.

The dull camouflage paint adopted early in 1942 cut by 60 to 80 per cent the time needed to paint an airplane. Spot-welding was being used on an increasing number of parts. A newly designed horizontal piercing die reduced by 90 per cent the time required to put holes in certain sheet metal parts. The use of infra-red light for drying paint cut the time for this operation down surprisingly.

One Consolidated department, which formerly used separate jigs for drilling holes in the gunner's floor and gun rings, under the new practice used a fixture which held both assemblies and by doing so cut 30 per cent off the drilling time. Another department designed a new die which accomplished in one operation what formerly required four operations. In this same department a row of screws in the pilot's enclosure, once formerly ground off, was cut off with a special cutting tool, saving 65 per cent of the time required.

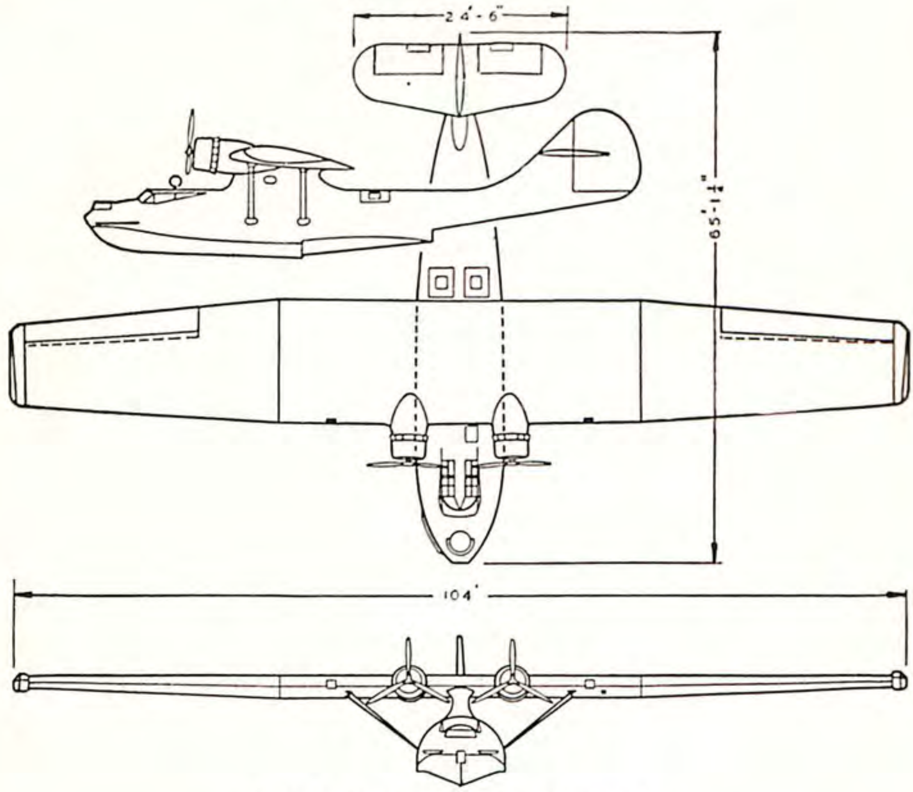
The large plant tool room was de-centralized so that each department had its own tool room and could tell just how the supply of tools and detail parts stood. Blueprints were being replaced by pictures of the completed assembly with all component parts labeled and numbered. The workman could tell at a glance what the assembly looked like, just where each part went and when it should be put on. This was particularly advantageous in an industry with such a large percentage of inexperienced labor. Rivet machines were being operated 24 hours a day, the shifts of the operators so staggered that the machines were in continuous motion.

Increasing numbers of parts were being pre-drilled, thus saving time which was previously taken up by hand-drilling each hole at the assembly table. Cables which formerly had hand spliced terminals were machine swaged. This operation was not only faster but it resulted in a higher efficiency. Automatic cable testing replaced old-fashioned hand-operated lever apparatus.

In making sheet metal blanks, Consolidated production engineers developed an inexpensive method of making blanking dies, using plow steel punches and kirksite dies. The outstanding feature of this method was that it did not require skilled tool makers.

Another Consolidated development was a fixture for constructing skin stringer segments. This fixture supported parts in proper relation to each other and provided drill bushing holes for drilling all holes in the parts. The drill bushing holes had been made large enough to rivet through after the bushing was removed, making it possible to complete the drilling operation before removing the part from the fixture.

Even the anodizing process at Consolidated was placed on a conveyor system, running to the paint conveyor. That made it necessary to handle the material only once, inspection and unloading being accomplished at the point where the metal was transferred from the anodizing conveyor to the paint conveyor.



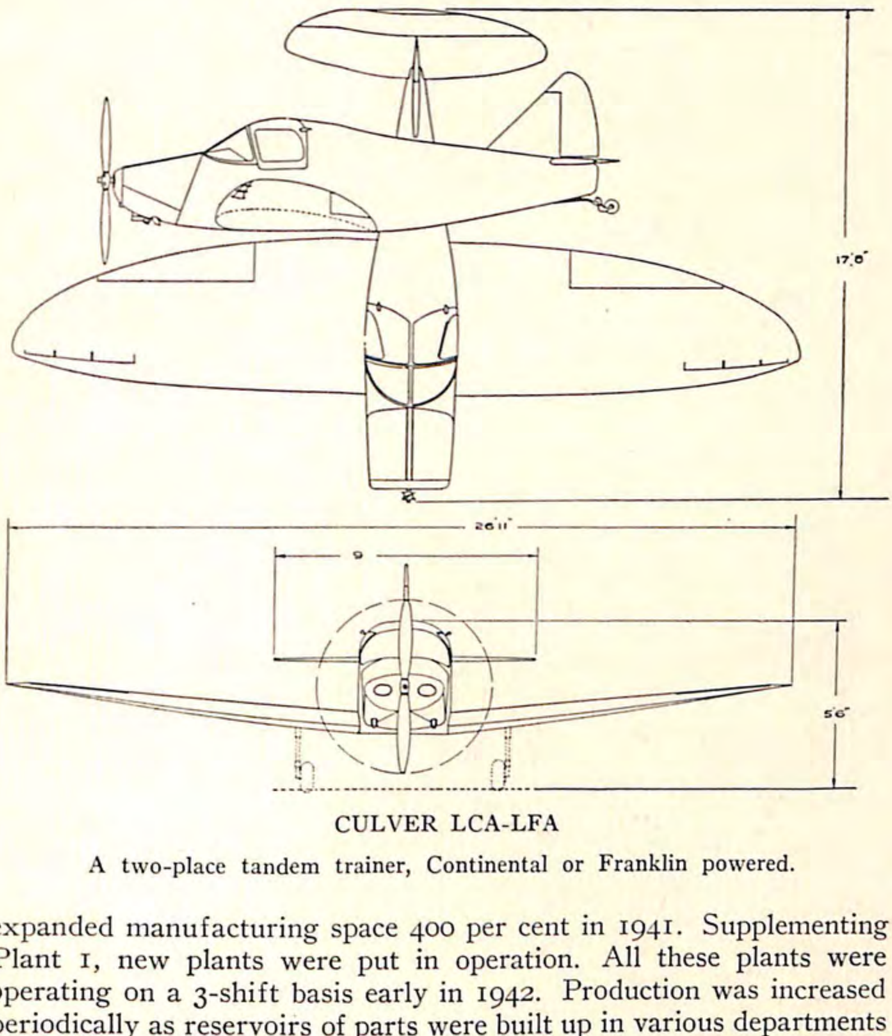
CONSOLIDATED CATALINA PBY

A patrol bomber powered by two Pratt & Whitney Twin Wasp engines.

Vastly important in the war production program was the training of new employees. Consolidated's program had been expanded rapidly to reach even prospective employees, men already at work and leadmen, foremen and supervisors. The instruction brought immediate results in better and safer production, better and safer airplanes.

Culver Aircraft Corporation, Wichita, Kans., early in 1942 was planning further expansion of personnel which had increased 135 per cent in 1941. The company had a contract with the U. S. Army Air Forces, and was in production on two models, the Culver LCA powered by a 75 h.p. Continental engine and the LFA powered by an 80 h.p. Franklin engine and completely equipped with an electric starter, generator, battery, navigation lights, cabin heater and ventilators. The company extended its field of distributors at home and abroad, chiefly in South America.

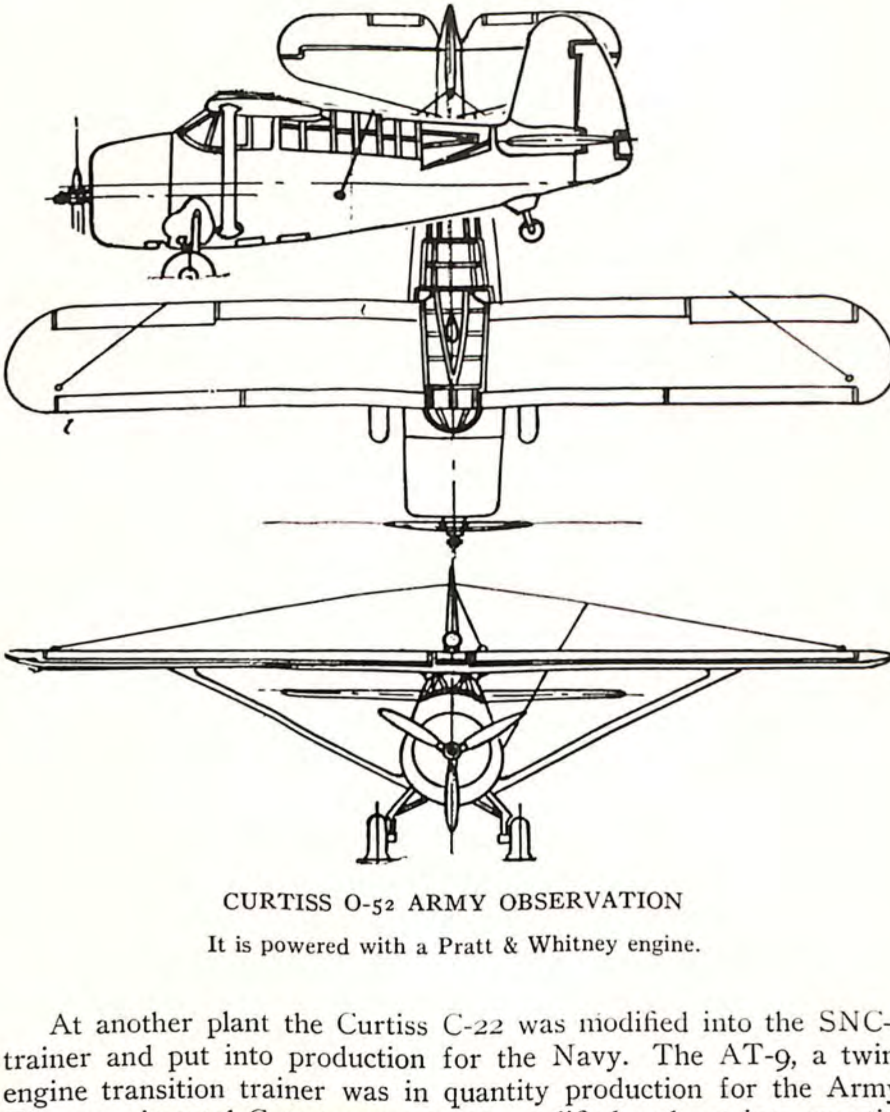
Curtiss-Wright Corporation's Airplane Division, Buffalo, N. Y.;



CULVER LCA-LFA

A two-place tandem trainer, Continental or Franklin powered.

expanded manufacturing space 400 per cent in 1941. Supplementing Plant 1, new plants were put in operation. All these plants were operating on a 3-shift basis early in 1942. Production was increased periodically as reservoirs of parts were built up in various departments and larger quantities of raw materials were received. The Curtiss P-40B, C, D, E and F models of single-place pursuit planes for the U. S. Army Air Forces and the R. A. F., were on production lines which were maintained with increasing daily output through the model changes. For the U. S. Navy air forces the Curtiss SB2C-1 Helldiver dive bomber was completed and test flown. The SO3C-1 Seagull scout observation was put in production early in 1942. One plant was in production on the O-52 high-wing observation plane for the Army. There also were being produced, besides pursuits for the Army, various export orders, including the Curtiss Hawk 81-A Tomahawk and Curtiss Hawk 87-A Kittyhawk for the R. A. F.

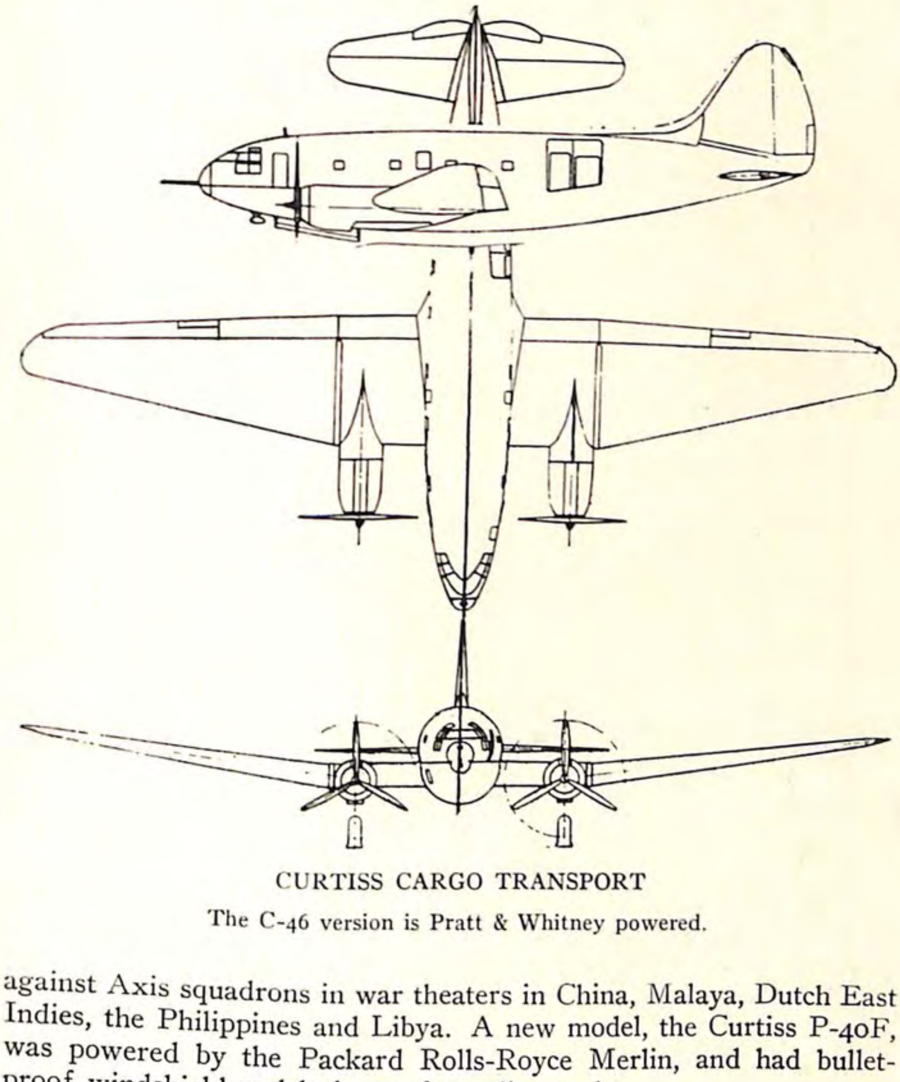


CURTISS O-52 ARMY OBSERVATION

It is powered with a Pratt & Whitney engine.

At another plant the Curtiss C-22 was modified into the SNC-1 trainer and put into production for the Navy. The AT-9, a twin-engine transition trainer was in quantity production for the Army. The experimental C-20 transport was modified and put into quantity production as the C-46 cargo transport for the Army. In 1942, new pursuit models were to go into production along with the C-46. One plant was to continue full-out production of the SO3C-1, while another was to carry on quantity production of the AT-9 and SNC-1.

Many thousands of employees were on the payrolls of the Curtiss-Wright airplane plants. The Curtiss P-40D pursuit plane, Allison-powered, produced in quantity in 1941, entered active service with the air forces of the United Nations and accounted for repeated victories



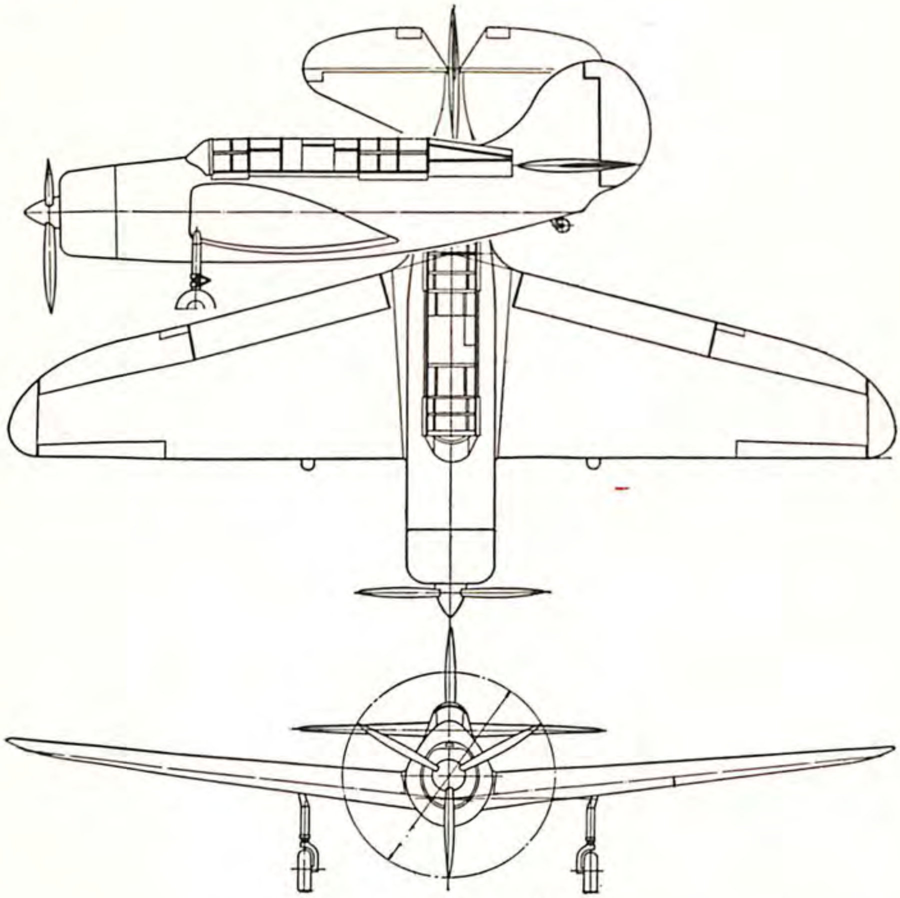
CURTISS CARGO TRANSPORT

The C-46 version is Pratt & Whitney powered.

against Axis squadrons in war theaters in China, Malaya, Dutch East Indies, the Philippines and Libya. A new model, the Curtiss P-40F, was powered by the Packard Rolls-Royce Merlin, and had bullet-proof windshield and leak-proof gasoline tanks.

The Curtiss C-46 Army cargo transport had a wing span of 108 ft. and a gross weight of more than 50,000 lbs. It could carry more than 36 fully equipped soldiers. The Curtiss AT-9 advanced trainer was powered by two Lycoming engines. The SB2C-1 Helldiver was powered by a Wright Cyclone 14 engine and was intended for service aboard Navy carriers. The SNC-1 Navy trainer had a Wright Whirl-wind engine.

Douglas Aircraft Company, Inc., Santa Monica, Calif., early in 1942 was in full-out production on several types of bombers for the

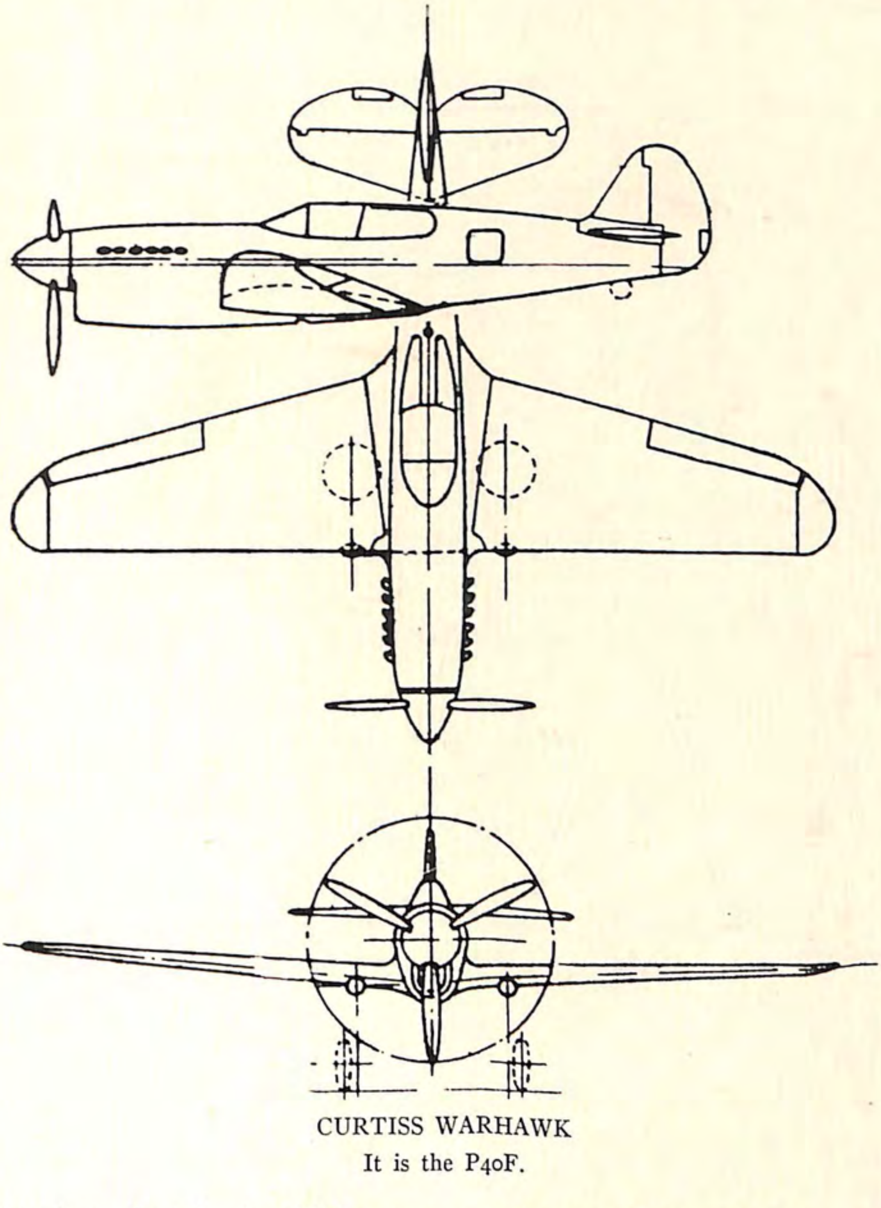


CURTISS HELLDIVER

This Navy Dive Bomber, SB2C-1, is powered with a Wright Cyclone 14 engine.

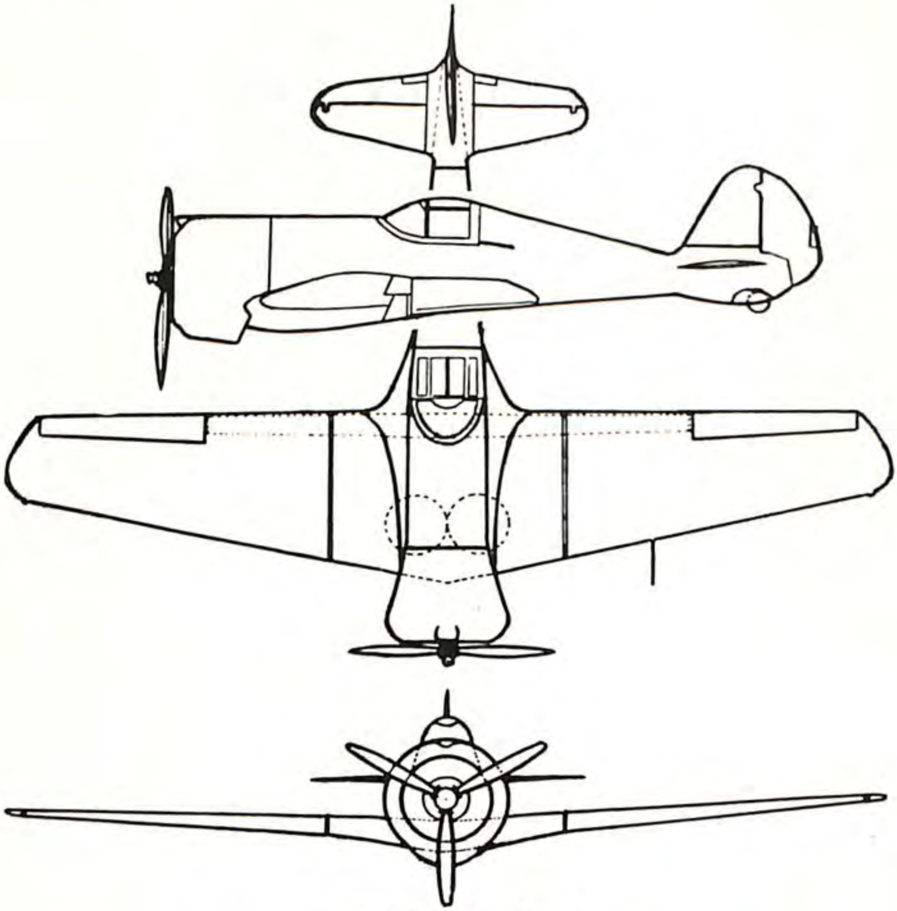
Army and Navy air forces as well as others among the United Nations. Employees and factory space had more than doubled in the last 12 months. Combined with a highly developed manufacturing technique as a result of years spent in perfecting design and construction methods, these rapidly expanding facilities were calculated to meet the air force requirements for certain types and models of combat aircraft which months before America's entry in the war had proved to be superior to similar machines in enemy use. Douglas combat and transport planes were in active service on all continents.

Vast expansion had taken place in the main Douglas plants. There also was a new plant near by where facilities were being doubled.



CURTISS WARHAWK
It is the P40F.

Another plant in the Midwest, was to be operated by Douglas for production of 4-engine bombers. The company also had several subcontractors, among them motor car companies turning out sub-assemblies for bombers. Some of the parts produced under subcontract required specially designed railroad cars, with end-doors, raised roof,

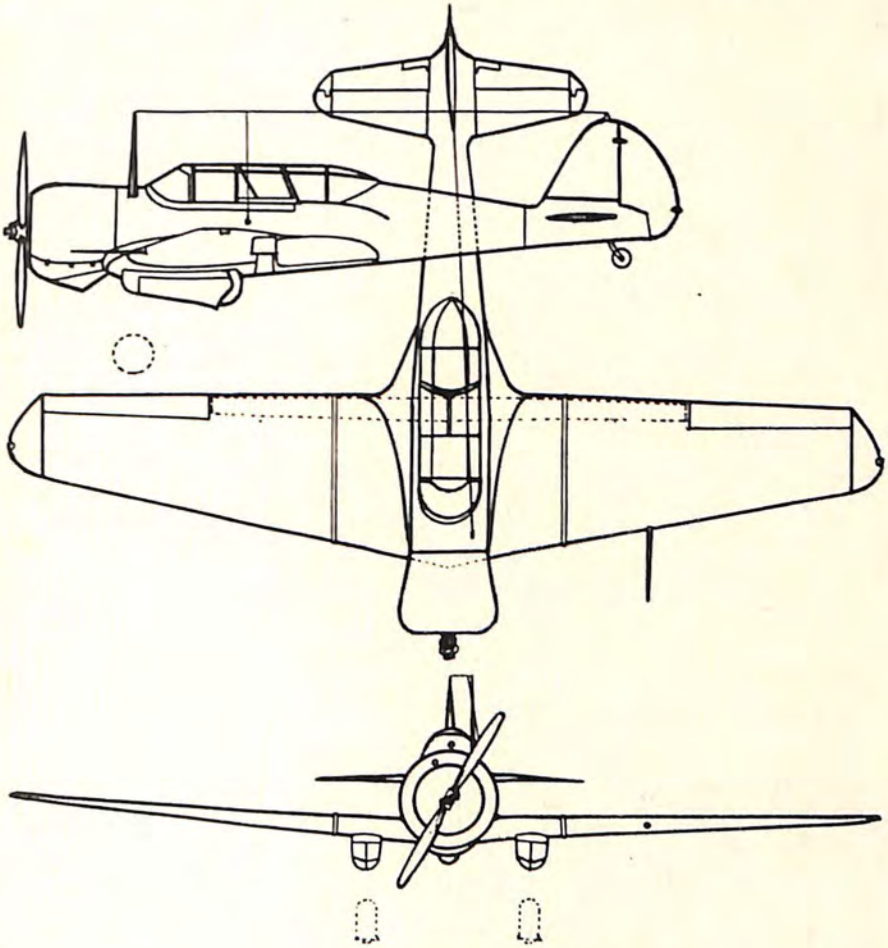


CURTISS MODEL 21B

An interceptor fighter with a Wright Cyclone engine.

steel floors and racks to which the assemblies could be bolted for transportation.

Among the many new Douglas manufacturing facilities were high-speed mechanized conveyor systems which, with radically rearranged assembly lines, speeded production greatly, and reduced by as much as 50 per cent the man-hours required for certain assembly units. Assembly line "time tables" thus were made possible. The Douglas warplanes were not even sidetracked for camouflaging, which was carried on as they moved down the assembly line. Another ingenious machine, the Guerin Press, was announced early in 1941. Developed by Douglas, this monster, equipped with revolutionary rubber mats which acted as female dies, could form and cut as many as 44,000



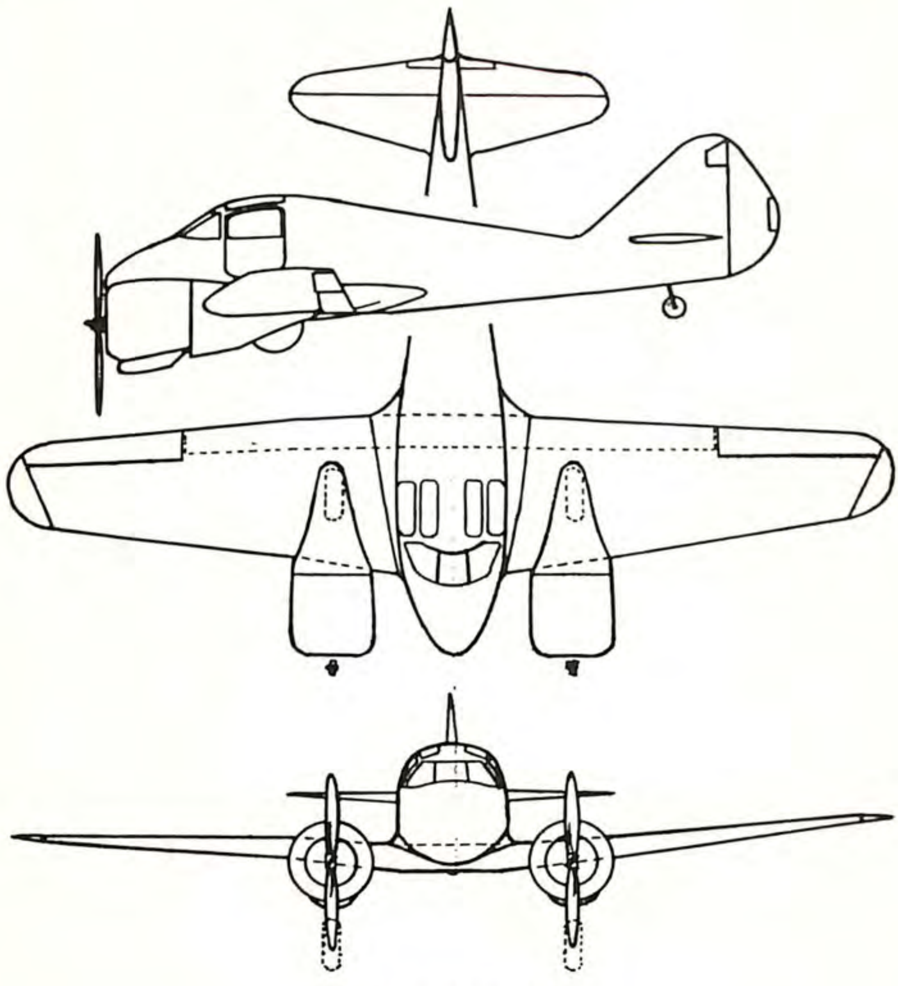
CURTISS MODEL 22B

A Wright Whirlwind-powered combat trainer.

plane components every 24 hours, under pressures ranging up to 10,000,000 lbs.

The Douglas company made an important contribution to standardization tending to speed up production when in 1941 it released to all other American companies its specially developed method of flush-riveting with 100-degree rivets. The system reduced resistance and increased speed.

The Douglas attack bomber, A-20 for the American services, DB-7 and Havoc on the Royal Air Force honor rolls, was officially characterized by the British Air Ministry in these words: "The outstanding



CURTISS 25A TRAINER

It has a Lycoming engine.

performance and excellent flying qualities of these aircraft have made them very popular with pilots of the R. A. F. fighter command." The Douglas Havoc was the plane which provided the solution to the question of how to stop the German night-raiders over England.

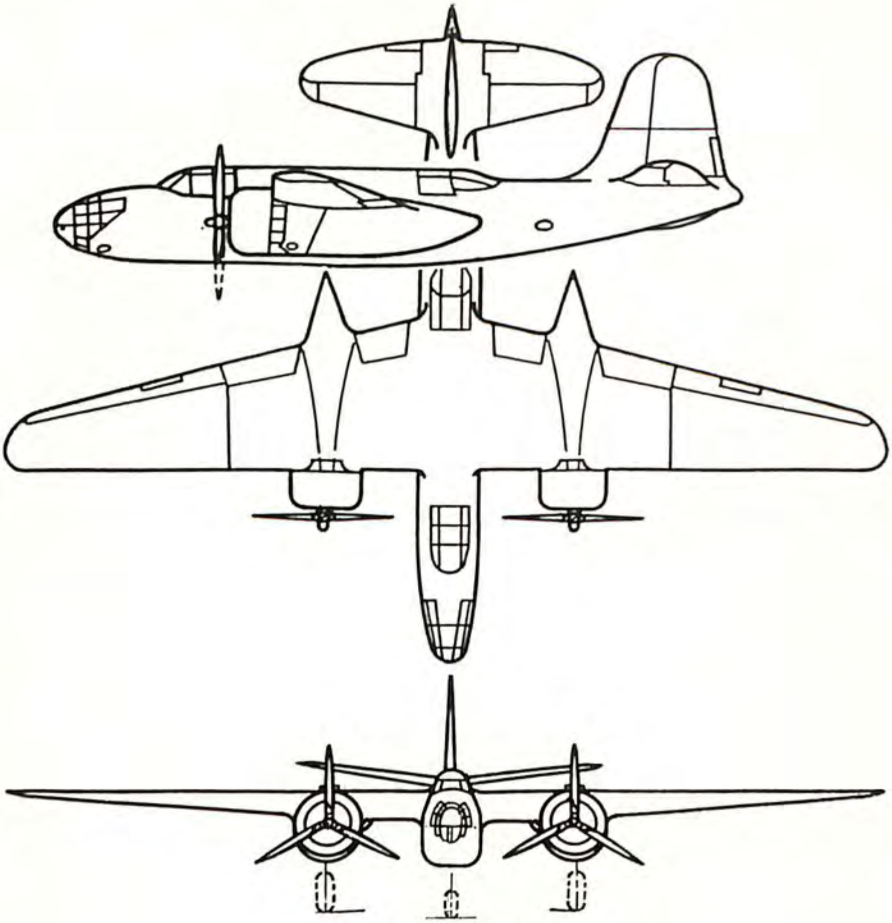
The Douglas dive bomber—Army A-24 and Navy SBD—was credited officially with being one of the nation's most important war craft. Of this and the attack bomber the Harter Committee, in its report made public in February, 1942, stated officially: "In the light bomber field, the A-24 dive bomber and the A-20 attack bomber made by Douglas also are superior to any enemy planes in their class, according to Army tests. The A-20 is so fast that the British use it as a night fighter under the name of Havoc. Combining the best features of the attack plane and a light, fast bomber, the A-20 is designed for use with ground troops, speeding ahead to bomb hostile ammunition dumps, bridges, troop concentrations and larger obstacles than demand the use of dive bombers."

Douglas listed another outstanding military accomplishment during 1941. This, the completion and first flight of the mammoth Douglas B-19 bomber, turned a new page in all aviation history. Weighing 82 tons, twice as much as any aircraft in the world, taking five years in the building, the gargantuan craft gave the world its greatest aviation thrill of the year on the day of its first test flight. By early 1942 it had flown many hours in Army service. The B-19 was capable of transporting 125 fully-equipped soldiers, and was pronounced capable of flying from New York to Europe non-stop and back without refueling. Illustrative of its size was the fact that its tail assembly alone stood as high as a three-story building. The Army Air Forces used the B-19 as a flying laboratory for the further development of long range bombers.

The Douglas B-19 was a land monoplane powered by four Wright Duplex Cyclone engines aggregating 6,800 h.p. at 5,700 ft. Gas capacity was 10,480 gal., increasing to 11,280 gal. with bomb bay

DOUGLAS DIVE BOMBER IN U. S. MARINES

The SBD-3, Navy scout bomber Dauntless, one of the most effective dive bombers in the world and superior to any "stuka" as yet used by the Nazi air forces.



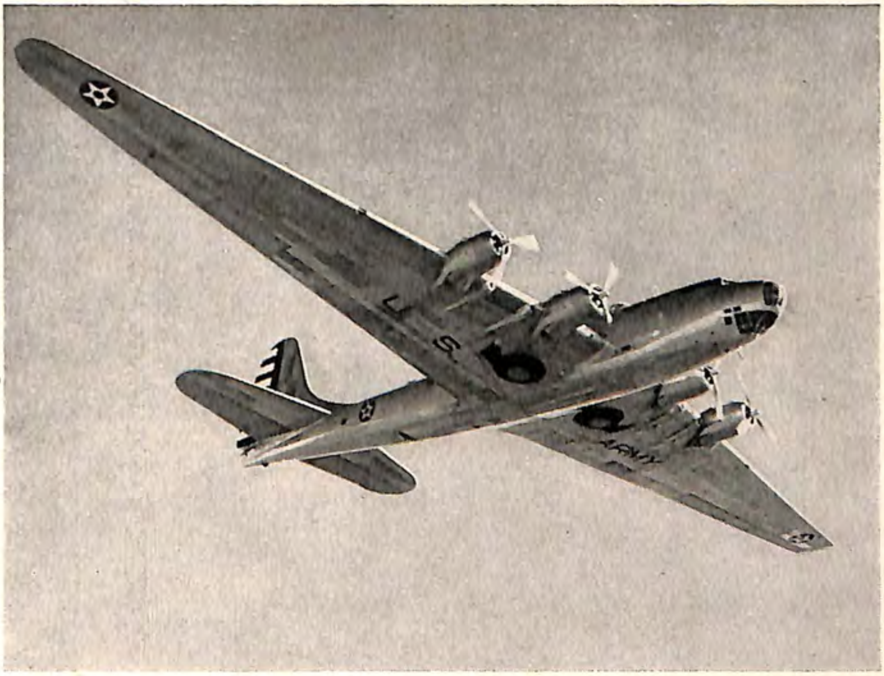
DOUGLAS DB-7B—BOSTON

tanks installed. It was equipped for a crew of 10, and had a cruising range, on maximum fuel, of 5,845 mi. Its stated high speed was more than 225 m.p.h., cruising at more than 200 m.p.h. and service ceiling of more than 20,000 ft. Its gross weight was 140,000 lbs. Its length overall was 132 ft. 4 in., wing span 212 ft., height overall 42 ft. Its main wheels were 96 in. in diameter. Its tricycle landing gear was retractable and the nose wheel was steerable.

The Douglas DC-3 transports continued to be standard equipment on the major air lines, as well as in the transport services of the air forces. More than 120 DC-3 transports were produced in 1941, and Government priorities had provided for continued production in 1942.

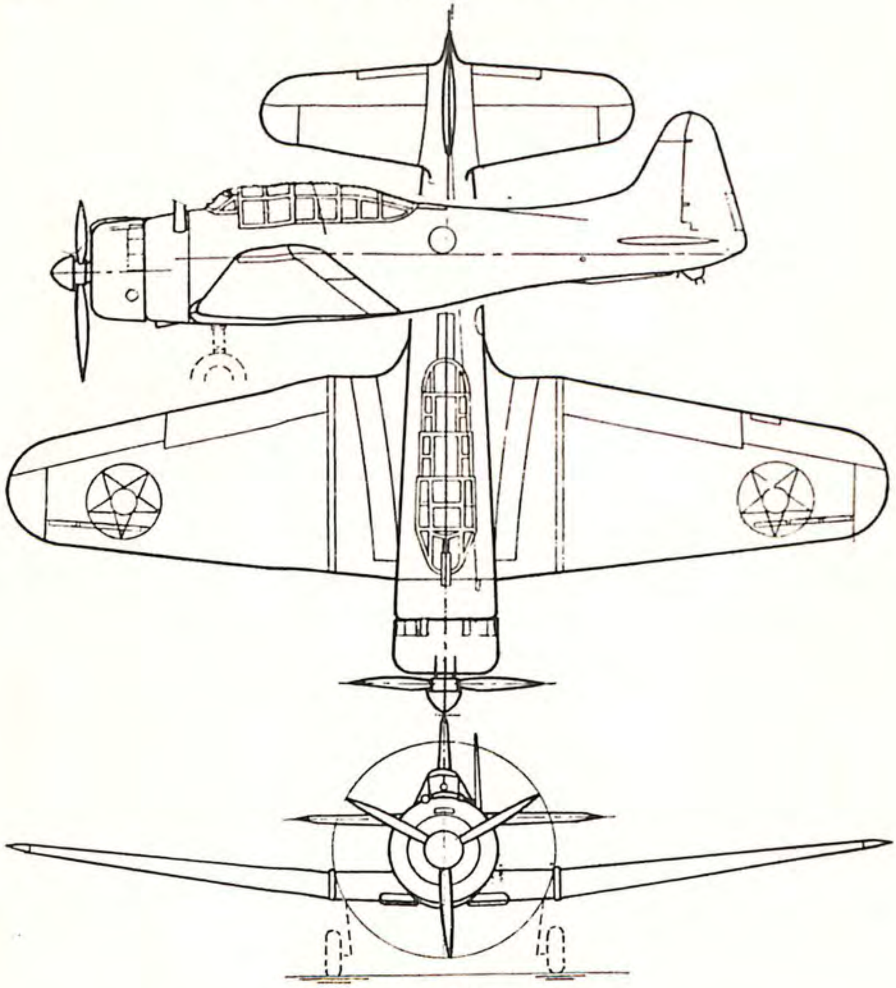
The swift and simultaneous expansion at Santa Monica and branch plants, production lines mechanized and streamlined, spectacular new methods and significant new processes, cooperative programs evolved with other aircraft builders, vast and successful subcontracting to automotive concerns,—all those activities were accompanied by doubling and redoubling personnel to meet the needs of its rapidly-expanding plants. This was no small problem. With the aircraft industry moving ever-closer to the mass-production goal, jobs became more highly specialized, and it was possible to hire, place and promote men and women with one particular skill. To tap the huge reservoir of "trainables" which thereby became available, the Douglas Education Department cooperated closely with institutions such as high schools, colleges, trade schools, NYA and CCC, in setting up short and intensive pre-employment courses in airplane manufacturing methods and materials.

To enable its own employees to develop further their training and ability and "up-grade" into positions of greater responsibility, the company augmented its special educational classes and courses both



THE DOUGLAS B-19

Successfully flown in a series of exacting Army Air Forces tests in 1941, it was the largest bomber in the world.

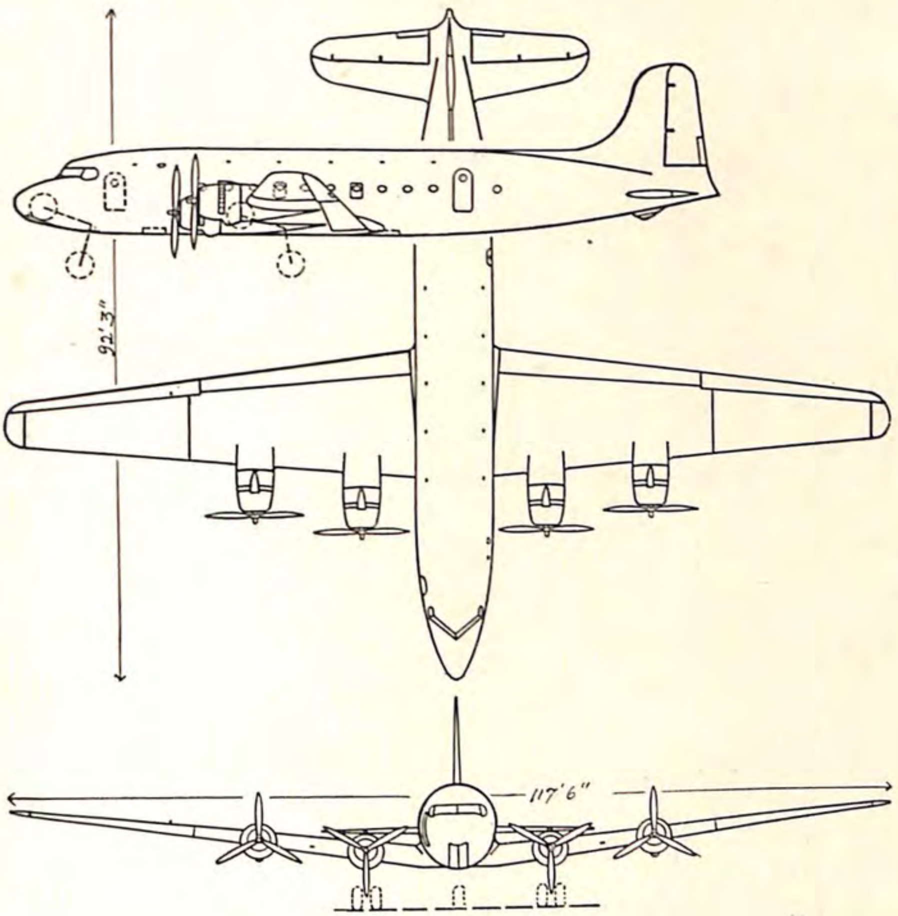


DOUGLAS SBD-3 and A-24

The SBD-3 is the Navy version and the A-24 is for the Army Air Forces.

within its plants and in public schools. Throughout the year these enrolled thousands of employees. In many cases, men needed at the new Douglas plants as precision machinists, or in other jobs that required high degrees of skill, were selected before the plants were completed and brought into other Douglas factories for apprentice training.

With new personnel being hired rapidly, and new high-speed machinery being installed, still greater attention was devoted to safety measures and the elimination of potentially dangerous methods and practices. Full-time industrial safety engineers at each of the

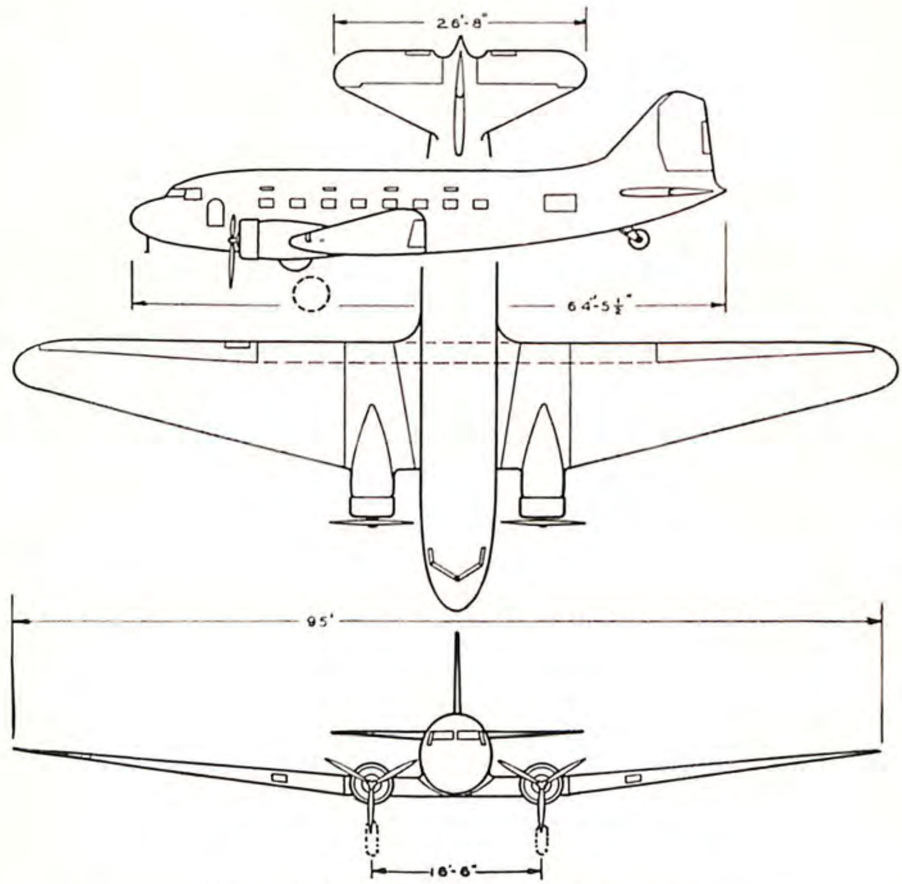


DOUGLAS DC-4

This 42-place transport is powered with either four Pratt & Whitney Twin Wasps or four Wright Cyclones.

company's plants, aided by volunteer safety inspectors in all departments, were able to reduce industrial accidents and injuries.

The support and cooperation of employees enabled the Douglas company to go still further in conquering the "waste material" problem. In 1941 the percentage of scrap to raw material handled decreased 12 per cent from 1940 and 40 per cent from 1939, despite a tremendous acceleration of production which ordinarily would be accompanied by increased waste. Vast quantities of items such as rivets, screws, machine tailings, dural odds and ends, foundry dross, fittings, imperfect parts and accessories, formerly lost as scrap, were

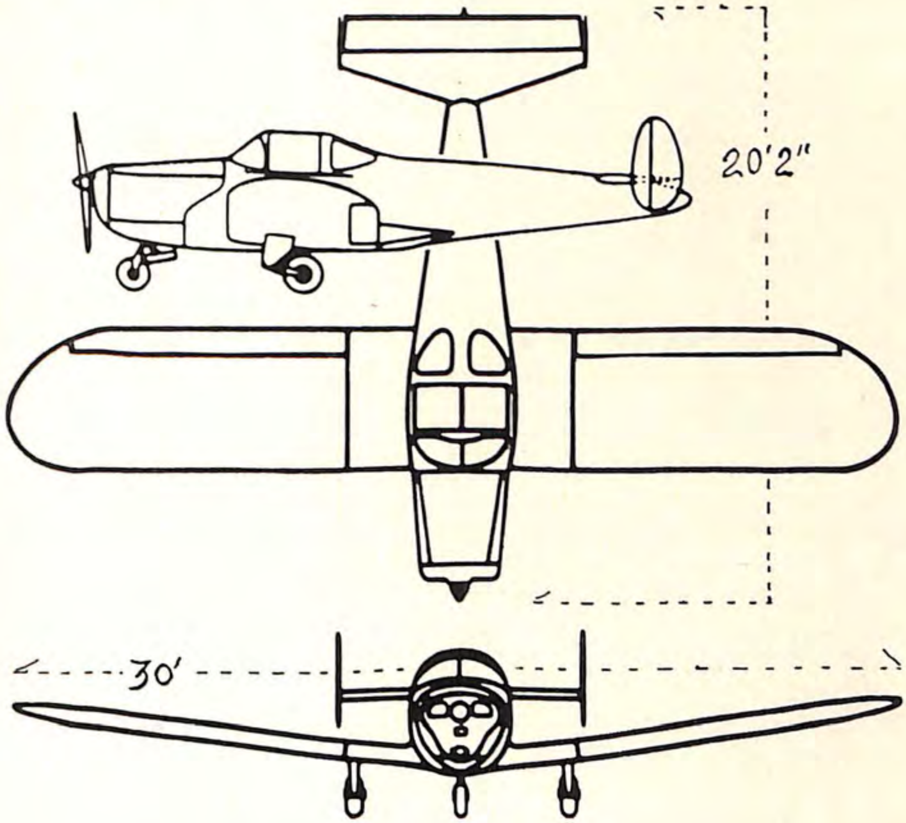


DOUGLAS DAY-SLEEPER TRANSPORT

Available either as a 21-passenger day plane (DC-3) or a 14-place sleeper (DS-T) these planes are powered with two Pratt & Whitney Twin Wasp or Wright Cyclone engines.

salvaged, sorted, reprocessed if necessary, and put to use in augmenting production.

Engineering and Research Corporation, Riverdale, Md., completed development work on a new model Ercoupe, 415-CA, which was practically the same as the 415-C with the exception of substitution of resinous bonded plywood for most of the sheet aluminum construction in the original model. Priority restrictions caused suspension of the metal Ercoupe production. Deliveries on the new model were scheduled for early 1942. Engines of 75 or 80 h.p. were to form standard increased power, with electric starters and generators as optional extra equipment.



THE ERCOUPE

A Continental powered two-place plane for the private owner.

Fairchild Aircraft Division of Fairchild Engine and Airplane Corporation, Hagerstown, Md., changed over into full-time military production in 1941, and increased its output of two models many fold.

The Fairchild M-62 Army PT-19 trainer was in daily use in primary training detachments of the Army Air Forces, which had several hundreds in the schools. The PT-19 was powered by the Ranger aircooled in-line 175 h.p. engine. It was constructed of essentially non-defense, non-critical materials. In addition to the Army Air Forces, the Royal Norwegian Air Force in Canada used it as a standard trainer. Brazil, Ecuador and Chile also used the PT-19. The Chilean version was powered by a 165 h.p. Warner engine, and it replaced German trainers which the Chileans had previously used.

Fairchild also completed arrangements with the Canadian Government for manufacture in Canada of the PT-19 powered by the Ranger

200 h.p. engine and designated the Fairchild Cornell. There it was to become the standard elementary trainer in the Canadian and Empire training program, replacing two obsolete types. As "elementary" training in Canada and Great Britain goes beyond the "primary" courses of the U. S., the Canadian Fairchild was equipped with instruments for night, cross country and blind night flying. In 1941 a limited number of these trainers was delivered to operators in the CPT program.

The Fairchild 24, a four-place cabin monoplane long popular among private owners, was designated C-61 by the Army and numbers were delivered to the armed forces of the United Nations as a light cargo and personnel transport. These planes early in 1942 were carrying out important missions almost daily in several combat zones. The C-61 was powered by the 165 h.p. Warner engine. Fairchild also contributed to the war effort by doing subcontract work for combat plane manufacturers.

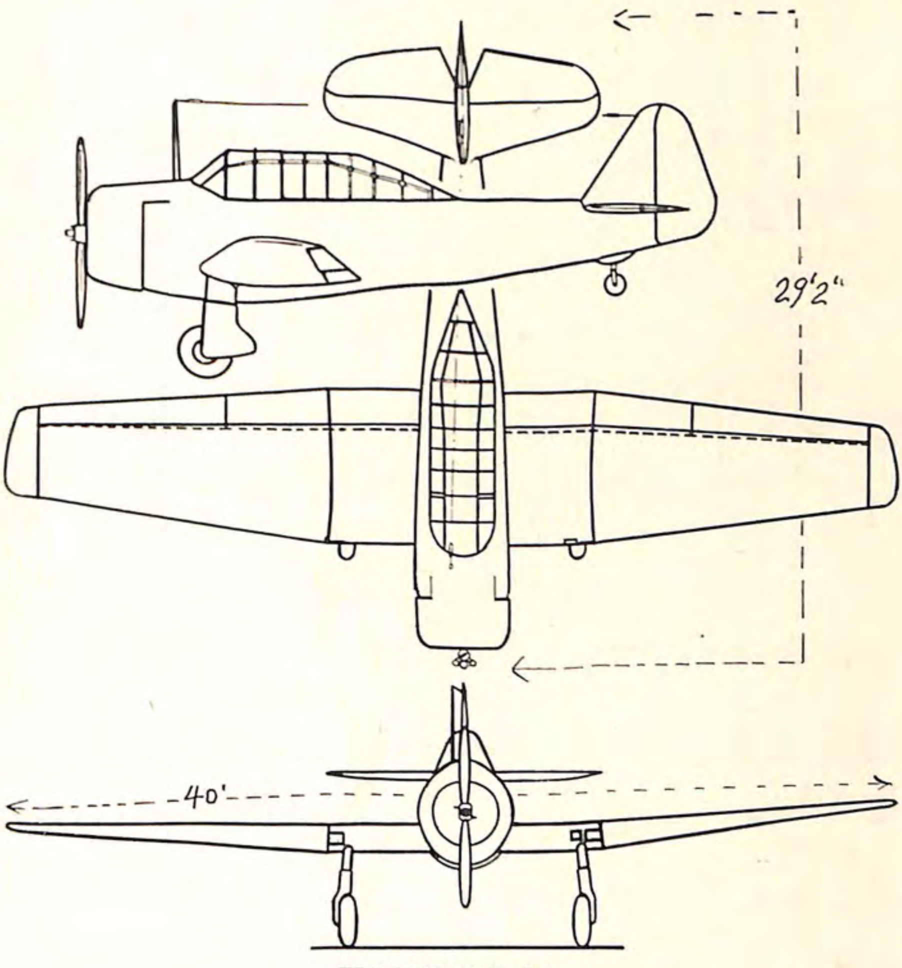
Fairchild, like other companies, increased production by adding women to the payrolls of several manufacturing departments. They were trained briefly and soon were doing riveting, sheet metal work, setting up work in jigs, as well as sewing fabric covers for control surfaces and upholstery. Others were employed in the wood-working department. The company planned to set up whole departments of women employes as quickly as women could be trained as supervisory personnel.

Fleetwings, Inc., Bristol, Pa., started preliminary production on its basic training plane BT-12 for the Army Air Forces, the first stainless-steel military airplane ever built. A large number was ordered by the Army. The airplane had a wing span of 40 ft., was 29 ft. in length, and was powered by a 450 h.p. Pratt and Whitney engine.

Fleetwings was also in large-quantity production on aircraft parts, principally control surfaces, of both aluminum alloy and stainless steel. The parts were for many of the leading military airplane manufacturers.

The management at Fleetwings effected a number of major advances in the plant to assure the maximum production of aircraft parts. New, efficient straight-line-flow production lines were installed, which more than tripled output of control surfaces. These lines, along with the other major improvements, enabled the company to maintain its record of keeping ahead of delivery schedules.

Plant personnel was expanded tremendously in order to meet the demands of the day, and an intensive vocational training school was instituted to provide the necessary training for factory candidates.



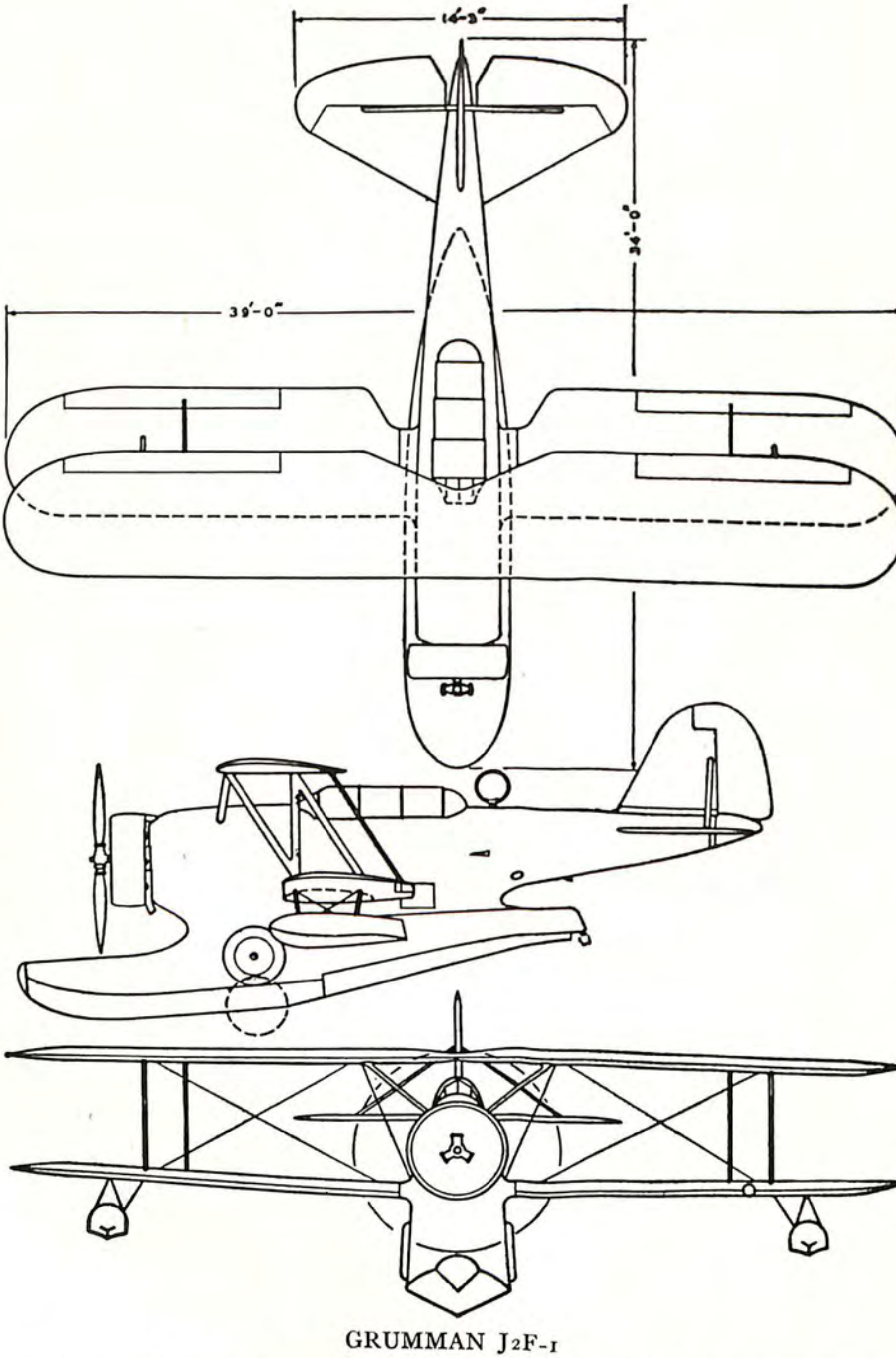
FLEETWINGS BT-12

A stainless steel basic trainer powered by a Pratt & Whitney 450 h.p. engine.

In addition to manufacturing control surfaces, Fleetwings supplied hydraulic equipment to the aircraft industry, a great number of hydraulic valves being used on one fighter.

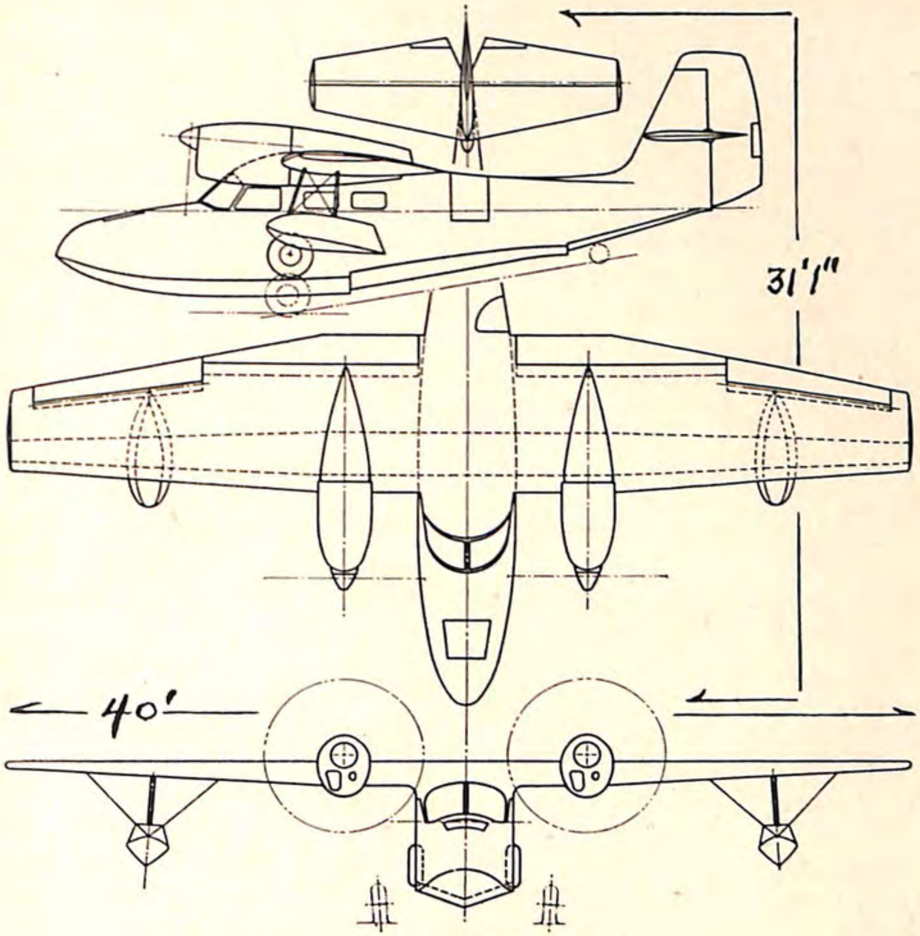
Construction of a new manufacturing plant was started during 1941. On completion in early 1942, the new unit was to double the capacity of Fleetwings. The new plant was a complete blackout structure, illuminated by banks of fluorescent lights.

A Fleetwings development was the series of straight-line-flow final assembly lines for the production of aircraft surfaces. Whereas surfaces previously were assembled on stationary jigs, under the new



GRUMMAN J2F-1

A two- to four-place military plane powered with a Wright Cyclone engine.



THE GRUMMAN WIDGEON

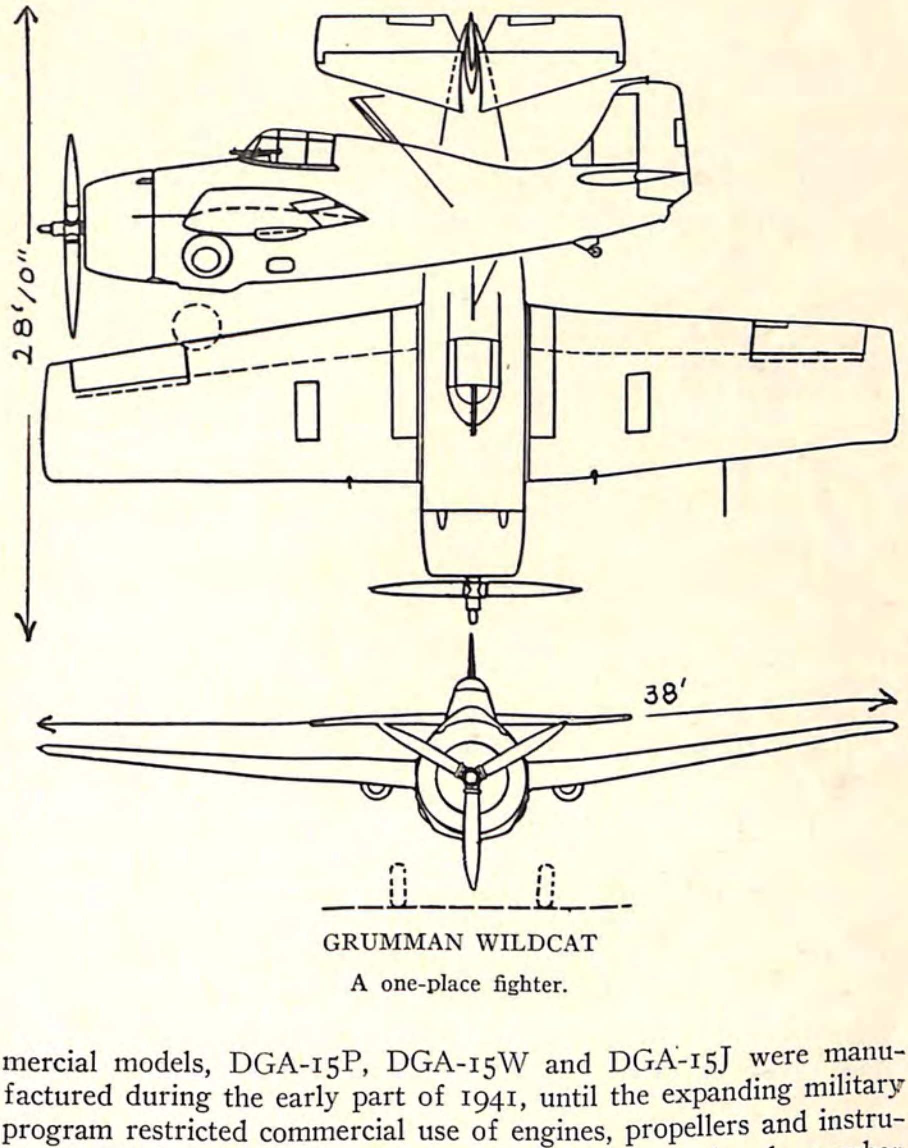
This four-five place amphibion is powered with two Ranger engines of 200 h.p. each.

system they were assembled on portable jigs which moved from one station to another along the line, a trio of workmen performing specialized operations, such as drilling and riveting, at each station. These lines more than tripled the output of airplane parts and made it possible to assign unskilled labor to line jobs, inasmuch as each man had to do only one or two specific operations instead of 15 or 20 formerly required on stationary jig assembly. Fleetwings also put into operation a number of electric arc welding machines to complement the many spot and seam welding machines pioneered by Fleetwings engineers. In installing arc welding, incidentally, Fleetwings was obtaining 25 per cent faster production, with fewer man hours per plane or part. Scores of small, ingenious tools, such as rivet punches and rivet cutters were doing 10 times as much work as previous tools invented by Fleetwings experts and helped substantially in increasing production. Fleetwings engineers also developed a method of forming stainless steel airplane ribs on the hydraulic rubber press, with a resulting increase in speed in producing this type of part. Previously, the ribs were spot-welded but by means of the rubber press, approximately 15 ribs could be stamped out in a fraction of the time formerly required.

Fletcher Aviation Corporation, Pasadena, Calif., having perfected a revolutionary method of fabricating airplane structures from resinous bonded plywood, January, 1941, began flight tests of its new basic trainer which culminated in extensive military commitments later in the year. The Fletcher plane was completely skin-stressed, using large sheets of plywood to cover entire assemblies as a single unit. This plywood was developed by Fletcher under the name of "Plastiply." The veneers were laid at the optimum angle so that maximum strength was combined with extreme flexibility. Bending even around the small radius of a leading edge was possible without using a mold or application of heat. The first Fletcher model was equipped with a 285 h.p. Wright engine and a conventional landing gear. The design provided for engine installations ranging from 165 to 450 h.p. as well as for tricycle landing gear.

Grumman Aircraft Engineering Corporation, Bethpage, N. Y., completed Plant No. 2, greatly increasing floor space. This plant soon was operating on a quantity production basis. During 1941, Grumman continued building single-seat fighters and utility amphibions for the U. S. Navy, the Marines and the Coast Guard. J2F and JRF amphibions were produced for the Navy and orders received for 1942 delivery. A Coast Guard order for the "Widgeon," designated the J4F-1, was completed and a subsequent order placed. Navy orders were completed for the F4F-3 and the F4F-4, the latter a folding wing version of the Grumman Wildcat shipboard fighter. This ship established a splendid record in Pacific war zones, the most spectacular example being their performance with the U. S. Marine Corps at Wake Island. Though heavily outnumbered, the Marine Corps pilots in their Grumman Wildcats downed many Japanese planes before Wake Island was surrendered to overwhelming surface forces of the enemy.

Howard Aircraft Corporation, Chicago, Ill., early in 1942 was engaged in confidential work for the air forces. The company added many sq. ft. of final assembly floor space in 1941. All Howard com-



GRUMMAN WILDCAT

A one-place fighter.

mercial models, DGA-15P, DGA-15W and DGA-15J were manufactured during the early part of 1941, until the expanding military program restricted commercial use of engines, propellers and instruments. During the latter part of the year, Howard produced a number of GH-1 5-place liaison transports for the Navy, and continued this production in 1942. At the same time, the company started production of the DGA-18 trainer for the Civilian Pilot Training secondary programs. The Howard DGA-15P was a 5-place machine with a 450 h.p. Pratt & Whitney Wasp engine, 210 sq. ft. wing area, 4,350 lbs. gross weight, 270 m.p.h. stated high speed, cruising at 200 m.p.h., 785 mi. range. The DGA-15J was a similar model with a 330 h.p.

HOWARD NAVY GH-1

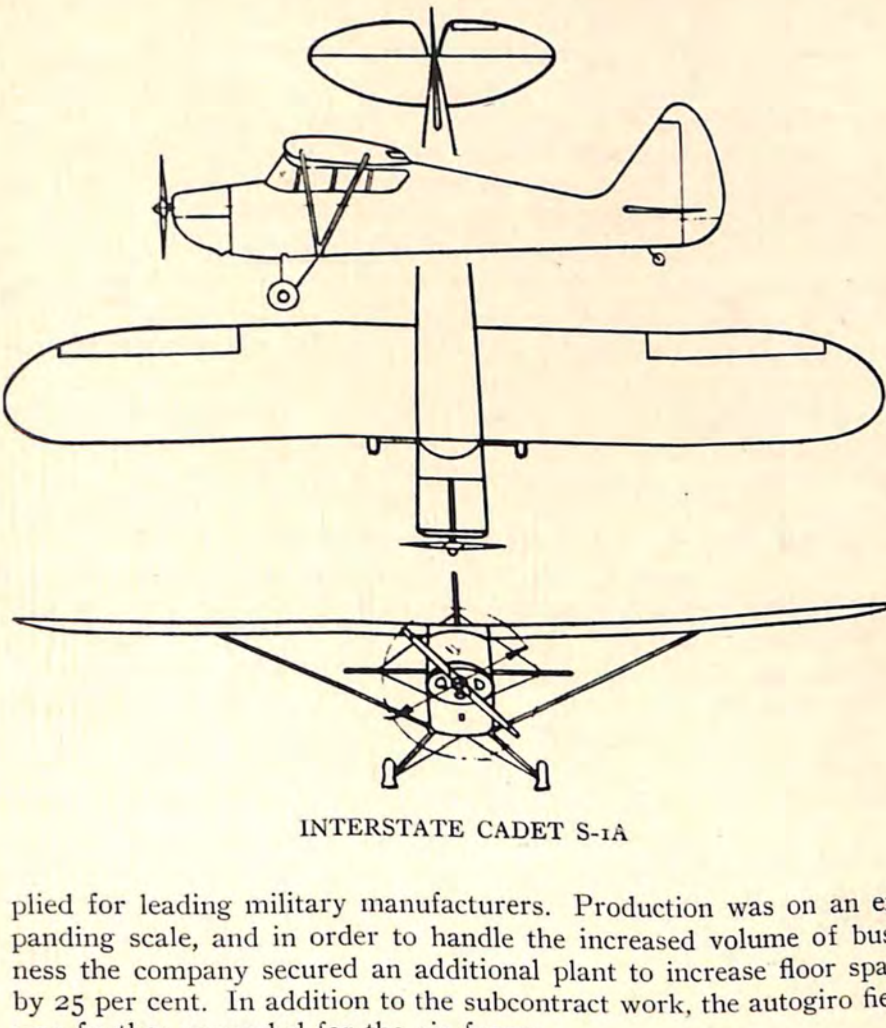
A light liaison transport manufactured by Howard Aircraft Corporation.

Jacobs engine, same wing area and gross weight, 261 m.p.h. stated high speed, cruising at 190 m.p.h. and 1,280 mi. range. The DGA-15W had a Wright 350 h.p. Whirlwind engine with performance similar to the Jacobs model. The DGA-18 was a 2-place trainer with 125 h.p. Warner engine, 179.5 sq. ft. wing area, 118 m.p.h. high speed, 108 m.p.h. cruising speed and 365 mi. range.

Interstate Aircraft and Engineering Corporation, El Segundo, Calif., was in production on two models of the high wing, tandem Interstate Cadet—the 65, powered by a 65 h.p. Continental engine, and the 90, powered by a 90 h.p. Franklin engine. The company also had three models in experimental stages, and was expanding production facilities, which in 1941 had been nearly doubled in both space and personnel. In addition the company produced bomb shackles, gun chargers, hydraulic systems and other precision units for military aircraft.

The Interstate Cadets 65 and 90 had a length of 24 ft., span 35 ft. 6 in., and height 7 ft. The Cadet 65 had a stated high speed of 107 m.p.h., the 90 had 116 m.p.h. They had cruising speeds of 100 and 108 m.p.h. respectively. Their range was 375 and 300 mi. respectively. Their weight empty was 735 and 790 lbs., gross weight 1,250 and 1,300 lbs. Both planes were for primary training.

Kellett Autogiro Corporation, Philadelphia, Pa., further expanded its position as a subcontractor in miscellaneous parts, as well as a prime manufacturer for the Army Air Forces. Among the subcontract items produced during the year were engine mounts, seats, flaps, bomb bay doors, fins and ailerons. Airplane parts were sup-



INTERSTATE CADET S-1A

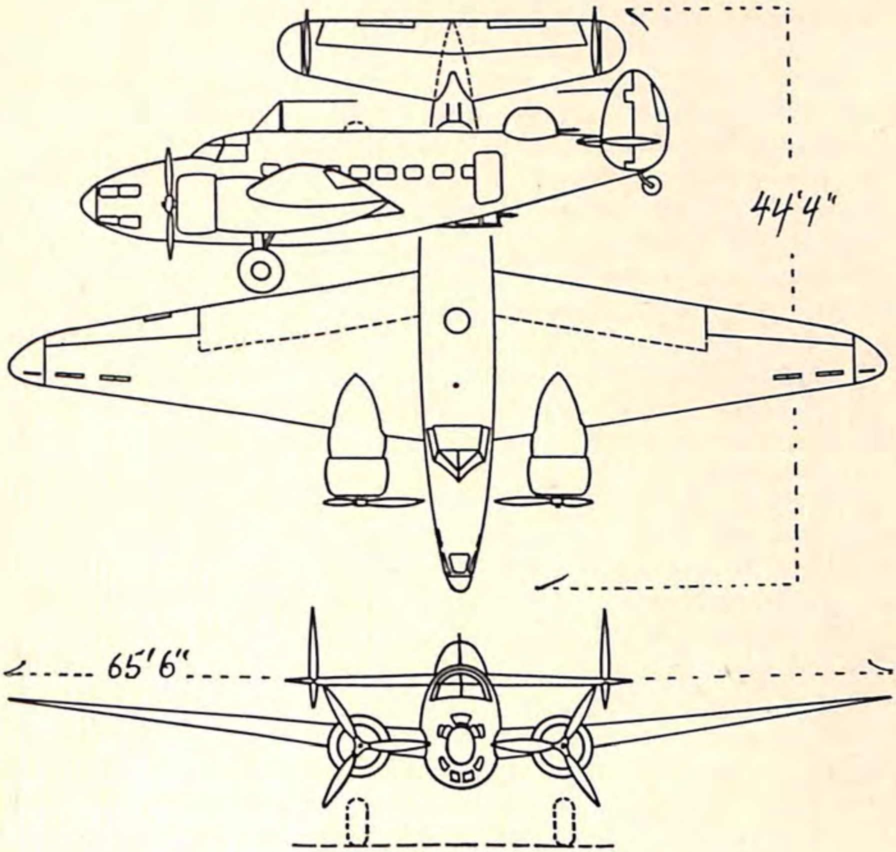
plied for leading military manufacturers. Production was on an expanding scale, and in order to handle the increased volume of business the company secured an additional plant to increase floor space by 25 per cent. In addition to the subcontract work, the autogiro field was further expanded for the air forces.

Lockheed Aircraft Corporation, Burbank, Calif., early in 1942 was still expanding its mass production of military planes for the U. S. Army Air Forces and the British R. A. F. At the same time, under limited priority requirements set up by the Government, Lockheed continued to produce vitally-needed transport planes. New plant buildings started in 1941 had been completed and put into operation. Other buildings were under construction. The number of employees had more than doubled in a year. Production of more than ninety-nine million dollars worth of airplanes, largely military, during the first nine months of 1941 had almost equaled the entire output of the company during its prior nine year history. The great new Vega plant opened in 1941 was getting under way with mass production of warplanes; and this, combined with the rapidly growing output of the parent plant, was to dwarf even that miracle of augmented production performed by the company in 1941.

At the Lockheed plant Hudson bombers were in quantity production for the R. A. F. There also a mass production line for the P-38 Lightning interceptor for the U. S. Army Air Forces and the R. A. F. was established. A few Lodestar and Lockheed 12 commercial transports were produced under priority restrictions. At the Vega plant, a new war model was in progress and a production line for Boeing Flying Fortresses was under way. The company planned to complete and test the Constellation, its first four-engine airplane, in 1942.

The Lockheed Hudson bomber was an all-metal, mid-wing military adaptation of the twin-engine, twin-tail Lockheed Model 14 commercial transport. Originally purchased by the British as a reconnaissance bomber for the R. A. F. Coastal Command, and for the Royal Australian Air Force, the Hudson performed so notably in combat that it was used for dive bombing and also as a fighter. It had greater speed at certain altitudes than a majority of enemy aircraft, and proved most difficult to bring down even after having one engine and part of a wing, tail or nose, on at least one occasion, shot away by anti-aircraft fire. A Hudson was the first to give the alarm that the German battleship Bismarck had left port, and the first capture of a submarine from the air was accomplished by a Hudson of the Coastal Command. The Hudson was powered by two 2,000 h.p. Pratt and Whitney or Wright radial aircooled engines. Its length was 42 ft., height 11 ft. 10 in., and wing spread 65 ft. 6 in.

The Lockheed P-38 Lightning for the U. S. Army Air Forces and the R. A. F., was a streamlined pursuit-interceptor with twin booms taking the place of the customary fuselage. The pilot-gunner in the twin-engine, single-place plane, rode in a bullet-like nacelle which was an integral part of the wing. All the cannon and machine guns were carried in the nose of this nacelle, directly in front of the pilot-gunner; and the controls of this concentrated fire-power were at his fingertips. Two slender nacelles, on either side of the pilot, each carried a 12-cyl. 1,150 h.p. liquid-cooled Allison engine. These engine nacelles extended like torpedoes back to the twin-tails of the plane, supplanting the conventional fuselage. The Lightning had a gross weight of approximately 13,000 lbs., wing span of 52 ft., and was 38 ft. long. The two three-blade, controllable pitch propellers rotated in opposite directions. Its function was to get off the ground quickly at the first sign of approaching enemy bombers, climb swiftly to altitudes of 35,000 ft. and greater, and dive down through the



THE LOCKHEED HUDSON BOMBER

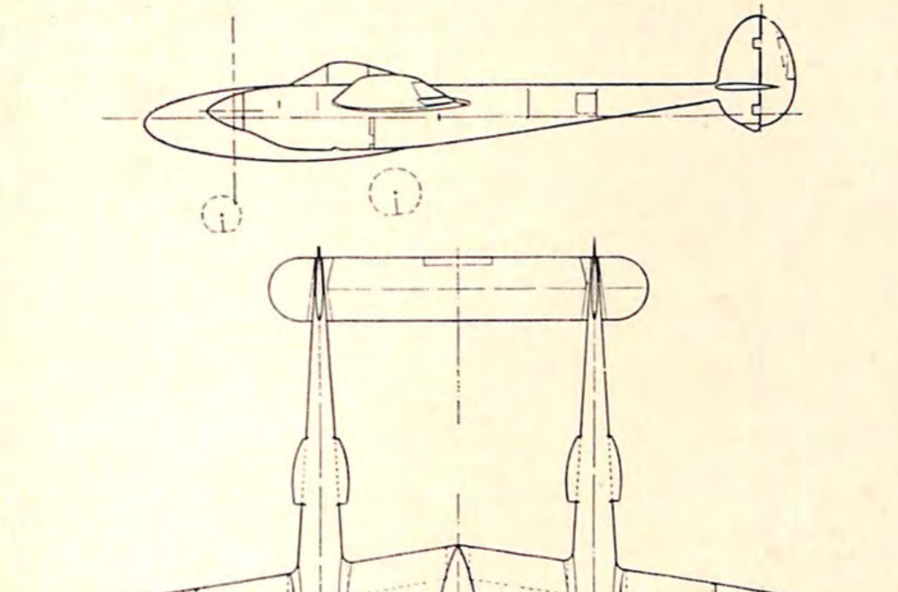
Powered either with two Pratt & Whitney or two Wright Cyclone engines, it can be used as a reconnaissance bomber, a dive bomber or a fighter.

fighters that escort the bombing squadron, chasing fighters and bombers alike out of the sky. Turbo-superchargers which maintained a constant power output in the rarefied substratosphere made high altitude performance possible.

The Lockheed Model 12 was an 8-place airplane similar to the 10-passenger Model 10, or Electra, and was designed especially to be used by corporations and executives as a privately owned transport. The Model 12 was faster than the Electra. Due to the excellent flying characteristics, maneuverability, ease of handling, speed and low cost maintenance, the Lockheed 12 was ordered in considerable quantities by various military services throughout the world for use as a command type personnel transport. Lockheed 12's explored the jungles of Central and South America, pioneered air routes for air lines around the globe, and were in daily use by hundreds of business men both in the United States and in the farthest foreign corners of the earth. It was powered by two 800 or 840 h.p. Pratt and Whitney Wasp Jr. or Wright Whirlwind engines; was 36 ft. 4 in., in length, and had a wing span of 49 ft. 6 in.

The Lockheed Lodestar was a commercial air liner, corporation or executive model, and was in service in South Africa, Europe, South America, the United States, Canada and Alaska. The transcontinental record for transports of 9 hrs. 29 min. 39 sec., established by G. T. Baker, president of National Air Lines, between Burbank, Calif., and Jacksonville, Fla., on November 2, 1940, was made in a Lodestar. Making one stop at Dallas, Tex., to refuel, Baker and a crew of four covered the 2,357 mile distance at a speed of more than 240 m.p.h. to shave 1 hr. 4 min. off the 10 hr. 34 min. mark established by Howard Hughes in a specially built racing plane in 1938. A feature of the flight was the fact that this Lodestar was a standard air transport in every sense of the word and was operated and equipped exactly as if it were being flown on schedule over an established airway, as a "stock plane" equipped for immediate use for the transportation of passengers, baggage and mail. Other Lodestars were outfitted as an executive model for top Army and Navy personnel, oil company executives and as a "flying office" for President Vargas of Brazil. Converted to military use, it was a parachute troop transport for the Netherlands East Indies Government. It was an all-metal, mid-wing, two-engine, land monoplane, designed and constructed primarily for use in air line operation carrying 14 passengers, a pilot, co-pilot and a stewardess. The plane was powered by two Wright Cyclone or Pratt and Whitney engines. Horsepower varied according to the type of engine selected and ranged between 900 h.p. and 1,050 h.p. in normal operation and went up to 1,200 h.p. for take-off. Three-blade Hamilton Standard hydromatic constant speed propellers were used. The overall length was 49 ft. 9⅞ in.; wing span 65 ft. 6 in.; height over cabin 11 ft. 10½ in.; height inside cabin 6 ft. 3 in.; length inside cabin 24 ft. 6 in.; width inside cabin 65½ in. The normal fuel capacity of the Lodestar was 644 gal., giving it a range of well over 1,000 miles at 500 h.p. per engine. Oil capacity was 44 gal. Maximum speed at 16,700 ft. approached 300 m.p.h. and was a bit less at critical altitude of 8,800 ft., and at sea level. The Lodestar cruised more than 200 m.p.h. at sea level. Take-off time at sea level without flaps was 15 sec., landing speed at sea level with flaps 65 m.p.h. Fowler flaps were standard equipment.

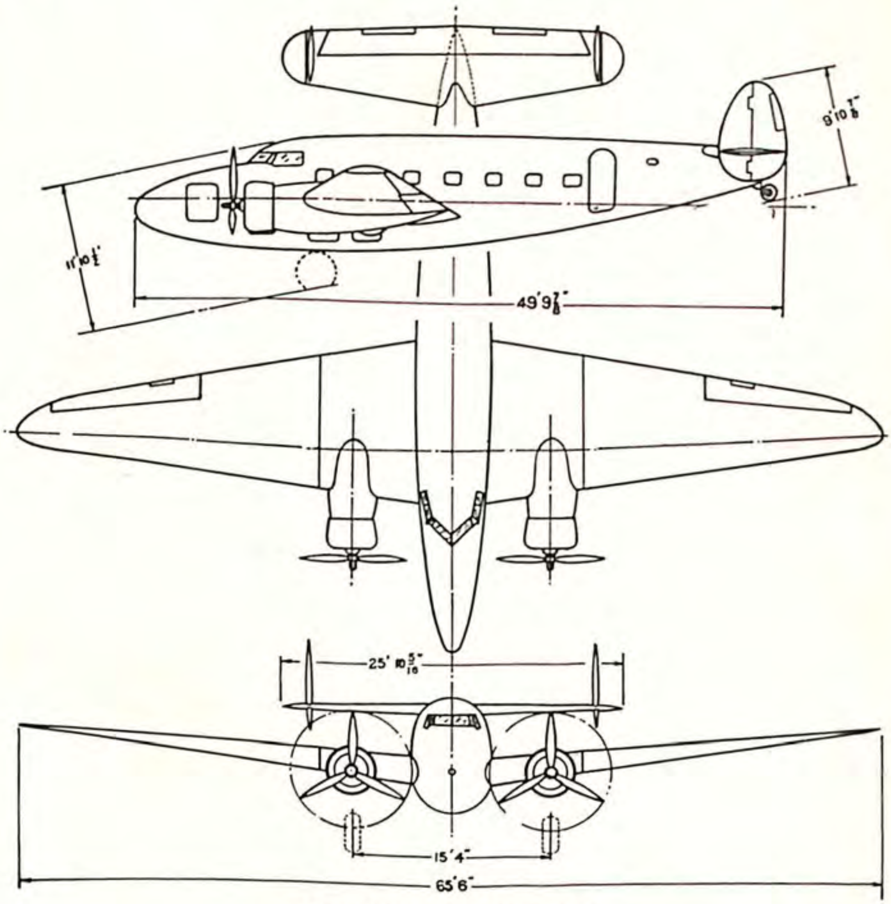
Within a week after the United States entered the war a complete blackout of all plants had been effected in the six huge Lockheed and



THE LOCKHEED INTERCEPTOR

The P-38, export version, 322-61, is a twin-engine, single-place plane designed for interception and attack. It is powered with two Allison engines.

Vega plants. Other steps taken to insure adequate protection for employees, plants and planes included U. S. Army anti-aircraft protection, restricted areas guarded by Army sentries, emergency traffic regulations, additional communications and first aid facilities, a ban



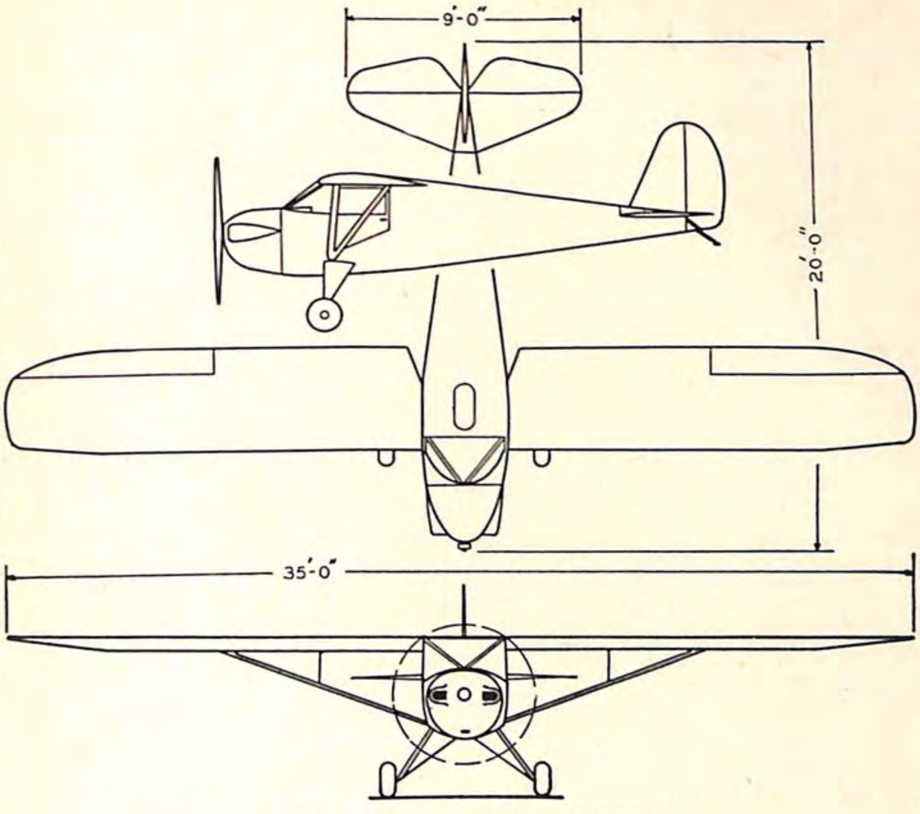
LOCKHEED LODESTAR

This twin-engine transport carries 17 and is powered with two Wright Cyclone or two Pratt & Whitney engines.

on visitors and restriction of information on production figures, movement of aircraft and other vital matters. Although the plants had been working three shifts six days a week for 18 months and a seven-day week in many departments, it was necessary to cover more than a million square feet of glass, or 27 acres, with a jet black paint to effect a complete blackout for uninterrupted night production.

The tremendous job of spraying these windows and skylights with 3,500 gal. of paint was accomplished in five days with a crew of more than 100 men, working around the clock.

In their never-ending search for methods to cut production time on defense aircraft, the personnel of the Lockheed-Vega organization



LUSCOMBE MODEL 8 SERIES

A two-place plane powered with a Continental 50 h.p. engine.

made notable achievements. Among the inventions were a magnetic riveter for use on the Lockheed P-38 "Lightning," for which William Holcomb received a $2,500 second place Revere medal; the Onsrud Extrusion Miller, designed by the Onsrud Company in collaboration with the Lockheed plant engineering department, and which saved 87½ hrs. production time on the P-38; the development of a composite cable for aircraft control systems, by Carl Beed, Lockheed engineer, and a magnesium fire extinguisher, by Capt. R. B. Gottschalk and Michael Farris of the Vega fire department. Another invention was developed by John E. Browne, of Lockheed plant engineering. It was a device which cut the time required to check and double-check the maze of electrical installations in Lockheed planes from an average of 16 or 20 hrs. to only 15 min.

Luscombe Airplane Corporation, West Trenton, N. J., in 1941 manufactured and delivered nearly 300 planes, basically the Luscombe 2-place Model 8, with different designations determined by power plant installations. Parts were also produced for the British. New equipment was added to the plant. Model 8A-2 with a 65 h.p. Continental engine, had a stated high speed of 110 m.p.h., cruising at 105 m.p.h., 350 mi. range. The 8A-2 seaplane, similarly powered, had a stated high speed of 105 m.p.h., cruising at 100 m.p.h., 325 mi. range. Model 8B-2 had a 65 h.p. Lycoming engine. The 8D with 75 h.p. Continental engine had a stated top speed of 115 m.p.h., cruising at 110 m.p.h. and 550 mi. range.

McDonnell Aircraft Corporation, St. Louis, Mo., was working on many projects, chiefly prime contracts with the U. S. Government for production and experimental airplanes. In addition to its prime contracts the company was serving the aircraft industry by subcontract production on horizontal stabilizers, vertical stabilizers, rudders and elevators; flexible gun mounts and cowlings; landing gear parts, sub-assemblies, and other aircraft parts. The personnel of the company was being increased; and the plant was on a 3-shift basis.

The Glenn L. Martin Company, Baltimore, Md., had quadrupled factory space since September, 1940, when ground was broken for the first of the new units in the company's vast expansion program. Anticipating the urgent need for thousands of bombers, the company had drafted plans for huge wartime production facilities shortly after the war broke out in Europe. At first, large scale additions were made to the main plant; then an entirely new factory was put up a mile and a quarter away and forming part of the same plant group. Many thousands of employees were working on bombers for the U. S. Army Air Forces and the R. A. F. and on long-distance patrol flying boats for the U. S. Navy. The Martin plant group in the Baltimore area was one of the largest in the country.

In addition, the Martin company was to manage and operate a Government-constructed bomber assembly plant, in the Midwest. There Martin bombers were to be assembled, starting in 1942, from parts and sub-assemblies supplied under subcontract by automobile and other non-aeronautical concerns. The Midwest plant also had an airport and airport buildings.

In order to operate these huge factories on a wartime basis the Martin company put into practice two expedients. First, it participated in a much-extended training program carried on by the Baltimore and Maryland public schools systems and by universities in Maryland. Second, the company devised tooling and production systems designed to allow the employment of many workers of lower skill standards than could be used in the past.

The Martin company 10 years earlier had adopted a system of cooperating with the vocational and technical high schools in order to give basic training to young men of Maryland and neighboring States from which the company could create skilled craftsmen. It loaned equipment and materials to the schools, helped work out curricula and sent its own experts into the classrooms to act as instructors, thereby supplementing the work of the public school teachers.

Martin, like other companies, pioneered in employment of women in aircraft construction. Women were working shoulder-to-shoulder with the men, doing the same type of work and doing it well. Factory officials found that women could handle machinery such as riveters, drills and presses with efficiency; and they looked forward to the day when women might fill in the gaps in the production lines as growing numbers of men went to war.

Among the many contributions which speeded up production, the Martin photographic reproduction process was credited with being one of the most effective. A giant camera, one of the largest in the world, reproduced in four minutes drawings up to 10 by 5 ft. directly on nearly any kind of surface—metal, cloth, linen paper and glass—by means of a secret emulsion. The process was a combined engineer, tool-maker, die-maker and inspector, and it lightened the burden of the employees throughout the factory. It saved hours of time otherwise spent in redrafting. It expedited shop work by reproductions on metal to form the actual bases of jigs and fixtures in which plane parts were assembled. It aided the die-makers who thereby could work directly from the lines on their metal, instead of laboriously scribing the patterns. It helped the die-casters because the camera could enlarge

MARTIN PBM-3 MARINER

One of the new long range patrol bombers in production for U. S. Navy air forces at the plant of the Glenn L. Martin Company.

a drawing to just the proper size to allow for shrinkage of the cooling metal. It was of untold value to experimental workers, who found that they could cut out whole pieces of a new plane by simply sawing along the lines photographed on bare metal. Similarly, pieces of mock-up could be cut along lines reproduced directly on wood surfaces. The original reproduction unit was credited with having taken the place of 307 skilled engineers and technicians in a year when they were hard to find. It turned out a daily average of 200 pieces of work which otherwise must have been done by hand.

The Martin B-26 medium bomber for the U. S. Army Air Forces was one of the most aggressive warplanes. It had power turrets, great fire power, self-sealing fuel tanks and protective armor. It had high speed, despite its gross weight of 26,625 lbs. It was powered by two Pratt and Whitney 18 cyl. 1,850 h.p. Twin Wasp engines and 4-blade Curtiss automatic electric full feathering propellers 13½ ft. in diameter. An outstanding feature was its extreme streamlining. It was of mid-wing monoplane design and all-metal monocoque construction. The landing gear was of the retractable tricycle type.

The Martin 187 Baltimore bomber was supplied to the R. A. F. in increasingly large numbers.

One of the notable events in the flying boat branch of the industry was the completion of the huge Glenn L. Martin Navy long-range XPB2M-1 Mars. It was one of the largest aircraft ever built. It had a wing span of 200 ft., length 117 ft. 3 in., height 36 ft., beam of hull 13½ ft., maximum normal weight 140,000 lbs., gross displacement of hull 995,000 lbs., volume of hull 16,665 cu. ft. equal to the average 16-room house. It was powered by four 2,000 h.p. Wright Duplex Cyclone engines with 3-blade propellers 17½ ft. in diameter. The Mars had a draft of 5 ft. in the water. Its wings alone weighed 20,000 lbs. It carried 7½ mi. of wiring and 3,000,000 rivets. It had 1.9 miles of conduit and pipe, and its fuel capacity was equal to that of a railroad tank car. If stood on end, the wings of the Mars would be as tall as a 20-story building. The wings were thick enough for a corridor which extended through the inside so that the engines could be reached and serviced during flight. The Mars had two decks and accommodations, with sleeping quarters, for a crew of 11, with a wardroom for officers and a recreation room for the crew, with two messes and two shower baths. There was a private stateroom for the commanding officer on the bridge. As a troop transport, the Mars could carry 150 armed men. It could fly to Europe and back without stopping.

In active service with U. S. Navy air forces were the Martin PBM-1 Mariner long-range patrol flying boats. They carried a crew of 11 with ample living quarters. The Mariner had a wing span of

118 ft., overall length of 77 ft. 2 in., and weight of 40,000 lbs. It was powered by two 1,350 h.p. Wright Cyclone engines, was heavily armed for defensive purposes, had tremendous striking power and was equipped to spend long periods away from its home base. It was designed to act independently or in cooperation with the Fleet.

Early in 1942 the Glenn L. Martin Company started quantity production on the PBM-3 Mariner, a two-engine long-range patrol bomber flying boat for the Navy air forces. The Mariner was larger and more powerful than the PBM-1 then in Navy service. It had the same gull-shaped wing and toed-in rudders.

Meyers Aircraft Company, Tecumseh, Mich., was in production on three models of tandem biplane training planes. The OTW was powered by a Warner 125 h.p. Scarab engine. The OTW-145 had a 145 h.p. Warner Super-Scarab, and the OTW-KR had a 120 h.p. Ken Royce engine. All models were practically the same with different engines. The ship was used as a secondary trainer in the CPT program. The OTW had a span of 30 ft., length 22 ft. 8 in., wing area 262 sq. ft., stated high speed of 120 m.p.h., cruising at 105 m.p.h. Early in 1942 the company was conducting tests on a new low-wing tandem primary trainer, 2-place, with 165 h.p. Warner engine, model ME-165.

Monocoupe Aeroplane Division, Universal Moulded Products Corporation, Orlando, Fla., produced the Monocoupe 90AF, a light patrol-trainer high-wing monoplane, powered by a 90 h.p. Franklin engine. It was a 2-place side-by-side cabin plane, 20 ft. 11 in. in length, wing span 32 ft., height 6 ft. 10 in. Its stated high speed was 125 m.p.h., cruising at 110 m.p.h., landing at 45 m.p.h. 550 mi. range, gross weight 1,610 lbs.

North American Aviation, Inc., Inglewood, Calif., with enlarged production facilities devoted exclusively to the manufacture of warplanes, was contributing bombers, pursuit planes and training ships to the U. S. Army and Navy air forces and to the British R. A. F. North American had established a fine production record in 1941, and was to increase production at a tremendous rate in 1942. Adding to its enormous production facilities at the parent plant at Inglewood, the company had started independent manufacture of airplanes in a wholly-owned subsidiary plant in the Midwest. Also, North American had delivered the first Midwest B-25C medium bomber from a new "blackout" plant in the Midwest late in 1941. In cooperation with the Fisher Body division of General Motors, North American was thus the first of the aircraft companies teamed with an automotive company to start its Government-sponsored production program in the Midwest.

THE MONOCOUPE 90 AF
It is powered by a 90 h.p. Franklin engine.

At the beginning of 1942, North American production at Inglewood was devoted to the B-25 twin-engine medium bomber and the Allison-powered Mustang pursuit plane. The B-25 bombers leaving the conveyor assembly lines for the Army Air Forces in 1941 were very different from the B-25 bombers which had been considered almost the ultimate in medium bombardment efficiency a year before. The translation of war experience into design changes had resulted in more and better armor and armament, plus hundreds of other changes contributing to the overall value of the B-25 as a fighting machine. In February an Army B-25 sank a giant German submarine off the Atlantic Coast.

Mustang fighters secured their first combat experience with the R. A. F. abroad, and their speed, maneuverability and firepower made them important factors in the war in the air.

With the training of pilots being carried forward at the highest rate in our history, the accelerated production of training ships by the company was proving a vital factor in the air program. During 1941, North American delivered unprecedented quantities of AT-6A trainers to the Army, SNJ-3 trainers to the Navy, and Harvard trainers to the British.

In addition to multiplying its production facilities—by the addition of new plants and buildings and increasing its personnel to keep pace with expansion, North American achieved a new record in utilizing the powerful resources of allied industries. The company's subcontracting program doubled almost overnight as it made use of idle plant facilities resulting from necessary defense priorities. A total of nearly 1,000 subcontracting firms spread through most of the States were supplying parts and sub-assemblies to North American plants.

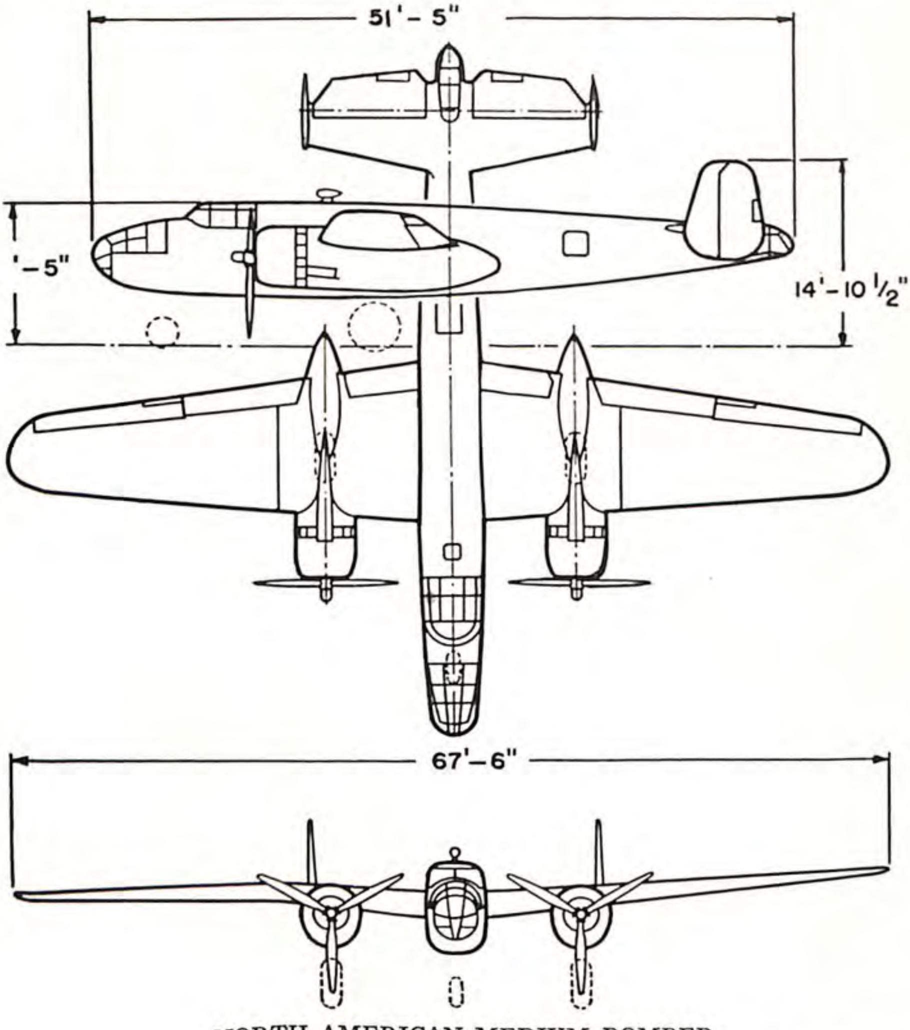
In an industry whose payrolls more than doubled during 1941, personnel problems necessarily became serious. North American's in-plant training programs were supplemented by Government and private schools, and early in 1942 employment offices still were managing to keep abreast of production schedules.

Undoubtedly the most significant change in personnel policy was that which led to the hiring of women for factory work. North American hired women first in a branch plant starting in November, 1941. The plan was so successful that the Inglewood and another branch plant began hiring women. The first groups of women were hired for work in the electrical sub-assembly department, but it was apparent that they would soon be performing many other operations in nearly all departments. Although North American immediately recognized the ability of women for aircraft work, the company emphasized that the purpose of the new policy was to release male labor for expansion in certain departments, and that in no instance would men be displaced.

North American continued its program of developing the most advanced technique for the construction of aircraft when monorail assembly lines to expedite the production of bombers and pursuit ships were installed early in December, 1941. The bomber assembly system extended from the master jig in the fuselage assembly to the entrance of the paint shop along a route 300 ft. long. The bomber front and rear sections moved down the assembly line suspended from overhead monorail conveyors. The line was divided into 32 sections, or positions, for the front section, and into 10 stations for the rear section. The work on each of the conveyors was so synchronized that at the end of each work shift, installations specified for each station were completed, and the fuselage section was moved to the next station. An electric hoist, equipped with canvas slings, lifted the fuselage sections out of the master jig onto the monorail conveyors, and at the end of the assembly line the sections were closely inspected.

When the fuselage structure of the pursuit plane built at Inglewood was completed in the master fuselage jig, it was attached to the overhead rails along two parallel conveyor systems in the assembly line. As the plane moved from station to station along the conveyor, it was fitted with the necessary assemblies and equipment. The plane was substantially complete when it reached the end of the conveyor and was transferred to a dolly, where the engine and the empennage were placed in position. The wing, with fuel tank and landing gear already installed, arrived on the assembly line at this stage and was attached to the plane.

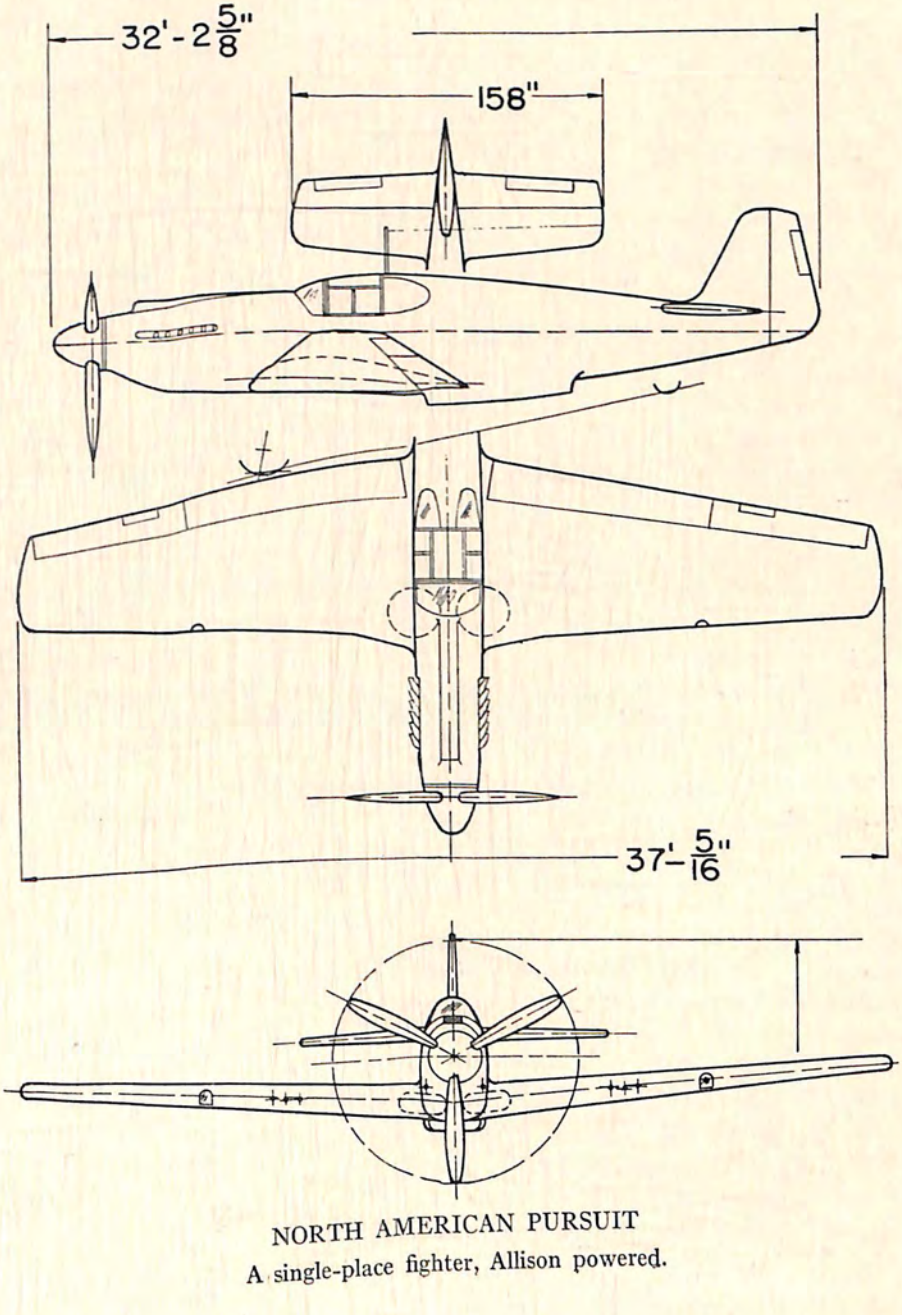
An X-ray photo-template duplicating system was installed in the Inglewood plant in 1941 as another contribution to speeding up pro-



NORTH AMERICAN MEDIUM BOMBER

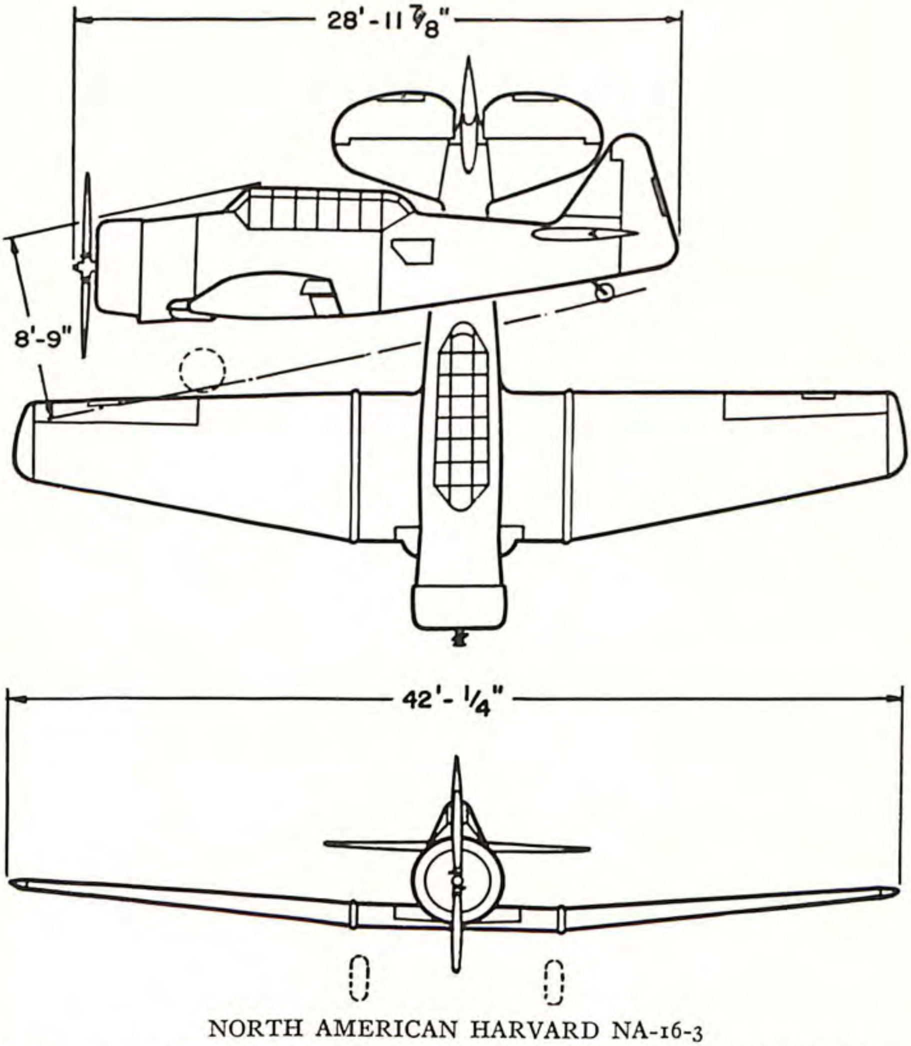
This bomber carries a crew of five and is powered with two Wright Cyclone engines.

duction. With the aid of an X-ray any master pattern could be duplicated in an hour. In addition to the regular metal templates, or master patterns, the process could reproduce the lines for Masonite dies used in forming sheet metal parts, and could duplicate the lines on wood jigs used with profiling machines. The process was worked out in cooperation with General Motors and Eastman Kodak research men. The idea made possible the saving of thousands of dollars. The loftsman inscribed the template design on metal sheets



NORTH AMERICAN PURSUIT

A single-place fighter, Allison powered.



NORTH AMERICAN HARVARD NA-16-3

A two-place advanced trainer powered with a 550 h.p. Pratt & Whitney Wasp engine.

that were previously treated with fluorescent lacquer, the effect of this lacquer being destroyed where he drew. The layout was then placed under the X-ray, causing the lacquered surface to glow. Because the lacquer's effect was destroyed by inscribing, the lines remained dark. The desired practical surface, coated on one side with film, was then placed next to the original template design, using a vacuum pressure arrangement to secure it firmly. When the afterglow of the scribed template reacted on the film, an opaque negative resulted. After the transfer process had been completed, the negative was developed by ordinary photographic means, and the finished product was ready to be cut, trimmed and sent to the shop for production use. Both positive and negative prints could be secured.

Another significant innovation among defense plants on the West Coast was the inauguration of a mass catering system called the "Travelunch," at North American's Inglewood plant. Streamlined cafeterias-on-wheels are rolled to 24 locations in the plant from a central cafeteria to bring hot food direct to the employees in the shop. Employees are provided with a different menu each day, including hot and cold sandwiches, and the complete personnel of the organization was served within 30 minutes.

Part of the aircraft industry swung inland during 1941 as new major plants were placed in operation in half a dozen cities between the Rockies and the Alleghenies. First such plant to deliver an airplane was North American's unit in the Midwest where AT-6A trainers were first delivered to the Army Air Forces and the Navy on April 7, 1941. Before the end of the year, the plant had a record production of training ships.

The bomber assembly plant in the Midwest, for operation by North American, was rushed to completion by the U. S. Army Corps of Engineers. The first B-25C medium bomber was rolled off the assembly line there on December 23, 1941. North American was teamed with General Motors in this project under a plan instituted by the Federal Government whereby the automotive and aviation industries pooled their vast resources to increase war production.

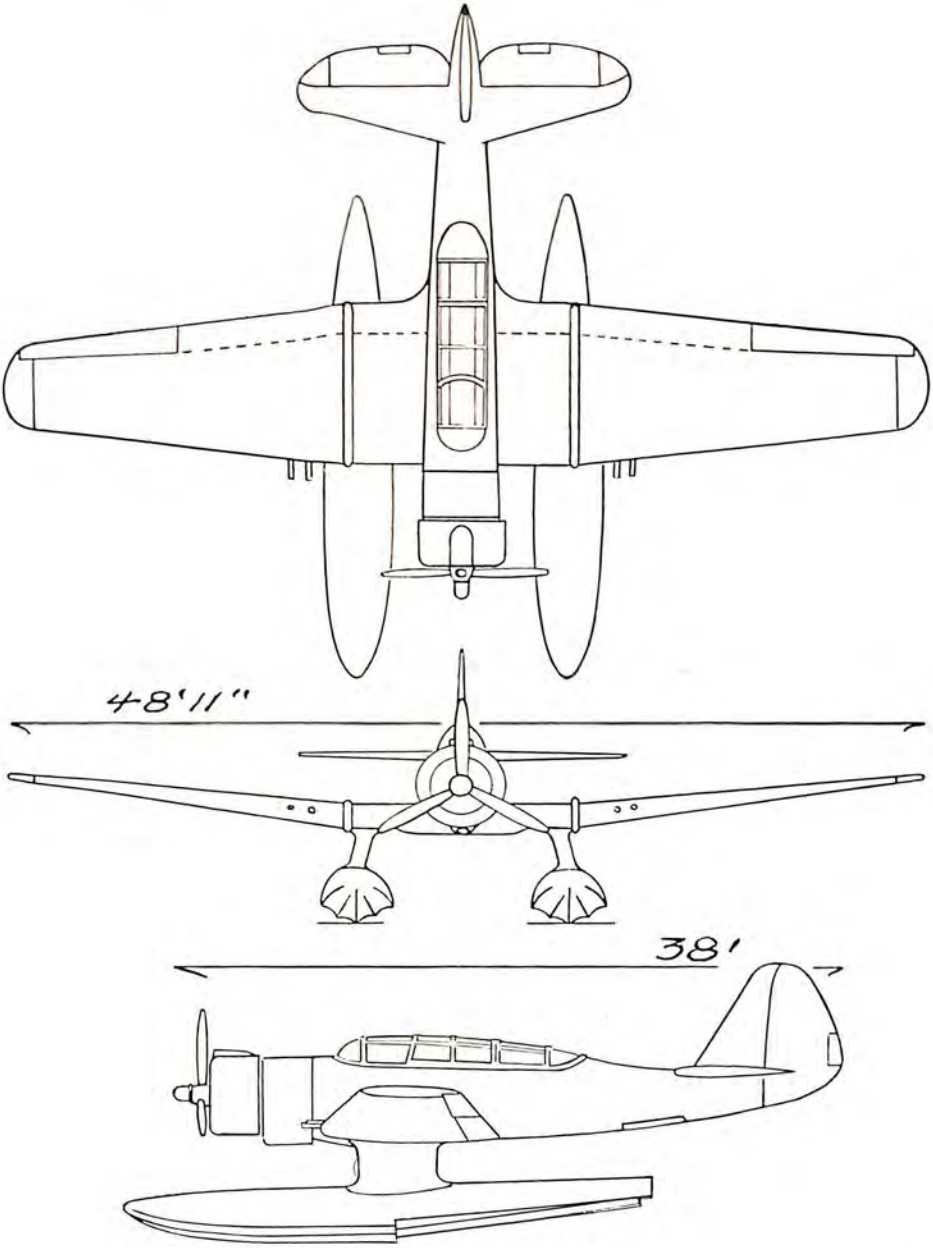
Northrop Aircraft, Inc., Hawthorne, Calif., on February 1, 1942, completed its second year as a manufacturing organization. The company started business manufacturing empennages under subcontract for a military manufacturer. In April, 1940, the company received its first contract for complete airplanes. This order, from the Norwegian Government, was for 24 seaplane patrol bombers. Eight months later the first ship was test-flown at Lake Elsinore, and the last ship on this order was delivered in March, 1941. Prior to the completion of the order, Norway was invaded and delivery of these aircraft was made to the Norwegian Naval Air Force operating outside that country. With a high speed of 257 m.p.h., this plane ranked as one of the world's fastest seaplane bombers. The company was unable to build additional planes of this type for a number of prospective customers, because of priority restrictions on engines. The planes were reported to have performed creditably in anti-submarine operations and to have played an important part in the sinking of the German battleship Bismarck. The N3-PB was a 3-place single-engine, low-wing full cantilever monoplane incorporating extensive armament and novel features of design and construction. In addition to a load of 2,000 lbs. of bombs, it carried six machine guns. Four 50-cal. machine guns were fixed in the leading edge of the wing, two on each side of the fuselage. Two other guns were flexible. One 30-cal. was in the turret above the fuselage aft, and another 30-cal. fired through a gun trap under the fuselage aft. In addition, bomb racks gave a wide selection of the type of bombs which might be carried, permitting a range choice of from 30-lb. to 1,000-lb. types or one 2,000 lb. torpedo. The fuselage was a semi-monocoque type utilizing aluminum alloy 24ST and incorporating a stressed skin covering. The structure was fabricated in two sections, divided along the horizontal centerline. The crew occupied tandem cockpits covered by easily operated, streamlined enclosures with good visibility in all directions. The front cockpit was equipped with all necessary flight and engine controls and instruments, and was occupied by the pilot. The rear cockpit was occupied by a gunner-observer located in the upper forward section, and a gunner-radio operator-bombardier was stationed in the lower rear section.

The wing was of full cantilever design, had a stressed skin covering, and was composed of five sections, the center section, two outer panels and removable tips. The NACA 2400 series airfoil section was used, and the flaps were of the split trailing edge type. Power was supplied by a Wright Cyclone GR-1820-G200 series engine rated 1,200 h.p. at 2,500 r.p.m. Two Edo floats were used on the seaplane, and were attached by full cantilever pedestals replacing the usual strut and wire type of support, thereby giving an unusual streamlined installation.

In September, 1940, the company received an order from the British for the manufacture of Vultee Vengeance dive bombers under a license from Vultee Aircraft. Northrop Aircraft, early in 1942, was in full production on the Vengeance. Additional orders were received from the U. S. Army Air Forces.

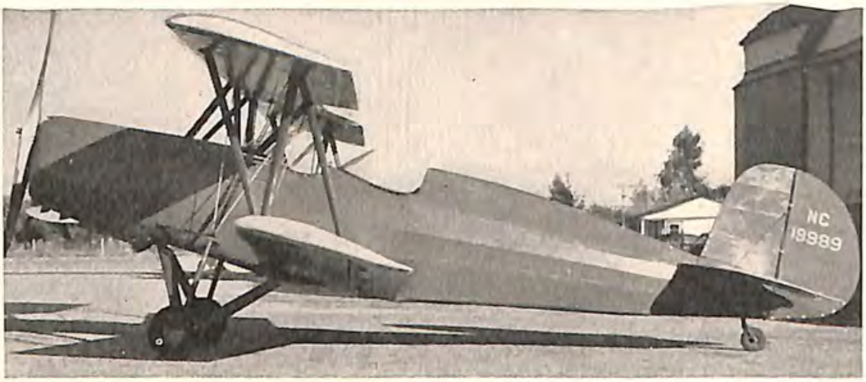
Northrop also was producing under subcontract the nacelles and cowling for bombers which made the company a major subcontractor in the heavy bomber program.

The carefully guarded secret of the Northrop Flying Wing became known in September, 1941, with the publication of design patents granted the company. By that time Northrop Aircraft had conducted over 200 experimental flights with this model over a period of 18 months. It represented a successful, true flying wing with no tail surfaces or fuselage. Power plant and personnel were housed within the airfoil, and there were no portions of the airplane which did not



THE NORTHROP N-3

A three-place patrol bomber powered with a Wright Cyclone 1,200 h.p. engine.



THE PHILLIPS CT-2

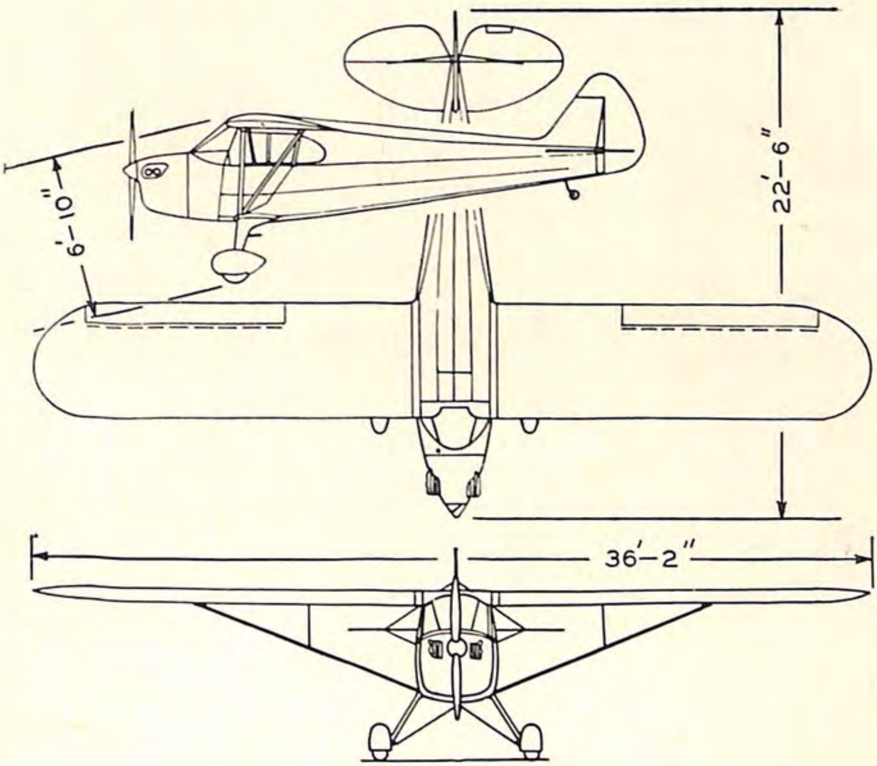
contribute directly to the lift of the airfoil, excepting the small propeller drive shaft housing extending above and to the rear of the wing. The wing had such configuration as to provide satisfactory static and dynamic stability about all three flight axes.

Northrop expanded employment and factory area. Shortly after the declaration of war, operations were placed on full 24 hours a day and 7 days a week basis. Women were added successfully to the factory personnel and the percentage of women employees was being gradually increased.

Phillips Aviation Company, Los Angeles, Calif., produced airplanes and aircraft engines. The plant consisted of five buildings at Metropolitan Airport at Van Nuys. Forty additional acres, also a part of Metropolitan Airport, were held under lease by the company, for future expansion. The Phillips 1B was a low-wing skin-stressed monoplane powered with a 125 h.p. Menasco C4 engine. This model was modified and redesignated the Phillips X-PT, and was powered with a 165 h.p. Ranger engine. The Phillips CT-2 and CT-2A biplane trainers represented a redesign and modification of the Driggs Skylark. The Phillips-Fleet was a Model 7 Fleet, powered with a 120 h.p. Phillips 333 engine. It had qualified for use as an advanced or secondary trainer in the Civilian Pilot Training Program.

Phillips Aviation Company acquired the engine business of the Glenn L. Martin Company in 1940. Martin had completed three models, with the 4th, 5th and 6th still in the design stage. The models were renamed Phillips. The 4-cyl. Phillips 333 was installed in the biplane trainers.

Piper Aircraft Corporation, Lock Haven, Pa., produced 3,197 light airplanes during 1941. It marked the tapering off of private



THE PIPER CUB COUPE

It is powered by a Continental 75 h.p. engine.

plane manufacturing and commencement of subcontract work as a part of national defense production. Bridging the gap between the two types of production, the company completed a sizeable order of O-59's, military version of the Cub Trainer, for the U. S. Army.

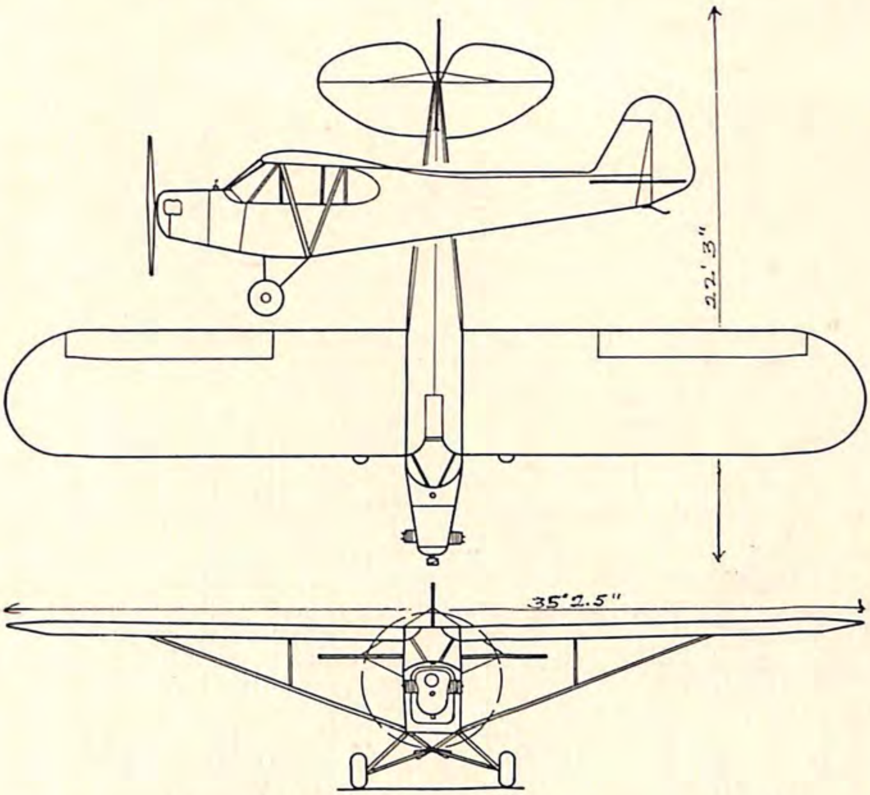
Factory construction and expansion continued into 1942. A new two-story office building was completed to house the sales, accounting and engineering departments. Plant additions included a crating and shipping building with indoor railroad siding, new modern dope building and a combined warehouse and repair shop. An 800 ft. spur track paralleled the entire building with a continuous unloading ramp, allowing delivery of carload shipments of dope, engines and other supplies. The additional trackage brought the total railroad system serving Piper buildings to more than a half mile. The plant operated on a 24 hour-a-day basis, using three shifts. The factory delivery system was introduced, to the advantage of purchasers and Piper employees alike. Dealers, who were often busy with flight instruction

PIPER FINAL ASSEMBLY

and other duties, found it increasingly difficult to spare good pilots to come to Lock Haven to secure planes. At the same time, there were many qualified pilots working at the Piper plant who were eager to make extended cross country flights. Under the factory delivery system, members of the Cub Fliers Flying Club made guaranteed plane deliveries to distributors and customers. Planes were delivered to nearly all States.

Piper offered three different models for private flying and commercial operation. Specifications for the three models remained basically unchanged. Most popular was the Continental 65 h.p. J-3 trainer, which was used extensively in the Civilian Pilot Training Program. The ability of the J-3 to get in and out of small fields suited the needs of private pilots. An outstanding development was the final acceptance by the U. S. Army of the Continental-powered O-59 for carrying messages, transporting officers behind the line, and directing artillery fire by means of two-way radio. Nicknamed "grasshoppers," these planes proved their worth in three months of maneuver testing.

The Piper Coupe continued to maintain its popularity with the private plane owner, with a 75-h.p. motor and a cruising range of 450 mi. The Cruiser model opened new revenue possibilities for the operator who desired to combine passenger carrying, student instruc-

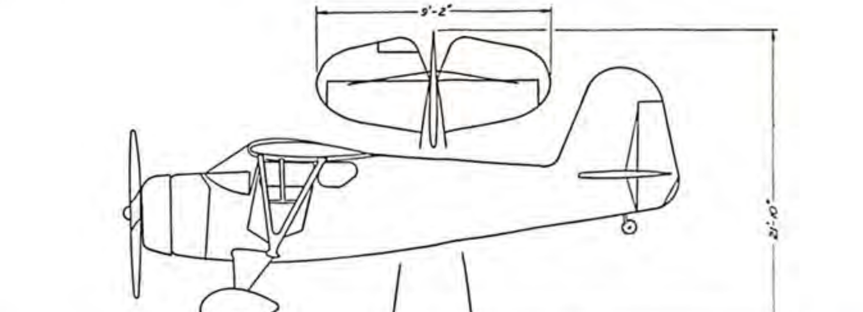


PIPER CUB TRAINER

This two-place Model J-3 is available with Continental, Franklin or Lycoming engine in a power range from 40 to 65 h.p.

tion and private flying. The 1942 model of this ship was the Super Cruiser, equipped with dual ignition, Lycoming 100 h.p. engine, stainless-steel exhaust muffler, semi-cantilever landing gear and full pressure cowling. There was ample room for two passengers in the wide, comfortable rear seat. It had a cruising range of 360 mi. provided by 25-gal. gasoline capacity. Standard equipment included dual hydraulic brakes, parking brake, compensated compass and full-swivel tail wheel. Paint design was an attractive patriotic color scheme.

Further data on Piper models included the O-59A, 2-places, powered by a 65 h.p. Continental engine, 173 sq. ft. wing area, 1,160 lbs. gross weight, stated high speed 88 m.p.h., cruising at 75 m.p.h., 206 mi. range. The J3C had a 65 h.p. Continental engine, 2-places, 173 sq. ft. wing area, 1,160 lbs. gross weight, stated high speed 88 m.p.h., cruising 75 m.p.h., 206 mi. range. The J5C was a 3-place



REARWIN CLOUDSTER

A two to three-place private owner plane with a choice of Ken-Royce engines from 90 to 120 h.p.

plane with a 100 h.p. Lycoming engine, 179 sq. ft. wing area, 1,550 lbs. gross weight, stated high speed 112 m.p.h., cruising 105 m.p.h., 360 mi. range. The J4 was a 2-place plane with 75 h.p. Continental engine, 183 sq. ft. wing area, stated high speed 96 m.p.h., cruising 90 m.p.h., 450 mi. range. The J5 was a 3-place plane, with a 75 h.p. Continental or Lycoming engine, 179 sq. ft. wing area, 1,450 lbs. gross weight, stated high speed 93 m.p.h., cruising at 80 m.p.h., 320 mi. range.

Rearwin Aircraft & Engines, Inc., Kansas City, Kans., was in production on the 8135T, an instrument training plane which had been adopted by many flying schools. Some of them had as many as five Rearwin 8135T ships on the line. The 8135T could be converted into a primary trainer by removing the rear instrument panel. Pan American Airways used the ships in its training classes. The 8135T was a development of the Rearwin Cloudster and was a cabin monoplane with tandem seats, and doors into each compartment. It was 21 ft. 6 in., in length, 34 ft. 1.5 in. wing span, 7 ft. 4 in., high, weight empty 1,340 lbs., useful load 560 lbs., gross weight 1,900 lbs., 34 gal. fuel capacity, stated high speed 135 m.p.h., cruising at 120 m.p.h., 600 mi. range. It was powered by a 120 h.p. Ken-Royce engine.

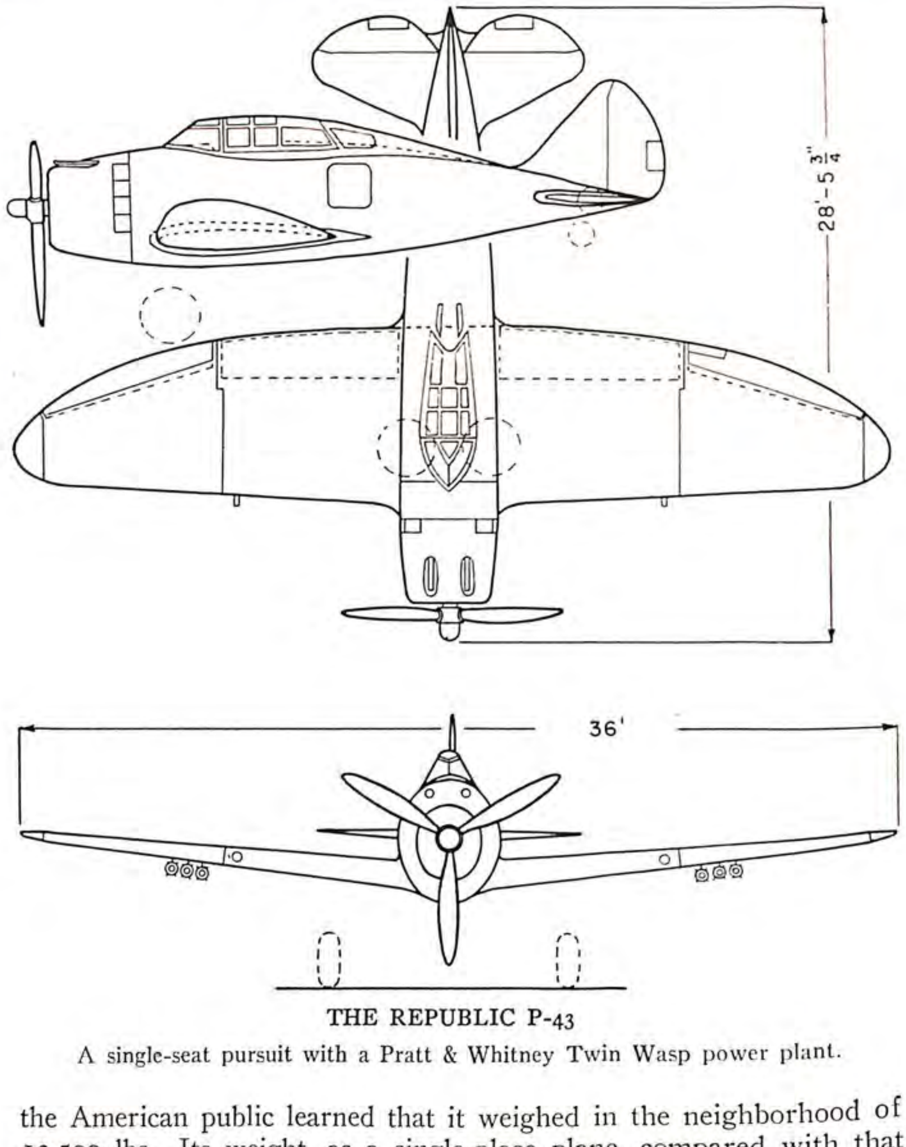
To meet the demand for an instrument trainer requiring less capital investment, Rearwin altered the design of its Sportster and introduced the 9000-KRT, smaller than the 8135T. All necessary blind flight instruments could be installed in the 9000-KRT. Its seating arrangement was tandem. It was powered by a 90 h.p. Ken-Royce engine. The length was 22.25 ft., span 35 ft., height 6.75 ft., stated high speed 115 m.p.h., cruising at 105 m.p.h., 450 mi. range. The Cloudster and Sportster models remained on the Rearwin list of planes for the private owner and flying school.

Republic Aviation Corporation, Farmingdale, N. Y., early in 1942 moved to the front rank among the nation's aircraft manufacturers as its vastly-expanded plant went into full-scale production on the super-powered P-47 Thunderbolt. Republic Aviation's planes, designed by Alexander Kartveli, chief engineer, had been notable for years because of specific features which had been the object of long study and single-minded concentration by the entire organization. These features included utilization of the highest-powered radial aircooled engines available, engine supercharging through use of advanced turbo-superchargers, concentration on the single-engine, single-place pursuit type and adoption of design and construction methods leading to the best possible performance at high altitudes.

As a result of this program, Republic Aviation was the first company to deliver to the U. S. Army Air Forces a single-engine pursuit or interceptor plane with an engine of 2,000 h.p., in this case the Pratt and Whitney Double Row Wasp. This was the Thunderbolt, a very heavily armed and armored fighter for which its builders claimed the most potent striking power. Measured in foot pounds of kinetic energy, the guns of the Thunderbolt delivered a punch in excess of 100,000,000 foot pounds, with all firing.

The Thunderbolt, was credited by Lieut. General H. H. Arnold, Chief of the Army Air Forces, with having exceptional operational ability at the high altitudes for which it was designed. It was equipped with the newest and most secret type of supercharger and had other unique design features.

Releasable public statements on the Thunderbolt were sketchy but



THE REPUBLIC P-43

A single-seat pursuit with a Pratt & Whitney Twin Wasp power plant.

the American public learned that it weighed in the neighborhood of 13,500 lbs. Its weight, as a single-place plane, compared with that of the 15-passenger tri-motored Ford transport plane of 1930. It had a wing span of 41 ft., height of 13 ft. and length of 32 ft. 8 in.

The essential turbo-supercharger installation in the plane contributed as greatly to its performance as it had to the design difficulties which it involved. One of the most difficult problems overcome by Kartveli and his staff was that of making possible the effective installation of the complicated and extensive supercharger apparatus in the restricted confines of a pursuit plane fuselage. The contribution of the turbo-supercharger to the performance of the Thunderbolt and the great Boeing Flying Fortress bomber was recognized by the award of the coveted Collier Trophy to Dr. Sanford A. Moss, of the General Electric Company, its inventor.

Although one of the most complex, heaviest and largest of single-seat pursuits, the Thunderbolt was reported by pilots to be readily and exceptionally maneuverable and quite easy to operate—so much so that youthful pilots were allowed to fly it immediately on completion of their regular training courses. Radical design changes over its predecessor Republic types, such as the P-43 and P-35, endowed the plane with even greater attraction for its pilots than the earlier designs, despite its increased performance and fighting ability. Thunderbolts were due to reach the war zones in 1942.

In addition to the Thunderbolt, Republic Aviation was in production on the Army P-43 Lancer, a high-altitude pursuit powered with a Pratt and Whitney 1,200 h.p. Wasp engine. The Lancer also was supercharged and was at home in the higher reaches of the atmosphere, with excellent speed characteristics.

Hundreds of Lancers were turned out by Republic Aviation in 1940 and 1941. The Lancer utilized a three-blade Curtiss electric propeller, had a length of 21 ft. 10½ in., span of 36 ft., height 10 ft., weight of 6,900 lbs., tread of 9 ft. 2¼ in., and was one of the first standard pursuit planes to reach production with complete flush-riveting and the modern turbo-supercharging installation.

Republic P-43 Lancers and P-35A's were in service on several fronts. The Lancer was the standard Army pursuit which had perpetuated service developments of aircooled, supercharged engine design during the period of great expansion by the Army of the in-line liquid-cooled engine types. It was produced in large numbers by Republic and met with a uniformly-favorable reception, primarily for its ability as a high-altitude fighter and interceptor. It had high speed far in excess of the guarantees called for in purchase contracts.

A typical Lancer performance was that reported by Captain James Philpott, U. S. Army Air Forces, who flew from Lowry Field, Air Force base near Denver, Colo., to New York City in 4 hrs. 43 min. flying time. This flight of more than 1,800 mi. gave the Lancer a cruising-speed performance of better than 381 m.p.h. Most of the flight was made at 30,000 ft. altitudes, the pilot reported.

The Lancer and Thunderbolt multiple production lines were operating in parallel fashion in the Republic Aviation plant during the early months of 1942, but it was planned to convert production from the older type as rapidly as was consistent with maximum results.

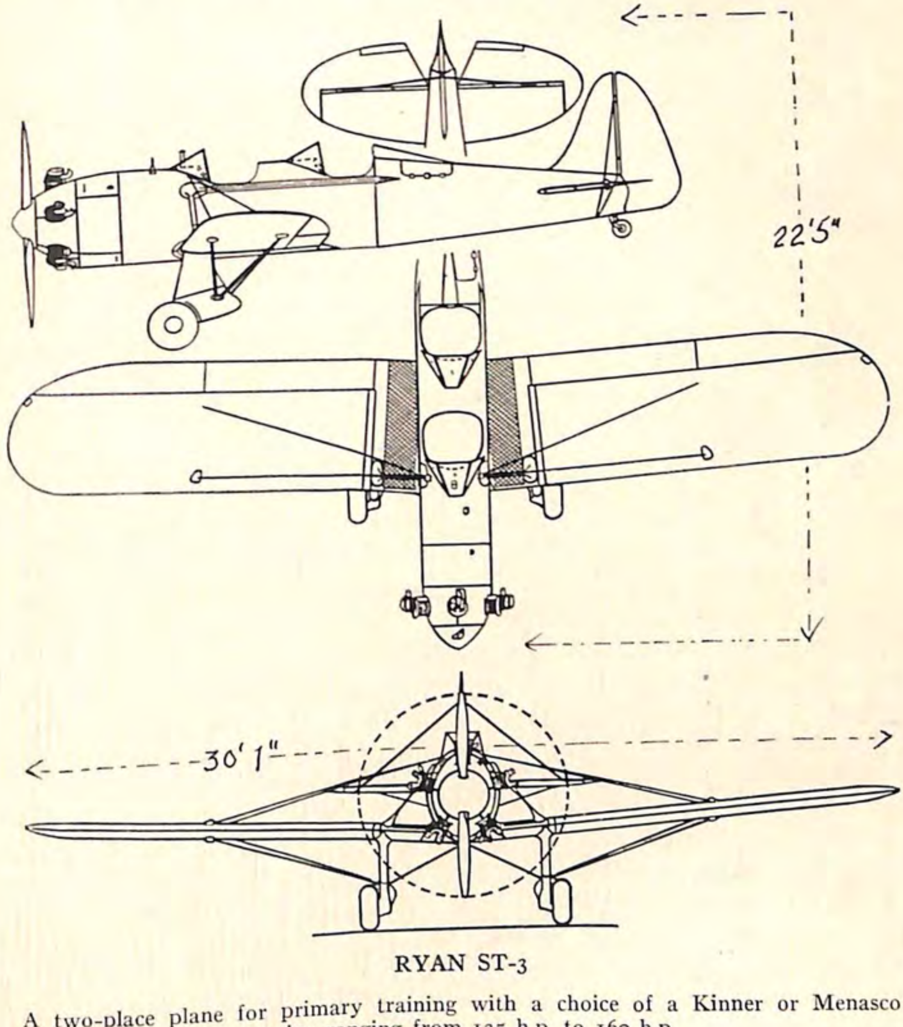
Mass production brought about a rapid expansion in Republic Aviation's personnel and facilities, so that on January 1, 1942, the company employed thousands of people and had at its command greatly expanded productive floor space. The personnel of the company had increased greatly during the previous 12 months.

The physical expansion of the organization was brought about through the erection of new factory buildings at Farmingdale, dwarfing the buildings nearby which previously had housed all the company's activities. The principal new structure was rushed to completion about midway through the year and was thoroughly modern in all respects. It was designed to contain all manufacturing and assembly activities, while the older buildings were converted to machine shop, tooling storage and experimental operations. The new building, which cost more than $6,400,000, was erected by means of a Government Facilities Agreement of conventional form, calling for reimbursement to the company of 20 per cent of the cost of the facilities each year for five years. In addition to the large assembly building, the 1942 expansion program required enlarging the adjoining company flying field from 100 to more than 200 acres, including mile-long grass runways. The factory was working on a 3-shift, 7-day, 168-hour a-week schedule. The company reported that the full wartime footing upon which it was operating included all possible precautionary steps to safeguard its property and operations.

Ryan Aeronautical Company, San Diego, Calif., completed new factory facilities and established a greatly increased production schedule. Manufacturing activities continued to be concentrated on the production of primary training monoplanes for the U. S. Army Air Forces, U. S. Navy and friendly foreign governments. The Ryan assembly line was stepped up to a high rate of production on the basic ST-3 type, and volume deliveries of models PT-21 and PT-22 were made to the Army and model NR-1 to the Navy. Ryan low-wing trainers were the first to be used by the U. S. Army for the initial instruction of military pilots. Many of the commercial flying schools which gave primary training under Air Corps contract to aviation cadets were equipped with Ryan PT-21 and PT-22 trainers in 1941. Similarly a large number of the planes were delivered to the new Navy pilot school in Florida.

Some export business was done by Ryan during the year. A large number of Ryan land plane and seaplane trainers were in service with the Netherlands East Indies Army and Navy, and also in China.

Supplementing its manufacture of aircraft, the Ryan Aeronautical



RYAN ST-3

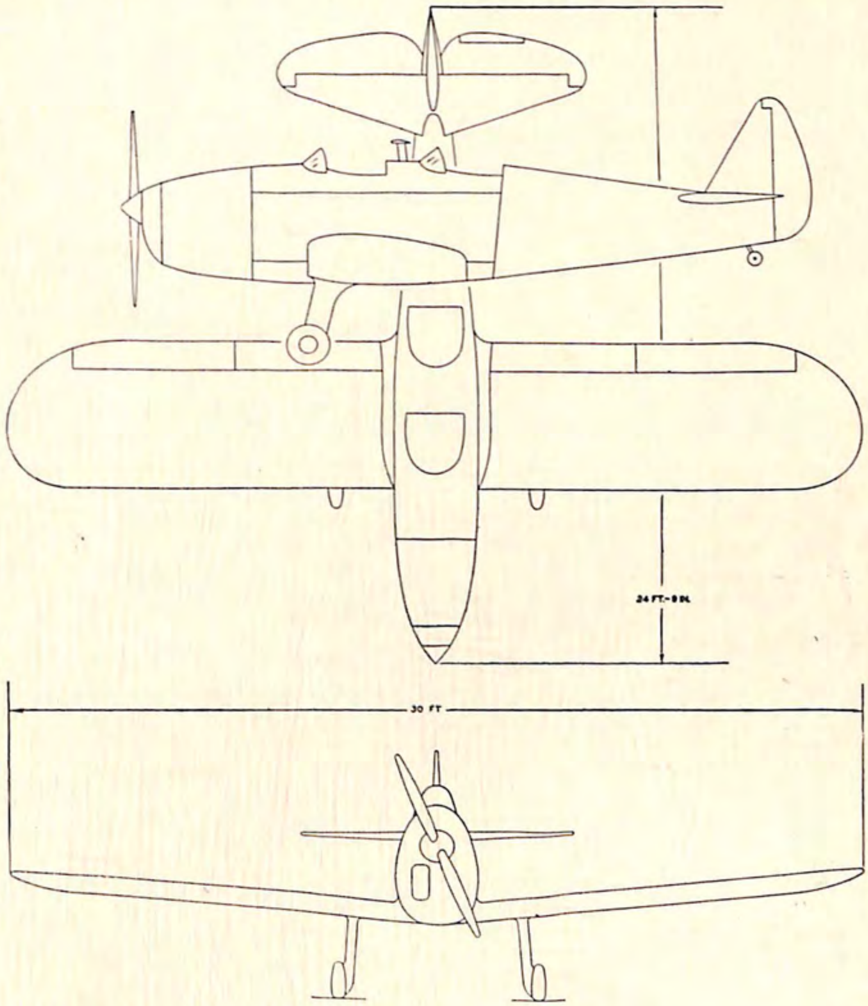
A two-place plane for primary training with a choice of a Kinner or Menasco engine ranging from 125 h.p. to 160 h.p.

Company specialized in building exhaust systems for other aircraft companies. Ryan manifolds were standard equipment on many outstanding military planes in use with the United States, British and other allied air forces. Principal technical development pioneered by Ryan's accessory manufacturing division was the universal "ball and socket" joint for exhaust manifold systems. This patented device permitted the collector ring to be supported on the engine mount, rather than on the engine, and eliminated excessive vibration. Production facilities of that division of the Ryan Company were greatly expanded, and straight line manufacturing methods were put into operation.

The Ryan factory was enlarged more than 60 per cent in productive area, while a program of installation of new machinery, tools and other technical equipment was carried out. In addition to the factory structure, other new buildings were completed to provide facilities for factory supervisory personnel and production departments. In the fields of plant protection, training programs and employee relations much was accomplished during the year to increase the efficiency of the productive effort of Ryan personnel. A problem within the factory itself was created by the necessity of training and equipping the manpower needed to supervise the work of the ever-increasing number of new employees. Lead-men and the more experienced workers with suitable seniority, particularly those with obvious qualities of leadership, were developed into foremen and sub-foremen through close contact with and study under the works manager, factory superintendent and personnel manager. Efficiency of the productive effort within the Ryan plant was increased greatly by bringing into the organization key executives with extensive aircraft production experience. During the year Ryan hired its first group of women workers, and early in 1942 the fabric department was staffed principally by women. Further calls upon the nation's manpower by draft boards was due to increase the use of women in the Ryan plant for certain types of light sheet metal work, welding and other skills for which women had shown adaptability.

Early in 1942, Ryan completed development of the ST3-S tandem seaplane trainer, differing from the PT-22 only in substitution of twin floats in place of the landing wheels. The ST3-S had a 160 h.p. Kinner radial engine. It was 22 ft. 5 in. in length and had a wing span of 30 ft. 1 in. The fuselage was of metal construction and the wings fabric-covered over wood and metal structure.

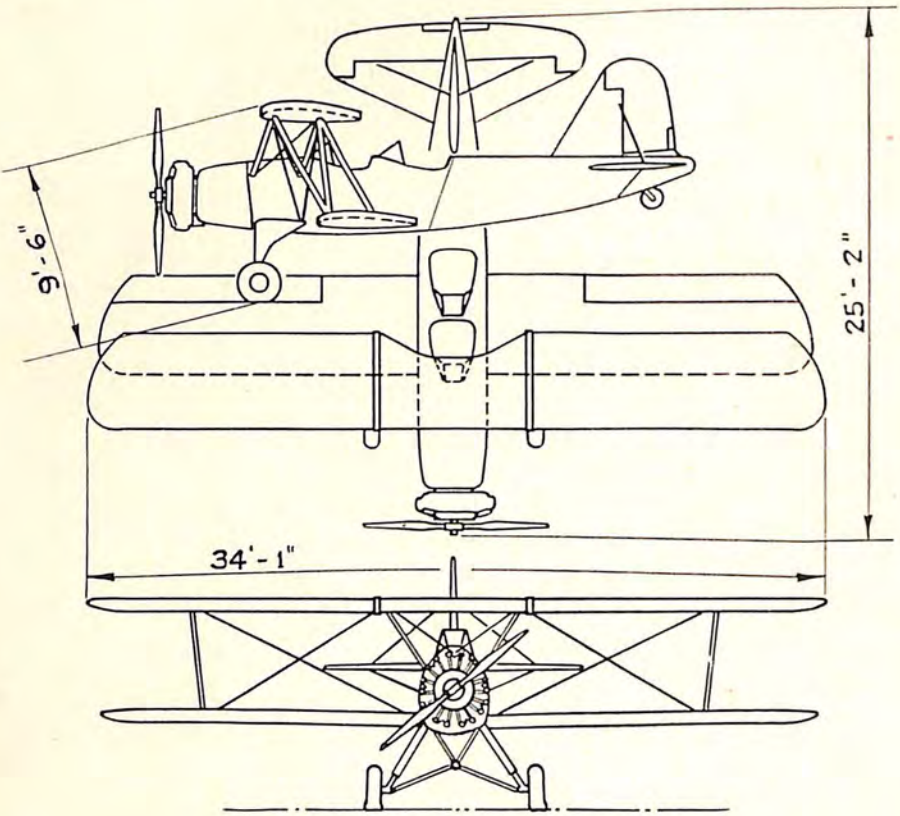
St. Louis Aircraft Corporation, St. Louis, Mo., collaborated with the U. S. Army Air Forces on restricted engineering projects, preparing for production contracts in 1942. St. Louis also produced airplane parts for prime contractors, as well as continuing with other aircraft activities including the building of balloon cars, ammunition mount assemblies, retractable skiis, expandable type rudders and spare parts for their primary trainers. One of the St. Louis models was the PT-LM-4, a low-wing monoplane, open cockpit, 2-place tandem dual stick control trainer, span 30 ft., length 24 ft. 9 in., height 7 ft. 10 in., 157 sq. ft. wing area, stated high speed 137 m.p.h., cruising at 125 m.p.h., 345 mi. range. It was powered by a 180 h.p. Ranger engine.



ST. LOUIS PT-LM-4

A two-place tandem open cockpit primary trainer with an 80 h.p. Ranger engine.

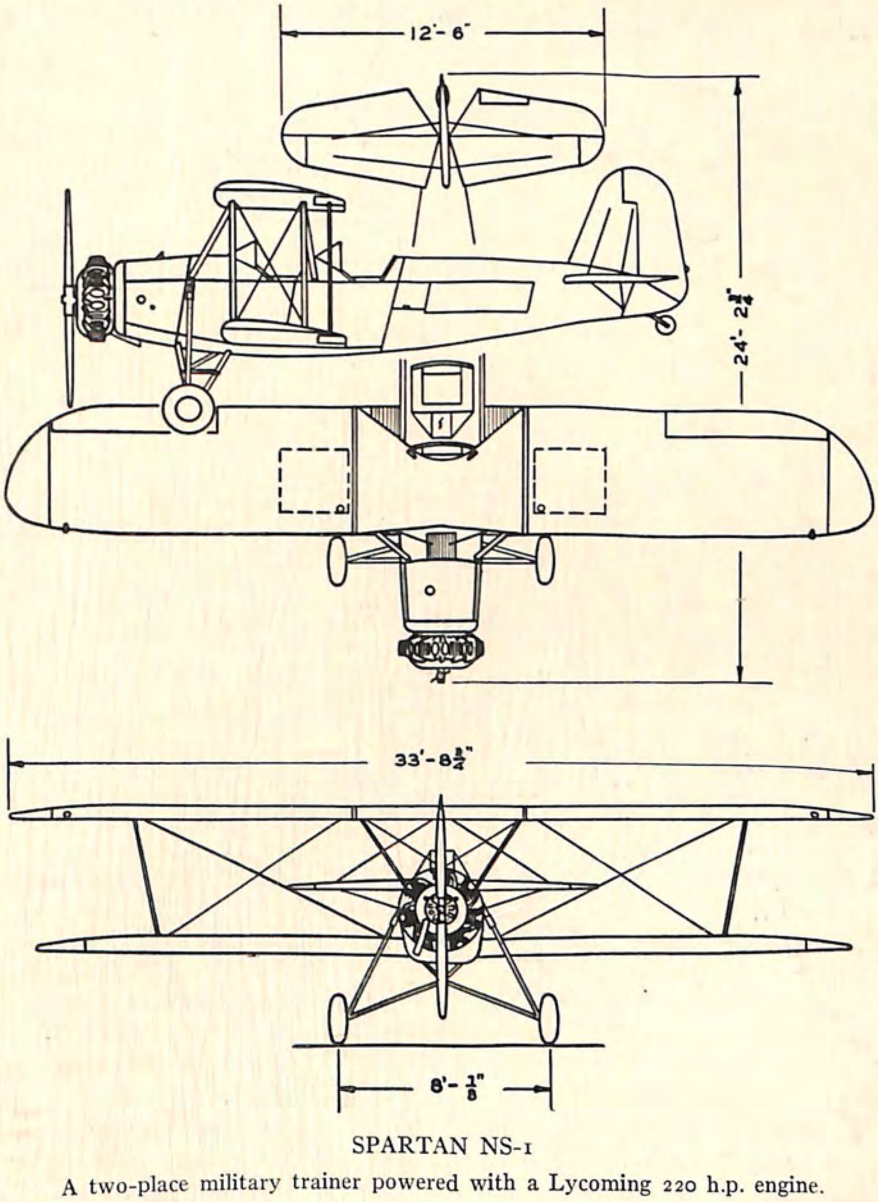
Southern Aircraft Corporation, Garland, Tex., had a 2-place, open cockpit, highly staggered biplane primary-secondary trainer, BM-10, built to requirements of the U. S. Army Air Forces. It was powered by a 225 h.p. Continental engine, had gas capacity of 42 gal., wing span upper 34 ft. 1 in., lower 33 ft., length 25 ft. 2 in., height 9 ft. 6 in., wing area 304.5 sq. ft., gross weight 2,790 lbs., useful load 720 lbs., stated high speed 123 m.p.h., cruising at 105 m.p.h., 355 mi. range.



SOUTHERN AIRCRAFT BM-10

This two-place military primary trainer may be powered with a Continental, Jacobs, Lycoming or Wright engine.

Spartan Aircraft Company, Tulsa, Okla., produced its NS-1 military primary trainer for the U. S. Navy. It was a 2-place biplane with a wing spread of 33 ft. 8⅜ in., height 9 ft. 4½ in., length 24 ft. 7¾ in., empty weight 2,080 lbs., useful load 720 lbs., gross weight 2,800 lbs. It had a welded steel fuselage frame, fabric covered aft of the rear cockpit; wing construction of laminated spruce spars, spruce ribs and drag struts, all fabric-covered with the exception of the removable metal tips; interplane and cabane struts of streamline steel tubing and ailerons of riveted aluminum alloy construction with fabric covering. The fin and stabilizer were of stressed skin aluminum alloy construction, and the elevator and rudder of riveted dural frame work, fabric covered. A single tab controllable from the cockpit provided horizontal trim. The landing gear, of the split axle type, and the

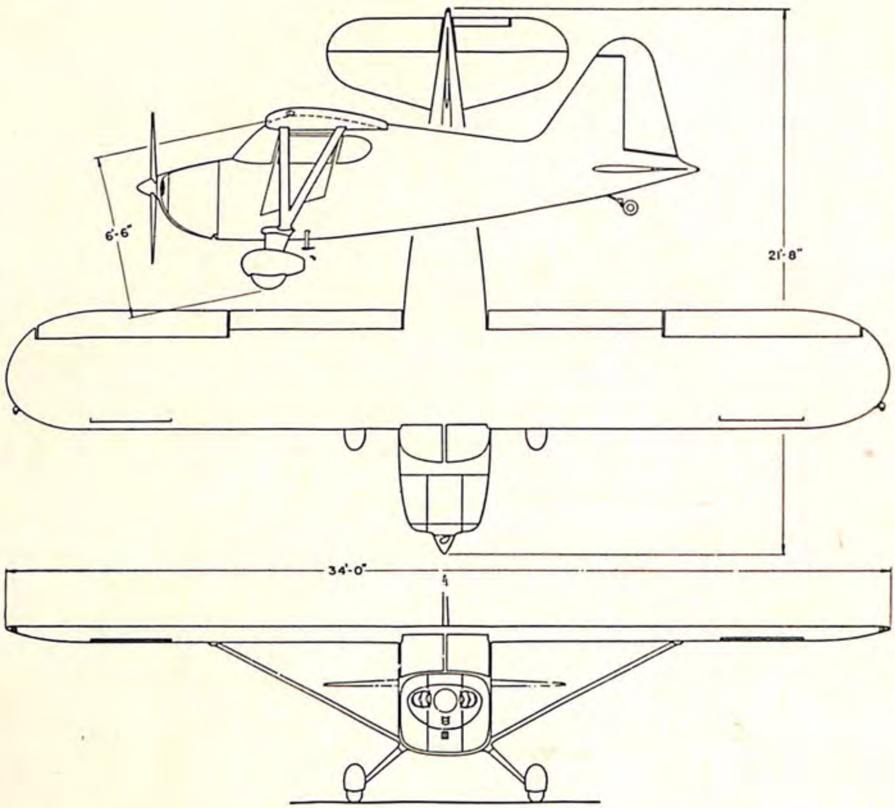


SPARTAN NS-1

A two-place military trainer powered with a Lycoming 220 h.p. engine.

swiveling tail wheel unit were equipped with oleo shock absorbers. The plane had a 220 h.p. Lycoming engine.

Swallow Airplane Company, Inc., Wichita, Kans., had under final stages of development a high-wing tandem training plane pow-

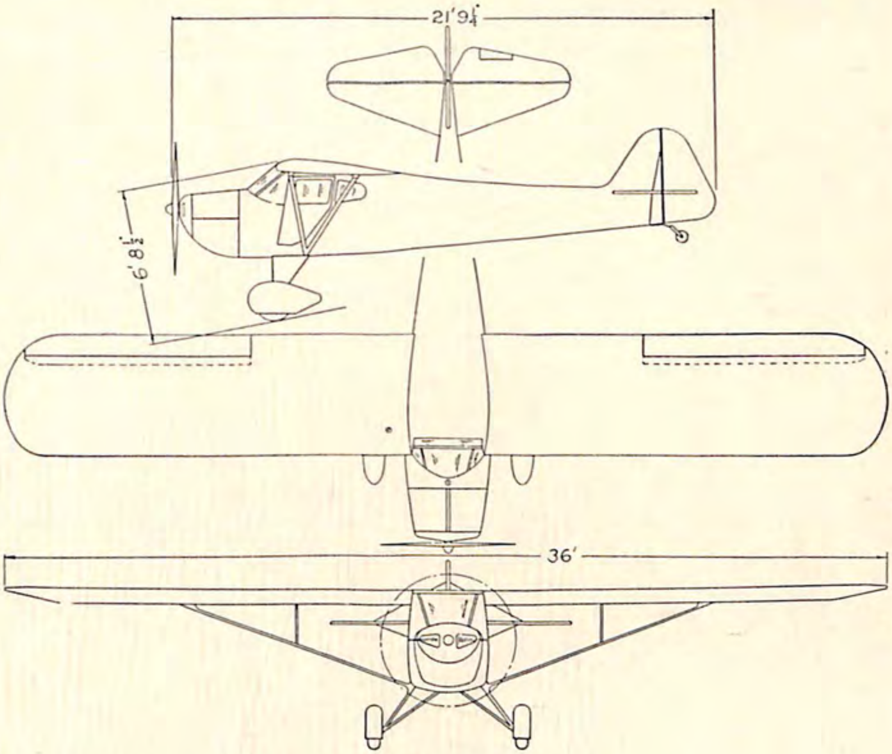


THE STINSON VOYAGER

A three-place plane for the private owner, powered by a Franklin 90 h.p. engine.

ered by a 50 h.p. or 65 h.p. Continental engine. The Swallow LJ 65 trainer was a prior development but the company could not put it into production because of priority restrictions. Swallow, meanwhile, operated a well-equipped training school for aircraft workmen.

Taylorcraft Aviation Corporation, Alliance, O., moved into its new factory and office buildings early in 1941, the formal dedication taking place on February 5, coincident with the annual distributors' meeting. The expansion, which increased the company's total manufacturing and administrative space greatly, was completed with a minimum of interference with production. The increased floor space permitted larger operating room for each department, from two and a half to three times former areas, and an almost perfect "in-line" production system. The new dope shop was an innovation made possible by the new factory addition. Built in the central west side of the new



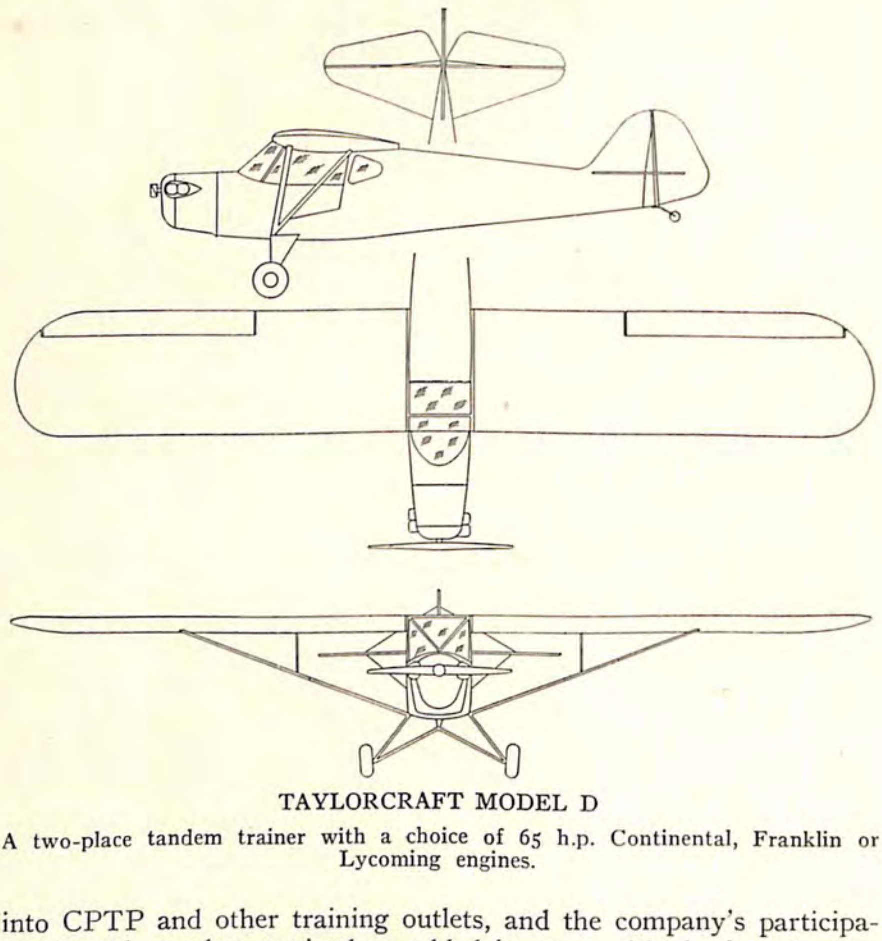
TAYLORCRAFT MODEL B

This two-place trainer is offered with a choice of Continental, Franklin or Lycoming 65 h.p. engines.

addition, it was separated from surrounding departments by a 13-inch double brick wall, with crossed-glass windows in the outside wall and in the monitor-type roof. An elaborate and most modern DeVilbiss air conditioning system handled 52,000 cu. ft. of air per minute, with a water-wash exhaust system in the spraying booths reducing fire hazard to a minimum. In the wing department a specially designed double track system greatly increased assembly of wings.

Taylorcraft "Duotone" Deluxe was introduced. Offered in a wider choice of color designs that represented a new departure in aircraft sales practice, the Deluxe easily maintained its position in sales of side-by-side airplanes. The side-by-side trainer was fitted with a closed cowl, somewhat similar to that used on the Deluxe, resulting in cleaner streamlining and appearance, and adding to the speed factor by lessening head resistance.

A substantial majority of Taylorcraft sales during 1941 went



TAYLORCRAFT MODEL D

A two-place tandem trainer with a choice of 65 h.p. Continental, Franklin or Lycoming engines.

into CPTP and other training outlets, and the company's participation in this market received an added impetus with the introduction of the first Taylorcraft tandem trainer, stick controlled. This trainer met with approval on the part of operators throughout the country. Orders for all models gave the company a substantial backlog. After September 1, 1941, Taylorcraft required an affidavit from every customer attesting that the airplane purchased was to be used in one of the nine officially designated defense categories. The company's entire effort after that date, therefore, was devoted to war production.

The Taylorcraft tandem plane participated in the summer and fall Army maneuvers in the South and as a result of its outstanding performance the company received its first production order from the Army Air Forces. Field officers of the Army ground forces were emphatically in favor of extensive use of these light planes, which they called "grasshoppers," and indications were that the relatively small orders would be followed by larger ones in the future.

With the formation of the Civil Air Patrol a good deal of the uncertainty in light plane manufacturing was removed. In fact, the Taylorcraft management was of the opinion that private fliers had an added patriotic incentive to purchase and fly their own airplanes. In addition, it anticipated renewed demand for light training planes from the possible expansion of the CPTP.

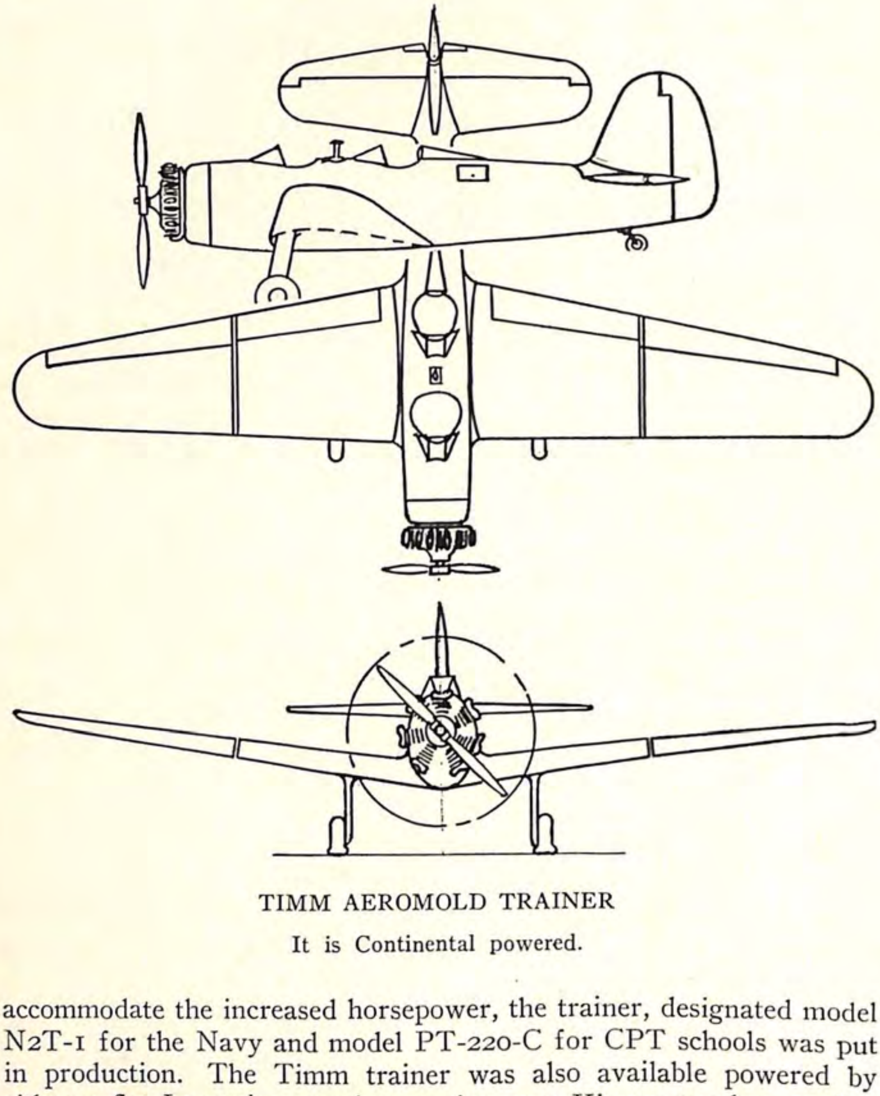
Plans of the Taylorcraft company for 1942 were centered around training and military activities, calling for a still larger proportion of its output to be devoted to the trainer models, all powered by 65 h.p. Continental, Franklin or Lycoming engines.

Timm Aircraft Corporation, Van Nuys, Calif., was in full-time war production. It had suspended temporarily completion of development work on its twin-engine, 6-place, high-wing transport airplane model T-840, which already had been flown successfully. This bimotored transport plane employed a tricycle landing gear having a hydraulically operated steerable nose wheel. The company also suspended, for the time being, engineering and research on a fast pursuit ship based on the famous transcontinental record holding Hughes low-wing monoplane which it owned. Full time was concentrated on preparing the Timm Aeromold trainer for CAA tests. Model S-160-K had been flown successfully several months previously. This was a 2-place, cantilever low-wing, military type monoplane, with fuselage, wings and control surfaces built entirely of plastic-bonded plywood by the Timm Aeromold process.

Meanwhile, substantial contracts had been received from other aircraft manufacturers for quantities of metal sub-assemblies. These were put in production immediately, thus affording the company the necessary income to continue the important development of the Timm trainer.

On April 2, 1941, model S-160-K was awarded the first approved type certificate ever given a training airplane fabricated entirely of plastic-bonded plywood. The tests revealed that such construction produced an airplane of sturdy strength, well-balanced performance, dependability, economy and ease of maintenance and repair. Its maneuverability was especially outstanding. As a result, the ATC covered both primary and secondary training.

The S-160-K was flown to Wright Field for Army tests and from there to Washington for flight tests by the Navy. The Navy placed a contract for several test planes powered with a Continental W-670, 7 cyl., 220 h.p. engine. After the necessary structural adjustments to



TIMM AEROMOLD TRAINER

It is Continental powered.

accommodate the increased horsepower, the trainer, designated model N2T-1 for the Navy and model PT-220-C for CPT schools was put in production. The Timm trainer was also available powered by either a flat Lycoming 175 h.p. engine or a Kinner 175 h.p. engine. It had a length of 24 ft. 6⅝ in., wing span 36 ft. and height of 7 ft. 7¼ in.

Of great importance to the future of the aircraft industry as a whole, and to Timm Aircraft Corp. in particular, was the interest manifested by the Army and Navy, other Government bureaus and airplane companies in Timm's Aeromold process of fabricating plywood parts. The company found it necessary to organize a special Aeromold division, exclusive of metal parts production, to specialize on production of plastic-bonded plywood sub-assemblies for metal combat ships and advanced trainers, in addition to the Timm trainer. Extensive research in that field culminated in test orders from several manufacturers, which gave rise to enthusiastic predictions for the adaptation of plastic-bonded plywood parts to general aircraft production.

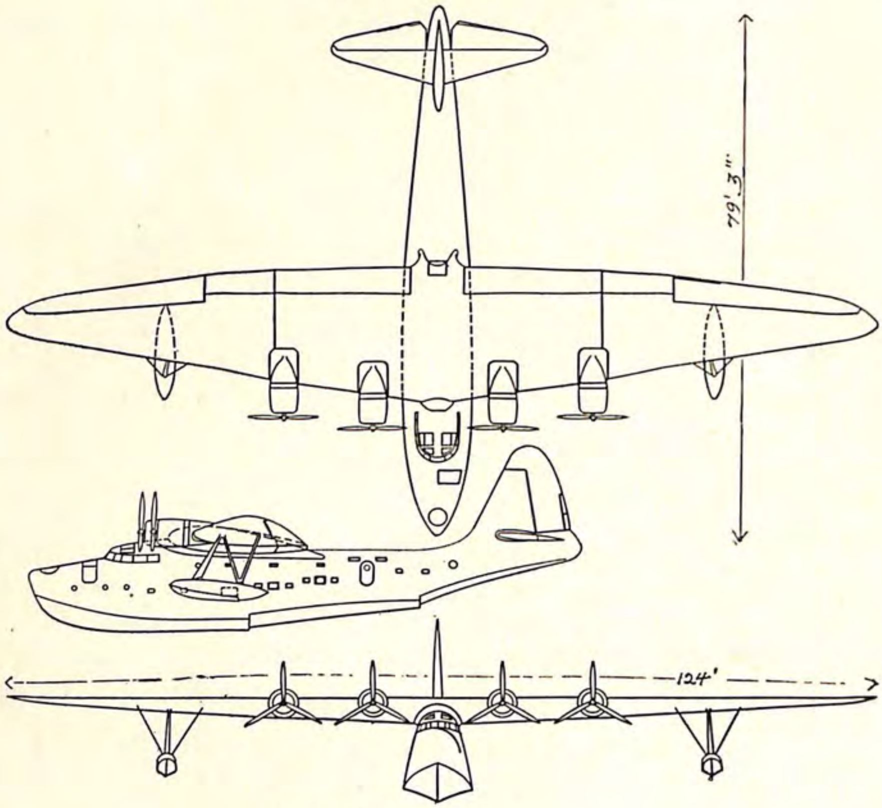
With Timm's rapid growth, necessity for plant expansion became apparent early in the year. Therefore, the company purchased 54 acres of land immediately adjacent to the Los Angeles Metropolitan Airport, Van Nuys, Calif., on which its plant was located. A service hangar was completed, and a modern factory building was nearly ready.

Timm's Aeromold Division was to be transferred to the new plant, leaving the old plant for manufacture of metal parts exclusively. The new site not only permitted ample room for further expansion but included a private runway of 1,600 ft. for flight testing Timm trainers and other airplanes.

Early in 1942 Timm had triple the number of employees with which it began the year, a capacity business of building both metal and aeromold parts for the nation's combat airplanes and, instead of an untested plastic-bonded plywood trainer, a successful training airplane in production.

Vought-Sikorsky Aircraft Division of United Aircraft Corporation, Stratford, Conn., completed its second major expansion in 1941, increasing factory floor space to several times that existing at the beginning of the emergency. Activities at Vought-Sikorsky Aircraft included in the quantity production of airplanes for the U. S. and British Navies, the manufacture of large flying boats for transoceanic operation, and the development of new and secret types. Large-scale production of the Vought SB2U-3 scout dive bombers and the Vought OS2U-3 observation scouts was undertaken for the U. S. Navy. At the same time, "Chesapeake I" (V-156) dive bombers were turned out in quantity for the British Navy. During the year, preparations were made for quantity production of the Vought F4U-1 "Corsair" single-seat shipboard fighter for the U. S. Navy. This airplane, equipped with a Pratt & Whitney Double Wasp engine and a Hamilton Standard Hydromatic propeller, was considered a valuable and important part of the Naval aircraft program. It was credited with being the fastest Navy shipboard fighter in the world, and was known to have outstanding performance at high altitudes. It was a low-wing, all-metal monoplane of monocoque construction with a spot-welded fuselage and inverted gull type wing.

The Vought scout dive bombers produced for the U. S. Navy



VOUGHT-SIKORSKY VS-44A

This 28 to 40 place ocean transport is powered with four Pratt & Whitney Twin Wasps.

(Vindicators) were similar or improved versions of the SB2U-2 monoplanes already in service. Those built for the British Navy (Chesapeakes) were of the two-place low-wing, internally-braced monoplane type, each equipped with a Pratt & Whitney Twin Wasp Junior engine and a Hamilton Standard constant speed propeller. The Vought OS2U-3 (Kingfisher) observation scouts for the U. S. Navy were of the low-wing monoplane type, with metal monocoque fuselage using extensive spot-welding. This type was also manufactured under license by the Naval aircraft factory.

During 1941, Vought-Sikorsky Aircraft continued its policy of subcontracting to a more extensive degree—obtaining major airplane parts from the automotive industry.

The first of the three giant VS-44A flying boats for American

Export Airlines, the "Excalibur," was completed near the end of 1941. It was a commercial version of the Navy's massive Sikorsky patrol bomber. It was a four-engine high-wing cantilever monoplane with a semi-monocoque hull, and built of metal throughout. Equipped with Pratt & Whitney Twin Wasp engines and Hamilton Standard Hydromatic propellers, it was designed to incorporate every modern improvement, including accommodations for 16 overnight passengers and a crew of 11, plus a substantial load of mail and express. With a top speed of 235 m.p.h., the "Excalibur" had a maximum non-stop range, under special fuel and load conditions, in excess of 6,000 mi. It was built for non-stop transatlantic service, and underwent flight tests early in 1942. Additional airplanes of this type were on order for the U. S. Navy.

The Vought-Sikorsky VS-300 experimental helicopter was further improved. It was an experimental rotating-wing aircraft which in several hundred flights proved capable of rising straight up from the ground, hovering motionless, flying forward, backward or sideways, and landing by vertical descent without any forward run. On May 13, 1941, Igor I. Sikorsky flew this helicopter to a new world's endurance record for this type of one hr., 32 min., 30 sec. at Stratford, Conn. He thus broke the previous record of 1 hr., 20 min., 49 sec. held by Germany since 1937, and surpassed the Western hemisphere record of 1 hr., 5 min., 14.5 sec. which he established with the same machine on April 15, 1941.

Early in 1942, arrangements were being made with other manu-

VOUGHT-SIKORSKY F4U-1 CORSAIR

A Navy shipboard fighter, powered by a Pratt & Whitney 2,000 h.p. Twin Wasp engine and a Hamilton Standard Hydromatic propeller.

VULTEE VENGEANCE

A dive bomber ordered in quantity by both the U. S. Army Air Forces and the R. A. F. It was powered by a 1,600 h.p. Wright Cyclone engine.

facturers for building both the Corsair fighter and the VS-44A flying boat under license.

Vultee Aircraft, Inc., Downey, Calif., with its subsidiary plants in the South and Midwest was in total war production on pursuit planes, dive bombers, observation planes and trainers for the United States and other allied air forces. Floor space had been increased many fold during the last year of peace, and employes, too, grown into an army, including both men and women who were taken into the Vultee plants and trained in numerous repetitive operations. The plant at Vultee Field, Downey, was producing pursuits and trainers early in 1942. A branch plant was turning out dive bombers and observation planes. Another branch was entering into production on liaison airplanes for the Air Corps and advanced trainers for the Fleet Air Arm of the British Navy, and was producing parts and subassemblies. There also, in a great new manufacturing and research department, methods and processes were devised for adaptation to all Vultee operations.

The five types of Vultee aircraft in production included the Vengeance dive bomber originally ordered by the R.A.F., and later purchased in quantity by the Army Air Forces as A-31. It was a 2-place, single-engine, mid-wing dive bomber of all metal construction, with the center section integral with the fuselage. The landing gear was fully retractable, folding back and up into the wing under section. The Vengeance was powered by a Wright 1,600 h.p. Cyclone 14 engine.

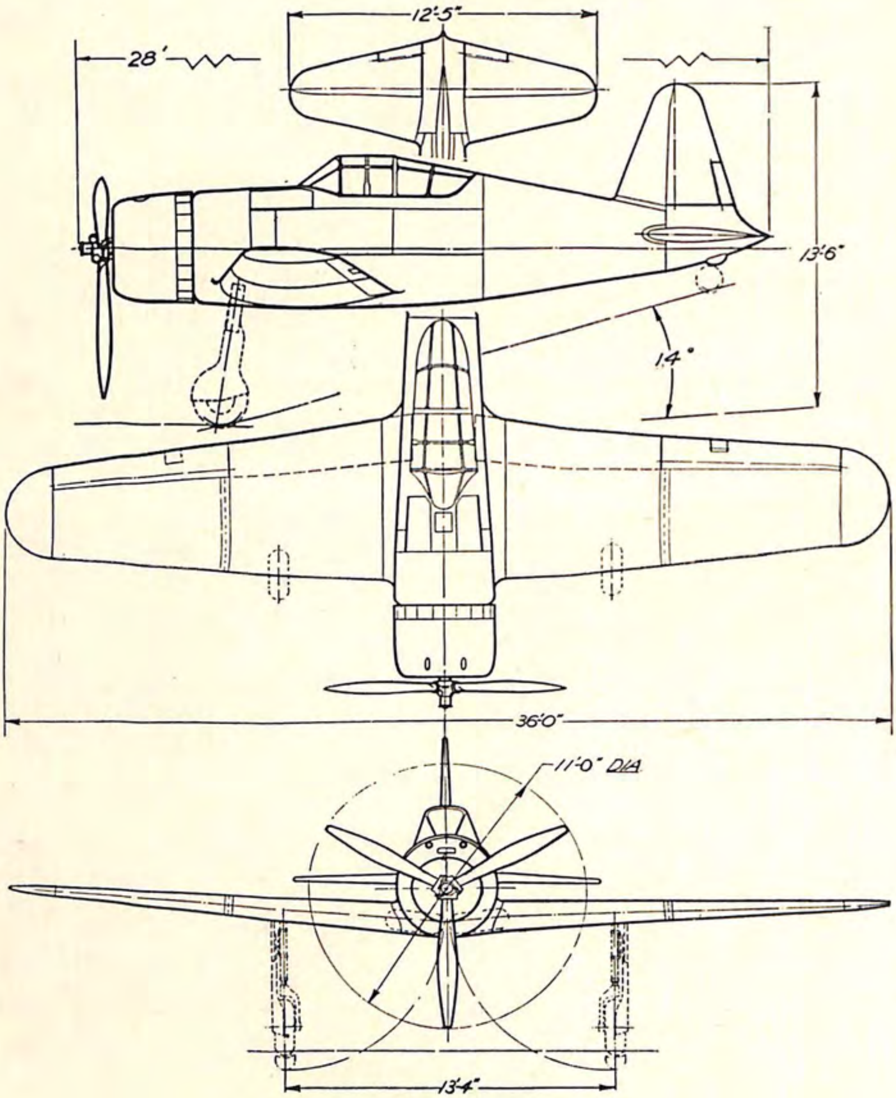
The Vultee Vanguard was a low-wing, all-metal pursuit plane, with center section integral with the fuselage and with center panels bolted on at the butt joints. It was powered by a Pratt & Whitney

Twin Wasp engine. Large numbers of the Vanguard were shipped to the Royal Air Force.

The Vultee BT-13A and BT-15 Valiant were low-wing basic trainers with different engines, the 13A with a Pratt & Whitney Wasp Junior and the 15 with a Wright Whirlwind. The fuselage was of welded steel tubing in the forward section with removable metal panels, and the after section was semi-monocoque. The cockpits were tandem and canopy-covered. The wings were metal-covered with slotted flaps. The Valiant was used by both the Army and Navy, and was the principle basic trainer used by those forces early in 1942. The Peruvian air force also used the Valiant.

The Vultee O-49 Vigilant was an observation-liaison plane, of steel tubing and fabric construction, with high wing externally braced and affording good vision. The closed cockpit carried two tandem. It

THE VULTEE VENGEANCE DIVE BOMBER

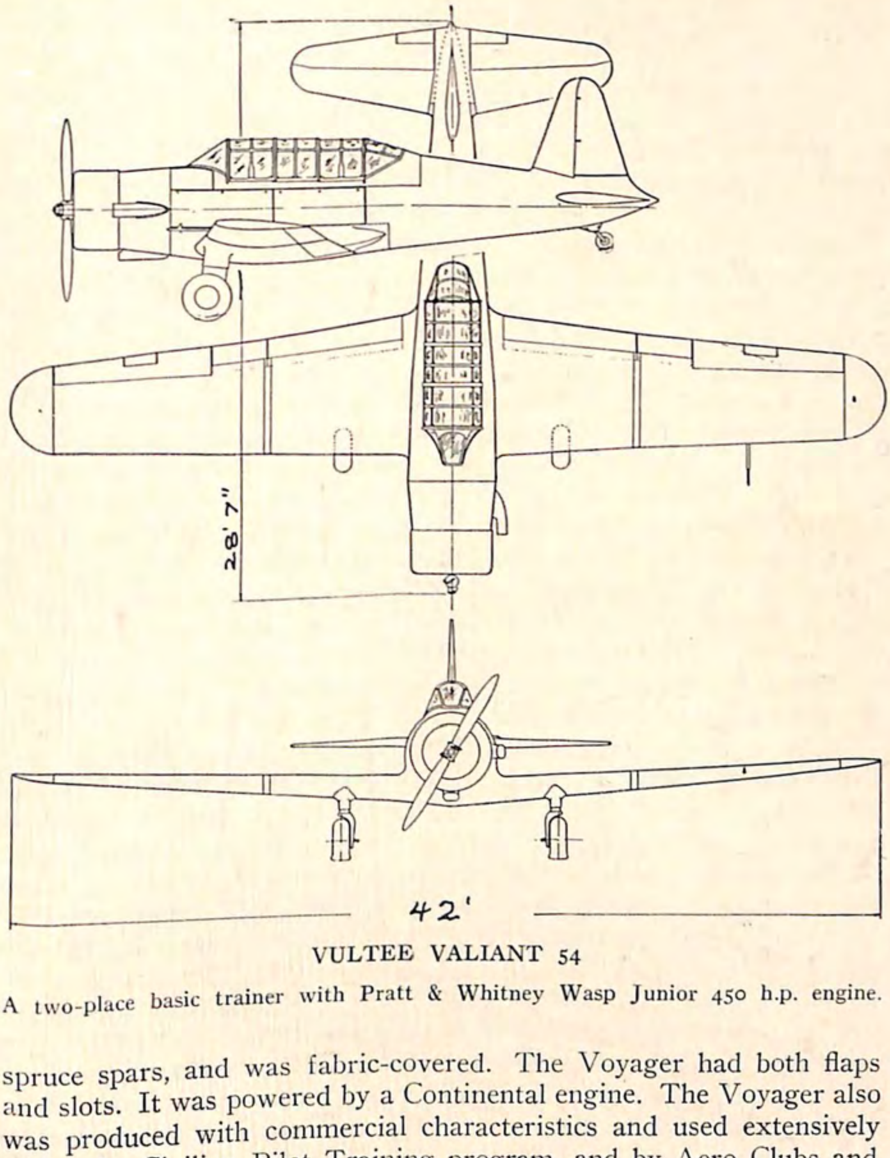


VULTEE VANGUARD

A one-place pursuit powered with a Pratt & Whitney Twin Wasp engine.

was powered by a Lycoming engine. Hundreds of Vigilants were supplied to the Army Air Forces and a quantity was delivered to the Royal Air Force.

The Stinson YO-54 Voyager was a 2-place liaison monoplane of tubing and fabric construction. The wing was built of metal ribs and



VULTEE VALIANT 54

A two-place basic trainer with Pratt & Whitney Wasp Junior 450 h.p. engine.

spruce spars, and was fabric-covered. The Voyager had both flaps and slots. It was powered by a Continental engine. The Voyager also was produced with commercial characteristics and used extensively under the Civilian Pilot Training program, and by Aero Clubs and schools in the foreign field.

Vultee made amazing progress in straight line production by using a maximum of automatic machinery. Outstanding among the machine processes unique in Vultee manufacture was the substitution of the hydropress technique for the cumbersome drop hammer in stamping out wing ribs and other parts. Minster crank presses were employed, using the more accurate and longer-lived steel dies. A reduction of as much as 66 per cent in production time was experienced on trainer wing ribs. The manufacturing technique for which Vultee was noted was its mile-long mechanized final assembly line, completed in May, 1941. In addition to the main assembly line, "feeder lines" reached out, finger-like into various sub-assemblies to carry the completed major units of the plane into position for final assembly.

The final assembly line included an overhead oval track, located at the head of the final assembly, from which dangled 25 cradles fed with raw fuselage frames. The frames moved through 25 assembly stations, and at each one groups of three to six men or women attached themselves, each in their interval, upon the skeletons, stringing control wires, bolting or screwing on fuel valves, cockpit enclosures, electrical systems, control columns, fire walls, instrument panels and instruments. Forty hours later, when the frame was wheeled off the oval track, it was ready to become an airplane. On an overhead trolley, impelled by an electric button, the engines rode down, complete with exhaust stacks, cowling, engine controls, oil tanks and "plumbing"; and from the sub-assemblies and the paint shops, each at its proper moment, the monocoques, the empennages, the center section and the landing gears were pushed in on conveyers.

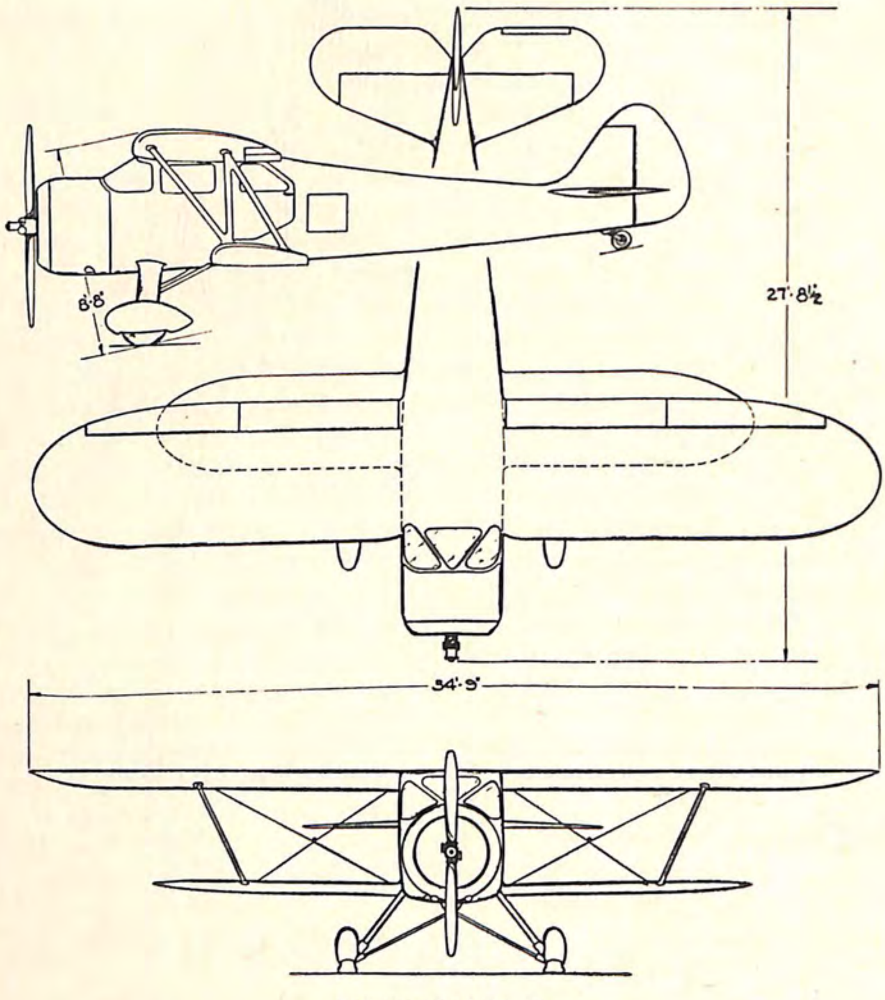
Vultee's program of putting women to work on every type of operation suitable to their skills and capacities met with great success. The first experimental hiring took place in April, 1941, and early in 1942 hundreds of women were employed and put to work throughout the factory. The use of women workers was desired not so much in anticipation of a shortage of male workers as it was a means of permitting women a fuller contribution to the defense program, the adaptation of female skills to the growing multitude of intricate assembly operations requiring considerable finger dexterity; and finally, permitting the up-grading of the men workers to advance them to more important work, leaving the simpler repetitive operations to women.

The steady addition and training of women workers raised the ratio rapidly. The women did not displace men workers, but simply freed them for more rapid advancement than would otherwise have been possible. They received the same wage scale as the men for the same work. Ninety per cent of them had previous experience in manufacturing work and that accustomed them to factory discipline and made it easy to fit them into the schedule along with the men. The number of women available for this work seemed to be adequate for many months to come, and in an emergency, it was believed possible to approach the figure of 80 per cent women workers reported by some British factories.

In practically all cases, it took only from two hours to a single eight hour shift to train a new woman worker for her job. In addition, about 10 or 15 per cent of the women took advantage of the trade extension training program available through the Federal Government's national defense training plan, resulting in the betterment of themselves in their present jobs and in their advancement to more responsible jobs. The women averaged about 27 years of age. More than two thirds of them were married, and more than one half of them had one or more children to support or help support. The type of task to which a woman was assigned was scientifically adapted to the female physique and temperament. Women were not given any work requiring continuous, heavy muscular exertion or lifting. They were not required to move around a great deal, and generally they worked best sitting down. They were not expected to reach too far away, to reach up above their heads, or to work climbing or crawling over jigs or airplane structures. Women proved ideally suited to all sorts of delicate work requiring precision and speed and proved exceptionally handy with tools and micrometers. A material reduction in assembly time on small operations was experienced at the beginning of the woman worker experiment. Encouraged by this success, Vultee turned to the machine shop and began to place women on such simple operations as burring and filing of small parts. Following this, they soon proved their mettle on light drill press work, performing drilling, spot facing and reaming operations. Vultee discovered that it was typical of the women to try to outdo the men. Going on a job at the beginning of a shift, it was found that the women first would check up to find out how many parts the male operators had turned out on the previous shift and then attempt to surpass that production.

From the simple drill press operation, many women graduated to milling machines and others to screw machines and some to turret lathes. While women were not used on heavier riveting work, their light touch proved advantageous on a number of delicate riveting operations. Their fine sense of touch was also advantageous in the exacting technique of welding. Women were ideally suited for inspection work of many kinds. Their natural dexterity and usually keen eyesight helped them to turn out inspection work on a production basis equal to the best male standards. They also played an important part in the final assembly line at stations where light parts were attached to the fuselage. Vultee's unique powered assembly line, allowing all work to be done from a normal position, made it possible to use female skill to great advantage in this work.

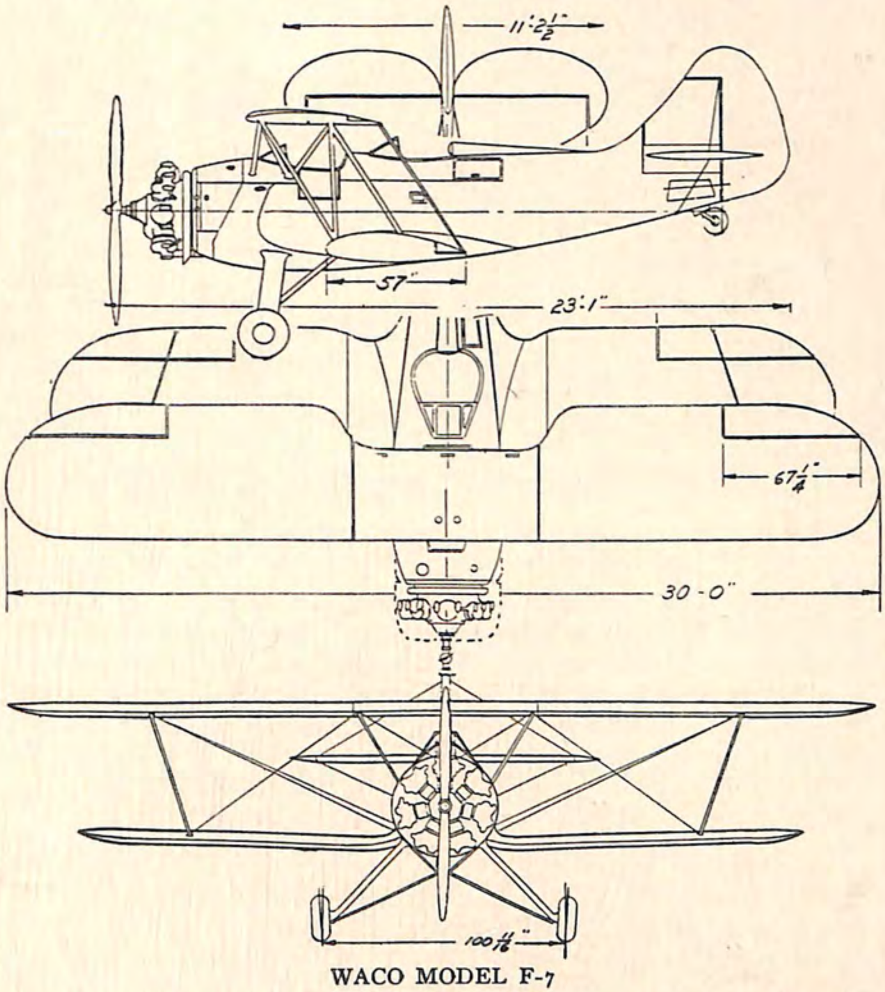
The Waco Aircraft Company, Troy, O., attained an all-time high in production of aircraft and parts. At one period a large number



WACO MODEL E

A four-five place plane with a choice of Jacobs, Lycoming, Pratt & Whitney or Wright engine, ranging from 300 to 420 h.p.

of UPF-7 trainers a week were produced in addition to production on other commercial and private aircraft in the 4- to 5-place category. After August, 1941, Waco's entire efforts were devoted to defense contracts, however, and the aircraft production consisted entirely of UPF-7 trainers for CPTP work. These were turned out in improved form. Having the experience of furnishing large numbers of these trainers for Civilian Pilot Training Programs in 1940, Waco con-



WACO MODEL F-7

A two-place military trainer with a choice of Continental, Jacobs or Lycoming engine of 220 or 225 h.p.

tinued to make changes found advisable and suggested by cooperative operators and its own greatly enlarged corps of engineers.

Late in 1941, Waco began experimenting with the thought in mind of converting the Waco VKS-7 into a cross-country cabin trainer needed by CPTP. By studying the requirements and suggestions, Waco made necessary changes and planned to have available early in 1942 model VKS-7F, especially designed and built for requirements set forth in the cross-country Civilian Pilot Training Program contracts.

THE WACO VKS-7F TRAINER

In preparing for further defense contracts, Waco added a new addition to the factory and office, most of which was used to house a new and modern moisture controlled wood working department. Further additions were to be made in 1942. Waco held numerous prime and subcontracts with the U. S. Army Air Forces. The company expected to triple its payrolls in 1942.

Aircraft Engine Builders

Aircooled Motors Corporation, Syracuse, N. Y., was in war production on four and six cyl. Franklin aircooled engines for light planes and trainers. A new engineering building, put up in 1941, nearly doubled the plant's floor space and was in operation within 12 weeks. It was designed for engines of a higher horsepower than the 65 and 135 h.p. engines which the company had been producing. The Franklin 6AC-298-F3 was a split crankcase, six cyl. horizontally opposed, overhead valve, direct drive, aircooled engine rated 130 h.p. at 2,550 r.p.m., bore 4½ in., stroke 3½ in., compression ratio 7 to 1, piston displacement 298 cu. in. The Franklin 4AC-176-F3 was a split crankcase, four cyl. horizontally opposed, overhead valve, direct drive, rated 80 h.p. at 2,500 r.p.m., bore 4 in., stroke 3½ in., compression ratio 7 to 1, with 176 cu. in. piston displacement. The Franklin 4AC-199-E3 was similar, with 4½ in. bore, 3½ in. stroke, 199 cu. in. piston displacement and 90 h.p. at 2,500 r.p.m. The Franklin 6AC-264-F3 had 120 h.p. at 2,600 r.p.m.

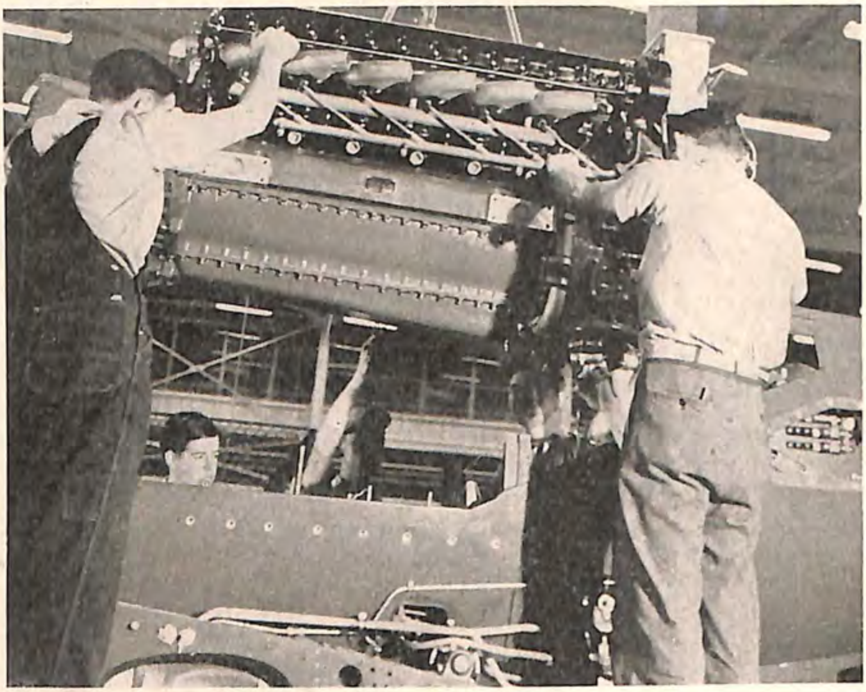
Allison Division, General Motors Corporation, Indianapolis, Ind., on December 17, 1941, attained the mass production goal set a year before by the Army after increasing the required monthly rate of production many times between June, 1939, and December, 1940. Allison engines first started rolling out of the Speedway plant in production quantities in May, 1940; and shipments rose each month thereafter. Allison-powered fighter planes, in service both at home and abroad, were in the thousands. In 30 months since May, 1939, a laboratory and a cornfield had been converted into a great "blackout" plant with thousands of "assembly line" workers and 104 subcontractors in 60 cities enrolled to supply the plant. New manufacturing processes were evolved. The plant operated on a three-shift, 24-hour basis.

The Allison V-1710-C15, an altitude rated 1,090 h.p. engine, was the production model, when the Army in May, 1939, issued its first quantity order. It was the 14th model of 20 engines, custom-built by hand, part by part, during the eight-year development period.

One month before receiving the Army quantity order, two months before declaration of war in Europe, General Motors had broken ground for factory, office and testing space. The concept of the Allison production schedule, with each succeeding Axis aggression in Europe, was revised upward by the Army. The new Allison plant was planned without windows and with other blackout features.

The problem of putting a custom-built precision engine into mass production presented many challenges. The Allison contained roughly 7,000 pieces. Rough castings and blanks were to be analyzed before acceptance, inspected individually after each machining process, and after test of the engine. One-fifth of all Allison employes, therefore, were classified as inspectors. All highly stressed steel parts, like crankshafts, rods, and all rotating and reciprocating parts were to be "magnafluxed," both before and after machining. The engine called for 62 different specifications of metal, all of which would soon be high on OPM list of critical metals. Many parts required precision machining of the highest standard known. Involute gear profiles and some splines were to be machined to a .0001 in. tolerance; crankshaft pins and main journals to .0005 in.

As Allison tooled up and trained personnel, management and workers developed new manufacturing techniques. The hand micrometer, long regarded as the symbol of precision work, was not sensitive enough to check the closest limits to which parts had to be machined. New automatic gauges were devised. Available materials were adapted wherever possible, but recent metallurgical research was heavily drawn upon for new methods of processing and heat treatment. Shot blasting was adopted to toughen the "skin" of stressed steel



THE ALLISON ENGINE IN THE BELL AIRACOBRA

Overhead monorail systems greatly simplify the task of installing liquid-cooled Allison engines in the Airacobra fuselage at one of the Bell Aircraft Corporation's plants.

parts. Nitriding, it was discovered, gave greater strength to the crankshaft, which with the same weight had to turn over 10 times the power of a fine automobile crankshaft.

Other divisions of General Motors took assignments from Allison. The Cadillac and Delco-Remy Divisions made the major contribution. Cadillac, with its precision background, made 250 Allison parts, including crankshafts, connecting rods and gear-reduction assemblies. Delco-Remy furnished aluminum and magnesium castings, in addition to 75 different machined parts. For Allison production, Delco-Remy added two new specially constructed plants. Other General Motors divisions, subcontracting Allison parts were Chevrolet, New Departure, Hyatt Bearing, Delco Products, Packard Electric, A.C. Spark Plug, Antioch Foundry, Harrison and Inland. Outside General Motors, 93 suppliers of raw materials, semi-finished and finished parts were enrolled. Early in 1942 only 20 per cent of parts, the most intricate, were machined at the Allison plant. The remaining 80 per cent flowed into the plant from 60 different cities, from Iowa to Connecticut.

The 7,000 parts in the Allison engine comprised only 700 "piece parts," or separate production problems, as against 2,300 "piece parts" in the most widely known European rival engine. For example, piece parts in one small sub-assembly were reduced from 38 to 3 by simply casting the part whole rather than bolting it together; this resulted in a part that could be machined with greater accuracy for durability. The implications of Allison's record 700 "piece parts" were important. Patently, the Allison was easier to maintain than a European engine, with three times as many parts. Reduction of overhaul periods meant more fighting hours for a squadron of fighting ships, more economy in maintenance. Number of actual fighting hours that could be wrung out of a squadron might well overcome a numerical disadvantage.

Putting the Allison engine into production did not mean that it was frozen there. Power output of the engine was first increased from 1,090 to 1,150 h.p. early in 1940. Model change usually meant complete shutdown of production for necessary retooling, but Allison managed to maintain at least 60 per cent of its productive output during the switch-over. The C engine powered the Curtiss P-40.

The Army let a contract for the building of the Allison V-3420, simply the power sections of two V-1710's geared together. Planned features for a new V-1710 were designed into the V-3420 model which showed up well in preliminary tests but lost priority to single-engine production. Thus, interchangeability, as well as simplification of piece parts, was established as a principle for the Allison engine. Planned interchangeability of parts, according to the proved American principle, made it possible to produce the V-3420 in record time.

The E engine was developed for the Bell Airacobra. Design called for development of a 10-foot propeller speed extension shaft. Koolhaven and others in Europe had tried and dropped the idea. Allison engineers approached the problem with trepidation. Torsional analysis gave the extension shaft good characteristics through the range normally checked, but, at low speed, terrific vibrations developed that broke down a flexible shaft at the rear of the engine. Solution was a simple hydraulic damper application; in effect a shock absorber that cushioned rebound in any direction.

The E engine with extension shaft gave the Bell Airacobra a combination of features unparalleled in any other pursuit plane. The extended drive shaft permitted installation of the engine behind the pilot who thus had unimpeded vision. The outboard gearbox was designed to provide for mounting of a 37 mm. cannon through the hollow propeller shaft which, supplemented by varying numbers of cockpit and wing machine guns, permitted heavy and deadly armament on so fast a ship. Another exclusive Allison feature is the symmetrical crankshaft, which made right or left-hand rotation optional on current models. This gave the two-engine Lockheed P-38 Lightning counter-rotating propellers that helped to make it superior. The P-38 was equipped with two turbosuperchargers for rapid climb to high altitudes. The British version had common rotating propellers and mechanical supercharging only.

The F model was designed to give Allison higher horsepower output. It was 30 lbs. lighter, with 10 per cent less frontal area, and was 10 in. shorter than the C model, due to a redesigned reduction gear. In June, 1941, the F passed a successful 150-hour type approval test at 1,325 h.p. altitude rating. This represented an increase of 175 h.p. The F engine was furnished in several models, right or left-hand rotation, sea level or altitude supercharging, and various power ratings ranging from 1,150 to 1,325 h.p. Production, late in 1941 was changed over from one model of the C type to four models of the E and F. The first month of the changeover, E and F production fell only one-third below peak C production, and the second month exceeded that level. Production thereafter rose steadily.

Continental Motors Corporation, Muskegon, Mich., extended the power range of its A engine to 80 h.p., making the A type available with ratings of 50, 65, 75 and 80 h.p. Continental also developed an "exclusive" fuel injection system for the A engine. The fuel injector replaced the conventional carburetor, eliminated carburetor icing troubles, increased fuel economy, reduced fire hazards, permitted fast warm-up, and through its more uniform distribution of fuel added greatly to smoothness of operation. The Continental W670 aircraft engine carried no major design changes, but continued to live up to its long established reputation for dependable and economical operation in trainer planes and commercial aircraft.

Jacobs Aircraft Engine Company, Pottstown, Pa., which had been one of the leading producers of aircraft engines in the 200 to 400 h.p. range for commercial and private aircraft, in 1940 received from the Canadian Government the first major defense contract awarded for engines in this power class. As the total volume in this class had been relatively small in the pre-war years, the deliveries involved required a major expansion of plant, personnel and production in the shortest possible time. The Jacobs management called on the wide experience of the engineering firm of Ford, Bacon and Davis which it had retained previously to prepare its "M-Day" report, to engineer and supervise the plant expansion and to advise and assist the management in the rapid expansion of personnel and production. The result of these combined efforts and abilities was that the military requirements were met with an expansion of production unsurpassed for rapidity and percentage of increase in the history of precision engine manufacturing. Before the expansion program was well under way, the delivery requirements of the Canadian Government were increased, and substantial schedules for the U. S. Army Air Forces were superimposed on them. The company's program had been laid out with sufficient flexibility that each new requirement was met within a relatively short time after it was made known. Within a few months after signing the initial contract, the Jacobs engine production rate had increased tremendously; and early in 1942 it was progressing at a more rapid pace.

In order to meet the demands, a number of innovations in manufacturing methods and equipment were instituted by Jacobs. Many of these consisted of new adaptations of methods developed in the automotive and other industries, while some were entirely original. In order to circumvent insofar as possible the tight machine tool situation, permanent set-ups consisting of special fixtures with standard drillheads attached were devised for the majority of the drilling and tap-

SPEEDING UP JACOBS PRODUCTION

Shot-blasting master rods reduced the finishing operation to one-fifteenth the time consumed in a polishing process formerly employed. Two rods on fixtures are about to move into the shot-blasting compartment on the rotating table. Two others will then move out for reloading.

ping operations which previously had been done on large radial drill presses. The result was economy of heavy equipment and substantial speeding of operations. A four hour grinding operation on the master rod was reduced to 40 minutes by changing to diamond boring on a specially designed machine, thereby producing a better bearing surface, although boring generally had been considered impossible for this operation because of the hardness of the steel. The surface finishing operation on these rods was changed from the conventional polishing method to shot-blasting, resulting in a better surface and a reduction in time from 1½ hours to 6 minutes per rod. Drying of the protective enamel on the cylinders which formerly required from 8 to 15 hours, depending on atmospheric conditions, now was accomplished in about 6 minutes by sending them through a battery of infra-red lamps on a conveyor. The enamel baked harder because it dried from the inside outward. Those were but a few instances of the methods used to cut production time while never sacrificing, and usually improving, quality and durability.

Jacobs production was concentrated on two basic engine types, with several models of one of these types for different specific installations. The L-4PT model, rated 225 h.p. at 2,000 r.p.m., powered the Boeing PT-18 trainer. The L-4MB and the L-4MBB, with a normal rating of 225 h.p. at 2,000 r.p.m. and take-off rating of 245 h.p. at 2,200 r.p.m. powered the AT-17's and the Cessna "Crane's," widely used by the Army Air Corps and the Royal Canadian Air Force for twin-engine advanced training. The L-6MB model, with a normal rating of 300 h.p. at 2,100 r.p.m. and a take-off rating of 330 h.p. at 2,200 r.p.m., powered the Avro Anson twin-engine advanced trainer and the Fleet "Fort" single engine intermediate trainer, both produced in Canada.

The Jacobs company, like others in the industry, was prepared for the emergency requirements by a number of years of engineering, small-scale production and service experience in the commercial field, with engines operating in commercial and private planes in 26 countries under every variety of climatic and operating conditions.

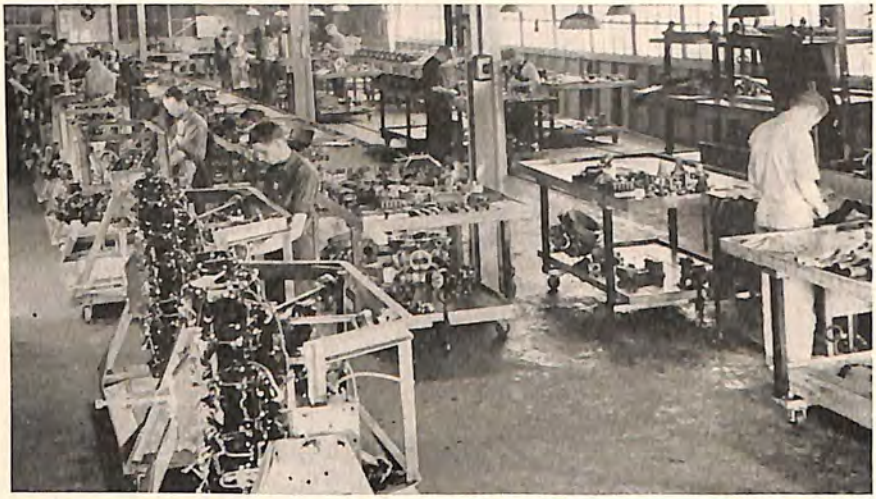
Kinner Motors, Inc., Glendale, Calif., continued the rapid growth it had enjoyed since it succeeded the former Kinner Airplane & Motor Corporation, Ltd., in 1939. Kinner became the West Coast's largest producer of aircraft engines in 1941. The basis for this growth was established in 1940 when Canada placed a large order for Kinner engines to power the Fleet Finch II trainers used in the British Commonwealth Air Training Scheme and when, some time later, the U. S. Army Air Corps selected the Kinner engine to power the Ryan trainers used by the Army and Navy. These commitments naturally led to a tremendous increase in the company's production and to an expansion of plant facilities and personnel. Extensive investments were made in new machines and tools, and a new administration and engineering building was built late in 1941. All this was as though in preparation for greater responsibilities, for just at the year's end Kinner received a large engine order from the War Department. This large order necessitated a further expansion of facilities and Kinner officials were rushing plans for this early in 1942.

Production centered chiefly on the 125 h.p. B-54 and the 160 h.p. R-55. Both were five cyl., radial, aircooled engines. The company established an enviable production record. While under war conditions there was no such thing as being "ahead of schedule," Kinner delivered practically all its orders well ahead of the dates set forth in its contracts.

As a result of a favorable personnel situation and numerous improvements in manufacturing methods, Kinner's rate of horsepower production per man became one of the highest in the country. With the engineering and production departments' cooperation, literally scores of steps were taken to step up production. Slight alterations in design were made to simplify machine operations. Brinell specifications were changed in some instances, in cylinder heads, for example, which were raised from 70 to 75-80, to permit a faster machining of aluminum parts. Tungsten carbide tools were substituted for softer cutting edges, both increasing the efficiency of the machines and lengthening the life of the tools from 10 days to as much as four months. Dual jigs and fixtures were designed to increase production. In other instances, jigs and fixtures were altered to eliminate mistakes and reduce scrappage. In no month did Kinner scrappage reach one per cent.

The speed of some manufacturing operations was increased by more than 200 per cent. The facing of the intake and exhaust ports on the cylinder head was a case in point. A special carboloid tool with an inserted tooth cutter was designed by Kinner toolmakers. Operated at 1,500 r.p.m. and used on a Cincinnati vertical mill equipped with dual fixtures, the tool turned out 100 heads a day, with both ports faced, as against 90 heads, with only one port faced, under former methods. Further, the tool required sharpening only every 10 days to two weeks as against every 10 hours previously.

Kinner developed a new engine during the year, the 175 h.p. R-53, which received an A.T.C. Like the other Kinner products, the 100 h.p. K-5, the 125 h.p. B-54 and the 160 h.p. R-55, the R-53 was five cyl. radial and aircooled. The additional power over the 160 h.p. R-55 was obtained by a slight step-up of compression ratio and r.p.m. It



LYCOMING FINAL ASSEMBLY

A section of the department devoted to final assembly of Lycoming aircraft engines.

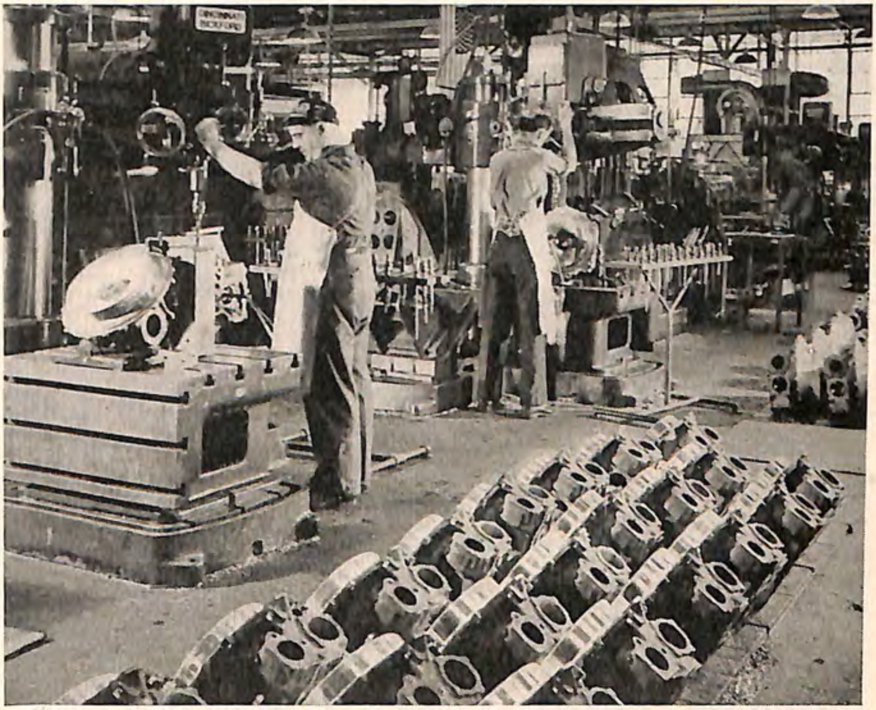
was designed particularly for training purposes. Its mounting dimensions were identical with those of the B-54 and the R-55. It was virtually interchangeable with the R-55, while it could be substituted for the B-54 with only slight installation alterations. The Kinner R-55 was selected to power two new planes used in the C.P.T.P., the Howard DGA-18 and the Wally Timm.

During 1941 the company shipped engines or parts, and in most instances both, to China, Portugal, Canada, Turkey, Mexico, The Dutch East Indies and several of the South American countries. However, with the outbreak of war the company began producing exclusively for the American military forces.

The Lycoming Division of The Aviation Corporation, Williamsport, Pa., met the growing demand for aircraft engines with vastly increased production. Greatest emphasis was placed on lifting the output of the R-680 series nine-cylinder radial aircooled engines for primary and advanced training planes of the Army and Navy. Another sharp step up in production was to follow the opening of a new plant addition devoted entirely to that series engine. The production setup for radial engines was completely revised and included machinery of the most modern type. Twin-engine trainers powered by the R-680 engine included the Curtiss AT-9, the Beechcraft AT-10 and the Cessna AT-8. Lycoming engines also powered primary training planes made by Boeing and Spartan and observation planes produced by Stinson.

Under pressure of the national emergency, research and development at Lycoming reached an unprecedented pace. In addition to the development of a tank engine and a liquid cooled aircraft engine, Lycoming's engineers made important improvements in the company's line of commercial engines from 50 to 300 h.p. Among them was a new series of four and six-cylinder horizontally-opposed engines ranging from 100 to 220 h.p. This series had the advantage of many interchangeable parts and was being constructed largely on former automotive machinery.

Despite an unprecedented increase in employment Lycoming was able to obtain or develop workmen of high technical ability. A large number of the new employees were trained by the Williamsport Technical Institute. These men were fitted in carefully around the company's older craftsmen, over a hundred of whom had been building



LYCOMING AIRCRAFT ENGINE PLANT
The section where accessory housings are finished.

AT THE MENASCO PLANT

The Menasco Manufacturing Company in war production on landing gear struts. Here a main strut is being turned.

engines at Lycoming for more than 20 years. By close co-operation with the Institute and through its own classes in the plant, Lycoming was able to maintain a constant flow of skilled men so vital to fine engine production.

Menasco Manufacturing Company, Burbank, Calif., during 1940 greatly expanded its facilities by the construction of a new plant and administration building. In the new Burbank plant were housed the two largest divisions of the Menasco Manufacturing Company, the aviation engine division and the hydraulic strut division, as well as the general offices. The plant was equipped with the latest types of machine tools and designed for quantity production of both engines and hydraulic landing gear struts.

Engine production during 1941 was increased considerably over previous years, and was concentrated mainly on Model D4, 125 h.p. In addition, a very considerable amount of Menasco Hydraulic Shock Struts were delivered; in fact so great was the demand for Struts that the company, through the facilities of the Defense Plant Corporation, has tripled its 1941 capacity to meet the increased demands of the National Defense Program.

The company's former headquarters were occupied exclusively by the company's foundry division which produced nonferrous castings by the Antioch process. This process was developed by Antioch College at Yellow Springs, O., and perfected during the last 10 years, and last year was purchased by General Motors. Aluminum or bronze castings made by this process combine the finish and accuracy of die-castings with the physical properties of the best sand castings. Also, it is possible by means of the Antioch process to mold and pour aluminum or bronze castings which formerly were impossible to make by other recognized processes.

Pratt & Whitney Aircraft, East Hartford, Conn., one of the three divisions of United Aircraft Corporation, founded in August, 1925, for the express purpose of developing high-powered aircooled aircraft engines, was in full-out war production, having expanded facilities five times since June, 1940. When the President of the United States issued his call for airplanes in June, 1940, Pratt & Whitney Aircraft was expansion-minded, since, only a short time before, it had undertaken two major expansions to assist the French and British governments in supplying their urgent demand for radial aircooled airplane engines. Accordingly, Pratt & Whitney Aircraft undertook to expand its facilities very rapidly. Since June, 1940, the requirements of the Government for Pratt & Whitney engines had been revised five times—and each revision called for a large increase in engine production. These requirements were met by further ad-

U. S. Navy photo

GRUMMAN F4F-3

A single-place fighter powered by a Pratt & Whitney Twin Wasp engine.

WOMEN WORK ON ENGINES

At Pratt & Whitney's aircraft engine plant hundreds of women are inspectors of precision made parts. Here the inspector is using micrometers to measure the outside diameter of a piston.

ditions to the Pratt & Whitney Aircraft plants, by still further expansion of the then-extensive practice of subcontracting and by the licensing of other manufacturers to build Pratt & Whitney engines.

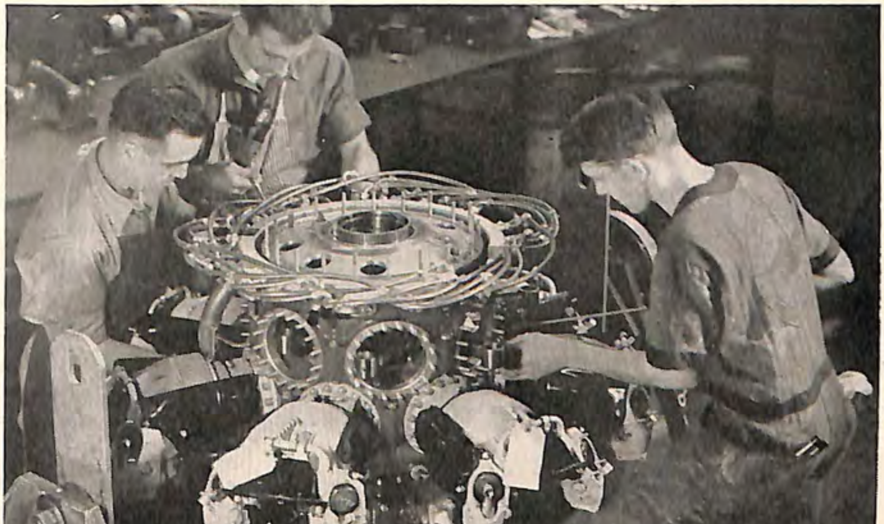
The magnitude of the task which faced Pratt & Whitney Aircraft in meeting these requirements was clearly indicated by the fact that this Division occupied several times as much factory space as it did before the emergency, and had increased employment even further since that time. Its engine output was kept ahead of schedule since the inception of the American defense program—and, early in 1942, with its plant operating on a 24-hour, seven-days a week schedule, was producing at a rate that far surpassed its pre-emergency output.

The importance of this activity was emphasized by the fact that, long before the automotive industry could be geared up to carry part of the tremendous engine-producing task imposed by the defense program, Pratt & Whitney Aircraft was supplying a major share of the American engines so desperately needed by United States and Great Britain. In addition to increasing the quantity output of three of its engines designed prior to 1940, Pratt & Whitney Aircraft, during 1941, went into full production of a 2,000 h.p. engine—the most powerful and compact engine in full-scale production anywhere in the world.

Pratt & Whitney Aircraft also was in quantity production on four major types of airplane engines, the 450 h.p. Wasp Junior; the 600 h.p. Wasp; the 1,200 h.p. Twin Wasp and the 2,000 h.p. Double Wasp. They were in wide use on almost all classifications of aircraft used by the Army and Navy as well as by the R.A.F. including basic and advanced trainers, pursuits, observation scouts, bombers and patrol bombers. In addition, a new 1,350 h.p. model of the Twin Wasp engine, known as the R-2000, was developed and put into quantity production.

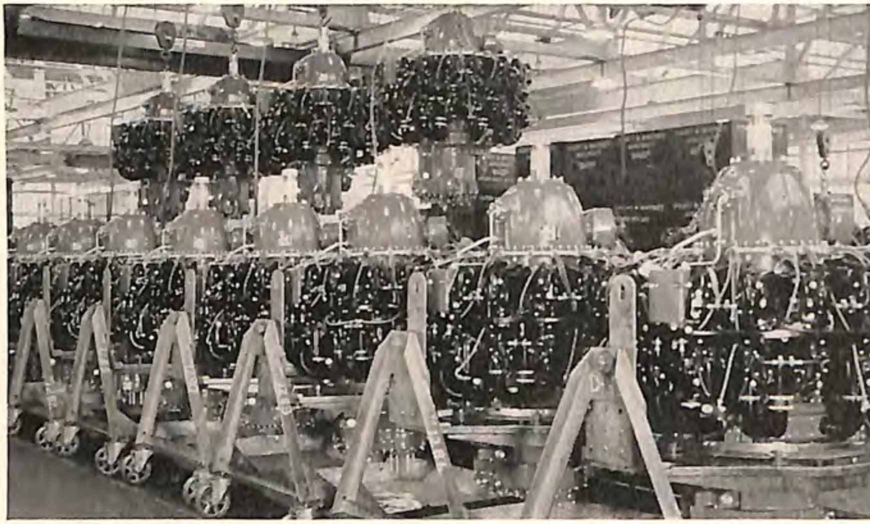
During 1941 Pratt & Whitney Aircraft expanded its program of intensive technical research and development. Existing engine models were refined and improved, and new types developed under rigid restrictions as to secrecy.

Ranger Aircraft Engines, Farmingdale, N. Y., division of the Fairchild Engine and Airplane Corporation, completed the first phase of its War expansion program. New test facilities included 12 sound-



INSTALLING TWIN WASP CYLINDERS

On the final assembly floor at the Pratt & Whitney plant.



PRATT & WHITNEY DOUBLE WASP ENGINES

On the packing line ready for shipment.

proof and air-conditioned production test stands and the one new test house devoted to experimental work, containing two dynamometers, 1,600 h.p. and 600 h.p., plus a flight-propeller endurance test stand and a tilting test stand. In process of completion early in 1942 were a supercharger laboratory, equipped for full temperature control to 30,000 ft. altitude; vibration, photoelastic, X-ray, ignition, and oil laboratories; plus a group of new apparatus for the endurance and fatigue testing of a large variety of engine components. A new density measuring machine for the inspection of castings was installed in the inspection department. Believed to be the first of its kind in America, this machine accurately and quickly determined the porosity of castings without even marking the material.

The engineering organization was expanded to a major extent as required by new facilities and by the large increase in new military engineering projects scheduled for completion over the coming four years.

Production deliveries included six and 12 engines, all of the inverted, in-line aircooled type. In numbers the major deliveries consisted of the Ranger 6-440C-2, Army designation L-440-1, which became established as one of the principal engines for primary training in the Army Air Forces through the thousands of hours per day it served in PT-19 Trainers under all climatic conditions. The Production models of this series included the 6-440C-2, rated at 175 h.p.

at 2,450 r.p.m. using 65 octane fuel; the 6-440C-3, rated at 180 h.p. at 2,450 r.p.m. using 73 octane fuel; the 6-440C-4, rated at 190 h.p. at 2,450 r.p.m. using 80 octane fuel; and the 6-440C-5, rated at 200 h.p. at 2450 r.p.m. using 87 octane fuel. That group of models had the same general specifications throughout, with bore of 4.125 in., stroke of 5.5 in., displacement of 441 cu. in., weight (dry, including standard equipment) 376 lbs., and no. 20 spline propeller shaft. The models were installed not only in the Army Pt-19 trainers, manufactured by Fairchild Aircraft, but in the Grumman twin-engine J4F-1 amphibions for the U. S. Coast Guard. Six-cyl. Rangers were also adopted as standard equipment in Canada by the R.C.A.F. and by the Royal Norwegian Air Force.

Production of the 12 cyl. Model SGV-770C-1 Ranger for the U. S. Navy was commenced in 1941. The arrival of this model at the production stage marked the introduction of a basically new engine type for quantity installation in American tactical military airplanes. Installed in the new Curtiss SO3C-1 naval scout observation airplane, this new engine type, in-line and aircooled, offered in combination some of the advantages possessed by both liquid-cooled in-line engines and aircooled radial engines, and helped to make possible an airplane of outstanding performance, which was scheduled for continuing major production.

Throughout the year the high percentage of work sub-contracted to plants other than Ranger was continued. It was estimated that 65 per cent of the labor hours which went into the completed Ranger engines were performed at plants throughout the eastern United States. The utmost in quality control was extended to these purveyors, however, and all final critical machining, fitting and testing was performed in the Ranger plant by Ranger personnel.

Rearwin Aircraft and Engines, Inc., Kansas City, Kansas,

BUILDING PRATT & WHITNEY ENGINES

One section of the final assembly department in the Pratt & Whitney plant.

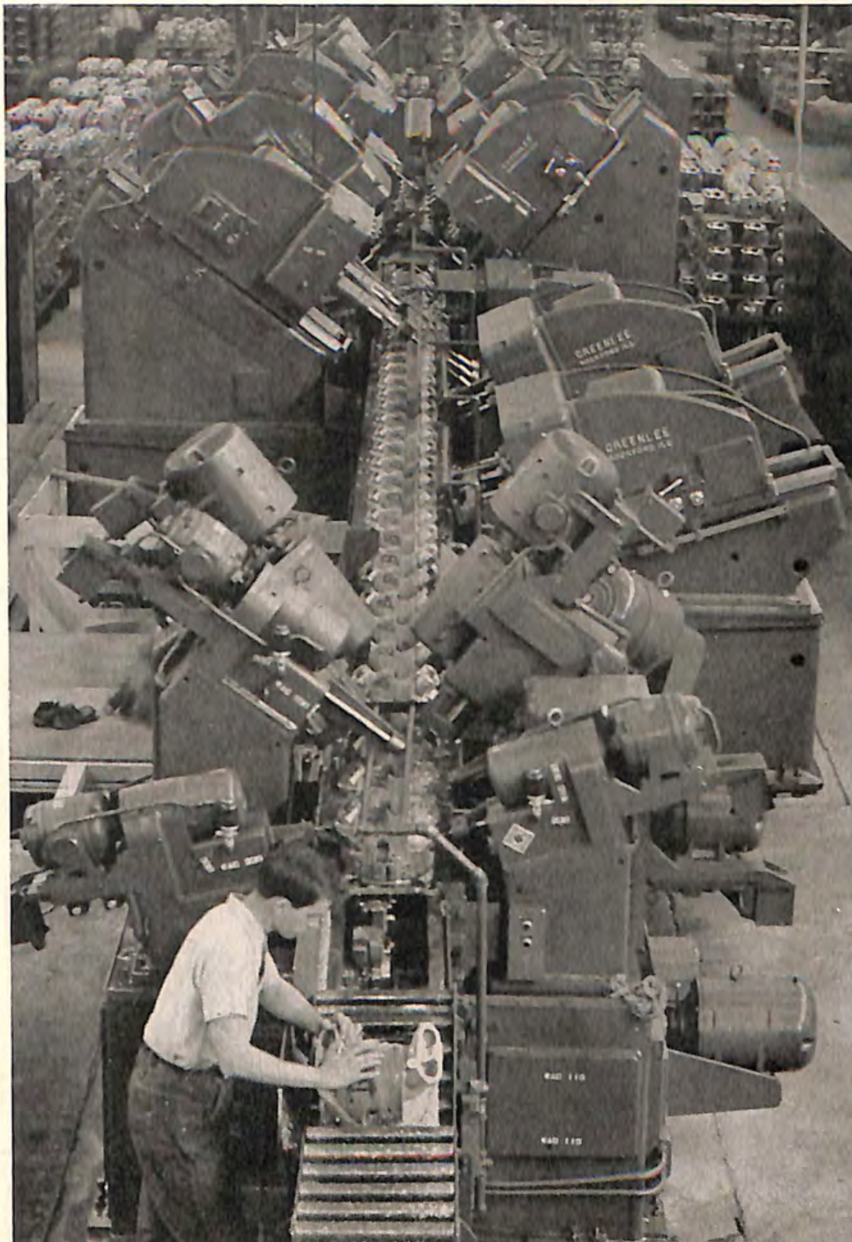
CURTISS SO3C-1 SEAGULL

U. S. Navy scout observation for operations with the Fleet.

produced 3 models. The Ken-Royce Model 5E was a direct drive aircooled engine with C.A.A. rating of 70 h.p. at 1,950 r.p.m. The Ken-Royce Model 50 had a rating of 90 h.p. at 2,250 r.p.m. Ken-Royce Model 7G had a rating of 120 h.p. at 2,225 r.p.m.

Warner Aircraft Corporation, Detroit, Mich., continued production of the Scarab and Super Scarab engines Series 50 type, rated at 125 h.p. and 145 h.p. respectively. In addition to the Series 50 Scarab and Super Scarab engines, production was continued on the Super Scarab Model 165, 7 cyl. aircooled engine rated at 165 h.p. Production on this model was increased considerably over the previous year. This was brought about by the demand for this engine for installation in preliminary training airplanes for both domestic and export use. In the export field shipments of Warner engines were made to manufacturers for use in airplanes to be exported to South America, Australia and Great Britain. The personnel of The Warner Aircraft Corporation was increased approximately 33 1/3 percent during the year. The company continued the manufacture of hydraulic brake control units which were supplied to a number of manufacturers of military aircraft.

Wright Aeronautical Corporation, Paterson, N. J., with an unbroken record of achievement in the production of high power aircraft engines since the first 211 h.p. radial aircooled Whirlwind was produced in 1923, was in vastly expanded war production. The Cyclone first developed in 1927, with 525 h.p., had grown to be among the most powerful engines in the world. Wright manufacturing procedures were improved to make possible, through special-purpose, automatic machine tools, the fabrication of engine parts on a mass



GIANT TOOLS FOR WRIGHT ENGINES

In a Wright Aeronautical engine plant this huge Greenlee automatic transfer machine handles 72 Cyclone cylinder heads at one time. It drills, reams, countersinks, bores and chamfers, and taps the heads as they move down the track.

WRIGHT ENGINE ASSEMBLY

War production of Cyclone engines in full swing at one of the plants of the Wright Aeronautical Corporation.

production basis. Production of complete engines was increasing by progressive assembly methods. An enormous new Wright plant in the Midwest began shipping engines in June, 1941.

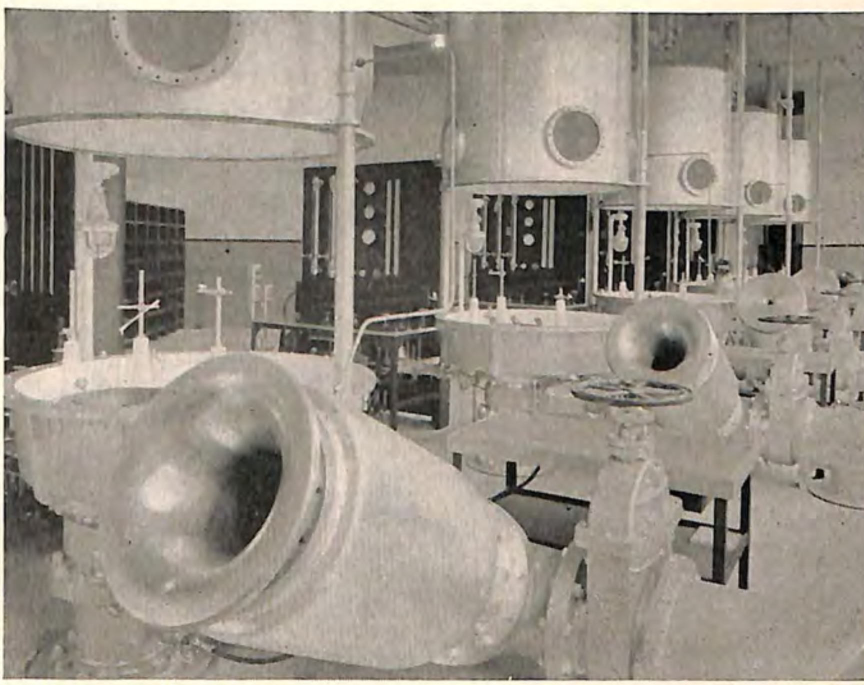
Production of Wright Whirlwinds in both the 7 and 9 cyl. models was continued, although the output of the 7 cyl. model was sharply reduced. This type was used principally in primary training and was rated at from 235 to 350 h.p. The 9 cyl. Whirlwind, with a power rating of from 365 to 450 h.p., was employed chiefly in basic and scout training planes, and also proved very successful as a power plant for the Navy patrol airships. A special model of this engine was also produced in large quantities for use in M-3 tanks.

The 9 Cyclone in the G-100 and G-200 series was continued in production, although the greater part of the output in this type was confined to the G-200 series. Both models featured a two piece forged steel crankcase, but in the case of the G-200 this was refined in outside profile, and the use of through bolts for attaching the two sections together was discontinued in favor of small internal lugs and short connecting bolts and nuts.

The 1,200 h.p. rating of the G-200 series was the highest ever accorded to a 9 cyl. radial, and four of these engines were installed as the standard power plant of the Boeing B-17 Flying Fortresses. Other outstanding military uses included installations in Brewster F2A-2 and F2A-3 fighters, Grumman F4F-5 and GB36-A fighters, Curtiss Mohawk fighter, Douglas R3D and R4D transports, Lockheed R-50 transports and Lockheed Hudson bombers.

Other Cyclone 9's with powers varying from 750 to 1,100 h.p. were used in Curtiss attack planes, Douglas and Curtiss dive bombers, Douglas C-39 cargo planes and R2D-1 transports, Douglas B-18 medium bombers, Lockheed R50-1 transports, North American O-47B, and Douglas OA-5 observation planes, Brewster and Grumman utility planes, and Consolidated patrol flying boats.

In the commercial field, Wright engines met with extensive use in the passenger planes of major air lines, including American Airlines, Transcontinental and Western Air, Eastern Air Lines, Chicago and Southern Air Lines, Braniff Airways, Pennsylvania-Central Airlines, Pan American Airways System, National Airline, Delta Air Corporation, Canadian Colonial Airways, Catalina Air Transport, White Pass Airways, Canadian Airways, MacKenzie Air Service, Starratt Airways and Transportation, Aer Lingus (Eire), British Overseas Airways, China National Aviation Corporation, Indian Na-



WRIGHT CARBURETOR TEST

Test laboratory in Wright Aeronautical plant where carburetors are tested and calibrated before installation in Cyclone and Whirlwind engines.

WRIGHT ENGINES FOR BOEING FORTRESSES

Wright Cyclone engines are moved by truck to the wing installation jig line to be installed before the actual wing is fitted to the completed fuselage.

tional Airways, Pan American-Grace Airways, Aerovias Nacionales de Costa Rica, Aerovias Nacionales de Colombia (Avianca), Uraba, Medellin and Central Airways, Panair do Brasil, Compania Nacional Cubana de Aviacion, Compania Mexicana de Aviacion, Linea Aerea Nacional (Chile), T.A.C.A., K.N.I.L.M., K.L.M., Ansett Airways, Australia National Airways, Guinea Airways, and many other air transport systems throughout the world. In particular, the Boeing 307 Stratoliners, the Douglas DC-2 and DC-3 air liners, and the Lockheed Lodestar air liners made extensive use of Cyclone engines.

By far the greater part of the Wright production facilities were directed to the manufacture of Cyclone 14's for military uses. Originally introduced in 1936, this 14 cyl. engine scored outstanding success in the Boeing 314 Clipper ships of the Pan American Airways, and proved itself capable of withstanding the tremendous strains imposed by long hours of continuous running. An improved model, the R2600-B, was introduced, with a steel crankcase in place of the forged aluminum case used on the earlier R2600-A engines. With an approved rating of 1,700 h.p. for take-off, this engine achieved spectacular success in the Douglas A20 twin-engine dive bomber, and the North American B-25 twin-engine medium bomber.

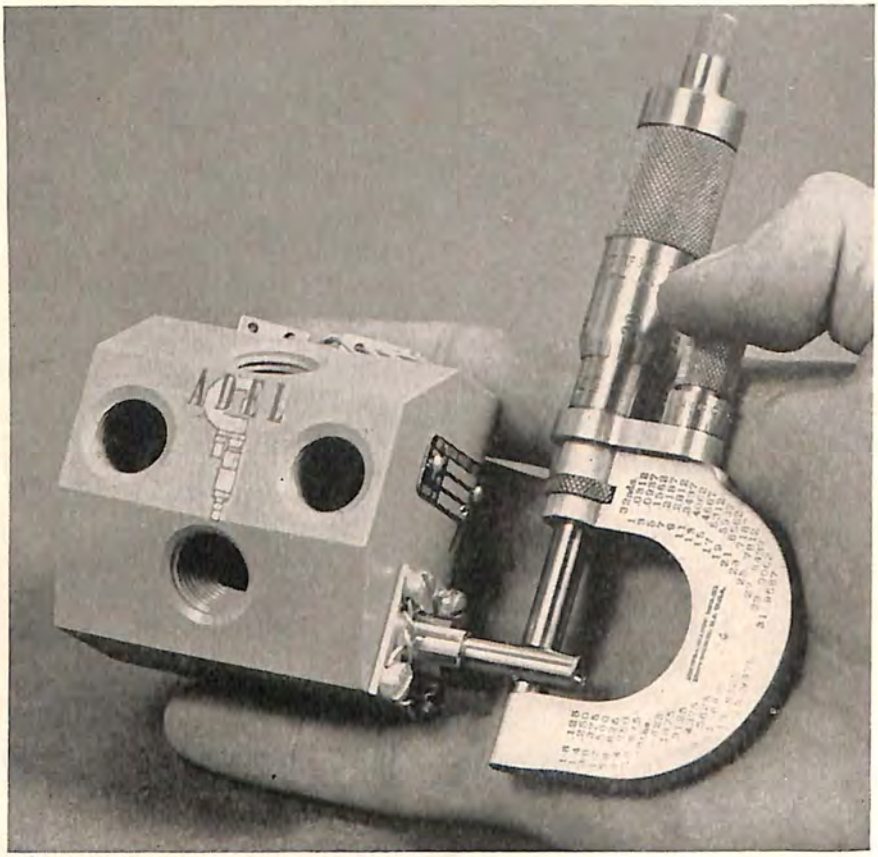
The Wright Cyclone 18 gave convincing proof of its ability when four of these 18 cyl. engines carried the huge Douglas B-19 bomber on its maiden flight. With a rating of 2,000 h.p., this engine also was selected to power the Consolidated Model 31 flying boat, and the giant Martin "Mars" flying boat.

All Wright Cyclones were equipped with the Wright dynamic damper, and in the case of the G-100, and G-200 series of the Cyclone 9, as well as the Cyclone 14 and 18, this was applied to both front and rear crankcheeks. Cylinder heads were aluminum alloy castings, screwed and shrunk on to the nitrided cylinder barrels, valve rockers were pressure lubricated through the push rod assembly, and adequate cooling was obtained through the use of full pressure baffling. Provision was made for hydraulic controls for either constant speed or variable pitch propellers. The exclusive Wright Torque Meter was built into the lower part of the nose section, and was made available on all 9, 14, and 18 cyl. Cyclones.

There was a marked increase in the use of metallizing in place of the paint commonly used on cylinders, all engines produced in a Midwest plant being treated in this manner, as well as many of those made in the other plants. The Wright two-speed supercharger, available on most Cyclone engines became of even greater importance as both commercial and military flying went to the upper altitudes. This device provided two gear ratios for the supercharge impeller drive in a light and exceedingly compact planetary gear unit, the change from low to high or high to low being accomplished through a simple control in the pilot's cockpit. A moderate degree of supercharge was thus available for take-off and low altitude operation, and a greater supercharge to maintain high performance during upper altitude flight. Turbo-supercharging, in which the supercharger was driven by a turbine utilizing the engine exhaust gases, was adopted successfully, and proved particularly effective during extremely high altitude flights.

Manufacturers of Accessories

The Acrotorque Company, Cleveland, O., expanded production of its all weather windshield wiper, introducing a number of new models for transport, Army and Navy aircraft. Many more wipers were to be produced in 1942. New installations included curved as well as flat windshield surfaces, powered by either hydraulic or electrical systems. Light in weight and entirely non-magnetic in construction, the Acrotorque wiper was designed to meet all requirements and was standard equipment. Windshield de-icing equipment (alcohol) operating independently of the wiper itself was available as optional equipment on most models. Acrotorque also manufactured a feathering valve that permitted five-second feathering of Hamilton Standard Hydromatic Propellers in time of emergency, automatically cutting off once the propeller had reached the feathered position.



ADEL'S MIGHTY MIDGET

A new four-way hydraulic selector valve.

Actus Products Corporation, Mt. Vernon, N. Y., developed its Actus hose clamp to meet the particular needs of the aircraft industry, and also continued manufacture of patented Wraplock hose clamps and binding tape and numerous other accessories. Operating at the full capacity of recently expanded plant facilities, the company continued production of piston skirt expanders, valve guide cleaners, piston ring compressors, "spitfire" spark plugs for use on stationary engines and other accessories and specialties. Actus Hi-pressure stainless steel hose clamps were in use on the planes of the Navy, Coast Guard, R.A.F. and R.C.A.F.

Adel Precision Products Corporation, Burbank, Calif., manufactured more than 3,000 sizes and types of line supports, hydraulic control valves and general hydraulic units, anti-icing pumps and controls, synthetic rubber products and allied aircraft proprietaries, and increased production many fold. Adel's Canadian engineering office in Toronto was completed, and the Huntington Precision Products Division of the firm was established. One of the company's most important product developments was the Mighty Midget hydraulic valve. Reduced weight and improved pressure drop characteristics were obtained almost entirely through improvement of design detail and further design simplification through mechanical and metallurgical research. Ample capacity for landing gear actuation of typical bimotored aircraft was built into the smaller model of the valve, this assembly weighing but 8 ounces and saving 83 per cent in weight as compared with predecessor units. Bodies were fabricated from dural bar stock, thus permitting operating pressure up to 3,000 p.s.i., with ample safety factor for momentary overload in excess of these values. Operating handle loads of as low as 16 inch-pounds were provided for operation at 800 p.s.i., with special cams for further reducing handle load at higher operating pressures.

Aeromarine Instrument Company, New York City, utilized its greatly expanded plant facilities to increase its output of aircraft instruments, the list including air speed indicators, manifold pressure gauges, rate-of-climb indicators, temperature gauges, pressure gauges, tachometers, altimeters, compasses, etc., with the company's activities being largely devoted to filling defense-related commitments.

Aeroproducts Division of General Motors Corporation, Dayton, O., was in production of the Aeroproducts propeller for the Army Air Forces. This was a variable pitch, constant speed propeller of unit construction, chief features including hydraulic operation and hollow steel blades containing longitudinal ribs and unrestricted shaft hole for cannon installation.

Aeroquip Corporation, Jackson, Mich., manufactured in increasingly large quantities self-sealing couplings, designed to permit the disconnection of liquid-carrying pipe lines without either loss of fluid or inclusion of air upon reconnection. Sub-assemblies or complete units could be made in separate factories and used without tedious priming and bleeding operations.

Air-Maze Corporation, Cleveland, O., produced air filters for installation on all air intakes of aircraft engines.

Aircraft Accessories Corporation, Glendale, Calif., manufacturers of hydraulic actuating equipment for aircraft, increased production through use of facilities in its new plant building, and expedited supply of equipment to plane manufacturers engaged in filling national defense and British orders. Research and experimentation were carried on at an intensified rate in the new plant, to permit development of new hydraulic equipment and further improvement of present products, including Airaco directional control valves, hand pumps, check valves, relief valves, brake valves, and pressure regulators.

Aircraft Accessories Corporation of Missouri, Kansas City, Mo., manufactured radio transmitters and receiving equipment, and aircraft maintenance and repair equipment. A special item was the propeller governor testing unit to test all types of propeller governors. In addition to its complete line of aircraft radio equipment, including antennae, bearing indicators, amplifiers, maintenance and repair equipment, the company manufactured air field operations equipment such as auxiliary starters, propeller dollies, battery carts, variable inductances, neutralizing condensers, and variable condensers. The company's machine shop accepted orders and subcontracts for aluminum alloy sand castings for aircraft use both raw and machined; hand screw machine and turret lathe parts, in aluminum, brass, and steel, and radio and electrical wiring assemblies for aircraft use. A large personnel and plant expansion was carried out by erection of a modern building with air-conditioned offices and water-cooled plant.

Aircraft Hardware Manufacturing Company, Inc., New York City, makers of many types of constructional hardware for aircraft, continued manufacture of its standard line of bolts, nuts and turnbuckles. The firm's stainless steel department was expanded several times over that which had previously been in operation, with special screw machine parts and swedging terminals being among the most important items in sales.

Aircraft Screw Products Company of Long Island City, N. Y., designed and manufactured a number of aircraft specialties to prevent the failure of threaded fastenings in the lighter metals usually due to relatively low fatigue capacity and shock resistance. The Aero Thread screw thread system, designed to eliminate this handicap in plane construction, employed a bronze or stainless steel insert in the tapped hole, effectively protecting the threads from wear and abrasion, and providing a hard anti-friction surface into which the stud or cap screw fitted smoothly. It provided the member in which it was installed with 100 per cent greater fatigue resistance and 25 per cent greater static strength than the conventional thread.

Aircraft Tools, Inc., Los Angeles, Calif., with expanded facilities was in war production on specialized tools urgently needed by the industry. A complete line of more than 100 bucking bars and new sheet holders, sheet holder pliers and dimpling dies was introduced.

Aircraft Welders, Inc., Wichita, Kans., added new personnel and expanded plant facilities in 1941 for the manufacture of engine mounts, landing gears, welded structural parts, etc., according to individual specifications. The firm employed many certified welders who were qualified under Army-Navy test regulations.

Ajax Electric Company, Inc., Philadelphia, Pa., utilized its immersed electrode salt bath furnaces for heat treating and hardening explosive shells and aircraft armor plate. Bath hardening equipment consisted of standard Ajax-Hultgren furnaces and controls, together with interesting conveying mechanisms, including conveyorized oil quench and automatic washing system. The salt bath process shortened the usual two-hour time cycles to one-quarter or one-sixth the time required in previous years.

Allied Aviation Corporation, Dundalk, Md., handled a considerable amount of subcontract work on such items as flaps, tail cones and fuselages for warplanes.

Aluminum Company of America, Pittsburgh, Pa., expanded its far-flung facilities so that its aluminum production was brought up to a point several times greater than that of 1938, the last peacetime year. Because of this enlarged production schedule, the company was enabled to reduce the price of aluminum ingot to 15 cents a pound, the lowest level in history. The company was in full war production, with nothing for its civilian markets, built up over the last half century. Vast amounts of company funds were devoted to war expansion. The company also was constructing for the Government five aluminum plants and one alumina plant, the latter the largest in the world. Three of the aluminum plants, with a total productive capacity exceeding what the whole nation produced in 1938, were to be operated by Alcoa, as well as the alumina plant. Completion of all the plants, and additional plants to be built by others in the industry, were to raise the nation's total productive capacity for aluminum to an amount exceeding what it was believed all the countries under control of the Axis powers had ever produced in a year. The company's capacity for making fabricated forms such as forgings, rivets, extrusions, wire, rod, bar, tubing, sheet, including high strength alloy sheet, was increased greatly.

American Bosch Corporation, Springfield, Mass., devoted a major part of its manufacturing facilities to turning out quantities of aviation magnetos for use on 7, 9, and 14-cyl. airplane engines and also included on its schedule production of magnetos for huge 18-cyl. engines. A new building was erected to meet war demands. The Delco-Remy Division of General Motors Corporation also was manufacturing the Bosch magneto under a licensing agreement.

American Phenolic Corporation, Chicago, Ill., turned much of its production facilities to the manufacture of "AN" connectors for use by the aircraft industry on navigation instruments, aerial machine guns, bomb racks, radios and other installations where electrical failure was not to be tolerated. Used by leading manufacturers of military planes and accessories, these connectors were noted for their lightness of weight and the ease with which they could be connected and disconnected. The company also produced coaxial cables for low-loss radio frequency transmission, and conduit ferrules, fittings and coupling nuts in accordance with army and navy specifications.

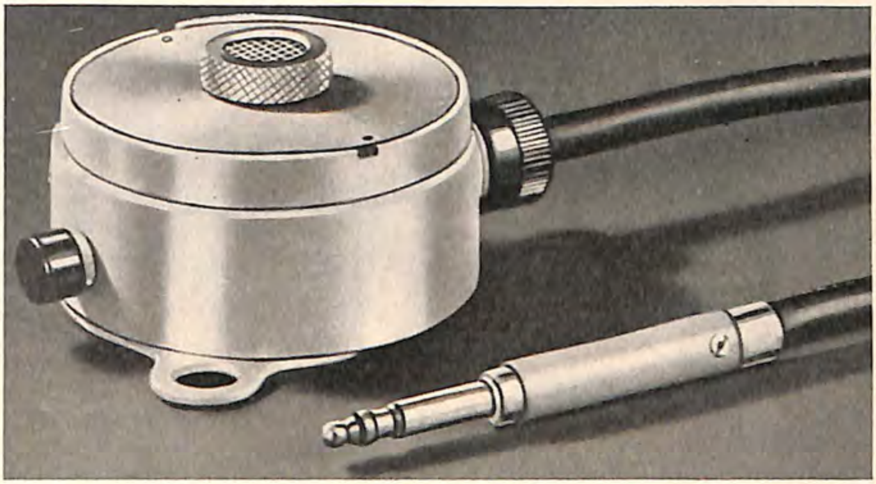
American Propeller Corporation, Toledo, O., a subsidiary of the Aviation Corporation, was incorporated in 1941 to manufacture propellers and hollow steel blades formerly turned out by the Aviation Corporation's Lycoming Division at Williamsport, Pa. The Army and Navy had been using these hollow steel blades on training planes for several years, and Government contracts were held for the larger diameter blades, some of which were intended for bombers.

American Screw Company, Providence, R. I., continued to supply the aircraft industry with wood, machine and sheet metal screws and miscellaneous hardware.

American Tube Bending Company, Inc., New Haven, Conn., increased its output by 136 per cent over that of the previous year in production of parts for planes and engines manufactured to the customers' designs and specifications. These products included such items as intake pipes, exhaust collectors and manifolds, oil lines, landing gear struts and forks, airplane seat frames, control sticks, oil slinger tubes for propeller de-icing, landing floats and other accessories.

The Aro Equipment Corporation, Bryan, O., produced propeller hubs for both wood and steel blade propellers on training planes. Large numbers of fluid segregators were delivered and mass deliveries of vacuum pumps were scheduled. Facilities were set up for producing oxygen demand regulators. Aro engineers completed a number of special engineering projects assigned by the Army Air Forces. Production of aircraft products was consolidated in a new addition to the Aro factory and an extensive employee training program was put into effect.

E. C. Atkins and Company, Indianapolis, Ind., manufacturers of wood and metal-cutting saws, increased its production schedules during 1941 to supply the demand for their tools in the aircraft plants of the nation. From these plants, the company stated, came reports indicating that the Atkins products were setting up performance records, cutting for lengthy periods of time without re-grinding, per-



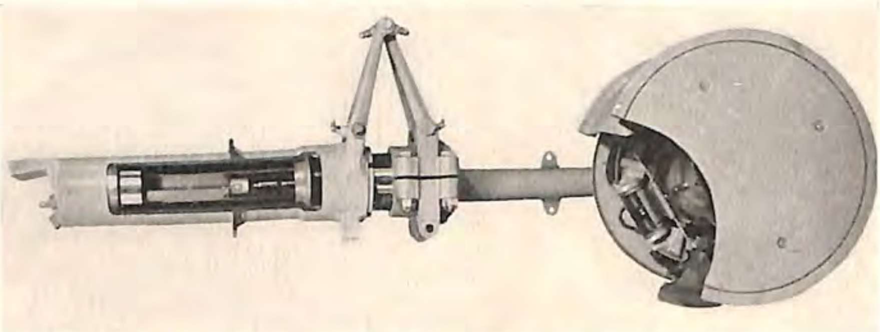
AUTOMATIC ELECTRIC MICROPHONE

Type 26, product of the Automatic Electric Co., is for use between crew members in flight or radio communication with ground stations, excluding extraneous noises.

mitting higher saw speeds and reducing time-out for saw change-overs.

Automatic Electric Company, Chicago, Ill., pioneer manufacturer of automatic telephone systems, devoted much of its production activities to the construction of supply relays, stepping switches and other electrical control devices for installations in the field of military aeronautics. The company's equipment was used in aircraft lighting systems, motor controls, interior telephone systems, landing controls and radio apparatus, with numerous similar applications.

The B. G. Corporation, New York, spark plug manufacturers, continued with the development and introduction of many new spark plug models to keep pace with the requirements of high specific power output engines. A greatly enlarged engineering department carried on an extensive program for the investigation of the many problems directly connected with airplane ignition systems. An interesting development was a spark plug test set designed to check the electrical condition of spark plugs at predetermined voltages. It utilized a high voltage bridge circuit, in one leg of which was incorporated the spark plug under test as well as the spark plug pressure chamber. This chamber placed the plug in position for the test, opened a pressure valve and controlled the electrical energy in the circuit, all by one movement of a small lever arm, thus greatly simplifying the testing procedure.



BENDIX PNEUDRAULIC SHOCK STRUT

With 27-inch smooth contour wheel; 11 x 2 duo servo brake display.

B. H. Aircraft Company, Long Island City, N. Y., in 1941 continued to supply the Federal Government and the aircraft industry with fabricated sheet metal parts of various kinds and styles.

Babcock Aircraft Corporation, DeLand, Fla., was contributing to the war effort as a subcontractor manufacturing parts.

Bellanca Aircraft Corporation, New Castle, Del., manufactured for the aircraft industry flush-riveted fins, floats, tanks, reservoirs, instrument panels, gun turrets, plastic bonded plywood structures and miscellaneous aircraft parts.

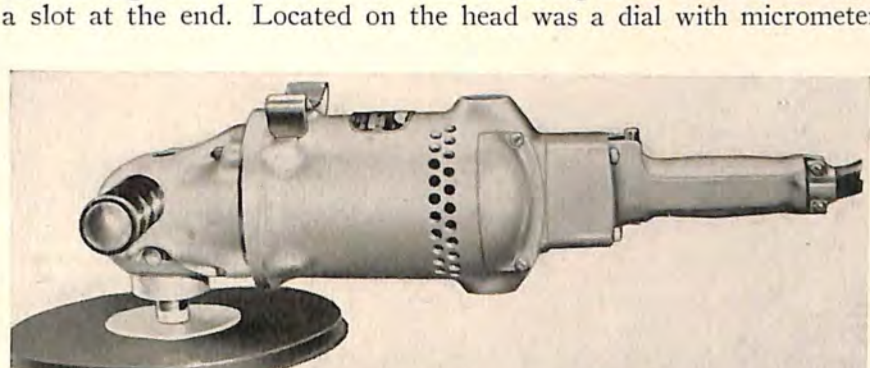
Bendix Aviation Corporation, Bendix Products Division, South Bend, Ind., makers of more than a hundred different aircraft instruments, specialties and other equipment, was in full-out war production, with two large new buildings in South Bend. One housed equipment for the heat treating of forgings, and the inner and outer cylinders of the Bendix pneudraulic shock struts. In addition to the expansion of heat treating facilities, an elaborate assembly line was installed for mass production of large type shock struts for twin and four-engine bombers. Bendix continued to increase its output of aircraft wheels and brakes, with a large engineering force busy in an endeavor to improve still further these accessories, to take up the least possible amount of space for the wheel and to dissipate more and more energy per square inch of rubbing space. Machines for increased production of tail wheels and tail wheel knuckles also were installed. Pilot seat and master cylinder assembly lines were set up and an increased production of power brake valves was accomplished.

Bendix Aviation, Ltd., Los Angeles, Calif., west coast subsidiary of Bendix Aviation Corporation, made rapid strides in its efforts to bring about vastly increased war production of hydraulic accessories, radio equipment and tube clamps. In its hydraulic accessory department there were produced some 30 proprietory items of its own design, including hand pumps, selector, check, sequence, relief and restrictor valves, disconnect couplings, power brake valves, accumulators and hydraulic electric switches. A notable development was the plastic poppet. Much longer life for the accessories resulted from the switch in manufacture of this device from steel to plastic material. The plastic units were found to be lighter in weight, chatter-free in operation, and simple to assemble and service. A new line of tube clamps for the first time incorporated a neoprene cushion permanently vulcanized to the metal clamp itself.

The Benwood-Linze Company, St. Louis, Mo., manufactured the B-L electrical rectifiers, which were designed by the firm's engineers in cooperation with aircraft engineers and production experts. These rectifiers are in use by the United States armed forces—dry plate metallic electrical rectifier elements in selenium, copper oxide, copper sulphide, and tube, together with inverters for converting D.C. to A.C., and rectifier devices for converting A.C. to D.C.

The Black & Decker Manufacturing Company, Towson, Md., was in war production on portable electric tools for the aircraft industry. New electric speed drills, sanding devices, grinding and punching accessories and electric tools of many varieties were engineered to the heavy production requirements of airplane, aircraft accessories and similar fabricating and assembly operations. An important product was the new heavy-duty Holgun, an electric hand drill, widely utilized through aeronautical plants.

The Bokum Tool Company, Detroit, Mich., presented a new method of spotfacing and boring through its new B. & B. spotfacer and boring tool, a head or bar with a cutting blade running through a slot at the end. Located on the head was a dial with micrometer



FOR FASTER PRODUCTION

Black & Decker heavy duty sander with nine-inch abrasive disc for metal surfacing.

readings permitting the operator to set the blade to precise diameter readings within ten-thousandths of an inch. Each blade had a rack on the inner or back edge which engaged with the micro-adjusting screw.

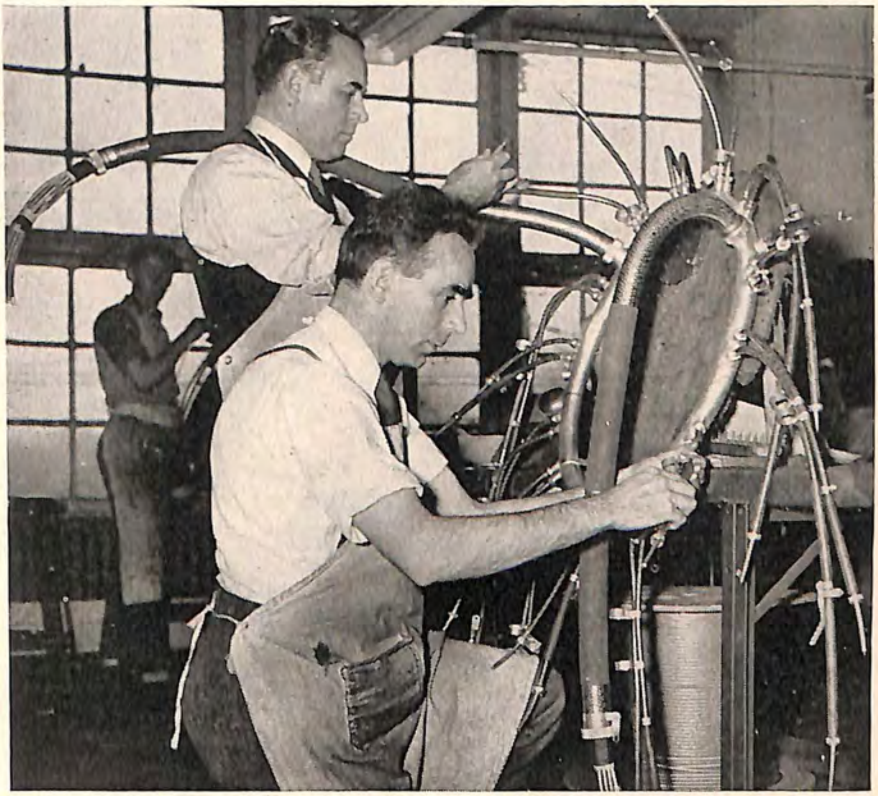
The Boots Aircraft Nut Corporation, New York, established a research and development laboratory for the purpose of adapting its wing style all-metal, self-locking nut to the numerous specific applications needed by the aircraft industry. Among new adaptations of the Boots nut were the gang channel, offering the feature of removable nuts; the floating anchor nuts of various base designs, also embracing the feature of easy removal; stainless steel nuts drawn from sheet metal; the Boots nut for blind plywood fastenings; the multiple unit anchor nut often known as the "rivet saver" because of the fewer number of rivets needed to attach an equivalent number of plate nuts. The Boots principle for the self-locking of nuts consisted of a load-carrying portion connected by a spring member. The locking threads were set out of phase with the load-carrying threads. When the nut was screwed on the bolt, the spring was forced to expand well within its ultimate strength until the locking threads were brought into phase with the thread system at which time the nut could be threaded on the bolt by the continued exertion of torque.

Breeze Corporations, Inc., Newark, N. J., increased its output of assemblies for aircraft, anti-aircraft, tanks, warships and ground defense equipment. Backlog, plant space and personnel increased by huge percentages and further expansion plans were under way. Breeze Corporations celebrated its 50th anniversary late in 1941 by further developing and refining its scores of products. These included a fast and efficient method of manufacturing armor plate for warplanes and other fighting units; improvements in and increasing production of cartridge starters and radio ignition shielding, conduits and fittings, conduit junction boxes, swaging machines and hand swaging tools, electrical connectors, resistance type thermometers, tab controls, ammunition rounds counters, internal tie rods, tachometer, fuel pump and remote control drives and other equipment. A new line of multiple-circuit electrical connectors was introduced for use at firewall, generator, radio and instruments with improved contacts. The fuel-air ratio indicator made by Breeze afforded a fast, accurate reading of the fuel-air mixture based on the analysis of exhaust gas. The cartridge engine starter developed by Breeze secured its energy from a shell using slow-burning fuel to generate the required power at a controlled rate which provided ample torque without danger of shock to engine parts. The starter could be used without drain on the airplane batteries, as the shell was fired by the current from a flashlight cell.

Briggs Manufacturing Company, Detroit, Mich., following an expansion of shop personnel and manufacturing space was in mass production on airplane parts, including wings and tail sections, bomber doors, and a wide variety of wing flaps and gas tank doors. The company was also at work on a considerable number of airplane supplies for Great Britain.

Buhl Stamping Company, Detroit, Mich., which had produced automobile parts and dairy equipment, was devoting much of its expanded factory space to aircraft and engine parts and miscellaneous assemblies.

Cambridge Instrument Company, Inc., New York, worked at full capacity producing precision instruments designed for the increasingly important practice of aviation medicine. Among these was the Cambridge Electrocardiograph, important in this branch of medicine be-



BREEZE RADIO SHIELDING

Joseph J. Mascuch, general manager of Breeze Corporations and pioneer in radio ignition shielding, and E. V. Rocky of the supervisory staff.

cause it produced records which revealed the condition of the heart muscle, thus aiding the flight surgeon in the examination of his personnel. Also produced was the fabric permeameter for testing the permeability of fabrics treated to hold hydrogen, helium and carbon dioxide, used in manufacture of lighter-than-air craft, life rafts, life jackets and gas masks.

Cannon Electric Development Company, Los Angeles, Calif., developed the Cannon solderless pins and sockets—a new development in the aircraft cable conductor field, designed to save up to 50 per cent of installation time by substituting bench-tool operations for hand labor wiring on aircraft parts during final assembly. The plugs eliminated soldering of both pins and sockets as all wires were attached by a "crimp-seal" method by means of solderless terminals. Cannon's contribution consisted of a locking device by means of which the prong or socket was held in the assembled insert. Each pin and socket was individually locked in the bakelite insert when the new Cannon device was used, yet solder-type terminals still could be used for emergency replacement in the field or substituted in bench production if desired. Some other Cannon "firsts" included split-shell construction, elimination of all machine screws, shell polarization and spaced-end bell rotation.

Central Aircraft Corporation, Keyport, N. J., was doing subcontracting for the industry.

Champion Spark Plug Company, Toledo, O., completed construction and tooling of a huge new plant addition for increased aircraft spark plug production. Champion ceramic insulated plugs, originally developed in 1940, met with such uniform acceptance among aviation engine builders that they almost completely replaced the mica insulated type. These plugs were said to be particularly successful as installations in high output aviation engines, for some of which no satisfactory plug with mica insulation previously had been obtainable. Specially designed Champion ceramic insulated plugs likewise came into general use in light plane and trainer engines.

Chandler-Evans Corporation, South Meriden, Conn., makers of Ceco carburetors, fuel pumps and Protek-Plugs, had increased its productive plant and set under way a further expansion program designed to meet war needs for its pressure type carburetors and fuel pumps. The Protek-Plug was a device for prevention of corrosion by dehydrating the atmosphere immediately surrounding the surface to be protected, and was utilized most extensively in the spark plug openings in aircraft engines. New and improved designs of the Protek-Plugs were put into production to meet the requirements of all types of engines and to conform to Government specifications. Detailed improvements in the company's fuel pumps met new specifications of the Army and Navy. Development testing was completed on a new type of variable capacity pump.

Chicago Aerial Survey Company, Chicago, Ill., continuously engaged since 1924 in producing aerial photographic surveys, maps and oblique views, enlarged their manufacturing operations during the year to include the new type "Sonne" Aerial Camera, the result of many years of development experience. The company held numerous contracts with the Army Air Forces.

C. P. Clare & Company, Chicago, Ill., for five years had been manufacturing telephone type relays for industrial uses and in 1941 devoted much of its manufacturing operations to the production of

HELPING TO SPEED UP PRODUCTION

Specially designed time-saving machines of the Cannon Electric Development Company break a "bottleneck" in die cast shells by means of this battery of automatic finish threaders.

such devices for use in the aviation field. Company engineers developed the Type G short coil telephone type relay which was used mainly in aircraft radio and Army command equipment. A 400-cycle relay was designed for use in high-speed pursuit planes and operated as an inverter warning relay. Numerous other custom-built aircraft relays, most of them of a confidential nature, were manufactured for various airplane installations.

Clark Tructractor Division of the Clark Equipment Company, Battle Creek, Mich., expanded its manufacturing facilities for turning out 3-wheel gas-powered tractors and fork trucks generally used in aircraft plants and at airports. Included was the Clarktor-6, a tractor built in five models for airport use in spotting ships in position and also for towing planes and hauling materials and parts in trailer trains. The Clarkat was a three-wheel tractor used often in traversing rough terrain and for quick transportation of baggage, freight and commissary containers. The Clark fork trucks were lifting, carrying and tiering machines, ranging in capacity from 2,000 to 7,000 lbs. They tiered loads as high as 108 inches.

The Cleveland Pneumatic Tool Company, Cleveland, O., manufacturers of Aerol Shock Absorbing struts and Cleco pneumatic tools, operated 100 per cent on defense orders and with an increased manufacturing area. The Aerol struts continued to be the leading product filling landing gear requirements for Army and Navy planes. Output in this field was reported to be something like eight times as large as that of the early months of 1940. The pneumatic tool division supplied aircraft manufacturers with riveting, drilling and grinding equipment to meet the war demand, and remained well ahead of commitments. Improvements in riveters and squeezers were incorporated in design to speed up these functions and further reduce operator fatigue. A patented sheet-holder for holding aluminum sheets together while being riveted—thus dispensing with the old-fashioned bolt and nut method—was further improved to speed up this most important function.

Clifford Manufacturing Company, Boston, Mass., extended its facilities for serving the aircraft industry with basic materials for engine cooling and cooling control. It manufactured the Hydron thin-wall extruded tubing for aircraft radiators, oil coolers, intercoolers and heat interchangers for liquid and air-cooled engines; and also turned out the Hydron thin-wall hydraulically-formed metallic bellows for use in all types of temperature and pressure control devices for engine cooling systems, carburetors and superchargers.

Colgate-Larsen Aircraft Company, Amityville, N. Y., extended during the year the operations it had begun in 1940 in sheet metal and welding on a sub-contract basis for other aircraft companies. Abandoning plans for the production of a new four-place amphibion plane, the company turned its entire plant facilities over to the manufacture of wing tips, landing gear struts, engine mounts and other sheet metal and welded sub-assemblies.

Crescent Insulated Wire & Cable Company, Trenton, N. J., manufactured for the airplane industry electrical wire and cable, Crescent box strapping and electro-galvanized strip steel in widths from ¼ to 2 in. and .010 to .70 in thickness.

Crouse-Hinds Company, Syracuse, N. Y., manufacturers of electrical products, specialized in the output of airport lighting equipment, the company's line including all material needed to light and render safe for night flying both large and small fields. Principal among the company's products was the Type DCB-36 rotating beacon, which projected light beams in two directions 180 degrees apart. Equipped with one end clear and one end green and rotated at 6 r.p.m., the beacon met C.A.A. specifications. It also could be equipped to serve as a land beacon.

Crown Fastener Corporation, Warren, R. I., developed heavy

CROWN FASTENER ZIPPER COVER

On an engine of the Martin B-26 bomber.

duty weather-proof covers for aircraft engines and other war equipment, employing its Crown Chevron 10C slide fastener in the Jumbo Zipper. Under the direction of Harvey L. Williams, the first waterproof, sandproof covers were developed for the Martin B-26 bomber, providing adequate protection for vital exposed parts of the plane in desert operations or in areas having excessive rainfall. The Crown fastener covers could be stripped off a 2-engine combat plane in less than two minutes and off a 4-engine plane in less than three minutes. Similar equipment was developed for anti-aircraft guns, field artillery, tops of half-track cars and other machines.

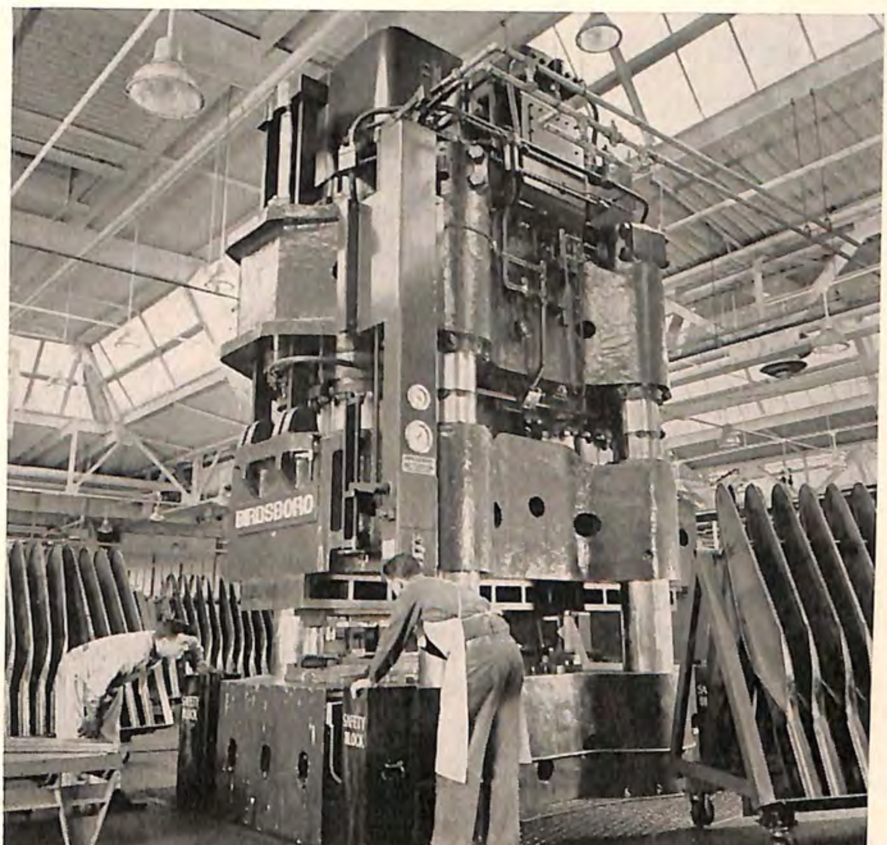
Curtiss-Wright Corporation, Propeller Division, with headquarters at Caldwell, N. J., was in vastly augmented war production of Curtiss electric propellers. The Caldwell plant was opened early in 1941. Curtiss electric propellers were standard equipment on such planes as the Curtiss P-40 series, Martin PBM-1 flying boats and Republic P-43 Lancer. Especially designed hollow-shaft propellers were on the Bell P-39 Airacobras; Curtiss electric propellers were also standard on the Martin B-26 bomber, Curtiss SB2C-1 dive bomber, Grumman F4F3, Lockheed P-38 Lightning, Brewster Buffalo, Curtiss-Wright C-55 Transport, Consolidated B-24 Liberators and PB2Y-2 patrol bombers, North American Mustangs and Republic P-47 Thunderbolt. The "hollow-shaft" for the Bell Airacobra permitted an aircraft cannon to fire through the hub of the propeller.

The four-blade propellers on the Martin B-26 and Republic P-47B permitted most efficient use of the 1,850 to 2,200 h.p. available in the more powerful aircraft engines. Continued improvements were made on reversible pitch propellers to facilitate maneuvering on the water; and the automatic synchronizer control, which resulted in quieter propeller operation and reduced strain on the pilot. This latter was adopted, together with the reverse pitch feature, as standard equipment for large flying boats.

Curtiss continued pioneering development of hollow steel blades, the production of which was under way on a large scale. The blades had many outstanding features. They were of light weight construction, and possessed abrasion-resisting characteristics. Development of larger propellers, suitable for operation at the higher altitudes at which military aircraft of the future must operate, was in active progress.

Dial Light Company of America, Inc., New York, manufactured underwriters approved models of pilot lights and special assemblies for special applications to individual specifications. The line included assemblies to meet Army and Navy requirements from 3/8 to 1 1/4 in. in diameter.

Diebold Safe & Lock Company, Canton, O., greatly expanded its plant facilities to produce light armor plate. Production of case-hardened airplane armor plate was increased to the point where the firm was one of the largest producers. The company also manufactured complete armored bodies for 4-wheel and half-trac type scout cars, light and medium tank armor plate, trench mortar stands and armored seats and fittings for airplane pilots. It also supplied a line of business tools to process or protect vital records. Included in such equipment were bomb and flood-proof vault doors, fire-resistive safes, and the Cardineer, an ingenious wheel record system to speed up card posting and reference work.



PROPELLERS FOR WAR

Experts at a giant 2,000-ton press shape hollow steel blades for Curtiss electric propellers at one of the plants of the Curtiss-Wright Corporation's Propeller Division.

HUBS FOR CURTISS PROPELLERS

Final microscopic inspection of three-way hubs for Curtiss electric propellers.

Dowty Equipment Corporation, New York, manufacturers of aircraft landing gear and hydraulic equipment under license from Dowty Equipment Limited of Cheltenham, England, began operations in 1940 and more than tripled facilities in a year. Delivery was completed on a large order for Live-Line hydraulic pumps placed by a Canadian customer, and substantial orders were received on this unit for the Army Air Forces as well as for British clients. Deliveries were begun on a large order of main oleo struts and tail wheel struts for use on British warplanes. A new type levered suspension tricycle undercarriage was supplied for a secret warplane project.

Eagle Parachute Corporation, Lancaster, Pa., expanded facilities and increased production of parachutes for the Army, Navy, Marine Corps and Forest Service. For the last-named group the firm manufactured a 30-ft. steerable canopy chute in the back-type pack, and a 27-ft. model with the chest-type pack. The Service "smoke jumpers" used these models to drop from a plane to the vicinity of a forest fire. The parachute had a low rate of descent and was non-oscillating. Eagle held exclusive manufacturing rights on the "Parasuit," a streamlined flying suit into which was fashioned a parachute and harness. This parachute could be worn like a coat and enabled the wearer to pass through unusually small apertures. The "Parasuit" was recommended for overwater flying as it contained a set of rubber lungs which could be inflated automatically by the pull of a small lever, thus insuring the flier sufficient buoyancy to keep him afloat for a number of hours. For the Marine Corps parachute troops, Eagle was producing a 28-ft. white silk canopy packed in a back pack, and a 24-ft. silk parachute in an emergency chest pack. The back pack could be opened either automatically by a static line attached to the plane or manually by a rip cord assembly.

Eastman Kodak Company, Rochester, N. Y., during the year manufactured numerous items of photographic equipment for use of the air forces of the Army and Navy and the aircraft industry in general.

Eaton Manufacturing Company, Cleveland, O., made considerable expansions in both its manufacturing space and personnel, including several Eaton plants, and permitting the company to increase its output on aircraft engine parts which its Wilcox-Rich division had been producing for some time. It was the Wilcox-Rich division which developed the Sodium-cooled aircraft valve.

Eclipse Aviation Division of Bendix Aviation Corporation, Bendix, N. J., increased the production of aircraft accessory equipment many fold, primarily through the use of sub-contracting plants for the manufacture of complete units, sub-assemblies, parts and tools. Manufacturing facilities at the Bendix plant were increased further by the addition of a new foundry building equipped with the latest type furnace installations, more than doubling the output of magnesium sand castings. Numerous sub-contracting plants manufacturing complete units and sub-assemblies were set up and operated at full capacity, producing, under Eclipse supervision, more than 39 per cent of the total output of Eclipse accessory equipment. More than 375 vendors were engaged in supplying raw materials and fabricated parts for Eclipse accessories. New items of starting, generating, pneumatic and hydraulic equipment were developed and placed in production.

New Eclipse accessories designed and developed during 1941 included several types of starting equipment, the most important of which were new types of combination inertia and direct cranking electric starters of entirely new design and applicable to aircraft engines rated from 400 to 3,000 h.p. A light-weight direct cranking electric starter weighing 32 lbs. for engines rated up to 3,000 h.p. and incorporating a slow-speed motor of 7,500 r.p.m. was developed. Refinements, including simplification of design, were incorporated in the standard production line of combustion starters. Considerable development work was carried on in connection with a multiple breech starter in which the multiple breech was mounted on and formed an integral part of the starter unit itself. A cartridge was fired in the breech remote from the starter proper. The powder charge was placed in the firing chamber of the starter and burned directly in front of the piston.

Another Eclipse development in starting equipment was a fluid coupling starter energizer which incorporated a fluid coupling in place of the usual friction disc clutch. The fluid clutch, in addition to reducing the shock of engagement, limited the peak torque developed by the energizer, resulting in considerable saving in weight, size and cost of the unit.

A complete line of light and heavy duty gear boxes was manufactured in standard and special sizes for attachment to engine accessory drives for operation of accessory units such as air compressors, generators, hydraulic pumps and fuel pumps. The hydraulic department of Eclipse Aviation placed in production a complete series of engine and motor driven hydraulic pumps with both gear and gerotor mechanisms in various capacities and drives. Also new in production was a light weight, hydraulically operated windshield wiper.

In the experimental stage Eclipse had variable displacement and constant displacement plunger type hydraulic pumps with working pressures of 1,500 to 3,000 p.s.i. Following extensive experimental work, electric propeller governor control heads of improved design were placed in production. Among the electrical Eclipse units produced was a complete series of light weight, high speed, engine driven generators with outputs ranging from 375 to 6,000 watts. Their speeds varied from 2,200 to 10,000 r.p.m., and the weight of the largest unit was only 32 lbs. A complete series of both 110 volt and 30 volt DC motors were designed for various types of motor driven accessories. They ranged from ¼ to 4½ h.p. Several types of inverters, convertors and motor generator sets went into quantity production.

Development of cabin supercharging equipment as well as air pump and de-icer systems was carried out, among which was a new series of engine-driven air pumps of various capacities, Government approved and released for quantity production. For high altitudes a new large size air pump with capacity 50 per cent greater than the conventional B-4 type unit was developed.

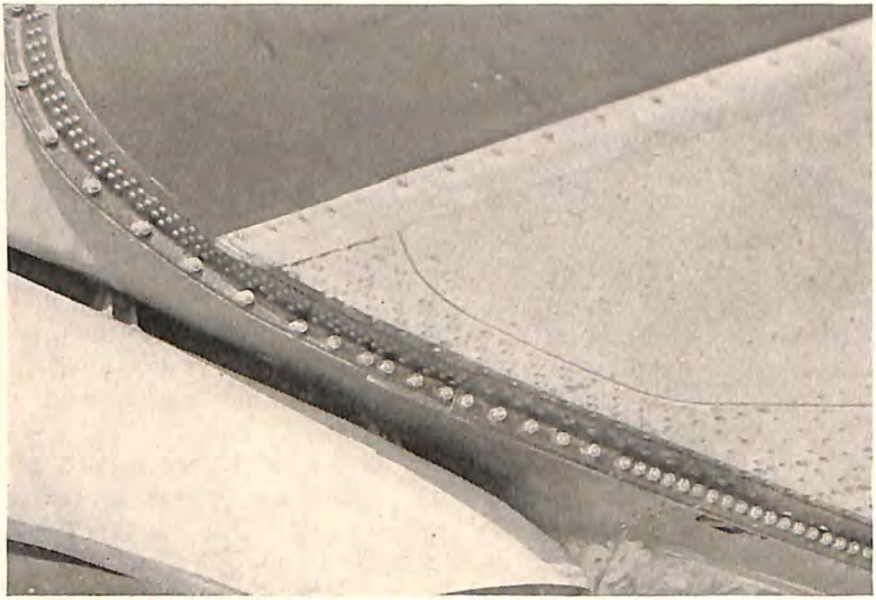
An entirely new Eclipse mechanical de-icing system known as the manifold de-icing system, utilizing Goodrich wing and tail surface rubber de-icer shoes, was developed. It consisted of two tubes, pressure and vacuum, running to each wing tip. Incorporated in the tubes were solenoid operated valves connected directly to the individual de-icer boots or shoes. The system was particularly adaptable to large airplanes operating at high altitudes where most efficient performance was desired.

Extensive experimentation with cabin superchargers resulted in a marked trend toward positive type blower applications for small airplanes, new developments including a hydraulic cabin control, multi-speed gearing and small, high speed electrically driven blower units. An auxiliary power supply system for cabin supercharging, bilge pump operation and emergency generating equipment was another major development of Eclipse aircraft accessory equipment.

Edo Aircraft Corporation, College Point, N. Y., manufacturers of all-metal seaplane floats for airplanes ranging in gross weight from 1,000 to 20,000 lbs., doubled manufacturing facilities with a correspondingly large increase in personnel. Plant facilities were devoted largely to production of float orders for the U. S. Navy for observation and scout planes. Edo's design, featuring the utilization of a stressed skin to take the loads imposed by catapulting and rough water landings, proved satisfactory while in standard use with the Fleet. Edo also built floats for experimental use on trainers and observation planes, such as the Ryan ST3-SKR, the Stinson O-49 and the North American O-47A for the Army Air Forces. Military planes of a number of foreign governments were similarly equipped. Edo also built parts for Army and Navy bombardment aircraft. New developments were launched in Edo's engineering and experimental departments.

Eisemann Magneto Corporation, New York, placed in production its new model LA aircraft magneto for 2, 4, 5 and 6 cyl. engines. It had a unit-cast housing with integral mounting flange, a single-piece cast magnet rotor, self-lubricating bearings, complete sealing against entry of oil or fumes and simplicity of design and operation.

The Elastic Stop Nut Corporation, Union, N. J., manufactured a complete line of self-locking nuts and aircraft fittings designed to meet Army, Navy and C. A. A. specifications for structural and secondary aircraft applications. Features which made these nuts of particular adaptibility to the aircraft construction work included absolute locking effectiveness against all types of vibration. They could be reused numerous times without loss of locking efficiency, and they were available in all threads, sizes, types and materials. They did not damage threads or plating when applied to the bolt. Incorporated into the construction of the nut was a chemically hardened fiber collar. The inside diameter of this collar was slightly smaller than the bolt and it was not threaded. The locking action was created when the bolt, after passing through the nut threads, met the resistance of



ELASTIC STOP NUTS

On wing fastening of a Douglas DC-3 transport.

the fiber collar. At this point a strong resilient force was exerted downward on the bolt, bringing the load-bearing sides of the nut and bolt threads into positive contact throughout the nut. As the bolt passed further through this collar, its threads impressed themselves into the fiber and the downward pressure remained constant, eliminating all axial play.

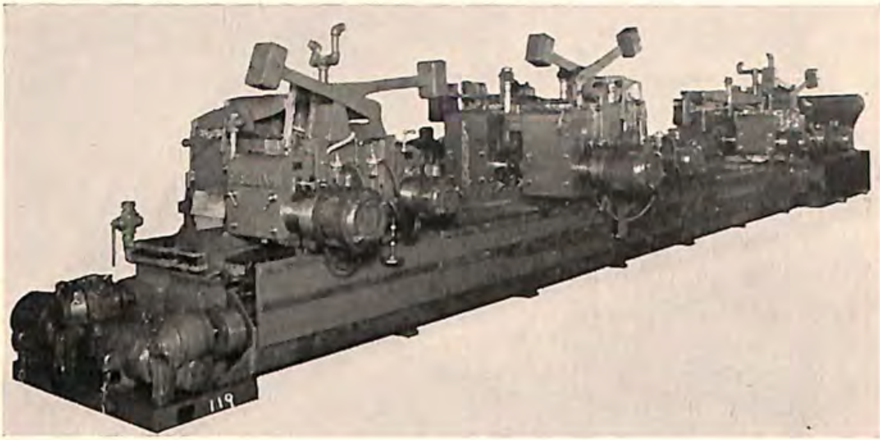
The Electronic Specialty Company, Los Angeles, Calif., manufacturers of lightweight aircraft radio receivers and transmitters, turned out increased quantities of their Ranger R4A and T5A receiver and transmitter units.

The Exact Weight Scale Company, Columbus, O., produced units for weighing, parts counting, measuring and testing operations in aircraft engine and other manufacturing plants. It produced the Shadowgraph, an electrically-operated weighing unit of high accuracy for connecting rod balancing and selection, and also the Shadowgraph A, an electrically-operated unit for piston selection and precision. For the Wright Aeronautical Corporation the company designed and installed an efficient connecting rod selection operation on which tolerance is to 0.03 lb. of a predetermined standard weight.

Fairchild Aerial Surveys, Inc., Los Angeles, Calif., was engaged almost exclusively in defense activities. Contour maps of cantonment sites and arsenals were produced by the photogrammetric method. An outstanding example of this type of work was found in one area of 75,000 acres where the entire job was done, beginning with the putting in of ground control and ending with the delivery of maps at a scale of 1 in. to 500 ft. and 10-foot contours, in a total elapsed time of four weeks. On account of world conditions, the company's foreign activities were limited to Latin America.

Fairchild Aviation Corporation, Jamaica, N. Y., designed and put into production several new aerial cameras, including the F-56, K-17, K-18, K-19 and K-20 cameras and the gun sight aiming point camera. In addition, Fairchild undertook the development and manufacture of other precision equipment not related to aerial photography. Included were range finders, gun synchronizers, gun fire control equipment, octants and ultra high frequency radio. The K-17 aerial camera was an advanced design of the well-known Army Type K-3B general purpose camera of which thousands were still in use throughout the world. It provided for the use of interchangeable lens cones of 6, 12 and 24-in. focal length and interchangeable roll film magazines having capacities for 110 exposures 7 x 9 in. in size or 200 exposures 9 x 9 in. in size. It could be adapted to either oblique or vertical photography and could be operated manually or fully automatic as desired. The Fairchild F-56 aerial camera was developed expressly for installation in Naval aircraft where space was limited. A time recording feature was incorporated in the F-56 providing the image of a split-second stop watch in the corner of each negative. The gun sight aiming point camera was credited with making possible considerable progress in aerial combat gunnery training during the year. The camera took its name from the fact that it photographed not only the image of the target but also the illuminated reticle of the gun sight, thereby providing a record of the point of aim of the machine gun with which it was used. Also, it served as a means of obtaining a pictorial record of the actual aerial combat. The unit was operated by a small electrical motor and used 16 mm. motion picture film.

Farnham Manufacturing Company, Buffalo, N. Y., perfected a series of improvements and refinements in its spar cap milling machine which it brought out in 1940. Whereas the first mill had two heads of 10 h.p. each, machines built during the year had as many as seven heads with a combined cutting power of 110 h.p. Such machines were capable of cutting spars 40 ft. in length in a single pass, each machine being engineered to fit the requirements of the spar being milled. In the machines shipped during the year there were 16 different designs. Still further improvements in this equipment



FOR FAST PRODUCTION

Special Farnham straight spar miller with seven milling heads mounted in three carriages independently fed.

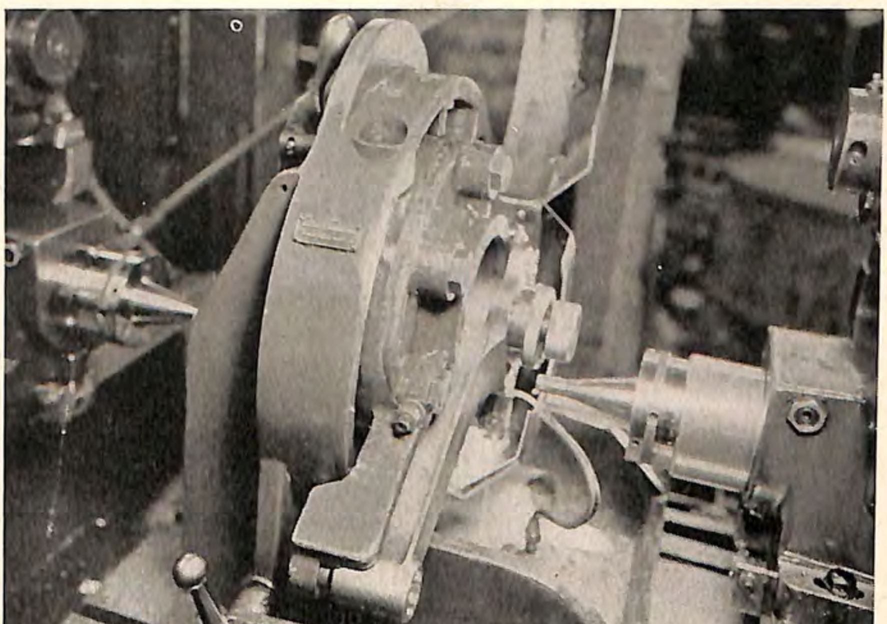
were under way in 1942, and there appeared to be no limit to what could be accomplished in the high-speed milling of aluminum. Because of the necessity of developing the larger and faster spar mills to serve the aircraft industry, the company limited new products, although numerous new special designs of countersinkers and hy-cycle drills for spar drilling were delivered throughout the country. The rolls for leading edge skins also were improved in important respects. The company doubled its capacity and acquired new facilities for still greater production.

Federal Metal Hose Corporation, Buffalo, N. Y., furnished to the larger part of the aircraft manufacturing industry flexible metallic tubing in a large range of sizes from 3/8 in. I. D. to 14 in. O. D. This flexible aluminum tubing was supplied to the industry in both the United States and Canada.

Fenwal, Incorporated, Ashland, Mass., expanded its plant facilities for the manufacture of its Fenwal Thermoswitch, a thermo-responsive electric switch which was widely used by aircraft manufacturers.

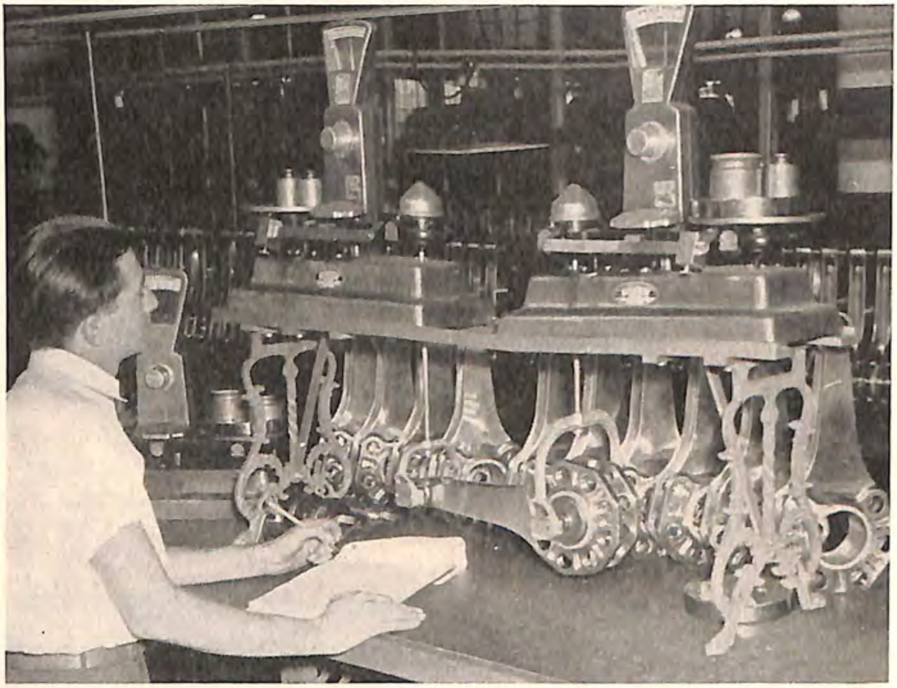
Finch Telecommunications, Inc., New York, produced facsimile transmitting and receiving equipment which made possible the sending or receiving of written or printed matter by radio to or from aircraft. Such items as sketches of artillery positions, weather maps and storm warnings, written orders and reports, and even photographs, could be sent from air to ground and ground to air with this equipment.

The Firestone Tire & Rubber Company, Akron, O., established a new subsidiary, the Firestone Aviation Products Company, and increased output of aviation products more than 1,000 per cent. New products were developed for the war effort. A new molded type of self-sealing gasoline cell for airplanes greatly increased the sealing ability and, at the same time, permitted a uniformity for mass production theretofore impossible with ordinary methods of manufacture. Production of the self-sealing tanks also was continued. A new low profile tire for nosewheels on airplanes having tricycle landing gears was developed in collaboration with Bell Aircraft. It provided both maximum wheel diameter and a minimum of overall tire diameter, and, at the same time, maintained approximately the same cross-section or footprint area, affording much greater flotation under adverse landing and take-off conditions. Another tire, the Channel Tread, had a wide tread extending nearly to the sidewalls and reinforced on both sides by radical ribs or buttresses. The entire width of the tread thus came in contact with the soil at once, without having to sink in to get con-



FOR JACOBS AIRCRAFT ENGINES

Ex-Cell-O diamond-boring machine with special cutting tools and fixture for boring the knuckle-pin holes in the master rod. The two heads move in and bore simultaneously from opposite sides. Holes are held to a tolerance of .0015 in.



EXACT WEIGHT MACHINE

Made by the Exact Weight Scale Co., this connecting rod selection operation has a tolerance of only .03 lb. of a predetermined standard weight.

tact area. The new Channel Tread tire permitted fast pursuit planes to land on muddy or sandy fields or on other terrain where otherwise they would bog down.

The problem of confining oxygen, under great pressure, in lightweight shatterproof cylinders for bombers and fighter planes operating at high altitudes, was solved by Firestone engineers after extensive experimentation and research. The Firestone oxygen cylinder was the first to be approved by the War Department following a series of tests where .50-caliber machine gun bullets were tumbled through the thin metal casing containing oxygen at 400 lbs. pressure per sq. in.

In the foamed latex field, where the original development was for the production of mattresses and cushions, the Firestone Aviation Products Company provided an airplane wing-filler material for reducing the hazards occurring when a plane is subject to gun fire. The material filled the empty space in airplane wings surrounding gasoline cells and overcame the hazard by occupying the dead-air space so completely with a foamed latex product that the vital area would not support a combustable mixture. A wide variety of other uses for liquid latex in the rearmament program at Firestone included parachute seats, airplane seat and back cushion upholstering and bullet-sealing crash pads.

Other general Firestone aeronautical products in mass production included Neoprene sheet rubber, seadrome contact light buoys (manual and remote controlled with portable or fixed bases), mooring buoys, motor mounts, landing gear shock absorber discs, both hydraulic and mechanical wheels and brakes, airplane tires and tubes (regular and puncture proof) and specially constructed static conductor type tires and tubes for tail wheels. Firestone was also in seven days a week quantity production on barrage balloons.

Flex-O-Tube Company, Detroit, Mich., continued to supply the aircraft manufacturing industry with fittings and equipment.

The Formica Insulation Company, Cincinnati, O., producers of mechanical and electrical parts, doubled capacity and put many operations on a 24-hour basis. Among the specialties manufactured for the aircraft industry were control pulleys, fairlead bushings and spools,

FIRESTONE BULLET-SEALING FUEL TANK

buttons, tubes and punched parts, air pump vanes, propeller shanks, fluorescent name plates and trailing edge filler blocks. The advantages of the material from which these accessories were fashioned were its light weight—the specific gravity was 1.3—the fact that it was chemically inert and resistant to corrosion, non-absorbent and possessing a low coefficient of thermal expansions. A recent development was instrument panels for night flying printed in fluorescent inks so they glow when illuminated with black or invisible light. The panels were protected by a plastic film protecting the fluorescent lettering from grease and making them easy to clean without injury to the markings.

General Aircraft Corporation, South Lowell, Mass., because of priority restrictions, discontinued production of its two-control airplane G1-80, Skyfarer, and devoted its activities to subcontract and experimental work.

General Bronze Corporation, Long Island City, N. Y., fabricator of distinctive metal work for the construction industry, in 1941 did considerable work for many of the leading prime contractors in the aircraft field, with practically all its facilities engaged solely in defense-related activities. The firm turned out non-ferrous metal castings, and its fabricating shop handled numerous types of sheet and plate work, including forming, welding and finishing. General Bronze was awarded the Navy "E" for excellence in naval ordnance production.

General Controls Company, Glendale, Calif., attained high operating efficiencies on direct current in a newly-improved series of electric valves for aircraft use. The improvement was developed in a basic design avoiding some of the inherent constructional features of typical solenoid valves, which rendered stationary designs unsuitable for aircraft use or in moving or vibrating machinery. For controlling gasoline, hydraulic, oil, anti-icing fluid, cabin heating fuel, air or other gases, various types of single, normally open or closed valves, three or four-way selectors simplified pilot supervisory control, pressure and temperature problems and reduced weight. The company was active in pioneering improvements and developments of magnetic type automatic valves especially capable of operation in any position, and off-setting the effects of vibration.

General Electric Company, Inc., Schenectady, N. Y., in 1941 increased manufacturing facilities for the production of a wide variety of accessories utilized in aircraft construction. These products included motors, dynamotors, control devices, voltage regulators and relays, superchargers, switches, wire, radio transmitting and receiving equipment, magnetos, generators, instruments and Mycalex, a stone-like insulating material. General Electric was in full time war production on aeronautical equipment. It paid particular attention to accurate laboratory controls of details which affected the size and weight of its output and devoted the utmost care to close tolerances and procurement of high-quality raw materials.

The General Engineering Company, Buffalo, N. Y., perfected and introduced an improved model of its GMR general multiple riveter, through the use of which aircraft builders reported savings in excess of 200 per cent over previous methods of rivet heading. Multiple riveting proved practical for any flat, straightaway work lending itself to efficient handling at the machine, and was of especial value for riveting wing spars, wing skin assemblies, and fuselage and wing bulkheads. The Model GMR was equipped with sensitive, automatic controls, and its operation was so simple that an unskilled operator could be trained in less than one day to operate the device satisfactorily. The company also built several other types of riveting equipment as well as accessories, such as anvils, roll top tables and stands.

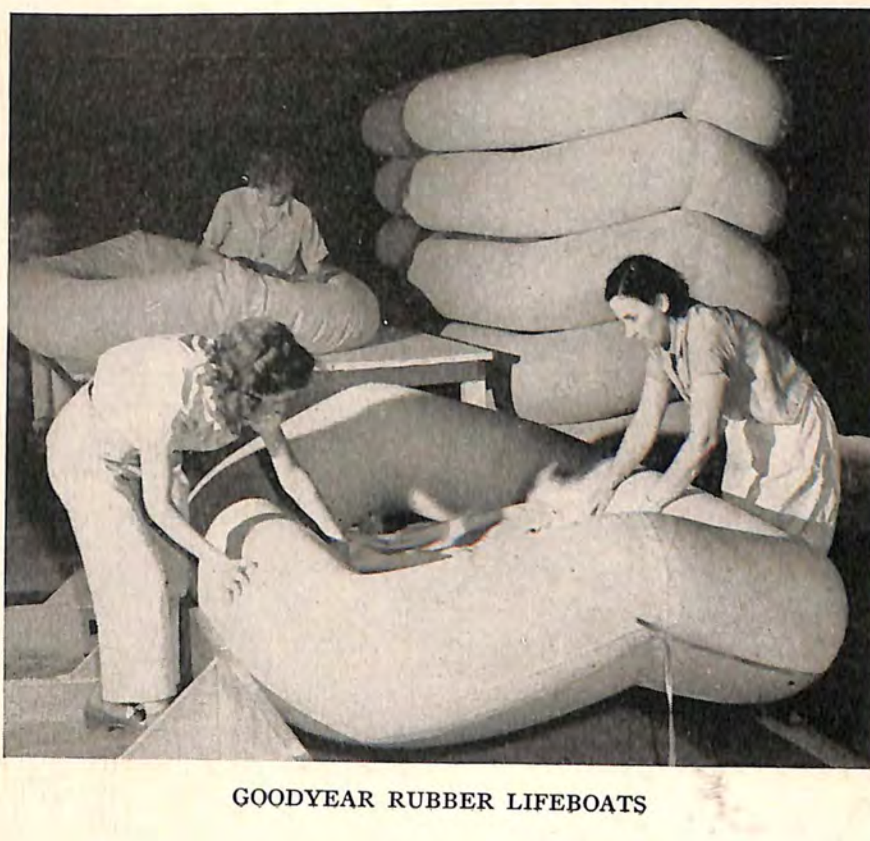
Globe Steel Tubes Company, Milwaukee, Wis., featured the Gloweld welded stainless steel tubing which was produced in large quantities for aircraft plants. Fashioned through a closely-held electric welding process, the tubing provided a high degree of corrosion resistance, strength with minimum weight and uniformity of structure. The method of welding the stainless strip was such as to result in a tube with very little "flash," thereby reducing to a minimum the amount of grinding or cutting off of flash required to obtain a smooth finished tube. The tubing could be readily bent, coiled, swaged and formed, so as to work well into hydraulic lines, engine parts and other applications. It was available in a wide range of diameters and wall sizes and in nearly all stainless steel analyses.

The B. F. Goodrich Company, Akron, O., geared its resources to reflect the vastly increased military demands for aeronautical rubber products. More than 80 products of natural and synthetic rubber were considered essential in the make-up of a combat airplane. Tires and tubes, brake expander-tubes, de-icers and a host of molded and extruded items, were augmented by such specialized articles as bullet-sealing fuel tanks and fuel hose, parachute cushions, oxygen equipment, new-type electrical insulation and airmen's suits for high-altitude operations. The development of additional rubber articles was underway, as the resiliency, lightness, resistance to oils, greases and solvents, and other properties of the versatile material, were adapted to aeronautical use.

The most significant improvement in wing de-icers in 1941 was the Goodrich development of a design providing greater wing coverage—extending over not only the fairing strip, as in former models, but beyond—with but a minor increase in weight, as compared with standard types. One design of the new de-icer was twice the standard width at the inboard end, tapering to standard at the tip. It was installed on several of the U. S. Army Air Corps transport airplanes, as well as on ships used by four commercial air lines. As a result of the success of these installations, it became standard practice to design all new de-icers for a minimum coverage of seven per cent of the chord length, both top and bottom of the wing, or 50 to 100 per cent wider than previous types. Special researches were made in the company's refrigerated wind tunnel on still wider de-icers, which were designed and tested. Object of the wider-coverage designs was to permit more efficient airplanes of higher wing-loadings and greater speeds to operate safely through more severe icing conditions. Aerodynamic refinements in de-icers, introduced experimentally in 1940, were adopted as standard design in 1941. One such refinement was the use of latex sponge padding on the underside of the elastic area for greater uniformity of the surface contour, resulting in improved aerodynamic effects and ice-removing efficiency. Aerodynamic tests at the N.A.C.A. laboratories, Langley Field, Va., and at the Daniel F. Guggenheim Airship Institute measuring the effect of de-icers on some high-speed airplanes, indicated that recessed installations are needed if the efficiency of new low-drag air foils is to be maintained. Recessed de-icers, standard equipment on the B-24 bomber—featuring one of the new air foils—show no loss of aerodynamic efficiency. A new propeller feed shoe, modified over the 1940 model to provide greater icing protection and less susceptibility to water erosion and stone abrasion, was adopted by five major air lines. Their experience indicated that when properly installed and operated, the new feed shoe assured complete freedom from propeller ice, permitting the use of full power and conserving anti-freeze fluid. Damage to the fuselage, caused by large ice particles from the propeller, was minimized because the new design effectively lessened the adhesion of ice and prevented large formations. An intensive test program was carried on in collaboration with Pratt and Whitney to measure the effect of impact icing on engine air intake systems. Improvements in tread wear and cutting resistance of aircraft tires were made by Goodrich, and sizes and types were introduced to meet new service demands. To conserve rubber, the airplane tire line was reduced 25 per cent in the number of sizes and types, and tube sizes cut 20 per cent. Removing rubber fairing strips above the rim-flange of some tires resulted in substantial saving.

The Goodyear Tire & Rubber Company, Akron, O., considerably increased its production pace in turning out sub-assemblies for planes manufactured by several leading companies. Several small training airships and long-range non-rigid patrol airships were completed and greater production started. Barrage balloons were in quantity production as were wheels and brakes. Bullet sealing gasoline tanks, early types of which were developed by Goodyear during World War I, flotation bags which could be inflated automatically to keep afloat land planes forced down on water, inflatable emergency life rafts to serve as lifeboats in water crashes, inflatable life vests for pilots—all were in quantity production. For the Navy, Goodyear produced non-rigid airships in two sizes, two L type trainer ships, the same size as those of the Goodyear fleet, and the larger K ships, large enough to make extensive patrols and carry armament, chiefly bombs and machine guns. Coordinated with airplane and surface ship patrols, these larger blimps were used primarily in the coastal areas, 200 miles out, guarding against submarines and mine-layers at harbor entrances.

George Gorton Machine Company, Racine, Wis., developed a new



GOODYEAR RUBBER LIFEBOATS

and simplified design of its Gorton munitions engraver suited for production use on war armament products such as gun range scales, indicator plates, gun barrels, airplane propeller pump housings, range finder bands, gun sight dials, gun elevation scales and many other parts for guns, planes, ships, tanks, bombs, shells and torpedoes. The simplified unit included a new spindle drive, the fixed pantograph ratio and a table that was adjustable only in vertical direction. The spindle was a self-contained ball-bearing unit that could be removed to grind cutters in place. It was fitted with a micrometer feed graduated in thousandths for a maximum movement of 5/16 in.

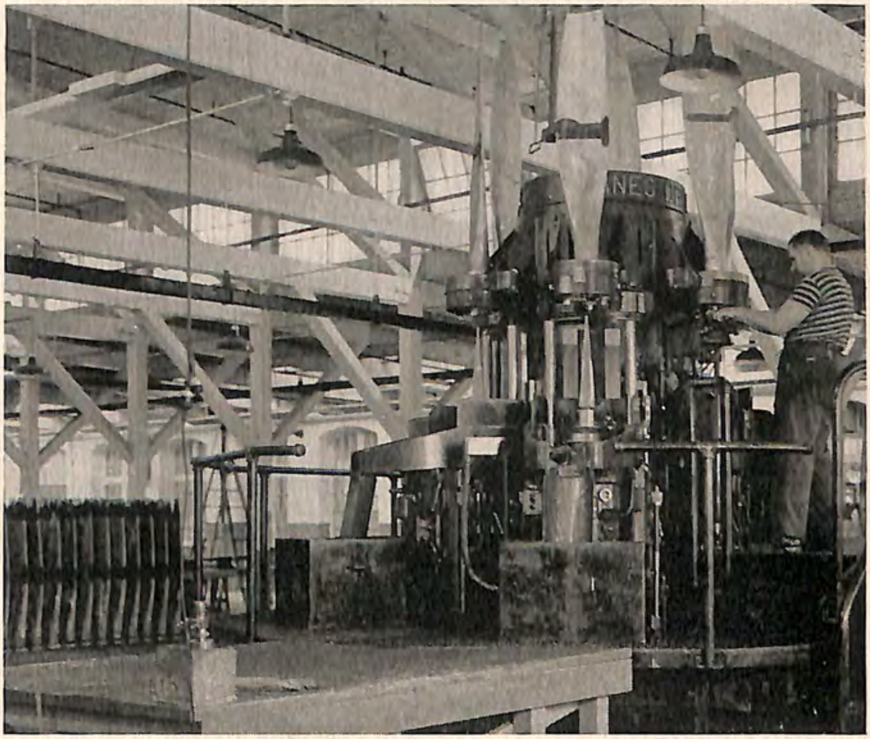
The Govro-Nelson Company, Detroit, Mich., continued at capacity the manufacture of its automatic drilling unit which was in wide use in the aircraft industry. The unit, made in several sizes, was designed primarily for the protection of small drills, particularly where they broke at an angle to the surface or in corners or ribs. By employing the principle of centrifugal force for feed pressure and by regulating the rate of feed through the use of weights, the unit permitted drilling faster than was possible with power feed mechanism which must be set to protect a partially dull drill. Meeting of hard spots in the material or drilling with overly dull tools, did not break the drill.

Grimes Manufacturing Company, Urbana, O., designers and manufacturers of lighting equipment, in 1941 introduced several types of new fixtures for aircraft service. Experiments were conducted with various new ultra-violet sources in connection with the development of instrument panel lighting. A "sealed beam," 600 watt landing light also was introduced for service on some types of aircraft.

The Hall Manufacturing Company, Toledo, O., makers of valve seat grinders and valve refacers, produced the Hall Aero Grinders which found widespread usage among the aeronautical plants. Incorporated in these devices was what the company termed "the blind grinding feature," which made it possible for the operator to determine when the grinding wheel first contacted the high or untrue side of the seat. As the operator continued to feed into the seat, it indicated when the grinding wheel—traveling progressively, eccentrically around the seat—was grinding all the way around the diameter of the valve seat. Then, by permitting the grinding wheel to dwell on the valve seat, accuracy was assured. In the Hall model 80A valve refacer was incorporated wet grinding to prevent distortion and surface burning. It also had dual motors with rheostat control of grinding head speed for valves of varying diameters and different metals, and a special patented chucking system holding the valve securely without brinelling.

Hamilton Standard Propellers Division of United Aircraft Corporation, East Hartford, Conn., so increased production that it was ahead of schedule. Hamilton Standard was one of the largest producers of aircraft propellers. Assisting to make this production possible was the fact that, during 1941 a recently-leased plant reached its output capacity. Subcontracting had always played a large part in Hamilton Standard's production methods. At the beginning of 1941, approximately 62 per cent of the East Hartford plant production was made possible by subcontracted material. During 1941, subcontracting was extended even further.

To augment the production of Hamilton Standard propellers, Nash-Kelvinator Corporation was licensed, in June, 1941, to build the Hydromatic type for the Government. Following the practice already established by United Aircraft in licensing automotive com-



MAKING HAMILTON STANDARD PROPELLERS

Many special machine tools are required for mass production. This machine is used for reaming taper holes in propeller blade shanks. This is just one of many processes contributing to tremendously increased production.

HAMILTON STANDARD PROPELLER LABORATORY

panies to build engines, Hamilton Standard Propellers gave this license to Nash-Kelvinator for a nominal fee.

During 1941, Hamilton Standard Propellers increased its enrollment of college graduates recruited from the major engineering schools of the country. Graduates of this six months training course —which had been in operation since 1938—greatly assisted the engineering staff in undertaking extensive research problems, approached in the interest of future aviation development.

During 1941, numerous Hydromatic propellers which had accumulated from 5,000 to more than 7,500 hrs. of service time were returned to Hamilton Standard Propellers for detailed inspection. They all were found to be in excellent condition, and were returned to the operators for further service. The overhaul time on Hamilton Standard propellers early in 1942 ranged from 600 to 1,100 hrs.

The Hartzell Propeller Company, Piqua, O., expanded production of airplane propellers, both wood and metal, with increased personnel and plant facilities. Special emphasis was placed on the production of metal propellers.

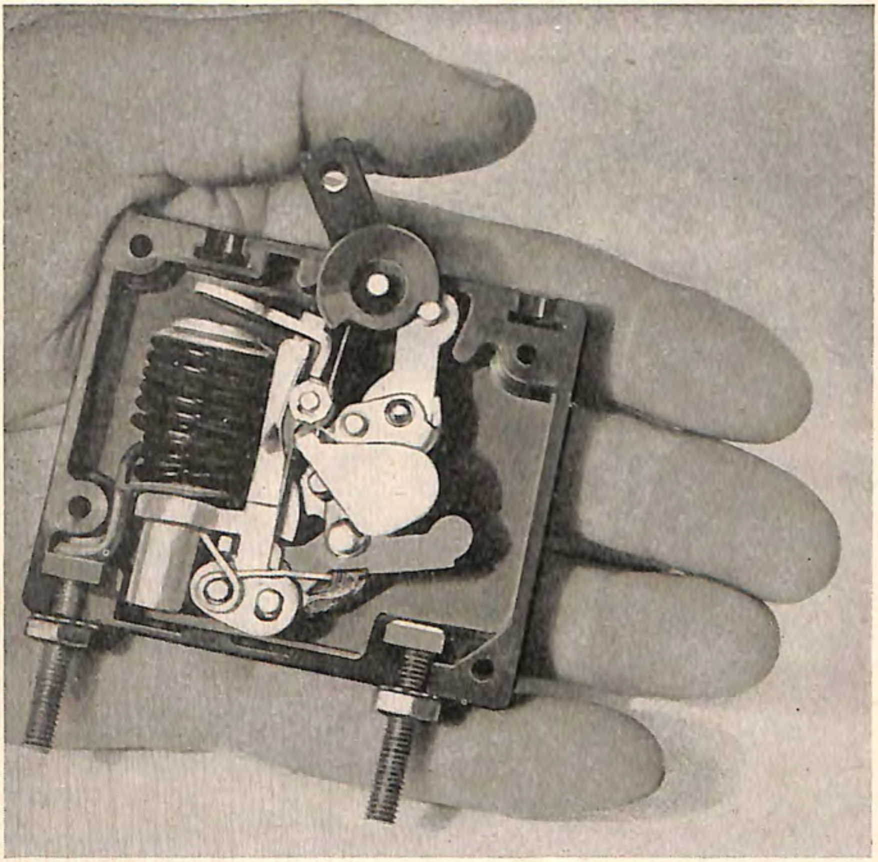
Hayes Industries, Inc., Jackson, Mich., makers of aircraft wheels and brakes, expanded production of its standard line and materially increased plant capacity. Development work on a new type wheel and brake of high energy capacity was undertaken.

Hayes Manufacturing Corporation, Grand Rapids, Mich., producers of aircraft parts, parachutes and dies and stampings, continued turning out outer wing panels for a military prime contractor, and one of its three main plants was re-equipped and devoted exclusively to this production. In its stamping division, Hayes switched to the production of structural parts for planes, such as ribs and fairings.

In the section once devoted to automotive upholstery work were produced large numbers of aviation parachutes of several types for Army and Navy use.

Heath Company, Benton Harbor, Mich., produced for the aircraft manufacturing industry a line of covers, floats and skiis, radios, radio compasses, radio shielding and equipment, stampings, and tail wheel assemblies as well as wheels and brakes.

Heinemann Circuit Breaker Co., Trenton, N. J., completed development of a small, fully electro-magnetic circuit breaker that met the demand for circuit protective devices to stand up under the severe conditions encountered in airplane operations. The standard panel



HEINEMANN CIRCUIT BREAKER

This is an electro-magnetic airplane circuit breaker for protection of lighting, motor, radio and control circuits.

type breaker was redesigned into a model for the protection of radio, motor, lighting and heating circuits of both military and commercial planes. The unit was highly efficient in action and was in wide use for current ratings up to 150 amperes and voltages up to 110 DC. To meet size and weight limitations in certain types of aircraft construction, however, company engineers reduced both the size and weight of the breaker by approximately half. This small unit operated on current ratings up to 50 amperes and voltages up to 28 DC. A magnetic trip with time delay gave delayed trip on harmless overloads and a high-speed trip on short circuits. The Heinemann line also included one-, two- and three-pole breakers widely used in radio transmitters, auxiliary breakers for the protection of fractional horsepower motors, panel type circuit breakers and equipment protectors.

The Homestead Insulation Company, Hartford, Conn., engineers and contractors for heat, cold and sound insulation, utilized Soundstone acoustical stone cast in blocks or slabs in treating test cells at the plants of numerous aircraft engine manufacturers. Because of the noises developed during full throttle test of powerful engines and propellers, the noise level in an untreated structure goes as high as 165 decibels. By treating the stacks or flues in the test houses, the firm was able to reduce this noise level to below 100 decibels. The company completed installations at the Pratt and Whitney, Wright Aeronautical, Ranger, Jacobs and Lycoming plants.

Industrial Sheet Metal Works, Detroit, Mich., perfected its new Hydro-Whirl dust collector for plant use in picking up dust created by buffing, polishing and grinding of parts, particularly in the processing of magnesium and its alloys. Trapped in a tank in the device, the dust was removed from the area of operations and transformed into an inactive sludge.

Intercontinent Aircraft Corporation, Miami, Fla., with its new manufacturing plant, was in production on war contracts. These included building complete sub-assembly units comprising complicated center-wing sections which represented some 18 per cent of the total man-hours in the completion of a plane. The company also fabricated tail surfaces, cowlings and related parts.

International Flare-Signal Division of the Kilgore Manufacturing Company, Tipp City, O., expanded production facilities to take care of an increased volume of orders from the United States and foreign governments for different types of military pyrotechnics so essential in modern warfare. For many years the company had specialized in its Tipp City operations in the development and manufacture of pyrotechnics for aviation and marine uses, and various of its products were standard equipment with the military and maritime services.

The I. Jacoel Cable Splicing Equipment Co., Buffalo, N. Y., was in war production on its cable splicing tool designed especially for use in splicing aircraft control cables and hoisting slings. A feature was removable and adjustable jaws fitting cables sizes 1/16 in. to 7/16 in. It either could wrap non-flexible cable or splice extra-flexible cable. Another feature was a resistance regulator for overcoming torque, enabling the mechanic to open the strands in the cable being spliced. The U. S. Navy, Marine Corps and Coast Guard used the splicer.

Jessop Steel Company, Washington, Pa., served the aircraft industry with Jessop tool and die steels for machining and forming body and engine parts. The list included high-speed steels, carbon tool steels, high-carbon-high-chromium die steels, hot work die steels and special alloy steels. The company featured aircraft quality steels, magna-flux tested to meet government specifications, for use in plane parts subjected to stress and strain, and turned out special propeller blade steel and airplane armor plate.

The Johnson Rubber Company, Middlefield, O., extended its plant facilities and greatly increased its production of extruded, molded and cut gaskets, hose, strips, packings, tubings, bumpers, grommets and other rubber parts for the aircraft industry. The company during the year purchased a complete line of Army-Navy 930 and 931 grommet molds, and maintained in its engineering department a corps of technicians to assist the aviation industry in solving problems relating to accessories of this type.

Knu-Vise, Inc., Detroit, Mich., developed and introduced its model No. 830 midget toggle clamp which was found of particular value to the aircraft industry. It measured but 4 in. by 1½ in. high and obtained a pressure of 500 lbs. The Knu-Vise line of toggle action clamping fixtures early in 1942 numbered 93 different models of clamps, pliers, plier-parallels, "C" clamps, riveters and drill fixtures.

The Koehler Tool and Manufacturing Company, Detroit, Mich., increased its production facilities during 1941 for the manufacture of valves for aircraft fuel and oil systems, its products being made according to standard Army and Navy types and to the individual specifications of the airplane manufacturers.

Kollsman Instrument Division of Square D Company, Elmhurst, N. Y., placed in operation its large new research laboratory which started a dual task of finding improved materials for present production and doing long-range research on new developments. An angle dial direction indicator for mounting at the bottom of the instrument panel and a drag cup motor with rapid reversal characteristics were among the new products. Significant of the high speeds and ceilings of new combat aircraft was the development of a sensitive altimeter with a range of 50,000 ft. and a 700 m.p.h. air speed indicator. A marked trend was also noted from individually lighted instruments to fluorescent lighting. Accelerated development of new instruments increased the need for a testing plane, and a Lockheed "12" was used for this work. The parent company, Square D, entered the aircraft field with the development of a special combination circuit breaker and "on and off" switch for airplanes, providing circuit protection in a regular sized toggle switch. Another development was a special limit switch.

Kropp Forge Company, Chicago, Ill., manufacturers of aircraft forgings and other parts, installed a 20,000 lb. Chambersburg drop hammer to expedite war production of airplane fuselage cross ties, and devoted much effort to the making of landing gear, bomb rack, nacelle and fuselage parts, connecting rods and cam shafts for airplane engines. Another point of the expansion was enlargement of the inspection service to include new and additional Magnaflux equipment. All aircraft forgings were routed through this department for scrutiny to reveal any internal defects.

Lawrance Engineering and Research Corporation, Linden, N. J., specialized in the development and application of equipment to supply the electrical power for airplane accessory operation independent of the main engine generators. Long-range bombers and patrol aircraft were principal users of such auxiliary power early in 1942, but it promised to develop to a stage making it available for all military and commercial planes of high horsepower. In production at the Linden plant was the Model 30C-2 unit, which comprised a 2-cyl. horizontally opposed 15 h.p. air-cooled engine operating a 5 KW generator. Completely enclosed and sound-proofed, it provided DC current for the 24-volt aircraft electrical system. Operation could be controlled remotely without need for continual attention from the crew or flight engineer. Control of r.p.m. was maintained by a governor restricting engine speed to within the full load and no load range. By use of an altitude carburetor loads up to 3 KW could be applied at the rated altitude of 20,000 ft. Standard instruments for recording of oil temperatures and pressures, fuel pressure and cylinder head temperatures also were provided to facilitate remote operation.

Leach Relay Company, Inc., Los Angeles, Calif., devoted activities to war production, supplying relays suitable for military aircraft and for all branches of the service. New relays were designed and others were in process of development. The firm's products were in general use on air lines.

The Leece-Neville Company, Cleveland, O., was in war production on 12-volt voltage regulated engine-driven electric generators and control units in four capacities, 15, 25, 50 and 100 amperes, and 24-volt in three capacities, 25, 50 and 100 amperes. The voltage regulator provided a desirable method for charging an electric storage battery because, by this method, the battery received a comparatively high beginning charging current, which gradually decreased as the battery became charged, so that by the time charging had been completed the current had decreased to a relatively low value.

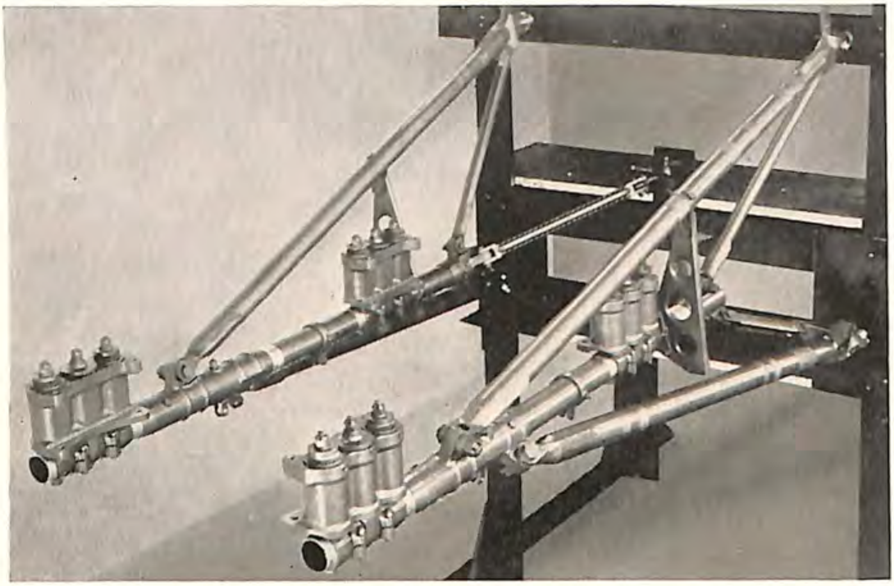
Liberty Aircraft Products Corporation, Farmingdale, N. Y., manufactured aircraft accessories, precision machine parts, tools, production machine parts to order, screw machine products, milling and gear cutting work, engine cylinders, pistons and crankcases, heat treating and carbonizing in electric furnaces with atmospheric control, cadmium plating and anodizing alloy parts, aircraft sheet metal work, wing assemblies, tail surfaces, pontoons, bomb racks and complete aircraft doping and finishing work. The corporation expanded plant facilities extensively.

The Liquidometer Corporation, Long Island City, N. Y., expanded production of tank quantity gauges for use on Army, Navy and commercial and export aircraft. Liquidometer gauges were used to indicate the quantity of fuel, lubricating oil, de-icer fluid, windshield alcohol or other liquids in tanks. The company continued research and development work which resulted in improved instruments. Plant capacity was increased, as was the number of employees.

Lite Manufacturing Company, New York, utilized its largely expanded plant facilities for the manufacture of towing targets, safety belts, flyers' bags, tents, covers and other cloth, leather and canvas specialties, much of which was designed for use by the armed forces.

Littelfuse, Inc., Chicago, Ill., manufacturers of aircraft fuse products, completed a large new plant in the West and greatly increased shop personnel. The Littelfuse line of anti-vibration type of aircraft fuses comprised the 4AG, 5AG and 4AB, glass or bakelite enclosed, with locked cap construction. The caps were not cemented on but were so locked by the Littelfuse patented design that they could not be loosened by shattering shock, vibration or climatic conditions. Thus the cap with its markings was not lost. The caps hermetically sealed the elements which, twisted at 90 degrees, were braced against vibration. Fuse failure caused by crystallization resulting from contraction and expansion was overcome in the Littelfuse by a spring-like forming or "goose-neck" at the end of the element. Numerous other types of fuses suitable for aeronautical use were produced in quantity, as was the "Jerkit" fuse puller which made fuse removal instantaneous and easy.

Lord Manufacturing Company, Erie, Pa., makers of vibration



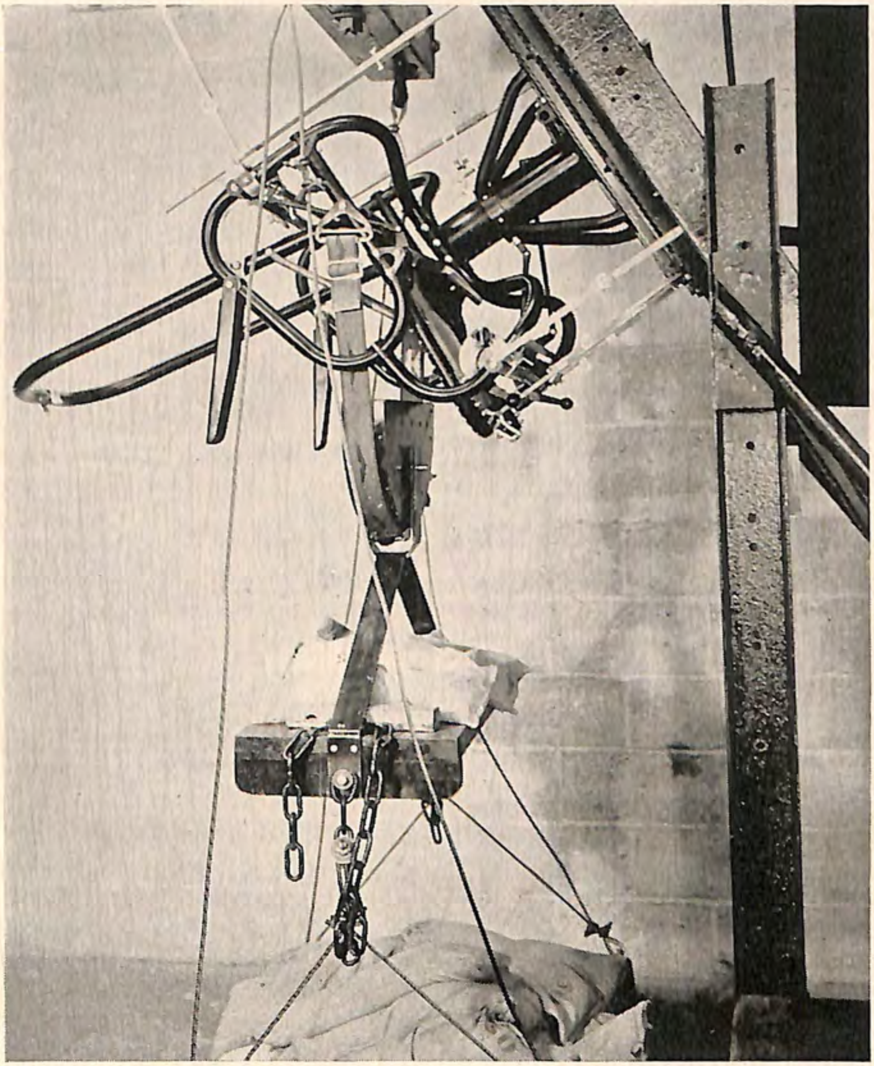
LORD ENGINE MOUNTING

On a Curtiss pursuit plane, the Lord shear type tube form mountings in triple-socket assemblies provide elastic support preventing vibration being transmitted to frame of the plane.

dampers, engine suspensions, couplings and flexible joints, concentrated almost wholly on defense-related production activities. Much of its equipment was of the type designed to isolate delicate aircraft instruments from surrounding vibration and for preventing transmission of engine-propeller vibration to the frame of the aircraft. To determine vibration isolation characteristics of Lord Shear Type mountings under severe vibratory conditions, a test panel set-up was made for North American Aviation consisting of a power-driven vibration source, panel mounting jig and a standard instrument panel assembly. The instrument panel was flexibly suspended at three points along the top and three at the bottom. Each flexible support consisted of two standard 150P series Lord Plate Form Mountings connected in series through the center sleeve. Metal snubbing washers, placed at the top and bottom of each series mounting assembly, contacted the rubber snubbing shoulders of the mountings during periods of resonance, and limited excessive movement of the mounted system. The use of two mountings in series doubled the axial softness over the rating of the individual units, and gave large load capacity without loss of extreme sensitiveness. Tests conducted by North

American engineers demonstrated that with the jig vibrating at an appreciable amplitude at 2,400 c.p.m., there was no perceptible vibratory movement evident in the instrument panel.

Warren McArthur Corporation, New York, designers, engineers and producers of seating equipment for military and naval aircraft,



TESTING A PILOT'S SEAT

To assure maximum safety under all conditions, this Warren McArthur pilot's seat is tested for strain under a safety belt load of 1,075 lbs.

made considerable progress in standardizing such accessories. Highly technical research, set under way several years ago, resulted in the development of more than 50 types of seats, each adaptable to the particular design requirements of aircraft manufacturers. Since 1939 the company had completed designs for many leading manufacturers. Many mechanical movements and adjustments were necessary to give the seats the required functions and, at the same time, a maximum of comfort. Such problems were chiefly structural, because most seats were cantilevers, being in essence a pedestal supported at the base and subjected to various loads at the free end. The Army, Navy and aircraft manufacturers specified load requirements generally consisting of a seat load applied downward, a safety belt load applied forward and upward at varying angles, and a back load applied either horizontally or perpendicularly over the back of some specified area. Military planes were required to take loads up to 2,400 lbs. on the seat, 1,600 lbs. on the safety belt and 1,200 lbs. on the back.

McKenna Metals Company, Latrobe, Pa., supplied aircraft and other industrial plants with Kennametal, the steel-cutting carbide permitting rapid cutting and machining of high tensile steel. This tool material permitted aircraft machinists to cut the heat-treated "Chrome-Moly" steel at from three to six times the spindle speeds they formerly used, and to utilize more fully the horsepower and machining abilities of their equipment during the war shortage of both machines and skilled operators. Users gained other advantages from this metal-cutting carbide. The long tool life between grinds saved much time, and also saved time of setting stops, which, on most turret-lathe set-ups was of greater importance than the actual grinding time on the tools. The ability to "hold size" saved frequent adjusting of stops and permitted long cuts to be made without appreciable taper due to tool wear.

Macwhyte Company, Kenosha, Wis., manufacturers of aircraft cable, swaged cable terminals and tie rods and aircraft slings, grades and constructions, increased their floor space and expanded their equipment in all lines. Macwhyte "Safe-Lock" swaged cable terminals were made in eye-end, fork-end, stud-end and turnbuckle end. The "Hi-Fatigue" aircraft cables were made from galvanized, tinned and stainless steel, fabricated to reduce constructional stretch and increase fatigue resisting properties. Macwhyte aircraft wire rope slings were used on the airplane itself and also in the production, handling and shipping of the plane. Navy planes were equipped with this sling. Macwhyte tie rods for internal and external bracing were produced from corrosion resisting alloys for rods and terminals.

The Marquette Metal Products Company, Cleveland, O., steadily increased its facilities for the production of precision parts and assemblies. Marquette was an important factor in the aircraft engine industry, supplying engine parts, propeller hub parts, governor parts and assemblies, front and rear cones and other aircraft products in which close tolerances had to be maintained.

Mechanical Products, Inc., Jackson, Mich., expanded its facilities to continue serving the airplane industry by production of aircraft accessories, aircraft parts and general machined parts.

Menasco Manufacturing Company of Burbank, Calif., late in 1941 switched over entirely to the production of hydraulic landing gear struts, except for spare parts being made for engines previously produced. This action was taken to meet the demands for hydraulic landing gear production on the Pacific Coast. Menasco began tooling for its initial strut output late in 1940, after moving into its new plant. At that time major emphasis was on the production of four cyl., in-line, inverted, aircooled aircraft engines which it had pioneered. From the latter part of 1940 to the fall of 1941, Menasco turned out a sizeable number of these engines for Canada, the Dutch East Indies and for domestic users. Most of the machine tools moved into the new Menasco plant were of the latest design and adaptable to hydraulic landing gear strut production, which was one of the factors that influenced the decision to concentrate on struts. At the time the change-over was approved, the Defense Plant Corporation endorsed a lease agreement for an addition to the Menasco factory that virtually doubled its manufacturing space and placed the company in position to triple its output. Installation of new machine tools enabled Menasco to produce struts for four-engine bombers, as well as the smaller twin-engine bombers and interceptors. While giving up all idea of being able to return to engine production during the war, Menasco officials were not forgetting that the company started originally as a manufacturer of aircraft engines. The company continued its production of aluminum and alloy castings, both by the Antioch and sand casting processes. The entire output of its foundry, located in the factory building formerly occupied by the company's engine division, was going to the aircraft industry.

Micro Switch Corporation, Freeport, Ill., manufacturers of electrically operated precision, snap-action switches, more than doubled its factory floor space to keep abreast of war orders. Micro switches, used primarily as limits, interlocks, safeties and push buttons were designed into instruments, gauges, thermostats, machine tools, accessories, motors and controls demanding an electric switch of light weight and small size. The Curtiss-Wright transport "Tell Tale" panel board control system was an example of an extensive use of

Micro-switches. The 36-passenger transport was equipped with 40 Micro-switches used as propeller governor, throttle control, cowl flap control, tail wheel lock, parking brake, mixture control, automatic pilot centralizer, carburetor heat indicator, impeller ratio, tab controls, flap, landing gear latch, hydraulic 4-way valve and tail wheel latch.

Moore-Eastwood & Company, Dayton, Ohio, supplied the aircraft industry with tools, dies and special machinery, and produced bomb racks, bomb shackles, gun sights, gun mounting posts, gun mount adapters, filler valves, gun synchronizer generators, pistol mountings, tab controls and cable meters for tow-targets.

The National Screw & Manufacturing Company, Cleveland, O., produced a wide variety of aircraft parts and accessories, including aviation nuts, wing nuts, plain and drilled, recessed head screws, aviation screws to the AC and AN specifications in carbon steel, nickel steel and brass, cotters, regular and corrosion resistant steel, aviation clevis bolts, studs, wood screws and rivets in all styles, shapes and sizes. The company specialized in automatic screw thread work as well as headed and threaded special parts made to specifications.

Norma-Hoffmann Bearings Corporation, Stamford, Conn., went ahead with augmented production of its lines of precision ball, roller and thrust bearings, adapted for practically every load, speed and duty. In the aviation division, new styles of sealed aircraft control ball bearings, designed to meet special requirements for control applications, were developed and marketed. The company's line included single and double-row, shielded and unshielded, as well as enclosed felt seal bearings with removable seals.

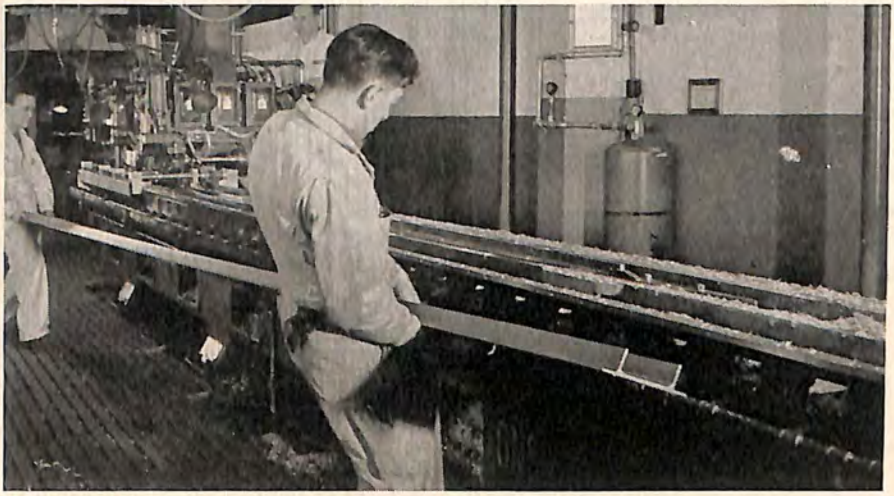
Northwest Air Service, Inc., Seattle, Wash., continued to produce and market its specialized line of propeller pitch setters for repairing and repitching metal propellers. War production increased shipments to the air forces of the United Nations.

Numberall Stamp & Tool Company, Inc., Huguenot Park, Staten Island, N. Y., expanded facilities for its output of numbering machines and marking devices especially adapted for use by manufacturers of aircraft and engines. These machines were utilized in numerous industries to mark machine parts, gears, airplane parts and sheet metal, and to stamp details into name plates.

Onsrud Machine Works, Inc., Chicago, Ill., designers and manufacturers of air turbine and high cycle tools and machines, was in full war production on Onsrud machine tools for a variety of services in aircraft plants. Two important tools were introduced to help break two serious production bottle-necks. One was the A-80 extrusion or spar miller. It speeded up the machining of spar beams and similar extrusions as much as 18,000 per cent. Another was the A-69 tilting spindle shaper which simplified and greatly speeded up the bevel shaping of a variety of aircraft production parts such as form blocks for hydraulic press work. One of the major factors contributing to the successful high speed operations of the machines was the Onsrud patented system for proper and constant lubrication of the drive motor spindle bearings. This oiling device comprised a simple centrifugal force feed system housed within the spindle itself and known as metered mist lubrication.

Pacific Aviation, Inc., Los Angeles, Calif., makers of aircraft hydraulic units, produced its equipment exclusively for military aircraft. Because present plant facilities were crowded to the utmost, the firm was planning new expansions of its factory space and shop personnel. The principle articles of manufacture were various types and sizes of hydraulic actuating cylinders. The company has concentrated its efforts on engineering and in rounding out its machine tools and manufacturing methods to make not only better hydraulic actuation cylinders but make them faster and less expensive. In addition to making cylinders, Pacific Aviation also produced selector valves, relief valves, disconnect blocks, fuel shut-off cocks and pressure cabin relief valves. Under development and experimental test were what promised to be superior servo-brake valves and engine pump unloading valves.

The Palnut Company, Irvington, N. J., produced for the war



FOR FAST PRODUCTION

Placing a 20-foot extrusion for the main beam of a pursuit plane on the bed of an Onsrud extrusion or spar miller.

program the "Palnut" locknuts designed to hold nut-and-bolt assemblies tight even under the severest vibration. It was a single thread lock nut, made of spring steel, hardened and tempered after forming to make it tough and resilient. The Palnut was applied to the bolt after the regular nut had been tightened and could be locked with a Yankee driver or power driver.

Parker Appliance Company, Cleveland, O., produced seamless tubular plumbing for aircraft with Parker tube couplings. Parker also developed a number of thread compounds, thread seals and valve lubricants to overcome the tendency of threaded aluminum alloy parts to seize when assembled. The company also produced a line of fabricating tools.

Pioneer Instrument Division of Bendix Aviation Corporation, Bendix, N. J., increased production, engineering and development facilities many fold in a three-way expansion program. The large floor space acquired in a new plant was completely utilized for the production of aircraft instruments. By establishing a vast subcontracting program it was possible to increase production facilities and production of aircraft instruments, a procedure which involved assigning one type of instrument to one subcontractor for large scale production. Lastly, a new plant was under construction to supply additional floor space for additional aircraft instruments. To fulfill the requirements for skilled labor, Pioneer established several training schools in its plants, and trained personnel in the specialized task of instrument manufacture. Late in 1941, women were trained successfully in instrument assembly and light manufacturing processes. Pioneer for two years had been developing mass production systems as distinguished from small order lots. Production quantities of tens of thousands of each of the various types of flight instruments, navigational instruments and engine instruments became the rule. While effectively dealing with the problems of maintaining adequate quality control during this expansion program, a new field of production and engineering was undertaken, namely, the development and production of restricted instruments and devices for the various Government agencies, the products and performance of which were to become common information after the war.

The most notable production achievements in 1941 included the Pioneer Autosyn Remote Indicating System for engine instruments in quantities sufficient to cover the demands of military aviation expansion. Also, production of the Pioneer Magnesyn Remote Indicating Compass served to eliminate many of the old problems incidental to magnetic navigation. A new development in rate of climb indicator mechanism design was presented by Pioneer. This Indicator, besides having numerous service advantages from the overhaul standpoint, had a logarithmically expanded scale permitted by the use of a varying pitch diameter linkage system. New higher ranges were incorporated in some of the rate of climb indicators, due to the demands of some of the later types of military aircraft. In order to meet demands caused by the high service ceilings of military aircraft, it was necessary for Pioneer to develop a new type of oxygen regulator. This regulator was controlled by the pressure differential created by normal breathing and did not require manual regulation with altitude. It was a product of considerable investigation into the effects of high altitude flying.

Development of high speed military aircraft and the accurate measurement of these high speeds were responsible for Pioneer producing the multi-revolution high range airspeed indicator with a uniform scale. The development of a new type of accelerometer, utilizing a simpler mechanism system was carried on by Pioneer. The demand for a suitable compass for installation in armored tanks brought forth from Pioneer Engineering Laboratories a design incorporating all necessary compensators essential to satisfactory performance. By utilizing a new type of temperature compensation for sensitive altimeters, the previous problems of hysteresis were greatly minimized.

Pioneer Parachute Company, Manchester, Conn., working with the weavers, in 1941 succeeded in producing a nylon fabric embodying all the required characteristics of parachute silk. The achievement crowned two years of intensive research carried on by Pioneer in close cooperation with the du Pont company and Cheney Brothers, Manchester silk manufacturers. Because of its lightness and strength, silk had been used almost exclusively in the manufacture of parachutes, but with war time restrictions on silk imports, Pioneer early had joined in the search for a satisfactory replacement for silk in parachutes. A new method of twisting nylon yarn and weaving it into cloth with the requisite strength and characteristics of parachute silk was found, although Pioneer and its collaborators first had to overcome innumerable technical obstacles and difficulties. During 1941 Pioneer rapidly expanded its production facilities and by the first of the year was manufacturing more parachutes in one week than the average parachute company ordinarily turned out in a full year of peace-time effort. The company continued its research into parachute performance with the tower it had developed for testing and improving these devices. As a result of such research several changes in parachute design and packing methods were made, and a new fool-proof, foul-proof pilot chute was introduced. The value of the tower was recognized in both Government and commercial aviation circles, and Pioneer started to erect two similar towers for the Government's use.

Pioneering Engineering & Manufacturing Company, Detroit, Mich., makers of Pioneer coolant and lubricant pumps, erected a new plant in accordance with the defense recommendations of the Army, Navy and FBI, and expanded personnel and shop facilities. Many of the personnel were expert engineers whose talents were available to other plants throughout the country in need of specialized engineering services. Their services included such classifications as plant layout, development of new products, tool designing, analysis and handling of proposals, estimating and engineering counsel.

Poulson & Nardon, Inc., Los Angeles, Calif., made shipments to eastern aircraft manufacturers from its new Los Angeles plant. These included aluminum shells for leak-proof fuel tanks, conduit fittings, cable terminals, junction boxes, screw machine fittings and stampings.

The Pump Engineering Service Corporation, Cleveland, O., a subsidiary of the Borg-Warner Corporation, in 1941 geared its production to meet greatly increased requirements of military and commercial aircraft for fuel, air and hydraulic pumps and accessories. Recent military requirements for plane operations at extremely high altitudes necessitated an intensive development of fuel system booster pumps, including electrically-driven centrifugal pumps installed at the bottom of the fuel tank. Pesco was responsible for the development of a booster pump that not only boosted the inlet pressure to the engine-driven fuel pump—to prevent vapor lock—but also conditioned the fuel to prevent dissolved air from being liberated in the carburetor metering passages, thus influencing metering even before vapor lock would occur. It was accomplished by means of a propeller just ahead of the impeller in the centrifugal pump. Because present-day carburetors in many cases operated at 15 p.s.i., and the new high-horsepower engines required large quantities of fuel, the operation of a hand wobble pump became quite fatiguing, especially at high altitudes. Fuel engineers desired to combine the booster and the stand-by pumps, eliminating the hand wobble pump. Pesco booster pumps were arranged to serve this double capacity through the use of an electric motor with two windings, one providing a boost pressure of about 8 p.s.i., and the other winding providing 16 p.s.i., which could be utilized in event of engine pump failure. To meet the demand for hydraulic pressures up to 1,500 p.s.i., Pesco developed a gear type hydraulic pump which functioned satisfactorily at this pressure with speeds as low as 500 r.p.m. The new design was termed the pressure-loaded gear pump, and was supplied to the industry in production quantities.

Reynolds Metals Company, Inc., Richmond, Va., entered into aluminum production in 1941 with a plant which was built in two days less than six months after ground was broken. A second plant was erected and equipment ordered for three new units. In addition to this plant construction, other activities included completion of an extrusion plant for the fabrication of strong alloy aluminum rod, shapes, tubes and other extruded parts. Other new and revamped plants increased the company's capacity for the rolling of aluminum rod and sheet and for the extrusion of the rod, tubes and shapes. Early in 1942, all the plants operated by Reynolds were being devoted almost exclusively to war production.

The Robot Machinery Company, Brooklyn, N. Y., specialized in the manufacture of machine tools for use in the aircraft plants. One of these items was the 6 x 18 inch Robot Surface Grinder, designed to speed up straight, flat and parallel surface work. The company announced a new development in shock-proof reversing. Instead of the conventional method of reversing table travel with a rack and pinion drive, new models of this surface grinder were equipped with a clutch mechanism which reversed the table without shock and assured permanent smoothness, a big advantage in maintaining highly accurate work. The machine was built to handle work up to its full table capacity.

The Rockbestos Products Corporation, New Haven, Conn., manufacturers of heatproof and fireproof wires, cables and cords, expanded manufacturing facilities to accommodate large war orders for defense-related materials. The first fireproof aircraft circuit wire, forerunner of industry's new standard of small diameter lightweight aircraft wires, was originated by this firm in 1937 when it made the first fireproof radio hook-up wire to meet the old Bureau of Air Commerce specifications. Rockbestos fireproof aircraft circuit wire was said not to burn either from the attack of external flames or from the heat of a molten short circuited conductor, hence offered no pathway for the spread of flames. Performance was attained by the inclusion in the insulation of a layer of impregnated felted asbestos. Primary dielectric strength was supplied by layers of helically applied thin synthetic tape directly over the conductor, surmounted by the firewall, and this in turn was finished with a fireproof lacquered braid of glass rayon or cotton yarn.

John A. Roebling's Sons Company, Trenton, N. J., manufacturers of numerous wire products for the aircraft industry, including control cords, wires and strands, swaged terminals and fittings, wire rope slings and electrical wires and cables, introduced a new development in control cable known to the trade as "Lock-Clad." It was conceived by the Lockheed Aircraft Corporation to meet the requirements of military planes, and was given exhaustive tests at the Roebling research laboratories for more than a year. The new type of control cable was designed to minimize stretch as well as the tightening or slacking of controls due to extreme temperature changes. Its other purposes were to permit lower rigging loads, reduce flutter tendencies and maintain relatively low and uniform friction values in the control system. The smooth outer surface of the clad section and the complete sealing of all voids in the cable by the swaging process made Lock-Clad particularly well adapted for control cables passing through certain types of pressure seals on aircraft designed for upper altitude flight. The new cable comprised a standard 7 x 7 or 7 x 19 preformed tinned steel cable as regularly used, to which was swaged a duralumin tube of proper dimensions for the required characteristics. The swaging compacted the steel wires into a composite unit, which acted in combination with the swaged dural tube to reduce the stretch normally encountered. The thermal characteristics of the two materials (duralumin and steel) combined to provide a coefficient of expansion that more nearly approached the value for the structure of the airplane itself. Thus the safety feature of a multi-strand steel cable was retained while at the same time lost motion and friction were materially reduced.

Ruckstell-Burkhardt Engineering Company, Phoenix, Ariz., continued its production of auxiliary power engines for the aircraft industry.

S K F Industries, Inc., Philadelphia, Pa., steadily increased production of aircraft ball and roller bearings by the addition of a new plant. Balls and rollers were held to size within 25 millionths of an inch while other dimensions of the rings were controlled by tolerances of 10 thousandths of an inch. Rigid inspections and tests insured this accuracy. Outstanding among aircraft types were the cylindrical roller bearings used for the crankshaft main bearings in the principal radial engines and the grooved type ball bearings for the propeller thrust location on all engines. In addition, many bearings of both types were made for use on auxiliary parts and accessories, rocker arms, superchargers, generators and starters. S K F control bearings of either cylindrical roller or deep groove ball types were made for aircraft control units.

A. Schrader's Son, Division of Scovill Manufacturing Company, Inc., Brooklyn, N. Y., utilized its greatly expanded plant facilities for tire valves, tire valve replacement parts and tire pressure gauges. The firm also manufactured shock strut valves, a type fashioned on the same principle as the standard tire valve. It had a special high pressure valve core, which was replaceable, and a special high pressure cap. The sealing washer in this model was made of soft copper which formed an air-tight seal when the cap was applied to the valve and tightened with a wrench.

Scintilla Magneto Division of Bendix Aviation Corporation, Sidney, N. Y., supplied Bendix-Scintilla magnetos for all types of airplane engines, spark plugs, switches and radio shielding.

Sensenich Brothers, Lititz, Pa., enlarged their airplane propeller plant and almost doubled production in 1941. All Sensenich propellers were manufactured of laminated yellow birch wood glued together with cold-setting urea-formaldehyde glue. This glue was waterproof and impervious to fungi. Two large presses were installed solely for glueing test "clubs," for an engine range of from 40 h.p. to 2,000 h.p. Sensenich propellers were accepted by both the Army and the Navy Bureau of Aeronautics, and also were used in connection with the Civilian Pilot Training programs.

The Sheffield Corporation, Dayton, O., makers of tools and dies, added a wide variety of uses for its Multichek and Precisionaire, two gages used for the rapid inspection of mass production of parts having several critical internal and external dimensions. Sheffield also produced a gage, the Precisionaire-Electrichek, which combined in one housing and simultaneous operation the features of the other two instruments. The Precisionaire was developed to check as many as six critical internal diameters at one pass. It was an air-flow type of gage, the principle being that it measured a quantity of escaping air from the part being gaged and the gaging spindle. Applications included checking alignment and size of camshaft bearings, checking alignment of connecting rod holes, measuring bearing size of master rod and articulating rods on radial motors, checking bearings on electric motor and frame, various holes in machine gun mounts and the bore, rifling, bore-after-rifling and chamber of gun barrels.

Shell Oil Company, Inc., New York, was engaged in a gigantic program of war production, not only for the military services, but also for engine manufacturers, air schools training pilots for the air forces, and commercial air lines. Production facilities were expanded to meet all requirements. Adequate production was only half the battle, however. Research was being carried on extensively. The 100-octane aviation gasoline, first produced commercially by Shell, once was considered the top limit in high-octane fuel. Yet early in 1942, Shell scientists were planning to produce an even higher-octane aviation gasoline, to give the more powerful aircraft engines of the near future new speed, new range and new "ceiling."

Other products came from the research chemist's test tube. "Greenhouses," the protective globes that house a bomber's pilot, bombardier, and gunner, were molded from a light, durable, transparent plastic, made possible by combining certain molecules from petroleum gases. Butadiene, used in the manufacture of synthetic rubber, offered a possible escape from the current national shortage of natural rubber supply, and, for some particular uses, was found to be superior to the natural product.

Toluene, a basic ingredient of the explosive TNT, was being manufactured through a still different combination of petroleum molecules. For the actual cleaning of grease and dirt from aircraft engines run for periods of time, both in the air and in the plants of engine manufacturers, Shell supplied an "alkyl-phenol" type solvent which cut and dissolved grease, leaving parts clean and bright again.

Simmonds Aerocessories, Inc., New York, produced the Simmonds-Corsey push-pull flexible controls, Simmonds-Benton aircraft power plugs, non-slip aircraft flooring, cowling clips and fasteners and chronometric radiosondes. Production was started on a new and simplified type of accumulator designed to avoid excessive maintenance costs. Other accessories under development included high pressure hydraulic equipment, fuel contents gauges, induction pressure controls and navigation instruments.

Sinclair Refining Company, New York, took part in the defense program by providing aircraft oils for testing military planes. Training schools throughout the country also were supplied with oils. Air lines, plane and engine manufacturers and Government air forces used the company's petroleum products. Airline mileage flown on Sinclair's Pennsylvania GX oil alone totalled 75,000 mi. each day in 1941. At New York's LaGuardia Field, Sinclair had a unique oil delivery truck which simultaneously filled the plane's fuel tanks while draining used oil from the companion engine. This streamlined motor unit was designed to run under wings in crowded hangars or rush deliveries to any part of the airport.

Anton Smit & Company, New York, distributors of industrial diamonds, found a widening market for their products in the industry as the war program hit full stride. The importance of the diamond in the tool and machinery industries lay in keeping grinding wheels true to shape for precision grinding operations. As no other substance even approaches the diamond in hardness, tools set with specially shaped diamonds were in ever-increasing demand for precision machining operations. In these shaped tools, diamonds were cut exactly to the shape or angle required, with highly polished surfaces. They were made up to the user's specifications for special jobs—machining such materials as plastics, rubber and fiber, and such metals as aluminum, brass, copper and bronze.

Socony-Vacuum Oil Company, Inc., New York, manufacturers of Aero Mobilgas, Aero Mobiloil and other products for the aviation industry, supplied its products to air lines, Federal aviation services, aircraft engine and plane builders and private operators. Extensive research work was carried on by the organization.

Solar Aircraft Company, San Diego, Calif., designers and manufacturers of exhaust manifolds and related power plant accessories, in 1942 entered its 12th year after an expansion of all productive facilities for war planes. Extensive studies of production control and standardization resulted in the reduction in the number of operations performed by each workman. Other developments to increase productive output included rearrangement of the flow of production, improvements in tooling and the reduction in the number of changes in manufacturing set-ups by producing in larger quantities at one time. Improved methods brought about a marked reduction in scrap metal and broad improvements in manufacturing processes simplified operations. The chemical cost and man-hours per sq. ft. of pickling heat-treated stainless steels was substantially reduced by careful control of a new pickling solution and procedure. The company secured the co-operation of the Edward G. Budd Manufacturing Company of Philadelphia, pioneers in fabrication of stainless steel, to aid in the production of manifolds, cowling and other aircraft parts and accessories. Solar was licensed by Budd to use the patented "shotweld" process of resistance welding. Solar fabrication of muffs, cowlwells and shrouds was carried on in a new plant, thus allowing expansion of exhaust manifold production in the San Diego factory.

Sperry Gyroscope Company, Inc., Brooklyn, New York, manufacturers of airplane instruments and an entire system of equipment for utilization against air attack, used the productive capacity of more than 145 different firms to increase production rates on national defense equipment through subcontracting. Educational orders—some of them placed as early as 1937—proved the feasibility of spreading the work by subcontracts, and the policy of using subcontracting in lieu of building additional manufacturing capacity was adopted. It was only when the production requirements on highly technical parts, machined to extremely fine tolerances and not suitable to subcontracting, reached such proportions that new construction became essential, that Sperry resorted to a program involving the erection of new facilities. There were two basic results of Sperry's policy of spreading the

WOMEN IN WAR INDUSTRIES
Calibrating Gyro-Horizons in the Sperry plant.

work. First, delivery of equipment was speeded; second, hundreds of relatively small shops in 1942 were operating at full capacity, most of them better equipped for precision work than before their association with Sperry. Through subcontracting, Sperry's production capacity continued to be increased. Such a subcontracting program, it was found, called for careful planning and close supervision. Inexperienced firms not entirely familiar with precision manufacturing could spoil vitally important parts. Once they were spoiled, there was no opportunity to recover lost time. Sperry maintained several training courses, including apprenticeships and learnerships to develop adequately trained personnel for work in its own plants. New courses were set up to train engineers so that they would be familiar with Sperry technique. The company maintained special training facilities for the personnel who were to use the equipment when delivered, for the Army, Navy, merchant marine and air lines and those who were to direct gunfire by Sperry instruments.

The period of the company's apprenticeship course was 200 work weeks or approximately 8,000 hrs. Training was carried on in the school and in the factory departments of the company when work in the factory permitted. The learner program was a streamlined apprenticeship designed to produce skilled operators in 2½ yrs. instead of the 4 yrs. required to graduate an apprentice. It trained young men as machine, assembly and inspection specialists.

Construction of a new plant to provide additional new facilities for production was nearing completion early in 1942. The Sperry Company cooperated with the Army and Navy in standardizing flight instruments. These instruments conformed to standards determined by the Aeronautical Board applying not only to the instruments themselves and the performance test standards, which in the past had differed between the Services, but also to lettering on dials and their illumination, cover glasses, name plates and overall dimensions. The Army-Navy standard incorporated in these instruments every function required for commercial use. In addition, the new A-N Gyro-Horizon included a caging device which was necessary only in military planes because of their maneuverability and the probability that the indicating range of the instrument would be exceeded during operations. The caging device served to minimize the effect of the tremendous strain on all working parts of the instrument resulting from operating outside the designed angular limits. As this feature was not required for commercial installations, the external parts of the caging mechanism could be removed in either the caged position for shipment or the uncaged position for operation. A combination of radio active and fluorescent markings and graduations permitted the use of either the ordinary or the recently standardized ultra-violet floodlighting. No built-in electric lighting was provided. The instrument was equipped with an air inlet adapter permitting connection to an external type air filter.

The new Sperry directional gyro was similar to and completely interchangeable with the standard directional gyro. The Army-Navy standard did away with the ball bank inclinometer and built-in lighting, formerly included in other models. Markings and graduations permitted the use of either the ordinary or ultra-violet floodlighting. An air inlet adapter similar to that used on the gyro-horizon indicator was provided for connecting the instrument to an external air filter. Army-Navy standards made it possible for Sperry to eliminate multiple production lines and produce one standard type of each instrument for Army, Navy and commercial requirements alike. The standardization of the gyropilot was being coordinated under the direction of the Aeronautical Board with a view to establishment of suitable A-N specifications.

Of Sperry's total factory payroll seven per cent were women. They were employed on sub-assembly work on small flight instruments, and also in some lines of inspection testing. Some women employees operated small drill presses.

Sperry Products, Inc., Hoboken, N. J., arranged for increased production of its remote hydraulic exactor control, used extensively as throttle and mixture controls in aircraft engine test stands and also as Diesel engine controls.

Spriesch Tool & Manufacturing Company, Inc., Buffalo, N. Y., expanded plant facilities and personnel, which materially added to its production of bomb racks and shackles for the aircraft industry.

Standard Oil Company of California, San Francisco, Calif., changed the brand name of its aviation petroleum products from Stanavo to Standard. Much of the company's activity was devoted to the production and distribution of high octane aviation gasoline for air line, aircraft factory and military uses. The year also was marked with intensive research and development work on aviation petroleum products, particularly high octane fuels, and arrangements were completed for additional refining facilities.

Standard Oil Company of New Jersey, New York, concentrated research on the development of lubricants and high octane fuels for the Army and Navy. Noteworthy progress was made in the development of aircraft hydraulic oils. A new grade of this commodity, Univis 34, was added to the company's line.

Steel Products Engineering Company, Inc., Springfield, O., manufactured a line of segregators and other accessories for the industry.

The Strippit Corporation, Buffalo, N. Y., devoted much of its production facilities to hole punching and notching equipment, used by more than 30 aircraft plants. The distinguishing feature of the dies was that the punch, stripping mechanism and die were built into the same holder so that no part of the punching apparatus was attached to the ram of the press or press brake. Strippit maintained a die designing and development service which worked on a number of innovations in these lines, and announced development of many new methods of punching holes and cutting notches in aircraft parts, prominent among which were dies permitting sheets to be fed entirely through the dies.

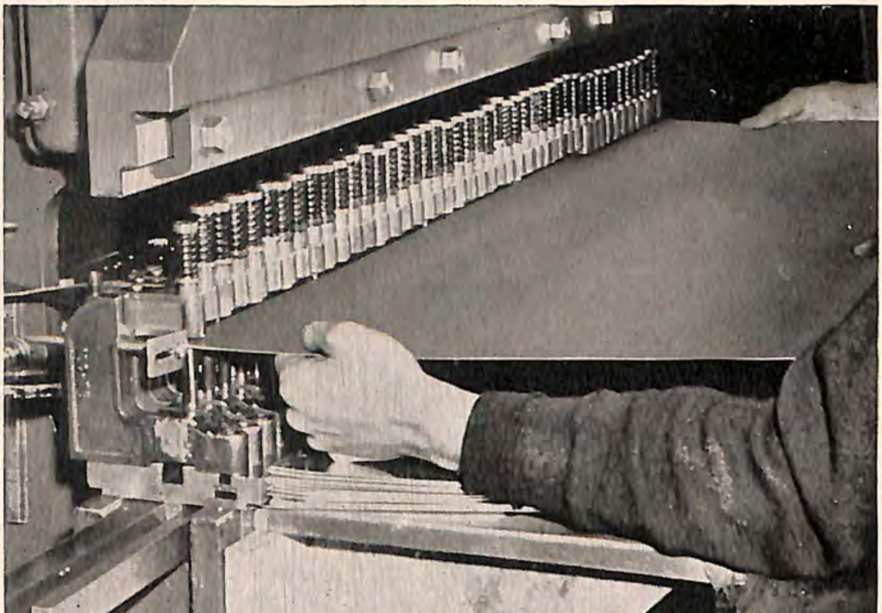
Summerill Tubing Company, Bridgeport, Pa., carried through plant expansion and at the same time developed tapered tubes for aircraft for a wide range of uses, including push rods and engines, landing gear struts and torque tubes. Plant facilities in building and equipment were nearly doubled, and plans were made for further expansion. A large percentage of Summerill production was devoted directly to tubing for use in connection with the defense program.

Other items produced for applications to ordnance included magazines for fire control apparatus and anti-aircraft guns. Summerill continued to produce cold-drawn seamless tubing for aircraft. It included tubing for fuselages, engine mounts, landing gears, control surfaces, push rod tubes for engines, and stainless and special low carbon tubing for service and hydraulic lines. Besides being an important manufacturer of vital defense materials, Summerill had a continuous record of having carried on a policy of research and development since the founding of the company in 1899.

Suncook Mills, New York, produced specialized fabrics and tapes for the aeronautical and mechanical trade. These fabrics, known as Flightex, were manufactured to Army and Navy specifications.

Grade "A" airplane fabric was available in widths of 36, 42, 60, 69 and 90 in. Surface tapes, both pinked and straight edge, were produced in all standard widths along with three types of reinforcing tapes. Intermediate fabric and tape were available for light plane manufacture, and a special CAA Grade "A" fabric was developed in cooperation with the Civil Aeronautics Administration for small commercial planes.

Superior Tube Company, Norristown, Pa., increased production



STRIPPIT WALES HOLE PUNCHING DIES

In actual operation on a press brake at Boeing.

or prepare specific studies for any position at which installation of the bearings was under consideration.

Tinnerman Products, Inc., Cleveland, O., manufacturers of speed nuts and speed clips, devoted all the resources of their development and engineering departments to improvement of aircraft assembly devices. Company executives declared that tests made by aircraft manufacturers revealed an average of 80 per cent in weight reduction on fastenings and a saving of 50 per cent in assembly time through the adoption of the speed nut system of spring tension assembly. These fastening devices also were said to be four times tougher in resistance to vibration loosening. During 1941 hundreds of new styles of speed nuts were developed and manufactured exclusively for the aircraft industry.

Titanine, Inc., Union, N. J., continued production of its line of dopes, primers, surfacers, lacquers and thinners for the aircraft industry, and established new plant facilities for war production.

Transue & Williams Steel Forging Corporation, Alliance, O., manufactured commercial drop forgings ranging in weight from an ounce to 1,000 lbs. The company maintained a corps of engineers to assist customers in designing forgings from a standpoint of practical design, strength and economy. Much of the company's output was absorbed by the aircraft industry during the year. In addition to its forging division, the company maintained a department for the production of deep drawn stampings of medium size, also a stamping division for welding and assembling.

Uniloy Accessories Corporation, Lancaster, N. Y., producers of tail wheel assemblies for light aircraft and high-strength ferrous-alloy and aluminum alloy castings, expanded its operating space by more than 300 per cent during 1941. Uniloy produced a wide variety of aluminum and bronze castings, and late in 1941 began production of oxygen regulators. This instrument supplied oxygen to as many as ten men at various altitudes up to seven miles above the earth. In response to the war demands, Uniloy increased its aluminum foundry facilities and also enlarged its staff of engineers and research specialists to develop new products.

United Aircraft Products, Inc., Dayton, O., continued mass production of oil temperature regulators, fuel pumps, oil dilution solenoids, gun-firing solenoids, fuel strainers, finger strainers, Y drain valves and joint assemblies for the aircraft industry. The company perfected and placed on the market a new type anti-congealing, quick warming oil temperature regulator to meet the demands of the higher-powered aircraft operating at higher altitudes and lower temperatures. The company's own wind tunnel and analogous cold weather equipment was utilized in developing this item. At the company's Western division, complete hydraulic equipment, such as hydraulic actuating cylinders, tail shocks, accumulators, hydraulic control valves and landing gear struts were manufactured on an increasingly large scale.

United-Carr Fastener Corporation, Cambridge, Mass., makers of the "Dot" line of metal fasteners, devoted much of its 1941 production facilities to making fastening devices for aviation parts and assemblies of all kinds, and developed a new line of aircraft cowling fasteners. The principal type was known as Airloc Cowling Fastener, and was especially designed for high-speed ships. An older style was the ring type fastener used on training planes, access doors and baffles. The line was rounded out with medium size and miniature fasteners of the same type for use on junction boxes. Special fasteners were also made for carpets and rugs to attach these removably to wooden or plastic flooring. Other fasteners attached upholstery panels or insulation material to a metal base. Special wiring clips were developed for many sizes of wire to be attached under a variety of conditions. Dot plug buttoms were an ingenious device for plugging or covering holes in sheet or solid metal. They were light, rugged and space-saving, and made in a variety of shapes and sizes. In addition, United-Carr makes grommets, eyelets, washers and numerous other stampings specially engineered and adapted for use in the aircraft industry.

United Chromium, Inc., New York, supervised the installation of chromium plating facilities in large numbers of plants, and redesigned existing equipment to adapt it to the special requirements of the aircraft industry. Chromium, because of its hardness, low coefficient of friction and resistance to corrosion and erosion, was specified as a plated finish on aircraft engine parts, landing gear, gun mounts and numerous other items. In addition, the use of chromium plating on dies, mandrels and certain tools in the manufacture of plane parts and accessories, increased greatly, thereby prolonging the life of such tools and making possible the saving of labor man-hours and valuable materials. The use of chromium plating for salvaging worn or over-machined parts was valuable from the same viewpoint. The corporation, which had branches in the Midwest and East, developed materials useful in saving metals. Unichrome "Air Dry" rack coating was used for coating racks to hold work to be plated or anodized. In the case of plating racks, it prevented deposition of metal on the rack itself, thereby saving metals which would otherwise be wasted. The racks so protected gave longer wear and needed fewer repairs.

Utica Drop Forge & Tool Corporation, Utica, N. Y., specialized in Utica pliers and other tools suitable for use in the industry—all of which were so fashioned as to give long tool hours and provide adaptability to the special work required of them. One of the latest numbers added to the list was the No. 84, a 7¾-in. control cable shaper plier.

The Variety Aircraft Corporation, Dayton, O., manufacturers of aeronautical accessories, and contractors to the U. S. Government, was enabled to increase its production through additions to plant facilities and technical and shop staff.

Vickers, Inc., Detroit, Mich., in 1941 manufactured a line of hydraulic equipment for the aeronautical industry. The firm's list of precision products included pressure relief valve, gear type pump or fluid motor, piston type pump or fluid motor, pressure unloading valve, dual directional valve and five-in. accumulator.

Victor Metal Products Corporation, Brooklyn, New York, produced metal vials, stampings, collapsible tubes, specialties and package closures. Impact extrusion was utilized in fashioning the company's collapsible tubes. Equipment used were such machines as knuckle joint and crank presses with strokes ranging from two to 11½ in. Parts ranging from ½ in. to three or four in. in diameter and from one to 7 in. in height were produced. The machines had a capacity of from 30 to 250 tons, with 40 to 60 strokes a minute. The extrusions were formed through pressure exerted by a tipped shank on a slug resting in a female die, forcing the metal to flow up the sides of the shank and assume the shape of the punch and shank. Shaving cream tubes for years had been made by this process. The company, as a result of its experience, believed that many aluminum parts, now forged, could be produced by impact extrusion.

The Weatherhead Company, Cleveland, O., continued mass production of gasoline and oil proof flexible hose, choke controls, drain cocks, tube fittings and punch press and automatic screw machine products. New Weatherhead flexible hose assemblies were developed for use in oxygen systems. These assemblies eliminated problems of taste and odor while having the strength characteristics to handle high pressures.

During the year Weatherhead went into full production on a wide variety of valves. One type, the Fuel Tank Selector Valve, represented a special development of a simple automatic valve which maintained flow to the main fuel lines regardless of the position of the airplane. Hydraulic actuating cylinders were designed to Air Corps and Navy specifications and were produced in quantity for aircraft manufacturers. Special forgings were produced on contract for aircraft manufacturers as well as for Weatherhead's own products, Wellington Sears Company, New York, continued on an increasingly large scale the manufacture of aeronautical fabrics for use on wing and fuselage structures in airplanes—the company producing more than 25,000 cotton fabrics in its 18 modern mills. Among the firm's best-known lines of airplane cloth was style BA30 grade A, utilized widely on Army and Navy planes.

The Wellman Bronze and Aluminum Company, Cleveland, O., operated at full capacity two large plants devoted to the production of castings. In the older plant were produced castings of heat-treated aluminum, bronze and brass alloys and numerous types of bronzes. In the newer plant operations were confined to patterns and manganese castings. Among the firm's products were cast magnesium generator housings and aircraft landing wheels, cast aluminum pneumatic tool housing and Dowmetal pneumatic tool handles.

Western Electric Company, New York, through Bell Telephone Laboratories laid emphasis on the development and production of a complete line of ultra-high frequency transmitting and receiving equipment required in an efficient system of instrument flying and landing. Among such new units was the 27B marker beacon receiver designed for operation in both short-wave and long-wave bands. Permanently tuned to 75 megacycles, this unit was employed in the reception of marker beacon signals, radio landmarks along major air routes and at many airport approaches. With this instrument, a pilot, navigator or private flier could get a definite fix on his location while flying the air lines between terminal points of a scheduled flight or when approaching an airport. Bell Laboratories developed other new high frequency aircraft radio units which went into production at Western Electric. The 32A radio receiver operating in the 110 megacycle and 123-132 megacycle bands served both as a localizer receiver and as a radio range finder. It featured quick shift mechanism, enabling the pilot to select any one of the 30 frequencies in about two seconds. A vacuum tube circuit assembly assured the equivalent of crystal stability. The 32A receiver was a mobile counterpart of the new system of ultra-high frequency beam stations on the nation's airways. Another unit was the 35A glide path receiver, operating on a frequency of 98.4 megacycles. Here the primary requirements of stable operation were adequately met. Battery voltage could vary between 20 and 30 volts, temperature from –30 to 120 degrees F, pressure from 30,000 ft. to sea level and humidity from 15 to 60 per cent. For communication between pilot and airport, the 233A two-way radio telephone permitted operation in the band from 140 to 144 megacycles and formed the third link in the vital chain of apparatus required for a complete instrument landing system. Supplementing its production of commercial radio in aviation, the company in 1941 devoted much of its technical facilities to turning out land, sea and air communications equipment for the armed forces.

Western Electric manufactured radio "command sets" for combat and training planes, "throat microphones" and "bomber mikes" for Army pilots, battle announcing and battle telephone systems for the Navy, and high-powered radio units for ground use, as well as field wire, field telephones and field switchboards. To meet the increasing demand for new commercial telephone facilities, Western Electric made many billions of conductor feet of cable, built and installed central office equipment in new or expanding Bell exchanges, produced and installed telephone apparatus in Army and Navy locations and in many defense plants. New plants were leased to handle this extra work load and thousands of new employees were hired. Early in 1942, the company, by employing alternate materials, was saving enough aluminum annually to build hundreds of combat planes. Much zinc was saved and replaced by less valuable materials and large quantities of nickel, crude rubber, phenol varnish and silk were released for war use, and programs to conserve even more of these and other strategic materials were well under way.

Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., produced main drive engine generators and their controls, instruments, lighting equipment radio receivers and transmitters and Micarta products, including pulleys of all sizes and various molded and fabricated parts. The firm also developed and placed in manufacture 200 amp. 28.5-30 volt main engine driven generators. A new Silverstat voltage regulator was developed and put in production to control the voltage of this generator as well as other ratings of generators. A 200 amp. 30 volt D. C. reverse current cutout also was manufactured. Dynamos for aircraft communication equipment were produced in greatly increased quantities during the year, and a new type of Westinghouse ceramic insulation material, Prestite, was introduced for use in aircraft ignition systems, particularly for spark plug insulation sleeves and magneto parts.

In conjunction with the Civil Aeronautics Administration, further advances were made toward standardization of airport lighting and control equipment for various classes of airports. Extensive use of radio controlled seadrome lights made night landing and take-off of seaplanes and clipper ships as safe on water as on any landing field.

Five to ten times greater production and greatly reduced cost in heat treatment of steels used for aircraft engines and other plane parts were accomplished with installations of the new Westinghouse "Endogas" heat treating furnaces. Electronic control developed by Westinghouse for resistance welding added greatly to the acceptance and use of spot welding in place of and in addition to riveting in the aircraft industry. Portable rectox airplane engine starters were developed and produced during the year. These units gave a continuous source of 12 and 24 volt direct current power from a standard a-c supply, and were utilized in testing aircraft radio and other accessories in addition to their principal function of starting airplane engines both at airports and in the engine factories.

The S. S. White Dental Manufacturing Company, New York, manufactured flexible shafts, flexible casings and fittings for aircraft use. Combinations of these accessories were made available for remote control of radio transmitters and receivers, loops, reels, tabs, cowl flaps, bank indicators, bomb sights, heating registers and air conditioning installations; also power drives for tachometers, fuel pumps, variable pitch propeller governors, ammunition rounds counters, windshield wipers and other driven apparatus.

The Wittek Manufacturing Company, Chicago, Ill., manufacturers of feeds for punch presses and stainless steel hose clamps, designed for aircraft use the new FB hose clamp—a solid band clamp of stainless steel, welded with four spots at the nut which assured the full strength of the solid band. The bridge was floating, which eliminated friction and strain and permitted the use of a torque-indicating wrench so that all clamps could be tightened uniformly. As an added safety feature, the thumbscrew head was punched for tie-wire. Wittek 6L automatic feed roll and 3B reel stand were designed for rapid, smooth and accurate feeding for punch press operations.

During 1941 there were many companies active in the aeronautical field other than those actually manufacturing aeronautical equipment. Companies engaged in the distribution and export of aircraft, aircraft engines and aeronautical equipment included Aircraft Export Corporation, New York; Edwin D. Allmendinger, New York; American Eastern Corporation, New York; Aviation Equipment & Export, Inc., New York; Charles H. Babb Company, Glendale, Calif.; Bendix Export Division of Bendix Aviation Corporation, New York; China Airmotive Company, New York; Curtiss-Wright Corporation, Export Division, New York; Gillies Aviation Corporation, Bethpage, N. Y.; J. V. W. Corporation, Newark, N. J.; Miranda Brothers, Inc., New York; Northwest Air Service, Inc., Seattle, Wash.; Royal Shipping Company, New York; Tri American Aircraft Corporation, New York; United Aircraft Export Division of United Aircraft Corporation, East Hartford, Conn.; and O. J. Whitney, Inc., New York. Insurers or classifiers of aeronautical risks included Aero Insurance Underwriters, New York; Associated Aviation Underwriters, New York; National Aviation Agency, Chicago, Ill.; Newhouse & Sayre, Inc., New York; Parker & Company, Philadelphia, Pa., and U. S. Aviation Underwriters, Inc., New York. Among other companies whose activities were concerned with some phase of aviation business were Aviation Capital, Inc., Barr Shipping Corporation, Bluefries-New York, Inc., Hirsch, Lilienthal & Company, Loomis, Suffern & Fernald, National Credit Office, Inc., Standard & Poor's Corporation, all of New York City; Cox & Stevens Aircraft Corporation, Mineola, N. Y.; Hamilton Investment Corporation, Chicago, Ill.; and Don A. Luscombe Company, Hallowell, Pa.

WESTERN ELECTRIC'S THROAT MICROPHONE

Two miniature buttons held snugly against the throat enable the airman to converse in battle by radio unhampered by the conventional telephone. The throat microphone is sensitive only to the vibrations of the vocal cords, and transmits no noise of wind, guns or engines.

Directory Section

CLASSIFIED DIRECTORY OF EQUIPMENT MANUFACTURERS

AIRCRAFT ARMAMENT

E. C. Atkins & Co.
Bendix Products Div.
Dayton Manufacturing Co
Diebold Safe & Lock Co.
Formica Insulation Co.
Julien P. Friez & Sons
Harvey Machine Co.
Jessop Steel Co.
Johnson Rubber Co.
Knu-Vise, Inc.
Leach Relay Co.
Linear Packing & Rubber Co.
Moore-Eastwood & Co.
National Machine Products
Pollak Manufacturing Co.
Reynolds Metals Co.
Safetee Glass Co.
Spriesch Tool & Mfg. Co.
Thompson Grinder Co.
Tietzmann Engineering Co.

AIRPORT EQUIPMENT

American Airport Equipment Co.
Austin Co.
Aqua Systems, Inc.
Blaw-Knox Co.
S. F. Bowser & Co.
Byrne Doors, Inc.
Caterpillar Tractor Co.
Circo Products Co.
Crouse-Hinds Co.
Curtis Lighting, Inc.
Dry-Zero Corp.
Flotation Systems, Inc.
Four Wheel Drive Auto Co.
Gilbert & Barker Mfg. Co.
Herrick Iron Works
Ideal Power Lawn Mower Co.
Imperial Brass Mfg. Co.
International Derrick & Equipment Div.
Republic Steel Corp.
H. H. Robertson Co.
Snow Removal Equipment Co.

AMMUNITION BOXES & COUNTERS

Aircraft Components, Inc.
Anchor Post Fence Co.
Associated Foundries & Mfrs., Inc.
B. H. Aircraft Co.
Benson Manufacturing Co.
Edward G. Budd Mfg. Co.
Butler Manufacturing Co.
Chas. W. Carll Sons
Dayton Manufacturing Co.
Dayton Tool & Engineering Co.
Defiance Stamping Co.
Eclipse Aviation Div.
Edwards Manufacturing Co.
Fulton Co.
General Aviation Equipment Co.
General Electric Co.
Harvey Machine Co.
Johnson Rubber Co.
Kenyon Instrument Co.
Kinney Aluminum Co.
Kirk & Blum Manufacturing Co.
H. K. Lorentzen, Inc.
Lyon Metal Products, Inc.
Pollak Manufacturing Co.
J. V. G. Posey & Co.
Solar Aircraft Co.
Technical Ply-Woods
Tennessee Aircraft, Inc.
Variety Aircraft Corp.

AUXILIARY POWER PLANTS

Eclipse Aviation Div.
Formica Insulation Co.
Lawrance Engineering & Research Corp.
Mobile Refrigeration, Inc.
National Machine Products
Rohr Aircraft Corp.
Ruckstell-Burkhardt Engineering Co.

ADEL manufactures over 3,000 sizes and types of line supports, hydraulic units, anti-icing pumps and controls, synthetic rubber products and allied aircraft proprietaries.

BASIC MATERIALS & FABRICATIONS

Allegheny Ludlum Steel Corp.
Aluminum Company of America
American Cellulose Co.
American Nickeloid Co.
American Rolling Mill Co.
Atlantic India Rubber Works
Bridgeport Fabrics, Inc.
Carnegie-Illinois Steel Corp.
Carpenter Steel Co.
Catalin Corp.
Celanese Celluloid Corp.
L. C. Chase & Co.
Climax Molybdenum Co.
Corning Glass Works
Crucible Steel Co. of America
Dow Chemical Co.
Dry-Zero Corp.
E. I. DuPont de Nemours & Co.
Durez Plastics & Chemicals, Inc.
Felters Co.
General Bronze Corp.
B. F. Goodrich Co.
Harbor Plywood Corp.
Homestead Insulation Co.
Irvington Varnish & Insulator Co.
Jessop Steel Co.
Johnson Rubber Co.
Jones-Dabney Co.
Lackawanna Leather Co.
Laidlaw Co.
Miller Co.
Nixon Nitration Works
Owens-Corning Fiberglas Corp.
Plxweve Manufacturing Co.
Radel Leather Manufacturing Co.
Republic Steel Corp.
Roddis Lumber & Veneer Co.
Rohm & Haas Co.
Joseph T. Ryerson & Son
S.A.E. Steels
Safetee Glass Co.
Salta Corp.
Schwarzenbach Huber Co.
Spruce Lumber and Veneer Co.
Standard Felt Co.
E. J. Stanton & Son
Steel Products Engineering Co.
Suncook Mills
Tallmadge Co.
Taylor-Winfield Corp.
Tennessee Eastman Corp.
Timken Roller Bearing Co.
Wellington Sears Co.

BATTERIES

Electric Storage Battery Co.
B. F. Goodrich Co.
National Battery Co.
Karl Ort
Prest-O-Lite Battery Co.
Reading Batteries, Inc.
Willard Storage Battery Co.

BEARINGS

Ahlberg Bearing Co.
Atlas Brass Foundry
Bunting Brass & Bronze Co.
E. W. Carpenter Mfg. Co.
Fafnir Bearing Co.
Federal Bearings Co.
Johnson Bronze Co.
McQuay-Norris Manufacturing Co.
New Departure Div.
Norma-Hoffman Bearing Corp.
Karl Ort
Phillips Bronze Corp.
Precision Bearings, Inc.
Randall Graphite Products Corp.
SKF Industries, Inc.
Schatz Manufacturing Co.
Torrington Co.

BOMB RACKS

Aircraft Components, Inc.
All American Aircraft Products, Inc.
Associated Foundries & Mfrs., Inc.
Butler Mfg. Co.
Chas. W. Carll Sons
Formica Insulation Co.
Fulton Co.
General Aviation Equipment Co.
Harvey Machine Co.
Harvill Die Casting Corp.
Kirk & Blum Manufacturing Co.
Liberty Aircraft Products Corp.
Linear Packing & Rubber Co.
Lyon Metal Products, Inc.
Moore-Eastwood & Co.
National Machine Products
Pollak Manufacturing Co.

(Bomb Racks) *Continued*
R E F Aircraft Corp.
Rohr Aircraft Corp.
Tennessee Aircraft, Inc.
Thompson Grinder Co.
Variety Aircraft Corp.

CAMERAS (Aerial, Gun)

Bell & Howell Co.
Chicago Aerial Survey Co.
Eastman Kodak Co.
Fairchild Aviation Corp.
Folmer Graflex Corp.
Formica Insulation Co.
Mark Hurd Manufacturing Corp.
H. K. Lorentzen, Inc.
Thompson Grinder Co.
Carl Zeiss, Inc.

CARBURETORS

Bendix Products Div.
Chandler-Evans Corp.
Holley Carburetor Co.
Lear Avia, Inc.
Marvel-Schebler Carburetor Div.
Karl Ort
Thompson Grinder Co.

CASTINGS & FORGINGS

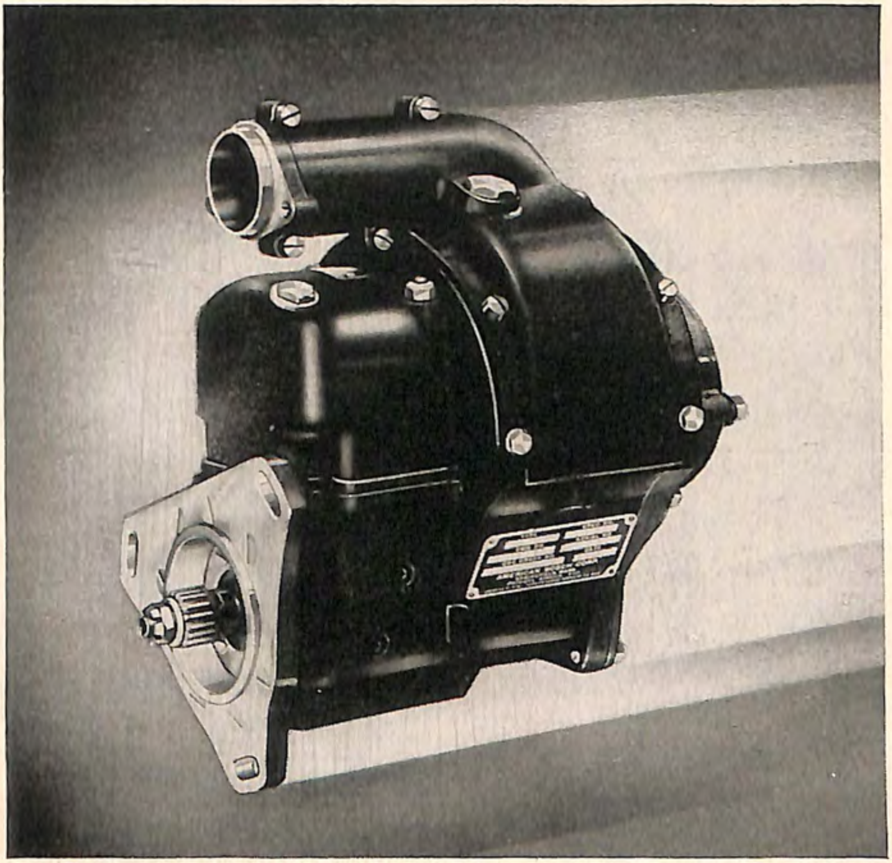
Aircraft Mechanics, Inc.
Aluminum Industries, Inc.
Ampco Metal, Inc.
Atlas Drop Forge Co.
Billings & Spencer Co.
Champion Machine & Forging Co.
E. D. Clapp Manufacturing Co.
Cooper Alloy Foundry Co.
Crown Fastener Corp.
Doehler Die Casting Co.
Electric Auto-Lite Co.
Herbrand Corp.
Hills-McCanna Co.
International Nickel Co.
Kropp Forge Co.
Moore Drop Forging Co.
Nielson Tool & Die Co.
Park Drop Forge Co.
Progressive Brass Mfg. Co.
Shuler Axle Co.
Springfield Brass Co.
Transue & Williams Steel Forging Corp.
Uniloy Accessories Corp.
Union Manufacturing Co.
Wellman Bronze & Aluminum Co.
Wyman-Gordon Co.

CLAMPS

Actus Products Corp.
Adel Precision Products Corp.
Advance Spring Corp.
Aero Supply Manufacturing Co.
Aero Trades Co.
Air Associates, Inc.
Aircraft Components, Inc.
Associated Foundries & Mfrs., Inc.
Bendix Aviation, Ltd.
Benson Manufacturing Co.
Billings & Spencer Co.
Edward G. Budd Mfg. Co.
Cleveland Metal Stamping Co.
Detroit Stamping Co.
Glenn-Roberts Co.
Harvill Die Casting Corp.
Heyman Manufacturing Co.
Holister Coil Spring Mfg. Co.
Ideal Clamp Manufacturing Co.
Knu-Vise, Inc.
Karl Ort
Joseph Pollak Corp.
Pollak Manufacturing Co.
Southern California Plating Co.
Tinnerman Products, Inc.
Variety Aircraft Corp.
Wittek Manufacturing Co.

CLEANERS & CLEANING COMPOUNDS

Cee Bee Chemical Co.
Detroit Rex Products Co.
J. B. Ford Sales Co.
E. A. Gerlach Co.
Kelite Products, Inc.
Magnus Chemical Co.
Miller Manufacturing Co.
Petroleum Solvents Corp.
Pierce & Stevens, Inc.
Puritan Co.
Turco Products, Inc.



COLLECTOR RINGS, COWLS, STREAMLINES

Aero Trades Co.
Aircraft Welders, Inc.
All American Aircraft Products
Allied Aviation Corp.
American Tube Bending Co.
B. H. Aircraft Co.
Benson Manufacturing Co.
Edward G. Budd Mfg. Co.
Buhl Stamping Co.
Engel Aircraft Specialties
Harvey Machine Co.
Harvill Die Casting Corp.
Hill Aircraft Streamliners Co.
Intercontinent Aircraft Corp.
Mercury Aircraft, Inc.
Met-L-Wood Corp.
Pollak Manufacturing Co.
Solar Aircraft Co.
Spartan Aircraft Co.
Teicher Manufacturing Corp.
Tietzmann Engineering Co.
Wallace Supplies Mfg. Co.

CONTROLS

Adel Precision Products Corp.
Aero Supply Manufacturing Co.
Aeronautical Manufacturing Corp.
Air Associates, Inc.
Aircraft Engineering Products, Inc.
Aircraft Mechanics, Inc.
All American Aircraft Products
Arens Controls, Inc.
Automatic Electric Co.
Bendix Aviation, Ltd.
Daven Co.
Eclipse Aviation Div.
Fenwal, Inc.
Formica Insulation Co.
Julien P. Friez & Sons
Goodyear Aircraft Corp.
Harvey Machine Co.
Harvill Die Casting Corp.
Imperial Brass Manufacturing Co.
Kenyon Instrument Co.
Linear Packing & Rubber Co.
Martin-Decker Corp.
Thomas Mason Co.
Mobile Refrigeration, Inc.
Molded Insulation Co.
Precision Tube Co.
R E F Aircraft Corp.
Simmonds Aerocessories, Inc.
C. J. Tagliabue Mfg. Co.
Tennessee Aircraft, Inc.
Thompson Grinder Co.
Voges Manufacturing Co.

CONTROL STICKS & WHEELS

American Tube Bending Co.
B. F. Goodrich Co.
Goodyear Aircraft Corp.
Karl Ort
Southern California Plating Co.
U. S. Rubber Co.

COVERS (Engine, Cockpit, Windshield)

Air Associates, Inc.
Airway Manufacturing Corp.
Associated Foundries & Mfrs., Inc.
L. C. Chase & Co.
Goodyear Aircraft Corp.
Heath Co.
Longines-Wittnauer Watch Co.
Mellus Bros. & Co.
Murray Corp. of America
Karl Ort
Parachute Corp. of America
Voges Manufacturing Co.
Wilber & Son

COWLINGS

Aero Trades Co.
Aircraft Components, Inc.
All American Aircraft Products
Benson Manufacturing Co.
Edward G. Budd Mfg. Co.
Buhl Stamping Co.
Chas. W. Carll Sons
Engel Aircraft Specialties
Goodyear Aircraft Corp.
Harvey Machine Co.
Hill Aircraft Streamliners Co.
Intercontinent Aircraft Corp.
Kirk & Blum Manufacturing Co.
Murray Corp. of America
Pollak Manufacturing Co.
Robertson Aircraft Corp

OFFICIAL PHOTOGRAPH U. S. NAVY

"AN" Connectors

For Navigation Instruments—Aerial Machine Guns—Bomb Racks—Radios—and wherever electrical failure cannot be tolerated, Amphenol "AN" Connectors are used. They are light weight—dependable—easily and quickly connected and disconnected. Used by leading makers of military planes and accessories.

Conduit ferrules, fittings, and coupling nuts in accordance with Army and Navy specifications.

Coaxial cables for low-loss radio frequency transmission.

AMPHENOL AMERICAN PHENOLIC CORP. • CHICAGO

(Cowlings) *Continued*
Rohr Aircraft Corp.
Solar Aircraft Co.
Spartan Aircraft Co.
Variety Aircraft Corp.

DE-ICER EQUIPMENT

Adel Precision Products Corp.
Air Associates, Inc.
Aircraft & Marine Specialty Co.
Aircraft Engineering Products
Benson Manufacturing Co.
Eclipse Aviation Div.
Firestone Aviation Products Co.
Fulton Co.
B. F. Goodrich Co.
Harvill Die Casting Co.
Imperial Brass Mfg. Co.
Minneapolis-Honeywell Regulator Co.
Pump Engineering Service Corp.
Quality Electric Co.
Romec Pump Co.
Solar Aircraft Co.
Special Machine Tool Engineering Works
Voges Manufacturing Co.

DYNAMOTORS

John Chatillon & Sons
Eclipse Aviation Div.
Federal Products Corp.
General Armature Corp.
General Electric Co.
Quality Electric Co.
Westinghouse Electric & Mfg. Co.

ELECTRICAL EQUIPMENT

American Bosch Corp.
American Phenolic Corp.
Appleton Electric Co.
Belden Manufacturing Co.
Benwood Linze Co.
Boston Insulated Wire & Cable Co.
Cannon Electric Development Co.
Century Electric Co.
C. P. Clare & Co.
Cole-Hersee Co.
R. W. Cramer Co.
Crescent Co.
Crescent Insulated Wire & Cable Co.
Cutler-Hammer, Inc.
Denison Engineering Co.
Detroit Surfacing Machine Co.
Struthers Dunn, Inc.
Durakool, Inc.
Eitel-McCullough, Inc.
Electric Auto-Lite Co.
Fibre Conduit Co.
General Aircraft Equipment
General Cable Corp.
Glenn-Roberts Co.
Heinemann Circuit Breaker Co.
Hickok Electrical Instrument Co.
International Resistance Co.
Kenyon Instrument Co.
Kenyon Transformer Co.
Lawrance Engineering & Research Corp.
Leach Relay Co.
Lempco Products, Inc.
Littlefuse, Inc.
Thomas Mason Co.
Miller Co.
Molded Insulation Co.
Moore-Eastwood & Co.
North American Electric Lamp Co.
Ohmite Manufacturing Co.
Packard Electric Div.
Rochester Ropes, Inc.
Rockbestos Products Corp.
John A. Roebling's Sons Co.
Searle Aero Industries, Inc.
Sigma Instruments, Inc.
Snap-On Tools Corp.
Spencer Thermostat Co.
Teleregister Corp.
Thomas & Betts Co.
U. S. Electrical Tool Co.
Weston Electrical Instrument Corp.

Generators

Champion Aviation Products Co.
Eclipse Aviation Div.
Electric Auto-Lite Corp.
Emerson Electric Mfg. Co.
General Armature Corp.
General Electric Co.
Harris Calorific Co.
Jack & Heintz, Inc.
Leece-Neville Co.
Moore-Eastwood & Co.

(Generators) *Continued*
Karl Ort
Quality Electric Co.
Thompson Grinder Co.
Westinghouse Electric & Mfg. Co.

Magnetos

Eclipse Aviation Div.
Edison-Splitdorf Corp.
Eisemann Magneto Corp.
Fairbanks, Morse & Co.
S. G. Frantz Co.
Karl Ort
Scintilla Magneto Div.
Thompson Grinder Co.
Ward Leonard Electric Co.

Motors

Adel Precision Products Corp.
Air Associates, Inc.
E. F. Andrews Laboratories
Barber-Colman Co.
Champion Aviation Products Co.
Dumore Co.
Eclipse Aviation Div.
Emerson Electric Mfg. Co.
General Electric Co.
Lear Avia, Inc.
Leece-Neville Co.
Karl Ort
Quality Electric Co.
B. F. Sturtevant Co.
Thompson Grinder Co.
Westinghouse Electric & Mfg. Co.

Switches

Adel Precision Products Corp.
Air Associates, Inc.
American Phenolic Corp.
Arrow-Hart & Hegeman Electric Co.
Bendix Aviation, Ltd.
R. W. Cramer Co.
Cutler-Hammer, Inc.
Daven Co.
Durakool, Inc.
General Electric Co.
Instrument Design, Inc.
Lewis Engineering Co.
Micro Switch Corp.
Ohmite Manufacturing Co.
Karl Ort
Pausin Engineering Co.
Joseph Pollak Corp.
Quality Electric Co.
Scintilla Magneto Div.
Ward Leonard Electric Co.
Westinghouse Electric & Mfg. Co.

ENGINE MOUNTS

Aero Trades Co.
Aircraft Components, Inc.
Aircraft Mechanics, Inc.
Aircraft Welders, Inc.
American Tube Bending Co.
B. H. Aircraft Co.
Benson Manufacturing Co.
Colgate-Larsen Aircraft Co.
Connecticut Hard Rubber Co.
Firestone Aviation Products Co.
Goodyear Aircraft Corp.
Houde Engineering Corp.
Intercontinent Aircraft Corp.
Johnson Rubber Co.
Kinney Aluminum Co.
Manhattan Rubber Mfg. Div.
Mercury Aircraft, Inc.
Robertson Aircraft Corp.
Spartan Aircraft Co.
Wallace Supplies Mfg. Co.

EXHAUST MANIFOLDS

Aero Trades Co.
Aircraft Components, Inc.
Aircraft Welders, Inc.
American Tube Bending Co.
B. H. Aircraft Co.
Edward G. Budd Mfg. Co.
Buhl Stamping Co.
Engel Aircraft Specialties
Kinney Aluminum Co.
Kirk & Blum Manufacturing Co.
Mercury Aircraft, Inc.
Met-L-Wood Corp.
Pollak Manufacturing Co.
Ryan Aeronautical Co.
Solar Aircraft Co.
Spartan Aircraft Co.
Special Machine Tool Engineering Works
Wallace Supplies Mfg. Co.

FASTENERS

Adel Precision Products Corp.
Aero Trades Co.
Air Associates, Inc.
American Screw Co.
Bemis & Call Co.
Bendix Aviation, Ltd.
Boots Aircraft Nut Corp.
Bristol Co.
Cleveland Metal Stamping Co.
Continental Screw Co.
Corbin Screw Corp.
Crown Fastener Corp.
Cullman Wheel Co.
Dill Manufacturing Co.
Dycer Aviation Supplies
Dzus Fastener Co.
Elastic Stop Nut Corp.
B. F. Goodrich Co.
Heyman Manufacturing Co.
Holister Coil Spring Mfg. Co.
Ideal Clamp Manufacturing Co.
Knu-Vise, Inc.
Laminated Shim Co.
Lamson & Sessions Co.
Master Lock Co.
Karl Ort
J. A. Otterbein
Packless Metal Products Corp.
Palnut Co.
Penn Rivet Corp.
Pollak Manufacturing Co.
Rockford Screw Products Co.
Simmonds Aerocessories, Inc.
Thompson Products, Inc.
Tinnerman Products, Inc.
United-Carr Fastener Corp.
Voges Manufacturing Co.

FILTERS AND STRAINERS

Adel Precision Products Corp.
Aero Supply Manufacturing Co.
Air Associates, Inc.
S. F. Bowser & Co.
Cuno Engineering Corp.
Eclipse Aviation Div.
Fostoria Pressed Steel Corp.
S. G. Frantz Co.
Imperial Brass Mfg. Co.
Kenyon Transformer Co.
Linear Packing & Rubber Co.
Michigan Wire Cloth Co.
Newark Wire Cloth Co.
Pollak Manufacturing Co.
Purolator Products, Inc.
Rockwood Sprinkler Co.
Southern California Plating Co.
United Aircraft Products, Inc.

FIRE EXTINGUISHERS

Dugas Engineering Corp.
General Detroit Corp.
Walter Kidde & Co.
Karl Ort
Rockwood Sprinkler Co.
Wil-X-M'F'G Corp.

FIRST AID EQUIPMENT

Air Associates, Inc.
Bauer & Black Div.
E. D. Bullard Co.
General Scientific Equipment Co.
Mine Safety Appliances Co.
Karl Ort

FITTINGS

Aero Supply Manufacturing Co.
Aero Trades Co.
Aeronautical Mfg. Corp.
Aeroquip Corp.
Agawam Aircraft Products, Inc.
Air Associates, Inc.
Aircraft Engineering Products
Associated Foundries & Mfrs., Inc.
Breeze Corporations, Inc.
Cooper Alloy Foundry Co.
Devilbiss Co.
Elastic Stop Nut Corp.
Flex-O-Tube Co.
Goodyear Aircraft Corp.
Harvey Machine Co.
Houde Engineering Corp.
Imperial Brass Mfg. Co.
Linear Packing & Rubber Co.
H. K. Lorentzen, Inc.
Thomas Mason Co.
Mercury Aircraft, Inc.
National Aircraft Equipment Co.
Karl Ort
Parker Appliance Co.

(Fittings) *Continued*
Pump Engineering Service Corp.
R E F Aircraft Corp.
John A. Roebling's Sons Co.
Southern California Plating Co.
Springfield Brass Co.
Tennessee Aircraft, Inc.
Union Aircraft Products Corp.
Variety Aircraft Corp.
Voges Manufacturing Co.
Walworth Co.
Weatherhead Co.
S. S. White Dental Mfg. Co.
Yale & Towne Mfg. Co.

FLARES

Air Associates, Inc.
Associated Foundries & Mfrs., Inc.
Irving Air Chute Co.
Kilgore Manufacturing Co.
Kinney Aluminum Co.
Modern Engineering Co.
New Jersey Fulgent Co.
Karl Ort
Switlik Parachute Co.

FLOATS, SKIIS

Air Transport Equipment, Inc.
All American Aircraft Products
Allied Aviation Corp.
Associated Foundries & Mfrs., Inc.
B. H. Aircraft Co.
Colgate-Larsen Aircraft Co.
Edo Aircraft Corp.
Engel Aircraft Specialties
Federal Aircraft Works
Goodyear Aircraft Corp.
Heath Co.
Karl Ort
Technical Ply-Woods

FUELS & LUBRICANTS

Gulf Oil Co.
Pennzoil Co.
Phillips Petroleum Co.
Pure Oil Co.
Shell Oil Co.
Sinclair Refining Co.
Socony-Vacuum Oil Co.
Standard Oil Co.
Standard Oil Co. of California
Standard Oil Co. of New Jersey
Texas Co.
Wayne Chemical Products Co.

HEATERS

Air Transport Equipment, Inc.
American Foundry & Furnace Co.
American Instrument Co.
Bryant Heater Co.
Carrier Corp.
Clifford Manufacturing Co.
Dayton Rubber Mfg. Co.
Despatch Oven Co.
Eclipse Fuel Engineering Co.
Electric Furnace Co.
Engel Aircraft Specialties
G & G Manufacturing Co.
Harvey Machine Co.
Leeds & Northrup Co.
Karl Ort
States Co.
B. F. Sturtevant Co.
Trane Co.
Ward Leonard Electric Co.
Young Radiator Co.

HYDRAULIC CONTROLS & ASSEMBLIES

Adel Precision Products Corp.
Aero-Coupling Corp.
Aeronautical Manufacturing Corp.
Air Associates, Inc.
Aircraft Accessories Corp.
Aircraft Accessories Corp. of Mo.
Aircraft Engineering Products
Aro Equipment Corp.
Bendix Aviation, Ltd.
Blackhawk Manufacturing Co.
Clifford Manufacturing Co.
Dowty Equipment Corp.
Eclipse Aviation Div.
Formica Insulation Co.
Julien P. Friez & Sons
General Controls Co.
Graton & Knight Co.
Houde Engineering Corp.
Johnson Rubber Co.
Liberty Aircraft Products Corp.
Linear Packing & Rubber Co.
Molded Insulation Co.

(Hydraulic Controls & Assemblies) *Continued*

National Aircraft Equipment Co.
Pump Engineering Service Corp.
R E F Aircraft Corp.
Sperry Products, Inc.
United Aircraft Products, Inc.
U. S. Rubber Co.
Vard, Inc.
Vickers, Inc.
Paul G. Wagner Co.
Woodward Governor Co.

INDIRECT LIGHTING SYSTEMS

Drake Manufacturing Co.
General Electric Co.
Grimes Manufacturing Co.
Kliegl Brothers
Westinghouse Electric & Mfg. Co.

INSTRUMENTS

Abrams Instrument Co.
Aeromarine Instrument Co.
Air Associates, Inc.
Air-Safe Aircraft Instrument Co.
American Instrument Co.
American Paulin System
Automatic Electric Co.
Bell & Howell Co.
Boston Auto Gage Co.
Breeze Corporations, Inc.
Bristol Co.
Cambridge Instrument Co.
John Chatillon & Sons
Clifford Manufacturing Co.
Consolidated Engineering Corp.
Cox & Stevens Aircraft Corp.
Daven Co.
Dayton Tool & Engineering Co.
Eclipse Aviation Div.
Edison-Splitdorf Corp.
Electric Auto-Lite Co.
Engis Equipment Co.
Federal Products Corp.
Formica Insulation Co.
Julien P. Friez & Sons
Gaertner Scientific Corp.
General Electric Co.
W. & L. E. Gurley
Hardwick, Hindle, Inc.
Instrument Design, Inc.
Jaeger Watch Co., Inc.
Johnson-National Insignia Co.
Kenyon Instrument Co.
Kollsman Instrument Div.
Leach Relay Co.
Lewis Engineering Co.
Link Aviation Devices, Inc.
Liquidometer Corp.
H. K. Lorentzen, Inc.
Lorenzen Propeller Co.
Lufkin Rule Co.
Manning, Maxwell & Moore, Inc.
Martin-Decker Corp.
J. E. Menaugh Co.
Mine Safety Appliances Co.
Minneapolis-Honeywell Regulator Co.
Modern Engineering Co.
Tinius Olsen Testing Machine Co.
Karl Ort
Pioneer Instrument Div.
Precision Tube Co.
Safetee Glass Co.
Geo. Scherr Co.
Sperry Gyroscope Co.
L. S. Starrett Co.
M. C. Stewart
C. J. Tagliabue Mfg. Co.
Thompson Grinder Co.
Uniloy Accessories Corp.
United Aircraft Products, Inc.
United States Gauge Co.
Universal Microphone Co.
Vard, Inc.
Variety Aircraft Corp.
Voges Manufacturing Co.
Washington Institute of Technology
Weems System of Navigation
Westinghouse Electric & Mfg. Co.
Wheelco Instruments Co.

LANDING AND NAVIGATION LIGHTS

Air Reduction Sales Co.
Crouse-Hinds Co.
Dial Light Company of America
Electronic Laboratories, Inc.
Instrument Design, Inc.
International Derrick & Equipment Div.
Johnson-National Insignia Co.
Kenyon Instrument Co

(Landing and Navigation Lights)
Continued
Kliegl Bros.
Ohmite Manufacturing Co.
Joseph Pollak Corp.
Pollak Manufacturing Co.
Pyle-National Co.
Quality Electric Co.
Standard Aircraft Products
Variety Aircraft Corp.
Westinghouse Electric & Mfg. Co.

LANDING GEARS

Aircraft Mechanics, Inc.
Aircraft Products & Equip. Corp.
Aircraft Welders, Inc.
Alpha Metal & Rolling Mills
Bendix Aviation, Ltd.
Bendix Products Div.
Cleveland Pneumatic Tool Co.
Dowty Equipment Corp.
Firestone Aviation Products Co.
Goodyear Aircraft Corp.
Harvey Machine Co.
Houde Engineering Corp.
Kinney Aluminum Co.
Lear Avia, Inc.
Linear Packing & Rubber Co.
National Aircraft Equipment Co.
R E F Aircraft Corp.
Randall Graphite Products Corp.
Romec Pump Co.
Thompson Grinder Co.
Thompson Products, Inc.

MACHINE TOOLS

Aircraft Machinery Corp.
Avey Drilling Machine Co.
Baird Machine Co.
Baush Machine Tool Co.
E. W. Bliss Co.
Bullard Co.
Cedar Rapids Engineering Company of Delaware
Ex-Cell-O Corp.
Farnham Manufacturing Co.
J. A. Fay & Egan Co.
Ferracute Machine Co.
Flexible Shaft Co. of New York
Fray Machine Tool Co.
General Engineering Co.
Gisholt Machine Co.
George Gorton Machine Co.
Govro-Nelson Co.
Hall Manufacturing Co.
Hardinge Brothers, Inc.
Harris Calorific Co.
Heald Machine Co.
Hendey Machine Co.
R. Hoe & Co.
Landis Machine Co.
Lempco Products, Inc.
Liberty Aircraft Products Corp.
Lodge & Shipley Machine Tool Co.
Micromatic Hone Corp.
Mine Safety Appliances Co.
National Automatic Tool Co.
Oilgear Co.
Onsrud Machine Works, Inc.
C. F. Pease Co.
Progressive Welder Co.
Robot Machinery Co.
Sheffield Corp.
Smith Welding Machine Corp.
Strippit Corp.
Sundstrand Machine Tool Co.
Tannewitz Works
Taylor-Winfield Corp.
George A. Terry Co.
U. S. Electrical Tool Co.
U. S. Tool Co.
Van Norman Machine Tool Co.
Wiedemann Machine Co.
Wilkening Manufacturing Co.
Yoder Co.

MANIFOLDS

American Tube Bending Co.
Edward G. Budd Mfg. Co.
Buhl Stamping Co.
Engel Aircraft Specialties
Mercury Aircraft, Inc.
Met-L-Wood Corp.
Pollak Manufacturing Co.
Wallace Supplies Mfg. Co.

MISCELLANEOUS HARDWARE

Aero Supply Mfg. Co.
Air Associates, Inc.
Air Transport Equipment, Inc.
Aircraft & Marine Specialty Co.

(Miscellaneous Hardware) *Continued*

Aircraft Engineering Products
Aircraft Hardware Manufacturing Co.
Aircraft Screw Products Co.
Allith-Prouty, Inc.
American Screw Co.
Associated Foundries & Mfrs., Inc.
Bell & Howell Co.
Bristol Co.
Cherry Rivet Co.
Chicago Rivet & Machine Co.
Cincinnati Shaper Co.
Cleveland Metal Stamping Co.
Continental Screw Co.
Corbin Screw Corp.
Curtis Pneumatic Machinery Div.
Dayton Manufacturing Co.
Detroit Gasket & Mfg. Co.
Elastic Stop Nut Corp.
Forsberg Manufacturing Co.
General Aircraft Supply Corp.
Heim Co.
Holister Coil Spring Mfg. Co.
Howard B. Jones
H. K. Lorentzen, Inc.
Lucas Screw Products, Inc.
Mercury Aircraft, Inc.
Mid-State Manufacturing Co.
Milford Rivet & Machine Co.
National Screw & Mfg. Co.
Ohlsson & Rice Mfg. Co.
Pheoll Manufacturing Co.
Ramsey Accessories Mfg. Corp.
Rockford Screw Products Co.
Rockwood Sprinkler Co.
Rolock, Inc.
Joseph T. Ryerson & Son
S K F Industries, Inc.
A. Schrader's Son
Shakespeare Products Co.
Thompson Grinder Co.
United-Carr Fastener Corp.
Vellumoid Co.
Voges Manufacturing Co.
Worcester Pressed Steel Co.
Wrought Washer Mfg. Co.
Yale & Towne Mfg. Co.

MISCELLANEOUS ENGINE EQUIPMENT

Air Associates, Inc.
Aircraft & Marine Specialty Co.
Allen Electric & Equipment Co.
Aluminum Industries, Inc.
American Bosch Corp.
American Tube Bending Co.
Arens Controls, Inc.
Associated Foundries & Mfrs., Inc.
Chas. W. Carll Sons
Chamberlin Aircraft Co.
Eaton Manufacturing Co.
Eclipse Aviation Div.
Ertel Machine Co.
Ex-Cell-O Corp.
Fairbanks, Morse & Co.
Federal Aircraft Works
Govro-Nelson Co.
Holister Coil Spring Mfg. Co.
Carlyle Johnson Machine Co.
Kropp Forge Co.
Liberty Aircraft Products Corp.
Lord Manufacturing Co.
McQuay-Norris Mfg. Co.
Manhattan Rubber Mfg. Div.
Meisel Press Manufacturing Co.
Mercury Aircraft, Inc.
Minneapolis-Honeywell Regulator Co.
Ohio Piston Co.
Karl Ort
Sealed Power Corp.
Thompson Grinder Co.
Thompson Products, Inc.
Whiting Corp.
Wilkening Manufacturing Co.
Worcester Pressed Steel Co.
Worcester Stamped Metal Co.

PAINTS, VARNISHES AND FINISHES

Acme White Lead & Color Works
Arco Co.
Ault & Wiborg Co.
Berry Brothers, Inc.
Burnside Veneer Co.
General Aircraft Supply Corp.
E. A. Gerlach Co.
Hilo Varnish Corp.
Irvington Varnish & Insulator Co.
Kay & Ess Co.
Lowe Brothers Co.
Markal Co.
Monsanto Chemical Co.
Paasche Airbrush Co.
Permatex Co.

(Paints, Varnishes and Finishes) *Continued*

Perry-Austen Manufacturing Co.
Pierce & Stevens, Inc.
Pratt & Lambert, Inc.
Roddis Lumber & Veneer Co.
Seidlitz Paint & Varnish Co.
Sherwin-Williams Co.
Titanine, Inc.
United Chromium, Inc.
Valentine & Co.
Wailes Dove-Hermiston Corp.
Wesley Lacquer Co.

PANELS

Aero Supply Manufacturing Co.
Aero Trades Co.
Aircraft & Marine Specialty Co.
Aircraft Welders, Inc.
Airway Manufacturing Corp.
Allied Aviation Corp.
D. L. Auld Co.
Edward G. Budd Mfg. Co.
Butler Manufacturing Co.
Crescent Panel Co.
Detroit Gasket & Mfg. Co.
Formica Insulation Co.
Harvey Machine Co.
Kirk & Blum Mfg. Co.
Liberty Aircraft Products Corp.
Thomas Mason Co.
Met-L-Wood Corp.
Plywood Products Corp.
Robertson Aircraft Corp.
States Co.
Technical Ply-Woods
Tennessee Aircraft, Inc.
Washington Institute of Technology
Westinghouse Electric & Mfg. Co.

PARACHUTES

Airway Manufacturing Corp.
Detroit Gasket & Mfg. Co.
Eagle Parachute Corp.
Hayes Manufacturing Corp.
Irving Air Chute Co.
Karl Ort
J. A. Otterbein
Parachute Corp. of America
Pioneer Parachute Co.
Switlik Parachute Co.
Tallmadge Co.

PARTS

Ace Hardware Mfg. Corp.
Aero Supply Manufacturing Co.
Agawam Aircraft Products, Inc.
Air Associates, Inc.
Aircraft & Marine Specialty Co.
Aircraft Mechanics, Inc.
Aircraft Welders, Inc.
Allied Aviation Corp.
Ampco Metal, Inc.
Associated Foundries & Mfrs., Inc.
B. H. Aircraft Co.
Bailey Co.
Bellanca Aircraft Corp.
Edward G. Budd Mfg. Co.
Buhl Stamping Co.
Centerless Grinding Co.
Corbin Screw Corp.
Duramold Aircraft Corp.
Eaton Manufacturing Co.
Engis Equipment Co.
Ex-Cell-O Corp.
General Aircraft Equipment
General Aircraft Supply Corp.
Goodyear Aircraft Corp.
Graton & Knight Co.
Greist Manufacturing Co.
Hartford Special Machinery Co.
Harvey Machine Co.
Hayes Manufacturing Co.
Holister Coil Spring Mfg. Co.
Imperial Brass Mfg. Co.
Intercontinent Aircraft Corp.
Liberty Aircraft Products Corp.
Marquette Metal Products Co.
Mercury Aircraft, Inc.
National Aircraft Equipment Co.
National Machine Products
Newark Wire Cloth Co.
J. A. Otterbein
Joseph Pollak Corp.
R E F Aircraft Corp.
Rohr Aircraft Corp.
Solar Aircraft Co.
Southern California Plating Co.
Spartan Aircraft Co.
Special Machine Tool Engineering Works
Spier Aircraft Corp.

CESSNA DELIVERED MORE

Twin-Engined, Bomber-Pilot Trainers During 1941 Than All Other U. S. Aircraft Manufacturers Combined


CLARK


WRIGHT
WHIRLWIND
AVIATION ENGINE
PRATT & WHITNEY
AIRCRAFT
WASP

(Parts) *Continued*
Spriesch Tool and Mfg. Co.
Swedlow Aeroplastics Corp.
Technical Ply-Woods
Thompson Products, Inc.
Universal Moulded Products Corp.
Variety Aircraft Corp.
Vellumoid Co.
Victor Metal Products Corp.
Vimalert Co.
Voges Manufacturing Co.
Washington Aircraft & Transport Corp.
Wilkening Manufacturing Co.
Yale & Towne Mfg. Co.

PRIMERS

Acme White Lead & Color Works
Adel Precision Products Corp.
Air Associates, Inc.
Arco Co.
Ault & Wiborg Corp.
Andrew Brown Co.
Federal Products Corp.
Hilo Varnish Corp.
Imperial Brass Mfg. Co.
Jones-Dabney Co.
Kay & Ess Co.
Lowe Brothers Co.
Minneapolis-Honeywell Regulator Co.
Monsanto Chemical Co.
Parker Appliance Co.
Sherwin-Williams Co.
Titanine, Inc.
Valentine & Co.

PROPELLERS & PROPELLER PARTS

Aero Supply Manufacturing Co.
Aeroproducts Div.
Air Transport Equipment Co.
Allied Aviation Corp.
American Propeller Corp.
Aro Equipment Corp.
Associated Foundries & Mfrs., Inc.
Chamberlin Aircraft Co.
Curtiss-Wright Corp.
Denison Engineering Co.
Eclipse Aviation Div.
Engineering & Research Corp.
Ex-Cell-O Corp.
Fahlin Manufacturing Co.
Formica Insulation Co.
Freedman-Burnham Engineering Corp.
Gardner Propeller Co.
General Aircraft Supply Corp.
Graton & Knight Co.
Hamilton Standard Propellers
Hartzell Propeller Co.
Johnson Rubber Co.
Koppers Co.
Lake State Products, Inc.
Leach Relay Co.
Linear Packing & Rubber Co.
Lorenzen Propeller Co.
McCauley Steel Propeller Co.
McQuay-Norris Mfg. Co.
Marquette Metal Products Co.
Karl Ort
Sensenich Brothers
Special Machine Tool Engineering Works
Stone Propeller Co.
Thompson Grinder Co.
Thompson Products, Inc.
Toledo Scale Co.
Worcester Pressed Steel Co.
Worcester Stamped Metal Co.

PROTECTIVE CLOTHING & EQUIPMENT

Air Associates, Inc.
Air Transport Equipment, Inc.
Airway Manufacturing Corp.
American Optical Co.
Associated Foundries & Mfrs., Inc.
E. D. Bullard Co.
Detroit Gasket & Mfg. Co.
Gaertner Scientific Corp.
General Aircraft Supply Corp.
General Scientific Equipment Co.
Goggle Parts Co.
Irving Air Chute Co.
Mine Safety Appliances Co.
Karl Ort
Pangborn Corp.
Parachute Corp. of America
Resistoflex Corp.
Sellstrom Manufacturing Co.
Switlik Parachute Co.
Vard, Inc.
Willson Products, Inc.
Carl Zeiss, Inc.

COOLING

of AIRCRAFT ENGINES

SERVING THE AIRCRAFT INDUSTRY WITH BASIC MATERIALS

for ENGINE COOLING

HYDRON EXTRUDED TUBING

We manufacture HYDRON thin-wall extruded tubing for aircraft radiators, oil coolers, inter-coolers, and heat inter-changers, for liquid-cooled and air-cooled motors.

for COOLING CONTROL

HYDRON METALLIC BELLOWS

HYDRON thin-wall hydraulically-formed metallic bellows are used in all types of temperature and pressure control devices for aircraft engine cooling systems, carburetors and super-chargers.

CLIFFORD MANUFACTURING CO.

564 EAST FIRST STREET. BOSTON

CHICAGO. 221 North LaSalle Street

DETROIT. 6432 Cass Avenue

HYDRON

PUMPS

Adel Precision Products Corp.
Aero Supply Manufacturing Co.
Aeronautical Mfg. Corp.
Air Associates, Inc.
Aircraft Accessories Corp.
Aircraft Engineering Products
Aro Equipment Corp.
Bendix Aviation, Ltd.
Blackmer Pump Co.
Chandler-Evans Corp.
Cleveland Pneumatic Tool Co.
Dayton Tool & Engineering Co.
Eastern Engineering Co.
Eaton Manufacturing Co.
Eclipse Aviation Div.
Fairbanks, Morse & Co.
Granberg Equipment, Inc.
Houde Engineering Corp.
Imperial Brass Mfg. Corp.
Liberty Aircraft Products Corp.
Linear Packing & Rubber Co.
Marquette Metal Products Co.
Pacific Aviation, Inc.
Pump Engineering Service Corp.
Romec Pump Co.
Thompson Grinder Co.
Thompson Products, Inc.
United Aircraft Products, Inc.
Vickers, Inc.
Yale & Towne Mfg. Co.

RADIATORS

Airesearch Manufacturing Co.
Edward G. Budd Mfg. Co.
Clifford Manufacturing Co.
G & G Manufacturing Co.
Harrison Radiator Div.
Karl Ort
Standard Aircraft Products
Young Radiator Co.

RADIOS

Air Associates, Inc.
Air Transport Equipment, Inc.
Aircraft Accessories Corp. of Mo.
E. F. Andrews Laboratories
Bell & Howell Co.
Bendix Aviation, Ltd.
Doolittle Radio, Inc.
Electronic Specialty Co.
Engineering & Research Corp.
Fairchild Aviation Corp.
Federal Telegraph Co.
Fisher Research Laboratory
General Electric Co.
Gray Radio Co.
Harvey Machine Co.
Heath Co.
Islip Radio Manufacturing Corp.
Leach Relay Co.
Lear Avia, Inc.
National Co.
RCA Manufacturing Co.
Radio Receptor Co.
Sparks-Withington Co.
Washington Institute of Technology
Westinghouse Electric & Mfg. Co.

RADIO COMPASSES

Fairchild Aviation Corp.
Finch Telecommunications, Inc.
Fisher Research Laboratory
Gray Radio Co.
Heath Co.
Islip Radio Mfg. Corp.
Lear Avia, Inc.
H. K. Lorentzen, Inc.
RCA Manufacturing Co.
Searle Aero Industries, Inc.
Washington Institute of Technology

RADIO SHIELDING & EQUIPMENT

Aladdin Radio Industries, Inc.
American Phenolic Corp.
Arens Controls, Inc.
Belden Manufacturing Co.
Bell & Howell Co.
Bendix Aviation, Ltd.
Eclipse Aviation Div.
Electronic Laboratories, Inc.
Electronic Specialty Co.
Federal Telegraph Co.
Finch Telecommunications, Inc.
Heath Co.
Hickok Electrical Instrument Co.
Leach Relay Co.
Manhattan Rubber Mfg. Div.
Molded Insulation Co.
Panoramic Radio Corp.

(Radio Shielding & Equipment)
Continued

Precision Tube Co.
Rockbestos Products Corp.
Saylor Electric Products Corp.
Searle Aero Industries, Inc.
Shure Brothers
Switlik Parachute Co.
Televiso Products, Inc.
Thordarson Electric Mfg. Co.
Titeflex Metal Hose Co.
Universal Microphone Co.
Ward Leonard Electric Co.
Washington Institute of Technology
Western Electric Co.

SEATS

Aircraft Components, Inc.
Aircraft Welders, Inc.
Airway Manufacturing Corp.
Bendix Products Div.
Edward G. Budd Mfg. Co.
Diebold Safe & Lock Co.
Engel Aircraft Specialties
Firestone Aviation Products Co.
B. F. Goodrich Co.
Irving Air Chute Co.
Warren McArthur Corp.
Murray Corp. of America
Parachute Corp. of America
Robertson Aircraft Corp.
Southern California Plating Co.

SHOCK STRUTS & CORD

Firestone Aviation Products Co.
B. F. Goodrich Co.
Houde Engineering Corp.
Liberty Aircraft Products Corp.
Linear Packing & Rubber Co.
Pacific Aviation, Inc.
Southern California Plating Co.

SPARK PLUGS

Aero Spark Plug Co.
B. G. Corp.
Champion Spark Plug Co.
Denison Engineering Co.
Edison-Splitdorf Corp.
Firestone Aviation Products Co.
J. E. Menaugh Co.
Motor Master Products Corp.
Karl Ort

SPRINGS

Advance Spring Corp.
All-Weather Springs
American Steel & Wire Co.
Barnes-Gibson-Raymond Div.
Holister Coil Spring Mfg. Co.
W. B. Jones Spring Co.
Kline Spring Co.
Raymond Manufacturing Co.
Thomas Wire & Spring Co.
Tuthill Spring Co.
Wichita Wire Products Co.

STAMPINGS

Ace Hardware Mfg. Corp.
Advance Spring Corp.
Aircraft & Marine Specialty Co.
Aircraft Components, Inc.
All American Aircraft Products
Alofs Manufacturing Co.
Associated Foundries & Mfrs., Inc.
D. L. Auld Co.
Bailey Co.
Bell & Howell Co.
Brasco Manufacturing Co.
Edward G. Budd Mfg. Co.
Buhl Stamping Co.
Butler Manufacturing Co.
Cleveland Metal Stamping Co.
Dayton Manufacturing Co.
Defiance Stamping Co.
Detroit Gasket & Mfg. Co.
Detroit Stamping Co.
Dill Manufacturing Co.
Eaton Manufacturing Co.
Edwards Manufacturing Co.
Engel Aircraft Specialties
Forsberg Manufacturing Co.
Fulton Co.
Goodyear Aircraft Corp.
Greist Manufacturing Co.
Harvey Machine Co.
Hayes Manufacturing Corp.
Heath Co.
Heim Co.
Heyman Manufacturing Co.
Holister Coil Spring Mfg. Co.
Kirk & Blum Mfg. Co.


4 CURTISS PLANES SHOOT DOWN 8 NAZIS ON LENINGRAD FRONT
TOMAHAWKS GET 15 NAZI IN PROTECTING CONVOY
"GOOD SHOW, CHAPS"
20 Tomahawks Rout 60 Enemy
M'ARTHUR'S FLIERS SHOOT DOWN 2 JAPS IN BATAN ENCOUNTER
Me.'s fall apar in mid-air
HEADLINES for HISTORY
P-40's Go Into Action Against Odds
TOMAHAWK AIRCRAFT FOR TURKEY
Outnumbered 3 to 1 P-40s Defeat Nazis
British Take Buffalo Planes Straight Into Cloud of Foes in Libya
CURTISS FIGHTERS DOWN 17 STUKAS IN DESERT BATTLE
P-40's Strike First Blow For Indies
CURTISS P-40 GET 20 NAZI PLANE DAMAGE 10 OTHER
TOMAHAWKS GET BOMBER
Practically Blew Up In My Face"—Pilot
TOMAHAWKS IN ACTION
Desert Shoot-up
R. A. F. Pilot Says "It Was Like Swatting Flies" as in N. Africa
Buffalo-Made Planes Have Nazis on Run
New Curtiss Planes Rout Nazi Aircraft
Curtiss first on every battlefront
Australian Pilots Praise Kittyhawks And Tomahawks
CURTISS WRIGHT Corporation
AIRPLANE DIVISION
BUFFALO, N. Y.

(Stampings) *Continued*
Lansing Stamping Co.
H. K. Lorentzen, Inc.
Mercury Aircraft, Inc.
Met-L-Wood Corp.
Murray Corp. of America
National Aircraft Equipment Co.
Numberall Stamp & Tool Co.
J. A. Otterbein
Parker Stamp Works, Inc.
Penn Rivet Corp.
Joseph Pollak Corp.
Pollak Manufacturing Co.
Production Tool & Die Co.
R E F Aircraft Corp.
Raymond Manufacturing Co.
Rockwood Sprinkler Co.
Southern California Plating Co.
Strippit Corp.
Tietzmann Engineering Co.
Tinnerman Products, Inc.
Transue & Williams Steel Forging Corp.
United-Carr Fastener Corp.
Variety Aircraft Corp.
Victor Metal Products Corp.
Voges Manufacturing Co.
Worcester Pressed Steel Co.
Worcester Stamped Metal Co.
Wrought Washer Mfg. Co.

STARTERS

Aircraft Products & Equipment Corp.
Champion Aviation Products Co.
Eclipse Aviation Div.
Jack & Heintz, Inc.
Leach Relay Co.
Mechanical Products, Inc.
Philadelphia Div., Bendix Aviation Corp.
Westinghouse Electric & Mfg. Co.

SUB-ASSEMBLIES

Ace Hardware Mfg. Corp.
Aircraft & Marine Specialty Co.
Aircraft Components, Inc.
All American Aircraft Products
American Phenolic Corp.
Aro Equipment Corp.
Associated Foundries & Mfrs., Inc.
Bailey Co.
Brasco Manufacturing Co.
Briggs Manufacturing Co.
Edward G. Budd Mfg. Co.
Buhl Stamping Co.
Colgate-Larsen Aircraft Co.
Columbia Aircraft Industries
Detroit Gasket & Mfg. Co.
Eaton Manufacturing Co.
Julien P. Friez & Sons
Fulton Co.
Goodyear Aircraft Corp.
Greist Manufacturing Co.
Harvey Machine Co.
Hayes Manufacturing Corp.
Intercontinent Aircraft Corp.
Kinney Aluminum Co.
Lear Avia, Inc.
Liberty Aircraft Products Corp.
H. K. Lorentzen, Inc.
Marquette Metal Products Co.
Thomas Mason Co.
Mercury Aircraft, Inc.
Met-L-Wood Corp.
Molded Insulation Co.
Murray Corp. of America
National Aircraft Equipment Co.
National Machine Products
R E F Aircraft Corp.
Robertson Aircraft Corp.
Simmonds Aerocessories, Inc.
Spartan Aircraft Co.
Spriesch Tool and Mfg. Co.
Tennessee Aircraft, Inc.
Thompson Grinder Co.
United Aircraft Products, Inc.
Variety Aircraft Corp.
Victor Metal Products Corp.
Vidal Research Corp.
Voges Manufacturing Co.

SUPERCHARGERS

Clifford Manufacturing Co.
General Electric Co.
Lawrance Engineering & Research Co.
McCulloch Engineering Corp.
Thompson Grinder Co.
Turbo Engineering Corp.

TAIL WHEEL ASSEMBLIES

Aero Trades Co.
Air Associates, Inc.

(Tail Wheel Assemblies) ***Continued***
Air Transport Equipment, Inc.
Aircraft Mechanics, Inc.
Aircraft Products & Equipment Corp.
Aircraft Welders, Inc.
Bendix Aviation, Ltd.
Bendix Products Div.
Firestone Aviation Products Co.
Fulton Co.
General Aircraft Supply Corp.
General Tire & Rubber Co.
B. F. Goodrich Co.
Goodyear Aircraft Corp.
Heath Co.
National Aircraft Equipment Co.
Karl Ort
R E F Aircraft Corp.
Thompson Grinder Co.
Uniloy Accessories Corp.
Variety Aircraft Corp.

TANKS

Aero Trades Co.
Aircraft & Marine Specialty Co.
Aircraft Components, Inc.
Aircraft Welders, Inc.
All American Aircraft Products
Alpha Metal & Rolling Mills
Associated Foundries & Mfrs., Inc.
Benson Manufacturing Co.
Edward G. Budd Mfg. Co.
Chas. W. Carll Sons
Colgate-Larsen Aircraft Co.
Edwards Manufacturing Co.
Engel Aircraft Specialties
Firestone Aviation Products Co.
B. F. Goodrich Co.
Goodyear Aircraft Corp.
Harvey Machine Co.
Kirk & Blum Mfg. Co.
Leach Relay Co.
Mercury Aircraft, Inc.
Met-L-Wood Corp.
Pollak Manufacturing Co.
Porcupine Co.
R E F Aircraft Corp.
Spartan Aircraft Co.
Teicher Manufacturing Corp.
U. S. Rubber Co.

TIRES & TUBES

Firestone Aviation Products Co.
General Tire & Rubber Co.
B. F. Goodrich Co.
Goodyear Aircraft Corp.
Goodyear Tire & Rubber Co.
Karl Ort
U. S. Rubber Co.

TOOLS

Ace Hardware Mfg. Corp.
Aero Tool Co.
Aircraft Tools, Inc.
E. C. Atkins & Co.
Billings & Spencer Co.
Black & Decker Mfg. Co.
Blackhawk Manufacturing Co.
Bridgeport Hardware Mfg. Corp.
Buckeye Portable Tool Co.
Chamberlin Aircraft Co.
Cleveland Pneumatic Tool Co.
Dayton Tool & Engineering Co.
Denning Manufacturing Co.
Firth-Sterling Steel Co.
General Scientific Equipment Co.
Hayes Manufacturing Corp.
Herbrand Corp.
Imperial Brass Mfg. Co.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.
Knu-Vise, Inc.
Lufkin Rule Co.
McKenna Metals Co.
Irwin McNiece
Millers Falls Co.
National Aircraft Equipment Co.
Parker Stamp Works, Inc.
Peck-Stow & Wilcox Co.
Sal Metal Products Co.
Geo. Scherr Co.
A. Schrader's Son
Seiden Pneumatic Tool Co.
Sheffield Corp.
Anton Smit & Co.
Snap-On Tools Corp.
South Bend Lathe Works
L. S. Starrett Co.
George A. Terry Co.
Tungsten Electric Corp.
Utica Drop Forge & Tool Corp.
Wilkening Manufacturing Co.
Winter Brothers Co.

TUBING

Brasco Manufacturing Co.
Chicago Metal Hose Corp.

★★★ Aircraft Accessory Equipment

AN ECLIPSE CONTRIBUTION TO National Defense


U. S. AIR CORPS


U. S. NAVY


U. S. MARINE CORPS


U. S. COAST GUARD


U. S. ARMY

Significant is the fact, that for more than 20 years Eclipse Aviation has pioneered in the development and manufacture of accessory equipment for the United States Military Services.

Whether the need has been for equipment applications on the ground, at sea or in the air, Eclipse products have consistently proved their ability to fulfill the requirements of military service.

We are justifiably proud of this record of reliability, service and progress—and honored too at the part Eclipse Accessory Equipment is playing in the nation's fight for Victory.

AIRCRAFT ACCESSORY EQUIPMENT UTILIZED BY U. S. MILITARY SERVICES

ECLIPSE

ENGINE STARTERS: Inertia, Direct Cranking Electric, Combustion, Hand Turning Gears, Combination Direct Cranking Electric and Inertia.

STARTER ACCESSORIES: Battery Booster Coils, Solenoid Switches, Solenoid Engaging Devices, Control Switches, Magnetos, Energizers.

GENERATING EQUIPMENT: Single Voltage Generators, A. C. Alternators, Autosyn Alternators and Dynamotors, Radio Dynamotors, Filter Boxes, Control Panels and Boxes, Cutouts, Relays, Current Regulators.

VACUUM PUMP AND ICE-ELIMINATION EQUIPMENT: Air Valves, De-Icer Control Valves, De-Icer Distributing Valves, Suction Regulating Valves, Suction Relief Valves, Check Valves, Pressure Relief Valves, Oil Separators, Engine Driven Air Pumps, Propeller Anti-Icer Pumps.

HYDRAULIC EQUIPMENT: Engine Driven Hydraulic Pumps, Motor Driven Hydraulic Pumps, Hand Hydraulic Pumps, Hydraulic Remote Control Units.

MISCELLANEOUS ACCESSORY EQUIPMENT: Direct Reading Fuel Flowmeters, Retracting Motors, Supercharger Regulators, Automatic Mixture Controls, Propeller Governor Controls, Engine Synchroscope, Ammunition Rounds Counters and Contactors, Mechanical Engaging Solenoids, Auxiliary Engines, Auxiliary Power Supply Systems, Accessory Gear Boxes.

ECLIPSE AVIATION
DIVISION OF BENDIX AVIATION CORPORATION
BENDIX, NEW JERSEY, U. S. A.

(Tubing) *Continued*

Clifford Manufacturing Co.
Dayton Rubber Manufacturing Co.
Federal Metal Hose Corp.
Globe Steel Tubes Co.
Goodyear Aircraft Corp.
Johnson Rubber Co.
Manhattan Rubber Mfg. Div.
National Copper & Smelting Co.
Ohio Seamless Tube Co.
Packless Metal Products Corp.
Republic Steel Corp.
Joseph T. Ryerson & Son
Saylor Electric Products Corp.
Seamlex Co.
Searle Aero Industries, Inc.
Summerill Tubing Co.
Superior Tube Co.
Titeflex Metal Hose Co.
U. S. Rubber Co.
A. H. Wells & Co.
Wolverine Tube Co.

UNIFORMS & CLOTHING

Aero Leather Clothing Co.
Irving Air Chute Co.
H. D. Lee Mercantile Co.
Perry Sportswear, Inc.
Russell Uniform Co.
Willis & Geiger, Inc.

VALVES

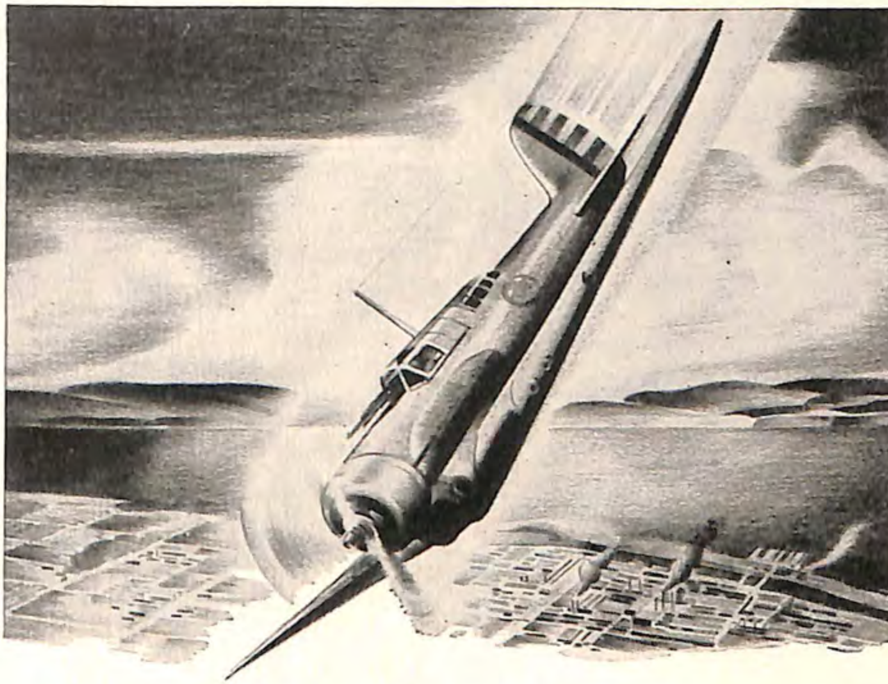
Acrotorque Co.
Adel Precision Products Corp.
Aero Supply Manufacturing Co.
Aeronautical Mfg. Corp.
Aircraft Accessories Corp.
Aircraft Engineering Products
Airesearch Manufacturing Co.
Aluminum Industries, Inc.
Aro Equipment Corp.
E. C. Atkins & Co.
Bendix Aviation, Ltd.
Cooper Alloy Foundry Co.
Dill Manufacturing Co.
Eaton Manufacturing Co.
Eclipse Aviation Div.
General Controls Co.
Goodyear Aircraft Corp.
Imperial Brass Mfg. Co.
Kenyon Instrument Co.
Koehler Tool & Mfg. Co.
Marquette Metal Products Co.
Minneapolis-Honeywell Regulator Co.
Moore-Eastwood & Co.
Karl Ort
Pacific Aviation, Inc.
Parker Appliance Co.
Pump Engineering Service Corp.
Romec Pump Co.
A. Schrader's Son
Thompson Products, Inc.
United Aircraft Products, Inc.
Vickers, Inc.
Walworth Co.
Weatherhead Co.

VENTILATING & AIR CONDITIONING EQUIPMENT

American Foundry & Furnace Co.
American Machine & Metals, Inc.
Anemostat Corp. of America
Brunner Manufacturing Co.
Bryant Heater Co.
Carrier Corp.
Despatch Oven Co.
Devilbiss Co.
Eclipse Fuel Engineering Co.
Edwards Manufacturing Co.
H. H. Robertson Co.
Seaman Paper Co.
Spencer Thermostat Co.
B. F. Sturtevant Co.
Young Radiator Co.

VIBRATION DAMPERS

Aircraft Accessories Corp.
Connecticut Hard Rubber Co.
Eclipse Aviation Div.
Goodyear Aircraft Corp.
Houde Engineering Corp.
Carl Hussman Engineers, Inc.
Imperial Brass Mfg. Co.
Johnson Rubber Co.
Lord Manufacturing Co.
Manhattan Rubber Mfg. Div.
Seamlex Co.
Thompson Grinder Co.
U. S. Rubber Co.

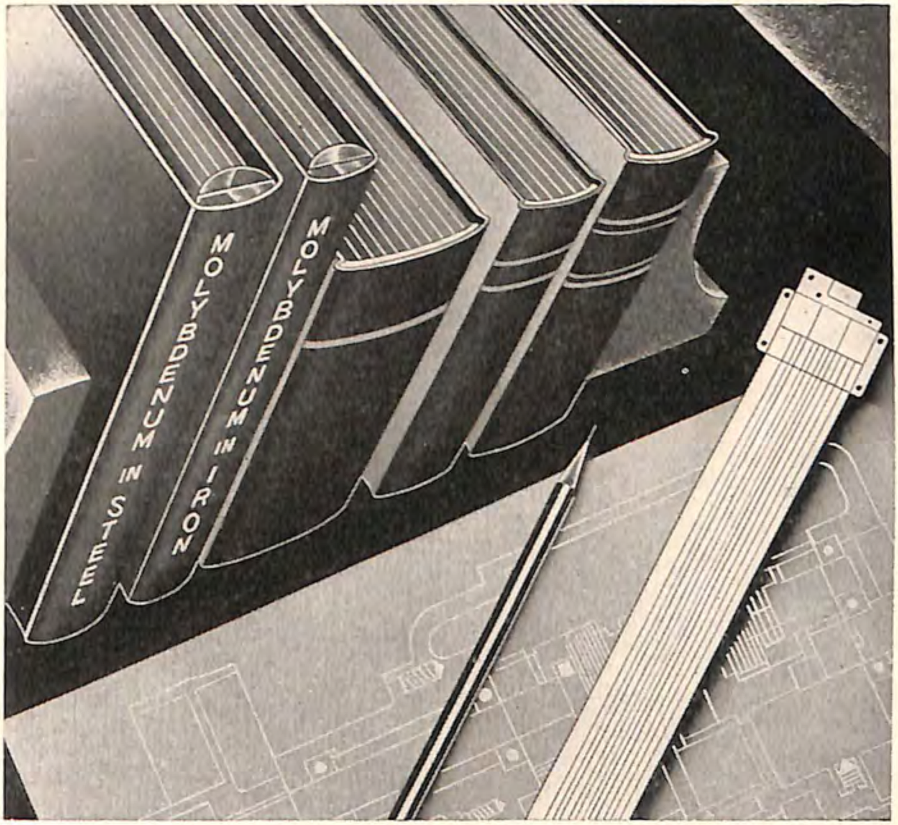


WHEELS AND BRAKES

Air Associates, Inc.
Bendix Products Div.
Cincinnati Shaper Co.
Firestone Aviation Products Co.
General Tire & Rubber Co.
B. F. Goodrich Co.
Goodyear Aircraft Corp.
Goodyear Tire & Rubber Co.
Hayes Industries, Inc.
Heath Co.
Variety Aircraft Corp.

MISCELLANEOUS

Acrotorque Co.
Air Reduction Sales Co.
Aircraft Hardware Mfg. Co.
Aircraft Screw Products Co.
Alofs Manufacturing Co.
American Steel & Wire Co.
Anchor Post Fence Co.
Apex Machine & Tool Co.
Armstrong Cork Co.
Semon Bache & Co.
Backstay Welt Co.
Baker Industrial Truck Div.
Brush Development Co.
Celanese Celluloid Corp.
John Chatillon & Sons
Clark Tructractor Div.
Cleveland Tractor Co.
Commonwealth Industries, Inc.
Davison Chemical Corp.
Denning Manufacturing Co.
Dycer Aviation Supplies
Exact Weight Scale Co.
Fahlin Manufacturing Co.
A. B. Farquhar Co.
Farrel-Birmingham Co.
Fellows Gear Shaper Co.
Fibre Conduit Co.
Frick-Gallagher Mfg. Co.
Fuel Injection Corp.
Gardner Propeller Co.
General Aircraft Equipment, Inc.
Granberg Equipment, Inc.
Gwinn Aircar Co.
Hammond Aircraft Co.
Hobby Model Mfg. Co.
Holo-Krome Screw Corp.
Homestead Insulation Co.
E. F. Houghton & Co.
Hydraulic Press Mfg. Co.
Irvington Varnish & Insulator Co.
I. Jacoel Cable Splicing Equipment Co.
Jardur Import Co.
Johns-Manville Sales Corp.
Johnson-National Insignia Co.
Kester Solder Co.
Leeds & Northrup Co.
Lisle Corp.
Macwhyte Co.
Magnaflux Corp.
Miller Rubber Co.
Modern Engineering Co.
Monite Waterproof Glue Co.
Olmstead Manufacturing Co.
C. F. Pease Co.
Plaskon Co.
Protectoseal Co. of America
Radiator Specialty Co.
Resistoflex Corp.
Sal Metal Products Co.
Schlegel Manufacturing Co.
Snap-On Tools Corp.
Sparks-Withington Co.
Standard Machinery Co.
Star Pattern Works
Telautograph Corp.
Templeton, Kenly & Co.
Triplett & Barton, Inc.
Uniform Hood Lace Co.
Union Manufacturing Co.
United States Gauge Co.
Weems System of Navigation
Western Automatic Machine Screw Co.
Western Machine Co.
Winter Brothers Co.


MOLYBDENUM IN STEEL
MOLYBDENUM IN IRON

ALPHABETICAL DIRECTORY OF MANUFACTURERS

MANUFACTURERS OF AIRCRAFT

AGA AVIATION CORP.,
Pitcairn Field, Willow Grove, Pa.
PERSONNEL: Virgil H. Frazier, Pres. & Gen. Mgr.; Paul Thomas, V. Pres. & Secy.; George B. Knecht, Treas.; K. G. Funk, Pur. Agt.

AERONCA AIRCRAFT CORP.,
Municipal Airport, Middletown, O.
PERSONNEL: Carl Friedlander, Pres. & Gen. Mgr.; John Friedlander, V. Pres.; G. L. Hoffman, Secy.; Albert Helmers, Treas.; L. H. Smith, Sales Mgr.; E. H. Wideman, Pur. Agt.; W. Mitchell, Pub. Dir.

AIR TRANSPORT MANUFACTURING CO., LTD., 614 W. Colorado Blvd., Glendale, Calif.
PERSONNEL: E. L. Hollywood, Pres. & Gen. Mgr.; A. K. Peterson, V. Pres.; Conant Wait, Secy.; Fred J. Vandenbosh, Treas.

AMERICAN EAGLECRAFT CO.,
Fort Worth, Tex.
PERSONNEL: V. A. Robinson, Pres. & Gen. Mgr.; H. E. Stevenson, V. Pres. & Sales Mgr.; E. D. Robinson, Secy. & Treas.; M. J. Stevenson, Pers. Dir. & Pub. Dir.

BABCOCK AIRCRAFT CORP., DeLand, Fla.
PERSONNEL: M. B. Harvey, Pres.; V. C. Babcock, V. Pres.; W. H. Deegan, Jr., Secy.; D. R. Moul, Pur. Agt.

BEECH AIRCRAFT CORP., Wichita, Kans.
PERSONNEL: W. H. Beech, Pres.; John P. Gaty, T. A. Wells, R. K. Beech, V. Pres.; O. A. Beech, Secy. & Treas.; Carl B. Wootten, Sales Mgr.; W. E. Blazier, Pers. Dir.; W. H. McDaniel, Pub. Dir.

BELL AIRCRAFT CORP.,
2050 Elmwood Ave., Buffalo, N. Y.
PERSONNEL: Lawrence D. Bell, Pres. & Gen. Mgr.; Ray P. Whitman, V. Pres.; Charles L. Beard, Secy. & Treas.; V. J. Dolan, Pur. Agt.; Paul M. Grezelle, Pers. Dir.; Fred R. Neely, Asst. Secy.

BOEING AIRCRAFT CO., Seattle, Wash.
PERSONNEL: P. G. Johnson, Pres.; H. O. West, V. Pres.; H. E. Bowman, Secy. & Treas.; F. P. Laudan, Gen. Supt.; E. B. Collins, Sales Mgr.; C. B. Gracey, Pur. Agt.; Paul Frederickson, Pers. Dir.; Harold Mansfield, Pub. Dir.

BREWSTER AERONAUTICAL CORP.,
Northern Blvd. at 35th, Long Island City, N. Y.
PERSONNEL: Ralph M. Singer, Pres. & Gen. Mgr.; George F. Chapline, V. Pres.; John R. Hunt, Secy. & Treas.; E. J. Walsh, Pers. Dir.; Z. Soucek, Sales Mgr.; W. M. Grampp, Pur. Agt.

BRIEGLEB AIRCRAFT CO., INC.,
16005 Bassett St., Van Nuys, Calif.
PERSONNEL: Wm. G. Briegleb, Pres., Gen. Mgr. & Pers. Dir.; E. W. Hill, V. Pres.; D. A. Matlin, Secy.; R. Monroe, Treas.; A. W. Black, Sales Mgr.; Paul Hepburn, Pur. Agt.

CENTRAL AIRCRAFT CORP.,
Locust & Walnut Sts., Keyport, N. J.
PERSONNEL: Preston M. Neilson, Pres.; Thos. E. Curry, Secy. & Treas.; C. F. Mullen, Pub. Rel. Dir.; Murray Berkow, Ch. Eng.

CESSNA AIRCRAFT CO., Wichita, Kans.
PERSONNEL: Dwane L. Wallace, Pres. & Gen. Mgr.; Tom Salter, V. Pres.; Dwight S. Wallace, Secy. & Treas.; Don Flower, Sales Mgr.; Wm. Whipple, Pur. Agt.; Myron Russ, Pers. Dir.; Prentiss Cleaves, Adv. Dir.

CONSOLIDATED AIRCRAFT CORP.,
Lindbergh Field, San Diego, Calif.
PERSONNEL: Harry Woodhead, Pres.; R. W. Millar, Exec. V. Pres.; R. A. Stanberry, Secy.; W. M. Shanahan, Treas.; I. M. Laddon, Gen. Mgr.; J. H. Waterbury, Pers. Dir.; E. N. Gott, Pub. Rel. Dir.; J. W. Thompson, Pub. Dir.

CULVER AIRCRAFT CORP.,
600 E. 35th St., Wichita, Kans.
PERSONNEL: C. G. Yankey, Pres.; W. H. Beech, V. Pres. & Gen. Mgr.; V. M. Laing, Secy.; F. M. Farrell, Treas.; T. B. Woodbury, Sales Mgr.; R. C. Faris, Pur. Agt.; H. S. Kinsley, Pers. Dir.

CUNNINGHAM-HALL AIRCRAFT CORP.,
13 Canal St., Rochester, N. Y.
PERSONNEL: F. E. Cunningham, Pres. & Sales Mgr.; A. J. Cunningham, V. Pres.; R. Morgan, Secy.; J. W. Fulreader, Treas.; J. D. Finneran, Pers. Dir.

CURTISS-WRIGHT CORP.,
30 Rockefeller Plaza, New York, N. Y.
PERSONNEL: Guy W. Vaughan, Pres.; J. S. Allard, R. L. Earle, C. W. France, W. F. Goulding, M. B. Gordon, C. W. Loos, J. A. B. Smith, Burdette S. Wright, V. Pres.; E. S. Cramer, Secy. & Treas.; H. E. Lawrence, Dir. Pub. Rel. & Adv.; Mark E. Nevils, Pub. Dir.

CURTISS-WRIGHT CORP., AIRPLANE DIV., Buffalo, N. Y.
PERSONNEL: Burdette S. Wright, V. Pres. in Charge; James C. Evans, Asst. Secy.; George S. Lapp, Asst. Treas.; F. A. Maley, Pur. Dir.; C. S. Mattoon, Pers. Dir.
Plants One and Two
PERSONNEL: Burdette W. Wright, Gen. Mgr.; C. S. Mattoon, Pers. Dir.
Plant Three,
PERSONNEL: J. A. Williams, Gen. Mgr.; W. F. O'Brien, Pers. Dir.
Plant Four,
PERSONNEL: C. W. France, Gen. Mgr.; O. L. Allman, Pers. Dir.

DOAK AIRCRAFT CO., INC., 1559 Sepulveda Blvd., Hermosa Beach, Calif.
PERSONNEL: E. R. Doak, Pres. & Gen. Mgr.; W. C. Deeds, V. Pres.; R. H. Parkin, Secy. & Treas.; S. F. Hinchliffe, Sales Mgr.; G. A. Cook, Pur. Agt.

DOUGLAS AIRCRAFT CO., INC., Santa Monica, Calif.
PERSONNEL: Donald W. Douglas, Pres.; C. A. Cover, V. Pres.; T. C. McMahon, Secy.; H. P. Grube, Treas.; A. M. Rochlen, Dir. Pub. Rel.; S. O. Porter, Pers. Dir.; C. T. Reid, Educ. Dir.; John M. Rogers, Sales Mgr.

ENGINEERING & RESEARCH CORP., Riverdale, Md.
PERSONNEL: H. A. Berliner, Pres.; L. A. Wells, V. Pres.; M. W. King, Secy.; W. G. Carroll, Treas.

FAIRCHILD AIRCRAFT DIVISION, FAIRCHILD ENGINE & AIRPLANE CORP., Park Lane, Hagerstown, Md.
PERSONNEL: J. Carlton Ward, Jr., Pres.; R. S. Boutelle, Gen. Mgr.; W. H. Schwebel, Secy.-Treas.; A. F. Flood, Asst. Secy. & Treas.; A. M. Brown, Sales Mgr.; E. B. Ormond, Pur. Agt.; John Stuart, Pub. Rel. Dir.

FLEETWINGS, INC., Bristol, Pa.
PERSONNEL: Frank de Ganahl, Pres.; Carl de Ganahl, I. S. Wilson, V. Pres.; C. M. Kaltwasser, Gen. Mgr.; A. R. Relinger, Pur. Agt.; W. E. Strang, Pers. Dir.; Paul F. Biklen, Pub. Rel. Dir.

FLETCHER AVIATION CORP., 190 W. Colorado, Pasadena, Calif.
PERSONNEL: W. S. Fletcher, Pres.; Frank P. Fletcher, V. Pres. & Gen. Mgr.; M. C. Fletcher, Secy., Treas., & Sales Mgr.; D. D. Williams, Pur. Agt.; Stuart Leavell, Pers. Dir.

FRANKFORT SAILPLANE CO., Joliet, Ill.
PERSONNEL: James J. Smiley, Jr., Pres. & Gen. Mgr.; S. R. Corcoran, V. Pres.; Bruce C. Hightower, Secy. & Treas.; E. F. Mangold, Pur. Agt.; W. Paul Resop, Pers. Dir. & Pub. Dir.

THE GENERAL AIRCRAFT CORP., Lowell Airport, S. Lowell, Mass.
PERSONNEL: O. C. Koppen, V. Pres.; K. I. Deane, Secy.; J. T. Geuting, Jr., Treas. & Pub. Dir.; H. Fahnestock, Jr., Gen. Mgr.

GLOBE AIRCRAFT CORP., Box 4277 North Side Station, Fort Worth, Tex.
PERSONNEL: John Kennedy, Pres.; Wm. Viner, V. Pres.; C. D. Reimers, Secy. & Treas.; E. J. Rivers, Fact. Mgr.; E. H. Jackson, Sales Mgr. & Pub. Dir.; J. E. James, Pur. Agt. & Pers. Dir.

GRUMMAN AIRCRAFT ENGINEERING CORP., Bethpage, N. Y.
PERSONNEL: Leroy R. Grumman, Pres.; L. A. Swirbul, V. Pres.; E. W. Poor, Treas.; Joseph A. Stamm, Secy.; Paul Gilbert, Pers. Dir.

HARLOW AIRCRAFT CO., Alhambra Airport, Alhambra, Calif.
PERSONNEL: E. M. Allison, Pres.; Frank Der Yuen, V. Pres. & Gen. Mgr.; D. C. Mendenhall, Ch. Eng.; M. J. Hoffman, Prod. Mgr.

HELICOPTER CORPORATION OF AMERICA, 36 W. 44th St., New York, N. Y.
PERSONNEL: B. Sergievsky, V. Pres.; Watson Washburn, Secy. & Treas.

HOWARD AIRCRAFT CORP., Chicago, Ill.
PERSONNEL: B. D. DeWeese, Pres.; C. W. Freitag, V. Pres.; H. E. Greene, Secy. & Treas.; S. C. Senyard, Pur. Agt.; S. G. Petzold, Pers. Dir.

HUGHES AIRCRAFT CO., Florence Ave. at Teale St., Culver City, Calif.
PERSONNEL: Howard R. Hughes, Pres.; Noah Dietrich, Secy.; Glenn E. Odekirk, Plant Mgr.; Earl W. Daley, Pur. Agt.; T. H. Sisk, Pers. Dir.

INTERSTATE AIRCRAFT & ENGINEERING CORP., 2600 W. Imperial Highway, El Segundo, Calif.
PERSONNEL: Don P. Smith, Pres. & Gen. Mgr.; W. E. Hirtensteiner, W. A. Hite, V. Pres.; L. B. Cameron, Secy. & Treas.; L. A. Kavanaugh, Sales Mgr.; R. B. Powell, Pur. Agt.; R. W. Limacher, Pers. Dir.; H. Holmes, Pub. Dir.

KELLETT AUTOGIRO CORP., 58th & Grays Ave., Philadelphia, Pa.
PERSONNEL: W. W. Kellett, Pres.; R. G. Kellett, R. H. Prewitt, V. Pres. W. F. Palmer, Secy. & Treas.; S. P. Lyon, Gen. Mgr.; W. V. Trelease, Sales Mgr.; C. Sprague, Pers. Dir.; L. B. Cooper, Pub. Dir.

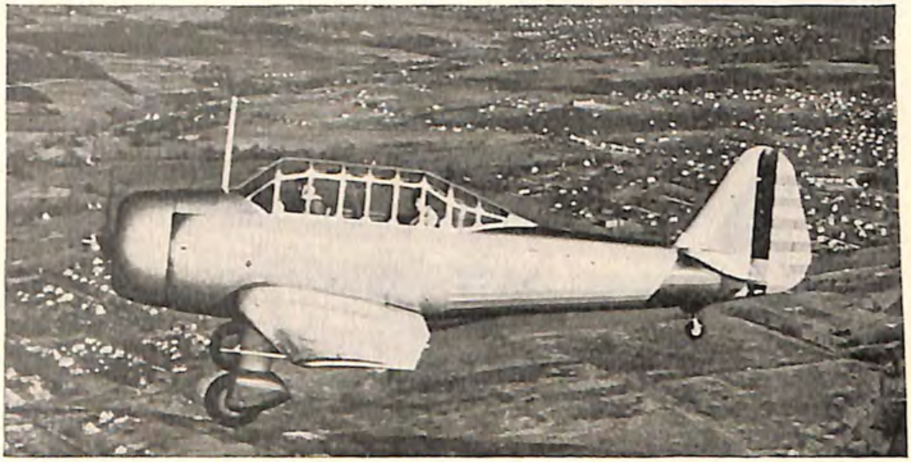
LANGLEY AVIATION CORP., 30 Rockefeller Plaza, New York, N. Y.
PERSONNEL: C. S. Bragg, Pres.; A. F. Draper, V. Pres.; F. W. Potts, Secy. & Treas.;

LOCKHEED AIRCRAFT CORP., 1705 Victory Pl., Burbank, Calif.
PERSONNEL: Robert E. Gross, Pres.; C. A. Barker, Jr., V. Pres. & Treas.; Carl B. Squier, Sales Mgr.; Cyril Chappellet, Secy.; Leonard Schwartz, Dir. Pub. Rel.; Bert W. Holloway, Pub. Dir.

LOS ANGELES AIRCRAFT CORP., 5015 Wilshire Blvd., Los Angeles, Calif.
PERSONNEL: F. J. Buckley, Pres.; A. M. Peters, Secy.

LUSCOMBE AIRPLANE CORP., West Trenton, N. J.
PERSONNEL: J. H. Torrens, Pres.; L. H. P. Klotz, V. Pres.; R. H. Johnson, Secy. & Treas.; C. E. Burgess, Prod. Mgr.; R. H. Washburn, Sales Mgr.; L. K. Collingwood, Pur. Agt.; L. P. Taylor, Pers. Dir.

THE GLENN L. MARTIN CO., Middle River, Md.
PERSONNEL: Glenn L. Martin, Pres.; T. H. Jones, Secy.; M. G. Shook, Treas.; J. T. Hartson, H. F. Vollmer, W. K. Ebel, V. Pres.; Harry Rowland, Sales Mgr.; C. W. Chidester, Pur. Agt.; D. W. Siemon, Pers. Dir.; Avery McBee, Pub. Dir.



McDONNELL AIRCRAFT CORP.,
Lambert Field, Robertson, Mo.
PERSONNEL: J. S. McDonnell, Pres.; G. W. Carr, V. Pres.; L. A. Smith, Secy. & Treas.; J. S. McDonnell, Sales Mgr.; W. L. Desloge, Pur. Agt.; E. H. Neff, Pers. Dir.

MEYERS AIRCRAFT CO., Tecumseh, Mich.
PERSONNEL: A. H. Meyers, Pres. & Gen. Mgr.; H. Bender, V. Pres.; B. W. Hoffman, Secy., Treas., & Pur. Agt.; F. R. Palmer, Sales Mgr. & Pub. Dir.; R. P. Betzoldt, Pers. Dir.

MONOCOUPE DIVISION UNIVERSAL MOULDED PRODUCTS CORP.,
Orlando, Fla.
PERSONNEL: Thomas H. McKoy, Jr., Ch. of Board; Eugene A. Hults, Pres.; Clare W. Bunch, V. Pres. & Gen. Mgr.; R. L. Reed, Secy.; A. R. Bell, Jr., Treas.

MORTON AIRCRAFT CORP., Omaha, Nebr.
PERSONNEL: G. R. Morton, Pres.; J. H. Hefti, V. Pres., Gen. Mgr., Sales Mgr., Pers. Dir. & Pub. Dir.; Emily Allen, Secy. & Treas.; C. P. Bancroft, Pur. Agt.

PHILLIPS AVIATION CO.,
412 W. 6th St., Los Angeles, Calif.
PERSONNEL: J. A. Phillips, Jr., Pres., Gen. Mgr. & Sales Mgr.; F. R. Phillips, V. Pres.; L. M. Phillips, Secy. & Treas.; T. P. Watson, Pur. Agt.; C. H. Wilkins, Pers. Dir. & Pub. Dir.

NASHVILLE DIVISION OF VULTEE AIRCRAFT, INC., Nashville, Tenn.

NORTH AMERICAN AVIATION, INC.
5701 Imperial Highway, Inglewood, Calif.
PERSONNEL: J. H. Kindelberger, Pres.; J. L. Atwood, V. Pres. & Gen. Mgr.; L. R. Beardslee, Secy.; R. A. Lambeth, Treas.; R. L. Burla, Dir. Pub. Rel.; Marshall E. Beaman, Ind. Rel.

NORTHROP AIRCRAFT, INC.,
Northrop Field, Hawthorne, Calif.
PERSONNEL: LaMotte T. Cohu, Gen. Mgr.; John K. Northrop, Pres.; G. H. Irving, V. Pres.; Theodore C. Coleman, Sales Mgr.; Moye W. Stephens, Secy.; Claude N. Monson, Treas.; J. Lyle Manion, Dir. Pub. Rel.; W. T. Gage, Pers. Dir.; P. I. Chase, Pur. Agt.

PIPER AIRCRAFT CORP., Lock Haven, Pa.
PERSONNEL: W. T. Piper, Pres., Treas., & Gen. Mgr.; T. V. Weld, V. Pres.; W. T. Piper, Jr., Secy.; W. B. St. John, Sales Mgr.; R. McKissick, Pur. Agt.; H. Herritt, Pers. Dir.; W. B. Strohmeier, Pub. Dir.

PLATT-LePAGE AIRCRAFT CO.,
Eddystone, Pa.
PERSONNEL: W. L. LePage, Pres.; H. A. Platt, V. Pres.; E. C. Cheston, Secy.; E. E. Denniston, Pur. Agt.

REARWIN AIRCRAFT & ENGINES, INC.,
Fairfax Airport, Kansas City, Kans.
PERSONNEL: R. A. Rearwin, Pres.; R. S. Rearwin, V. Pres.; K. R. Rearwin, Secy. & Treas.; J. E. Vigus, Gen. Mgr.; W. B. MacWhirter, Sales Mgr.; F. K. Kerns, Pur. Agt.

REPUBLIC AVIATION CORP.,
Farmingdale, N. Y.
PERSONNEL: R. S. Damon, Pres.; A. Kartveli, C. H. Miller, H. W. Flickinger, V. Pres.; T. Davis, Secy. & Treas.; P. R. Shays, Pers. Dir.; W. L. Wilson, Pub. Rel. Dir.

RYAN AERONAUTICAL CO.,
Lindbergh Field, San Diego, Calif.
PERSONNEL: T. Claude Ryan, Pres.; Treas. & Gen. Mgr.; Earl D. Prudden, V. Pres.; E. A. Smith, Secy.; S. C. Breder, Sales Mgr.; Fred Ford, Pur. Agt.; M. Marco, Pers. Dir.; William Wagner, Pub. Dir.

ST. LOUIS AIRCRAFT CORP.,
8000 N. Broadway, St. Louis, Mo.
PERSONNEL: Edwin B. Meissner, Pres. & Gen. Mgr.; N. L. Rehnquist, V. Pres.; J. F. Tringl, Secy.; E. Augustine, Treas.; W. A. Fitzgerald, Pur. Agt.

SCHWEIZER AIRCRAFT CORP.,
Prescott Ave., Elmira Heights, N. Y.
PERSONNEL: E. Schweizer, Pres. & Secy.; Paul A. Schweizer, V. Pres. & Treas.; Wm. I. Brown, Pur. Agt.

SOUTHERN AIRCRAFT CORP.,
Garland, Tex.
PERSONNEL: W. C. Brown, Pres. & Gen. Mgr.; A. E. Pattison, V. Pres. & Treas.; F. H. Brown, Secy. & Pers. Dir.; L. D. Barnhill, Pur. Agt.

SPARTAN AIRCRAFT CO.,
1900 N. Sheridan Rd., Tulsa, Okla.
PERSONNEL: W. G. Skelly, Pres.; M. W. Balfour, V. Pres.; F. T. Hopp, Secy. & Treas.; R. E. Brown, Gen. Mgr.; H. K. Powell, Pur. Agt.

STINSON AIRCRAFT DIV. OF VULTEE AIRCRAFT, INC., Wayne, Mich.
PERSONNEL: J. E. I'Anson, Works Mgr.; W. A. Mara, Sales Mgr.; A. C. Schwalm, Pur. Agt.; Ray C. Jolly, Pers. Dir.

SWALLOW AIRPLANE CO., INC.,
917 E. Lincoln, Wichita, Kans.
PERSONNEL: Sam Bloomfield, Pres. & Gen. Mgr.; Solon Burgess, V. Pres.; Morris H. Cundiff, Secy. & Treas.; L. R. Wilson, Sales Mgr.

TAYLORCRAFT AVIATION CORP.,
Alliance, O.
PERSONNEL: C. G. Taylor, Chairman; R. H. Depew, Jr., V. Pres. & Treas.; D. L. Zacharias, Secy.; C. W. Elkins, Sales Mgr.; R. M. Carlson, Ch. Eng.; F. G. Osgood, Works Mgr.; K. W. Tibbits, Prod. Mgr.; M. W. Third, Pers. Mgr.; J. F. Masterson, Pub. Rel. Dir.

TIMM AIRCRAFT CORP.,
8055 Woodley Ave., Van Nuys, Calif.
PERSONNEL: Otto W. Timm, Pres.; F. E. Dent, V. Pres.; G. Shrader, Secy. & Treas.; J. P. Davies, Sales Mgr.; A. J. Van Pelt, Jr., Pur. Agt.; E. R. Harman, Pers. Dir.; Wilson Silsby, Pub. Dir.

WALLY TIMM CO., Grand Central Air Terminal, 1020 Airway, Glendale, Calif.
PERSONNEL: Wally Timm, Owner; J. R. Thuerer, Pur. Agt.; V. Summerhays, Pers. Dir.; J. K. Highley, Prod. Mgr.; R. E. White, Auditor.

VEGA AIRPLANE CORP., 923 E. San Fernando Blvd., Burbank, Calif.
PERSONNEL: C. S. Gross, Pres.; C. A. Barker, Jr., V. Pres.; Cyril Chappellet, Secy.; Robert E. Gross, Treas.; Carl B. Squier, Sales Mgr.; Leonard K. Schwartz, Dir. Pub. Rel.; K. E. French, Pur. Agt.

VOUGHT-SIKORSKY AIRCRAFT DIVISION OF UNITED AIRCRAFT CORP., Stratford, Conn.
PERSONNEL: C. J. McCarthy, Gen. Mgr.; J. J. Gaffney, Asst. Secy. & Treas.; E. W. Dichman, Sales Mgr.; Norman V. Clements, Pub. Dir.; C. E. Berg, Pur. Agt.

VULTEE AIRCRAFT, INC., Vultee Field, Calif.
PERSONNEL: Tom M. Girdler, Ch. of Board; R. W. Millar, Pres.; H. Woodhead, Exec. V. Pres.; V. C. Schorlemmer, R. W. Palmer, D. I. Carroll, W. E. Burdick, Hugh Fenwick, L. I. Hartmeyer, V. Pres.; T. C. Sullivan, Secy.; L. K. Grant, Treas.; Ross Laughlin, Pur. Agt.; W. G. Tuttle, Pers. Dir.

THE WACO AIRCRAFT CO., Troy, O.
PERSONNEL: C. J. Brukner, Pres.; H. R. Perry, V. Pres. & Sales Mgr.; L. E. St. John, Secy.; R. E. Hoefflin, Treas.; W. D. Wigmore, Pur. Agt.; A. N. Conard, Pers. Dir.; A. L. Riggs, Pub. Dir.

WICHITA DIVISION, BOEING AIRPLANE CO., Wichita, Kans.
PERSONNEL: J. E. Schaefer, V. Pres. & Gen. Mgr.

MANUFACTURERS OF AIRCRAFT ENGINES

AIRCOOLED MOTORS CORP., Liverpool Rd., Syracuse, N. Y.
PERSONNEL: L. E. Pierson, Jr., Pres.; C. T. Doman, V. Pres.; C. R. Tuckerman, Secy. & Treas.; C. F. B. Roth, Sales Mgr.; F. L. Howard, Pur. Agt.

ALLIED AVIATION CORP., Metropolitan Airport, Van Nuys, Calif.
PERSONNEL: J. L. Cohn, Pres. & Gen. Mgr.; J. J. Sheridan, V. Pres.; Elmer Heller, Secy. & Treas.; Morris P. Carr, Pur. Agt.

ALLISON DIVISION, GENERAL MOTORS CORP., Indianapolis, Ind.
PERSONNEL: F. C. Kroeger, Gen. Mgr.

CONTINENTAL MOTORS CORP., Muskegon & Detroit, Mich.
PERSONNEL: C. J. Reese, Pres.; B. F. Tobin, Jr., V. Pres. & Secy.; H. W. Vandeven, Treas.; C. J. Reese, Gen. Mgr.; D. H. Hollowell, Sales Mgr.; E. P. Gallagher, Pur. Agt.; J. J. Baker, Pers. Dir.; J. L. Wierengo, Pub. Dir.

JACOBS AIRCRAFT ENGINE CO., Pottstown, Pa.
PERSONNEL: C. J. Abbott, Pres.; J. Story Smith, V. Pres. & Secy.; H. B. Knerr, Treas.; C. E. Collander, Pur. Agt.; C. E. Heitman, Pers. Dir.

KINNER MOTORS, INC., Glendale, Calif.
PERSONNEL: B. B. Robinson, Pres.; G. Brashears, V. Pres.; V. E. Semrau, Secy. & Treas.; Earl Herring, Gen. Mgr.; G. Edenquist, Sales Mgr.; Ralph Lee, Pur. Agt.; John B. Shaw, Pub. Dir.

LYCOMING DIV., THE AVIATION CORP., 652 Oliver St., Williamsport, Pa.
PERSONNEL: V. Emanuel, Pres.; W. F. Wise, V. Pres.; L. I. Hartmeyer, V. Pres.; R. S. Pruitt, Secy.; W. A. Mogensen, Treas.; W. K. Cooper, Sales Mgr.

MENASCO MANUFACTURING CO., 805 E. San Fernando Rd., Burbank, Calif.
PERSONNEL: R. Insley, J. Royall, O. E. Mohler, V. Pres.; Robert Miller, Secy.; E. C. Carlson, Treas.; G. B. Taylor, Pur. Agt.

PACKARD MOTOR CAR CO., 1580 E. Grand Blvd., Detroit, Mich.
PERSONNEL: M. M. Gilman, Pres.; W. M. Packer, V. Pres.; H. J. Ferry, Secy. & Treas.; G. T. Christopher, Gen. Mgr.; J. H. Marks, Pur. Agt.; C. E. Weiss, Pers. Dir.; C. M. Vanderburg, Pub. Dir.

PHILLIPS AVIATION CO., 412 W. 6th St., Los Angeles, Calif.
PERSONNEL: J. A. Phillips, Jr., Pres. & Gen. Mgr.; F. R. Phillips, V. Pres.; L. M. Phillips, Secy. & Treas.; T. P. Watson, Pur. Agt.; C. H. Wilkins, Pers. Dir. & Pub. Dir.

PRATT & WHITNEY AIRCRAFT, DIV. OF UNITED AIRCRAFT CORP., 400 S. Main St., E. Hartford, Conn.
PERSONNEL: H. Mansfield Horner, Gen. Mgr.; H. L. Hartman, Asst. Secy.; W. R. Robbins, Asst. Treas.; T. E. Tillinghast, Sales Mgr.; Norman V. Clements, Pub. Mgr.; J. W. Dunnell, Pur. Agt.

RANGER AIRCRAFT ENGINES, DIV. OF FAIRCHILD ENGINE & AIRPLANE CORP., Farmingdale, N. Y.
PERSONNEL: J. Carlton Ward, Jr., Pres.; D. B. Cox, V. Pres. & Gen. Mgr.; W. H. Schwebel, Secy. & Treas.; S. A. McClellan, Sales Mgr.; B. F. Lickey, Pers. Dir.; John Stuart, Pub. Dir.

REARWIN AIRCRAFT & ENGINES, INC., Fairfax Airport, Kansas City, Kans.
PERSONNEL: R. A. Rearwin, Pres.; R. S. Rearwin, V. Pres.; K. R. Rearwin, Secy. & Treas.; J. E. Vigus, Gen. Mgr.; W. B. MacWhirter, Sales Mgr.; F. K. Kerns, Pur. Agt.

THE WARNER AIRCRAFT CORP., 20263 Hoover Ave., Detroit, Mich.
PERSONNEL: W. O. Warner, Pres. & Gen. Mgr.; L. A. Faunce, L. A. Majneri, V. Pres.; W. J. Jarvie, Secy. & Treas.

WRIGHT AERONAUTICAL CORP., 132 Beckwith Ave., Paterson, N. J.
PERSONNEL: G. W. Vaughan, Pres.; J. A. B. Smith, V. Pres.; C. C. King, Treas.; E. S. Cramer, Secy.; W. W. Bishop, Pers. Dir.; Philip H. Gustafson, Pub. Dir.

MANUFACTURERS OF ACCESSORIES, PARTS AND SUPPLIES

A

ABRAMS INSTRUMENT CO., 606 E. Shiawassee St., Lansing, Mich.
PERSONNEL: Talbert Abrams, Pres. & Sales Mgr.; L. Abrams, Secy.; F. G. Christensen, Treas.; W. S. Karr, Gen. Mgr. & Pers. Dir.; E. P. Chaddock, Pur. Agt.
PRODUCTS: Stereoscopes; Contour finders; Intervalometers; Precision instruments.

Instruments


Motors


Dynamotors


Control Devices


Superchargers


Radio


Switches


Voltage Regulators


Generators

PRECISION-BUILT ELECTRIC EQUIPMENT FOR PRECISION-BUILT AIRCRAFT

IN designing and building G-E accessories for aircraft, our goal is to exceed the precision requirements which are required of accessories for high-performance aircraft. Careful attention is paid to close tolerances. High-quality materials are used, with accurate laboratory control of details that affect size and weight. Capable workmen and excellent facilities assure you of well-built devices. For information on the accessories shown here or on other types of electric equipment for your planes or plants, get in touch with our nearest office. Or write General Electric, Schenectady, N. Y.

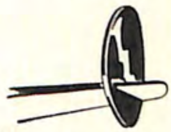
GENERAL ELECTRIC

640-70

Helping Democracy achieve more safe miles in the air!

B. F. Goodrich Airplane Silvertowns—"the safest airplane tires ever built."

B. F. Goodrich Expander Tube Brakes for greater ground control.



B. F. Goodrich De-Icers—to help prevent ice formation on wings, tail and rubber surfaces, etc.

B. F. Goodrich Parachute Seats—Bullet-Sealing Fuel Tanks—Bullet-Sealing Hose—Rivnuts.

For full information about any of the 50 different B. F. Goodrich rubber products now serving the aviation industry, write to B. F. Goodrich, Aeronautical Sales Dept., Akron, Ohio, or Los Angeles, California.

Fly with

BF Goodrich

FIRST IN RUBBER

ACE HARDWARE MFG. CORP.,
20198 Orleans St., Philadelphia, Pa.
PERSONNEL: George Jones, Pres., Treas. & Gen. Mgr.; F. G. Schutz, V. Pres.; A. W. Engel, Secy. & Pur. Agt.; F. C. Loesche, Pers. Dir.
PRODUCTS: Machine parts; Tools; Stampings; Assemblies.

ACME WHITE LEAD & COLOR WORKS,
8250 St. Aubin St., Detroit, Mich.
PERSONNEL: C. A. Campbell, V. Pres. & Gen. Mgr.; F. L. Knapp, Secy.; R. H. Stephens, Treas.; A. J. Reiss, Sales Mgr.; W. T. Glidden, Pur. Agt.; J. Mitchell, Pers. Dir.; F. J. Schulte, Pub. Dir.
PRODUCTS: Primers; Paints and varnishes; Lacquers; Enamels.

THE ACROTORQUE CO.,
4815 Lexington Ave., Cleveland, O.
PERSONNEL: G. P. Day, Pres. & Treas.; E. D. Jackson, V. Pres., Secy. & Gen. Mgr.; R. S. Atkinson, Mgr.; J. W. Griggs, Pur. Agt.
PRODUCTS: Valves; Windshield wipers.

ACTUS PRODUCTS CORP.,
14 N. Bleeker St., Mount Vernon, N. Y.
PERSONNEL: C. W. Prochaska, Pres.; H. Mc Cahan, V. Pres.; J. M. Regan, Secy.; H. McCarthy, Treas.
PRODUCTS: Clamps.

ADEL PRECISION PRODUCTS CORP.,
10777 Van Owen St., Burbank, Calif.
PERSONNEL: H. R. Ellinwood, Pres.; H. E. Webb, V. Pres.; P. M. Dollard, Secy. & Treas.; J. L. Reynolds, Gen. Mgr.; R. L. Freeman, Sr., Pur. Agt.; R. S. Furst, Pers. Dir.
PRODUCTS: Clamps; Controls; Anti-icing equipment; Motors; Switches; Fasteners; Filters and strainers; Hydraulic controls and assemblies; Primers; Pumps; Valves.

ADVANCE SPRING CORP.,
1749 Carroll Ave., Chicago, Ill.
PERSONNEL: F. C. Mueller, Pres.; D. E. Mielke, V. Pres. & Sales Mgr.; A. D. Mueller, Secy.
PRODUCTS: Clamps; Springs; Small stampings.

AERO-COUPLING CORP.,
1051 N. Hollywood Way, Burbank, Calif.
PERSONNEL: A. A. Eisenman, Pres.; H. M. Davis, V. Pres. & Gen. Mgr.; A. A. Burckle, Secy.
PRODUCTS: Hydraulic controls and assemblies.

AERO LEATHER CLOTHING CO.,
79 Ferry St., Beacon, N. Y.
PERSONNEL: Louis Kramer, John E. Liebmann, and Abe Wolkowitz, partners.
PRODUCTS: Aviation clothing.

AERO SPARK PLUG CO., INC.,
635 Greenwich St., New York, N. Y.
PERSONNEL: W. E. Blood, Pres. & Treas.; A. A. Kasarjian, V. Pres.; A. P. Walker, Secy.; L. R. Dooley, Sales Mgr.; H. S. Van Cleve, Pur. Agt.
PRODUCTS: Spark plugs.

AERO SUPPLY MANUFACTURING CO., INC., 611 W. Main St., Corry, Pa.
PERSONNEL: F. N. Ames, Pres.; S. J. Irvine, V. Pres., Sales Mgr. & Gen. Mgr.; L. E. Graham, Secy. & Treas.; H. W. Jewell, Pur. Agt.; H. O. Blount, Pers. Dir. & Pub. Dir.
PRODUCTS: Clamps; Controls; Filters and strainers; Fittings; Miscellaneous hardware; Panels; Parts; Propeller parts; Pumps; Valves.

AERO TOOL CO.,
231 W. Olive Ave., Burbank, Calif.
PERSONNEL: L. Deutsch, Owner; P. E. Holzman, Gen. Mgr.
PRODUCTS: Aircraft tools.

AERO TRADES CO.,
Roosevelt Field, Mineola, N. Y.
PRODUCTS: Clamps; Collector rings, cowls, streamlines; Cowlings; Engine mounts; Exhaust manifolds; Fasteners; Fittings; Panels; Tail wheel assemblies; Tanks; Miscellaneous.

AEROMARINE INSTRUMENT CO.,
385 Gerard Ave., Bronx, N. Y.
PERSONNEL: Adolf Urfer, Pres.
PRODUCTS: Altimeters; Air speed indicators; Compasses; Tachometers; Gauges.

AERONAUTICAL MFG. CORP.,
377—4th St., Niagara Falls, N. Y.
PERSONNEL: A. M. Patterson, Pres. & Treas.; C. J. Lane, V. Pres. & Gen. Mgr.; S. J. Lockwood, Secy.
PRODUCTS: Controls; Fittings; Hydraulic controls and assemblies; Pumps; Valves.

AEROPRODUCTS DIV., GENERAL MOTORS CORP., Dayton, O.
PERSONNEL: C. E. Wilson, Pres.; W. J. Blanchard, Gen. Mgr.; W. Kreitzer, Pur. Agt.; R. Daly, Pers. Dir.; C. J. Proud, Pub. Dir.
PRODUCTS: Propellers.

AEROQUIP CORP., Jackson, Mich.
PERSONNEL: Don T. McKone, Pres.; Chas. H. Hollerith, V. Pres.; F. W. Corwin, Secy.; W. G. Howe, Treas.; M. W. Brandau, Chief Eng.
PRODUCTS: Self-sealing couplings; Hose fittings Flexible hose line assemblies.

AGAWAM AIRCRAFT PRODUCTS, INC.,
Sag Harbor, N. Y.
PERSONNEL: Albert P. Loening, Pres.; G. A. Dippel, Factory Supt.; A. H. Butts, Pur. Agt.
PRODUCTS: Fittings; Parts.

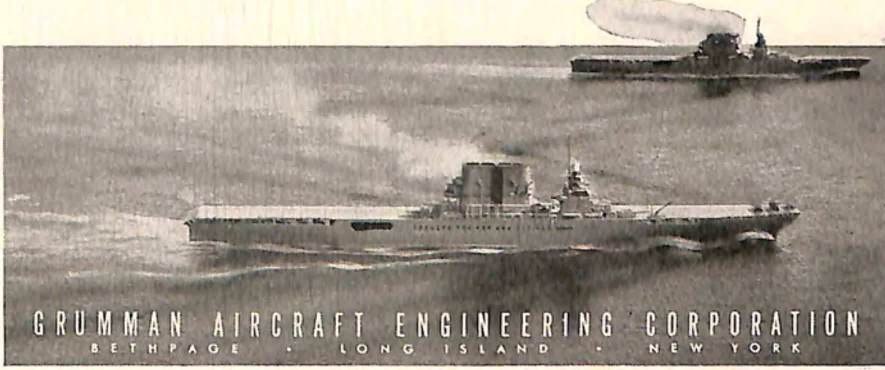
AHLBERG BEARING CO.,
3025 W. 47th St., Chicago, Ill.
PERSONNEL: C. J. Bender, Pres.; F. O. Burkholder, V. Pres.; P. F. McGuinn, Secy. & Pur. Agt.; L. J. Behm, Treas.; C. W. Pearsall, Sales Mgr.
PRODUCTS: Bearings.

AIR ASSOCIATES, INC., Bendix, N. J.
PERSONNEL: F. G. Coburn, Pres.; H. I. Crow, V. Pres. & Sales Mgr.; G. S. Kleverstrom, Secy. & Treas.; P. Smith, Pur. Agt.; R. D. Collins, Pers. Dir.
PRODUCTS: Clamps; Controls; Covers; De-icer equipment; Motors; Switches; Fasteners; Filters and strainers; First aid equipment; Fittings; Flares; Goggles; Helmets; Hydraulic controls and assemblies; Instruments; Miscellaneous hardware; Miscellaneous engine equipment; Parts; Primers; Pumps; Radios; Safety belts; Tail wheel assemblies; Wheels and brakes.

AIR REDUCTION SALES CO.,
60 E. 42nd St., New York, N. Y.
PRODUCTS: Landing and navigation lights; Miscellaneous.

AIR-SAFE AIRCRAFT INSTRUMENT CO.,
6309 Wilshire Blvd., Los Angeles, Calif.
PERSONNEL: J. F. Carssow, Pres.; W. B. Carssow, Secy. & Treas.
PRODUCTS: Instruments.

AGILE as the wildcat after which it has been named, the formidable Grumman F4F-3 U. S. NAVY FIGHTER boasts an enviable record in the day-in, day-out performance of its gruelling task.



HALL ECCENTRIC VALVE SEAT GRINDING UNIVERSALLY ADOPTED FOR PRODUCTION AND MAINTENANCE

In airplane engine production and maintenance HALL ECCENTRIC Valve Seat Grinders have been adopted because of the finer precision and finish obtained with greater speed. Here is a partial list of HALL users: FORD (Pratt & Whitney Engines), PACKARD (Rolls-Royce and Marine Engines), BUICK (P. & W. Engines), CHEVROLET (P. & W. Engines), ELECTRO-MOTIVE CORP., PRATT & WHITNEY (Canada), PRATT & WHITNEY (Australia), WRIGHT (Canada), GUIBERSON Diesel Engine Co., LYCOMING, RANGER, MENASCO, CONTINENTAL, PAN-AMERICAN AIRWAYS, PENNSYLVANIA CENTRAL AIRLINES, ROLLS-ROYCE (England), ARMSTRONG-SIDDELEY (England), DeHAVILAND (England), U. S. AIR CORPS, U. S. NAVY, U. S. TANK CORPS, R. A. F., R. C. A. F.

Below: Part of a battery of AWA Grinders shipped to Ford for P. & W. engine production.

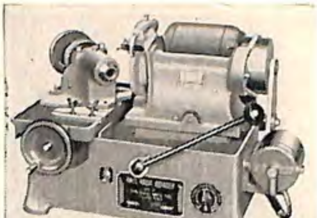
Left: AW wet type ECCENTRIC Grinder. Made in production and service types. Operator can "blind" grind valve seats to finest precision and finish without losing time by repeated grinding and gauging operations.

At right: HALL AWA Universal Dual type ECCENTRIC Grinder set up for wet grinding valve seats in Allison engine.

At left: HALL AWA Universal Dual type Grinder shown above set up for wet grinding of seats in radial cylinders.

Right: HALL ECCENTRIC Grinder as built for Packard airplane and marine engine production.

Right: HALL Model 80A Wet Type Valve Refacer. Has dual motors with rheostat control for work head motor. Has Micrometer Feed. Provides finish and precision to match HALL-ground valve seats.



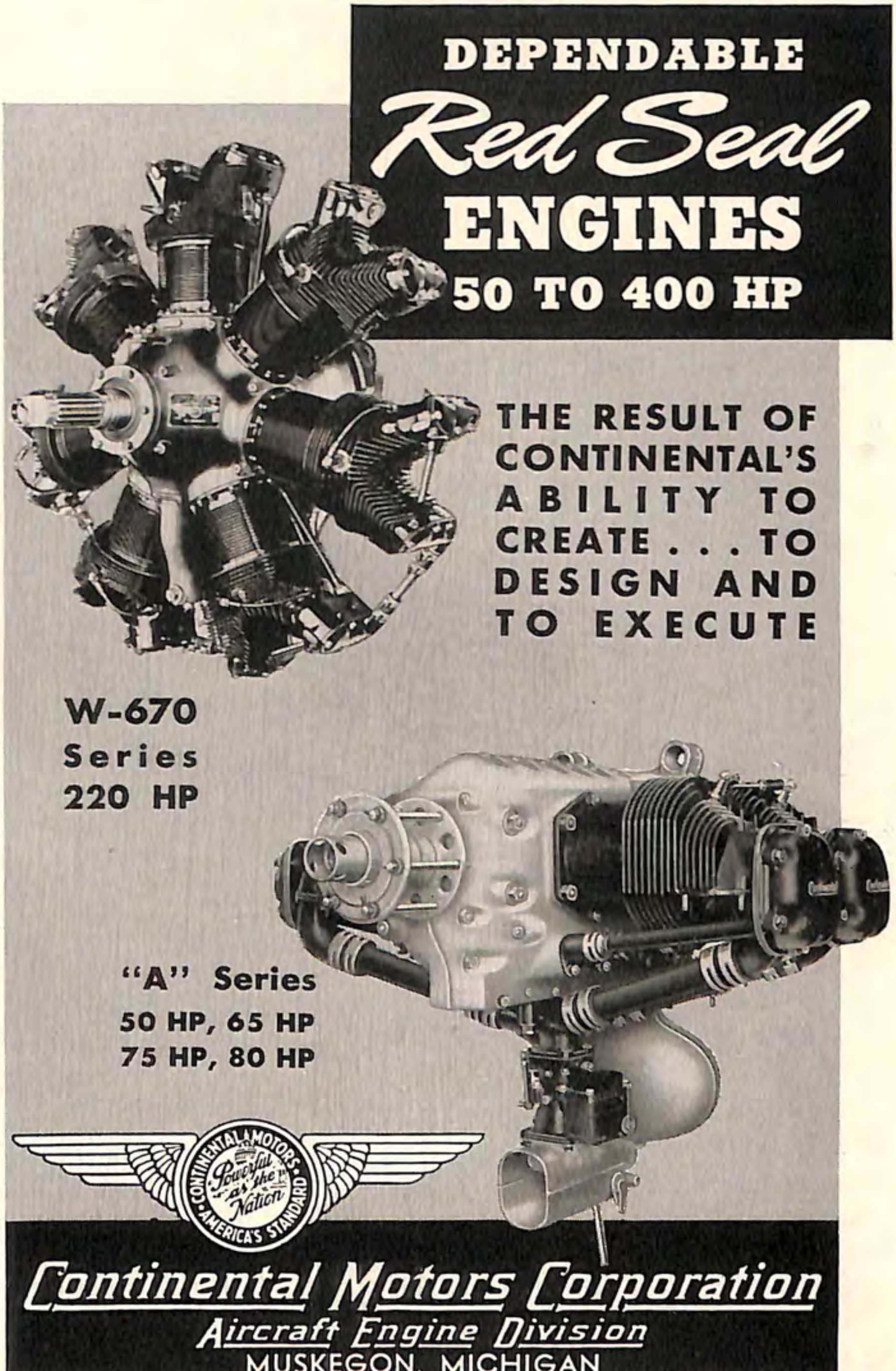
Left: E. J. A. ECCENTRIC Grinder for production or service of valve seats located deep in in-line cylinders.

WRITE FOR CATALOG

Write for catalog or put your particular grinding problem up to HALL Engineers as scores of others have done.

THE HALL MANUFACTURING CO., TOLEDO, OHIO, U. S. A.

HALL


DEPENDABLE
Red Seal
ENGINES
50 TO 400 HP
THE RESULT OF CONTINENTAL'S ABILITY TO CREATE . . . TO DESIGN AND TO EXECUTE
W-670 Series 220 HP
"A" Series
50 HP, 65 HP
75 HP, 80 HP
CONTINENTAL MOTORS
Powerful as the Nation
AMERICA'S STANDARD
Continental Motors Corporation
Aircraft Engine Division
MUSKEGON, MICHIGAN

AIR TRANSPORT EQUIPMENT, INC., Roosevelt Field, Hangar 20-A, Garden City, N. Y.
PERSONNEL: A. A. Pedu, Pres., Secy. & Gen. Mgr.; M. Bammann, V. Pres., Treas., & Pur. Agt.
PRODUCTS: Floats, skiis; Goggles; Heaters; Log books; Miscellaneous hardware; Propellers and propeller parts; Radios; Tail wheel assemblies.

AIRCRAFT ACCESSORIES CORP., 166 W. Olive Ave., Burbank, Calif.
PERSONNEL: R. C. Walker, Pres.; T. E. Colvin, V. Pres. & Gen. Mgr.; W. J. Hosmer, Secy.; J. A. Habegger, Treas.; F. Salt, Pur. Agt.; W. A. Cooke, Pers. Dir.
PRODUCTS: Hydraulic controls and assemblies; Pumps; Valves; Vibration dampers.

AIRCRAFT ACCESSORIES CORP. OF MISSOURI, Fairfax and Funston Rds., Kansas City, Kans.
PERSONNEL: R. C. Walker, Pres. & Gen. Mgr.; W. R. Williamson, Treas.; R. S. Van Cleve, Sales Mgr.; H. E. Slade, Pur. Agt.; W. A. Cooke, Pers. Dir.
PRODUCTS: Hydraulic controls and assemblies; Propeller test equipment; Radios; Antennae.

AIRCRAFT & MARINE SPECIALTY CO., 302 S. Central Ave., Baltimore, Md.
PERSONNEL: H. D. Baldwin, Pres.; H. Hammond, Secy.; R. B. Smithers, Treas.; J. R. Speer, Jr., Sales Mgr.
PRODUCTS: De-icer equipment; Miscellaneous hardware; Miscellaneous engine equipment; Panels; Parts; Stampings; Sub-assemblies; Tanks.

AIRCRAFT COMPONENTS, INC., 8000 Woodley Ave., Van Nuys, Calif.
PERSONNEL: G. G. Budwig, Pres. & Gen. Mgr.; L. Comegys, V. Pres.; J. N. Combs, Secy. & Treas.; K. J. Wilson, Sales Mgr.; G. Weisberg, Pur. Agt.; E. J. Prevost, Pers. Dir.
PRODUCTS: Ammunition boxes and counters; Bomb racks; Clamps; Cowlings; Engine mounts; Exhaust manifolds; Seats; Stampings; Sub-assemblies; Tanks.

AIRCRAFT ENGINEERING PRODUCTS, INC., 2 Ackerman Ave., Clifton, N. J.
PERSONNEL: A. G. Roth, Pres., Secy. & Gen. Mgr.; L. E. Amann, V. Pres. & Treas.; E. T. Den Bleyker, Sales Mgr.; G. Roth, Pur. Agt. & Pers. Dir.; J. Roche, Pub. Dir.
PRODUCTS: Controls; De-icer equipment; Fittings; Hydraulic controls and assemblies; Miscellaneous hardware; Pumps; Valves.

AIRCRAFT HARDWARE MFG. CO., INC. 1381 Lafayette Ave., New York, N. Y.
PERSONNEL: O. Mazzei, Pres. & Gen. Mgr.; M. Bresciani, V. Pres.; A. Babboni, Secy. & Pur. Agt.; S. Mazzei, Treas.; F. Buhling, Sales Mgr.
PRODUCTS: Machine products; Hardware.

AIRCRAFT MACHINERY CORP., 332 N. First St., Burbank, Calif.
PERSONNEL: Jerome Robins, Pres. & Gen. Mgr.; R. A. Speed, V. Pres.; G. C. Hewitt, Secy., Treas. & Pur. Agt.; R. R. Davis, Sales Mgr.
PRODUCTS: Milling machines.

AIRCRAFT MECHANICS, INC., Colorado Springs, Colo.
PERSONNEL: P. W. Nichols, Pres.; M. A. Ohlander, Treas.
PRODUCTS: Controls; Engine mounts; Landing gears; Parts; Tail wheel assemblies; Drop forgings.

AIRCRAFT PRODUCTS AND EQUIPMENT CORP., Franklin & Lacey Sts., West Chester, Pa.
PERSONNEL: R. S. Jett, Pres.; E. K. Gray, V. Pres. & Pur. Agt.; P. C. Jett, Secy.; J. H. Stephens, Treas. & Gen. Mgr.
PRODUCTS: Landing gears; Starters; Tail wheel assemblies.

AIRCRAFT SCREW PRODUCTS CO., INC., 47-23 — 35th St., Long Island City, N. Y.
PERSONNEL: B. Sack, V. Pres.; E. P. Huisking, Pur. Agt.; H. W. Cram, Sales Mgr.
PRODUCTS: Miscellaneous; Screw Thread System.

AIRCRAFT TOOLS, INC., 750 E. Gage Ave., Los Angeles, Calif.
PERSONNEL: W. E. Miller, Pres.; E. V. Miller, V. Pres. & Sales Mgr.; G. E. LaFollette, Secy. & Treas.; G. W. Periman, Gen. Mgr.; J. H. Glassman, Pur. Agt.; R. L. Ferrucci, Pers. Dir.; H. Marquis, Pub. Dir.
PRODUCTS: Riveting equipment; Dies; Cutters; Sheet holders.

AIRCRAFT WELDERS, INC., 530 East Second, Wichita, Kans.
PERSONNEL: O. A. Sutton, Pres., Treas. & Gen. Mgr.; W. P. Innes, Jr., V. Pres.; P. R. Kitch, Secy.
PRODUCTS: Collector rings, cowls, streamlines; Engine mounts; Exhaust manifolds; Landing gears; Panels; Parts; Seats; Tail wheel assemblies; Tanks.

AIRESEARCH MANUFACTURING CO., DIV. OF THE GARRETT CORP., 9851 Sepulveda Blvd., Inglewood, Calif.
PERSONNEL: J. C. Garrett, Pres.; W. C. Brownlee, V. Pres., Treas. & Gen. Mgr.; W. C. Whitehead, Secy.; L. B. Williams, Sales Mgr.; J. B. Meyer, Pur. Agt.; N. Loomis, Pers. Dir.; T. D. Darlington, Pub. Dir.
PRODUCTS: Radiators; Valves; Aftercoolers; Intercoolers; Regulators.

AIRWAY MFG. CORP., 410 Frelinghuysen Ave., Newark, N. J.
PERSONNEL: J. Gurwin, Pres. & Sales Mgr.; J. Schiller, V. Pres., Secy., Treas. & Gen. Mgr.
PRODUCTS: Engine, cockpit and windshield covers; Panels; Parachutes; Safety belts; Seats; Tow targets; Bags; Tents.

ALADDIN RADIO INDUSTRIES, INC., 501 West 35th St., Chicago, Ill.
PERSONNEL: V. S. Johnson, Pres.; J. C. McGinley, V. Pres. & Gen. Mgr.; A. J. Dudle, Pur. Agt.; W. C. Matthews, Pers. Dir.
PRODUCTS: Radio frequency apparatus.

ALL AMERICAN AIRCRAFT PRODUCTS, INC., 1207 Euclid Ave., Long Beach, Calif.
PERSONNEL: G. R. Adler, Pres.; E. Adler, V. Pres. & Gen. Mgr.; C. F. Bittel, Secy.; K. E. Robertson, Treas. & Pur. Agt.
PRODUCTS: Bomb racks; Collector rings, cowls, streamlines; Controls; Cowlings; Floats, skiis; Stampings; Sub-assemblies; Tanks.

ALL-WEATHER SPRINGS, 72 Washington St., New York, N. Y.
PERSONNEL: J. W. Rockefeller, Jr., Gen. Mgr.
PRODUCTS: Instrument springs.


Safety in the Air with Modern Circuit Protection
OFF
HEINEMANN
AERO-MAGNETTE
Fully Electro-Magnetic Circuit Breaker
Designed for the protection of lighting, control, radio and motor circuits, AERO-MAGNETTE Circuit Breaker opens instantly on short circuits but permits harmless overloads of short duration—such as inrush current in starting motor. It is positive in action, vibration proof and shock resisting. For night flying, fluorescent lettering indicates position of handle, on or off.
HEINEMANN CIRCUIT BREAKER CO.
Subsidiary of Heinemann Electric Co. Est. 1888
111 PLUM STREET
TRENTON, NEW JERSEY

It's GORTON For

Super-Speed

ENGRAVING
PROFILING
MILLING AND
DUPLICATING

(Above) A few examples of the routing, profiling and engraving done by Gorton machines.

IN AIRCRAFT PRODUCTION

Engine makers, instrument makers, accessory makers, and fabricators in the United States' aircraft industry rely on Gorton machines for the accuracy and speed so necessary to their production.

Call on Gorton to help you with any problem of engraving, profiling, milling and duplicating.

(Right) This Gorton is milling triangular cavities in an aircraft engine articulating rod.

GEORGE GORTON MACHINE CO.
1331 RACINE STREET, RACINE, WISCONSIN, U. S. A.

MOORE EASTWOOD & CO.

DAYTON OHIO.

Manufacturers of Airplane Parts, Especially Armament Equipment for past 18 years — Contractors For Army, Navy, and Leading Airplane Companies.

ALLEN ELECTRIC AND EQUIPMENT CO., 2101-2117 N. Pitcher St., Kalamazoo, Mich.
PERSONNEL: G. H. Allen, Pres.; L. F. Woolman, V. Pres. & Sales Mgr.; M. E. McMartin, Secy. & Gen. Mgr.; A. Higdon, Treas.; R. Aldrich, Pur. Agt.; L. Feltes, Pers. Dir.; D. Howard, Pub. Dir.
PRODUCTS: Engine testers; Cell testers; Chargers; Welders.

ALLEGHENY LUDLUM STEEL CORP., 2319 Oliver Bldg., Pittsburgh, Pa.
PERSONNEL: H. G. Batcheller, Pres.; W. A. Givens, V. Pres.; E. J. Hanley, Secy. & Treas.; R. M. Allen, Sales Mgr.; E. L. McGraw, Pur. Agt.
PRODUCTS: Steel.

ALLIED AVIATION CORP., Baltimore, Md.
PERSONNEL: R. E. Breed, Pres.; B. Litchfield, V. Pres. & Gen. Mgr.; Kurt Winters, Secy. & Treas.; W. Rich, Pur. Agt.; S. C. Register, Pers. Dir.
PRODUCTS: Streamlines; Cowlings; Floats, skiis; Panels; Parts; Propeller parts; Miscellaneous.

ALLITH-PROUTY INC., 819 N. Bowman Ave., Danville, Ill.
PERSONNEL: D. E. Willard, Pres.; A. Macdonald, Secy. & Treas.; R. B. Older, Gen. Mgr. & Pur. Agt.; N. B. Hart, Sales Mgr.
PRODUCTS: Hardware.

ALOFS MANUFACTURING CO., 1615 Madison Ave., S. E., Grand Rapids, Mich.
PERSONNEL: H. G. Alofs, Gen. Mgr.
PRODUCTS: Stampings; Dies; Fixtures.

ALPHA METAL & ROLLING MILLS, INC., 363 Hudson Ave., Brooklyn, N. Y.
PERSONNEL: I. I. Shonberg, Pres. & Treas.; H. Shonberg, V. Pres. & Secy.
PRODUCTS: Landing gears; Tanks.

ALUMINUM COMPANY OF AMERICA, 801 Gulf Bldg., Pittsburgh, Pa.
PERSONNEL: F. C. Pyne, Aviation Dept.
PRODUCTS: Aluminum alloys.

ALUMINUM INDUSTRIES, INC., 2416-38 Beekman St., Cincinnati, O.
PERSONNEL: John Eckerle, Pres.; M. A. Beckmann, V. Pres.; R. T. Mesker, Secy.; H. J. Hater, Treas. & Gen. Mgr.; C. C. Rensing, Sales Engr.; E. F. Eckerle, Pur. Agt.; J. Hubert Cuni, Pers. Dir.; B. V. Keller, Pub. Dir.
PRODUCTS: Castings; Pistons; Pins; Valves.

AMERICAN AIRPORT EQUIPMENT CO., 5958-60 Washington Blvd., Chicago, Ill.
PERSONNEL: George F. Kelly, Gen. Mgr.
PRODUCTS: Indicators; Cones; Overhaul stands; Directional signs.

AMERICAN BOSCH CORP., 3664 Main St., Springfield, Mass.
PERSONNEL: D. P. Hess, Pres.; F. N. Perry, V. Pres.; R. A. Wickes, Secy. & Treas.; T. J. Kiely, Sales Mgr.; W. T. Barton, Pur. Agt.; A. B. Howe, Pers. Dir.; G. W. Carlson, Pub. Dir.
PRODUCTS: Magnetos; Fuel injection equipment.

AMERICAN CELLULOSE CO., P. O. Box 506, Indianapolis, Ind.
PERSONNEL: Louis R. Sereinsky, Gen. Mgr.
PRODUCTS: Plastics; Protective coverings.

AMERICAN FOUNDRY & FURNACE CO., Bloomington, Ill.
PERSONNEL: L. G. Whitmer, Pres.; H. A. Soper, V. Pres.; R. P. Whitmer, Secy.
PRODUCTS: Heaters; Blowers; Air conditioning units; Ventilating specialties.

AMERICAN INSTRUMENT CO., Silver Spring, Md.
PERSONNEL: L. Freeman and W. H. Reynolds, partners; Chas. L. Schuettler, Sales Mgr. & Pub. Dir.
PRODUCTS: Heaters; Instruments; Indicators; Gages.

AMERICAN MACHINE & METALS, INC., East Moline, Ill.
PERSONNEL: P. G. Mumford, Pres.; J. C. Vander Pyl, V. Pres., Secy. & Gen. Mgr.; H. T. McMeekin, Treas.; Wayne Mendell, Sales Mgr.; S. H. Dekker, Pur. Agt.; J. Bauersfield, Pers. Dir.; R. Denman, Pub. Dir.
PRODUCTS: Testing machines; Fans; Ventilating equipment.

AMERICAN NICKELOID COMPANY, Peru, Ill.
PERSONNEL: F. M. Maze, Pres.; C. C. Struever, V. Pres. & Gen. Mgr.; James Maze, Secy.; Hamilton Maze, Treas.; C. B. Meng, H. L. Decker, Pur. Agt.; M. Pomatto, Pub. Dir.
PRODUCTS: Metals.

AMERICAN OPTICAL CO., Southbridge, Mass.
PERSONNEL: G. B. Wells, Pres.; Ira Mosher, V. Pres. & Gen. Mgr.; A. T. Wells, Secy.; E. E. Williams, Treas.; C. O. Cozzens, Sales Mgr.; G. P. Brockway, Pur. Agt.; R. Parkinson, Pers. Dir.; R. Gentzler, Pub. Dir.
PRODUCTS: Goggles; Safety clothing; Welding helmets; Respirators.

AMERICAN PAULIN SYSTEM, 1847 S. Flower St., Los Angeles, Calif.
PERSONNEL: A. F. Munter, Pres., Treas. & Gen. Mgr.; H. A. Munter, V. Pres.; W. L. Sample, Secy.; R. W. Criswell, Sales Mgr.; E. G. Larson, Pur. Agt. & Pers. Dir.; E. F. Franklin, Pub. Dir.
PRODUCTS: Instruments; Altimeters; Indicators.

AMERICAN PHENOLIC CORP., 1830 South 54th St., Chicago, Ill.
PERSONNEL: A. J. Schmitt, Pres. & Sales Mgr.; D. B. Alexander, V. Pres. & Gen. Mgr.; E. G. Johnson, Pur. Agt.; C. Overman, Pers. Dir.
PRODUCTS: Connectors; Conduits; Cables.

AMERICAN PROPELLER CORP., Toledo, O.
PERSONNEL: W. F. Wise, Pres.; R. C. Hicks, Treas.; D. T. Waltz, Pur. Agt.; J. D. Young, Pers. Dir.
PRODUCTS: Propellers.

THE AMERICAN ROLLING MILL CO., 703 Curtis St., Middletown, O.
PERSONNEL: C. R. Hook, Pres.; C. Verity, V. Pres. & Gen. Mgr.; W. D. Vorhis, Secy.; M. A. Brawley, Treas.; J. A. Ingwersen, Sales Mgr.; N. Ebersole, Pur. Agt.; C. H. Murray, Pers. Dir.
PRODUCTS: Stainless steels; Steel sheets.

AMERICAN SCREW CO.,
21 Stevens St., Providence, R. I.
PERSONNEL: Paul C. Nicholson, Pres.; E. E. Clark, V. Pres. & Gen. Mgr.; J. F. Doherty, Secy.; E. W. Lane, Treas.; C. O. Drayton, Sales Mgr.; W. A. Smedley, Pur. Agt.; J. A. Beauregard, Pers. Dir.; H. Mayoh, Pub. Dir.
PRODUCTS: Screws; Fasteners.

AMERICAN STEEL AND WIRE CO.,
Rockefeller Bldg., Cleveland, O.
PERSONNEL: C. F. Hood, Pres.; H. B. Jordan, V. Pres.; A. F. Allen, Secy. & Treas.; John May, Sales Mgr.; F. E. Chesney, Pur. Agt.
PRODUCTS: Cables; Bars; Fence; Springs; Ropes; Nails.

AMERICAN TUBE BENDING CO., INC.,
5 Lawrence St., New Haven, Conn.
PERSONNEL: H. W. Jones, Pres. & Treas.; E. W. Stolz, Secy.; A. F. Cewe, Pur. Agt.; R. H. Hanabury, Pers. Dir.
PRODUCTS: Collector rings, cowls, streamlines; Control sticks and wheels; Engine mounts; Exhaust manifolds; Manifolds; Miscellaneous engine equipment.

AMPCO METAL, INC.,
1745 S. 38th St., Milwaukee, Wisc.
PERSONNEL: C. J. Zaiser, Pres. & Gen. Mgr.; R. H. Kunz, V. Pres.; R. W. Uecker, Secy. & Treas.; J. D. Zaiser, Sales Mgr.; C. H. Dawley, Pur. Agt.; N. Krogsund, Pers. Dir.; G. S. Hamilton, Pub. Dir.
PRODUCTS: Castings; Parts.

ANCHOR POST FENCE CO.,
6500 Eastern Ave., Baltimore, Md.
PERSONNEL: W. F. Brannan, Pres.; R. D. Logee, V. Pres. & Sales Mgr.; Carlton R. McCarthy, Secy.; C. W. Burton, Jr., Treas.; C. A. Bishop, Pur. Agt.; M. J. Donahue, Pub. Dir.
PRODUCTS: Ammunition boxes and counters; Fences.

E. F. ANDREWS LABORATORIES,
4367 Oakenwald Ave., Chicago, Ill.
PERSONNEL: E. F. Andrews, Eng. Dir.
PRODUCTS: Motors; Radios; Miscellaneous.

ANEMOSTAT CORPORATION OF AMERICA, 10 E. 39th St., New York, N. Y.
PERSONNEL: A. Rust-Oppenheim, Pres.; F. J. Kurth, V. Pres.; J. C. Anderer, Treas.; J. B. Hewett, Sales Mgr.; R. Bassin, Pur. Agt.; J. W. Molitor, Pub. Dir.
PRODUCTS: High velocity air diffusers.

THE APEX MACHINE & TOOL CO.,
1025 S. Patterson Blvd., Dayton, O.
PERSONNEL: Carl A. Lange, Pres. & Gen. Mgr.; Walter N. Frank, V. Pres.; E. S. Newlin, Secy. & Treas.; Paul R. Baker, Sales Mgr.; Harry G. Fischer, Pur. Agt.
PRODUCTS: Universal joints.

APPLETON ELECTRIC CO., 1701-1729 Wellington Ave., Chicago, Ill.
PERSONNEL: A. I. Appleton, Pres., V. Pres. & Treas.; J. V. Painter, Secy.; M. J. Whitfield, Sales Mgr.; W. A. Robertson, Pur. Agt.; C. A. Bloom, Pub. Dir.
PRODUCTS: Electrical conduit fittings; Hose.

AQUA SYSTEMS, INC.,
385 Gerard Ave., New York, N. Y.
PERSONNEL: R. K. Blanchard, Pres.; A. C. Kaestner, V. Pres., Secy. & Sales Mgr.; H. W. Ballantine, Treas.; W. J. Peter, Ch. Eng. & Pur. Agt.; R. W. Ballantine, Pub. Dir.
PRODUCTS: Installation of refueling systems.

THE ARCO CO.,
7301 Bessemer Ave., Cleveland, O.
PERSONNEL: H. E. Wise, Pres.; P. L. Hexter, V. Pres.; E. Spoerry, Jr., Secy. & Treas.; L. J. Esther, Pur. Agt.; G. E. Relph, Pers. Dir.; E. R. Righter, Pub. Dir.
PRODUCTS: Primers; Finishes.

ARENS CONTROLS, INC.,
2253 S. Halsted St., Chicago, Ill.
PERSONNEL: C. A. Arens, Pres. & Treas.; C. Norton, V. Pres., Secy. & Gen. Mgr.; C. E. Otto, Sales Mgr.; W. L. Hagen, Pur. Agt.; R. Johnston, Pers. Dir.; F. C. Nahser, Pub. Dir.
PRODUCTS: Controls; Miscellaneous engine equipment; Radio shielding and equipment.

ARMSTRONG CORK CO., Lancaster, Pa.
PERSONNEL: H. W. Prentis, Jr., Pres.; F. L. Suter, V. Pres.; C. D. Armstrong, Secy.; K. Powlison, Treas.; F. E. Stevens, Gen. Mgr.; W. B. Tucker, Sales Mgr.; R. A. Barton, Pur. Agt.; J. J. Evans, Jr., Pers. Dir.; W. D. Shilling, Pub. Dir.
PRODUCTS: Gaskets; Washers; Seals.

THE ARO EQUIPMENT CORP., Bryan, O.
PERSONNEL: J. C. Markey, Pres.; J. P. Johnson, V. Pres.; L. L. Hawk, Treas.; C. W. Ginter, Works Mgr.; G. J. Brew, Sales Mgr.; C. H. Rice, Pur. Agt.; C. E. Ihrie, Pub. Dir.
PRODUCTS: Hydraulic controls and assemblies; Propeller parts; Pumps; Sub-assemblies; Valves; Miscellaneous.

ARROW-HART & HEGEMAN ELECTRIC CO., 103 Hawthorn St., Hartford, Conn.
PERSONNEL: J. R. Cook, Pres.; S. P. Williams, V. Pres.; E. B. Grier, Secy.; T. A. Inch, Treas.; G. C. Barry, Sales Mgr.; N. P. Belcourt, Pur. Agt.; H. J. Cook, Pers. Dir.; R. N. Peck, Pub. Dir.
PRODUCTS: Switches.

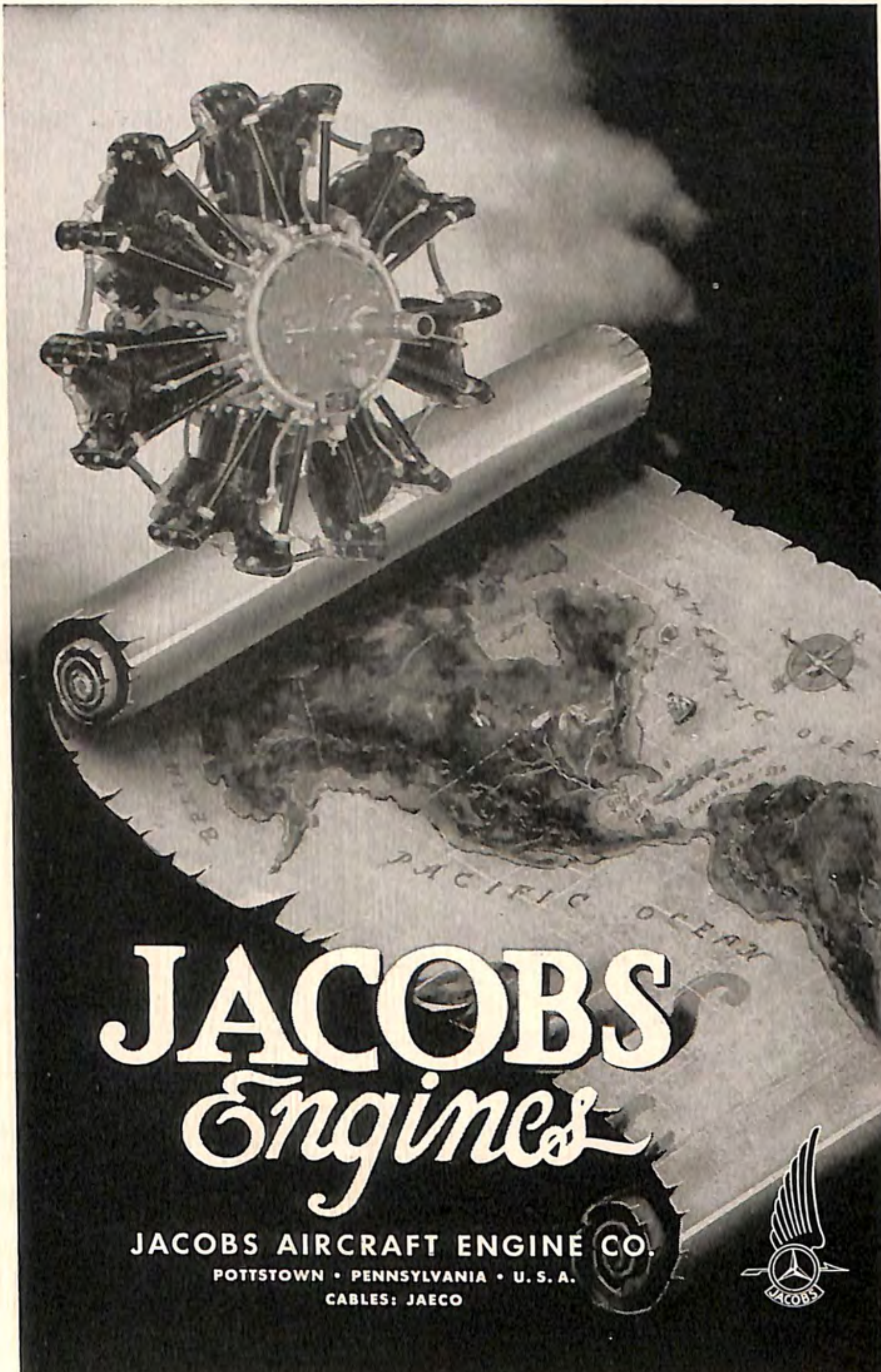
ASSOCIATED FOUNDRIES & MANUFACTURERS, INC., 503-507 West 56th St., New York, N. Y.
PERSONNEL: J. L. Hutchinson, Pres.
PRODUCTS: Ammunition boxes and counters; Bomb racks; Clamps; Covers; Fittings; Flares; Floats; Skiis; Helmets; Miscellaneous hardware; Miscellaneous engine equipment; Parts; Propellers and propeller parts; Stampings; Sub-assemblies; Tanks; Miscellaneous work.

E. C. ATKINS AND CO.,
402 S. Illinois St., Indianapolis, Ind.
PERSONNEL: H. C. Atkins, Pres. & Gen. Mgr.; E. C. Atkins, V. Pres.; D. H. Potter, Secy. & Treas.; K. W. Atkins, V. Pres. & Sales Mgr.; M. M. Poole, Pur. Agt.; C. E. Woods, Pers. Dir.; M. W. Dallas, Pub. Dir.
PRODUCTS: Valves; Armor plate; Saw tools.

ATLANTIC INDIA RUBBER WORKS, INC.,
1453 West Van Buren St., Chicago, Ill.
PERSONNEL: C. O. Moore, Pres.; R. V. Kline, V. Pres.; M. E. Moore, Secy.; W. G. Linard, Sales Mgr. & Pur. Agt.

ATLAS BRASS FOUNDRY,
1901 Santa Fe Ave., Los Angeles, Calif.
PERSONNEL: Frank Anderson, Pres.; E. Prentice, V. Pres.; M. M. Anderson, Secy.; Stanley Frase, Treas.
PRODUCTS: Bearings.

ATLAS DROP FORGE CO., Lansing, Mich.
PERSONNEL: R. H. Scott, Pres. & Gen. Mgr.; J. W. Hubbard, Asst. Secy.; N. R. Buckingham, Sales Mgr.; A. O. Peterson, Pur. Agt.
PRODUCTS: Drop forgings.


ATLANTIC OCEAN
PACIFIC OCEAN
JACOBS
Engines
JACOBS AIRCRAFT ENGINE CO.
POTTSTOWN • PENNSYLVANIA • U. S. A.
CABLES: JAECO
JACOBS

THE D. L. AULD CO., Columbus, O.,
PERSONNEL: S. G. Brooks. Pres. & Gen. Mgr.; G. Matt, V. Pres. & Sales Mgr.; H. E. Auld, Secy.; C. R. Kimmel, Treas.; S. G. Brooks, Gen. Mgr.; F. H. Auld, Pur. Agt.
PRODUCTS: Panels; Stampings.

AULT & WIBORG CORP.,
1754 Dana Ave., Cincinnati, O.
PERSONNEL: J. R. Esposito, Pres.; M. W. Frishkorn, V. Pres.; W. Wright, Secy.; H. Dunne, Treas.; J. G. Morris, Gen. Mgr.; H. B. Bond, Sales Mgr.; W. F. Saas, Pur. Agt.; M. J. Cleary, Pers. Dir.; D. Donovan, Pub. Dir.
PRODUCTS: Primers; Enamels; Dopes.

THE AUSTIN CO.,
16112 Euclid Ave., Cleveland, O.,
PERSONNEL: G. A. Bryant, Pres.; G. W. Plaisted, V. Pres.; A. S. Austin, Secy.; C. W. Kinnison, Treas.
PRODUCTS: Design and construction of factories, hangars, wind tunnels, airports.

AUTOMATIC ELECTRIC CO.,
1033 W. Van Buren St., Chicago, Ill.
PERSONNEL: P. W. Conrad, Pres.; W. J. Caverly, V. Pres.; C. S. Cadwell, Sales Mgr.; W. E. A. Nottorf, Pur. Agt.; E. C. Seepe, Pers. Dir.; H. E. Clapham, Pub. Dir.
PRODUCTS: Controls; Instruments.

THE AVEY DRILLING MACHINE CO.,
Cincinnati, O.
PERSONNEL: L. B. Patterson, Pres. & Treas.; G. K. McKee, V. Pres. & Gen. Mgr.; D. A. Patterson, Secy.; J. E. Shriver, Sales Mgr.; J. M. Moore, Pur. Agt.
PRODUCTS: Machine tools; Drilling machines.

B

THE B. G. CORP.,
136 W. 52nd St., New York, N. Y.
PERSONNEL: R. Goldsmith, Pres., Treas. & Gen. Mgr.; L. L. Goldsmith, V. Pres.; T. S. Mack, Secy.; K. S. Lindsay, Sales Mgr.; M. Miller, Pur. Agt.; H. C. Redden, Pers. Dir.
PRODUCTS: Spark plugs.

B. H. AIRCRAFT CO., 27-01 Bridge Plaza N., Long Island City, N. Y.
PERSONNEL: Seymour J. Baum & Edwin Huck, partners.
PRODUCTS: Ammunition boxes and counters; Collector rings, cowls, streamlines; Engine mounts; Exhaust manifolds; Floats; Parts.

SEMON BACHE & CO.,
636 Greenwich St., New York, N. Y.
PERSONNEL: Joe Dreyfuss, Pres.; B. Newton, V. Pres.; R. M. Dreyfuss, Secy.; E. O. Salman, Treas.; M. S. Goodman, Pur. Agt.
PRODUCTS: Glass; Mirrors; Specialties.

BACKSTAY WELT CO., Union City, Ind.
PERSONNEL: R. C. Schemmel, Pres.; G. G. Barr, V. Pres.; P. J. Keck, Secy., Treas. & Gen. Mgr.; A. C. Pogue, Sales Mgr.; Herman Welch, Pers. Dir.
PRODUCTS: Bindings; Fabrics; Leather specialties; Paper; Silencers; Sponge rubber; Weatherstrips.

THE BAILEY CO., INC.,
21 Water St., Amesbury, Mass.
PERSONNEL: S. R. Bailey, Pres. & Gen. Mgr.; D. C. Bailey, Secy. & Treas.; L. H. Gibson, Sales Mgr.; W. M. Hilliard, Pur. Agt.; O. W. Young, Pers. Dir.; R. W. Chilson, Pub. Dir.
PRODUCTS: Parts; Stampings; Sub-assemblies; Miscellaneous.

THE BAIRD MACHINE CO.,
Bridgeport, Conn.
PERSONNEL: L. A. Warner, Pres., Treas. & Gen. Mgr.; A. J. Lewis, Sr., Secy.; Albert Pott, Sales Mgr. & Pub. Dir.; J. E. Reynolds, Pur. Agt.; B. C. Warner, V. Pres. & Pers. Dir.
PRODUCTS: Automatic equipment.

BAKER INDUSTRIAL TRUCK DIV. OF THE BAKER-RAULANG CO., 2168 W. 25th St., Cleveland, O.
PERSONNEL: E. J. Bartlett, Pres. & Gen. Mgr.; E. J. Stahl, V. Pres.; J. W. Moran, Secy. & Treas.; D. L. Darnell, Sales Mgr.; E. W. Sankey, Pur. Agt.; W. F. Parsons, Pers. Dir.; M. W. McMillan, Pub. Dir.
PRODUCTS: Trucks; Tractor; Cranes.

BARBER-COLMAN CO., Rockford, Ill.
PERSONNEL: H. D. Colman, Pres.; H. A. Severson, V. Pres. & Gen. Mgr.; J. G. Jones, Secy. & Treas.; R. P. Dewey, Mgr. Aviation Products Div.; H. W. Bails, Pur. Agt.; A. M. Monks, Pers. Dir.
PRODUCTS: Electrical equipment; Motors.

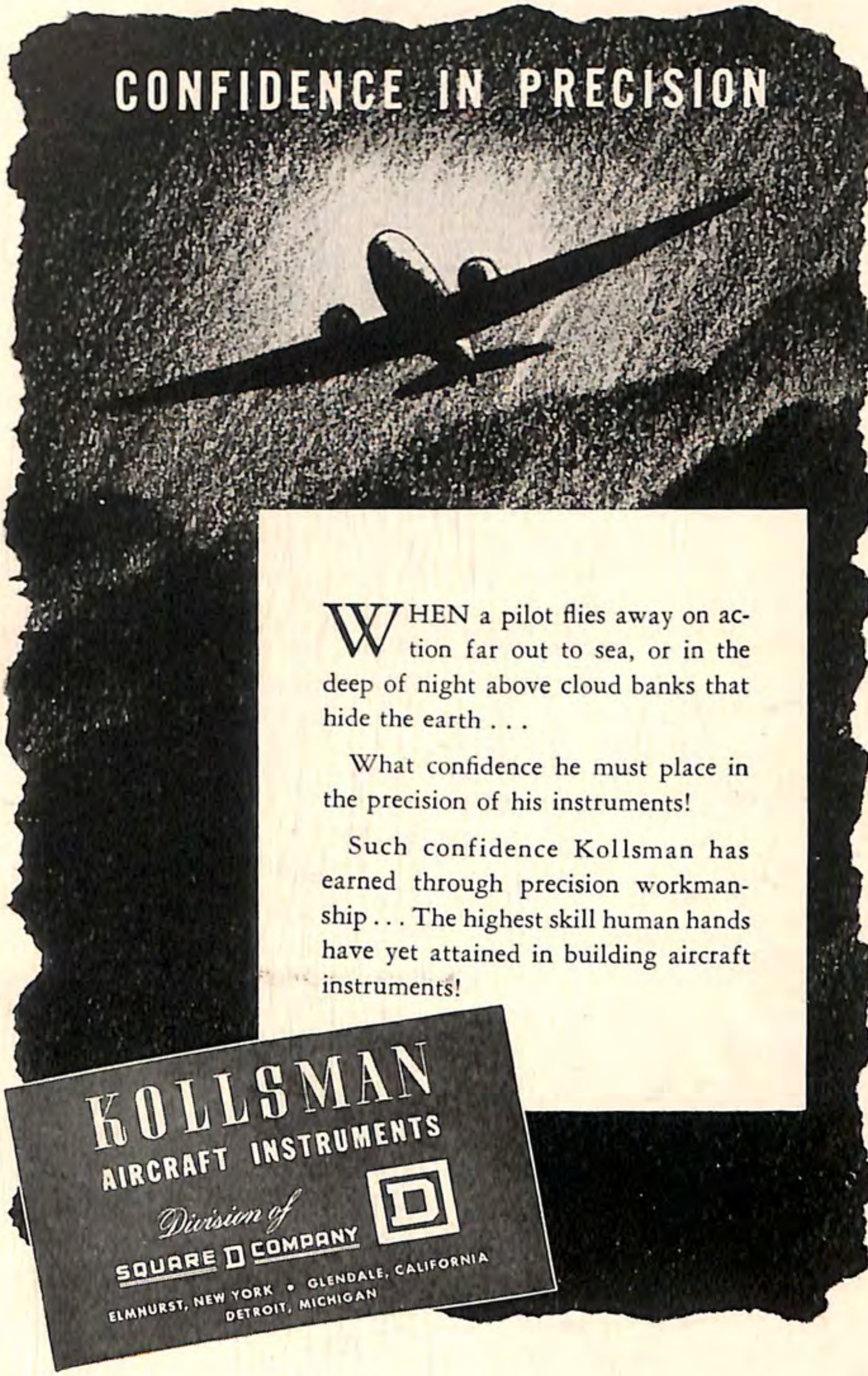
BARNES-GIBSON-RAYMOND DIV. OF ASSOCIATED SPRING CORP., 6400 Miller Ave., Detroit, Mich.
PERSONNEL: L. D. Adams, V. Pres. & Gen. Mgr.; W. J. Black, Sales Mgr.; C. W. Naas Factory Mgr.; L. E. Hilts, Pur. Agt.
PRODUCTS: Springs; Miscellaneous.

BAUER & BLACK DIV. OF THE KENDALL CO., 2500 S. Dearborn St., Chicago, Ill.
PERSONNEL: W. H. Miller, Industrial Sales Mgr.; R. D. Barnes, Pur. Agt.
PRODUCTS: Adhesive tape; First aid equipment

BAUSH MACHINE TOOL CO.,
156 Wason Ave., Springfield, Mass.
PERSONNEL: G. D. Haskell, Pres.; C. Loring, Secy.; R. W. Daniels, Treas.; W. Wetsel, Sales Mgr.; S. McCracken, Pur. Agt.
PRODUCTS: Boring mills; Drilling and tapping machines; Special machinery; Universal joints.

BELDEN MANUFACTURING CO.,
4647 W. Van Buren St., Chicago, Ill.
PERSONNEL: W. Jacobs, Pres.; H. W. Clough, V. Pres.; A. Beutler, Secy.; A. L. Wanner, Treas.; H. A. Neil, Sales Mgr.; W. A. Sandy Pur. Agt.; S. F. Kiss, Pub. Dir.
PRODUCTS: Radio shielding and equipment; Wire and cable.

BELL & HOWELL CO., 1801-15 Larchmont Ave., Chicago, Ill.
PERSONNEL: J. H. McNabb, Pres. & Treas.; A. S. Howell, V. Pres.; C. A. Ziebarth, Secy.; J. H. Booth, Sales Mgr.; H. R. Cleland, Pur. Agt.; H. Eisler, Pers. Dir.; R. H. Unseld, Pub. Dir.
PRODUCTS: Cameras; Instruments; Miscellaneous hardware; Radios; Radio shielding and equipment; Stampings.


CONFIDENCE IN PRECISION
WHEN a pilot flies away on action far out to sea, or in the deep of night above cloud banks that hide the earth . . .
What confidence he must place in the precision of his instruments!
Such confidence Kollsman has earned through precision workmanship . . . The highest skill human hands have yet attained in building aircraft instruments!
KOLLSMAN
AIRCRAFT INSTRUMENTS
Division of
SQUARE D COMPANY
ELMHURST, NEW YORK • GLENDALE, CALIFORNIA
DETROIT, MICHIGAN

BELLANCA AIRCRAFT CORP.,
New Castle, Del.
PERSONNEL: Joseph S. Wilson, Pres.; L. C. Milburn, V. Pres.; J. R. Morford, Secy.; W. R. Yarnall, Treas.; H. L. Thompson, Sales Mgr.; R. F. Wright, Pur. Agt.; E. H. Cole, Pers. Dir.
PRODUCTS: Parts.

BEMIS & CALL CO.,
125 Main St., Springfield, Mass.
PERSONNEL: H. A. Lincoln, Pres. & Treas.; S. A. Lincoln, V. Pres.; F. G. Kelley, Works Mgr.; J. C. Cooper, Sales Mgr.
PRODUCTS: Keyless locks.

BENDIX AVIATION, LTD.,
11600 Sherman Way, N. Hollywood, Calif.
PERSONNEL: P. Nicholls, V. Pres. & Gen. Mgr.; J. A. Tillotson, Secy. & Treas.; M. M. Burns, Asst. Gen. Mgr. & Sales Mgr.; R. Galbraith, Pur. Agt.; A. Malmquist, Pers. Dir.
PRODUCTS: Clamps; Controls; Switches; Fasteners; Hydraulic controls and assemblies; Landing gears; Pumps; Radios; Radio shielding and equipment; Tail wheel assemblies; Valves.

BENDIX PRODUCTS DIV. OF BENDIX AVIATION CORP., 401 Bendix Dr., South Bend, Ind.
PERSONNEL: M. P. Ferguson, Gen. Mgr.; C. E. Budd, Pur. Agt.; M. A. Heidt, Pers. Dir.; H. L. Sharlock, Pub. Dir.; J. R. Cautley, C. D. Manhart, R. Ledbetter, Sales Managers.
PRODUCTS: Aircraft armament; Carburetors; Landing gears; Seats; Tail wheel assemblies; Wheels and brakes.

THE BENSON MANUFACTURING CO.,
3001-15 E. 18th St., Kansas City, Mo.
PERSONNEL: A. J. Benson, Pres. & Pers. Dir.; E. A. Benson, V. Pres., Treas. & Pur. Agt.; E. L. Benson, Secy.; E. H. Benson, Pub. Dir.
PRODUCTS: Ammunition boxes and counters; Clamps; Collector rings, cowls, streamlines; Cowlings; De-icer equipment; Engine mounts; Tanks.

THE BENWOOD LINZE CO.,
1911-19 Locust St., St. Louis, Mo.
PERSONNEL: H. J. Wrape, Pres.; C. E. Peters, V. Pres.; I. W. Veigel, Treas.
PRODUCTS: Electrical equipment.

BERRY BROTHERS, INC.,
211 Leib St., Detroit, Mich.
PERSONNEL: Arthur Kiernan, Pres. & Gen. Mgr.; E. H. Dunn, Treas.; C. E. Spooner, Aviation Sales Mgr.; H. Dedenback, Pur. Agt.
PRODUCTS: Dopes; Lacquers; Paints; Varnishes.

THE BILLINGS & SPENCER CO.,
1 Laurel St., Hartford, Conn.
PERSONNEL: W. A. Purtell, Pres., Treas. & Gen. Mgr.; H. E. Oberg, V. Pres.; W. D. Endres, Sales Mgr.; W. H. Blackburn, Pur. Agt.; R. H. Young, Pub. Dir.
PRODUCTS: Clamps; Wrenches; Forgings.

BINKS MANUFACTURING CO.,
3114-40 Carroll Ave., Chicago, Ill.
PERSONNEL: J. F. Roche, Pres. & Sales Mgr.; S. Bramsen, E. F. Watts, V. Pres.; J. C. Johnson, Secy. & Treas.; G. Gasser, Pur. Agt.; R. T. Hastie, Pers. Dir.
PRODUCTS: Finishing equipment; Exhaust fans; Compressors.

THE BLACK & DECKER MFG. CO.,
Towson, Md.
PERSONNEL: S. D. Black, Pres.; A. G. Decker, V. Pres.; C. A. Sacra, Secy.; F. J. Nagell, Treas.; R. D. Black, Sales Mgr.; C. Mann, Pur. Agt.; J. A. Gary, Jr., Pers. Dir.
PRODUCTS: Drills; Tools; Assembly tools; Scales.

BLACKHAWK MFG. CO.,
5325 W. Rogers, Milwaukee, Wisc.
PERSONNEL: H. P. Brumder, Pres.; John Merker, V. Pres.; L. E. Bertane, Secy.; G. H. Goehrig, Sales Mgr.; G. E. Cremer, Pur. Agt.; P. J. Spielman, Pers. Dir.; B. E. Hotvedt, Pub. Dir.
PRODUCTS: Hydraulic controls and assemblies; Wrenches; Indicators; Jacks.

BLACKMER PUMP CO.,
Grand Rapids, Mich.
PERSONNEL: M. G. Klise, Pres.; N. J. Harkness, V. Pres. & Gen. Mgr.; G. Norcross, Secy.; John Vande Bunte, Treas.; J. B. Trotman, Sales Mgr.; L. Pangborn, Pur. Agt.
PRODUCTS: Pumps.

BLAW-KNOX CO., Pittsburgh, Pa.
PERSONNEL: W. P. Witherow, Pres.; C. H. Lehman, V. Pres.; A. L. Cuff, Secy.; G. L. Dumbauld, Treas.
PRODUCTS: Standard steel buildings.

E. W. BLISS CO.,
53rd St. & 2nd Ave., Brooklyn, N. Y.
PERSONNEL: H. H. Pinney, Pres.; H. U. Herrick, V. Pres.; E. S. McClary, Secy. & Treas.; R. Biggane, Sales Mgr.; F. B. Smith, Pur. Agt.; W. Smith, Pers. Dir.; M. Stumm, Pub. Dir.
PRODUCTS: Presses; Feeds; Cushions.

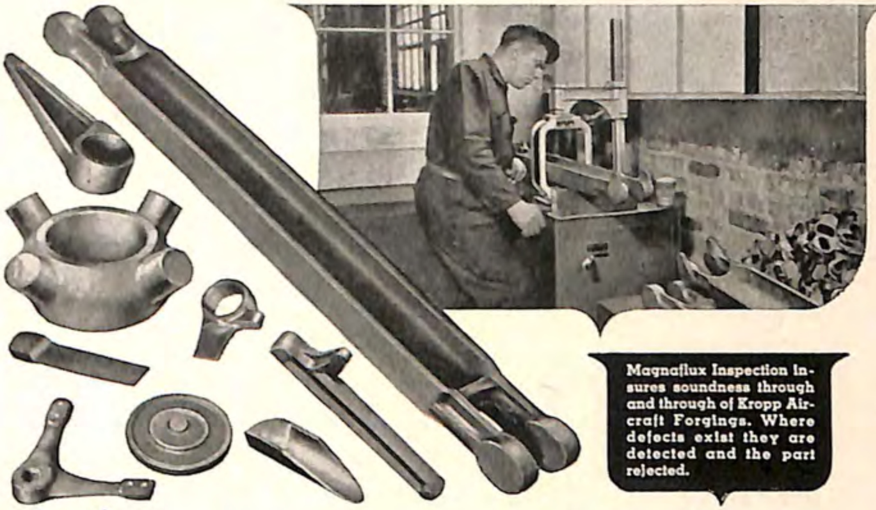
BOOTS AIRCRAFT NUT CORP.,
New Canaan, Conn.
PERSONNEL: N. J. Boots, Pres.; R. W. Luce, V. Pres.; O. H. Schell, Secy.; C. A. Milton, Treas., Pur. Agt. & Pers. Dir.; R. W. Johnson, Gen. Mgr.; R. F. Hibbert, Sales Mgr. & Pub. Dir.
PRODUCTS: Fasteners; Self-locking nuts.

THE BOSTON AUTO GAGE CO.,
Pittsfield, Mass.
PERSONNEL: T. C. Nelson, Pres., Secy. & Sales Mgr.; H. MacKelvie, V. Pres. & Pur. Agt.; H. Martin, Treas.
PRODUCTS: Instruments.

BOSTON INSULATED WIRE & CABLE CO.,
Dorchester, Mass
PERSONNEL: H. B. Burley, Pres. & Treas.; J. C. Burley, V. Pres. & Sales Mgr.
PRODUCTS: Electric wires.

S. F. BOWSER & CO., INC., 1302 E. Creighton Ave., Fort Wayne, Ind.
PERSONNEL: R. H. Damon, Pres.; E. D. Eggimann, V. Pres.; J. F. Bartels, Secy. & Treas.; E. C. Marsh, Sales Mgr.; C. F. Bollman, Pur. Agt.; L. Bricker, Pers. Dir.; H. J. Slack, Pub. Dir.
PRODUCTS: Filters and strainers; Refueling systems.

BRASCO MANUFACTURING CO.,
Harvey, Ill.
PERSONNEL: Leroy Baumgartl, Pres.; M. J. Rosenfeld, V. Pres. & Treas.; C. B. Hess, Secy.; T. H. Huff, Gen. Mgr.; R. J. Faas, Sales Mgr.; A. W. Sorenson, Pur. Agt.; Earl Roach, Pers. Dir.; J. J. Arnsfield, Pub. Dir.
PRODUCTS: Stampings; Sub-assemblies; Tubing.



Magnaflux Inspection insures soundness through and through of Kropp Aircraft Forgings. Where defects exist they are detected and the part rejected.

1837 K 1942

The Mark of a Sound Aircraft Forging

Over a hundred years of forging experience—a modern, well equipped shop that has kept young and flexible in ideas and retooled as superior equipment became available—a staff of extremely capable hammersmiths—a modern heat-treating department — a machine shop equipped for die sinking and every conceivable phase of metal working—a working knowledge of metallurgy—these are the things that make the Diamond "K" mark on forgings a surety bond as to their Soundness.

KROPP FORGE COMPANY

5301 W. Roosevelt Road, Chicago

World's Largest Job Forging Shop

KROPP

Makers of Drop, Hammer and Upset Forgings for Aircraft and Engine Builders. Engine, fuselage, wing, landing gear and bomb rack forgings to specification.

BREEZE CORPORATIONS, INC.,
41 S. 6th St., Newark, N. J.
PERSONNEL: J. F. Lucas, V. Pres. & Sales Mgr.; A. L. Johnston, Jr., V. Pres.; J. T. Mascuch, Secy. & Treas.; M. M. Eells. Pers. Dir.
PRODUCTS: Fittings; Connectors; Tachometers; Thermometers; Metal tubing.

BRIDGEPORT FABRICS, INC.,
805 Wood Ave., Bridgeport, Conn.
PERSONNEL: H. B. Naramore, Pres.; R. W. Naramore, V. Pres.; E. J. Morrell, Secy.; T. N. Wakeman, Treas.
PRODUCTS: Weather-stripping; Fabrics.

THE BRIDGEPORT HARDWARE MFG. CORP., 461 Iranistan Ave., Bridgeport, Conn.
PERSONNEL: H. B. Curtis, Pres.; Annetta G. Ryan, Secy.; John F. Windsor, Treas.
PRODUCTS: Mechanics hand tools.

BRIGGS MANUFACTURING CO.,
11631 Mack Ave., Detroit, Mich.
PERSONNEL: W. P. Brown, Pres. & Gen. Mgr.; M. L. Briggs, V. Pres.; H. W. Griffith, Secy.; R. Pierce, Treas.; H. J. Roesch, Pub. Rel. Dir.; L. J. McPharlin, Pur. Agt.
PRODUCTS: Wings and tail surfaces.

THE BRISTOL CO., Waterbury, Conn.
PRODUCTS: Instruments; Miscellaneous hardware; Fasteners.

ANDREW BROWN CO., 5431 So. Riverside Dr., Los Angeles, Calif.
PERSONNEL: Andrew Brown, Pres.; W. E. Moore, V. Pres. & Secy.; Newton Bergeron, Pur. Agt.; John Franks, Pers. Dir.
PRODUCTS: Primers.

BRUNNER MANUFACTURING CO.,
1821 Broad St., Utica, N. Y.
PERSONNEL: G. L. Brunner, Pres.; G. L. Brunner, Jr., V. Pres. & Secy.; A. G. Zumbrun, Treas.; B. J. Scholl, Sales Mgr.; E. H. Schiller Pur. Agt.; O. R. McDonald, Pub. Dir.
PRODUCTS: Air compressors.

THE BRUSH DEVELOPMENT CO.,
3311 Perkins Ave., Cleveland, O.
PERSONNEL: A. L. Williams, Pres.; V. B. Phillips, V. Pres.; W. L. Flory, Secy.; C. B. Sawyer, V. Pres. & Treas.; E. R. Parker, Pur. Agt.
PRODUCTS: Testing equipment.

THE BRYANT HEATER CO.,
17825 St. Clair Ave., Cleveland, O.
PERSONNEL: L. C. Harvey, Pres. & Gen. Mgr.; G. Rieley, V. Pres. & Secy.; R. R. Reimer, Treas.; Gordon Rieley, Sales Mgr.; A. C. Orth, Pur. Agt.; C. F. Cushing, Pub. Dir.
PRODUCTS: Hangar heaters; Dehumidifiers.

THE BUCKEYE PORTABLE TOOL CO.,
29 W. Apple St., Dayton, O.
PERSONNEL: M. J. McCombs, Pres. & Gen. Mgr.; H. O. Gummere, Secy. & Sales Mgr.; A. G. Lauzon, Treas.; E. E. Reeves, Pur. Agt.
PRODUCTS: Portable pneumatic tools.

EDWARD G. BUDD MANUFACTURING CO., Philadelphia, Pa.
PERSONNEL: E. G. Budd, Pres.; E. G. Budd Jr., V. Pres.; H. A. Coward, Secy.; Paul Zens, Treas.; S. A. Mahan, Gen. Mgr.; R. Heckschev, Sales Mgr.; F. White, Pur. Agt.; E. H. McIlvain, Pers. Dir.; J. M. Law, Pub. Dir.
PRODUCTS: Ammunition boxes and counters; Clamps; Collector rings, cowls, streamlines; Cowlings; Exhaust manifolds; Manifolds; Panels; Parts; Radiators; Seats; Stampings; Sub-assemblies; Tanks; Wings and surfaces.

BUHL STAMPING CO., Detroit, Mich.
PERSONNEL: L. D. Buhl, Pres.; J. M. Breen, V. Pres.; T. D. Buhl, Secy.; H. E. Ryan, Treas.; H. S. Finkenstadt, V. Pres. & Gen. Mgr.; R. J. Alcorn, Pur. Agt.
PRODUCTS: Collector rings, cowls, streamlines; Cowlings; Exhaust manifolds; Manifolds; Parts; Stampings; Sub-assemblies.

THE BULLARD CO.,
286 Canfield Ave., Bridgeport, Conn.
PERSONNEL: E. P. Bullard, Pres.; E. C. Bullard, V. Pres. & Gen. Mgr.; A. E. North, Secy. & Treas.; E. P. Blanchard, Sales Mgr.; R. T. Phipps, Pur. Agt.; F. H. Somers, Pers. Dir.; R. C. Bullard, Pub. Dir.
PRODUCTS: Machine tools.

E. D. BULLARD CO.,
275 Eighth St., San Francisco, Calif.
PERSONNEL: E. W. Bullard, Pres.; Alpheus Bull, Sales Mgr.; Russell Mills, Pur. Agt.; M. E. Wank, Pub. Dir.
PRODUCTS: First aid equipment; Goggles; Fire blankets.

THE BUNTING BRASS & BRONZE CO.,
715 Spencer St., Toledo, O.
PERSONNEL: C. E. Bunting, Pres. & Treas.; D. McKercher, V. Pres.; W. F. Volk, Secy.; G. H. Adams, Sales Dir.; J. Frautschi, Pur. Agt.; F. R. Jackson, Pers. Dir.
PRODUCTS: Bearings.

BURNSIDE VENEER CO., INC.,
Burnside, Ky.
PERSONNEL: Ross Kreamer, Pres. & Sales Mgr.; M. C. Wilkinson, V. Pres.
PRODUCTS: Veneer.

BUTLER MANUFACTURING CO.,
7400 E. 16th St., Kansas City, Mo.
PERSONNEL: E. E. Norquist, Pres.; R. S. Kemp, V. Pres.; F. A. Rufi, Secy.; O. D. Nelson, Treas. & Gen. Mgr.; G. C. Speakman, Sales Mgr.; L. P. Melcher, Pur. Agt.; C. C. Crouch, Pub. Dir.
PRODUCTS: Ammunition boxes and counters; Bomb racks; Panels; Stampings.

BYRNE DOORS, INC.,
1150 Griswold St., Detroit, Mich.
PERSONNEL: J. I. Byrne, Pres.; G. M. Bolton, V. Pres.; B. C. Walsh, Secy.; R. Ballantyne, Treas.; E. F. Dunkle, Sales Mgr.; W. B. Lyons, Pur. Agt.
PRODUCTS: Hangar doors; Hangars.

C

CAMBRIDGE INSTRUMENT CO., INC.,
3732 Grand Central Terminal, New York, N. Y.
PERSONNEL: R. H. Kruse, Pres. & Gen. Mgr.; H. N. Packard, V. Pres.; W. H. Jefferson, Secy.; B. O. Watkins, Aircraft sales; L. Birdsall, Pur. Agt.; R. Rick, Pub. Dir.
PRODUCTS: Instruments; Gas analyzers.

CANNON ELECTRIC DEVELOPMENT CO.,
3209 Humboldt St., Los Angeles, Calif.
PERSONNEL: J. H. Cannon, Pres. & Gen. Mgr.; R. J. Cannon, V. Pres.; G. Taylor, Secy.; D. H. Loukota, Sales Mgr.; R. L. Rowen, Pur. Agt.; F. G. Hobart, Pub. Dir.
PRODUCTS: Cable connectors; Electrical equipment.

CHAS. W. CARLL SONS, Cole St. & Reading R. R., Trenton, N. J.
PERSONNEL: Chas. M. Carll, Pres., Gen. Mgr. & Pers. Dir.; M. G. Newell, Secy.; J. W. Carll, Sales Mgr. & Pur. Agt.
PRODUCTS: Ammunition boxes and counters; Bomb racks; Cowlings; Miscellaneous engine equipment; Tanks; Miscellaneous.

CARNEGIE-ILLINOIS STEEL CORP., 434 Fifth Ave., Pittsburgh, Pa.
PERSONNEL: J. L. Perry, Pres.; H. W. Hamilton, Secy.; L. F. Payne, Treas.; T. J. Hilliard, Gen. Mgr.; D. F. Austin, Sales Mgr.; F. J. Rief, Pur. Agt.
PRODUCTS: Steel.

THE E. W. CARPENTER MANUFACTURING CO., 1565 Railroad Ave., Bridgeport, Conn.
PERSONNEL: D. J. O'Connor, Pres. & Secy.; R. T. Davis, Treas.; W. A. Patterson, Jr., Sales Mgr.; W. H. Fry, Pur. Agt.
PRODUCTS: Bronze hinges; Bearings.

THE CARPENTER STEEL CO., Reading, Pa.
PERSONNEL: J. Heber Parker, Pres.; F. R. Palmer, V. Pres.; J. S. Pendleton, Secy. & Treas.; R. V. Mann, Sales Mgr.; C. W. Gaul, Pur. Agt.; C. Weaver, Pers. Dir.
PRODUCTS: Steels.

CARRIER CORP., S. Geddes St., Syracuse, N. Y.
PERSONNEL: E. C. Wampler, V. Pres.; M. E. Snyder, Secy. & Treas.; F. Hubbard, Pur. Agt.; Roy Lansing, Pers. Dir.; W. A. Bowe, Pub. Dir.
PRODUCTS: Heaters; Air conditioning equipment; Refrigeration; Heating units.

CATALIN CORP., 1 Park Ave., New York, N. Y.
PERSONNEL: W. Theile, Pres.; Harry Krehbiel, V. Pres.; E. S. Horsman, Pub. Dir.
PRODUCTS: Plastic materials; Phenolics; Compounds; Resins.

CATERPILLAR TRACTOR CO., Peoria, Ill.
PERSONNEL: L. B. Neumiller, Pres.; A. T. Brown, V. Pres.; E. Bornstein, Secy.; W. J. McBrian, Treas.; G. E. Spain, Sales Mgr.; E. J. Ellertson, Pur. Agt.; W. Kinsey, Pers. Dir.; R. B. Terhune, Pub. Dir.
PRODUCTS: Snow removal equipment; Airport construction and maintenance equipment.

CEDAR RAPIDS ENGINEERING CO. OF DELAWARE, Cedar Rapids, Ia.
PERSONNEL: R. H. Meister, Pres. & Gen. Mgr.; T. M. Jones, V. Pres. & Sales Mgr.; Albert Hahn, Secy.; F. C. Hahn, Treas. & Pur. Agt.
PRODUCTS: Valve facing machines.

CEE BEE CHEMICAL CO., INC., 655 E. Gage Ave., Los Angeles, Calif.
PERSONNEL: S. C. Black, Pres.; C. D. Black Secy. & Treas.; E. W. Giddings, Aircraft Mgr.; L. D. Patterson, Sales Mgr.; D. Wright, Pur. Agt.
PRODUCTS: Cleaning compounds.

CELANESE CELLULOID CORP., 180 Madison Ave., New York, N. Y.
PERSONNEL: C. Dreyfus, Pres.; W. Cameron, V. Pres.; J. A. Larkin, Secy.; H. Blancke, Treas.; E. W. Ward, Sales Mgr.; D. M. Meeker, Pur. Agt.; P. P. Zingg, Pers. Dir.; H. E. Raymond, Pub. Dir.
PRODUCTS: Plastics; Packaging and insulating material.

THE CENTERLESS GRINDING CO., INC., 19 Staples St., Bridgeport, Conn.
PERSONNEL: W. Horberg, Pres.; H. A. Nelson, Secy. & Treas.
PRODUCTS: Engine and instrument parts.

CENTURY ELECTRIC CO., 1806 Pine St., St. Louis, Mo.
PERSONNEL: E. S. Pillsbury, Pres.; R. J. Russell, Secy.; J. F. Culver, Treas.; G. Smith, Gen. Mgr.; E. S. Moore, Sales Mgr.; G. Prosser, Pur. Agt.; T. Gainley, Pers. Dir.; A. Neher, Pub. Dir.
PRODUCTS: Electrical equipment.

CHAMBERLIN AIRCRAFT CO., 185 Washington St., Newark, N. J.
PERSONNEL: C. D. Chamberlin, Pres. & Treas.; L. A. Chamberlin, V. Pres.; T. A. Fields, Secy.
PRODUCTS: Tools and dies; Engines; Propellers

CHAMPION AVIATION PRODUCTS CO., 1702 S. Flower St., Los Angeles, Calif.
PERSONNEL: H. P. Lester, Pres.; T. B. Smallwood, V. Pres.; V. C. Nodges, Secy. & Treas.
PRODUCTS: Generators; Motors; Starters.

THE CHAMPION MACHINE & FORGING CO., 3695 E. 78th St., Cleveland, O.
PERSONNEL: H. W. Foster, Pres.; J. F. Connelly, V. Pres.; H. D. Krauss, Secy. & Treas.; F. F. Pepper, Sales Mgr.; L. O. Keepers, Pur. Agt.; D. A. Miller, Pers. Dir.
PRODUCTS: Drop forgings.

CHAMPION SPARK PLUG CO., Toledo, O.
PERSONNEL: R. A. Stranahan, Pres. & Gen, Mgr.; H. B. Speyer, Secy.; F. D. Stranahan. Treas.; C. L. Corwin, Sales Mgr.; J. F. Lewis, Jr., Pur. Agt.; M. C. Dewitt, Pub. Dir.
PRODUCTS: Spark plugs.

CHANDLER-EVANS CORP., So. Meriden, Conn.
PERSONNEL: C. W. Deeds, Pres.; B. H. Gilpin V. Pres.; H. L. Hartman, Gen. Mgr.; G. H. Day, Secy.; W. D. Keveney, Controller.
PRODUCTS: Carburetors; Fuel pumps.

L. C. CHASE & CO., 295 Fifth Ave., New York, N. Y.
PERSONNEL: W. H. Marland, Pres.; W. A. Spicer, V. Pres.; T. M. Goodall, Treas.; G. B. Ogan, Gen. Mgr.
PRODUCTS: Engine covering material; Upholstery fabrics.

JOHN CHATILLON & SONS, 89 Cliff St., New York, N. Y.
PERSONNEL: G. E. Chatillon, Pres. & Gen. Mgr.; A. J. Chatillon, V. Pres. & Treas.; R. J. Reiley, Jr., Secy.; E. M. Haines, Sales Mgr. & Pub. Dir.
PRODUCTS: Dynamometers; Special scales; Test apparatus.

CHERRY RIVET CO., 1819 Barranca St., Los Angeles, Calif.
PERSONNEL: W. B. Hubbard, Pres., Treas., Gen. Mgr., Pers. Dir., Pub. Dir.; Wendell Kinney, V. Pres.; Roland Kinney, Secy.; Milo C. Ketchum, Sales Mgr.; L. B. Potthoff, Pur. Agt.
PRODUCTS: Blind rivets.

CHICAGO AERIAL SURVEY CO., 332 S. Michigan Ave., Chicago, Ill.
PERSONNEL: E. W. Fuller, Pres.; F. T. Sonne, V. Pres.
PRODUCTS: Cameras; Photographic apparatus.

CHICAGO METAL HOSE CORP.,
1315 S. Third Ave., Maywood, Ill.
PERSONNEL: J. F. P. Farrar, Pres.; D. W. Fentress, V. Pres.; A. E. F. Johnson, Gen. Mgr.; A. S. Keller, Sales Mgr.; W. R. Knautz, Pur. Agt.
PRODUCTS: Hose; Tubing; Shielding.

CHICAGO RIVET & MACHINE CO.,
9600 W. Jackson Blvd., Bellwood, Ill.
PERSONNEL: J. A. Morrissey, Pres. & Pers. Dir.; H. J. Tonn, V. Pres.; E. J. Morrissey, Secy. & Sales Mgr.; E. P. O'Malley, Treas.; W. Bautz, Pur. Agt.; R. C. Hudson, Pub. Dir.
PRODUCTS: Riveters.

THE CINCINNATI SHAPER CO., Hopple, Garrard & Elam Sts., Cincinnati, O.
PERSONNEL: P. G. March, Pres.; H. S. Robinson, Secy., Treas. & Sales Mgr.; H. Fenner, Pur. Agt.
PRODUCTS: Brakes; Shears; Shapers.

CIRCO PRODUCTS CO., 2835 Chester Ave. Cleveland, O.
PERSONNEL: John F. Black, Pres. & Treas.; N. J. Leary, V. Pres. & Pur. Agt.; Paul E. Lees, Secy.
PRODUCTS: Cleaners; Degreasing machines; Rebuilding equipment.

THE E. D. CLAPP MANUFACTURING CO., Auburn, N. Y.
PERSONNEL: E. D. Clapp, Pres.; H. W. Clapp, V. Pres.; W. R. Steele, Secy. & Pur. Agt.; J. D. Hutchinson, Treas. & Sales Mgr.
PRODUCTS: Drop forgings.

C. P. CLARE AND CO.,
4719 Sunnyside Ave., Chicago, Ill.
PERSONNEL: C. P. Clare, Pres.; H. H. Logan, V. Pres.; J. I. McTaggart, Secy. & Treas.; J. E. Mossman, Sales Mgr.
PRODUCTS: Relays.

CLARK TRUCTRACTOR DIV. OF CLARK EQUIPMENT CO., Battle Creek, Mich.
PERSONNEL: Ezra W. Clark, Gen. Mgr.; H. B. Madison, Sales Mgr.; D. E. Leach, Pur. Agt.; E. L. Peck, Pers. Dir.
PRODUCTS: Tractors; Trucks.

THE CLEVELAND METAL STAMPING CO.,
3110 Payne, Cleveland, O.
PERSONNEL: H. G. Thompson, Pres.; E. J. Rice, V. Pres.; G. H. Thompson, Secy. & Pur. Agt.; C. R. Thompson, Treas. & Sales Mgr.
PRODUCTS: Clamps; Fasteners; Miscellaneous hardware; Stampings.

THE CLEVELAND PNEUMATIC TOOL CO., Marble Ave. & East 77th St., Cleveland, O.
PERSONNEL: H. W. Foster, V. Pres.; A. F. Barner, Secy.; J. DeMooy, Treas.; W. C. Wehnes, Pur. Agt.; F. H. Burr, Pers. Dir.; E. L. Oldham, Pub. Dir.
PRODUCTS: Pneumatic tools and accessories; Landing gears; Booster pumps.

THE CLEVELAND TRACTOR CO.,
19300 Euclid Ave., Cleveland, O.
PERSONNEL: W. K. White, Pres.; Grover Higgins, Secy.; E. M. Bell, Treas.; J. R. Walsh, Pur. Agt.; N. A. Emig, Pers. Dir.
PRODUCTS: Tractors

CLIFFORD MANUFACTURING CO.,
564 E. First St., Boston, Mass.
PERSONNEL: W. B. Clifford, Pres. & Treas.; John E. Woods, V. Pres. & Sales Mgr.; Elmer Wilcox, Pur. Agt.
PRODUCTS: Bellows; Heaters; Hydraulic controls and assemblies; Instruments; Radiators; Superchargers; Tubing.

CLIMAX MOLYBDENUM CO.,
500 Fifth Ave., New York, N. Y.
PRODUCTS: Calcium molybdate; Ferromolybdenum; Molybdic oxide briquettes.

COLE-HERSEE CO.,
54 Old Colony Ave., S. Boston, Mass.
PERSONNEL: L. Mayer, Pres., Treas. & Pers. Dir.; F. S. Carpenter, Gen. Mgr.; C. H. Southard, Sales Mgr.; J. D. Blumenthal, Pur. Agt.; S. L. Kamsler, Pub. Dir.
PRODUCTS: Electrical parts.

COLGATE-LARSEN AIRCRAFT CO.,
Amityville, N. Y.
PERSONNEL: G. Colgate, Pres.; V. A. Larsen, V. Pres.; E. H. Fulton, Secy., Treas., Pur. Agt. & Pers. Dir.
PRODUCTS: Engine mounts; Floats; Subassemblies; Tanks.

COLUMBIA AIRCRAFT INDUSTRIES,
512 S. E. Mill St., Portland, Ore.
PERSONNEL: J. S. J. Hlobil, Pres.; R. T. Montag, V. Pres.; D. W. Johnson, Secy. & Pub. Dir.; Guy R. Harper, Treas.; Larry Therkelsen, Sales Mgr.; S. T. Conlan, Pur. Agt.; E. T. Wilson, Jr., Pers. Dir.
PRODUCTS: Control surfaces; Structural assemblies.

COMMONWEALTH INDUSTRIES, INC.,
5922 Commonwealth Ave., Detroit, Mich.
PERSONNEL: C. G. Heilman, Pres. & Gen. Mgr.; H. W. Stark, V. Pres.; Max Hulett, Secy. & Treas.; D. M. Fleming, Sales Mgr.
PRODUCTS: Heat treating; Plating.

THE CONNECTICUT HARD RUBBER CO.
407 East St., New Haven, Conn.
PERSONNEL: J. A. Moffitt, Pres.; C. M. Doede, V. Pres. & Secy.
PRODUCTS: Engine mounts; Vibration dampers.

CONSOLIDATED ENGINEERING CORP.,
1255 E. Green St., Pasadena, Calif.
PERSONNEL: Herbert Hoover, Jr., Pres.; Harold Washburn, V. Pres.; E. A. Pielemeier, Secy.; P. S. Fogg, Treas.; Andrew E. Bain, Pur. Agt.
PRODUCTS: Vibration and strain measuring instruments.

CONTINENTAL SCREW CO.,
Mt. Pleasant St., New Bedford, Mass.
PERSONNEL: P. Sweeney, Pres. & Gen. Mgr.; D. D. Davis, V. Pres. & Sales Mgr.; M. D. Sweeney, Secy.; C. H. Wardwell, Treas.; M. Hunt, Pur. Agt.; W. P. Gallant, Pers. Dir.
PRODUCTS: Fasteners; Miscellaneous hardware.

THE COOPER ALLOY FOUNDRY CO.,
Biloy St., Hillside, N. J.
PERSONNEL: H. A. Cooper, Pres.; F. S. Cooper, V. Pres.; S. Zolin, Secy. & Treas.; C. J. Jernstrom, Gen. Mgr.; J. Victorine, Sales Mgr.
PRODUCTS: Castings; Valves; Pipe fittings.

THE CORBIN SCREW CORP.,
High Street, New Britain, Conn.
PERSONNEL: H. I. Lewis, Gen. Mgr.; E. C. Paddock, Sales Mgr.
PRODUCTS: Fasteners; Misc. hardware; Parts.

CORNING GLASS WORKS,
Corning, N. Y.
PERSONNEL: Glen W. Cole, Pres.; J. L. Peden, V. Pres.; W. H. Curtiss, Secy.; C. D. LaFollette, Treas.; C. J. Phillips, Sales Mgr.; F. S. Conable, Pur. Agt.
PRODUCTS: Insulators.

THE R. W. CRAMER CO., INC.,
Centerbrook, Conn.
PERSONNEL: R. W. Cramer, Pres. & Sales Mgr.; F. R. Brophy, V. Pres.; A. R. Boyd, Secy.; R. W. Cramer, Sales Mgr.; E. L. Schellens, Pur. Agt.
PRODUCTS: Automatic electric timers; Time switches.

THE CRESCENT CO., Cor. Front St. & Central Ave., Pawtucket, R. I.
PERSONNEL: M. C. Sapinsley, Gen. Mgr.; J. T. Birch, Sales Mgr.; A. R. Dahlstrom, Pur. Agt.
PRODUCTS: Insulated wire and cable.

CRESCENT INSULATED WIRE & CABLE CO., Trenton, N. J.
PERSONNEL: C. E. Murray, Pres.; C. E. Murray, Jr., V. Pres., Pers. Dir., Pub. Dir.; A. H. Battye, Secy.; J. C. Murray, Treas. & Gen. Mgr.; E. L. Robinson, Sales Mgr.
PRODUCTS: Wires; Cables; Cords.

CRESCENT PANEL CO.,
3131 W. Market St., Louisville, Ky.
PERSONNEL: E. O. Dulaney, Pres.; C. M. Hilton, V. Pres. & Sales Mgr.; W. C. Borgerding, Secy.; C. E. Strack, Treas.; J. R. Williams, Pur. Agt.
PRODUCTS: Plywood.

CROUSE-HINDS CO., Syracuse, N. Y.
PERSONNEL: H. B. Crouse, Pres.; W. L. Hinds, V. Pres.; H. B. Crouse, Jr., Secy.; W. C. Blanding, Treas.; Frank J. Fancher, Export Mgr.; M. D. Low, Pur. Agt.; H. C. Morrison, Pers. Dir.; F. W. Clary, Pub. Dir.
PRODUCTS: Beacons; Floodlights; Searchlights; Control equipment.

CROWN FASTENER CORP., Warren, O.
PERSONNEL: J. B. Clark, Pres.; R. M. Powell, Secy.; F. B. Hutton, Treas.; R. G. Plumley, V. Pres.; H. L. Williams, N. Y. Field Rep.
PRODUCTS: Slide fasteners; Small zinc alloy die-castings.

CRUCIBLE STEEL COMPANY OF AMERICA, 405 Lexington Ave., New York, N. Y.
PERSONNEL: F. B. Hufnagel, Pres.; A. T. Galbraith, V. Pres. & Sales Mgr.; K. R. Vogel, Secy.; F. L. Cooper, Treas.; R. H. Filsinger, Pur. Agt.; B. B. Wisner, Pers. Dir.; Gordon Tuthill, Pub. Dir.
PRODUCTS: Steels.

CULLMAN WHEEL CO.,
1344 Altgeld St., Chicago, Ill.
PERSONNEL: Otto Cullman, Pres., Gen. Mgr. & Sales Mgr.; L. Hornbrook, V. Pres.: L. Cullman, Secy. & Treas.; E. W. Meyers, Pur. Agt.
PRODUCTS: Sprockets; Reducers; Tool drives; Flexible couplings.

CUNO ENGINEERING CORP.,
Meriden, Conn.
PERSONNEL: C. H. Cuno, Pres. & Treas.; S. L. Wolfson, V. Pres.; W. A. Barnhart, Secy.; C. A. Lind, Sales Mgr.; R. A. Clark, Pur. Agt.; T. F Garvey, Pers. Dir.
PRODUCTS: Filters and strainers.

CURTIS LIGHTING, INC.,
6135 W. 65th St., Chicago, Ill.
PERSONNEL: Darwin Curtis, Pres.; M. C. Wilt, V. Pres.; L. N. West, Secy. & Treas.; G. T. Morrow, Sales Mgr.; R. C. Mason, Pur. Agt.; E. R. Brodeen, Pers. Dir.; E. J. Wilson, Pub. Dir.
PRODUCTS: Lighting equipment.

CURTIS PNEUMATIC MACHINERY DIVISION OF CURTIS MANUFACTURING CO., 1905 Kienlen Ave., St. Louis, Mo.
PERSONNEL: W. C. Hecker, Pres.; F. Ackerman, V. Pres.; C. W. Frees, Secy. & Treas.; J. D. Lodwick, Sales Mgr.; J. A. A. Hecker, Pur. Agt.
PRODUCTS: Compressors; Hoists; Cylinders; Lifts; Washers.

CURTISS-WRIGHT CORP., PROPELLER DIVISION, Caldwell, N. J.
PERSONNEL: Guy W. Vaughan, Pres.; Robert L. Earle, V. Pres. & Gen. Mgr.; R. E. Minton, Sales Mgr.; W. W. Gleeson, Pur. Agt.; N. A. Kirby, Pers. Dir.; John O'Hara Harte, Pub. Dir.
PRODUCTS: Propellers and propeller parts.

CUTLER-HAMMER, INC.,
315 N. 12th St., Milwaukee, Wisc.
PERSONNEL: F. R. Bacon, Pres.; H. F. Vogt, Secy.; W. E. Sargent, Treas.; B. M. Horter, Sales Mgr.; F. S. Wilhoit, Pur. Agt.; A. J. Holmes, Pers. Dir.
PRODUCTS: Switches; Contactors; Relays.

D

THE DAVEN CO.,
158 Summit St., Newark, N. J.
PERSONNEL: L. Newman, Pres.; G. H. Newman, V. Pres. & Pur. Agt.
PRODUCTS: Volume controls; Rheostats; Electrical test equipment; Dynamotor test equipment; Decade resistance boxes; Switches.

THE DAVISON CHEMICAL CORP.,
20 Hopkins Place, Baltimore, Md.
PERSONNEL: R. L. Hockley, Sales Mgr.
PRODUCTS: Dehydrating agent.

THE DAYTON MANUFACTURING CO.,
2240 E. 3rd St., Dayton, O.
PERSONNEL: H. D. Hendrick, Pres. & Gen. Mgr.; E. W. Mink, V. Pres., Sales Mgr. & Pub. Dir.; Norman Jones, Secy. & Pers. Dir.; D. A. Hendrick, Treas.; W. J. Walter, Pur. Agt.
PRODUCTS: Aircraft armament; Ammunition boxes and counters; Miscellaneous hardware; Stampings; Sanitary fixtures.

THE DAYTON RUBBER MANUFACTURING CO., 2342 W. Riverside Ave., Dayton, O.
PERSONNEL: A. L. Freedlander, Pres. & Gen. Mgr.; C. E. Hooven, V. Pres. & Secy.; E. A. Baker, Treas.; I. Eisbrouch, Sales Mgr.; J. C. Cunningham, Pur. Agt.; R. M. Weimer, Pers. Dir.; R. L. Wetzel, Pub. Dir.
PRODUCTS: Synthetic diaphragms; Rubber tubing; Rubber sealing strips; Cockpit heater; "U" cups.

Machine Hard Steel Aircraft Parts with KENNAMETAL, the *Accepted* Steel-Cutting Carbide

Turning a bomber landing gear cylinder of SAE 4130 with a Style No. 5 KENNAMETAL tool at 180 ft. per min., .046" feed, and 3/16" depth of cut.

Aircraft parts, particularly engine parts, are frequently difficult to machine because they are heat treated to as high as 405 Brinell to obtain desired physical properties. KENNAMETAL-tipped steel cutting tools, however, can machine these hard alloys at practical high speeds and without excessive cratering or tool wear—as shown by the following comparative performance records:

Rough Boring Engine Liners

KENNAMETAL—50 pieces per grind of tool, with 5 mins., 53 secs. machining time per piece.
OTHER CARBIDE TOOLS—15 pieces per grind, with 10 mins. machining time per piece.

Facing Engine Cylinder Sleeves

KENNAMETAL—140 ft./min. cutting speed.
HIGH SPEED STEEL—52 ft./min. cutting speed.

Turning Outside Diameter of Retractor Tubes

(SAE X4130 heat treated to 40–42 Rockwell C)
KENNAMETAL—256 rpm., 500 pieces per grind, fine finish obtained.
HIGH SPEED STEEL—4 times longer machining time, 1/8 as many pieces per grind.

Boring Aircraft Struts

(SAE 4150 heat treated to 402 Brinell)
KENNAMETAL—Roughing cut: Speed 125 ft./min., feed, .014", depth of cut, 1/16". Finishing cut: Speed, 150 ft./min., feed, .014", depth of cut, .010".
HIGH SPEED STEEL—The material was too hard to machine with high speed steel.
OTHER CARBIDES—Another carbide tool failed completely.

PROMPT DELIVERIES OF STANDARD TOOLS

You can get prompt deliveries, and save money, by ordering Standard or Modified Standard KENNAMETAL tools and blanks. Write for Catalog No. 42 listing specifications and prices.

McKENNA METALS Co.
373 LLOYD AVE., LATROBE, PENNA.
Foreign Sales: U. S. STEEL EXPORT CO., 30 Church St., New York (Exclusive of Canada and Great Britain)

DAYTON TOOL AND ENGINEERING CO.,
730 Lorain Ave., Dayton, O.
PERSONNEL: Cecil C. Senseman, Pres.; J. K. Matthews, V. Pres.; Geo. W. Houk, Secy.; Otto L. Spaeth, Treas.; Lawrence Trick, V. Pres.
PRODUCTS: Tools; Dies; Jigs; Instrument testing equipment; Ammunition box mounts; Pump parts.

THE DEFIANCE STAMPING CO.,
Defiance, O.
PERSONNEL: L. F. Serrick, Pres.; J. G. Murphy, V. Pres.; R. E. Phillips, Secy.; M. F. Serrick, Treas.; R. H. Serrick, Gen. Mgr. & Pur. Agt.
PRODUCTS: Ammunition boxes and counters; Stampings.

THE DENISON ENGINEERING COMPANY,
140 W. Chestnut St., Columbus, O.
PERSONNEL: W. C. Denison, Jr., Pres. & Treas ; G. W. Denison, V. Pres.; F. C. Norris, Gen. Mgr.; E. J. Flesch, Sales Mgr.; P. W. Norris, Pur. Agt.; J. T. Hively, Pers. Dir.; C. P. Roberts, Pub. Dir.
PRODUCTS: Testing stands; Presses.

THE DENNING MANUFACTURING CO.,
1777 E. 87th St., Cleveland, O.
PERSONNEL: P. F. Denning, Pres.; L. T. Denning, V. Pres.; E. E. Ojala, Secy. & Pur. Agt.; F. W. Denning, Treas., Gen. Mgr., Sales Mgr., Pers. Dir., Pub. Dir.
PRODUCTS: Tools; Dies; Jigs; Fixtures.

DESPATCH OVEN CO.,
622 9th St., S. E., Minneapolis, Minn.
PERSONNEL: A. E. Grapp, Pres. & Treas.; G. M. Lund, Secy. & Pur. Agt.; H. L. Grapp, V. Pres. & Gen. Mgr.; F. H. Faber, V. Pres., Sales Mgr. & Pub. Dir.; C. P. Wilbert, Pers. Dir.
PRODUCTS: Ovens; Furnaces; Air heaters; Laboratory equipment; Fans.

DETROIT GASKET & MANUFACTURING CO., 12640 Burt Rd., Detroit, Mich.
PERSONNEL: L. H. Diehl, Pres. & Gen. Mgr.; W. E. Ritter, V. Pres.; E. W. Diehl, Secy. & Treas.; B. S. Brown, Sales Mgr.; C. H. Strauss, Pur. Agt.; H. F. Doolittle, Pers. Dir.
PRODUCTS: Panels; Parachutes; Safety belts; Stampings; Sub-assemblies; Gaskets and gasket materials.

DETROIT REX PRODUCTS CO.,
13005 Hillview Ave., Detroit, Mich.
PERSONNEL: R. A. Emmett, Pres.; W. W. Davidson, V. Pres.; A. O. Thalacker, Secy. & Pers. Dir.; G. E. Powers, Treas.; C. F. Dinley, V. Pres. & Gen. Mgr.; D. E. Williard, Sales Mgr.; W. G. Smith, Pur. Agt.; G. W. Walter, Pub. Dir.
PRODUCTS: Degreasing machines; Solvents; Cleaning compounds; Alkali washing machines; Spirits washers.

DETROIT STAMPING COMPANY,
350 Midland Ave., Detroit, Mich.
PERSONNEL: G. H. Roberts, Pres., Treas. & Sales Mgr.; J. Beck, V. Pres.; H. G. Roberts, Secy.; George M. Trudeau, Gen. Mgr.
PRODUCTS: Clamps; Stampings.

DETROIT SURFACING MACHINE CO.,
7433 W. Davison, Detroit, Mich.
PERSONNEL: F. D. Nunemaker, Pres., Gen. Mgr. & Sales Mgr.; W. C. Evaul, V. Pres.; C. T. Ronan, Secy. & Pur. Agt., G. Snyder, Treas.; W. C. Richardson, Pub. Dir.
PRODUCTS: Electric sanding machines.

THE DEVILBISS CO.,
300 Phillips Ave., Toledo, O.
PERSONNEL: A. D. Gutchess, Pres.; F. A. Bailey, V. Pres. & Gen. Mgr.; W. W. Conklin, Secy. & Treas.; H. P. DeVilbiss, V. Pres.; R. A. Guyer, V. Pres. & Sales Mgr.; R. W. Witchner, Pur. Agt.
PRODUCTS: Air compressors; Spray painting equipment; Exhaust systems; Hose and hose connections.

DIAL LIGHT CO. OF AMERICA, INC.
90 West St., New York, N. Y.
PRODUCTS: Pilot light assemblies; Indicator jewels; Signal lights.

DIEBOLD SAFE & LOCK CO., Canton, O.
PERSONNEL: A. J. Roos, Pres. & Gen. Mgr.; H. C. Weible, Secy. & Treas.; H. A. Noble, Sales Mgr.; G. H. Bockius, Pur. Agt.; V. Smith, Pers. Dir.; M. E. Hole, Pub. Dir.
PRODUCTS: Aircraft armament; Seats.

THE DILL MANUFACTURING CO.,
700 E. 82nd St., Cleveland, O.
PERSONNEL: A. P. Williamson, Pres. & Treas.; E. F. Tobold, V. Pres.; A. E. Bronson, V. Pres. & Secy.; W. C. Holmes, Sales Mgr.; C. W. Bonifield, Pur. Agt.
PRODUCTS: Fasteners; Stampings; Tire valves.

DOEHLER DIE CASTING CO.,
386 - 4th Ave., New York, N. Y.
PERSONNEL: Chas. Pack, Pres.; F. J. Koegler, V. Pres.; F. Knoebel, Secy.; R. Bernhard, Treas.; Herbert Doehler, Pur. Agt.
PRODUCTS: Die castings; Permanent mold castings.

DOOLITTLE RADIO, INC.,
7421 S. Loomis Blvd., Chicago, Ill.
PERSONNEL: E. M. Doolittle, Pres. & Treas.; Dudley Gray, V. Pres.; A. Feeley, Secy.; C. M. Rodman, Sales Mgr.; J. Domotor, Pur. Agt.
PRODUCTS: Radios.

THE DOW CHEMICAL CO.,
Midland, Mich.
PERSONNEL: W. H. Dow, Pres. & Gen. Mgr.; L. I. Doan, V. Pres., Secy. & Sales Mgr.; E. W. Bennett, V. Pres. & Treas.; J. E. LeFevre, Pur. Agt.; S. L. Starks, Pers. Dir.; Geo. D. Welles, Pub. Dir.
PRODUCTS: Magnesium and magnesium alloy products.

DOWTY EQUIPMENT CORP., 41-28 - 37th St., Long Island City, N. Y.
PERSONNEL: A. E. Ulmann, Pres. & Sales Mgr.; T. F. Hanley, Treas.
PRODUCTS: Landing gears; Hydraulic pumps; Hydraulic equipment.

DRAKE MANUFACTURING CO.,
1713 W. Hubbard St., Chicago, Ill.
PERSONNEL: A. J. Foute.
PRODUCTS: Instrument panel lights; Radio dial lights.

DRY-ZERO CORPORATION,
222 N. Bank Drive, Chicago, Ill.
PERSONNEL: H. B. Lindsay, Pres.; M. A. Kemper, Secy.; N. S. McKay, Treas.; C. Duff Stevens, Sales Mgr.; W. A. Busch, Pur. Agt.; C. C. Backus, Pub. Dir.
PRODUCTS: Insulation; Portable hangars; Sentry's boxes; Rectifier housings.

E. I. DU PONT DE NEMOURS & CO. INC., PLASTICS DEPARTMENT, Arlington, N. J.
PERSONNEL: A. E. Pitcher, Gen. Mgr.; W. A. Joslyn, Sales Mgr.; H. F. Barnett, Pur. Agt.; D. M. Heider, Pers. Dir.
PRODUCTS: Plastics.

DUGAS ENGINEERING CORP., 59 E. Van Buren St., Chicago, Ill.
PERSONNEL: H. V. Higley, Pres.; A. A. Michaud, V. Pres. & Sales Mgr.; F. J. Hood, Secy. & Treas.; L. D. Clifford, Pur. Agt.; R. C. Hood, Pub. Dir.
PRODUCTS: Fire extinguishing compound.

THE DUMORE COMPANY, 1225 14th St., Racine, Wisc.
PERSONNEL: L. H. Hamilton, Pres.; R. L. Hamilton, V. Pres. & Sales Mgr.; J. M. Hamilton, Secy. & Pur. Agt.; H. F. Nehoda, Treas.; G. A. Zimmerman, Gen. Mgr.; P. Wellnitz, Pers. Dir.; R. B. Voelker, Pub. Dir.
PRODUCTS: Motors.

STRUTHERS DUNN, INC., 1315 Cherry St., Philadelphia, Pa.
PERSONNEL: M. L. Dunn, Pres.; H. W. Pfeffer, V. Pres. & Secy.; J. J. McKiernan, Jr., Treas.; C. F. Schattler, Gen. Mgr.; C. A. Packard, Sales Mgr.; E. T. Harvey, Pur. Agt.
PRODUCTS: Relays; Timing devices; Solenoids.

DURAKOOL, INC., 1010 N. Main St., Elkhart, Ind.
PERSONNEL: H. E. Bucklen, Jr., Pres.; H. E. Bucklen, III, V. Pres. & Pur. Agt.; R. L. Bucklen, Secy. & Treas.; M. W. Hollingsworth, Sales Mgr.; J. F. Slingo, Pers. Dir.
PRODUCTS: Switches, Electrical equipment relays.

DURAMOLD AIRCRAFT CORP., 542 W. 52nd St., New York, N. Y.
PERSONNEL: J. Carlton Ward, Jr., Pres.; W. H. Schwebel, Secy. & Treas.; H. V. Thaden, Sales Mgr.
PRODUCTS: Plastic parts.

DUREZ PLASTICS & CHEMICALS, INC., 1917 Walck Rd, North Tonawanda, N.Y.
PERSONNEL: Harry M. Dent, Pres. & Gen. Mgr.; Geo. E. Becker, V. Pres.; John F. Snyder, Secy. & Treas.; A. W. Hanmer, Jr., Sales Mgr.; C. M. Bell, Pur. Agt.; A. Hein, Pers. Dir.; H. S. Spencer, Pub. Dir.
PRODUCTS: Molding compounds; Resins.

DYCER AVIATION SUPPLIES, 11156 S. Main St., Los Angeles, Calif.
PERSONNEL: Edward A. Dycer, Owner.
PRODUCTS: Control couplings; Engine overhaul stands.

DZUS FASTENER COMPANY, INC., Babylon, N. Y.
PERSONNEL: W. Dzus, Pres., Treas. & Gen. Mgr.; Fullerton Wells, V. Pres.; Theodore Dzus, Secy.; G. H. Arnold, Pur. Agt.; L. F. Acker, Pub. Dir. & Sales Mgr.
PRODUCTS: Fasteners

E

EAGLE PARACHUTE CORP., 424 North Queen St., Lancaster, Pa.
PERSONNEL: C. J. Follmer, Pres.; E. O. Tunison, V. Pres. & Treas.; C. J. Follmer, Gen. Mgr.; R. E. Knoll, Secy. & Pur. Agt.
PRODUCTS: Parachutes.

EASTERN ENGINEERING CO., 45 Fox St., New Haven, Conn.
PRODUCTS: Pumps.

EASTMAN KODAK CO., Rochester, N. Y.
PERSONNEL: T. J. Hargrave, Pres.; M. B. Folsom, Treas.; M. K. Robinson, Secy.
PRODUCTS: Special film; Lenses; Materials for aerial photography.

EATON MANUFACTURING CO., Cleveland, O.
PERSONNEL: C. I. Ochs, Pres.; R. H. Daisley, V. Pres.; H. C. Sutessy, Secy. & Treas.; V. Cada, Pur. Agt.; A. H. Richards, Pers. Dir.; M. Fenley, Pub. Dir.
PRODUCTS: Miscellaneous engine equipment; Parts; Pumps; Stampings; Sub-assemblies; Valves.

ECLIPSE AVIATION DIV. OF BENDIX AVIATION CORP., Bendix, N. J.
PERSONNEL: R. P. Lansing, Gen. Mgr.; C. H. Knoch, Comp.; A. E. Raabe, Sales Mgr.; S. H. Webster, Adv. Mgr.; K. MacGrath, Factory Mgr.
PRODUCTS: Ammunition boxes and counters; Auxiliary power plants; Controls; De-icer equipment; Dynamotors; Generators; Magnetos; Motors; Filters and strainers; Hydraulic controls and assemblies; Instruments; Miscellaneous engine equipment; Propellers and parts; Pumps; Starters; Valves; Vibration dampers; Radio shielding and equipment.

ECLIPSE FUEL ENGINEERING CO., 711 South Main St., Rockford, Ill.
PERSONNEL: S. Hyer, Pres.; L. B. McKee, Secy.; G. W. McKee, V. Pres., Treas. & Gen. Mgr.; L. J. Strohmeyer, Pur. Agt.; K. A. Scharbau, Pers. Dir. & Sales Mgr.
PRODUCTS: Heaters and vaporizers; Process steam boilers; Furnaces; Gas burners; Pressure air blowers; Air-gas mixing equipment; Air control valves.

EDISON-SPLITDORF CORP., West Orange, N. J.
PERSONNEL: A. Walsh, Pres.; A. J. Clark, V. Pres., Gen. Mgr. & Sales Mgr.; F. C. Erwin, Secy.; H. H. Eckert, Treas.; G. H. McLaughin, Pers. Dir.; S. Schaeffer, Sales Promotion Mgr.
PRODUCTS: Magnetos; Instruments; Spark plugs.

EDO AIRCRAFT CORP., College Point, N. Y.
PERSONNEL: E. D. Osborn, Pres.; G. B. Post, V. Pres. & Sales Mgr.; K. D. Vosler, Secy.; S. E. Bostwick, Treas.; W. Konrad, Pur. Agt., J. H. Burkett, Pers. Dir.; H. Y. Satterlee, Pub. Dir.
PRODUCTS: Floats; Skiis; Sheet metal assemblies.

THE EDWARDS MANUFACTURING CO., Fifth & Butler Sts., Cincinnati, O.
PERSONNEL: H. W. Edwards, Pres. & Treas.; G. D. Myers, V. Pres. & Secy.; H. Smith, Sales Mgr.
PRODUCTS: Ammunition boxes and counters; Stampings; Tanks; Arches; Awnings; Elbows; Hoods; Crestings; Iron and steel corrugated sheets; Metal base plates for stoves; Shingles; Skylights; Ventilators; Tanks.


PRECISION PARTS AND ASSEMBLIES
Marquette has long been a very important factor in the ever-increasing demand for precision parts—so vital to the aircraft industry.
The Marquette METAL PRODUCTS CO.
1145 Galewood Drive • Cleveland, O. • U. S. A.

EISEMANN MAGNETO CORP.,
60 East 42nd St., New York, N. Y.
PERSONNEL: C. A. Brown, Pres.; F. S. Jerome, V. Pres. & Treas.; S. M. Cargill, Secy.; B. B. Woodford, Sales Mgr.; B. J. Sternkopf, Pur. Agt.; G. Weiss, Pers. Dir.; J. C. Affleck, Pub. Dir.
PRODUCTS: Magnetos.

EITEL-McCULLOUGH, INC.,
San Bruno, Calif.
PERSONNEL: W. W. Eitel, Pres.; J. A. McCullough, V. Pres. & Treas.; Bradshaw Harrison, Secy.; G. F. Wunderlich, Prod. Mgr.; O. H. Brown, Pur. Agt.
PRODUCTS: Transmitting vacuum tubes; Vacuum relays and rectifiers.

ELASTIC STOP NUT CORP.,
2377 Vauxhall Road, Union, N. J.
PERSONNEL: K. A. Swanstrom, Pres.; D. C. Hungerford, V. Pres.; W. F. McGuinness, Secy. & Treas.
PRODUCTS: Fasteners; Fittings; Miscellaneous hardware; Lock and self-locking nuts.

THE ELECTRIC AUTO-LITE CO.,
Toledo, O.
PERSONNEL: R. G. Martin, Pres.; D. H. Kelly, Exec. V. Pres.; W. V. Flood, J. H. McDuffee, B. A. Fay, L. H. Middleton, D. B. Stratton, V. Pres.; F. H. Landwehr, Secy.; E. H. Reed, Dir. of Pur.
PRODUCTS: Aluminum die castings; Low loss ignition cable; Insulated magnet wire; Ignition systems; Voltage and current regulators; Generators; Solenoid and manual circuit controls; Condensers; Distance type engine heat indicators; Fuel pressure gauges; Tachometers; Batteries; Horns; Relays.

THE ELECTRIC FURNACE CO., Salem, O.
PERSONNEL: R. F. Benzinger, Pres.; C. L. West, V. Pres.; R. D. Painter, Secy.; F. T. Cope, Gen. Mgr.; R. M. Warren, Pur. Agt.; A. E. Wright, Pub. Dir.
PRODUCTS: Industrial Furnaces.

THE ELECTRIC STORAGE BATTERY CO.,
19th St. & Allegheny Ave., Philadelphia, Pa.
PERSONNEL: R. C. Norberg, Pres. & Gen. Mgr.; S. W. Rolph, V. Pres.; H. C. Allan, Secy. & Treas.; F. T. Kalas, V. Pres. & Gen. Sales Mgr.; W. B. Gold, Pur. Agt.; L. W. Moseley, Pers. Dir.
PRODUCTS: Batteries.

ELECTRONIC LABORATORIES, INC.,
122 West New York St., Indianapolis, Ind.
PERSONNEL: N. R. Kevers, Pres.; W. W. Garstang, V. Pres.; E. Chapman, Secy.; T. D. Scheidler, Treas.; R. Pattison, Pur. Agt.; R. H. Dickson, Pers. Dir.
PRODUCTS: Landing and navigation lights; Radio equipment.

ELECTRONIC SPECIALTY CO., 3456 Glendale Blvd., Los Angeles, Calif.
PERSONNEL: David A. Marcus, Gen. Mgr.
PRODUCTS: Radios; Radio transmitters, receivers and interphones.

ENGEL AIRCRAFT SPECIALTIES,
P. O. Box 697, Escondido, Calif.
PERSONNEL: John H. Engel, Owner.
PRODUCTS: Collector rings, cowls, streamlines; Cowlings; Exhaust manifolds; Floats; Skiis; Heaters; Manifolds; Seats; Stampings; Tanks.

ENGINEERING AND RESEARCH CORP.,
Riverdale, Md.
PERSONNEL: H. A. Berliner, Pres.; L. A. Wells, V. Pres.; M. W. King, Secy.; W. G. Carroll, Treas.
PRODUCTS: Propellers; Radios.

ENGIS EQUIPMENT CO., 310 South Michigan Ave., Chicago, Ill.
PERSONNEL: J. P. Steindler, Pres.; E. J. Schneider, V. Pres. & Secy.; M. Steindler, Treas.
PRODUCTS: Parts; Clinometers; Instrument parts.

THE EMERSON ELECTRIC MANUFACTURING CO., 1824 Washington Ave., St. Louis, Mo.
PERSONNEL: W. S. Symington, Pres. & Gen. Mgr.; O. C. Schmitt, V. Pres.; R. H. McRoberts, Secy.; W. L. Hausman, Treas.; R. E. Otto, Sales Mgr.; J. Worley, Pur. Agt.; O. C. Oechsli, Pers. Dir.; C. A. Swanlund, Pub. Dir.
PRODUCTS: Generators; Motors; Arc welders; Power operated gun turrets.

ERTEL MACHINE CO., 2045 Martindale Ave., Indianapolis, Ind.
PERSONNEL: J. C. Ertel Jr., Pres.; C. B. Enochs, Gen. Mgr.; J. C. Ertel III, Sales Mgr.
PRODUCTS: Engine valve guides; Engine valve seats; Miscellaneous precision engine parts.

EX-CELL-O CORP.,
1200 Oakman Blvd., Detroit, Mich.
PERSONNEL: P. Huber, Pres.; T. M. Olson, V. Pres. & Sales Mgr.; H. G. Bixby, Secy. & Treas.; F. D. Sicklesteel, Pur. Agt.; F. Boucher, Pers. Dir.; J. Humphrey, Pub. Dir.
PRODUCTS: Parts; Propeller parts; Precision aircraft engine parts; Grinding spindles; Boring machines; Thread grinders; Carbide tool grinders; Center lapping machines; Internal lapping machines; Broaches; Counterbores; Miscellaneous special cutting tools.

THE EXACT WEIGHT SCALE CO.,
944 West Fifth Ave., Columbus, O.
PERSONNEL: K. B. Neff, V. Pres. & Treas.; S. L. Briggs, Secy.; W. A. Scheurer, V. Pres.; T. Hamilton, Pur. Agt.
PRODUCTS: Scales.

F

THE FAFNIR BEARING CO.,
Booth St., New Britain, Conn.
PERSONNEL: M. Stanley, Pres.; S. M. Cooper, Secy.; A. G. Way, Treas.; R. R. Searles, Gen. Mgr.; C. F. Stanley, Sales Mgr.; H. P. Knowles Pur. Agt.; D. M. Davidson, Pub. Dir.
PRODUCTS: Bearings.

FAHLIN MANUFACTURING CO.,
Columbia, Mo.
PERSONNEL: O. Fahlin, Pres.; D. Holt, V. Pres.; C. Roach, Secy.; A. Driscoll, Gen. Mgr.; R. Hills, Pub. Dir.
PRODUCTS: Propellers and propeller parts; Test clubs.

FAIRBANKS, MORSE & CO.,
600 So. Michigan Ave., Chicago, Ill.
PERSONNEL: R. H. Morse, Pres.; A. E. Ashcraft, V. Pres.; F. C. Dierks, Secy.; S. T. Kiddoo, Treas.; A. C. Dodge, Sales Mgr.; F. J. Heaslip, Pur. Agt.; H. N. Baum, Pub. Dir.
PRODUCTS: Magnetos; Pumps; Engines.


"Teamwork"
IS THE CALL TO VICTORY
NORTH AMERICAN AVIATION, INC.
INGLEWOOD, CALIF.

FAIRCHILD AVIATION CORP.,
88-06 Van Wyck Blvd., Jamaica, N. Y.
PERSONNEL: J. S. Ogsbury, Pres.; E. Robinson, V. Pres.; C. L. Terrill, Secy.; J. A. Hewlett, Treas.; J. E. Kaiser, Pur. Agt.; .R. W. Brown, Pers. Dir.; H. K. Yulke, Pub. Dir.
PRODUCTS: Cameras; Radios; Radio compasses.

FARNHAM MANUFACTURING CO.,
1646 Seneca St., Buffalo, N. Y.
PERSONNEL: Paul Duboscłard, Pres.; A. Farnham, Secy.; F. L. Boutet, Treas.
PRODUCTS: Milling machines.

A. B. FARQUHAR CO., LTD.,
142 N. Duke St., York, Pa.
PERSONNEL: F. Farquhar, Pres. & Treas.; W. J. Fisher, V. Pres. & Gen. Mgr.; D. Gregory, Sales Mgr.; J. Throne, Pur. Agt.
PRODUCTS: Hydraulic production presses.

FARREL-BIRMINGHAM CO., INC.,
Ansonia, Conn. & Buffalo, N. Y.
PERSONNEL: N. W. Pickering, Pres. & Gen. Mgr.; G. C. Bryant, Secy.; F. M. Drew, Jr., Treas.; C. Hitchcock, Sales Mgr.; C. E. Burton, Pur. Agt.; A. Steeves, Pers. Dir.; T. V. Busk, Pub. Dir.
PRODUCTS: Speed reducing gears; Hydraulic metal forming presses.

J. A. FAY & EGAN CO.,
1110 Alfred St., Cincinnati, O.
PERSONNEL: W. E. Schott, M. C. Schott, H. C. Schott, J. J. Schott, partners; C. G. Engbersen, Sales Mgr.; E. R. Gabriel, Pur. Agt.; L. W. Covert, Pers. Dir.
PRODUCTS: Woodworking machinery; Band saws.

FEDERAL AIRCRAFT WORKS, 3456 Mississippi Dr., Minneapolis, Minn.
PERSONNEL: F. J. Ditter, Pres. & Gen. Mgr.; A. A. Bursch, Sales Mgr., Pur. Agt., Pub. Dir.
PRODUCTS: Skiis; Miscellaneous engine equipment.

THE FEDERAL BEARINGS CO., INC.,
Poughkeepsie, N. Y.
PERSONNEL: H. A. Schatz, Pres. & Treas.; G. R. Bennett, Jr., V. Pres.; V. W. Fichtel Secy. & Pur. Agt.; H. F. Petersen, Sales Mgr.
PRODUCTS: Ball bearings.

FEDERAL METAL HOSE CORP.,
277 Military Rd., Buffalo, N. Y.
PERSONNEL: H. C. Neff, Pres., Treas. & Sales Mgr.; R. G. Yeager, V. Pres.; J. L. Yeager, Secy.; K. Lehr, Pur. Agt.
PRODUCTS: Flexible tubing.

FEDERAL PRODUCTS CORP.,
1144 Eddy St., Providence, R. I.
PERSONNEL: L. C. Lingley, Pres.; W. E. Carroll, V. Pres. & Gen. Mgr.; S. B. Reynolds, Secy.; C. N. Kingsford, Treas.; I. A. Hunt, Sales Mgr. & Pub. Dir.; J. G. Gunderson, Pur. Agt.; C. Collison, Pers. Dir.
PRODUCTS: Dial indicator gages; Dynamotors; Precision measuring instruments; Primers.

FEDERAL TELEGRAPH CO., INC.,
200 Mt. Pleasant Ave., Newark, N. J.
PERSONNEL: L. McNamee, Pres.; St. G. Lafitte V. Pres.; S. G. Ordway, Secy. & Treas.; L. C. Mercier, Pur. Agt.; J. A. Nelson, Pers. Dir.
PRODUCTS: Radios; Radio equipment.

THE FELLOWS GEAR SHAPER CO.,
78 River St., Springfield, Vt.
PERSONNEL: E. R. Fellows, Pres.; E. J. Fullam, V. Pres.; R. M. Fellows, Secy. & Treas.; E. W. Miller, Gen. Mgr.; C. M. Peter, Sales Mgr.; J. M. Rafford, Pur. Agt.; D. T. Hamilton, Pub. Dir.
PRODUCTS: Equipment for cutting, finishing and testing gears.

FELTERS CO., INC.,
210 South St., Boston, Mass.
PERSONNEL: L. H. Hansel, Pres. & Gen. Mgr.; G. H. Wood, V. Pres., Pur. Agt. & Pers. Dir.; W. C. King, Secy. & Sales Mgr.; E. M. Guillaume, Treas.
PRODUCTS: Felt.

FENWAL INCORPORATED,
Ashland, Mass.
PERSONNEL: T. L. Fenn, Pres.; W. J. Turenne, V. Pres.; C. W. Walter, Secy.; H. A. Varnum, Treas.; H. A. Turner, Sales Mgr.
PRODUCTS: Controls.

FERRACUTE MACHINE CO.,
Bridgeton, N. J.
PERSONNEL: G. E. Bass, Pres.; H. A. Janvier, V. Pres.; P. M. Meyers, Secy.; L. C. Meyers, Treas. & Gen. Mgr.; J. D. Lamson, Pur. Agt.
PRODUCTS: Presses; Press brakes; Dies.

THE FIBRE CONDUIT CO.,
292 Madison Ave., New York, N. Y.
PERSONNEL: H. J. Robertson, Jr., Pres.; F. P. Combier, V. Pres. & Sales Mgr.; F. G. Wehman, Secy. & Treas., G. Allen, Pur. Agt.
PRODUCTS: Electrical equipment; Miscellaneous.

FINCH TELECOMMUNICATIONS, INC.,
4th & Virginia Sts., Passaic, N. J.
PERSONNEL: F. C. Scofield, Pres.; F. R. Brick, V. Pres.; M. Gilman, Secy.; A. Gross, Treas.; L. Knapp, Gen. Mgr.; H. Budelman, Pur. Agt.; F. C. Ehlert, Pub. Dir.
PRODUCTS: Radio compasses; Radio shielding and equipment; Radio facsimile apparatus.

FIRESTONE AVIATION PRODUCTS CO.,
Firestone Pkwy., Akron, O.
PERSONNEL: L. K. Firestone, Pres.; W. W. Shaw, Sales Mgr.
PRODUCTS: De-icer equipment; Engine mounts; Landing gears; Seats; Shock struts and cord; Spark plugs; Tail wheel assemblies; Tanks; Tires and tubes; Wheels and brakes.

FIRTH-STERLING STEEL CO.,
McKeesport, Pa.
PERSONNEL: D. G. Clark, V. Pres.
PRODUCTS: Tools and dies; Tool steel; Stainless steel; Sintered carbide.

FISHER RESEARCH LABORATORY
University Ave., Palo Alto, Calif.
PERSONNEL: G. R. Fisher, Pres.; G. Brown, Secy.
PRODUCTS: Radios; Radio compasses.

FLEX-O-TUBE CO.,
Lafayette at 14th, Detroit, Mich.
PERSONNEL: J. L. Ward, Pres.; R. De Tamble, V. Pres.; J. H. Conn, Secy. & Treas.
PRODUCTS: Fittings.

FLEXIBLE SHAFT CO. OF NEW YORK,
72-76 Cortlandt St., New York, N. Y.
PERSONNEL: C. Ungeheuer, Pres.
PRODUCTS: Flexible cores, shafts and shaft grinders.

A SHORT-CUT TO TOKYO

This war will be won over drafting boards, as well as maps. A production hour saved, a mile a minute added, a load capacity increased—these are short-cuts to Tokyo.

In the aviation industries war schedule each plant is doing that which it is best equipped to do. To the Men and Machines of Northrop go a share of the responsibility which they have ably assumed in the past—that of achieving further advancements in production—further refinements in design.

So it is at Northrop that *plans for tomorrow* share the spotlight with *planes for today*—this assignment is a duty—and a privilege.

NORTHROP AIRCRAFT, INC. • NORTHROP FIELD, HAWTHORNE, CALIFORNIA, U.S.A. • CABLE "NORAIR"

FLOTATION SYSTEMS, INC.,
4031 Goodwin Ave., Los Angeles, Calif.
PERSONNEL: J. Q. Henry, Pres.; Fred E. Kalte, V. Pres.; H. D. Dargert, Secy. & Treas.
PRODUCTS: Gasoline fueling systems; Control equipment.

THE FOLMER GRAFLEX CORP.,
154 Clarissa St., Rochester, N. Y.
PERSONNEL: N. L. Whitaker, Pres. & Gen. Mgr.; J. E. B. Murphy, Secy.; C. H. Harper, Treas.; H. A. Schumacher, Sales Mgr.; C. J Krembel, Pur. Agt.; M. S. Murphy, Pers. Dir.; W. H. Field, Pub. Dir.
PRODUCTS: Cameras.

THE J. B. FORD SALES CO.,
1532 Biddle Ave., Wyandotte, Mich.
PERSONNEL: C. B. Robinson, Pres.; W. F. Torrey, V. Pres.; W. M. Cole, Sales Mgr.
PRODUCTS: Cleaners.

THE FORMICA INSULATION CO.,
4614 Spring Grove Ave., Cincinnati, O.
PERSONNEL: D. J. O'Conor, Pres.; W. H Kruse, Secy.; W. J. Gebhart, Treas.; J. R. White, Sales Mgr.; H. Heitbrink, Pur. Agt.
PRODUCTS: Aircraft armament; Auxiliary power plants; Bomb racks; Cameras; Controls; Hydraulic controls and assemblies; Instruments; Panels; Propellers and propeller parts.

THE FORSBERG MANUFACTURING CO.,
Bridgeport, Conn.
PERSONNEL: H. S. Forsberg, Pres.; C. M. Toomey, Secy.; J. W. Nystrom, Sales Mgr.
PRODUCTS: Miscellaneous hardware; Stampings.

THE FOSTORIA PRESSED STEEL CORP.,
Fostoria, O.
PERSONNEL: R. J. Carter, Pres. & Gen. Mgr.; E. L. Bates, V. Pres. & Sales Mgr.; C. W. McDaniel, Secy.; R. L. Hill, Pur. Agt.
PRODUCTS: Filters and strainers.

THE FOUR WHEEL DRIVE AUTO CO.,
Clintonville, Wisc.
PERSONNEL: W. A. Olen, Pres. & Gen. Mgr.; J. D. Cotton, V. Pres. & Pers. Dir.; S. H. Sanford, Secy.; D. J. Rohrer, Treas.; R. H. Schmidt, Sales Mgr.; L. J. Pinkowsky, Pur. Agt.; F. M. Higgins, Pub. Dir.
PRODUCTS: Crash, fire, airport maintenance and snow removal trucks.

S. G. FRANTZ CO., INC.,
161 Grand St., New York, N. Y.
PERSONNEL: S. G. Frantz, Pres., Treas. & Gen. Mgr.; E. H. Raymond, Secy.; F. H. Boyd, Sales Mgr.; G. C. Finster, Pur. Agt.; R. A. Trefethen, Pub. Dir.
PRODUCTS: Magnetic separators; Filters and strainers.

FRAY MACHINE TOOL CO.,
515 W. Windsor Rd., Glendale, Calif.
PERSONNEL: J. H. Richards, Pres. & Gen. Mgr.; Lock Hales, V. Pres.; R. D. Wollard, Secy. & Pur. Agt.; J. O. Ellison, Sales Mgr.
PRODUCTS: Milling machines.

FREEDMAN - BURNHAM ENGINEERING CORP., 659 East 6th St., Cincinnati, O.
PERSONNEL: G. L. Freedman, Pres.; W. E. Burnham, V. Pres.; S. S. Freedman, Secy.
PRODUCTS: Propellers and propeller parts.

FRICK - GALLAGHER MANUFACTURING CO., Wellston, O.
PERSONNEL: J. P. Gallagher, Pres.; A. J. Frick, V. Pres.; P. H. Frick, Secy. & Treas.; H. J. Geitz, Gen. Mgr.
PRODUCTS: Steel shelving; Bins.

JULIEN P. FRIEZ & SONS, DIV. OF BENDIX AVIATION CORP., Baltimore, Md.
PERSONNEL: L. L. Friez, Gen. Mgr.; Denis McCormack, Sales Mgr.; G. Parks, Pur. Agt.
PRODUCTS: Aircraft armament; Controls; Instruments; Hydraulic controls and assemblies; Sub-assemblies.

FUEL INJECTION CORP.,
Getty at Keating, Muskegon, Mich.
PERSONNEL: L. Wegusen, Pres.; C. F. High, V. Pres.; F. C. Smith, Treas.; G. L. Lundborg, Secy. & Gen. Mgr.
PRODUCTS: Fuel injection equipment.

THE FULTON CO.,
1912 S. 82nd St., Milwaukee, Wisc.
PERSONNEL: S. A. Fulton, Pres., Treas. & Gen. Mgr.; F. P. Fulton, V. Pres.; L. M. Fidler, Secy. & Pur. Agt.; E. L. Worcester, Sales Mgr.
PRODUCTS: Ammunition boxes and counters; Bomb racks; De-icer equipment; Stampings; Sub-assemblies; Tail wheel assemblies; Visors.

G

THE G & O MANUFACTURING CO.,
138 Winchester Ave., New Haven, Conn .
PERSONNEL: A. J. Verdi, Pres.; V. Carangelo , V. Pres.; F. I. Newton, Secy.; C. Oppe, Treas. & Gen. Mgr.; M. Wellman, Pur. Agt.
PRODUCTS: Heaters; Radiators.

GAERTNER SCIENTIFIC CORP.,
1201 Wrightwood Ave., Chicago, Ill.
PERSONNEL: W. Gaertner, Pres.; S. Jacobsohn, V. Pres.; J. Mandel, Secy.; W. A. Schumacher, Pur. Agt.
PRODUCTS: Oxygen regulator; Breathing masks; Bail-out equipment; Bomb sights; Mercurial barometers.

GARDNER PROPELLER CO.,
1215 Circle Ave., Forest Park, Ill.
PERSONNEL: Wm. H. Gardner, Gen. Mgr.
PRODUCTS: Propellers; Engine test clubs.

GENERAL AIRCRAFT EQUIPMENT, INC.,
South Norwalk, Conn.
PERSONNEL: C. M. Torrey, Pres. & Gen. Mgr.
PRODUCTS: Oxygen and electrical equipment; Remote gun controls; Flame damping exhausts; Sheet metal parts and assemblies.

GENERAL AIRCRAFT SUPPLY CORP.,
Detroit City Airport, Detroit, Mich.
PERSONNEL: L. F. Zygmunt, Pres.; P. Altman, V. Pres.; H. L. Mitchell, Secy. & Treas.
PRODUCTS: Log books; Miscellaneous hardware; Parts; Propellers and propeller parts; Safety belts; Tail wheel assemblies; Dopes and paints.

GENERAL ARMATURE CORP.,
Lock Haven, Pa., Chicago, Ill.
PERSONNEL: Lou Mervis, Pres. & Gen. Mgr.; Leonard Mervis, Sales Mgr.; A. C. Potratz, Pur. Agt.; G. K. Warner, Pub. Dir.
PRODUCTS: Dynamotors; Generators.


RADIAL ARM ROUTING
HAND ROUTING
GRINDING
DRILLING
MILLING

GENERAL AVIATION EQUIPMENT CO., INC., 61-73 Mary St., Ashley, Pa.
PERSONNEL: V. C. Bell, Pres.; G. R. Schultz, V. Pres.; G. C. Champe, Secy.; J. M. Faehndrick, Treas. & Gen. Mgr.; G. W. Von Arx, Sales Mgr. & Pub. Dir.; C. P. Elliot, Pur. Agt.
PRODUCTS: Gun and camera mounts; Data cases; Bomb racks; Control pulleys; Guncharging handle assembly; Ammunition box mount assembly.

GENERAL BRONZE CORP., 34-19 10th St., Long Island City, N. Y.
PERSONNEL: W. P. Jacob, Pres.; E. Peremi, V. Pres.; H. Meyer, Pur. Agt.; C. R. Hoyt, Pers. Dir.
PRODUCTS: Metals.

GENERAL CABLE CORP., 420 Lexington Ave., New York, N. Y.
PERSONNEL: D. R. G. Palmer, Pres.; P. D. Rensenhouse, V. Pres., Treas. & Secy.; D. M. Simmons, V. Pres.; H. E. Eagleston, Gen. Sales Mgr.; G. Sherry, Dir. of Pur.
PRODUCTS: Electrical wires and cables.

GENERAL CONTROLS CO., 801 Allen Ave., Glendale, Calif.
PERSONNEL: W. A. Ray, Pres.; A. W. Ray, V. Pres.; E. T. Howard, Sales Mgr.
PRODUCTS: Hydraulic controls and assemblies; Valves.

THE GENERAL DETROIT CORP., 2200 E. Jefferson Ave., Detroit, Mich.
PERSONNEL: C. K. Huthsing, Pres., Treas. & Gen. Mgr.; E. A. Warren, V. Pres. & Sales Mgr.; R. L. Braden, Secy. & Pers. Dir.; C. T. Thoman, Pur. Agt.; F. D. Bacon, Pub. Dir.
PRODUCTS: Fire extinguishers.

GENERAL ELECTRIC CO., Schenectady, N. Y.
PERSONNEL: C. E. Wilson, Pres.; E. O. Shreve, V. Pres.; W. W. Trench, Secy.; J. W. Lewis, Treas.; C. H. Lang, Sales Mgr.; H. L. Erlicher, Pur. Agt.; W. R. Burrows, Pers. Dir.; R. S. Peare, Pub. Dir.
PRODUCTS: Ammunition counters; Dynamotors, Generators; Motors; Switches; Indirect lighting; Instruments; Radios; Superchargers.

GENERAL ENGINEERING CO., 785 Hertel Ave., Buffalo, N. Y.
PRODUCTS: Riveting equipment.

GENERAL SCIENTIFIC EQUIPMENT CO., 2735 N. Broad St., Philadelphia, Pa.
PERSONNEL: M. Kline, Gen. Mgr.
PRODUCTS: First aid equipment; Goggles; Respirators; Eye and face shields; Storage battery tools.

THE GENERAL TIRE & RUBBER CO., Akron, O.
PERSONNEL: W. O'Neil, Pres.; C. J. Jahant, V. Pres.; H. R. Jenkins, Secy.; R. S. Shore, Treas.; L. A. McQueen, Sales Mgr.; R. Graham, Pur. Agt.; H. L. Barnes, Pub. Dir.; W. H. Marting, Aeronautical Sales Div.
PRODUCTS: Tail wheel assemblies; Tires and tubes; Wheels and brakes; Miscellaneous.

E. A. GERLACH CO., 3567-71 Sepviva St., Philadelphia, Pa.
PERSONNEL: R. G. Gerlach, Pres.; E. A. Gerlach, Secy.; T. Walker Cleeland, Sales Mgr.
PRODUCTS: Paint stripper compound; Decarbonizing compound; Degreasing compound.

GILBERT & BARKER MANUFACTURING CO., West Springfield, Mass.
PERSONNEL: S. C. Hope, Pres. & Gen. Mgr.; T. C. O'Donnell, V. Pres.; P. H. Bills, V. Pres. & Treas.; G. MacDonald, Secy.; W. C. Leitch, Sales Mgr.; H. D. Foss, Pur. Agt.; C. Umla, Pers. Dir.
PRODUCTS: Aeropits for fueling planes.

GISHOLT MACHINE CO., 1399 East Washington Ave., Madison, Wisc.
PERSONNEL: G. H. Johnson, Pres.; H. S. Johnson, Jr., V. Pres.; G. E. Gernon, Secy.; H. J. Homewood, Treas.; C. K. Swafford, Gen. Mgr.; F. L. Chapman, Sales Mgr.; R. K. Newton, Pur. Agt.; W. Lohff, Pers. Dir.; J. Hazlewood, Pub. Dir.
PRODUCTS: Turret lathes; Automatic lathes; Dynetric balancing machines.

GLENN-ROBERTS CO., 1009 Fruitvale Ave., Oakland, Calif.
PERSONNEL: G. G. Glenn. Pres.
PRODUCTS: Electrode holders; Welders; Clamps.

GLOBE STEEL TUBES CO., Milwaukee, Wisc.
PERSONNEL: W. C. Buchanan, Pres.; F. J. O'Brien, V. Pres. & Sales Mgr.; G. O. Ross, Secy. & Treas.; G. W. Walzer, Gen. Mgr.; A. Korsan, Pur. Agt. & Pub. Dir.
PRODUCTS: Tubing.

THE GOGGLE PARTS CO., Blackstone Bldg., Cleveland, O.
PERSONNEL: W. R. Paterson; J. D. Hill, Firm members.
PRODUCTS: Goggles and parts; Welding helmets and parts; Hand shields.

THE B. F. GOODRICH CO., 500 S. Main St., Akron, O.
PERSONNEL: J. L. Collyer, Pres.; S. M. Jett, Secy.; L. L. Smith, Treas.; G. E. Brunner, Gen. Mgr.; J. S. Pedler, Sales Mgr.; A. D. Moss, Pur. Agt.; C. V. Molesworth, Pers. Dir.; H. W. Maxson, Pub. Dir.
PRODUCTS: Batteries; Control sticks and wheels; De-icer equipment; Fasteners; Parachute seat and back cushions; Shock struts and cord; Tail wheel assemblies; Tanks; Tires and tubes; Wheels and brakes; Miscellaneous rubber goods.

GOODYEAR AIRCRAFT CORP., Akron, Ohio
PERSONNEL: P. W. Litchfield, Pres.; E. J. Thomas, V. Pres.; Karl Arnstein, V. Pres. & Chief Engr.; H. L. Hyde, Secy.; Z. C. Oseland, Treas.; T. A. Knowles, Sales Mgr.; L. A. Murphy, Pur. Agt.; W. E. Thomas, Pers. Dir.; L. E. Judd, Pub. Dir.
PRODUCTS: Controls; Control sticks and wheels; Covers (engine, cockpit, windshield); Cowlings; Engine mounts; Fittings; Floats; Skiis; Landing gears; Parts; Stampings; Tail wheel assemblies; Tanks; Tires and tubes; Valves; Vibration dampers; Tubing; Wheels and brakes; Sub-assemblies; Miscellaneous.

GOODYEAR TIRE & RUBBER CO., Akron, O.
PERSONNEL: R. S. Wilson, V. Pres.; V. R. Jacobs, Mgr.
PRODUCTS: Tires; Tubes; Wheels; Brakes.


PACIFIC AVIATION INCORPORATED

GEORGE GORTON MACHINE CO.,
Racine, Wisc.
PERSONNEL: G. Gorton, Sr., Pres.; G. Gorton III, V. Pres.; W. B. Tomlinson, Treas.; C. C. Erlandson, Secy.; J. Gorton, Pur. Agt.
PRODUCTS: Die cutting and engraving machines; Cutter and tool grinders; Tools and cutters.

THE GOVRO-NELSON CO.,
1931 Antoinette, Detroit, Mich.
PERSONNEL: V. Gauvreau, Gen. Mgr.
PRODUCTS: Aircraft engine parts; Drilling units.

GRANBERG EQUIPMENT, INC.,
1308 - 67th St., Oakland, Calif.
PERSONNEL: A. J. Granberg, Pres.; R. W. Lindsay, V. Pres. & Sales Mgr.
PRODUCTS: Pumps; Meters.

GRATON & KNIGHT CO.,
356 Franklin St., Worcester, Mass.
PERSONNEL: A. N. Bennett, Pres. & Treas.; W. Bishop, Jr., Secy.; G. L. Abbott, V. Pres. & Sales Mgr.; G. A. Barnard, Pur. Agt.
PRODUCTS: Hydraulic controls and assemblies; Parts; Propellers and propeller parts.

GRAY RADIO CO., West Palm Beach, Fla.
PERSONNEL: F. E. Gray, Pres.
PRODUCTS: Radios; Radio compasses.

GREIST MANUFACTURING CO.,
Blake & Valley Sts., New Haven, Conn.
PERSONNEL: H. Ely, Pres.; D. L. Bacon, V. Pres. & Gen. Mgr.; J. Wheeler, Secy.; W. C. Greist, Treas.; H. M. Greist, Jr., Pur. Agt.; C. F. Black, Pers. Dir.
PRODUCTS: Parts; Stampings; Sub-assemblies; Subcontractors.

GRIMES MANUFACTURING CO.,
515 N. Russell St., Urbana, O.
PERSONNEL: W. G. Grimes, Pres.; D. O. Printz, Mgr.
PRODUCTS: Lighting equipment.

GULF OIL CORP., Gulf Bldg., Pittsburgh, Pa.
PERSONNEL: A. Williams, Mgr. Aviation Dept.; B. W. Horton, Asst. Mgr. Aviation Dept.
PRODUCTS: Aviation fuel.

W. & L. E. GURLEY,
514 Fulton St., Troy, N. Y.
PERSONNEL: C. I. Day, Pres.; E. H. Betts, V. Pres.; H. M. Dibert, Secy.
PRODUCTS: Drift indicators; Weather recording instruments.

GWINN AIRCAR CO.,
3133 Browning St., San Diego, Calif.
PERSONNEL: J. M. Gwinn, Jr., Pres.
PRODUCTS: (Licensor of patents).

H

THE HALL MANUFACTURING CO.,
Toledo, O.
PERSONNEL: E. A. Hall, Pres. & Gen. Mgr.; R. P. Hall, V. Pres.; G. A. Powers, Secy. & Treas.; G. W. Smith, Sales Mgr.; W. Coffman, Pur. Agt.; H. F. Bradford, Pub. Dir.
PRODUCTS: Valve seat grinders; Valve refacers; Precision grinders.

HAMILTON STANDARD PROPELLERS DIV. OF UNITED AIRCRAFT CORP.,
East Hartford, Conn.
PERSONNEL: S. A. Stewart, Gen. Mgr.; H. M. Ellis, Sales Mgr.; Norman V. Clements, Pub. Dir.; Adam C. Wolz, Pur. Agt.
PRODUCTS: Propellers.

HAMMOND AIRCRAFT CO.,
S. San Francisco, Calif.
PERSONNEL: T. L. Ford, Pres.; D. B. Hammond, V. Pres. & Gen. Mgr.; A. A. Jones, Secy.; H. Bohling, Treas.; M. C. Casserly, Pur. Agt.; C. Bjornson, Pers. Dir.
PRODUCTS: General aircraft manufacturing.

HARBOR PLYWOOD CORP.,
Hoquiam, Wash.
PERSONNEL: E. W. Daniels, Pres.; H. F. Wise, Secy. & Treas.; M. S. Munson, Pub. Dir.
PRODUCTS: Plywood.

HARDINGE BROTHERS, INC.,
1420 College Ave., Elmira, N. Y.
PERSONNEL: D. G. Anderson, Pres. & Gen. Mgr.; L. R. Evans, V. Pres.; W. H. Mandeville, Secy.; A. F. Fischer, Treas.; D. R. Laux, Sales Mgr.; J. S. Netth, Pur. Agt.; R. A. Johnson Pers. Dir.
PRODUCTS: Chucks; Collets; Indexing devices; Lathes; Milling machines; Screw machines.

HARDWICK, HINDLE, INC.,
40 Hermon St., Newark, N. J.
PERSONNEL: A. H. Hardwick, Pres. & Sales Mgr.; R. F. Golden, V. Pres.; J. A. Greene, Secy. & Treas.; H. T. Moffett, Pur. Agt.
PRODUCTS: Resistors; Rheostats.

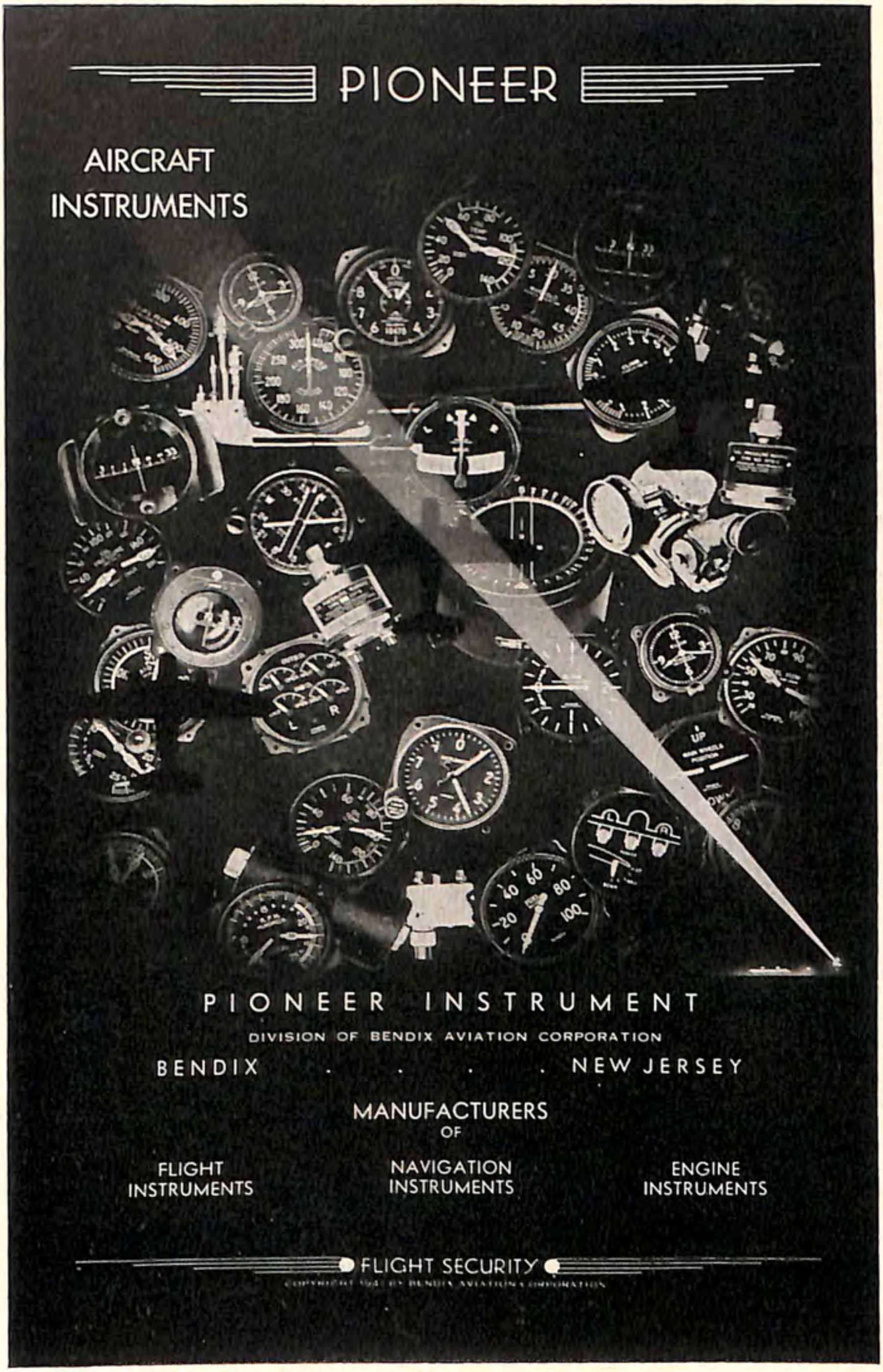
THE HARRIS CALORIFIC CO.,
5501 Cass Ave., N. W., Cleveland, O.
PERSONNEL: L. Campbell, Jr., Pres.; J. Milligan, Treas.
PRODUCTS: Gas welding and cutting apparatus; Regulators; Generators.

HARRISON RADIATOR DIV. GENERAL MOTORS CORP., Lockport, N. Y.
PERSONNEL: F. M. Hardiman, Gen. Mgr.; L. J. Schneider, Sales Mgr.; B. A. Bolton, Pur. Agt.; I. D. Jenkins, Pers. Dir.; K. F. Covert, Pub. Dir.
PRODUCTS: Intercoolers; Regulators.

THE HARTFORD SPECIAL MACHINERY CO., Hartford, Conn.
PERSONNEL: J. Merritt, Pres. & Treas.; R. P. Merritt, V. Pres.; R. J. Dunn, Secy.; E. P. Hopfer, Pur. Agt.
PRODUCTS: Engine and airplane parts.

HARTZELL PROPELLER CO., DIV. OF HARTZELL INDUSTRIES, INC.,
Piqua, O.
PERSONNEL: R. N. Hartzell, Pres. & Gen. Mgr.; Mrs. Geo. W. Hartzell, V. Pres.; Robert Reck, Secy.; R. V. Hartzell, Treas.; R. W. Zimmerlin, Sales Mgr. & Pur. Agt.
PRODUCTS: Propellers.

HARVEY MACHINE CO.,
6200 Avalon Blvd., Los Angeles, Calif.
PERSONNEL: L. M. Harvey, Pres.; L. A. Harvey, V. Pres. & Gen. Mgr.; R. Wolf, Pur. Agt.; Erling Weeks, Pers. Dir.
PRODUCTS: Aircraft armament; Ammunition boxes and counters; Bomb racks; Collector rings, cowls, streamlines; Controls; Cowlings; Fittings; Heaters; Landing gears; Panels; Parts; Radios; Stampings; Sub-assemblies; Tanks; Miscellaneous.


PIONEER
AIRCRAFT
INSTRUMENTS
PIONEER INSTRUMENT
DIVISION OF BENDIX AVIATION CORPORATION
BENDIX . . . . NEW JERSEY
MANUFACTURERS
OF
FLIGHT
INSTRUMENTS
NAVIGATION
INSTRUMENTS
ENGINE
INSTRUMENTS
FLIGHT SECURITY

HARVILL AIRCRAFT DIE CASTING CORP., 6251 W. Century Blvd., Los Angeles, Calif.
PERSONNEL: H. L. Harvill, Pres.; F. M. Hoefler, V. Pres.; L. W. Johnson, Secy. & Treas.; P. R. Jordan, Sales Mgr.; M. C. Goodfellow, Pur. Agt.; L. O. Gunn, Pers. Dir.
PRODUCTS: Bomb racks; Clamps; Collector rings, cowls, streamlines; Controls; De-icer equipment.

HAYES INDUSTRIES, INC., Jackson, Mich.
PERSONNEL: C. B. Hayes, Pres. & Gen. Mgr.; C. Hollerith, V. Pres. & Sales Mgr.; E. C. Hetherwick, Secy. & Treas.; G. B. Vass, Pur. Agt.
PRODUCTS: Wheels and brakes.

HAYES MANUFACTURING CORP., Grand Rapids, Mich.
PERSONNEL: R. W. Clark, Pres.; A. A. Anderson, V. Pres.; T. E. Dean, Secy.; J. H. Lee, Treas.
PRODUCTS: Structural parts; Sub-assemblies; Parachutes; Stampings; Tools; Dies; Fixtures.

THE HEALD MACHINE CO., New Bond St., Worcester, Mass.
PERSONNEL: R. N. Heald, Pres.; S. T. Massey, V. Pres.; R. S. Heald, Secy.; R. A. Heald, Treas.; G. C. Bestick, Pur. Agt.
PRODUCTS: Machine tools.

HEATH CO., 4th & Park Sts., Benton Harbor, Mich.
PERSONNEL: H. E. Anthony, Pres., V. Pres. & Gen. Mgr.; H. C. Anthony, Secy. & Treas.; D. B. Reagan, Sales Mgr.; D. Elferdink, Pers. Dir.
PRODUCTS: Covers; Floats; Skiis; Radios; Radio compasses; Radio shielding and equipment; Stampings; Tail wheel assemblies; Wheels and brakes.

THE HEIM CO., 46 Sanford Rd., Fairfield, Conn.
PERSONNEL: L. R. Heim, Pres. & Gen. Mgr.; N. E. Heim, V. Pres.; C. R. Heim, Secy., Treas. & Pur. Agt.; E. Hildes Heim, Sales Mgr.
PRODUCTS: Miscellaneous hardware; Stampings.

HEINEMANN CIRCUIT BREAKER CO., 111 Plum St., Trenton, N. J.
PERSONNEL: B. S. Berlin, Pres.; H. W. Haenni, Gen. Mgr.; E. Bromberg, Sales Mgr.; R. A. Berlin, Pur. Agt.
PRODUCTS: Circuit breakers.

THE HENDEY MACHINE CO., Torrington, Conn.
PERSONNEL: D. Ayr, Pres. & Gen. Mgr.; E. Seybold, V. Pres.; J. W. Markham, Secy. & Treas.; F. J. McCarty, Sales Mgr.; F. N. McKenzie, Pur. Agt. & Pub. Dir.; H. H. Fuessenich, Pers. Dir.
PRODUCTS: Machine tools.

THE HERBRAND CORP., Stone & Lake Sts., Fremont, O.
PERSONNEL: S. S. Boyer, Pres. & Gen. Mgr.; R. O. Mead, V. Pres.; C. T. Gottron, Secy. & Treas.; A. C. Gropp, Sales Mgr.; F. D. Betts, Pur. Agt.
PRODUCTS: Hand tools; Forgings.

HERRICK IRON WORKS, 1734 Campbell St., Oakland, Calif.
PERSONNEL: S. S. Herrick, S. G. Herrick, M. Herrick, partners; L. A. Peck, Sales Mgr.; A. T. Wilson, Pur. Agt.; C. Kehrlein, Pers. Dir.
PRODUCTS: Hangars; Hangar doors.

HEYMAN MANUFACTURING CO., Kenilworth, N. J.
PERSONNEL: H. W. Heyman, Pres.; F. Klumpp, Jr., V. Pres.; K. E. Fahnestock, Secy.
PRODUCTS: Clamps; Fasteners; Stampings.

THE HICKOK ELECTRICAL INSTRUMENT CO., 10514 Dupont Ave., Cleveland, O.
PERSONNEL: R. D. Hickok, Sr., Pres., Treas., & Gen. Mgr.; W. H. Eberle, Secy.; Robert Williams, Sales Mgr.; J. M. Landfear, Pur. Agt. & Pers. Dir.; R. Williams, Pub. Dir.
PRODUCTS: Radio service equipment; Meters.

HILL AIRCRAFT STREAMLINERS CO., 700 W. 6th St., Cincinnati, O.
PERSONNEL: J. A. Hill, Pres.; F. K. Hill, Secy.; W. A. Sundquist, Gen. Mgr.
PRODUCTS: Collector rings, cowls, streamlines; Cowlings.

HILLS-McCANNA CO., 3025 N. Western Ave., Chicago, Ill.
PERSONNEL: K. Carpenter, Pres.; D. W. Moll, V. Pres.; Treas. & Gen. Mgr.; F. R. Grassle, Secy. & Sales Mgr.; W. Macnider, Pur. Agt.; J. Little, Pers. Dir.; C. A. Howe, Pub. Dir.
PRODUCTS: Castings.

HILO VARNISH CORP., 42 Stewart Ave., Brooklyn, N. Y.
PERSONNEL: C. J. Schumann, Pres.; A. G. Schumann, V. Pres.; W. L. Schwalb, Secy. & Pur. Agt.; F. M. Schumann, Treas.; J. J. Mattiello, Sales Mgr.
PRODUCTS: Paints; Varnishes; Lacquers; Enamels; Primers.

HOBBY MODEL MANUFACTURING CO., INC., 204 Greene St., New York, N. Y.
PERSONNEL: F. Brooks, Pres. & Treas.; A. Brooks, Secy.; T. Brooks, Pers. Dir.; J. Brooks, Pub. Dir.
PRODUCTS: Balloon recording boxes.

R. HOE & CO., INC., 910 E. 138th St., Bronx, N. Y.
PERSONNEL: H. M. Tillinghast, Pres.; E. Foster, V. Pres.; C. E. Littleton, Secy.; T. S. Chadeayne, Treas.; J. L. Auer, Gen. Mgr.; A. Dressel, Sales Mgr.; R. F. Mooney, Pur. Agt.; C. Hopkins, Pers. Dir.
PRODUCTS: General machining.

HOLISTER COIL SPRING MANUFACTURING CO., 7100 Avalon Blvd., Los Angeles, Calif.
PERSONNEL: O. D. Perkins, Treas.; F. Holister, Gen. Mgr.; P. Wortman, Pur. Agt.
PRODUCTS: Clamps; Fasteners; Miscellaneous hardware; Miscellaneous engine equipment; Parts; Stampings; Springs; Wire forms.

HOLLEY CARBURETOR CO., 5930 Vancouver Ave., Detroit, Mich.
PERSONNEL: Earl Holley, Pres. & Treas.; D. W. Candler, B. W. Westcott, V. Pres.; J. F. English, Secy.; H. C. Webb, Pur. Agt.; H. J. Middleditch, Pers. Dir.
PRODUCTS: Air scoops.


PESCO
PESCO offers you two important advantages:
1. A complete line of Fuel Pumps, Vacuum Pumps, Hydraulic Pumps, Valves and Accessories proven by millions of flight miles.
2. A seasoned staff—in management, design, production and field service—directed by top-ranking executives with years of experience in aircraft design.
PUMP ENGINEERING SERVICE CORPORATION
DIVISION BORG-WARNER CORPORATION • 12910 TAFT AVENUE • CLEVELAND, OHIO
BW

THE HOLO-KROME SCREW CORP.,
Hartford, Conn.
PERSONNEL: W. A. Purtell, Pres., Treas. & Gen. Mgr.; W. C. Stauble, V. Pres. & Secy.; H. A. Neff, Pur. Agt. & Pers. Dir.
PRODUCTS: Socketed screw products.

THE HOMESTEAD INSULATION CO.,
224-A Garden St., Hartford, Conn.
PERSONNEL: G. U. Kierstead, Pres.; C. W. Lemmerman, V. Pres.; G. E. Wood, Secy.
PRODUCTS: Aircraft test cells; Soundproofing.

HOUDE ENGINEERING CORP.,
537 E. Delavan Ave., Buffalo, N. Y.
PERSONNEL: Chas. Getler, Pres.; R. F. Peo, V. Pres. & Gen. Mgr.; M. C. Mason, Secy.; G. C. Phelps, Treas.; E. L. Potter, Sales Mgr.; G. C. Kratzer, Pur. Agt.; B. S. Sanderson, Jr., Pers. Dir.
PRODUCTS: Engine mounts; Fittings; Hydraulic controls and assemblies; Landing gears; Pumps; Shock struts and cord; Vibration dampers.

E. F. HOUGHTON & CO.,
303 W. Lehigh Ave., Philadelphia, Pa.
PERSONNEL: A. E. Carpenter, Pres. & Gen. Mgr.; G. W. Pressell, V. Pres.; E. A. Carpenter, Secy.; R. H. Patch, Treas.; H. B. Fox, Pur. Agt.; J. Hunt, Pers. Dir.; D. C. Miner, Pub. Dir.
PRODUCTS: Packings; Oils; Heat treating compounds.

MARK HURD MANUFACTURING CORP.,
1313 Third Ave., So. Minneapolis, Minn.
PERSONNEL: T. W. Bennett, Pres.; J. G. Bennett, V. Pres.; M. M. Hurd, Secy., Treas. & Gen. Mgr.
PRODUCTS: Cameras and accessories.

CARL HUSSMAN ENGINEERS, INC.,
3001 N. Oakley Blvd., Chicago, Ill.
PERSONNEL: C. Hussman, Pres.
PRODUCTS: Vibration dampers.

THE HYDRAULIC PRESS MANUFACTURING CO., Mount Gilead, O.
PERSONNEL: H. F. MacMillin, Pres.; P. C. Pocock, V. Pres.; W. C. Batchelor, Secy. & Treas.; H. J. Miller, Sales Mgr.; A. L. Boggs, Pur. Agt.; J. E. Auld, Pers. Dir.; R. W. Powell, Pub. Dir.
PRODUCTS: Hydraulic presses.

I

IDEAL CLAMP MANUFACTURING CO., INC., 435 Liberty Ave., Brooklyn, N. Y.
PERSONNEL: P. Rauch, Pres.; L. J. Rauch, Treas.
PRODUCTS: Clamps; Fasteners.

IDEAL POWER LAWN MOWER CO.,
700 E. Kalamazoo St., Lansing, Mich.
PERSONNEL: C. S. Roe, Pres.; J. S. Shere, Jr., V. Pres. & Gen. Mgr.; M. U. Flanagan, Secy.; S. O. Briggs, Treas.; L. T. Beresford, Sales Mgr.; E. W. Sutterby, Pur. Agt.; W. L. Austin, Pub. Dir.
PRODUCTS: Airport gang mowers; Power sweepers; Motorized snow plows.

THE IMPERIAL BRASS MANUFACTURING CO., 1200 W. Harrison St., Chicago, Ill.
PERSONNEL: F. McNellis, Pres.; F. C. Shafer, V. Pres. & Gen. Mgr.; W. A. Leonard, J. T. Greenlee, Sales Mgrs.; W. B. Burnet, Pur. Agt.; B. Maloy, Pers. Dir.; C. H. Benson, Pub. Dir.
PRODUCTS: Controls; De-icer equipment; Filters and strainers; Fittings; Parts; Primers; Pumps; Valves; Vibration dampers; Airplane toilets; Soap dispensers; Lavatory fixtures; Tubing service tools; Welding equipment.

INDEPENDENT PNEUMATIC TOOL CO.,
600 W. Jackson Blvd., Chicago, Ill.
PERSONNEL: N. C. Hurley, Pres.; N. C. Hurley, Jr., V. Pres.; E. G. Gustafson, Treas.; W. H. Brewer, Gen. Mgr.; W. A. Nugent, Sales Mgr.; G. W. Jansen, Pur. Agt.; C. N. Kirchner, Pub. Dir.
PRODUCTS: Tools.

INGERSOLL-RAND CO.,
11 Broadway, New York, N. Y.
PERSONNEL: D. C. Keete, Pres.; W. R. Grace, V. Pres.; C. C. Hay, Secy.; R. L. Carpenter, Treas.; L. B. Abrams, Sales Mgr.; C. F. Schwep, Pur. Agt.; G. W. Morrison, Pub. Dir.
PRODUCTS: Tools.

INSTRUMENT DESIGN, INC.,
43 West Apple St., Dayton, O.
PERSONNEL: R. McGuire, Pres.; J. B. Thomson, V. Pres. & Treas.; G. W. Oliver, Secy.
PRODUCTS: Instruments; Land and navigation lights; Vacuum switches.

INTERCONTINENT AIRCRAFT CORP.,
36th St. & LeJeune Rd., Miami, Fla.
PERSONNEL: B. G. Leighton, Pres.; G. B. Arnold, V. Pres.; A. L. McCarthy, Secy.; R. W. Ring, Treas.; L. Hopkins, Jr., Sales Mgr.; A. D. McNamee, Pur. Agt.; H. A. Robinson, Sr., Pers. Dir.
PRODUCTS: Collector rings, cowls, streamlines; Cowlings; Engine mounts; Parts; Sub-assemblies.

INTERNATIONAL DERRICK & EQUIPMENT DIV. INTERNATIONAL-STACEY CORP., 875 Michigan Ave., Columbus, O.
PERSONNEL: O. M. Havekotte, Pres.; W. E. Gruening, V. Pres.; E. C. Meredith, Secy.; R. B. McCleery, Treas.; W. F. Barnes, Sales Mgr.; J. T. Dunlap, Pur. Agt.; L. R. Lunsford Pers. Dir.; C. R. Athy, Pub. Dir.
PRODUCTS: Airport equipment; Airport lighting equipment.

INTERNATIONAL FLARE SIGNAL DIV.
(See Kilgore Manufacturing Co.)

THE INTERNATIONAL NICKEL CO., INC.,
67 Wall St., New York, N. Y.
PERSONNEL: J. F. McNamara, Sales Mgr.
PRODUCTS: Castings.

INTERNATIONAL RESISTANCE CO.,
401 N. Broad St., Philadelphia, Pa.
PERSONNEL: E. Searing, Pres.; J. Marston, V. Pres.; M. J. Bethany, Pers. Dir.
PRODUCTS: Rheostats; Resistors.

IRVING AIR CHUTE CO., INC.,
1670 Jefferson Ave., Buffalo, N. Y.
PERSONNEL: G. Waite, Pres.; L. L. Irvin, V. Pres.; R. R. Brockett, Secy.; W. H. Schwinger, Treas.; H. G. Rogers, Sales Mgr. and Pub. Dir.; L. Porley, Pur. Agt. & Pers. Dir.
PRODUCTS: Parachutes; Safety belts; Seats; Flare parachutes; Flying suits; Tow targets.

The Aircraft Circuit Wire with the FIREWALL

The aviation industry's acceptance of fireproof wire as a standard for aircraft wiring, supplanting inflammable types of wire, came about as a direct result of a need for fireproof radio hookup wire.

In 1937 the radio section of the old Bureau of Air Commerce wrote specifications for the wiring of the airline, aircraft radio equipment "... the insulation (of which) is not susceptible of igniting into flame in the event of abnormal currents which would heat the conductor to incandescence."

The first wire which met this realistic specification was Rockbestos Fireproof Radio Hookup Wire. So completely did it fill the requirements that up to 1942 it had been adopted by more than 40 aircraft radio and aircraft accessory manufacturers.

The line between radio apparatus control cable and the electrical system of the airplane is indefinite, and when it was found that this Rockbestos Fireproof Radio Hookup Wire was lighter in weight and smaller in diameter than old standard aircraft wires, the industry adopted the new Fireproof Hookup Wire as Aircraft Wire and the new standard was established. More than 50,000,000 feet of Rockbestos Fireproof Aircraft Wire and Radio Hookup Wire have been installed as this book goes to press.

While admitting the desirability of the low weight and small diameter characteristics of Rockbestos Fireproof Aircraft Circuit Wire we continue to stress its fireproof characteristic which we believe is our special contribution to the aviation industry.

Most engineers specifying wire today recognize the need of fireproof wire wherever mass wiring exists. When they specify Rockbestos Fireproof Aircraft Circuit Wire they get the maximum fireproof performance that can be built into a wire. Whether attacked by the molten heat of a shorted conductor or by external flame, Rockbestos wire will not burn nor offer a path for the spread of flame, and coverage will remain on the conductor.

To those who are not acquainted with Rockbestos wire this may sound far fetched but a trial will convince.

CONDUCTORS: Standard flexible strandings of tinned dead soft copper in sizes No. 22 to 10 AWG; rope lay flexible strandings of tinned copper in sizes No. 8 to 4/0 AWG.

HIGH-DIELECTRIC TAPE: Helically wound layers of thin synthetic tape furnish high dielectric strength and moisture resistance. The method of application assures the accurate centering of the conductor in the insulation.

THE FIREWALL: A dense, compressed, felted asbestos wall having no laps, joints or seams and impregnated with flame, heat and moisture resisting compounds provides protection against insulation-destroying heat and prevents flaming under short circuit conditions. This felted wall also acts as a cushion against abrasion and vibration.

THE FIREPROOF BRAID: The braid is furnished in numerous coding patterns and finished with lacquer to a clear, hard, smooth surface that never becomes gummy or tacky, always pulls into conduit easily, and is resistant to flame, heat, moisture, oil, grease and gasoline.

SMALL DIAMETERS—LIGHT WEIGHT

Size A.W.G	Stranding	Average Finished Diameters		Net Weight Per M. Ft.	
4/0	2109/.010	.678	In.	719.38	lbs.
3/0	1672/.010	.604	"	573.61	"
2/0	1330/.010	.545	"	459.50	"
1/0	1045/.010	.496	"	364.60	"
1	836/.010	.451	"	294.36	"
2	665/.010	.408	"	236.45	"
4	133/.0177	.336	"	155.29	"
6	133/.0141	.282	"	98.31	"
8	133/.0112	.238	"	64.41	"
10	105/.010	.180	"	41.05	"
12	61/.010	.155	"	25.69	"
14	39/.010	.130	"	16.75	"
16	26/.010	.109	"	11.35	"
18	7/.0159	.093	"	8.30	"
20	7/.0126	.083	"	5.86	"
22	7/.010	.075	"	4.15	"

For samples and Bulletin 53A containing information and specifications write to:
ROCKBESTOS PRODUCTS CORPORATION
50 Mitchell Road, New Haven, Conn.

ROCKBESTOS ***specialists in heatproof and fireproof wires***

IRVINGTON VARNISH & INSULATOR CO.,
6 Argyle Terrace, Irvington, N. J.
PERSONNEL: A. E. Jones, Pres.; W. F. Hoffman, Jr., V. Pres.; F. M. Miller, Secy.; C. Egner, Treas.; J. D. VanValkenburgh, Gen. Mgr.; F. A. Shoemaker, Sales Mgr.; C. K. Johnson, Pur. Agt.; E. C. Jones, Pers. Dir.
PRODUCTS: Insulating varnish; Plastic products; Ignition markers; Insulating cambrics, tapes.

ISLIP RADIO MANUFACTURING CORP.,
Islip Airport, Islip, N. Y.
PERSONNEL: A. E. Theis, Pres., Treas. & Gen. Mgr.; M. Wiener, V. Pres.; W. Wiener, Secy.; A. C. Newman, Pur. Agt.
PRODUCTS: Radios; Radio compasses.

J

JACK & HEINTZ, INC.,
809 Hanna Bldg., Cleveland, O.
PERSONNEL: W. S. Jack, Pres., Gen. Mgr., Sales Mgr. & Pub. Dir.; R. M. Heintz, V. Pres. & Secy.; W. R. Jack, V. Pres. & Treas.; J. Zorn, Pur. Agt.; O. Foster, Pers. Dir.
PRODUCTS: Generators; Starters.

I. JACOEL CABLE SPLICING EQUIPMENT CO., 1880 Hertel Ave., Buffalo, N. Y.
PERSONNEL: I. Jacoel, Pres.
PRODUCTS: Hoisting slings.

JAEGER WATCH CO., INC.,
304 East 45th St., New York, N. Y.
PERSONNEL: E. L. Vail, Pres. & Gen. Mgr.; H. A. Gossner, Secy.; E. R. Palmer, Treas.; C. J. Boyle, Pur. Agt.; J. F. Schiebel, Pers. Dir.
PRODUCTS: Instruments; Clocks; Timepieces; Tachometers.

JARDUR IMPORT CO.,
21 West 19th St., New York, N. Y.
PERSONNEL: F. W. Donaldson, Gen. Mgr.; H. H. Clapper, Sales Mgr.; T. J. Waters, Pur. Agt.; C. W. Cromwell, Pub. Dir.
PRODUCTS: Chronographs; Wrist watches; Precision aviation accessories.

JESSOP STEEL CO., Washington, Pa.
PERSONNEL: R. E. Emery, Pres.; F. T. H. Youngman, V. Pres. & Treas.; R. J. Murray, Secy. & Pur. Agt.; T. W. Pennington, Sales Mgr.
PRODUCTS: Armor plate; Steels.

JOHNS-MANVILLE SALES CORP.,
22 East 40th St., New York, N. Y.
PERSONNEL: L. R. Hoff, Pres.; J. H. Trent, V. Pres.; V. Brown, Secy.; H. D. Bates, Pub. Dir.
PRODUCTS: Packings; Gaskets; Brake linings.

JOHNSON BRONZE CO.,
S. Mill St., New Castle, Pa.
PERSONNEL: P. J. Flaherty, Pres.; L. Sandler, V. Pres.; E. Flaherty, Secy. & Pur. Agt.; J. P. Flaherty, Treas.; H. Stenger, Gen. Mgr.; E. N. Beisheim, Sales Mgr.; H. Davies, Pers. Dir.; E. Scanlon, Pub. Dir.
PRODUCTS: Bearings.

THE CARLYLE JOHNSON MACHINE CO.,
53 Main St., Manchester, Conn.
PERSONNEL: S. H. Simon, Pres. & Sales Mgr.; A. E. Adams, V. Pres.; J. F. Dickey, Secy.; J. M. Miller, Treas.; A. R. Coe, Pur. Agt. & V. Pres. of Mfg.
PRODUCTS: Clutches.

JOHNSON - NATIONAL INSIGNIA CO. INC., 314 West 14th St., New York, N. Y.
PERSONNEL: W. F. Esling, Pres., V. Pres. & Treas.; A. Nodine, Secy.; V. DeAndrea, Gen. Mgr.
PRODUCTS: Landing and navigation lights; Pilots chronographs; Identifications; Employees service awards; Aviation jewelry; Memorial plaques; Special presentations.

THE JOHNSON RUBBER CO.,
Middlefield, O.
PERSONNEL: S. M. Johnson, Pres. & Pers. Dir.; L. M. Johnson, V. Pres.; H. G. Johnson, Secy. & Treas.; R. Caslow, Gen. Mgr.; P. Sperry, Sales Mgr. and Pub. Dir.; L. H. Huff, Pur. Agt.
PRODUCTS: Aircraft armament; Ammunition boxes and counters; Engine mounts; Hydraulic controls and assemblies; Propeller parts; Tubing (flexible); Vibration dampers; Rubber products; Miscellaneous.

JONES-DABNEY CO., INDUSTRIAL DIV. DEVOE & REYNOLDS CO., INC., Malden, Mass., Louisville, Ky.
PERSONNEL: W. C. Dabney, Pres. & Gen. Mgr.; A. W. Bornhauser, V. Pres.; O. P. Moss, Pur. Agt.; H. C. Reed, Mgr. Aviation Div.
PRODUCTS: Zinc chromate primer; Lacquers; Dopes; Seam compound.

HOWARD B. JONES,
2300 Wabansia Ave., Chicago, Ill.
PERSONNEL: H. B. Jones, Pres.; W. A. Bockius, Sales Mgr.; B. F. Becker, Pur. Agt.; C. W. Nelson, Pub. Dir.
PRODUCTS: Multi-circuit plugs and sockets; Barrier terminal strips; Fuse mounts; Shielded plugs and sockets;

W. B. JONES SPRING CO.,
124 East Seventh St., Cincinnati, O.
PERSONNEL: W. B. Jones, Pres.; A. G. George, V. Pres. & Sales Mgr.; M. L. Witte, Secy. & Treas.
PRODUCTS: Coil wire springs.

K

THE KAY & ESS CO., Dayton, O.,
PERSONNEL: H. G. Kittredge, Pres.; A. J. Turner, V. Pres., Gen. Mgr. & Sales Mgr.; E. C. Camp, Pur. Agt.; I. B. Wine, Pers. Dir.
PRODUCTS: Engine enamels; Heat resisting aluminum paints; Zinc chromate primers; Lacquers.

KELITE PRODUCTS, INC.,
909 East 60th St., Los Angeles, Calif.
PERSONNEL: L. C. Sorensen, Pres.; H. L. Smith, V. Pres.; H. Burrell, Secy. & Treas.; R. E. Medanich, Sales Mgr.; F. W. Frisenfeldt, Pub. Dir.
PRODUCTS: Cleaning compounds; Paint removers; Spray booth coating.

KENYON INSTRUMENT CO., INC.,
1345 New York Ave., Huntington, N. Y.
PERSONNEL: F. Waller, Pres.; A. T. Newell, V. Pres. & Gen. Mgr.; H. M. Baker, V. Pres.; H. R. Talbot, Secy. & Treas.; A. T. Newell, Sales Mgr.
PRODUCTS: Models; Aircraft lights; Flexible case and shaft assemblies; Tab control assemblies; Automatic flight controls; Ammunition rounds counter assemblies; Valves; Electrical parts; Machine gun sights; Anemometers; Barometers; Wind direction indicators.

KENYON TRANSFORMER CO., INC., 840 Barry St., New York, N. Y.
PERSONNEL: F. P. L. Kenyon, Pres.; G. Turney, Sales & Adv. Mgr.; C. S. Thomas, Pur. Agt.
PRODUCTS: Electrical equipment; Transformers; Filters.

KESTER SOLDER CO., 4201 Wrightwood Ave., Chicago, Ill.
PERSONNEL: F. C. Engelhart, Pres.; E. H. Williams, V. Pres.; P. C. Ripley, Sales Mgr. & Pub. Dir.; G. E. Fischer, Pur. Agt.; H. Prange, Pers. Dir.
PRODUCTS: Solders; Soldering fluxes.

WALTER KIDDE & CO., INC., 140 Cedar St., New York, N. Y.
PERSONNEL: S. G. Freck, Sales Mgr.; C. E. Gischel, Pub. Dir.
PRODUCTS: Fire extinguishers.

THE KILGORE MANUFACTURING CO., INTERNATIONAL FLARE SIGNAL DIV., Tipp City, Ohio
PERSONNEL: W. L. Payne, Pres.; A. F. Hubbard, V. Pres.; H. B. Watkins, Secy. & Treas.
PRODUCTS: Flares.

KINNEY ALUMINUM CO., 2019 Bay St., Los Angeles, Calif.
PERSONNEL: W. H. Kinney, Pres.; R. T. Kinney, V. Pres.; M. Queyrel, Secy.; J. Howell Byrnes, Treas.; B. E. Myers, Gen. Mgr.
PRODUCTS: Ammunition boxes and counters; Engine mounts; Exhaust manifolds; Flares; Landing gears; Sub-assemblies.

THE KIRK & BLUM MANUFACTURING CO., 2838-52 Spring Grove Ave., Cincinnati, O.
PERSONNEL: S. W. Kirk, Pres.; R. J. Blum, V. Pres.; C. F. Wulff, Secy. & Pur. Agt.; W. R. Meuttman, Treas. & Sales Mgr.
PRODUCTS: Ammunition boxes and counters; Bomb racks; Cowlings; Exhaust manifolds; Panels; Stampings; Tanks; Guards; Stacks; Breechings; Hoods; Louvres; Dust collectors; Ovens; Spray booths; Cabinets.

KLIEGL BROS. UNIVERSAL ELECTRIC STAGE LIGHTING CO., INC., 321 West 50th St., New York, N. Y.
PERSONNEL: J. H. Kliegl, Pres.; H. A. Kliegl, V. Pres.; F. Bliss, Secy. & Sales Mgr.; H. Fisher, Pur. Agt.; A. J. McGregor, Pub. Dir.
PRODUCTS: Indirect lighting systems; Landing and navigation lights.

THE KLINE SPRING CO., 19109 Firwood Rd., Cleveland, O.
PERSONNEL: A. B. Kline, Pres.; G. S. Kline, V. Pres.; A. K. Wickland, Secy. & Treas.; S. O. Kline, Gen. Mgr.
PRODUCTS: Mechanical springs.

KNU-VISE, INC., 16841 Hamilton Ave., Highland Park, Mich.
PERSONNEL: J. A. Herrington, V. Pres., Treas., Gen. Mgr. & Sales Mgr.; L. J. Portnoy, Secy.; L. Saulter, Pur. Agt.; D. M. Prouty, Pub. Dir.
PRODUCTS: Aircraft armament; Clamps; Riveters; Wrenches; Pliers.

KOEHLER TOOL & MANUFACTURING CO., 814 Vermont Ave., Dayton, O.
PERSONNEL: G. G. Koehler, Owner.
PRODUCTS: Valves.

KOLLSMAN INSTRUMENT DIV. OF SQUARE D CO., 80-08 45th Ave., Elmhurst, N. Y.
PERSONNEL: F. W. Magin, Pres.; P. Kollsman, Div. Mgr. & V. Pres.; H. Morgan, Secy. & Treas.; V. E. Carbonara, Works Mgr. & V. Pres.; W. C. Bonn, Sales Mgr.; J. Goodrich, Pur. Agt.; P. Knowles, Pers. Dir.; J. C. Carr, Pub. Dir.
PRODUCTS: Instruments; Altimeters, Air speed Indicators; Compasses; Direction indicators; Barometers, Tachometers; Manifold pressure gages; Pitotstatic tubes.

KOPPERS CO., BARTLETT HAYWARD DIV., Baltimore, Md.
PERSONNEL: W. F. Perkins, V. Pres.; S. H. Fedan, Sales Engr.
PRODUCTS: Propellers.

KROPP FORGE CO., 5301 W. Roosevelt Rd., Chicago, Ill.
PERSONNEL: R. A. Kropp, Pres.; A. W. Hellstrom, V. Pres.; C. F. Johnson, Secy.; R. B. Kropp, Treas.; J. H. Lund, Sales Mgr.; V. D. Oftedahl, Pur. Agt.; I. W. M. Harker, Pers. Dir.; L. Kreicker, Pub. Dir.
PRODUCTS: Steel forgings; Air frame and aircraft engine parts.

L

THE LACKAWANNA LEATHER CO., Hackettstown, N. J.
PERSONNEL: R. C. Good, Pres.; D. S. Good, V. Pres., Treas. & Gen. Mgr.; C. F. Good, Secy.
PRODUCTS: Upholstery leather.

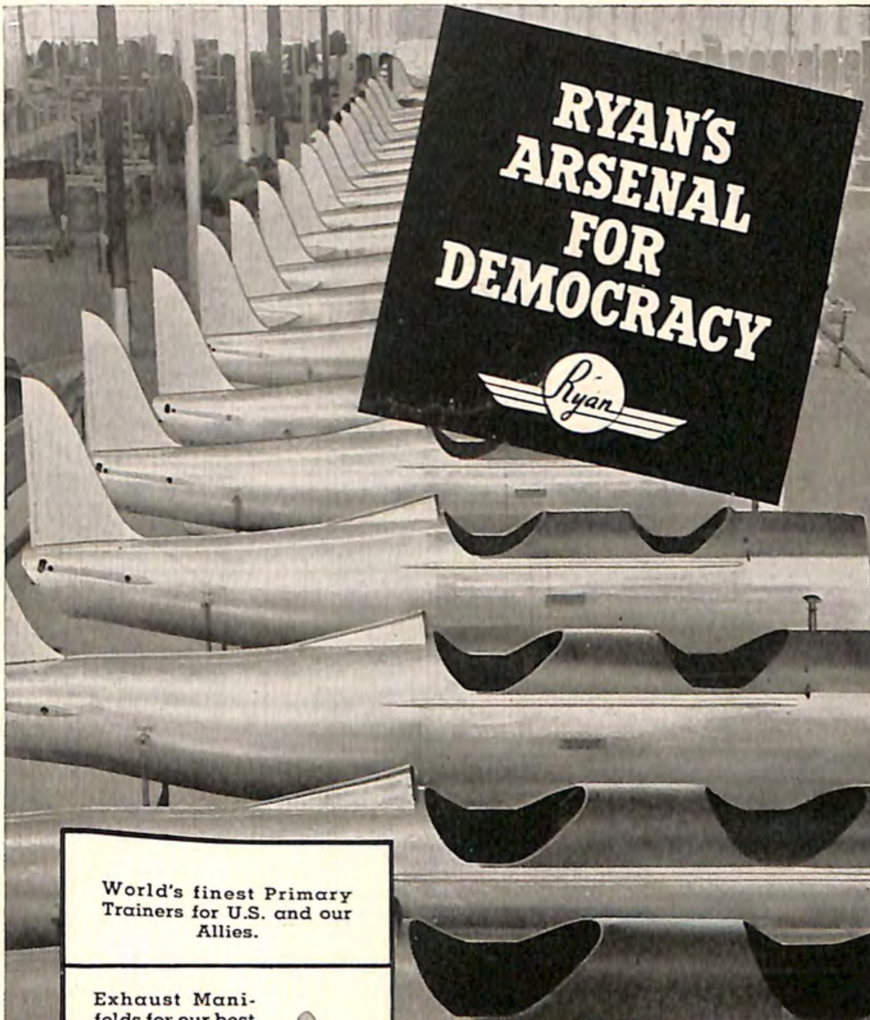
THE LAIDLAW CO., INC., 16 W. 60th St., New York, N. Y.
PERSONNEL: A. P. Laidlaw, Pres.
PRODUCTS: Upholstery.

LAKE STATE PRODUCTS, INC., Jackson, Mich.
PERSONNEL: E. C. Hetherwick, Pres.; L. S. Bisbee, V. Pres.; Ivah G. Brown, Secy. & Treas.
PRODUCTS: Axles; Propeller hubs.

LAMINATED SHIM CO., INC., Union St., Glenbrook, Conn.
PERSONNEL: A. V. Anderson, Treas.; R. Seipt, Sales Mgr.; E. B. Nisbet, Pur. Agt.; O. C. Jones, Pub. Dir.
PRODUCTS: Laminated and plain shims; Shim stock; Self-locking nuts.

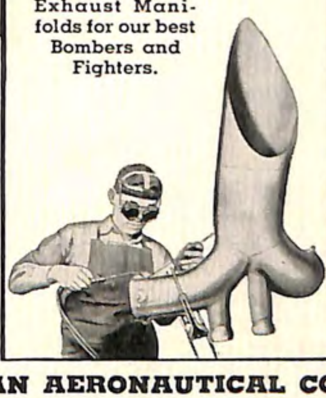
THE LAMSON AND SESSIONS CO., 1971 W. 85th St., Cleveland, O.
PERSONNEL: R. H. Smith, Pres.; J. F. Donahue, V. Pres. & Sales Mgr.; H. H. Winterberg, Secy.; I. L. Jennings, Treas.; A. E. R. Peterka, Gen. Mgr.; G. W. Hinds, Pur. Agt.; H. L. Judd, Pers. Dir.; J. C. Stephan, Pub. Dir.
PRODUCTS: Bolts; Nuts; Screws; Cotters and clevis pins.

LANDIS MACHINE CO., Waynesboro, Pa.
PERSONNEL: J. G. Benedict, Pres.; C. N. Kirkpatrick, V. Pres. & Gen. Mgr.; J. H. Elliot, Secy. & Pur. Agt.; W. C. Wertz, Treas.; G. M. Sticknell, Sales Mgr.; H. L. Steck, Pers. Dir.; M. B. Henneberger, Pub. Dir.
PRODUCTS: Machine tools.



World's finest Primary Trainers for U.S. and our Allies.

Exhaust Manifolds for our best Bombers and Fighters.



Here at Ryan, in one of America's most modern aircraft factories (doubled in size several times in the last 18 months) Democracy is at work *day* and *night* fashioning the tools for an overwhelming victory. And if it takes more of the same we *can* and *will* put out more!

RYAN AERONAUTICAL CO., Lindbergh Field, San Diego, California

LANSING STAMPING CO.,
S. Pennsylvania Ave., Lansing, Mich.
PERSONNEL: G. F. Conway, Pres.; M. W. Jacklin, Sales Mgr.; I. W. Swift, Pur. Agt.
PRODUCTS: Stampings.

LAWRANCE ENGINEERING AND RESEARCH CORP., North Stiles St., Linden, N. J.
PERSONNEL: Charles L. Lawrance, Pres.; Hugo Rutherfurd, V. Pres. & Gen. Mgr.; E. M. G. Lawrance, V. Pres.; F. H. Stokes, Secy.; Artemis Ward, V. Pres. & Controller; Silas C. Snyder, Sales Mgr.; S. Stugart, Sr., Pur. Agt.
PRODUCTS: Auxiliary power plants; Electrical equipment; Superchargers.

LEACH RELAY CO., INC.,
5915 Avalon Blvd., Los Angeles, Calif.
PERSONNEL: O. N. Leach, Pres.; E. K. Neale, V. Pres. & Gen. Mgr.; H. C. Croft, Secy. & Treas.; P. Henry, Sales Mgr.; L. E. Baldridge, Pur. Agt.
PRODUCTS: Aircraft armament; Instruments; Propellers and propeller parts; Radios; Radio shielding; Starters; Tanks; Relays; Solenoid.

LEAR AVIA, INC.,
Young & Weber Sts., Piqua, O.
PERSONNEL: W. P. Lear, Pres.; T. S. Harris, V. Pres.; H. C. Morrison, Secy. & Treas.; B. Miniat, Gen. Mgr.; S. Nesbitt, Sales Mgr.; G. Storar, Sr., Pur. Agt.; H. W. Roberts, Pub. Dir.
PRODUCTS: Carburetors; Motors; Landing gears; Radios; Radio compasses; Sub-assemblies; Miscellaneous.

THE H. D. LEE MERCANTILE CO.,
20th and Wyandotte, Kansas City, Mo.
PERSONNEL: L. C. Staples, Pres.; R. B. Caywood, V. Pres.; J. M. Mitchell, Secy.; F. C. Bachtold, Treas.; B. E. Kinney, Gen. Mgr.; C. A. Reynolds, Gen. Sales Mgr.; A. D. McCubbin, Pur. Agt.
PRODUCTS: Uniforms and work clothing.

THE LEECE-NEVILLE CO.,
5363 Hamilton Ave., Cleveland, O.
PERSONNEL: B. M. Leece, Pres. & Treas.; P. H. Neville, V. Pres.; J. P. Johnston, Secy.
PRODUCTS: Electrical equipment; Generators; Motors.

LEEDS & NORTHRUP CO.,
4970 Stenton Ave., Philadelphia, Pa.
PERSONNEL: C. S. Redding, Pres.; C. R. Cary, V. Pres. & Sales Mgr.; D. H. Schultz, Secy. & Treas.; L. Teker, Pur. Agt.; R. W. Johnson, Pers. Dir.
PRODUCTS: Electric heat-treating furnaces; Pyrometers; Thermocouples; Test sets.

LEMPCO PRODUCTS, INC.,
Dunham Road, Bedford, O.
PERSONNEL: J. F. Strand, Pres.; J. Y. Blazek, V. Pres. & Secy.; P. F. Hronek, Treas.; F. J. Schwab, Gen. Mgr.; J. S. Longdon, Sales Mgr.; J. Gulick, Pur. Agt.; E. Klika, Pers. Dir.
PRODUCTS: Accumulators; Electric and hydraulic presses; Brake drum grinding machines; Brake lining grinding machines; Engine rebuilding equipment.

THE LEWIS ENGINEERING CO.,
52 Rubber Ave., Naugatuck, Conn.
PERSONNEL: H. Whittemore, Jr., Pres.; C. S. Ham, V. Pres.; C. S. Austin, Secy. & Treas.; C. W. Pepperman, Sales Mgr.
PRODUCTS: Electrical switches; Instruments.

LIBERTY AIRCRAFT PRODUCTS CORP.,
Motor Ave., Farmingdale, N. Y.
PERSONNEL: R. Simon, Pres.; G. H. Hauser, V. Pres.; W. G. Holman, Secy.
PRODUCTS: Bomb racks; Hydraulic controls and assemblies; Miscellaneous engine equipment; Panels; Parts; Pumps; Shock struts and cord; Sub-assemblies; Precision machine parts and tools; Screw machine products; Engine cylinders; Pistons; Crankcases.

LINEAR PACKING & RUBBER CO., INC.,
6400 State Road, Philadelphia, Pa.
PERSONNEL: A. W. Swartz, Pres.; F. A. Lewis, V. Pres. & Sales Mgr.; W. C. Fisler, Secy. & Treas.; P. A. Swartz, Pur. Agt.
PRODUCTS: Aircraft armament; Bomb racks; Controls; Filters and strainers; Fittings; Hydraulic controls and assemblies; Landing gears; Propellers and propeller parts; Pumps; Shock struts and cord; Hydraulic packings for valves.

LINK AVIATION DEVICES, INC.,
Hillcrest, Binghamton, N. Y.
PERSONNEL: E. A. Link, Jr., Pres.; G. T. Link, V. Pres. & Treas.; M. C. Link, Secy.
PRODUCTS: Link instrument trainer; Sextants.

THE LIQUIDOMETER CORP., 3616 Skillman Ave., Long Island City, N. Y.
PERSONNEL: C. A. deGiers, Pres. & Gen. Mgr.; H. T. Cullinan, V. Pres., Sales Mgr. & Pub. Dir.; H. A. Kurowski, Secy. & Treas.; R. M. Hogan, Pur. Agt.; M. S. Evans, Pers. Dir.
PRODUCTS: Fuel gauges; Transmitters.

LISLE CORP., Clarinda, Ia.
PERSONNEL: C. V. Lisle, Pres. & Gen. Mgr.; J. R. Arthur, V. Pres.; T. E. Brooks, Secy.; A. A. Cambre, Treas.; E. G. Thompson, Pur. Agt.
PRODUCTS: Magnetic drain plugs.

LITTELFUSE, INC.,
4757 Ravenswood Ave., Chicago, Ill.
PERSONNEL: E. V. Sundt, Pres.; B. Kollath, V. Pres.; T. M. Blake, Secy. & Treas.; G. E. Spates, Gen. Mgr.; G. F. Taft, Sales Mgr., Pur. Agt. & Pers. Dir.; M. Symonds, Pub. Dir.
PRODUCTS: Aircraft fuses; Fuse panels; Accessories.

THE LODGE & SHIPLEY MACHINE TOOL CO., 3055 Colerain Ave., Cincinnati, O.
PERSONNEL: W. L. Dolle, Pres.; F. Albrecht, V. Pres. & Treas.; L. L. Weber, Secy.; J. H. Myers, Sales Mgr.; G. Brakeman, Pur. Agt.
PRODUCTS: Metal working lathes.

LONGINES-WITTNAUER WATCH CO., INC., 580 5th Ave., New York, N. Y.
PERSONNEL: J. P. V. Heinmuller, Pres.; M. F. Cartoun, V. Pres.; E. Detjen, Secy.; Morris Guilden, Treas.
PRODUCTS: Engine, cockpit and windshield covers.

LORD MANUFACTURING CO.,
1635 W. 12th St., Erie, Pa.
PERSONNEL: H. C. Lord, Pres.; T. Lord, V. Pres. & Gen. Mgr.; B. M. Hartman, Secy. & Treas.; C. E. Beavan, Sales Mgr. & Pub. Dir.; F. J. Kuhn, Pur. Agt.; D. Coddington, Pers. Dir.
PRODUCTS: Vibration dampers; Engine suspensions; Couplings; Flexible joints.

H. K. LORENTZEN, INC.,
391 W. Broadway, New York, N. Y.
PERSONNEL: H. K. Lorentzen, Pres.; S. R. Bond, V. Pres. & Pur. Agt.; R. E. Davis, Secy.
PRODUCTS: Ammunition boxes and counters; Parts for cameras; Fittings; Miscellaneous hardware; Parts for radio compasses; Stampings; Sub-assemblies; Miscellaneous; Film spools; Aerial camera magazine covers; Housings; Chassis; Shieldings for radio compasses; Direction finders.

LORENZEN PROPELLER CO.,
Municipal Airport, Niles, Mich.
PERSONNEL: R. E. Lorenzen, Pres.
PRODUCTS: Instruments; Propellers and propeller parts; Miscellaneous.

THE LOWE BROTHERS CO., Dayton, O.
PERSONNEL: D. A. Kohr, Pres.; C. W. Parrott, V. Pres.; D. Haber, Secy. & Treas.; C. H. Hampton, Sales Mgr.; W. Loges, Pur. Agt.; Glenn Clark, Pers. Dir.
PRODUCTS: Primers; Dopes; Lacquers; Camouflage products.

LUCAS SCREW PRODUCTS, INC.,
24 Verona St., Rochester, N. Y.
PERSONNEL: C. E. Lucas, Pres., Treas. & Gen. Mgr.; C. De Martin, V. Pres. & Secy.
PRODUCTS: Screw machine products.

THE LUFKIN RULE CO., Saginaw, Mich.
PERSONNEL: R. G. Thompson, Pres. & Gen. Mgr.; E. Russell, V. Pres.; H. F. Krauss, Secy. & Treas.; G. C. McBeth, Sales Mgr.; Walter Zoellner, Pur. Agt.
PRODUCTS: Micrometers; Rules; Tapes; Tools.

LYON METAL PRODUCTS, INC.,
226 Madison Ave., Aurora, Ill.
PERSONNEL: E. D. Power, Pres. & Gen. Mgr., H. B. Spackman, V. Pres. & Sales Mgr.; E. W. Nix, Secy. & Treas.; J. T. Hillenbrand, Pur. Agt.; M. A. Judd, Pers. Dir.; L. B. Rhodes, Pub. Dir.
PRODUCTS: Ammunition boxes and counters; Bomb racks; Cartridge boxes; Tool boxes and cabinets; Bomb scoops; Work benches; Mess tables.

M

WARREN McARTHUR CORP.,
1 Park Ave., New York, N. Y.
PERSONNEL: W. McArthur, Pres.; H. Lewis, V. Pres.; C. McArthur, Asst. Secy.; P. E. Plehn, Treas.; K. C. Grouse, Sales Mgr.; J. McHale, Pur. Agt. & Pers. Dir.; E. S. Jordan, Pub. Dir.
PRODUCTS: Seats.

McCAULEY STEEL PROPELLER CO.,
1840 Howell Ave., Dayton, O.
PERSONNEL: E. G. McCauley, Pres.; K. C. Long, V. Pres.; C. P. Pfarrer, Secy.; B. C. Taylor, Treas.; C. L. Van Dyne, Pur. Agt.
PRODUCTS: Propellers and propeller parts.

McCULLOCH ENGINEERING CORP.,
3420 W. Capitol Dr., Milwaukee, Wisc.
PERSONNEL: R. P. McCulloch, Pres.; B. B. McCulloch, V. Pres.; R. Wuerch, Secy. & Treas.; W. Durbin, Pur. Agt.
PRODUCTS: Cabin superchargers.

McKENNA METALS CO.,
368 Lloyd Ave., Latrobe, Pa.
PRODUCTS: Carbide cutting tools.

IRWIN McNIECE, 5314 Mt. Royal Dr.-Eagle Rock, Los Angeles, Calif.
PERSONNEL: Irwin McNiece, Owner.
PRODUCTS: Speedball rotary hand tools.

McQUAY-NORRIS MANUFACTURING CO.,
Southwest at Marconi, St. Louis, Mo.
PERSONNEL: W. K. Norris, Pres.; A. G. Drefs. V. Pres. & Treas.; H. W. Knapp, Secy.; F. J Jost, Pur. Agt.; A. J. Mummert, V. Pres.
PRODUCTS: Bearings; Propeller parts; Aluminum pistons; Piston pins; Piston rings; Hardened and ground parts.

MACWHYTE CO.,
2901 Fourteenth Ave., Kenosha, Wisc.
PERSONNEL: J. S. Whyte, Pres.; H. E. Sawyer, V. Pres., Treas. & Sales Mgr.; E. G. Knoedler, Pers. Dir.; F. J. Nelson, Pub. Dir.
PRODUCTS: Aircraft cable; Aircraft tie rods; Cable terminals; Wire rope slings; Wire rope.

MAGNAFLUX CORP.,
5908 Northwest Highway, Chicago, Ill.
PERSONNEL: A. V. deForest, Pres.; F. B. Doane, V. Pres. & Treas.; W. L. Burson, Jr., Asst. Secy. & Pur. Agt.; C. E. Betz, W. E. Thomas, D. F. Wells, Sales Mgrs.
PRODUCTS: Inspection equipment.

MAGNUS CHEMICAL CO., INC.,
South Ave., Garwood, N. J.
PERSONNEL: W. M. Campbell, Pres.; R. W. Mitchell, V. Pres.; W. M. Garbe, Secy. & Treas.; D. Blanchard, Charge of Sales; A. H. Johnson, Pur. Agt.; R. Kreie, Pub. Dir.
PRODUCTS: Aviation cleaning materials; Industrial soaps; Metallic soaps; Sulfonated oils; Emulsifying agents; Metal working lubricants; Hand cleaner.

THE MANHATTAN RUBBER MANUFACTURING DIV. OF RAYBESTOS-MANHATTAN, INC., 61 Willett St., Passaic, N. J.
PERSONNEL: J. J. DeMario, Pub. Dir.
PRODUCTS: Engine mounts; Radio shielding and equipment; Tubing; Vibration dampers; Brake linings; Clutch facings; Hose; Hydraulic packings; Molded parts and gaskets; Vibration dampers; Conveyor belts; Radio shielding tubing; Non-slip matting; Transmission belts.

MANNING, MAXWELL & MOORE, INC.,
11 Elias St., Bridgeport, Conn.
PERSONNEL: R. R. Wason, Pres.; W. J. Jarrett, V. Pres.; F. M. Kreiner, Secy. & Treas.; C. H. Butterfield, Sales Mgr.; W. T. O'Connor, Pur. Agt.; I. B. Van Houten, Pub. Dir.
PRODUCTS: Instruments.

MARKAL CO., 6 East Lake St., Chicago, Ill.
PERSONNEL: L. Aronberg, Pres.; B. Lytton, Gen. Mgr. & Pur. Agt., W. J. O'Brien, Sales Mgr.
PRODUCTS: Paint sticks.

THE MARQUETTE METAL PRODUCTS CO., 1145 Galewood Dr., Cleveland, O.
PERSONNEL: H. Gleitz, Pres.; J. S. Kustin, Secy. & Treas.; C. E. Miller, Sales Mgr.; W. O. Yohe, Pur. Agt.
PRODUCTS: Parts; Propellers and propeller parts; Pumps; Sub-assemblies; Valves.

MARTIN-DECKER CORP.,
3431 Cherry Ave., Long Beach, Calif.
PERSONNEL: W. R. Martin, Pres.; H. J. Blythe, V. Pres.; E. L. Decker, Secy., Treas. & Sales Mgr.
PRODUCTS: Tensiometers; Control cables.

Built with a world of care—
Backed by a world of experience
BENDIX-SCINTILLA

In aviation care and precision are *all-important.* Bendix-Scintilla Aircraft Magnetos, Spark Plugs, Switches and Radio Shielding have always been built with that thought uppermost in mind. And since we've been at this business of supplying ignition equipment to every branch of American aviation for many years, we can say with assurance that — Bendix-Scintilla products are *built with a world of care and backed by a world of experience.*

SCINTILLA MAGNETO DIVISION
Bendix Aviation Corporation, Sidney, N.Y.

BENDIX SCINTILLA

BUHL
STAMPING CO.
Detroit, Mich.

MANUFACTURERS
OF
EXHAUST MANIFOLDS

MISCELLANEOUS
AIRCRAFT PARTS
&
ASSEMBLIES

EST. 1888

CRESCENT
ELECTRICAL
WIRES & CABLES

for Aircraft Use to Army, Navy and Special Specifications.

Over 50 years experience in the manufacture of ALL TYPES of Electrical Wires and Cables.

CRESCENT INSULATED WIRE & CABLE CO.
Trenton, N. J.

MARVEL-SCHEBLER CARBURETOR DIV., 1910 St. John St., Flint, Mich.
PERSONNEL: S. W. Gray, Pres. & Gen. Mgr.; J. R. Emerson, V. Pres.; W. E. Walpole, Secy. & Treas.; N. M. Hurry, Sales Mgr.; W. G. Ryan, Pur. Agt.
PRODUCTS: Carburetors.

THE THOMAS MASON CO., INC., 280 Fairfield Ave., Stamford, Conn.
PERSONNEL: T. F. Mason, Pres.; M. A. Wick, Jr., V. Pres., Gen. Mgr. & Pers. Dir.; K. D. Browne, Secy. & Treas.; G. C. Bovaird, Sales Mgr. & Pub. Dir.; J. C. Harre, Pur. Agt.
PRODUCTS: Controls; Fittings; Panels; Subassemblies; Pulleys; Rollers; Electrical connector panels.

MASTER LOCK CO., Milwaukee, Wisc.
PERSONNEL: P. E. Yolles, Pres.; S. Soref, V. Pres. & Treas.; S. Stahl, Secy.; E. J. Tower, Sales Mgr.
PRODUCTS: Padlocks; Ratchet shackle locks.

MECHANICAL PRODUCTS, INC., 618 N. Mechanic St., Jackson, Mich.
PERSONNEL: A. D. Knapp, Pres.; E. C. Hedglen, Secy. & Treas.; C. W. Ryerson, V. Pres. & Gen. Mgr.
PRODUCTS: Starters.

MEISEL PRESS MANUFACTURING CO., 944 Dorchester Ave., Boston, Mass.
PERSONNEL: C. A. Meisel, Pres.; W. A. Skelton, V. Pres.; A. E. Meisel, Secy.; O. C. F. Meisel, Treas.; J. J. Swan, Pur. Agt.
PRODUCTS: Gears.

MELLUS BROS. & CO., 305 E. 4th St., Los Angeles, Calif.
PERSONNEL: L. R. Mellus, Pres. & Pur. Agt.; F. H. Mellus, V. Pres.; G. B. Mellus, Secy. & Treas.; E. J. Mundy, Sales Mgr.
PRODUCTS: Engine, cockpit and windshield covers.

J. E. MENAUGH CO., 549 Washington Blvd., Chicago, Ill.
PERSONNEL: J. E. Menaugh; M. M. Maher; A. S. Duesenberg; D. A. MacIntyre.
PRODUCTS: Aviation spark plugs; Torquometer.

MERCURY AIRCRAFT, INC., Hammondsport, N. Y.
PERSONNEL: J. F. Meade, Pres. & Gen. Mgr.; E. M. Meade, V. Pres.; M. C. Close, Secy.; S. Singer, Treas.; R. F. Moore, Pur. Agt.
PRODUCTS: Collector rings, cowls, streamlines; Engine mounts; Exhaust manifolds; Fittings; Miscellaneous hardware; Manifolds; Miscellaneous engine equipment; Parts; Stampings; Sub-assemblies; Tanks; Miscellaneous.

MET-L-WOOD CORP., 6755 W. 65th St., Chicago, Ill.
PERSONNEL: C. C. Kendrick, Pres.; L. M. Crow, Jr., Secy.; G. K. Lewis, Sales Mgr.
PRODUCTS: Collector rings, cowls, streamlines; Exhaust manifolds; Manifolds; Panels; Stampings; Sub-assemblies; Tanks.

MICHIGAN WIRE CLOTH CO., 2100 Howard St., Detroit, Mich.
PERSONNEL: A. A. Bull, Pres.; H. A. Wilson, V. Pres., Secy. & Gen. Mgr.; S. W. Farnsworth, Treas.; W. H. Blodgett, Sales Mgr., Pur. Agt. & Pub. Dir.; W. E. Seel, Pers. Dir.
PRODUCTS: Filters and strainers.

MICRO SWITCH CORP., Freeport, Ill.
PERSONNEL: W. B. Schulte, Pres.; A. L. Riche, V. Pres. & Sales Mgr.; M. W. Eaton, Secy. & Treas.; W. J. Young, Pur. Agt.
PRODUCTS: Switches.

MICROMATIC HONE CORP., 1345 E. Milwaukee Ave., Detroit, Mich.
PERSONNEL: K. W. Connor, Pres.; H. M. Whittaker, V. Pres. & Sales Mgr.; A. J. Prentice, Secy. & Treas.; R. E. Gauss, Pur. Agt.; L. S. Martz, Pub. Dir.
PRODUCTS: Cylinder honing tools; Honing machines; Fixtures.

MID-STATE MANUFACTURING CO., Waupun, Wisc.
PERSONNEL: W. Fleming, Jr., Pres. & Gen. Mgr.; A. G. Gibbons, V. Pres. & Secy.; C. A. Grainger, Sales Mgr.; B. H. Bredeson, Pur. Agt.
PRODUCTS: Rivets.

MILFORD RIVET & MACHINE CO., Milford, Conn.
PERSONNEL: F. H. Merwin, Pres. & Gen. Mgr.; S. Simpson, V. Pres.; R. B. Davis, Secy.; A. R. Knight, Treas.; A. M. Birks, Sales Mgr. & Pub. Dir.; H. P. Brewer, Pur. Agt.
PRODUCTS: Rivets; Fasteners; Screw machine products.

THE MILLER CO., Meriden, Conn.
PRODUCTS: Lighting equipment; Phosphor bronze and brass.

MILLER MANUFACTURING CO., 1100 N. 32nd St., Camden, N. J.
PERSONNEL: W. I. Miller, Pres.; E. E. Miller, Secy. & Treas.; L. Lanser, Sales Mgr.
PRODUCTS: Gasket compound; Corrosion remover.

MILLERS FALLS CO., Greenfield, Mass.
PERSONNEL: P. Rogers, Pres.; G. U. Hatch, V. Pres., Gen. Mgr. & Sales Mgr.; E. D. Holtby, Treas.; C. W. Parsons, Pur. Agt.; K. Y. Taylor, Pub. Dir.
PRODUCTS: Tools.

MILLER RUBBER CO., INC., MECHANICAL GOODS DIV., 1247 South High St., Akron, O.
PERSONNEL: J. L. Collyer, Pres.; S. M. Jett, Secy.; L. L. Smith, Treas.; B. F. Stauffer, Gen. Mgr.; J. F. Johnston, Sales Mgr.
PRODUCTS: Hydraulic seals; Oil seals; Accumulator diaphragms.

MINE SAFETY APPLIANCES CO., Pittsburgh, Pa.
PERSONNEL: N. R. Chillingworth, Sales Mgr.
PRODUCTS: Abrasive masks; Air line respirators; Ear defenders; First aid materials; Goggles; Instruments; Protective hats; Safety clothing; Safety equipment; Salt tablets and dispenser; Velocity power swaging press.

MINNEAPOLIS - HONEYWELL REGULATOR CO., 2753 Fourth Ave. S., Minneapolis, Minn.
PERSONNEL: H. W. Sweatt, Pres.; C. B. Sweatt, V. Pres.; C. C. Buckland, Secy.; W. L. Huff, Treas.; M. E. Knutson, Pur. Agt.; A. G. Dahlquist, and D. C. Owen, Pers. Dirs.; G. B. Benton, Pub. Dir.
PRODUCTS: Engine temperature control equipment; Primer valves; Aircraft flame detectors; De-icer equipment; Instruments; Valves; Primers.

MOBILE REFRIGERATION, INC.,
10 Rockefeller Plaza, New York, N. Y.
PERSONNEL: D. Pyzel, IV, Pres.; G. T. Senseney, V. Pres.; F. C. Butler, Secy.; J. Kruyne, E. J. Stafford, Sales Mgrs.
PRODUCTS: Auxiliary power plants; Controls; Equipment and personal temperature and altitude testing chambers; Instrument and auxiliary calibration and correction chambers.

MODERN ENGINEERING CO., INC.,
3401-15 Pine Blvd., St. Louis, Mo.
PERSONNEL: A. J. Fausek, Pres. & Gen. Mgr.; I. F. Fausek, V. Pres. & Treas.; J. J. Keane, Secy.
PRODUCTS: Torches; Regulators; Gauges; Hose; Accessories.

MOLDED INSULATION CO.,
335 E. Price St., Philadelphia, Pa.
PERSONNEL: V. I. Zelov, Pres.; A. Heer, V. Pres.; A. Zillger, Gen. Mgr.; M. Unis, Pur. Agt.; E. A. Berger, Pers. Dir.
PRODUCTS: Controls; Switches; Hydraulic controls and assemblies; Radio equipment; Sub-assemblies.

MONITE WATERPROOF GLUE CO.,
1628 No. 2nd St., Minneapolis, Minn.
PERSONNEL: H. L. Prestholdt, Pres.; H. W. Mattison, V. Pres. & Treas.
PRODUCTS: Glue; Gluing accessories.

MONSANTO CHEMICAL CO., St. Louis, Mo.
PERSONNEL: E. M. Queeny, Pres.; C. Belknap, V. Pres.; W. W. Schneider, Secy.; F. A. Ulmer, Treas.; G. L. Camp, Gen. Mgr.; J. A. Berninghaus, Sales Mgr.; C. A. Wolfe, Pur. Agt.; S. W. Allender, Pers. Dir.; J. W. Irwin, Pub. Dir.
PRODUCTS: Lacquers; Dopes; Thinners; Metal primers; Camouflage lacquers.

MOORE DROP FORGING CO.,
38 Walter St., Springfield, Mass.
PERSONNEL: J. M. Collins, Pres. & Treas.; A. T. Murray, V. Pres. & Sales Mgr.; F. S. Hatch, Asst. Treas. & Secy.
PRODUCTS: Drop forgings.

MOORE-EASTWOOD & CO.,
537 Monument Ave., Dayton, O.
PERSONNEL: H. C. Moore, Gen. Mgr.; L. N. Moore, Secy. & Treas.; Lee Scheid, Pur. Agt.
PRODUCTS: Bomb racks and shackles; Gun sights; Gun mount adapters; Filler valves; Cablemeters; Tab controls; Generators; Gun synchronizer.

MOTOR MASTER PRODUCTS CORP.,
Aeronautical Div., 549 Washington Blvd. Chicago, Ill.
PERSONNEL: J. E. Menaugh, Gen. Mgr.
PRODUCTS: Spark plugs.

THE MURRAY CORP. OF AMERICA,
7700 Russell St., Detroit, Mich.
PERSONNEL: C. W. Avery, Pres.; L. C. Hill, V. Pres. & Gen. Mgr.; H. W. Wurster, Secy. & Treas.; W. H. Greenwalt, Pur. Agt.; M. B. Lindquist, Pers. Dir.
PRODUCTS: Covers; Cowlings; Seats; Stampings; Sub-assemblies; Miscellaneous.

N

NATIONAL AIRCRAFT EQUIPMENT CO.,
275 N. Ave. 19, Los Angeles, Calif.
PERSONNEL: R. T. Kinney, Pres.; W. H. Kinney, V. Pres. & Gen. Mgr.; M. Quyerel, Secy.; H. Byrnes, Treas.; T. O. Marshall, Sales Mgr.; G. Level, Pur. Agt.; L. L. Martin, Pub. Dir.
PRODUCTS: Fittings; Hydraulic controls and assemblies; Landing gears; Parts; Stampings; Sub-assemblies; Tail wheel assemblies; Miscellaneous; Bucking bars; Small tools.

NATIONAL AUTOMATIC TOOL CO.,
Richmond, Ind.
PERSONNEL: H. W. Bockhoff, Pres. & Gen. Mgr.; E. D. Frank, V. Pres. & Sales Mgr.; A. B. McCrea, Secy.; R. C. Scheurman, Treas.; P. G. Nolte, Pur. Agt.; S. M. Greene, Pers. Dir.; Fred Holcomb, Pub. Dir.
PRODUCTS: Drilling machines; Machine tools.

NATIONAL BATTERY CO., GOULD COMMERCIAL DIVISION, 35 Neoga St., Depew, N. Y.
PERSONNEL: A. H. Daggett, Pres.; H. King, V. Pres.; C. R. Bachman, Secy.; E. F. Cary, Treas.; H. G. Barnes, Gen. Mgr.; J. C. Sykora, Sales Mgr.; B. T. Rabuse, Pur. Agt.
PRODUCTS: Batteries.

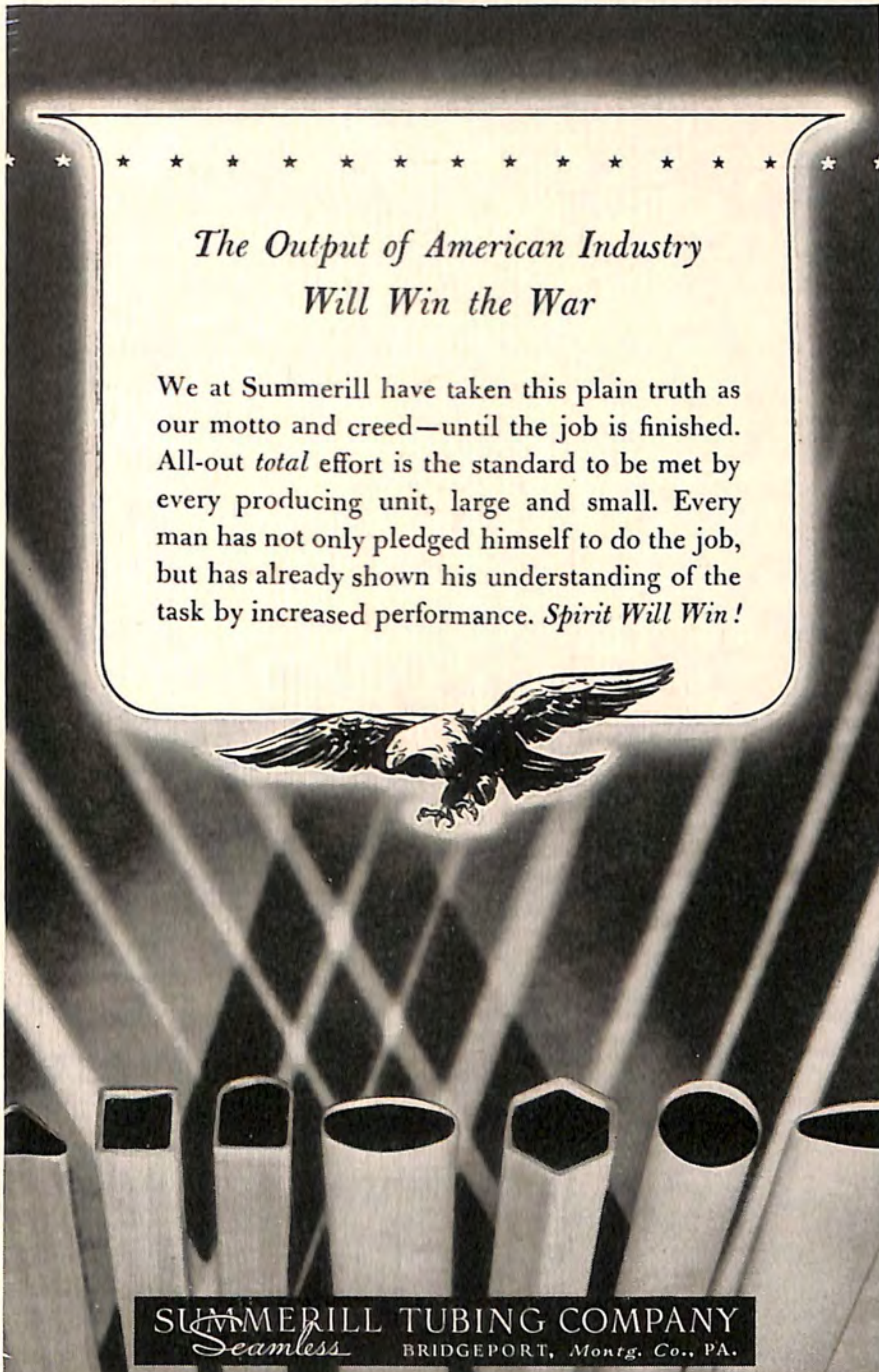
NATIONAL CO., INC.,
61 Sherman St., Malden, Mass.
PERSONNEL: W. A. Ready, Pres.; L. R. Shaffer, Secy.; W. H. Balcke, Treas.; J. J. Freeley Gen. Mgr.; G. Pike, Pur. Agt.
PRODUCTS: Radios.

THE NATIONAL COPPER & SMELTING CO., 1862 E. 123rd St., Cleveland, O.
PERSONNEL: H. B. Smith, Pres.; C. L. Smith, Gen. Mgr.
PRODUCTS: Seamless brass and copper tubing.

NATIONAL MACHINE PRODUCTS,
150 W. Slauson Ave., Los Angeles, Calif.
PERSONNEL: L. H. Seagrave, Pres. & Sales Mgr.; R. F. Sopris, V. Pres. & Gen. Mgr.; W. E. Griffin, Secy. & Pur. Agt.; A. E. Vorhis, Treas.
PRODUCTS: Aircraft armament; Auxiliary power plants; Bomb racks and shackles; Parts; Sub-assemblies.

THE NATIONAL SCREW & MANUFACTURING CO., 2440 E. 75th St., Cleveland, O.
PERSONNEL: H. P. Ladds, Pres.; C. F. Newpher, V. Pres. & Sales Mgr.; E. E. Griese, Secy. & Treas.; R. G. Burnham, Pur. Agt.; F. W. Oldham, Pers. Dir.; C. W. Baker, Pub. Dir.
PRODUCTS: Bolts; Nuts; Screws; Rivets; Cotter pins.

NEW DEPARTURE, DIVISION GENERAL MOTORS CORP., Bristol, Conn.
PERSONNEL: Charles S. Joy, Treas.; F. G. Hughes, Gen. Mgr.; L. G. Sigourney, Sales Mgr.; J. A. Ashwell, Pur. Agt.; C. B. Greene, Pers. Dir.; C. B. Beckwith, Pub. Dir.
PRODUCTS: Ball bearings.


The Output of American Industry
Will Win the War
We at Summerill have taken this plain truth as our motto and creed—until the job is finished. All-out *total* effort is the standard to be met by every producing unit, large and small. Every man has not only pledged himself to do the job, but has already shown his understanding of the task by increased performance. *Spirit Will Win!*
SUMMERILL TUBING COMPANY
Seamless
BRIDGEPORT, Montg. Co., PA.

NEW JERSEY FULGENT CO., INC.,
Whitman Ave., Metuchen, N. J.
PERSONNEL: S. D. Wiley, Pres.; W. F. Buchanan, Gen. Mgr.; G. D'Eustachio, Sales Mgr.
PRODUCTS: Flares; Pyrotechnics.

NEWARK WIRE CLOTH CO.,
351 Verona Ave., Newark, N. J.
PERSONNEL: M. E. Campbell, Pres.; E. Campbell, V. Pres.; L. C. Campbell, Secy. & Treas.; E. J. Korn, Pur. Agt.; A. B. Sanger, Pub. Dir.
PRODUCTS: Filters and strainers; Parts.

NIELSON TOOL & DIE CO.,
1861 Gardner Ave., Berkley, Mich.
PERSONNEL: H. M. Nielson, Owner.
PRODUCTS: Nose rib dies.

NIXON NITRATION WORKS,
Nixon, N. J.
PERSONNEL: Stanhope Nixon, Pres.; Chas. Schuster, Secy. & Gen. Mgr.; O. S. Blaine, Treas.; Mark W. Peters, Sales Mgr.; H. A. Hendrickson, Pur. Agt.; J. O. Daly, Pers. Dir.
PRODUCTS: Cellulose acetate; Cellulose nitrate; Sheets, rods and tubes.

NORMA-HOFFMANN BEARINGS CORP.,
Stamford, Conn.
PERSONNEL: C. P. Wilson, Pres. & Treas.; H. J. Ritter, V. Pres., Secy. & Sales Mgr.; C. B. Malone, V. Pres.; C. A. Wattson, Pur. Agt.
PRODUCTS: Bearings.

NORTH AMERICAN ELECTRIC LAMP CO.,
1014 Tyler St., St. Louis, Mo.
PERSONNEL: C. M. Rice, Pres.; E. O. Cohn, V. Pres.; L. Lander, Secy., Treas., Gen. Mgr., Sales Mgr. & Pub. Dir.; H. N. Adelstein, Pur. Agt. & Pers. Dir.
PRODUCTS: Drying equipment; Drying lamps.

NUMBERALL STAMP & TOOL CO., INC.,
Huguenot Park, Staten Island, N. Y.
PERSONNEL: M. Bayerdorffer, Pres.; C. Zeitler, V. Pres.
PRODUCTS: Stampings.

O

THE OHIO PISTON CO.,
5337 St. Clair Ave., Cleveland, O.
PERSONNEL: C. Birnham, Pres.; E. J. Gutman, V. Pres.; Dan P. Shaw, Secy. & Gen. Mgr.; R. G. Horsburgh, Treas.
PRODUCTS: Pistons; Cylinder sleeves; Pump sleeves; Pump cylinders.

THE OHIO SEAMLESS TUBE CO.,
Shelby, O.
PERSONNEL: W. C. Connelly, Pres. & Gen. Mgr.; W. W. Van Horn, V. Pres.; E. W. McNeill, Secy. & Treas.; A. Waines, Jr., Sales Mgr.; D. C. Reagan, Pur. Agt.; R. M. Pittinger, Pers. Dir.; M. W. Freese, Pub. Dir.
PRODUCTS: Seamless and electric welded steel tubing.

OHLSSON & RICE MANUFACTURING CO., 3340 Emery St., Los Angeles, Calif.
PERSONNEL: I. G. Ohlsson and H. T. Rice, Partners; Oliver Rouillard, Pur. Agt.; A. S. Lewis, Pers. Dir.
PRODUCTS: Aircraft screw machine parts.

OHMITE MANUFACTURING CO.,
4835 W. Flournoy St., Chicago, Ill.
PERSONNEL: D. T. Siegel, Gen. Mgr.; R. S. Laird, Sales Mgr.; W. B. Hills, Pur. Agt.; W. Hart, Pers. Dir.; H. H. Levy, Pub. Dir.
PRODUCTS: Rheostats: Landing and navigation light controls; Resistors, and switches.

THE OILGEAR CO.,
1403 W. Bruce St., Milwaukee, Wisc.
PERSONNEL: H. M. Swigart, Pres.; G. H. Fobian, V. Pres.; S. M. Heller, Secy. & Treas.; W. G. Prasse, Sales Mgr.; G. L. Hartman, Pur. Agt.
PRODUCTS: Propeller twisting machines; Propeller straightening presses; Machine tool feeds; Aircraft forming press parts.

OLMSTEAD MANUFACTURING CO.,
511 S. Redondo Blvd., Inglewood, Calif.
PERSONNEL: L. W. Olmstead, Pres.; J. C. Stephens, Secy. & Treas.; F. E. Shine, Pur. Agt. & Pers. Dir.
PRODUCTS: Process machining and assembly of aircraft parts.

TINIUS OLSEN TESTING MACHINE CO.,
500 N. 12th St., Philadelphia, Pa.
PERSONNEL: T. Y. Olsen, Pres. & Treas.; Tinius Olsen 2nd, V. Pres.; J. F. Sutton, Secy.; T. L. Richards, Sales Mgr.; C. R. Tait, Pur. Agt.
PRODUCTS: Materials testing equipment; Extensometers.

ONSRUD MACHINE WORKS, INC.,
3900-32 Palmer St., Chicago, Ill.
PERSONNEL: Oscar Onsrud, Pres.; R. F. Onsrud, Secy.; Victor E. Metzger, Sales Mgr.; J. Knox, Pur. Agt.
PRODUCTS: Aircraft production machinery Routers; Drills; Shapers; Milling machines.

KARL ORT, 614 W. Poplar St., York, Pa.
PRODUCTS: Batteries; Bearings, Carburetors; Clamps; Control sticks; Covers; Generators; Magnetos; Motors; Switches; Fasteners; Fire extinguishers; First aid equipment; Fittings; Flares; Floats; Goggles; Heaters; Parachutes; Instruments; Miscellaneous engine equipment; Propellers and propeller parts; Radiators; Radios; Spark plugs; Starters; Tail wheel assemblies; Tires and tubes; Valves; Miscellaneous.

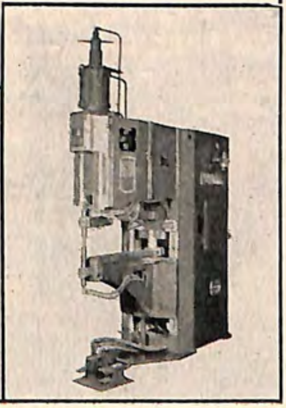
J. A. OTTERBEIN,
59-61 Hubbard St., Middletown, Conn.
PERSONNEL: J. A. Otterbein.
PRODUCTS: Fasteners; Parts; Parachute hardware; Stampings.

OWENS-CORNING FIBERGLAS CORP.,
Nicholas Bldg., Toledo, O.
PERSONNEL: H. Boeschenstein, Pres.; W. P. Zimmerman, V. Pres.; A. C. Freligh, Secy.; H. R. Winkle, Treas.; G. E. Gregory, Sales Mgr.; E. Weihe, Pur. Agt.; E. C. Ames, Pub. Dir.
PRODUCTS: Acoustical, thermal and electrical insulation.

P

PAASCHE AIRBRUSH CO.,
1909 Diversey Pkwy., Chicago, Ill.
PRODUCTS: Spray painting equipment.

←AWH-36, with 30° angle points
HWR—34—3CC1
HWRS



PACIFIC AVIATION, INC., 927 N. Sycamore Ave., Los Angeles, Calif.
PERSONNEL: H. V. Reynolds, Pres.; T. E. Springer, V. Pres.; P. J. Brady, Secy. & Treas.
PRODUCTS: Valves; Pumps; Struts.

PACKARD ELECTRIC DIV. GENERAL MOTORS CORP., Warren, O.
PERSONNEL: B. N. MacGregor, Gen. Mgr.; L. C. Wolcott, Sales Mgr.; E. E. DeBolt, Pur. Agt.; Keith Hoffman, Pers. Dir.
PRODUCTS: Cables.

PACKLESS METAL PRODUCTS CORP., 31 Winthrop Ave., New Rochelle, N. Y.
PERSONNEL: G. M. Pettee, Pres.; M. W. McLaren, V. Pres.; R. S. Frichette, Secy.; H. W. Cole, Treas.; W. L. Bryde, Sales Mgr.; T. J. Callagy, Pur. Agt.
PRODUCTS: Tubing; Hose; Couplings.

THE PALNUT CO., 49 Cordier St., Irvington, N. J.
PERSONNEL: J. R. Hotchkin, Pres.; A. H. Beggs, V. Pres.
PRODUCTS: Fasteners; Locknuts.

PANGBORN CORP., Pangborn Blvd., Hagerstown, Md.
PERSONNEL: T. W. Pangborn, Pres. & Gen. Mgr.; J. C. Pangborn, V. Pres. & Treas.; L. L. Stouffer, Secy.; V. F. Stine, Sales Mgr.; A. L. Gardner, Pub. Dir.
PRODUCTS: Helmets; Hose; Abrasives.

PANORAMIC RADIO CORP., 298 Broadway, New York, N. Y.
PERSONNEL: M. Wallace, Pres.; H. L. M. Capron, V. Pres.; J. I. Heller, Secy.; A. Strauss, Treas.
PRODUCTS: Stratoscope; Radio-spectroscope.

PARACHUTE CORPORATION OF AMERICA, 3206 Los Feliz Blvd., Los Angeles, Calif.
PERSONNEL: A. W. Burton, Pres.; W. M. Lathrop, V. Pres.; Everts Moulton, Secy. & Treas.; Nelson A. Frazer, Sales Mgr.; F. K. Leonard, Pers. Dir.
PRODUCTS: Covers; Parachutes; Safety belts; Seats.

THE PARK DROP FORGE CO., 730 East 79th St., Cleveland, O.
PERSONNEL: G. C. Gordon, Pres.; F. L. Ball, Secy. & Treas.; W. A. Humel, Gen. Mgr.; T. A. Knouff, Pur. Agt.
PRODUCTS: Forgings.

THE PARKER APPLIANCE CO., 17325 Euclid Ave., Cleveland, O.
PERSONNEL: A. L. Parker, Pres.
PRODUCTS: Fittings; Primers; Valves.

THE PARKER STAMP WORKS, INC., 650 Franklin Ave., Hartford, Conn.
PERSONNEL: H. L. Bitter, Pres. & Treas.; Kelsey F. Lingo, V. Pres.; J. T. F. Bitter, Secy. & Sales Mgr.; H. C. Bitter, Gen. Mgr. & Pur. Agt.
PRODUCTS: Stamps; Gages; Tools; Machine work.

PAUSIN ENGINEERING CO., 727-739 Frelinghuysen Ave., Newark, N. J.
PERSONNEL: H. R. Pausin, Pres. & Gen. Mgr.; L. C. Stokes, Secy.; E. Pausin, Treas.
PRODUCTS: Co ils; Switches.

THE C. F. PEASE CO., 2601 W. Irving Park Rd., Chicago, Ill.
PERSONNEL: T. Lord, Pres.; W. E. Pashley, V. Pres.; W. E. Timmerman, Secy. & Treas.; Paul E. Shaw, Pur. Agt.; James L. Worrall, Pers. Dir.; W. W. Brothers, Pub. Dir.
PRODUCTS: Blueprint machines; Process paper; Furniture and supplies.

PECK, STOW & WILCOX CO., Southington, Conn.
PERSONNEL: M. J. Lacey, Pres. & Gen. Mgr.; F. L. Wilcox, V. Pres.; S. C. Wilcox, Secy. & Treas.
PRODUCTS: Sheet-metal working machines and tools.

PENN RIVET CORP., Third & Huntingdon Sts., Philadelphia, Pa.
PERSONNEL: T. M. Searles, Pres. & Gen. Mgr.; J. A. Barnett, V. Pres.; E. M. Barto, Secy. & Treas.; J. J. Clement, Pur. Agt.
PRODUCTS: Rivets; Stampings; Rivet setting machines.

THE PENNZOIL CO., Drake Bldg., Oil City, Pa.
PERSONNEL: W. S. Zehrung, Pres.; M. A. Brewster, V. Pres. & Treas.; R. A. Browne, Secy.; J. L. King, Sales Mgr.; A. W. Clinger, Pur. Agt.; J. F. Vandeventer, Pers. Dir.
PRODUCTS: Lubricating oils.

PERMATEX CO., INC., 1720 Avenue Y, Brooklyn, N. Y.
PERSONNEL: C. A. Benoit, Pres., Treas. & Gen. Mgr.; L. C. Wills, V. Pres.; H. C. Fuchs, Secy.; H. J. Enders, Sales Mgr.; W. B. Corbett, Pur. Agt.; E. G. Heeren, Pers. Dir.; E. M. Amerman, Pub. Dir.
PRODUCTS: Cement; Oil; Enamels.

PERRY-AUSTEN MANUFACTURING CO., Grasmere, Staten Island, N. Y.
PERSONNEL: F. T. Perry, Pres.; W. F. Doerflinger, V. Pres.
PRODUCTS: Finishes; Paints; Lacquers.

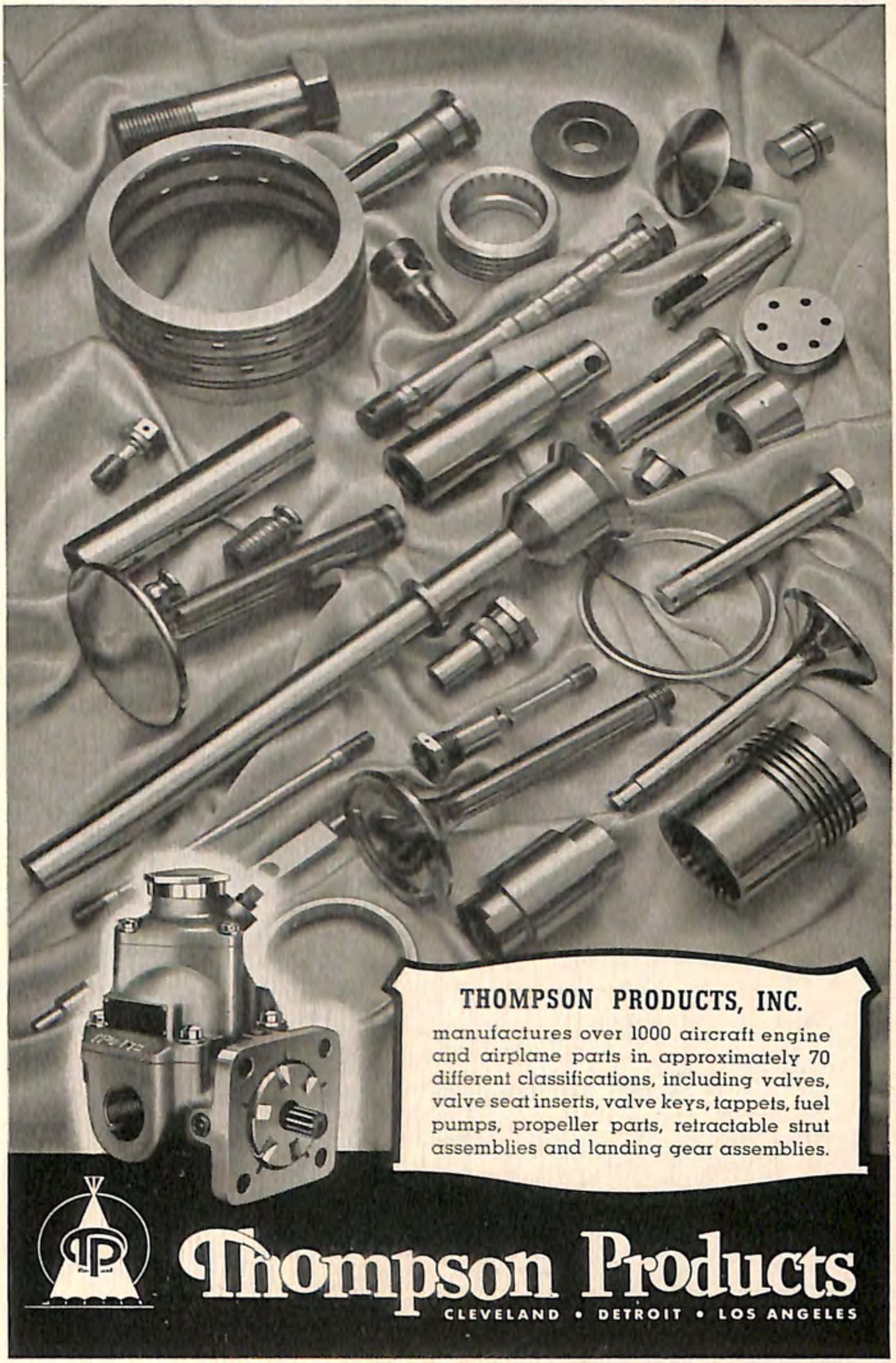
PERRY SPORTSWEAR, INC., 54 Liberty St., Newburgh, N. Y.
PERSONNEL: I. Freedman, Pres.; M. Langer, Secy. & Gen. Mgr.; L. Herbert, Treas.; S. Freedman, Sales Mgr.
PRODUCTS: Flying clothing.

PETROLEUM SOLVENTS CORP., 331 Madison Ave., New York, N. Y.
PERSONNEL: L. A. Staff, Pres. & Sales Mgr.; S. V. Hirschman, Treas., Gen. Mgr. & Pur. Agt.
PRODUCTS: Additives; Solvents.

PHEOLL MANUFACTURING CO., 5700 Roosevelt Rd., Chicago, Ill.
PERSONNEL: Mason Phelps, Pres.; E. M. Whiting, V. Pres. & Gen. Mgr.; J. J. Schwander, Secy. & Treas.; J. A. Perry, Sales Mgr.; A. A. Schmid, Pur. Agt.; M. E. Jensen, Pers. Dir.; N. L. Marvin, Pub. Dir.
PRODUCTS: Screws; Bolts; Nuts; Washers.

PHILADELPHIA DIV., BENDIX AVIATION CORP., Philadelphia, Pa.
PERSONNEL: N. B. McLean, Asst. Gen. Mgr.
PRODUCTS: Starters.

PHILLIPS BRONZE CORP., 1460 E. Washington Blvd., Los Angeles, Calif.
PERSONNEL: R. W. Phillips, Pres., R. W. Phillips, Jr., V. Pres., Gen. Mgr. & Pur. Agt.; G. R. Price, Secy. & Treas.
PRODUCTS: Bearings.


THOMPSON PRODUCTS, INC.
manufactures over 1000 aircraft engine and airplane parts in approximately 70 different classifications, including valves, valve seat inserts, valve keys, tappets, fuel pumps, propeller parts, retractable strut assemblies and landing gear assemblies.
Thompson Products
CLEVELAND • DETROIT • LOS ANGELES

PHILLIPS PETROLEUM CO.,
Bartlesville, Okla.
PERSONNEL: K. S. Adams, Pres.; A. M. Hughes, V. Pres.; B. F. Stradley, Secy.; R. M. Riggins, Treas.; M. B. Heine, Pur. Agt.; Warren Felton, Pers. Dir.
PRODUCTS: Aviation gasoline.

PIERCE & STEVENS, INC.,
710 Ohio St., Buffalo, N. Y.
PERSONNEL: R. D. Stevens, Pres.; A. L. Stevens, V. Pres.; P. P. Dauscher, Secy. & Treas.; G. T. Swing, Sales Mgr.; E. C. Stevens, Pur. Agt.
PRODUCTS: Dopes and lacquers; Cleaners; Solvents; Thinners.

PIONEER INSTRUMENT DIV. OF BENDIX AVIATION CORP., Bendix, N. J.
PERSONNEL: R. P. Lansing, Gen. Mgr.; R. H. Isaacs, Sales Mgr.; H. T. Leeming, Pur. Dir.; J. J. O'Donnell, Pers. Dir.
PRODUCTS: Flight, navigation, engine and remote indicating instruments; Aircraft instrument warning contactors.

PIONEER PARACHUTE CO., INC.,
168 Forest St., Manchester, Conn.
PERSONNEL: H. R. Mallory, Pres. & Treas.; J. F. Smith, V. Pres.; L. H. Ford, Sales Mgr.; C. D. Cheney, Secy.; J. C. Schumacher, Pur. Agt.
PRODUCTS: Parachutes.

PLASKON CO., INC.,
2112-24 Sylvan Ave., Toledo, O.
PERSONNEL: J. L. Rodgers, Pres.; H. Spitzer, V. Pres.; C. O. Marshall, Secy.; W. R. Feldtmann, Treas.; J. H. Jefferey, Pur. Agt.
PRODUCTS: Glue.

PLXWEVE MANUFACTURING CO.,
3900 Burlos Ave., Burbank, Calif.
PERSONNEL: R. G. Harper, Pres. & Treas.; C. L. Bates, V. Pres. & Secy.; A. D. Greenwood, Exec. V. Pres. & Sales Mgr.
PRODUCTS: Wood-plastic components for aircraft.

PLYWOOD PRODUCTS CORP.,
Bay City, Mich.
PERSONNEL: B. B. Shaw, Pres.; W. J. Bauer Secy.; L. A. Whalen, Pur. Agt.
PRODUCTS: Panels.

JOSEPH POLLAK CORP., 81 Freeport St., Dorchester, Boston, Mass.
PERSONNEL: J. Pollak, Pres., Treas. & Gen. Mgr.; H. Brandt, V. Pres. & Sales Mgr.; Ralph Holub, Secy.; Frank Smith, Pers. Dir.
PRODUCTS: Clamps; Switches; Landing and navigation lights; Parts; Stampings.

POLLAK MANUFACTURING CO.,
541 Devon St., Arlington, N. J.
PERSONNEL: L. L. Pollak, Pres. & Sales Mgr.; C. Schlesinger, V. Pres., Treas. & Gen. Mgr.; P. Calabro, Secy.; F. Hazen, Pur. Agt.; T. Breen, Pers. Dir.
PRODUCTS: Aircraft armament; Ammunition boxes; Bomb racks; Clamps; Collector rings, cowls, streamlines; Cowlings; Exhaust manifolds; Fasteners; Filters and strainers; Landing and navigation lights; Manifolds; Stampings; Tanks.

THE PORCUPINE CO.,
Fairfield, Conn.
PERSONNEL: J. K. Williamson, Pres.; C. W. Brooks, V. Pres.; H. H. Williamson, Secy.; R. L. Alvey, Treas.; J. R. Williamson, Gen. Mgr.; L. H. Burr, Pur. Agt.
PRODUCTS: Treating tanks.

J. V. G. POSEY & CO.,
1008 S. W. 6th Ave., Portland, Ore.
PERSONNEL: J. V. G. Posey, Pres.
PRODUCTS: Ammunition boxes and counters; Spruce.

PRATT & LAMBERT INC.,
79 Tonawanda St., Buffalo, N. Y.
PERSONNEL: H. E. Webster, Pres.; R. W. Lindsay, V. Pres.; W. P. Werheim, Secy.; T. E. Murphy, Sales Mgr.; J. P. Nolan, Pur. Agt.
PRODUCTS: Dopes; Enamels; Lacquers; Varnishes.

PRECISION BEARINGS, INC., 1706-08 South Grand Ave., Los Angeles Calif.
PERSONNEL: O. P. Wilson, Pres.; H. R. Swanton, V. Pres.; H. J. Ritter, Secy.; L. H. Travis, Treas.; C. M. Slocum, Pur. Agt.
PRODUCTS: Bearings.

PRECISION TUBE CO.,
3828 Terrace St., Philadelphia, Pa.
PERSONNEL: N. H. Jack, Pres. & Sales Mgr.; N. H. Jack, Jr., Gen. Mgr. & Pur. Agt.
PRODUCTS: Controls; Instruments; Radio shielding and equipment.

PREST-O-LITE BATTERY CO., INC.,
Indianapolis, Ind.
PERSONNEL: J. H. McDuffee, Pres.; H. E. Komitch, V. Pres., Gen. Mgr. & Sales Mgr.; F. H. Landwehr, Secy.; W. V. Flood, Treas.; R. A. Nowlan, Pur. Agt.
PRODUCTS: Batteries.

PRODUCTION TOOL & DIE CO., INC.,
572 St. James Ave., Springfield, Mass.
PERSONNEL: R. J. Gaudreau, Pres.
PRODUCTS: Stampings.

PROGRESSIVE BRASS MANUFACTURING CO., 1702 E. 6th St., Tulsa, Okla
PERSONNEL: E. J. Thomas, Pres.; N. A. Doolittle, V. Pres. & Treas.; C. O. Beckett, Secy
PRODUCTS: Castings.

PROGRESSIVE WELDER CO.,
3050 E. Outer Drive, Detroit, Mich.
PERSONNEL: F. H. Johnson, Pres.; W. H. Martin, Secy. & Treas.; L. M. Benkert, Gen. Mgr.; J. R. G. Harris, Sales Mgr.; W. Nixon, Pur. Agt.
PRODUCTS: Spot welders; Automatic resistance welding equipment.

PROTECTOSEAL CO. OF AMERICA, INC.,
1906-1920 S. Western Ave., Chicago, Ill.
PERSONNEL: R. J. Anschicks, Pres.; R. M. Rosenwald, V. Pres.; C. Chapin, Secy.; H. W. Barber, Treas. & Gen. Mgr.; L. J. Lohnes, Sales Mgr.; C. Lisciani, Pur. Agt.; F. A. Wenck, Pers. Dir.
PRODUCTS: Fire baffle screens for fuel tanks.

PUMP ENGINEERING SERVICE CORP.,
12910 Taft Ave., Cleveland, O.
PERSONNEL: R. J. Minshall, Pres. & Gen. Mgr.; H. H. Brooksieker, V. Pres.; C. Bissell, Secy.; J. L. Menart, Treas.; C. Stanley, Sales Mgr.; H. H. Krause, Pur. Agt.
PRODUCTS: De-icer equipment; Fittings; Hydraulic controls and assemblies; Pumps; Valves; Miscellaneous.

TIMKEN BEARINGS *for Modern Aircraft*

In Landing and Tail Wheels

Timken Bearings tremendously increase wheel stability; prevent wheel wobbling; simplify lubrication; and greatly reduce maintenance attention. No wear on wheel spindles and practically none in the bearings themselves. Radial, thrust and combined loads safely carried under all conditions. An overwhelming majority of American land planes—military, transport and private; all types and sizes—use Timken Bearing Equipped landing and tail wheels.

In Engine Rocker Arms

Timken Rocker Arm Bearings are especially designed for rocker arm use. They hold rocker arms in rigid alignment; prevent wear on rocker arm shafts; reduce "brinneling" to the vanishing point. Timken Rocker Arm Bearings are used in both radial and "in-line" aircraft engines, including one of the most powerful in the world.

Additional information will be furnished on request. Our engineering department is always available for consultation.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

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

THE PURE OIL CO.,
35 E. Wacker Dr., Chicago, Ill.
PERSONNEL: H. M. Dawes, Pres.
PRODUCTS: Fuels and lubricants.

PURITAN COMPANY INC.,
573 Lyell Ave., Rochester, N. Y.
PERSONNEL: A. Beach, Pres. & Treas.; John F. Bush, Jr., V. Pres. & Sales Mgr.; C. S. Wilcox, Secy.
PRODUCTS: Soaps and cleaners; Polishes; Automotive chemicals.

PUROLATOR PRODUCTS, INC.,
91 Empire St., Newark, N. J.
PERSONNEL: R. R. Layte, Pres.; E. B. Headden, V. Pres.; H. W. Thogode, Treas. & Pers. Dir.; John H. Schafer, Pur. Agt.
PRODUCTS: Filters; Strainers.

THE PYLE-NATIONAL CO.,
1334 N. Kostner Ave., Chicago, Ill.
PERSONNEL: J. A. Amos, Pres.; R. D. Grant, V. Pres.; E. W. Botts, Secy. & Treas.; W. A. Ross, Sales Mgr.; H. A. Redmon, Pur. Agt.; W. A. Wulle, Pub. Dir.
PRODUCTS: Landing and navigation lights.

Q

QUALITY ELECTRIC CO., LTD., 1235 E. Olympic Blvd., Los Angeles, Calif.
PERSONNEL: J. O. Gase, Pres. & Gen. Mgr.; A. W. Wotkyns, V. Pres. & Treas.; W. R. Frampton, Secy.
PRODUCTS: Windshield de-icer equipment; Dynamotors; Generators; Motors; Switches; Radio marker beacons; Automatic temperature control; Landing and navigation lights.

R

R C A MANUFACTURING CO., INC.,
Front & Cooper Sts., Camden, N. J.
PERSONNEL: G. K. Throckmorton, Pres.; M. Brunet, V. Pres.; F. H. Corregan, Secy.; E. F. Haines, Treas.; H. M. Hucke, Sales Mgr.; W. S. Bosworth, Pur. Agt.; E. C. Morse, Pers. Dir.; T. F. Joyce, Pub. Dir.
PRODUCTS: Radios; Radio compasses.

R E F AIRCRAFT CORP.,
Syosset, N. Y.
PERSONNEL: D. deLackner, Pres.; L. E. Faust, V. Pres.; M. Rochman, Secy.; R. H. Faust, Treas.; J. Kearney, Sales Mgr.; C. D. Birmingham, Pur. Agt.; A. Richard Willis, Jr., Pub. Dir.
PRODUCTS: Bomb racks; Controls; Fittings; Hydraulic controls and assemblies; Landing gear parts; Aircraft parts; Stampings; Subassemblies; Tail wheel assemblies; Tanks; Miscellaneous.

RADEL LEATHER MANUFACTURING CO.,
445 Wilson Ave., Newark, N. J.
PERSONNEL: F. J. Radel, Pres.; C. B. Schubert, Secy. & Treas.; R. H. Cudlipp, Sales Mgr.; E. J. Bauerlein, Pur. Agt.
PRODUCTS: Upholstery leather.

RADIATOR SPECIALTY CO.,
P. O. Box 1109, Charlotte, N. C.
PERSONNEL: I. D. Blumenthal, Pres.; H. F. Meltsner, V. Pres. & Sales Mgr.; S. Kraft, Secy.; M. A. Brown, Treas. & Pur. Agt.
PRODUCTS: Sealing compound.

RADIO RECEPTOR CO., INC.,
251 W. 19th St., New York, N. Y.
PERSONNEL: L. Arnson, Pres. & Sales Mgr.; Hugo Cohn, V. Pres. & Treas.; H. R. Zeamans, Secy.; W. Ostrove, Pur. Agt.
PRODUCTS: Radios.

RAMSEY ACCESSORIES MANUFACTURING CORP., 3693 Forest Park Blvd., St. Louis, Mo.
PERSONNEL: J. A. Ramsey, Pres.; H. Ramel, V. Pres.; L. A. Ramsey, Secy.; O. C. Holaday, Sales Mgr.; G. D. Whitling, Pur. Agt.; W. G. Myers, Pub. Dir.
PRODUCTS: Piston rings.

RANDALL GRAPHITE PRODUCTS CORP.,
609 W. Lake St., Chicago, Ill.
PERSONNEL: W. P. Thacher, Pres.; R. H. Whiteley, V. Pres.; E. A. Zimmerman, Secy.; M. E. Clark, Sales Mgr.; G. G. Terris, Pur. Agt.; C. E. Lowgren, Pers. Dir.
PRODUCTS: Bearings; Landing gears.

RAYMOND MANUFACTURING CO., DIV. ASSOCIATED SPRING CORP., 226 S. Center St., Corry, Pa.
PERSONNEL: F. E. Barnes, Pres.; E. W. Feldt, V. Pres. & Gen. Mgr.; F. E. Whittlesey, Secy.; C. H. Holden, Treas. & Pur. Agt.; J. E. Mount Sales Mgr.
PRODUCTS: Stampings; Springs.

READING BATTERIES, INC.,
Box 916, Reading, Pa.
PERSONNEL: D. R. Bomberger, Pres. & Treas.; F. M. Moore, V. Pres.; J. Turner Moore, Jr., Secy. & Gen. Mgr.; H. Peck, Sales Mgr.
PRODUCTS: Batteries.

REPUBLIC STEEL CORP.,
Republic Bldg., Cleveland, O.
PERSONNEL: R. J. Wysor, Pres.; N. J. Clarke, V. Pres. & Sales Mgr.; C. M. White, V. Pres.; W. W. Hancock, Secy. & Treas.; C. A. Ilgenfritz, Pur. Agt.
PRODUCTS: Tubing; Steels; Hangar doors.

RESISTOFLEX CORP.,
39 Plansoen St., Belleville, N. J.
PERSONNEL: E. S. Peierls, Pres., Treas. & Gen. Mgr.; H. E. Krebs, V. Pres. & Sales Mgr.; C. E. Stretton, Secy. & Pur. Agt.
PRODUCTS: Flexible hose; Instrument lines; Gloves; Aprons.

REYNOLDS METALS CO.,
810 E. Franklin St., Richmond, Va.
PERSONNEL: R. S. Reynolds, Pres.; W. G. Golden, V. Pres.; C. F. Manning, Secy.; R. S. Reynolds, Jr., Treas.; J. Louis Reynolds, Sales Mgr.; H. L. Charlton, Pur. Agt.; L. C. Lovejoy, Pers. Dir.; V. MacNair, Pub. Dir.
PRODUCTS: Aircraft armament.

H. H. ROBERTSON CO., 2400 Farmers Bank Bldg., Pittsburgh, Pa.
PERSONNEL: H. H. Robertson, Pres.; J. H. Young, V. Pres. & Gen. Mgr.; A. G. Spurlock, Secy. & Treas.; F. C. Russell, Sales Mgr.; J. Morrow, Pur. Agt.; H. B. Winslow, Pub. Dir.
PRODUCTS: Floors; Ventilators; Aircraft manufacturing buildings.

Most SPEED NUTS for aircraft actually weigh only 20% to 30% as much as fastenings formerly used in same locations. They are applied about twice as fast and also give your assembly a double spring tension lock. In resistance to vibration loosening, they are four times tougher than conventional fastenings.

Long before the Defense Program started, over a billion SPEED NUTS had already been used in revolutionizing the assembly of automobiles, refrigerators, radios, stoves, ranges, heaters, etc. and cut average net assembly costs 50%.

Any assembly line using SPEED NUTS moves faster at lower cost and turns out a better assembled product. Send us your assembly details and we will mail samples and engineering data promptly.

★
1000, 8-32
SPEED NUTS
weigh only
11 ounces
★

TINNERMAN PRODUCTS, INC.,

2090 Fulton Road, Cleveland, Ohio

Manufacturers of Patented SPEED NUTS

IN CANADA: Wallace Barnes Co., Ltd., Hamilton, Ontario
IN ENGLAND: Simmonds Aerocessories, Ltd., London.

OVER A BILLION IN USE—OVER 800 SHAPES AND SIZES

ROBERTSON AIRCRAFT CORP.,
Lambert-St. Louis Municipal Airport, Robertson, Mo.
PERSONNEL: Wm. B. Robertson, Pres.; H. F. Heideman, V. Pres.; C. A. Bacon, Secy.; N. Schuyler, Treas.; B. W. Bell, V. Pres.
PRODUCTS: Cowlings; Engine mounts; Panels; Seats; Sub-assemblies.

ROBOT MACHINERY CO.,
326-340 Ten Eyck St., Brooklyn, N. Y.
PERSONNEL: L. Robaczynski, Sr., Pres.; L. Robaczynski, Jr., V. Pres. & Pur. Agt.
PRODUCTS: Surface grinders.

ROCHESTER ROPES, INC., Jamaica, N. Y.
PERSONNEL: W. L. Rochester, Sr., Pres. & Treas.; W. L. Rochester, Jr., V. Pres.; H. Schroeder, Secy.; T. J. Burke, Sales Mgr.; T. J. McCusker, Pur. Agt.
PRODUCTS: Control cables.

ROCKBESTOS PRODUCTS CORP.,
50 Mitchell Rd., New Haven, Conn.
PERSONNEL: A. G. Newton, Pres.; B. H. Reeves, V. Pres. & Gen. Mgr.; W. C. Armstrong, Secy. & Treas.; H. O. Anderson, Sales Mgr.; E. L. Alvord, Pur. Agt.; K. A. Redfield, Pub. Dir.
PRODUCTS: Wire and cable; Radio equipment.

ROCKFORD SCREW PRODUCTS CO.,
2501 Ninth St., Rockford, Ill.
PERSONNEL: O. G. Nelson, Pres.; S. Hillman, V. Pres. & Gen. Mgr.; D. E. Johnson, Secy. & Treas.; C. A. Carter, Sales Mgr.; C. C. Ericson, Pur. Agt.; B. R. J. Hassell, Pub. Dir.
PRODUCTS: Fasteners; Bolts and screws.

ROCKWOOD SPRINKLER CO.,
38-40 Harlow St., Worcester, Mass.
PERSONNEL: W. J. Carroll, Pres. & Gen. Mgr.; H. C. Kendall, V. Pres.; P. S. Smith, Treas.; S. H. Reando, Pur. Agt.; F. H. Perry, Pers. Dir.; J. J. Ryan, Pub. Dir.
PRODUCTS: Miscellaneous hardware; Stampings; Filters and strainers; Fire extinguishers.

RODDIS LUMBER & VENEER CO.,
Marshfield, Wisc.
PERSONNEL: H. Roddis, Pres. & Gen. Mgr.; R. M. Roddis, L. Korth, V. Pres.; J. Hobelsberger, Secy.; R. T. Beggs, Treas.; C. G. Yerkes, Sales Mgr.; H. E. Wenzel, Pur. Agt.
PRODUCTS: Plywood; Veneers.

JOHN A. ROEBLING'S SONS CO.,
640 S. Broad St., Trenton, N. J.
PERSONNEL: W. A. Anderson, Pres.; C. G. Williams, V. Pres.; C. R. Tyson, Secy. & Treas.; E. C. Low, Sales Mgr.; L. Van Dike, Pur. Agt.
PRODUCTS: Wire rope and fittings; Wire rope and grommet slings; Aircraft cord, wire and strands; Electrical wire and cables; Swaged rope and aircraft cord fittings.

ROHM & HAAS CO.,
Washington Square, Philadelphia, Pa.
PERSONNEL: O. Haas, Pres.; E. C. B. Kirsopp, V. Pres.; S. C. Kelton, Secy.; V. A. Wallin, Treas.; D. S. Frederick, Sales Mgr.; E. Greene, Pub. Dir.
PRODUCTS: Plastics.

ROHR AIRCRAFT CORP., Chula Vista, Calif.
PERSONNEL: F. H. Rohr, Pres. & Treas.; J. E. Rheim, V. Pres.; E. P. Campbell, Secy.; J. A. Stromberg, Pur. Agt.
PRODUCTS: Auxiliary power plants; Bomb racks; Cowlings; Parts.

ROLOCK, INC., Southport, Conn.
PERSONNEL: R. P. Welles, Pres. & Treas.; L. A. Beadle, V. Pres. & Secy.
PRODUCTS: Metal baskets; Wire mesh.

ROMEC PUMP CO.,
347 E. Bridge St., Elyria, O.
PERSONNEL: W. H. Hill, Pres.; C. D. Gentsch, V. Pres., Secy. & Sales Mgr.; A. B. Taylor, Treas.; J. H. Lyons, Pur. Agt.; Webster Schmaling, Pub. Dir.
PRODUCTS: De-icer equipment; Landing gears; Valves; Pumps.

RUCKSTELL - BURKHARDT ENGINEERING CO., 320 Security Bldg., Phoenix, Ariz.
PERSONNEL: G. E. Ruckstell, Pres.; F. B. Patterson, Secy. & Treas.
PRODUCTS: Power plant equipment.

RUSSELL UNIFORM CO.,
1600 Broadway, New York, N. Y.
PERSONNEL: J. A. Russell, Pres.; A. Russell, V. Pres.; H. A. Zeimer, Sales Mgr.
PRODUCTS: Uniforms.

RYAN AERONAUTICAL COMPANY,
Lindbergh Field, San Diego, Calif.
PERSONNEL: T. C. Ryan, Pres., Treas. & Gen. Mgr.; E. D. Prudden, V. Pres.; E. A. Smith, Secy.; S. C. Breder, Sales Mgr.; F. Ford, Pur. Agt.; M. Marco, Pers. Dir.; W. Wagner, Pub. Dir.
PRODUCTS: Exhaust manifolds.

JOSEPH T. RYERSON & SON, INC.,
Chicago, Ill.
PERSONNEL: E. D. Graff, Pres.; R. C. Ross, Secy.; E. L. Hartig, Treas.; H. B. Ressler, Sales Mgr.; M. J. Hartigan, Pur. Agt.; G. Handtmann, Pers. Dir., K. J. Evans, Pub. Dir.
PRODUCTS: Stainless steel bars, plates, sheets, etc.; Tool steel; Welding electrodes and rods; Alloy steels; Tubing; Nuts; Bolts.

S

S. A. E. STEELS,
1420 E. 47th St., Cleveland, O.
PERSONNEL: A. B. Betz, Owner; F. H. Michell, Gen. Mgr.; E. R. Salisbury, Sales Mgr.
PRODUCTS: Steels.

S K F INDUSTRIES INC.,
Front St. & Erie Ave., Philadelphia, Pa.
PERSONNEL: W. L. Batt, Pres.; R. F. Runge, V. Pres.; T. W. Dinlocker, Secy. & Treas.; R. H. DeMott, Sales Mgr.; H. J. Lance, Pur. Agt.; H. S. Langdon, Pers. Dir.; R. C. Byler, Pub. Dir.
PRODUCTS: Bearings; Hangers; Pillow blocks; Post hangers; Balls.

SAFETEE GLASS CO.,
4717 Stenton Ave., Philadelphia, Pa.
PERSONNEL: R. A. Gibbs, Pres.; J. W. Gibbs, V. Pres.; A. Boehm, Secy.; C. L. Krebs, Treas.; C. A. McCusker, Sales Mgr. & Pur. Agt.
PRODUCTS: Aircraft armament; Bullet resisting glass; Instrument covers.

SAL METAL PRODUCTS CO.,
191 Pearl St., Brooklyn, N. Y.
PRODUCTS: General machinists; Metal stampers; Tools and dies.

SALTA CORP.,
1 Exchange Place, Jersey City, N. J.
PERSONNEL: W. L. Smith, Pres. & Gen. Mgr.; S. A. Odlum, V. Pres.; M. C. Mulloy, Secy.; C. A. Warden, Treas.; H. F. Gremmel, V. Pres. & Sales Mgr.
PRODUCTS: Rubber.

SAYLOR ELECTRIC PRODUCTS CORP.,
1014 Lynn St., Detroit, Mich.
PERSONNEL: W. L. Saylor, Pres.; W. R. Saylor, V. Pres. & Pur. Agt.; J. M. Sharkey, Secy.; C. C. Saylor, V. Pres. & Treas.; C. J. Saylor, Pers. Dir.
PRODUCTS: Radio shielding and equipment; Tubing.

THE SCHATZ MANUFACTURING CO.,
Poughkeepsie, N. Y.
PERSONNEL: H. A. Schatz, Pres. & Gen. Mgr.; G. R. Bennett, Jr., Secy.; H. F. Petersen, Sales Mgr.; V. W. Fichtel, F. W. Recknagel, Pur. Agt.
PRODUCTS: Ball bearings.

GEO. SCHERR CO., INC.,
128 Lafayette St., New York, N. Y.
PERSONNEL: G. Scherr, Pres.; F. Koenig, Secy.; K. F. Kirchlofer, Sales Mgr.
PRODUCTS: Gages; Measuring instruments; Precision tools.

SCHLEGEL MANUFACTURING CO.,
277 N. Goodman St., Rochester, N. Y.
PERSONNEL: C. P. Schlegel, Pres.; J. F. Sproat, Secy. & Sales Mgr.; G. C. Schlegel, Treas. & Pur. Agt.; C. F. Schlegel, Gen. Mgr.; E. J. Schultz, Pers. Dir.; T. G. White, Pub. Dir.
PRODUCTS: Glass run channel; Pilots sliding window run; Seaming cord welt; Broadlace; Weatherstripping; Sliding hatch runs.

A. SCHRADER'S SON, DIV. SCOVILL MANUFACTURING CO., 470 Vanderbilt Ave., Brooklyn, N. Y.
PERSONNEL: W. T. Hunter, V. Pres. & Gen. Mgr.
PRODUCTS: Tire valves, replacement parts and service tools; Tire gauges.

SCHWARZENBACH HUBER CO.,
498 Seventh Ave., New York, N. Y.
PERSONNEL: E. G. Glaesel, Pres. & Gen. Mgr.; A. Schwarzenbach, V. Pres.; J. W. Betts, Jr., Secy.; O. Froelicher, Treas.
PRODUCTS: Textiles.

SCINTILLA MAGNETO DIV. BENDIX AVIATION CORP., Sidney, N. Y.
PERSONNEL: H. Hanni, Gen. Mgr.; T. Z. Fagan, Sales Mgr.; A. Bekker, Pur. Agt.; E. M. Van Name, Pers. Dir.; A. J. Poole, Sales Engr.
PRODUCTS: Magnetos; Switches.

SCOTT AVIATION CORP.,
207 Erie St., Lancaster, N. Y.
PERSONNEL: Earle M. Scott, Pres. & Gen. Mgr.; R. D. Pollock, V. Pres. & Treas.; Emery C. Prior, Secy. & Sales Mgr.; Elmer J. Allein, Pur. Agt.; H. F. Whittaker, Pers. Dir. & Pub. Dir.
PRODUCTS: Instruments; Tail wheel assemblies; Castings.

SEALED POWER CORP., Muskegon, Mich.
PERSONNEL: C. E. Johnson, Pres.; P. C. Johnson, V. Pres.; R. R. Beardsley, Secy. & Treas.; N. A. Moore, Gen. Mgr.; G. W. Davies, Sales Mgr.; R. Harvey, Pur. Agt.; W. R. Tyson, Pers. Dir.
PRODUCTS: Piston rings; Pistons; Cylinder liners and sleeves.

SEAMAN PAPER CO.,
222 W. Adams St., Chicago, Ill.
PERSONNEL: D. R. Seaman, Pres.; L. Springer, Secy.; A. J. Drusch, Treas. & Gen. Mgr.
PRODUCTS: Soundproofing and thermal insulation.

SEAMLEX CO., INC.,
5-19 48th Ave., Long Island City, N. Y.
PERSONNEL: F. F. Jacobson, Pres.; A. E. Loeb, Pur. Agt.
PRODUCTS: Tubing; Vibration dampers.

SEARLE AERO INDUSTRIES, INC.,
226 N. Hawthorne Blvd., Hawthorne, Calif.
PERSONNEL: M. O. Searle, Pres. & Pur. Agt.; G. M. Marco, V. Pres.; V. A. Marco, Secy. & Sales Mgr.; D. L. Rahn, Pers. Dir.
PRODUCTS: Electrical equipment; Radio compasses; Tubing; Radio shielding; Transmitters.

SEIDEN PNEUMATIC TOOL CO.,
423 Barrett St., Jackson, Mich.
PERSONNEL: O. D. Lutes, Pres.; E. J. Seiden, Prod. Mgr.
PRODUCTS: Pneumatic hammers.

SEIDLITZ PAINT & VARNISH CO.,
Kansas City, Mo.
PERSONNEL: C. N. Seidlitz, Pres. & Gen. Mgr.; L. J. Bohannon, V. Pres.; K. W. Ward, Secy. & Pur. Agt.; W. P. Marsh, Treas.
PRODUCTS: Finishes.

SELLSTROM MANUFACTURING CO.,
615 North Aberdeen St., Chicago, Ill.
PERSONNEL: G. E. Sellstrom, Pres.; G. E. Wenstrom, Secy. & Treas.; C. E. Dennis, Sales Mgr.; R. L. Calm, Pur. Agt.
PRODUCTS: Goggles.

SENSENICH BROTHERS, Lititz, Pa.
PERSONNEL: H. M. Sensenich & Martin M. Sensenich, Partners; R. N. Bomberger, Sales Mgr. & Pub. Dir.; M. S. Erb, Pur. Agt.
PRODUCTS: Propellers and propeller parts; Test clubs.

SHAKESPEARE PRODUCTS CO., 241 E. Kalamazoo Ave., Kalamazoo, Mich.
PERSONNEL: H. G. Shakespeare, Pres.; D. E. Wallace, V. Pres.; M. Shakespeare, Secy. & Gen. Mgr.; W. J. Harrison, Treas.; M. Balch, Sales Mgr.; H. Barron, Pur. Agt.
PRODUCTS: Fuel gauges.

THE SHEFFIELD CORP.,
721 Springfield St., Dayton, O.
PERSONNEL: L. Poock, Pres.; A. Poock, V. Pres.; P. Poock, V. Pres. & Sales Mgr.; R. Cannon, Pur. Agt.; W. Conrad, Pers. Dir.; M. Messick, Pub. Dir.
PRODUCTS: Machine tools; Precision gages; Dies; Special tools.

SHELL OIL CO., INC., AVIATION DEPT.,
50 West 50th St., New York, N. Y.
PERSONNEL: R. T. Goodwin, Mgr.; M. Hamon, Asst. Mgr.; G. G. Hughes, J. L. Wheeler, J. W. Freeman, Pilot Salesmen.
PRODUCTS: Fuels and lubricants.

THE SHERWIN-WILLIAMS CO., 101 Prospect Ave., N. W., Cleveland, O.
PRODUCTS: Paints; Varnishes; Lacquers; Enamels; Primers.

SHULER AXLE CO., INC., Louisville, Ky.
PERSONNEL: J. P. Potter, Pres. & Gen. Mgr.; O. G. Byrn, Secy. & Treas.; L. J. Haming, Pur. Agt.
PRODUCTS: Steel drop forgings.

SHURE BROTHERS,
225 W. Huron St., Chicago, Ill.
PERSONNEL: S. N. Shure, Gen. Mgr.; J. A. Berman, Sales Mgr.
PRODUCTS: Microphones; Acoustic devices.

SIGMA INSTRUMENTS, INC.,
76-78 Freeport St., Dorchester, Mass.
PERSONNEL: S. B. Allen, Pres.; C. Bassett, Treas.; R. T. Fisher, Gen. Mgr.; H. N. Boyle, Jr., Sales Mgr.; C. Metcalf, Pub. Dir.
PRODUCTS: Electrical relays.

SIMMONDS AEROCESSORIES, INC.,
10 Rockefeller Plaza, New York, N. Y.
PERSONNEL: W. R. Enyart, Pres. & Gen. Mgr.; E. M. Dowd, Secy.; H. V. Beazlie, Pur. Agt.
PRODUCTS: Power plugs; Push-pull flexible controls; Clips and fasteners; Flooring; Sub-assemblies.

SINCLAIR REFINING CO.,
630 Fifth Ave., New York, N. Y.
PERSONNEL: E. W. Sinclair, Pres.; J. W. Carnes, V. Pres.; O. M. Gerstung, Secy.; M. L. Gosney, Treas.; H. B. Malone, Pur. Agt.; D. T. Pierce, Pub. Dir.
PRODUCTS: Gasoline and lubricants.

ANTON SMIT & CO., INC.,
333 West 52nd St., New York, N. Y.
PERSONNEL: F. L. Meyjes, Pres. & Treas.; H. Brevet, L. J. A. Smit, V. Pres.; W. Schwartz, Secy.
PRODUCTS: Diamond cutting and truing tools.

SMITH WELDING EQUIPMENT CORP.,
2633 4th St., S. E., Minneapolis, Minn.
PERSONNEL: E. H. Smith, Pres. & Treas.; D. E. Geier, V. Pres.; L. L. McBurney, Secy. & Sales Mgr.; E. B. Johnson, Pur. Agt.
PRODUCTS: Welding and cutting equipment; Acetylene generators; Arc welders.

SNAP-ON TOOLS CORP.,
8028 28th Ave., Kenosha, Wisc.
PERSONNEL: J. Johnson, Pres.; R. Palmer, V. Pres.; W. A. Seidemann, Secy.; W. C. Nemitz, Treas.; F. A. Tetzlaff, Pur. Agt.; G. A. Smith, Pub. Dir.
PRODUCTS: Wrenches; Tool chests; Roller benches; Tools; Electric drills; Bench grinders.

SNOW REMOVAL EQUIPMENT CO.,
400 Seventh St., San Francisco, Calif.
PERSONNEL: N. K. Davis, Pres.; A. E. Mason, V. Pres., Gen. Mgr., Sales Mgr. & Pers. Dir.; J. M. Azevedo, Secy., Treas. & Pur. Agt.
PRODUCTS: Snow plows.

SOCONY-VACUUM OIL CO., INC.,
26 Broadway, New York, N. Y.
PERSONNEL: H. W. Lake, Aviation Sales Dept. Mgr.
PRODUCTS: Petroleum products.

SOLAR AIRCRAFT CO.,
Lindbergh Field, San Diego, Calif.
PERSONNEL: E. T. Price, Pres.; C. S. Marston, Secy.; A. W. Briggs, Treas.; A. J. Biddle, Pur. Agt.; D. Parkin, Sales Mgr.; W. E. Ottesen, Pers. Dir.; P. L. Ferris, Pub. Dir.
PRODUCTS: Ammunition boxes and counters; Cowlings; Collector rings, cowls, streamlines; De-icer equipment; Exhaust manifolds; Parts; Muffs; Shrouds.

SOUTH BEND LATHE WORKS,
425 E. Madison St., South Bend, Ind.
PRODUCTS: Toolroom and turret lathes; Gear lathes.

SOUTHERN CALIFORNIA PLATING CO.,
4444 Sunset Blvd., Los Angeles, Calif.
PERSONNEL: L. DeBell, Gen. Mgr.; E. W. Titzell, Pur. Agt.
PRODUCTS: Clamps; Control sticks and wheels; Fittings; Filters and strainers; Parts; Seats; Shock struts and cord; Stampings; Miscellaneous.

THE SPARKS-WITHINGTON CO.,
North St., Jackson, Mich.
PERSONNEL: W. Sparks, Pres.; W. J. Corbett, V. Pres. & Gen. Mgr.; D. Johnson, Secy.; H. Johnston, Treas.; E. T. H. Hutchinson, Sales Mgr. & Pub. Dir.; J. Towler, Pur. Agt.; M. Reason, Pers. Dir.
PRODUCTS: Landing gear warning signals or howlers; Radios; Bomb hoists; Mooring kits; Bomb releases.

SPARTAN AIRCRAFT CO.,
1900 North Sheridan Rd., Tulsa, Okla.
PERSONNEL: W. G. Skelly, Pres.; M. W. Balfour, V. Pres.; F. T. Hopp, Secy. & Treas.; H. K. Powell, Pur. Agt.
PRODUCTS: Collector rings, cowls, streamlines; Cowlings; Engine mounts; Exhaust manifolds; Parts; Sub-assemblies; Tanks.

SPECIAL MACHINE TOOL ENGINEERING WORKS, 254 Canal St., New York, N. Y.
PERSONNEL: W. Silber, V. Silber, C. Silber, Co-partners.
PRODUCTS: De-icer equipment; Exhaust manifolds; Parts; Propellers and parts.

SPENCER THERMOSTAT CO.,
34 Forest St., Attleboro, Mass.
PERSONNEL: R. Willard, Pres.; D. T. Schultz, V. Pres.; C. J. Stone, Secy. & Treas.; V. G. Vaughan, Gen. Mgr.; E. F. Kurtz, Sales Mgr.; E. B. Carpenter, Pur. Agt.
PRODUCTS: Circuit breakers; Thermostats; Temperature controls; Overload protectors.

SPERRY GYROSCOPE CO., INC., Manhattan Bridge Plaza, Brooklyn, N. Y.
PERSONNEL: R. E. Gillmor, Pres. & Gen. Mgr.; P. R. Bassett, V. Pres. Eng.; R. B. Lea, V. Pres. Sales; L. Malkovsky, V. Pres. Mfg.; J. Sanderson, V. Pres. Finance; H. H. Thompson, Secy.; J. E. Webb, Treas.; M. L. Patterson, Sales Mgr.; R. V. Elms, Pur. Agt.; D. G. Click, Pers. Dir.; J. A. Fitz, Pub. Dir.
PRODUCTS: Instruments.

SPERRY PRODUCTS, INC.,
1505 Willow Ave., Hoboken, N. J.
PERSONNEL: J. B. Farwell, Pres. & Gen. Mgr. E. G. Sperry, V. Pres. & Treas.
PRODUCTS: Exactor hydraulic controls.

SPIER AIRCRAFT CORP.,
200 Central Ave., Jersey City, N. J.
PERSONNEL: S. Spier, Pres.; I. Martin Spier, V. Pres. & Gen. Mgr.; B. B. Spier, Secy. & Pers. Dir.; N. F. Spier, Treas.; S. Javors, Pur. Agt.
PRODUCTS: Parts.

SPRIESCH TOOL AND MANUFACTURING CO., INC., 10 Howard St., Buffalo, N. Y.
PERSONNEL: J. Cheney, Pres.
PRODUCTS: Airplane parts and assemblies; Armament equipment.

SPRINGFIELD BRASS CO., Springfield, O.
PERSONNEL: W. Kelley, Pres.
PRODUCTS: Brass, aluminum and bronze castings; Machining; Assembling; Brass aircraft pipe fittings.

SPRUCE LUMBER & VENEER CO.,
Box 771, Vancouver, Wash.
PERSONNEL: H. H. McLaughlin, Pres. & Gen. Mgr.; G. K. Voss, Secy.
PRODUCTS: Spruce and fir lumber.

STANDARD AIRCRAFT PRODUCTS, INC.,
121 Franklin St., Dayton, O.
PERSONNEL: R. N. Webster, Pres.; C. Wilcke, V. Pres.; T. E. Wilson, Secy.; R. Casey, Treas.; R. F. Whisler, V. Pres. & Gen. Mgr.; F. Prinz, Pur. Agt.; D. E. Stauffer, Pers. Dir.
PRODUCTS: Lights; Radiators.

STANDARD FELT CO., DIV. OF HUNTINGTON LAND & IMPROVEMENT,
29-115 South Palm Ave., Alhambra, Calif.
PERSONNEL: H. S. Cook, V. Pres. & Gen. Mgr.; W. H. Helpes, Secy.; J. S. Murray, Sales Mgr.; J. S. Roome, Pur. Agt.; C. M. O'Donnell, Pers. Dir.
PRODUCTS: Felt.

THE STANDARD MACHINERY CO.,
Mystic, Conn.
PERSONNEL: N. C. Wheeler, Pres.; O. R. Cottrell, Secy.
PRODUCTS: Plastic compression molding presses.

THE STANDARD OIL CO.,
Midland Bldg., Cleveland, O.
PERSONNEL: W. T. Holliday, Pres.; A. M. Maxwell, V. Pres.; W. J. Semple, Secy. & Treas.; F. W. Engle, Pur. Agt.; W. P. Edmunds, Pers. Dir.; E. J. Burkhardt, Aviation Dir.
PRODUCTS: Petroleum products.

STANDARD OIL CO. OF CALIFORNIA,
225 Bush St., San Francisco, Calif.
PERSONNEL: R. F. Bradley, Mgr., Aviation Sales.
PRODUCTS: Aviation gasolines, oils, greases and servo liquids.

STANDARD OIL CO. OF NEW JERSEY,
26 Broadway, New York, N. Y.
PERSONNEL: R. C. Oertel, Sales Mgr., Aviation Dept.
PRODUCTS: Petroleum products.

E. J. STANTON & SON,
2050 East 41st St., Los Angeles, Calif.
PERSONNEL: L. H. Stanton, Pres.; S. E. Hamilton, Secy. & Treas.; H. von Breton, Sales Mgr.
PRODUCTS: Spruce; Spruce spars.

STAR PATTERN WORKS,
1248 Ray St., Dayton, O.
PERSONNEL: C. L. Templeton, Gen. Mgr.
PRODUCTS: Photographic supplies; Airplane flight report holders.

THE L. S. STARRETT CO., Athol, Mass.
PERSONNEL: D. Findlay, Pres.; A. H. Starrett, V. Pres.; W. G. Nims, Treas.; W. J. Greene, Sales Mgr.; E. E. Warner, Pur. Agt.; H. E. Masters, Pub. Dir.
PRODUCTS: Precision tools; Dial indicators; Hacksaws; Bandsaws; Steel tapes.

THE STATES CO.,
19 New Park Ave., Hartford, Conn.
PERSONNEL: E. C. Alden, Pres.; H. N. Porter, Secy.; H. P. Blakeslee, Treas.; C. Fitchner, Pur. Agt.
PRODUCTS: Panels; Resistors; Heater units.

THE STEEL PRODUCTS ENGINEERING CO., Springfield, O.
PERSONNEL: J. E. McAdams, Pres. & Treas.; S. L. Tatum, R. C. Goddard, W. C. Jordan, V. Pres.; I. W. Clark, Secy.
PRODUCTS: Steel products.

M. C. STEWART, Ashburnham, Mass.
PERSONNEL: M. C. Stewart, Pres.
PRODUCTS: Weather instruments.

STONE PROPELLER CO.,
701 E. Gilbert, Wichita, Kans.
PERSONNEL: M. J. Stone, Pres.; W. B. Stone, V. Pres., Gen. Mgr. & Sales Mgr.; H. Stone, Secy.
PRODUCTS: Propellers; Test clubs.

THE STRIPPIT CORP.,
1200 Niagara St., Buffalo, N. Y.
PERSONNEL: G. F. Wales, Pres.
PRODUCTS: Stampings; Hole punching and notching dies; Punching machinery; Light stampings; Sheet metal blanks perforated.

B. F. STURTEVANT CO.,
Hyde Park, Boston, Mass.
PERSONNEL: E. B. Freeman, Pres. & Gen. Mgr.; J. H. Melzard, Secy.; B. S. Foss, Treas.; J. C. Thompson, Sales Mgr.; H. D. Orrok, Pur. Agt.; R. W. Chaplin, Pers. Dir.; E. W. Andros, Pub. Dir.
PRODUCTS: Heaters; Heating, ventilating, air conditioning, dust collecting, pneumatic-conveying, electric motors; Turbines; Steam engines; Fans; Blowers; Exhausters; Vacuum cleaners; Drying systems.

SUMMERILL TUBING CO., Bridgeport, Pa.
PERSONNEL: E. L. Parker, Pres.; R. R. Lawson, V. Pres.; G. P. Kraemer, Secy. & Treas.; G. E. Parker, Sales Mgr.; D. Frank, Pers. Dir.; C. W. Johnson, Pur. Agt.
PRODUCTS: Tubing.

SUNCOOK MILLS,
40 Worth Street, New York, N. Y.
PERSONNEL: J. L. Weld, Pres.; V. Dietz, Jr., Sales Mgr.
PRODUCTS: Fabrics.

SUNDSTRAND MACHINE TOOL CO.,
2531 11th St., Rockford, Ill.
PERSONNEL: H. L. Olson, Pres. & Gen. Mgr.; G. A. Lindblade, Secy. & Treas.; T. B. Buell, Sales Mgr.; A. E. Nelson, Pur. Agt.
PRODUCTS: Machine tools; Balancing tools; Bench centers; Index bases; Portable pneumatic rubbing and sanding machines.

SUPERIOR TUBE CO., Norristown, Pa.
PERSONNEL: R. H. Gabel, V. Pres.; C. A. Warden, Jr., Secy. & Treas.; S. L. Gabel, Gen. Mgr. & Pub. Dir.; H. B. Brown, Jr., Sales Mgr.; J. J. Buckley, Pur. Agt.; W. McFarland, Pers. Dir.
PRODUCTS: Tubing.

SWEDLOW AEROPLASTICS CORP.,
1505 Gardena Ave., Glendale, Calif.
PERSONNEL: D. Swedlow, Pres.; L. Green, V. Pres.; C. Birlenback, Secy. & Treas.; D. Mac Conaghy, Pur. Agt.; R. Heck, Pers. Dir.
PRODUCTS: Transparent plastic aircraft parts.

SWITLIK PARACHUTE CO., Trenton, N. J.
PERSONNEL: S. Switlik, W. Switlik, R. Switlik & L. Switlik, Partners; M. H. St. Clair, Sales Mgr.; J. A. McQuillen, Pur. Agt.
PRODUCTS: Parachutes; Safety belts; Flying suits; Helmets; Flare and bomb chutes; Radio covers; Canvas and leather specialties.

T

C. J. TAGLIABUE MANUFACTURING CO., Park & Nostrand Aves., Brooklyn, N. Y.
PERSONNEL: J. H. Nichols, Pur. Agt.
PRODUCTS: Controls; Instruments.

THE TALLMADGE CO., 132 West 14th St., New York, N. Y.
PERSONNEL: D. B. Tallmadge, Pres. & V. Pres.; E. T. Sweeney, Secy. & Treas.; E. F. Falkon, Gen. Mgr.
PRODUCTS: Parachutes; Airplane carpet and upholstery materials.

THE TANNEWITZ WORKS, 315 Front Ave., N. W., Grand Rapids, Mich.
PERSONNEL: C. E. Tannewitz, Pres. & Gen. Mgr.; O. De Groot, Asst. Mgr.
PRODUCTS: Band saw machines; Combination die saw machines.

THE TAYLOR-WINFIELD CORP., 1052 Mahoning Ave., Warren, O.
PERSONNEL: J. A. Anderson, Pres.; W. Anderson, E. A. Mallet, V. Pres.; N. H. Cobb, Secy. & Treas.; J. D. Gordon, Gen. Mgr.; E. J. Del Vecchio, Sales Mgr.; W. H. Marion, Pur. Agt.
PRODUCTS: Resistance welding equipment; Steel fabrications.

TECHNICAL PLY-WOODS, 228 North La Salle St., Chicago, Ill.
PERSONNEL: J. R. Fitzpatrick, Dir. & Gen. Mgr.; A. N. Carstens, Sales Mgr.; M. G. Grizwold, Secy. & Treas.; A. L. Baker, Pur. Agt.; A. Crawford, Pub. Dir.
PRODUCTS: Ammunition boxes and counters; Floats, skiis; Panels; Parts.

TEICHER MANUFACTURING CORP., 136-23 34th Ave., Flushing, N. Y.
PERSONNEL: A. A. Teicher, Pres.; G. B. Cluett, V. Pres.; L. L. Wilke, Secy.; L. Teicher, Treas.
PRODUCTS: Collector rings, cowls, streamlines; Tanks.

TELAUTOGRAPH CORP., 16 West 61st St., New York, N. Y.
PERSONNEL: W. F. Vieh, Pres.; G. J. Thomas, Secy. & Treas.; W. R. Hickok, Sales Mgr.; H. Wilkins, Pur. Agt.; S. Leonard, Pub. Dir.
PRODUCTS: Message service.

THE TELEREGISTER CORP., 60 Hudson St., New York, N. Y.
PERSONNEL: R. Daine, Pres.; M. L. Haselton, V. Pres.; G. B. Saterlee, Secy.; G. K. Huntington, Treas.
PRODUCTS: Electrical flight data.

TELEVISO PRODUCTS, INC., 2400 N. Sheffield Blvd., Chicago, Ill.
PERSONNEL: S. S. Schiller, Pres.; H. Von Jenef, V. Pres.; J. B. Atkinson, Secy.; D. Sherman, Pur. Agt.; D. Wanamaker, Pub. Dir.
PRODUCTS: Radio shielding and equipment.

TEMPLETON, KENLY & CO., 1020 South Central Ave., Chicago, Ill.
PERSONNEL: J. B. Templeton, Pres. & Gen. Mgr.; H. C. Dilsizian, V. Pres.; F. W. Krickhan, Secy.; P. H. McManus, Sales Mgr.; R. H. Webb, Pur. Agt.
PRODUCTS: Wings and tail jacks; Maintenance jacks.

TENNESSEE AIRCRAFT, INC., 126-10th Ave., So., Nashville, Tenn.
PERSONNEL: L. E. Reisner, Pres. & Gen. Mgr.; D. H. Chester, V. Pres.; W. J. Phillips, Secy. & Treas.
PRODUCTS: Ammunition boxes; Bomb racks; Fittings; Panels; Sub-assemblies; Control surfaces.

TENNESSEE EASTMAN CORP., Kingsport, Tenn.
PERSONNEL: P. S. Wilcox, Pres.; J. C. White, V. Pres. & Gen. Mgr.; M. K. Robinson, Secy.; J. C. Stone, Treas.; S. E. Palmer, Sales Mgr.
PRODUCTS: Cellulose acetate.

GEORGE A. TERRY CO., 350-356 South Elmwood Ave., Buffalo, N. Y.
PERSONNEL: G. A. Terry, Owner & Gen. Mgr.
PRODUCTS: Tools; Drilling attachments.

THE TEXAS CO., 135 East 42nd St., New York, N. Y.
PERSONNEL: W. S. S. Rodgers, Pres.; H. W. Dodge, V. Pres.; R. L. Saunders, Secy.; L. H. Lindeman, Treas.; W. H. Kershaw, Gen. Mgr.; A. Keif, Aviation Mgr.
PRODUCTS: Aviation petroleum products.

THE THOMAS & BETTS CO., Elizabeth, N. J.
PERSONNEL: G. C. Thomas, Jr., Pres.; A. McMurtrie, V. Pres. & Secy.; E. C. Hewitt, Acting Sales Mgr.; W. J. Long, Pur. Agt.
PRODUCTS: Electrical wire terminals; Electrical specialties; Bonding jumpers.

THOMAS WIRE & SPRING CO., INC., 1006-14 Clinton St., Hoboken, N. J.
PERSONNEL: F. C. Thomas, Pres. & Sales Mgr.; E. V. Thomas, V. Pres.; C. J. Fulcher, Secy. & Treas.; H. A. Granelli, Pur. Agt.
PRODUCTS: Springs.

THE THOMPSON GRINDER CO., Springfield, O.
PERSONNEL: C. Baldenhofer, Pres.; W. G. Baldenhofer, V. Pres.; R. M. McDonough, Secy.; R. R. Baldenhofer, Gen. Mgr.; J. C. Wilson, Sales Mgr.; R. L. Powers, Pur. Agt.
PRODUCTS: Aircraft armament; Bomb racks; Cameras; Carburetors; Controls; Generators; Magnetos; Motors; Instruments; Landing gears; Miscellaneous hardware; Miscellaneous engine equipment; Propellers and propeller parts; Pumps; Sub-assemblies; Superchargers; Tail wheel assemblies; Vibration dampers.

THOMPSON PRODUCTS, INC., 2196 Clarkwood Rd., Cleveland, O.
PERSONNEL: F. C. Crawford, Pres.; L. M. Clegg, Exec. V. Pres.; J. D. Wright, Secy.; J. H. Coolidge, Treas.; G. V. Sevald, Sales Mgr.; H. D. Myers, Pur. Agt.; R. S. Livingstone, Pers. Dir.; F. R. Witt, Pub. Dir.
PRODUCTS: Fasteners; Parts; Valves; Propeller parts; Pumps; Tappets; Retractable strut assemblies; Landing gear assemblies; Other hardened and ground parts.

January 10, 1942

Vultee Aircraft, Inc., at this moment, is devoting all its energies to the job of helping win the war. When that job is done, Vultee will concentrate with equal energy upon the solution of postwar aircraft problems.

Hugh Fenwick

VICE PRESIDENT

THORDARSON ELECTRIC MANUFACTURING CO., 500 West Huron St., Chicago, Ill.
PERSONNEL: C. H. Thordarson, Pres.; R. E. Onstad, V. Pres. & Gen. Mgr.; O. W. Storey, Secy.; L. G. Winney, Treas.; D. J. Fortune, Sales Mgr.; C. A. Schmitz, Pur. Agt.; E. J. Rehfeldt, Pub. Dir.
PRODUCTS: Audio transformers; Audio amplifiers; Transformers and chokes for communication equipment; Transmitter kits.

TIETZMANN ENGINEERING CO., 315 Main St., Englewood, O.
PERSONNEL: C. Tietzmann, Owner; W. A. Tietzmann, Gen. Mgr.
PRODUCTS: Aircraft armaments; Collector rings, cowls, streamlines; Stampings; Miscellaneous.

THE TIMKEN ROLLER BEARING CO., Canton, O.
PERSONNEL: W. E. Umstattd, Pres.; L. M. Klinedinst, V. Pres.; R. C. Brower, Secy. & Treas.; S. C. Partridge, Sales Mgr.; P. Voss, Pur. Agt.
PRODUCTS: Alloy steel; Seamless steel tubing

TINNERMAN PRODUCTS, INC., 2038 Fulton Rd., Cleveland, O.
PERSONNEL: A. H. Tinnerman, Pres. & Treas.; G. A. Tinnerman, V. Pres. & Gen. Mgr.; G. J. Schad, Pur. Agt.; W. M. Buttriss, Pub. Dir.
PRODUCTS: Clamps; Fasteners; Stampings; Speed nuts; Speed clips; Spring steel fastenings; Tube clamps; Cable clamps.

TITANINE, INC., Union, N. J.
PERSONNEL: E. G. Davis, Pres., Treas. & Gen. Mgr.; T. A. J. Ward, V. Pres.; W. A. Bagley, Sales Mgr.
PRODUCTS: Primers; Dopes; Lacquers; Enamels.

TITEFLEX METAL HOSE CO., 500 Frelinghuysen Ave., Newark, N. J.
PERSONNEL: C. W. Fletcher, Pres.; E. E. Husted, V. Pres., Gen. Mgr. & Sales Mgr.; P. L. Procter, V. Pres., Secy. & Treas.; C. E. Lane, Pur. Agt.; R. B. Breder, Pers. Dir.
PRODUCTS: Radio shielding and equipment; Tubing.

TOLEDO SCALE CO., Toledo, O.
PERSONNEL: H. D. Bennett, Pres. & Gen. Mgr.; W. A. Fink, Treas.; L. J. Colenback, Sales Mgr.; L. Ellingwood, Pub. Dir.
PRODUCTS: Propeller scales.

THE TORRINGTON CO., Torrington, Conn.
PERSONNEL: W. R. Reid, Pres. & Gen. Mgr.; L. J. Ross, V. Pres.; W. C. Thompson, Secy.; A. W. Burg, Treas.; C. H. Tallcott, Sales Mgr.; W. C. Cruess, Pur. Agt.
PRODUCTS: Bearings; Tie rods.

THE TRANE CO., 2nd & Cameron Ave., La Crosse, Wisc.
PERSONNEL: R. N. Trane, Pres.; R. H. Anderegg, V. Pres.; A. T. Holmes, Secy.; F. Hood, Treas. & Gen. Mgr.; D. C. Minard, Sales Mgr.; R. H. Pearse, Pur. Agt.; R. W. Gillette, Pers. Dir.; L. A. Trumble, Pub. Dir.
PRODUCTS: Heating equipment.

TRANSUE & WILLIAMS STEEL FORGING CORP., Alliance, O.
PERSONNEL: J. R. Gorman, Pres.; J. C. Redmond, V. Pres.; H. C. Senour, Secy. & Treas.; E. M. Cook, Sales Mgr.; H. C. Martin, Pur. Agt.; E. Meeks, Pers. Dir.
PRODUCTS: Stampings; Commercial drop forgings.

TRIPLETT & BARTON, INC., 1705 Victory Place, Burbank, Calif.
PERSONNEL: T. A. Triplett, Pres.; V. P. Barton, V. Pres.; R. E. Hiller, Secy.; R. R. Coe, Pur. Agt.; E. C. Pearson, Treas., Pers. Dir. & Pub. Dir.
PRODUCTS: X-ray equipment; Metallurgical and X-ray diagnosis.

TUNGSTEN ELECTRIC CORP., 540 39th St., Union City, N. J.
PERSONNEL: C. H. Kraft, Pres.; J. A. Storrs, V. Pres.
PRODUCTS: Carbide tools and tips.

TURBO ENGINEERING CORP., 853 Nottingham Way, Trenton, N. J.
PERSONNEL: G. D. Besler, Pres.; R. Birmann, Secy. & Treas.; L. S. Rice, Treas.
PRODUCTS: Superchargers.

TURCO PRODUCTS, INC., 6135 South Central Ave., Los Angeles, Calif.
PERSONNEL: S. G. Thornbury, Pres. & Treas.; R. Sanders, V. Pres. & Gen. Mgr.; E. S. Harrington, Secy.; J. C. Walker, Pur. Agt.; S. E. Goldsmith, Pub. Dir.
PRODUCTS: Cleaning and processing compounds.

TUTHILL SPRING CO., 760 Polk St., Chicago, Ill.
PERSONNEL: H. T. Moore, Pres., Gen. Mgr. & Sales Mgr.; W. S. Van Bergen, V. Pres.; J. H. Schmidt, Secy. & Pur. Agt.; O. C. Nuss, Treas.
PRODUCTS: Tail skid springs.

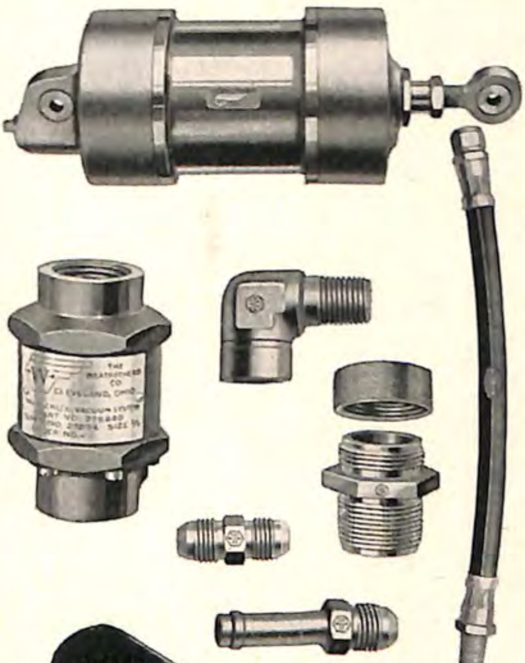
U

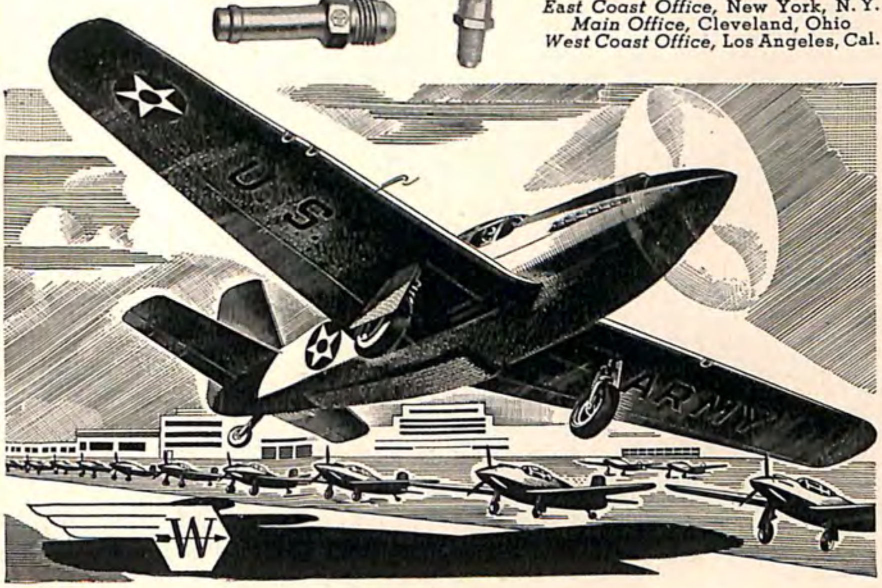
UNIFORM HOOD LACE CO., 1609 College Ave., Indianapolis, Ind.
PERSONNEL: J. L. Anthony, Pres. & Pur. Agt.; L. I. Mitchell, V. Pres.; B. J. Artman, Secy. & Treas.; Claude Jacks, Gen. Mgr.; J. R. Brown, Sales Mgr.
PRODUCTS: Anti-squeak material; Webbings.

UNION AIRCRAFT PRODUCTS CORP., 380 Second Ave., New York, N. Y.
PERSONNEL: I. M. Felt, Pres.; E. Ellinger, Jr., V. Pres. & Sales Mgr.; Spencer C. Jones, Secy. & Treas.; David Fordsman, Gen. Mgr.
PRODUCTS: Fittings.

UNION MANUFACTURING CO., New Britain, Conn.
PERSONNEL: C. S. Neumann, Pres. & Gen. Mgr.; H. H. Wheeler, Treas. & Pur. Agt.; C. N. Baisden, Pers. Dir.
PRODUCTS: Chucks; Hoists and trolleys; Castings.

UNITED AIRCRAFT PRODUCTS, INC., Huffman & Linden Aves., Dayton, O.
PERSONNEL: F. G. Sorensen, Pres.; C. Withers, V. Pres.; J. Shotwell, Secy. & Treas.; J. D. Peace, Jr., Sales Mgr.; J. A. Connolly, Pur. Agt.
PRODUCTS: Oil temperature regulators; Fuel pumps and systems; Solenoids; Strainers; Valves; Assemblies.




U.S.
ARMY
W

UNITED AIRCRAFT PRODUCTS, INC.,
2929 Santa Fe Ave., Los Angeles, Calif.
PERSONNEL: F. W. Wilkins, Gen. Mgr.
PRODUCTS: Hydraulic struts; Valves; Cylinders.

UNITED-CARR FASTENER CORP.,
31 Ames St., Cambridge, Mass.
PERSONNEL: Sinclair Weeks, Pres. & Treas.; A. W. Kimball, V. Pres.; A. S. Boynton, Secy. & Treas.; G. S. Maynard, Sales Mgr.; F. J. Ross, Pur. Agt.; William Nye, Pers. Dir.; N. A. Dill, Pub. Dir.
PRODUCTS: Miscellaneous hardware; Fasteners; Stampings.

UNITED CHROMIUM, INC.,
51 E. 42nd St., New York, N. Y.
PERSONNEL: R. O. Loengard, V. Pres. & Secy.; K. W. Schwartz, Treas.; H. D. McLeese, Sales Mgr.; E. L. Kries, Pur. Agt.
PRODUCTS: Lacquers; Plating process.

THE UNITED STATES ELECTRICAL TOOL CO., 2488 W. Sixth St., Cincinnati, O.
PERSONNEL: J. C. Smith, Pres. & Gen. Mgr.; G. E. Smith, V. Pres. & Treas.; C. D. Hogan, Secy. & Pub. Dir.; H. E. Neske, Pur. Agt.; D. Behlen, Pers. Dir.
PRODUCTS: Drills; Valve refacers; Valve seat grinders; Grinders.

UNITED STATES GAUGE CO.,
44 Beaver St., New York, N. Y.
PERSONNEL: J. W. Place, Pres.; E. A. Walter, V. Pres.; J. Lawler, Secy.; W. G. Ziegler, Sales Mgr.; F. D. Heyder, Pur. Agt.; R. F. Stackel, Pers. Dir.
PRODUCTS: Instrumnets; Miscellaneous.

UNITED STATES RUBBER CO.,
1230 Sixth Ave., New York, N. Y.
PERSONNEL: F. B. Davis, Jr., Pres.; T. J. Needham, V. Pres.; E. Burkman, Secy.; Arthur Surkamp, Treas.; E. Sheahan, Gen. Mgr.; W. W. Cowgill, Sales Mgr.; G. M. Tisdale, Pur. Agt.; C. S. Ching, Pers. Dir.; Russ Wilks, Pub. Dir.
PRODUCTS: Control sticks and wheels; Hydraulic controls and assemblies; Tanks; Tires and tubes; Tubing; Vibration dampers.

U. S. TOOL CO., INC., Ampere, N. J.
PERSONNEL: C. Todd, Pres.; A. E. Borton, V. Pres.; W. W. Downey, Pur. Agt.
PRODUCTS: Machines

UNIVERSAL MICROPHONE CO., LTD.,
424 Warren Lane, Inglewood, Calif.
PERSONNEL: J. R. Fouch, Pres. & V. Pres.; I. Sevey, Treas.; R. L. Griffin, Sales Mgr.; R. Powers, Pub. Dir.
PRODUCTS: Instruments; Microphones; Radio accessories.

UNIVERSAL MOULDED PRODUCTS CORP., Bristol, Va.
PERSONNEL: E. A. Hults, Pres. & Gen. Mgr.; J. D. Lincoln, V. Pres.; R. L. Reed, Secy.; H. W. Page, Treas.; George Miller, Pur. Agt.; John Gemmell, Pers. Dir.
PRODUCTS: Plywood parts.

UTICA DROP FORGE & TOOL CORP.,
2415 Whitesboro St., Utica, N. Y.
PERSONNEL: E. Norris, Pres. & Treas.; W. V. Daugherty, V. Pres.; D. L. Tyler, Secy.; G. J. Hecker, Pur. Agt.
PRODUCTS: Pliers; Nippers; Wrenches.

V

VALENTINE & COMPANY, INC.,
11 East 36th St., New York, N. Y.
PERSONNEL: T. J. Campbell, Pres.; G. M. Bralla, Secy. & Treas.; A. L. Clark, Sales Mgr.; W. P. McGrath, Pur. Agt.
PRODUCTS: Primers; Dopes; Lacquers; Thinners; Varnishes.

VAN NORMAN MACHINE TOOL CO.,
3640 Main St., Springfield, Mass.
PERSONNEL: J. Y. Scott, Pres., Treas. & Gen. Mgr.; L. F. Hunderup, V. Pres. & Pers. Dir.; F. D. Van Norman, Secy.; H. G. Hoglund, Sales Mgr.; C. A. Thompson, Pur. Agt.
PRODUCTS: Machine tools.

VARD, INC.,
2961 E. Colorado St., Pasadena, Calif.
PERSONNEL: V. B. Wallace, Pres.; W. C. Miller, V. Pres.; G. B. Wilshire, Secy.; H. M. Bray, Treas., Sales Mgr. & Pub. Dir.; N. Nelson, Pur. Agt.; H. E. Robinson, Pers. Dir.
PRODUCTS: Hydraulic controls and assemblies; Drafting machines and scales; Navigational plotters; Plug thread and ring gages; Optical goods.

THE VARIETY AIRCRAFT CORP.,
2901 W. 3rd St., Dayton, O.
PERSONNEL: I. M. Coppock, Pres. & Gen. Mgr.; C. A. Coppock, V. Pres. & Pers. Dir.; L. Altherr, Secy.; C. E. Monnier, Treas.; E. A. Johnson, Sales Mgr. & Pub. Dir.; A. R. Smith, Pur. Agt.
PRODUCTS: Ammunition boxes and counters; Bomb racks; Clamps; Cowling; Fittings; Instruments; Landing and navigation lights; Parts; Stampings; Sub-assemblies; Tail wheel assemblies; Wheels and brakes.

THE VELLUMOID CO.,
54 Rockdale St., Worcester, Mass.
PERSONNEL: R. B. Stanley, Pres.; R. B. Seamans, V. Pres.; B. Irving, Secy.; W. W. Webster, Treas.; L. Wald, V. Pres. & Gen. Mgr.; C. S. Livingston, V. Pres. & Sales Mgr.
PRODUCTS: Gaskets; Parts.

VICKERS, INC.,
1400 Oakman Blvd., Detroit Mich.
PERSONNEL: H. F. Vickers, Pres.; K. R. Herman, V. Pres.; F. T. Harrington, Sales Mgr.; R. M. McCabe, Pur. Agt.
PRODUCTS: Hydraulic controls and assemblies; Valves; Pumps.

VICTOR METAL PRODUCTS CORP.,
196 Diamond St., Brooklyn, N. Y.
PERSONNEL: J. Kronman, Pres. & Sales Mgr.; G. W. Temple, V. Pres.; L. Baron, Secy., Treas. & Gen. Mgr.; H. D. Mead, Pur. Agt.;
PRODUCTS: Moulded parts; Stampings; Subassemblies.

VIDAL RESEARCH CORP.,
Central Airport, Camden, N. J.
PERSONNEL: E. L. Vidal, Pres.; D. H. Starr, Secy.; N. B. Sangree, Treas.
PRODUCTS: Plastic plywood structures.

THE VOGES MANUFACTURING CO., INC.,
99th St. & 103rd Ave., Ozone Park, N. Y.
PERSONNEL: F. Voges, Pres.; F. W. Voges, V. Pres.
PRODUCTS: Controls; Covers; De-icer equipment; Fasteners; Parts; Fittings; Instruments; Miscellaneous hardware; Stampings; Subassemblies

W

PAUL G. WAGNER CO., 2965 E. Washington Blvd., Los Angeles, Calif.
PERSONNEL: P. G. Wagner, Owner; R. C. Wagner, Gen. Mgr.
PRODUCTS: Hydraulic controls and assemblies.

WAILES DOVE-HERMISTON CORP., 449 South Ave., Westfield, N. J.
PERSONNEL: L. Stuart, Pres.; W. H. T. Thornhill, V. Pres.; F. R. Stoveken, Secy.; L. deBeauchamp, Treas., Pur. Agt. & Pers. Dir.
PRODUCTS: Protective coatings; Paints.

WALLACE SUPPLIES MANUFACTURING CO., 1310-12 Diversey Pkwy., Chicago, Ill.
PERSONNEL: E. Metterhausen, Pres. & Sales Mgr.; E. J. DeWitt, V. Pres. & Gen. Mgr.; F. J. Lammers, Secy.; E. A. Ptack, Pur. Agt.
PRODUCTS: Collector rings, cowls, streamlines; Engine mounts; Exhaust manifolds; Manifolds.

WALWORTH CO., 60 East 42nd St., New York, N. Y.
PERSONNEL: W. B. Holton, Jr., Pres.; A. J. Eichler, V. Pres.; F. W. Belz, Treas.; G. R. Thomson, Pub. Dir.
PRODUCTS: Pipe fittings; Valves.

WARD LEONARD ELECTRIC CO., 31 South St., Mount Vernon, N. Y.
PERSONNEL: L. Kebler, Pres.; D. J. Burns, V. Pres.; L. H. Haight, Secy. & Treas.; F. Bullinger, Gen. Mgr.; A. A. Berard, Sales Mgr.; L. Bullinger, Pur. Agt.; J. R. Jones, Pub. Dir.
PRODUCTS: Switches; Heaters; Radio shielding and equipment; Magnetic relays.

WASHINGTON AIRCRAFT & TRANSPORT CORP., Boeing Field, Seattle, Wash.
PERSONNEL: A. E. Merrill, Pres.; E. H. Hadsen, V. Pres.; G. R. Cook, Secy. & Treas.
PRODUCTS: Parts.

WASHINGTON INSTITUTE OF TECHNOLOGY, INC., McLachlen Bldg., Washington, D. C.
PERSONNEL: S. F. Mashbir, Pres.; G. L. Davies, B. R. Shaw, V. Pres.; E. L. Reilly, Secy.; M. P. Bradshaw, Treas.; E. L. Virts, Pur. Agt.
PRODUCTS: Instruments; Panels; Mechanical flashlights; Plastic moldings; Radiosondes; Receivers; Radios; Radio compasses.

WAYNE CHEMICAL PRODUCTS CO., Copeland & M. C. R. R., Detroit, Mich.
PERSONNEL: E. G. Behr, Pres. & Gen. Mgr.; K. Behr, V. Pres.; W. L. Behr, Secy. & Treas.
PRODUCTS: Production lubricants.

THE WEATHERHEAD CO., 330 East 131st St., Cleveland, O.
PERSONNEL: A. J. Weatherhead, Jr., Pres.; J. R. Cox, V. Pres. & Gen. Mgr.; J. Reavis, Secy.; E. Ferguson, Treas.; H. Church, Sales Mgr.; C. T. Craig, Pur. Agt.; D. Gilchrist, Pers. Dir.; R. Weatherhead, Pub. Dir.
PRODUCTS: Fittings; Valves; Flexible hose assemblies; Vacuum check valves; Hydraulic actuating cylinders; Miscellaneous.

WEEMS SYSTEM OF NAVIGATION, Randall House, Annapolis, Md.
PERSONNEL: P. V. H. Weems, Pres.; A. Illyne, Exec. Secy.
PRODUCTS: Aircraft computers and plotters; Aeronautical charts; Drift indicators; Sextants.

WELLINGTON SEARS CO., 65 Worth St., New York, N. Y.
PERSONNEL: H. L. Bailey, Pres.; N. S. Hope, V. Pres.; C. A. Sweet, Secy.; C. R. Richmond, Treas.; W. O. Hay, Sales Mgr.
PRODUCTS: Fabrics.

WELLMAN BRONZE & ALUMINUM CO., 6017 Superior Ave., Cleveland, O.
PERSONNEL: F. S. Wellman, Pres. & Treas.; H. G. Wellman, V. Pres. & Secy.; J. E. Ingersall, Pers. Dir.
PRODUCTS: Metal castings; Pattern making; Machining.

A. H. WELLS & CO., INC., 563 Watertown Ave., Waterbury, Conn.
PERSONNEL: F. A. Wells, Pres.; G. H. Wells, V. Pres., Secy. & Treas.; I. F. Schoonmaker, Sales Mgr.
PRODUCTS: Seamless tubing.

WESLEY LACQUER CO., 95 4th St., Brooklyn, N. Y.
PERSONNEL: F. J. Wesley, Pres.
PRODUCTS: Lacquers; Dopes; Welding cement.

THE WESTERN AUTOMATIC MACHINE SCREW CO., Aircraft Products Div., Elyria, Ohio.
PERSONNEL: H. E. Penfield, Pres.; B. C. Franklin, V. Pres. & Gen. Mgr.; F. H. Bryant, Secy.; C. H. Smith, Treas.; R. D. Oldfield, Sales Mgr.; A. F. Steller, Pur. Agt.; R. D. Buol, Pers. Dir.
PRODUCTS: Special screw machine products; Special cold headed products; Cold drawn steel bar stock.

WESTERN ELECTRIC CO., 195 Broadway, New York, N. Y.
PERSONNEL: C. G. Stoll, Pres.; J. W. Bancker, V. Pres.; G. B. Proud, Treas.; H. B. Gilmore, Secy.; H. N. Willetts, Asst. Sales Mgr.; F. C. McMullen, Aviation Sales.
PRODUCTS: Radio equipment; Transmitters and receivers; Transformers.

WESTERN MACHINE CO., 121 N. Broadway, Milwaukee, Wisc.
PERSONNEL: W. E. Bechmann, Pres. & Treas.; E. W. Lueders, V. Pres. & Sales Mgr.; E. M. Bechmann, Treas.; E. A. Bartlein, Gen. Mgr. & Pur. Agt.
PRODUCTS: Screw machine products.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburgh, Pa.
PERSONNEL: G. H. Bucher, Pres.; R. Kelly, V. Pres.; C. B. Stainback, Sales Mgr.; G. E. Pendray, Pub. Dir.
PRODUCTS: Dynamotors; Generators; Motors; Switches; Indirect lighting systems; Instruments; Panels: Micarta pulleys; Radios; Starters; Landing and navigation lights.

WESTON ELECTRICAL INSTRUMENT CO., 614 Frelinghuysen Ave., Newark, N. J.
PERSONNEL: E. F. Weston, Pres.; C. Brown, V. Pres. & Secy.; E. R. Mellen, Treas.; H. L. Gerstenberger, Sales Mgr.; A. R. Briggs, Pur. Agt.; S. Cassey, Pub. Dir.
PRODUCTS: Electrical instruments; Electrical tachometers; Resistance bulbs.

WHEELCO INSTRUMENTS CO., Harrison and Peoria Sts., Chicago, Ill.
PERSONNEL: L. W. Wheeler, Pres. & Gen. Mgr.; L. A. Cohen V. Pres. & Ch. Engr.; G. A. Wheeler, Secy. & Treas.; R. A. Schoenfeld, Sales Mgr.; Wm. Flynn, Pur. Agt.; H. Munro, Pers. Dir.; R. W. Murphey, Pub. Dir.
PRODUCTS: Instruments.

S. S. WHITE DENTAL MANUFACTURING CO., 10 E. 40th St., New York, N. Y.
PRODUCTS: Flexible shafts and casings.

WHITING CORP., Harvey, Ill.
PERSONNEL: T. S. Hammond, Pres.; R. A. Pascoe, Secy.; E. E. Prussing, Treas.; H. W. Anderson, Gen. Mgr.; H. M. Rowlette, Pur. Agt.; W. C. Baker, Pers. Dir.
PRODUCTS: Miscellaneous engine equipment.

WICHITA WIRE PRODUCTS CO., 624 East Harry, Wichita, Kans.
PERSONNEL: D. E. Varner, Owner.
PRODUCTS: Springs; Housing; Cowl pins.

WIEDEMANN MACHINE CO., 1815 Sedgley Ave., Philadelphia, Pa.
PERSONNEL: O. F. Wiedemann, Pres.; T. A. Wiedemann, V. Pres. & Sales Mgr.; H. Wiedemann, Secy.; J. H. Bockrath, Treas.; E. J. Rollings, Gen. Mgr.
PRODUCTS: Hand and power operated turret punch presses.

WIL-X-M'F'G CORP., 29 Ryerson St., Brooklyn, N. Y.
PERSONNEL: E. A. Reynolds, Pres. & Secy.; H. L. Gage, V. Pres.; G. A. Schwaninger, Treas.; R. L. Harrison, V. Pres. & Sales Mgr.
PRODUCTS: Fire extinguishers.

WILBER & SON, 545 Mission St., San Francisco, Calif.
PERSONNEL: B. M. Wilber.
PRODUCTS: Fabric engine covers.

WILKENING MANUFACTURING CO., 2000 South 71st St., Philadelphia, Pa.
PERSONNEL: F. W. Wilkening, Pres.; W. S. Loeb, V. Pres.; C. Wilkening, Secy.; H. E. Gerstley, Treas.; D. A. Cowhig, Gen. Mgr.; W. K. Lee, Sales Mgr.; F. Solis-Cohen, Pur. Agt.; W. A. Kirkpatrick, Pub. Dir.
PRODUCTS: Miscellaneous engine equipment; Parts; Piston rings; Tools; Gauges; Machines.

WILLIS & GEIGER, INC., 45 West 27th St., New York, N. Y.
PERSONNEL: B. Willis, Pres.; P. P. Geiger, V. Pres.; H. W. Geiger, Treas.
PRODUCTS: Flight clothing.

WILLARD STORAGE BATTERY CO., 246 E. 131st St., Cleveland, O.
PERSONNEL: C. H. Gibney, Secy.; I. K. Schnaitter, Treas.; C. F. Oestermeyer, Sales Mgr.; F. L. Kulow, Pur. Agt.; S. E. Baldwin, Pub. Dir.; C. E. Murray, V. Pres. & Gen. Mgr.
PRODUCTS: Batteries.

WILLSON PRODUCTS, INC., Second & Washington Sts., Reading, Pa.
PERSONNEL: F. W. Willson, Pres.; T. A. Willson, V. Pres.; H. M. Hafer, Secy. & Treas.; M. C. Rider, Pur. Agt.; B. M. Leavy, Pub. Dir.
PRODUCTS: Goggles; Sun glasses.

WINTER BROTHERS CO., Kenderick St., Wrentham, Mass.
PERSONNEL: J. Winter, Pres.; M. Winter, V. Pres.; C. Winter, Secy.; J. L. Cook, Treas., Gen. Mgr. & Sales Mgr.; G. F. Gardner, Pur. Agt.; H. B. Stringer, Pers. Dir. & Pub. Dir.
PRODUCTS: Taps; Round adjustable dies; Threading tools.

WITTEK MANUFACTURING CO., 4305-15 W. 24th Pl., Chicago, Ill.
PERSONNEL: B. A. Tetzlaff, Pres. & Gen. Mgr.; R. Tetzlaff, V. Pres.; C. C. Tetzlaff, Secy., Treas. & Sales Mgr.; H. E. Forde, Pur. Agt.
PRODUCTS: Hose clamps; Feeds for punch presses.

WOLVERINE TUBE CO., 1411 Central Ave., Detroit, Mich.
PERSONNEL: C. C. Limbocker, Pres.; G. R. Anthony, V. Pres.; V. D. Hanna, Secy. & Treas.; O. Z. Klopsch, V. Pres. & Gen. Mgr.; R. H. Gill, Pur. Agt.; D. D. Decker, Pers. Dir.; J. A. Marshall, Pub. Dir.
PRODUCTS: Tube; Tubular fabricated parts.

WOODWARD GOVERNOR CO., Rockford, Ill.
PERSONNEL: I. C. Martin, Pres., Treas. & Gen. Mgr.; W. T. Woodward, V. Pres.; H. W. Thorell, Secy., Sales Mgr. & Pub. Dir.; A. H. Nielsen, Pur. Agt.; F. J. Crawford, Pers. Dir.
PRODUCTS: Hydraulic controls.

WORCESTER PRESSED STEEL CO., 100 Barber Ave., Worcester, Mass.
PERSONNEL: J. W. Higgins, Pres. & Treas.; A. P. Higgins, Secy.; T. P. Draper, V. Pres. & Gen. Mgr.; F. J. Riker, Sales Mgr.; C. C. Fletcher, Pur. Agt.; C. S. Holbrook, Pers. Dir.
PRODUCTS: Propeller parts; Stampings; Parachute harness hardware; Spinners; Engine parts.

WORCESTER STAMPED METAL CO., 9 Hunt St., Worcester, Mass.
PERSONNEL: F. E. Billings, Pres. & Treas.; C. F. Carlstrom, V. Pres. & Gen. Mgr.; W. E. Billings, Secy. & Pur. Agt.
PRODUCTS: Miscellaneous engine equipment; Stampings; Parts.

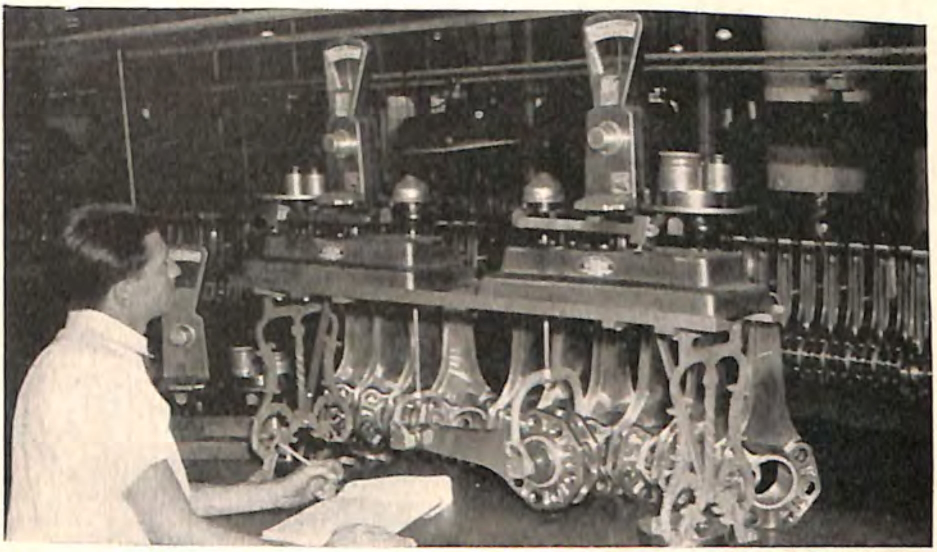
WROUGHT WASHER MANUFACTURING CO., 2100 South Bay St., Milwaukee, Wisc.
PRODUCTS: Stampings; Washers; Expansion plugs.

WYMAN-GORDON CO., 105 Madison St., Worcester, Mass.
PERSONNEL: H. G. Stoddard, Pres.; S. M. Havens, V. Pres.; C. C. Winn, Treas.; R. Powell, Sales Mgr.; A. M. Hansen, Pur. Agt.
PRODUCTS: Forgings.

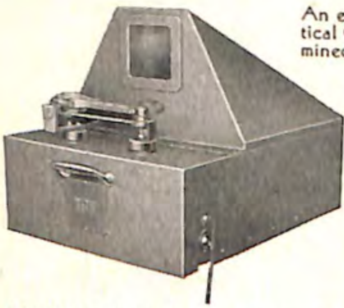
Y

THE YALE & TOWNE MFG. CO., Stamford, Conn.
PERSONNEL: W. G. Carey, Jr., Pres.; J. A. Horne, V. Pres.; F. Dunning, Secy. & Treas.; W. R. Hoyt, Gen. Mgr.; M. A. Miller, Sales Mgr.; A. B. Nordin, Pur. Agt.; J. Williams, Pers. Dir.
PRODUCTS: Fittings; Miscellaneous hardware; Parts; Pumps.

THE YODER CO., W. 55th St. & Walworth Ave., Cleveland, O.
PERSONNEL: C. M. Yoder, Pres.; H. O. Yoder, Secy. & Treas.; N. C. Rubin, Sales Mgr.; Charles Elicker, Pur. Agt.
PRODUCTS: Machinery.



An efficient connecting rod selection operation in the Wright Aeronautical Corporation, Paterson, N. J. Tolerance is to 0.03 lb. of a predetermined standard weight.



SHADOWGRAPH, an electrically operated weighing unit of high accuracy for connecting rod balancing and selection.

SHADOWGRAPH, Type A, an electrically operated scale for piston selection and precision.

EXACT WEIGHT Scales

for Aircraft Precision...

The democracies and their allies, aircraft factories in China, Russia, England, Canada and the United States use EXACT WEIGHT Scales for weighing, parts counting, measuring and testing operations. The high degree of accuracy required in aircraft manufacture, especially engines, makes unusual demands of scales. Actually precision measuring instruments incorporating the weighing principle is the paramount requirement. Our thorough knowledge of this production problem has gone into each EXACT WEIGHT unit sold thereby establishing a high reputation with the industry for delivering equipment that fits the particular operation for which it is intended. Write for details covering your particular specifications.

THE EXACT WEIGHT SCALE CO.

557 W. Fifth Ave., Columbus, Ohio

Exact Weight Scales

YOUNG RADIATOR CO.,
709 S. Marquette St., Racine, Wisc.
PERSONNEL: F. M. Young, Pres., V. Pres. & Gen. Mgr.; W. H. Schleck, Secy. & Treas.; G. J. Haislmaier, Sales Mgr.; R. W. Baggott, Pur. Agt.; A. D. Lynch, Pers. Dir.; R. M. Snow., Pub. Dir.
PRODUCTS: Heaters; Radiators; Oil regulators; Intercoolers.

Z

CARL ZEISS, INC.,
485 Fifth Ave., New York, N. Y.
PRODUCTS: Cameras; Gauges; Optical instrument.

DEALERS, DISTRIBUTORS, EXPORTERS AND SHIPPERS

EDWIN D. ALLMENDINGER,
15 Moore St., New York, N. Y.
AIRCRAFT EXPORT CORP.,
30 Rockefeller Plaza, New York, N. Y.
AMERICAN EASTERN CORP.,
30 Rockefeller Plaza, New York, N. Y.
AVIATION EQUIPMENT & EXPORT, INC.,
25 Beaver St., New York, N. Y.
CHARLES H. BABB CO., Grand Central Air Terminal, Glendale, Calif.
BAKER STEEL & TUBE CO.,
955 S. Alameda St., Los Angeles, Calif.
BARR SHIPPING CORP.,
25 Broadway, New York, N. Y.
BENDIX EXPORT DIV. OF BENDIX AVIATION CORP., 30 Rockefeller Plaza, New York, N. Y.
BLUEFRIES-NEW YORK, INC.,
44 Whitehall St., New York, N. Y.
CALIFORNIA PANEL & VENEER CO.,
955 Alameda St., Los Angeles, Calif.
CAMPBELL HARDWARE & SUPPLY CO.,
108 First Ave., So., Seattle, Wash.
CHINA AIRMOTIVE CO.,
444 Madison Ave., New York, N. Y.
CURTISS EXPORTS DIV. OF CURTISS-WRIGHT CORP., 30 Rockefeller Plaza, New York, N. Y.
GILLIES AVIATION CORP.,
Bethpage, N. Y.
J. V. W. CORPORATION,
1100 Raymond Blvd., Newark, N. J.
MIRANDA BROTHERS, INC.,
6 East 45th St., New York, N. Y.
NORTHWEST AIR SERVICE, INC.,
Boeing Field, Seattle, Wash.
ROYAL SHIPPING CO.,
21 Pearl St., New York, N. Y.
STANDARD AIRCRAFT EQUIPMENT CO.,
Roosevelt Field, Mineola, N. Y.
TRI-AMERICAN AIRCRAFT CORP.,
Graybar Bldg., New York, N. Y.
UNITED AIRCRAFT EXPORT DIV. OF UNITED AIRCRAFT CORP., E. Hartford, Conn.
THE VIMALERT COMPANY, LTD.
807 Garfield Ave., Jersey City, N. J.
O. J. WHITNEY, INC.,
9 Rockefeller Plaza, New York, N. Y.

AERONAUTICAL CHAMBER OF COMMERCE OF AMERICA, INC.

30 Rockefeller Plaza, New York — Shoreham Building, Washington, D. C. — 7046 Hollywood Blvd. Los Angeles, Calif.

Officers for 1942

John H. Jouett	President
P. G. Johnson	Vice President
J. Carlton Ward, Jr.	Vice President
C. S. Jones	Vice President
Harrison Brand, Jr.	Vice President
Howard Mingos	Vice President
Irving H. Taylor	Secretary
Stewart J. Moulin	Asst. Secretary
Harrison Brand, Jr.	Treasurer
Vincent Ford	Asst. Treasurer

Executive Committee for 1942

Clayton J. Brukner	The Waco Aircraft Company
A. T. Burton	North American Aviation, Inc.
Frank N. Fleming	Douglas Aircraft Company, Inc.
J. T. Hartson	The Glenn L. Martin Company
Palmer A. Hewlett	Vultee Aircraft, Inc.
Albert I. Lodwick	Lakeland School of Aeronautics
Charles Marcus	Bendix Aviation Corporation
Thomas A. Morgan	Sperry Corporation
James P. Murray	Boeing Aircraft Company
Fred R. Neely	Bell Aircraft Corporation
J. A. B. Smith	Curtiss-Wright Corporation
J. Story Smith	Jacobs Aircraft Engine Company
S. W. Voorhes	Lockheed Aircraft Corporation
Raycroft Walsh	United Aircraft Corporation
J. Carlton Ward, Jr.	Fairchild Engine & Airplane Corporation
H. E. Weihmiller	Consolidated Aircraft Corporation

Board of Governors for 1942

Charles H. Babb	Charles H. Babb Company
Clayton J. Brukner	The Waco Aircraft Company
A. T. Burton	North American Aviation, Inc.
George F. Chapline	Brewster Aeronautical Corporation
LaMotte T. Cohu	Northrop Aircraft, Inc.
Richard H. Depew, Jr.	Taylorcraft Aviation Corporation
J. A. Eubank	Affiliate
Frank N. Fleming	Douglas Aircraft Company, Inc.
L. R. Grumman	Grumman Aircraft Engineering Corporation
J. T. Hartson	The Glenn L. Martin Company
P. A. Hewlett	Vultee Aircraft, Inc.
C. S. Jones	Casey Jones School of Aeronautics
John H. Jouett	Aeronautical Chamber of Commerce of America, Inc.
Aubrey Keif	The Texas Company
W. Wallace Kellett	Republic Aviation Corporation
Albert I. Lodwick	Lakeland School of Aeronautics
Charles Marcus	Eclipse-Pioneer Division of Bendix Aviation Corporation
Thomas A. Morgan	Sperry Gyroscope Company, Inc.
James P. Murray	Boeing Aircraft Company
Fred R. Neely	Bell Aircraft Corporation
J. Brooks Parker	Parker & Company
Wayne Parrish	American Aviation Associates, Inc.
W. T. Piper	Piper Aircraft Corporation
E. T. Price	Solar Aircraft Company
Don Smith	Sacramento Municipal Airport
J. A. B. Smith	Curtiss-Wright Corporation, Airplane Div.
J. Story Smith	Jacobs Aircraft Engine Company
S. W. Voorhes	Lockheed Aircraft Corporation
Raycroft Walsh	Pratt & Whitney Aircraft Div., United Aircraft Corporation
J. Carlton Ward, Jr.	Fairchild Engine & Airplane Corporation
H. E. Weihmiller	Consolidated Aircraft Corporation
Alfred Wolf	Aircraft Owners & Pilots Association

Staff of the Chamber

John H. Jouett	President
Harrison Brand, Jr.	Vice President, Treasurer and Manager, Special Projects Dept.
Howard Mingos	Vice President and Manager, Public Relations Dept.
Irving H. Taylor	Secretary and Manager, Trade Development Dept.
Jack T. Gray	Manager, Technical Dept.
Vincent Ford	Asst. Treasurer and Manager, Los Angeles Office
Beatrice H. Sheppard	Manager, New York Office
Leon Shloss	Publicity Manager, Public Relations Dept.
John C. Ingram	Publications Executive, Public Relations Dept.
Ronald S. Gall	Asst. Manager, Public Relations Dept., New York Office
Francis Walton	Asst. Manager, Public Relations Dept., Los Angeles Office
Ken Ellington	Radio Executive, Public Relations Dept.
Kenneth C. Gordon	Asst. Manager, Technical Dept.
Henry L. Knight	Asst. Manager, Special Projects Dept.
Charles M. Cook	Asst. Manager, Trade Development Dept.
Albert W. Clayton	Asst. Manager, Research and Statistics, Public Relations Dept.
Stewart J. Moulin	Asst. Secretary and Asst. Manager, Los Angeles Office
Spence, Windels, Walser, Hotchkiss and Angell	Counsel (New York)
Franklin K. Lane, Jr.	Counsel (Washington)

MANUFACTURERS AIRCRAFT ASSOCIATION, INC.

30 Rockefeller Plaza, New York

Officers

1942

S. S. Bradley	Chairman of the Board
F. H. Russell	President
Edgar N. Gott	Vice President
Robert E. Gross	Vice President
Joseph T. Hartson	Vice President
J. H. Kindelberger	Vice President
John M. Rogers	Vice President
Wm. E. Valk	Vice President
E. E. Wilson	Vice President
James P. Murray	Secretary
C. J. Brukner	Treasurer
John A. Sanborn	Asst. Treas., Asst. Secy., and General Manager

Directors

S. S. Bradley	Chairman of the Board
Clayton J. Brukner	Waco Aircraft Company
Charles H. Chatfield	United Aircraft Corporation
Frank N. Fleming	Douglas Aircraft Company, Inc.
G. Sumner Ireland	Lockheed Aircraft Corporation
George D. Jones	The Glenn L. Martin Company
James P. Murray	Boeing Aircraft Company
Frank H. Russell	President
Leland R. Taylor	North American Aviation, Inc.
William E. Valk	Curtiss-Wright Corporation
H. E. Weihmiller	Consolidated Aircraft Corporation
Ray P. Whitman	Bell Aircraft Corporation

SOARING SOCIETY OF AMERICA, INC.

Address: Parker Leonard, Osterville, Mass.

President	Parker Leonard
Vice President	Donald Hamilton
Vice President	Jay Buxton
Secretary-Treasurer	Arthur B. Schultz

INSTITUTE OF THE AERONAUTICAL SCIENCES

1505 RCA Building West, 30 Rockefeller Plaza, New York

Officers for 1942

President	Hall L. Hibbard
Vice President	C. S. Jones
Vice President	Grover Loening
Vice President	Thomas A. Morgan
Vice President	J. G. Vincent
Executive Vice President	Lester D. Gardner
Treasurer	Earl D. Osborn
Secretary	C. E. Sinclair

Council Members for 1942

W. A. M. Burden	Leroy R. Grumman	R. D. MacCart
Charles H. Colvin	L. S. Hobbs	Arthur Nutt
Charles Froesch	Roger Wolfe Kahn	Elmer A. Sperry, Jr.
R. T. Goodwin	W. Wallace Kellett	J. Carlton Ward, Jr.

NATIONAL AERONAUTIC ASSOCIATION OF U. S. A.

Willard Hotel, Washington, D. C.

United States Representative of Federation Aeronautique Internationale
Governing Body for Sporting Aviation in the United States

Officers

President	Gill Robb Wilson
Vice President	Harry K. Coffey
Vice President	William R. Enyart
Vice President	Max C. Fleischmann
Treasurer	William P. Redding
Manager	Kendall K. Hoyt

Board of Directors

Thomas H. Beck	Carl Hinton	A. H. Near
W. W. Brinckerhoff	Earle L. Johnson	Wayne W. Parrish
Harry A. Bruno	John H. Jouett	J. S. Randall
Richard H. Depew, Jr.	Roger Wolfe Kahn	Carl B. Squier
Stanley C. Draper	Franklin K. Lane, Jr.	William B. Stout
Arthur S. Dudley	A. I. Lodwick	C. C. Thompson
T. B. Herndon	Merrill C. Meigs	Frank A. Tichenor

AIRCRAFT OWNERS AND PILOTS ASSOCIATION

Office of President	1424 Walnut Street, Philadelphia, Pa.
Service Office	Transportation Building, Chicago, Ill.

President	C. Townsend Ludington
Vice President	Philip T. Sharples
Secretary	Alfred L. Wolf
Treasurer	Laurence P. Sharples
Executive Consultant	Gill Robb Wilson
Executive Secretary	J. B. Hartranft, Jr.

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.

29 West 39th St., New York

Officers for 1942

President........A. W. Herrington
Vice President (Rep. Aircraft Engrg.)........Peter Altman
Vice President (Rep. Aircraft-Engine Engrg.)........C. F. Bachle
Secretary and General Manager........John A. C. Warner

The Council

H. L. Knudsen, Vice President
C. M. Larson, Vice President
Ernest E. Wilson, Vice President
Edwin L. Allen, Vice President
Joseph Geschelin, Vice President
F. L. Pfost, Vice President
Jean Y. Ray, Vice President
W. S. James, Councilor
J. V. Savage, Councilor
T. P. Wright, Councilor
N. C. Millman, Councilor
H. O. Mathews, Councilor
D. A. Fales, Councilor
David Beecroft, Treasurer
Arthur Nutt, Past President (1940)
A. T. Colwell, Past President (1941)

Aeronautic Committees

Aircraft Committee........Peter Altman, Chairman
Aircraft-Engine Committee........C. F. Bachle, Chairman
Standards Committee
- Aeronautics Division........Arthur Nutt, Chairman
  - Aircraft Engine Subdivision........Val Cronstedt, Chairman
  - Aircraft Access. & Equip. Subdivision........William Littlewood, Chairman
  - Aircraft-Engine Propeller Subdivision........Erle Martin, Chairman
  - Aircraft Materials & Processes Coordinating Subdivision...J. B. Johnson, Chairman
    - Aircraft-Engine Materials & Processes Committee......B. Clements, Chairman
    - Airframes Materials & Processes Committee........L. D. Bonham, Chairman

Research Committee
- Aircraft-Engine Lubricants Committee........G. K. Brower, Chairman

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 W. 39th Street, New York

Aviation Division, Executive Committee

Chairman........John E. Younger
Secretary........James M. Clark

E. E. Aldrin   C. F. Dolan   R. F. Gagg

AIR TRANSPORT ASSOCIATION OF AMERICA

1515 Massachusetts Ave., N.W.

Washington, D. C.

Officers

President........Edgar S. Gorrell
Vice President........Robert F. Six
Secretary and Treasurer........Fowler W. Barker

Directors

T. E. Braniff
Jack Frye
C. Bedell Monro
W. A. Patterson
E. V. Rickenbacker
C. E. Woolman
C. R. Smith

U. S. ARMY AIR FORCES, WAR DEPARTMENT

Washington, D. C.

Henry L. Stimson, Secretary of War
Robert W. Patterson, Undersecretary of War
Robert A. Lovett, Asst. Secretary of War for Air

Army Air Forces

April 1, 1942

Commanding General, Army Air Forces	Lt. Gen. Henry H. Arnold
Chief of Air Staff	Brig. Gen. Millard F. Harmon
Personnel (A-1)	Col. F. Trubee Davison
Air Intelligence (A-2)	Col. Robert L. Walsh
Training and Operations (A-3)	Col. Hoyt S. Vandenberg
Material and Supply (A-4)	Col. Thomas J. Hanley, Jr.
Plans (A-5)	Col. Howard A. Craig
Air Adjutant General	Col. W. W. Dick
Flying Training Command	Maj. Gen. Barton K. Yount
Technical Training Command	Maj. Gen. Walter R. Weaver
Materiel Command	Brig. Gen. O. P. Echols
Air Service Command	Brig. Gen. Henry J. F. Miller
Ferrying Command	Brig. Gen. Robert Olds
First Air Force	Brig. Gen. Follett Bradley
Second Air Force	Maj. Gen. Frederick L. Martin
Third Air Force	Brig. Gen. Walter H. Frank
Fourth Air Force	Maj. Gen. George C. Kenney

THE WAR PRODUCTION BOARD

Chairman	Donald M. Nelson
Secretary of War	Henry L. Stimson
Secretary of Navy	Frank Knox
Federal Loan Administrator	Jesse H. Jones
In Charge of Production	Lt. Gen. William S. Knudsen
Chief of Labor Division	Sidney Hillman
Administrator of O. P. A.	Leon Henderson
Chairman of the Board of Economic Warfare	Henry A. Wallace
Special Assistant to the President Supervising in Defense Aid Program	Harry L. Hopkins

Production Division

Director	W. H. Harrison

Aircraft Branch

M. C. Meigs	Chief
T. P. Wright	Assistant Chief
Lt. Col. E. M. Powers	Engineering Unit
A. E. Lombard, Jr.	Production Planning Unit
H. R. Boyer	Manufacturing Unit
Joint Aircraft Committee	Army, Navy, Treasury, British, OPM
T. P. Wright, Chairman	Standardization Sub-Committee
Lt. Col. D. G. Lingle, Recorder	Standardization Sub-Committee
A. E. Lombard, Chairman	Allocation Sub-Committee
C. Clay Crawford	Priority Specialist
A. O. Pierrot	Chief of Foreign Contacts
R. E. Lees	Chief of Priorities Section
T. H. Lowry	Administrator, Scheduling Unit
H. A. Shaffer	Aircraft Consultant

BUREAU OF AERONAUTICS, U. S. NAVY

Washington, D. C.

Frank Knox, Secretary of the Navy
James V. Forrestal, Under Secretary of the Navy
Artemus L. Gates, Assistant Secretary of the Navy for Air
Ralph A. Bard, Assistant Secretary of the Navy

Chief of Bureau	Rear Admiral John H. Towers
Assistant Chief of Bureau	Captain DeWitt C. Ramsey

U. S. FOREST SERVICE
DEPARTMENT OF AGRICULTURE

Washington, D. C.

Claude R. Wickard, Secretary of Agriculture

Acting Chief of the Forest Service: Earle H. Clapp

Northern Region	Headquarters: Missoula, Mont. Evan W. Kelley, Regional Forester
Rocky Mountain Region	Headquarters: Denver, Colo. Allen S. Peck, Regional Forester
Southwestern Region	Headquarters: Albuquerque, N. M. Frank C. W. Pooler, Regional Forester
Intermountain Region	Headquarters: Ogden, Utah C. N. Woods, Regional Forester
California Region	Headquarters: San Francisco, Calif. S. B. Show, Regional Forester
North Pacific Region	Headquarters: Portland, Ore. Lyle F. Watts, Regional Forester
Eastern Region	Headquarters: Philadelphia, Pa. R. M. Evans, Regional Forester
Southern Region	Headquarters: Atlanta, Ga. Joseph C. Kircher, Regional Forester
North Central Region	Headquarters: Milwaukee, Wis. Jay H. Price, Regional Forester
Alaska Region	Headquarters: Juneau, Alaska B. Frank Heintzleman, Regional Forester

FEDERAL COMMUNICATIONS COMMISSION

Washington, D. C.

Commissioners

James Lawrence Fly, Chairman

Paul A. Walker — T. A. M. Craven
Norman S. Case — Ray C. Wakefield
George Henry Payne — C. J. Durr

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

1500 New Hampshire Avenue, N. W., Washington, D. C.

Laboratories, Langley Field, Va.; Moffett Field, Calif.; Cleveland, O.

Created by act of Congress approved March 3, 1915, for the supervision and direction of the scientific study of the problems of flight. Its membership was increased to 15 by act approved March 2, 1939. The members are appointed by the President, and serve as such without compensation.

Jerome C. Hunsaker, Sc.D. (Chairman), Massachusetts Institute of Technology, Cambridge, Massachusetts.
George J. Mead, Sc.D. (Vice Chairman), West Hartford, Connecticut.
Charles G. Abbot, Sc.D., Secretary, Smithsonian Institution.
Henry H. Arnold, Lieutenant General, United States Army, Commanding General, Army Air Forces.
Lyman J. Briggs, Ph.D., Director, National Bureau of Standards.
Vannevar Bush, Sc.D., President, Carnegie Institution, Washington, D. C.
Donald H. Connolly, Brigadier General.
William F. Durand, Ph.D., Stanford University, California.
Oliver P. Echols, Brigadier General, United States Army, Materiel Command, Army Air Forces.
Robert H. Hinckley, A.B., Assistant Secretary of Commerce.
Sydney M. Kraus, Captain, United States Navy, Bureau of Aeronautics, Navy Department.
Francis W. Reichelderfer, Sc.D., Chief, United States Weather Bureau.
John H. Towers, Rear Admiral, United States Navy, Chief, Bureau of Aeronautics, Navy Department.
Edward Warner, Sc.D., Civil Aeronautics Board.
Orville Wright, Sc.D., Dayton, Ohio.

George W. Lewis, Sc.D., Director of Aeronautical Research.
John F. Victory, LL.M., Secretary.
Edward H. Chamberlin, Assistant Secretary.

Henry J. E. Reid, Engineer-in-Charge, Langley Memorial Aeronautical Laboratory, Langley Field, Virginia.

Smith J. DeFrance, Engineer-in-Charge, Ames Aeronautical Laboratory, Moffett Field, California.

Edward R. Sharp, Administrative Officer, Aircraft Engine Research Laboratory, Cleveland, Ohio.

POST OFFICE DEPARTMENT AIR MAIL SERVICE

Washington, D. C.

Postmaster General	Frank C. Walker
Second Assistant Postmaster General	Smith W. Purdum
Deputy Second Assistant Postmaster General	John E. Lamiell

Domestic Air Mail Service:

Superintendent	Roy M. Martin
Assistant Superintendent	Charles M. Knoble
Assistant Superintendent, New York, N. Y.	W. H. Nichols
Assistant Superintendent, Chicago, Ill.	J. A. Cruickshank
Assistant Superintendent, Atlanta, Ga.	B. H. Lockett
Assistant Superintendent, Fort Worth, Tex.	A. C. Hodges
Assistant Superintendent, San Francisco, Calif.	A. O. Willoughby


PIONEER *leads the way*
Time designs parachutes! Last year's model may be obsolete in the light of this year's research. Pioneer's leaders, rich in personal experience, supervise up-to-the-minute surveys and studies. Working side by side with top-flight engineers, they perfect *their* Parachutes, insure *your* safety.
PIONEER PARACHUTE COMPANY, INC.
MANCHESTER, CONNECTICUT, U. S. A.
CABLE ADDRESS: PIPAR, Manchester, Conn., U.S.A.
TELEPHONE: Manchester 6305
CHENEY SILKS


UL

U. S. DEPARTMENT OF COMMERCE

CIVIL AERONAUTICS ADMINISTRATION

Washington, D. C.

Jesse H. Jones, Secretary of Commerce
Wayne C. Taylor, Under Secretary of Commerce
Robert H. Hinckley, Asst. Secretary of Commerce

Administrator of Civil Aeronautics (Acting)	Charles I. Stanton
Deputy Administrator (Acting)	A. S. Koch
Executive Officer	A. E. Stockburger
General Counsel	R. E. Elwell
Regional Manager at Large	H. F. Rough
Director of Information and Statistics	Roscoe Wright
Director of Federal Airways	T. B. Bourne
Director of Safety Regulation (Acting)	J. F. Warlick
Director of Airports	C. B. Donaldson
Director of Civilian Pilot Training	J. P. Morris

Regional Managers

Region I	New York, New York	J. E. Sommers
Region II	Atlanta, Georgia	G. W. Vest
Region III	Chicago, Illinois	H. R. Neely
Region IV	Fort Worth, Texas	L. C. Elliott
Region V	Kansas City, Missouri	Leonard Jurden
Region VI	Los Angeles, California	J. S. Marriott
Region VII	Seattle, Washington	R. D. Bedinger
Region VIII	Anchorage, Alaska	M. C. Hoppin

CIVIL AERONAUTICS BOARD

L. Welch Pogue	Chairman
George P. Baker	Vice-Chairman
Harllee Branch	Member
Oswald Ryan	Member
Edward P. Warner	Member
Darwin Charles Brown	Secretary
George C. Neal	General Counsel
R. W. Stough	Director, Economic Bureau
Jerome Lederer	Director, Safety Bureau

Safety Bureau Branch Offices

Allen P. Bourdon	Investigator in Charge, New York, N. Y.
Richard C. Hughes	Air Safety Investigator, Boston, Mass.
Bruce C. Pettigrew	Air Safety Investigator, Newark, N. J.
Herbert V. Shebat	Air Safety Investigator, Pittsburgh, Pa.
Charles S. Collar	Air Safety Investigator, Baltimore, Md.
James N. Peyton	Investigator in Charge, Atlanta, Ga.
Thomas Fowler	Air Safety Investigator, Atlanta, Ga.
William A. Butters	Investigator in Charge, Chicago, Ill.
Ervin N. Townsent	Air Safety Investigator, Detroit, Mich.
Earl L. Smith	Air Safety Investigator, Minneapolis, Minn.
John F. Buckman	Air Safety Investigator, Chicago, Ill.
Ralph A. Reed	Investigator in Charge, Fort Worth, Tex.
Alexander E. Cabana	Air Safety Investigator, Fort Worth, Tex.
R. P. Parshall	Investigator in Charge, Kansas City, Mo.
Raymond B. Quick	Air Safety Investigator, Kansas City, Mo.
Warren E. Carey	Investigator in Charge, Santa Monica, Calif.
Perry Hodgden	Air Safety Investigator, Oakland, Calif.
Earle R. Mitchell	Air Safety Investigator, Santa Monica, Calif.
Leon D. Cuddeback	Investigator in Charge, Seattle, Wash.

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION

Standing Committees of the 77th Congress, second session, 1942

Senate

Appropriations

Carter Glass	(D)	Harry S. Truman	(D)
Kenneth McKellar	(D)	Theodore Francis Green	(D)
Carl Hayden	(D)	Francis Maloney	(D)
Elmer Thomas	(D)	Dennis Chavez	(D)
Millard E. Tydings	(D)	James M. Mead	(D)
Richard B. Russell	(D)	Gerald P. Nye	(R)
Pat McCarran	(D)	Styles Bridges	(R)
John H. Overton	(D)	Henry Cabot Lodge, Jr.	(R)
John H. Bankhead, 2d	(D)	Rufus C. Holman	(R)
Joseph C. O'Mahoney	(D)	Chan Gurney	(R)
Wall Doxey	(D)	C. Wayland Brooks	(R)
Burnet R. Maybank	(D)	Wallace H. White, Jr.	(R)

Interstate Commerce

Burton K. Wheeler	(D)	D. Worth Clark	(D)
Ellison D. Smith	(D)	Ernest W. McFarland	(D)
Robert F. Wagner	(D)	James M. Tunnell	(D)
Alben W. Barkley	(D)	Wallace H. White, Jr.	(R)
Homer T. Bone	(D)	Warren R. Austin	(R)
Harry S. Truman	(D)	Charles W. Tobey	(R)
Charles O. Andrews	(D)	Clyde M. Reed	(R)
Edwin C. Johnson	(D)	Chan Gurney	(R)
H. H. Schwartz	(D)	C. Wayland Brooks	(R)
Lister Hill	(D)	Henrik Shipstead	(R)
Tom Stewart	(D)		

Military Affairs

Robert R. Reynolds	(D)	James E. Murray	(D)
Elbert D. Thomas	(D)	Harley M. Kilgore	(D)
Edwin C. Johnson	(D)	Albert B. Chandler	(D)
Josh Lee	(D)	Warren R. Austin	(R)
H. H. Schwartz	(D)	Styles Bridges	(R)
Lister Hill	(D)	Chan Gurney	(R)
Sheridan Downey	(D)	Rufus C. Holman	(R)
Harry S. Truman	(D)	John Thomas	(R)
Mon C. Wallgren	(D)	Henry Cabot Lodge, Jr.	(R)

Naval Affairs

David I. Walsh	(D)	Allen J. Ellender	(D)
Millard E. Tydings	(D)	Scott W. Lucas	(D)
Ellison D. Smith	(D)	James M. Tunnell	(D)
Richard B. Russell	(D)	James J. Davis	(R)
Homer T. Bone	(D)	Hiram W. Johnson	(R)
Harry Flood Byrd	(D)	W. Warren Barbour	(R)
Peter G. Gerry	(D)	Alexander Wiley	(R)
Charles O. Andrews	(D)	Ralph O. Brewster	(R)
Guy M. Gillette	(D)		

Post Offices and Post Roads

Kenneth McKellar	(D)	Pat McCarran	(D)
Carl Hayden	(D)	Sheridan Downey	(D)
Josiah W. Bailey	(D)	James J. Davis	(R)
William J. Bulow	(D)	Clyde M. Reed	(R)
Joseph C. O'Mahoney	(D)	John Thomas	(R)
Dennis Chavez	(D)	Hugh A. Butler	(R)
Allen J. Ellender	(D)	William Langer	(R)
William H. Smathers	(D)	Raymond E. Willis	(R)
James M. Mead	(D)	Eugene D. Millikin	(R)
Lloyd Spencer	(D)		

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION

(Continued)

House of Representatives

Appropriations

Clarence Cannon	(D)	Harry R. Sheppard	(D)
Clifton A. Woodrum	(D)	Butler B. Hare	(D)
Louis Ludlow	(D)	Harry P. Beam	(D)
Malcolm C. Tarver	(D)	Albert Thomas	(D)
Jed Johnson	(D)	Vincent F. Harrington	(D)
J. Buell Snyder	(D)	John Taber	(R)
Emmet O'Neal	(D)	Richard B. Wigglesworth	(R)
George W. Johnson	(D)	W. P. Lambertson	(R)
James G. Scrugham	(D)	D. Lane Powers	(R)
James M. Fitzpatrick	(D)	J. William Ditter	(R)
Louis C. Rabaut	(D)	Albert E. Carter	(R)
David D. Terry	(D)	Robert F. Rich	(R)
John M. Houston	(D)	Charles A. Plumley	(R)
Joe Starnes	(D)	Everett M. Dirksen	(R)
Ross A. Collins	(D)	Albert J. Engel	(R)
Charles H. Leavy	(D)	Karl Stefan	(R)
Joseph E. Casey	(D)	Francis H. Case	(R)
John H. Kerr	(D)	Frank B. Keefe	(R)
George H. Mahon	(D)	Noble J. Johnson	(R)
Joe Hendricks	(D)	Robert F. Jones	(R)

Interstate and Foreign Commerce

Clarence F. Lea	(D)	Rudolph G. Tenerowicz	(D)
Robert Crosser	(D)	Jared Y. Sanders, Jr.	(D)
Alfred L. Bulwinkle	(D)	Charles A. Wolverton	(R)
Virgil Chapman	(D)	Pehr G. Holmes	(R)
William P. Cole, Jr.	(D)	B. Carroll Reece	(R)
Edward A. Kelly	(D)	James W. Wadsworth	(R)
Herron Pearson	(D)	Charles A. Halleck	(R)
Lyle H. Boren	(D)	Oscar Youngdahl	(R)
Martin J. Kennedy	(D)	Carl Hinshaw	(R)
Charles L. South	(D)	Clarence J. Brown	(R)
James P. McGranery	(D)	Richard M. Simpson	(R)
Donald L. O'Toole	(D)	George A. Paddock	(R)
Luther Patrick	(D)		

Military Affairs

Andrew J. May	(D)	Bolivar Pagan	Puerto Rico
R. Ewing Thomason	(D)	Clifford Davis	(D)
Dow W. Harter	(D)	Anthony J. Dimond	(D)
Charles I. Faddis	(D)	Walter G. Andrews	(R)
Andrew Edmiston	(D)	Dewey Short	(R)
Edwin M. Schaefer	(D)	Leslie C. Arends	(R)
Matthew J. Merritt	(D)	Charles R. Clason	(R)
John M. Costello	(D)	J. Parnell Thomas	(R)
Overton Brooks	(D)	Paul W. Shafer	(R)
John J. Sparkman	(D)	Thomas E. Martin	(R)
Paul J. Kilday	(D)	Charles H. Elston	(R)
Carl T. Durham	(D)	Forest A. Harness	(R)
William J. Fitzgerald	(D)	Samuel W. King	(R)
E. C. Gathings	(D)	Ivon O. Fenton	(R)

Naval Affairs

Carl Vinson	(D)	William S. Jacobsen	(D)
Patrick Henry Drewry	(D)	Michael J. Bradley	(D)
Leonard W. Schuetz	(D)	Beverly M. Vincent	(D)
William H. Sutphin	(D)	Ed. V. Izac	(D)
Joseph B. Shannon	(D)	Thomas A. Flaherty	(D)
Warren G. Magnuson	(D)	Lansdale G. Sasscer	(D)
Lyndon B. Johnson	(D)	Lawrence E. Imhoff	(D)

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION
(Continued)

Naval Affairs (Continued)

James J. Heffernan	(D)	Arthur B. Jenks	(R)
Anthony J. Dimond	(D)	John Z. Anderson	(R)
L. Mendel Rivers	(D)	James Wolfenden	(R)
Melvin J. Maas	(R)	William W. Blackney	(R)
James W. Mott	(R)	William H. Wheat	(R)
W. Sterling Cole	(R)	Ward Johnson	(R)
George J. Bates	(R)	Samuel W. King	(R)
William E. Hess	(R)		

Post Office and Post Roads

Milton A. Romjue	(D)	Francis J. Myers	(D)
Thomas G. Burch	(D)	Louis J. Capozzoli	(D)
Martin L. Sweeney	(D)	Fred A. Hartley, Jr.	(R)
Arthur W. Mitchell	(D)	E. Harold Cluett	(R)
B. Frank Whelchel	(D)	Noah M. Mason	(R)
J. Harold Flannery	(D)	Ben F. Jensen	(R)
David J. Ward	(D)	John Jennings, Jr.	(R)
Harry L. Haines	(D)	Charles L. Gerlach	(R)
Aime J. Forand	(D)	H. Carl Andersen	(R)
George D. O'Brien	(D)	Robert A. Grant	(R)
Greg Holbrock	(D)	Margaret Chase Smith	(R)
J. Percy Priest	(D)	Walter C. Ploeser	(R)
Jamie L. Whitten	(D)		

AVIATION WRITERS ASSOCIATION

c/o Aero Digest, 515 Madison Avenue, New York, N. Y.

Officers

President.......Devon Francis
Vice President.......Maurice Roddy
Vice President.......Selby Calkins
Secretary and Treasurer.......Michael H. Froelich

Governors

Robert S. Ball.......Detroit, Mich.
Selby Calkins.......Los Angeles, Calif.
Justin D. Bowersock.......Kansas City, Mo.
Albert D. Hughes.......Boston, Mass.
Wayne Parrish.......Washington, D. C.
Dick Kirschbaum.......Newark, N. J.
Maurice Roddy.......Chicago, Ill.
George E. Haddaway.......Dallas, Tex.
Howard Waldorf.......Oakland, Calif.

DIPLOMATIC SERVICE TO THE UNITED STATES

The following foreign aeronautical representatives may be addressed at their respective embassies in Washington, D. C.

Argentina............Capt. Alberto D. Brunet, Naval and Air Attaché.
Australia.............Rt. Hon. Richard G. Casey, D. S. O., M. C., Minister.
Belgium..............Count Robert van der Straten-Ponthoz, Ambassador E. and P.
Bolivia...............Col. Oscar Moscoso, Military and Air Attaché.
Brazil................Lt. Col. Armado de Souza e Mello Ararigboia, Air Attaché.
Canada..............Air Commodore G. V. Walsh, M. B. E., Air Attaché.
Chile................Group Captain Rafael Sáenz, Air Attaché.
China................Maj. Gen. Chu Shih-ming, Military Attaché.
Colombia............Col. Miguel J. Neira, Military Attaché.
Costa Rica...........Señor Don Luis Fernández, Minister.
Cuba................Major Felipe Munilla, Military and Air Attaché.
Dominican Republic...Dr. Julio Vega Batlle, First Secretary.
Ecuador.............Señor Capitán Colón Eloy Alfaro, Ambassador E. and P.
Egypt...............Mahmoud Hassan Bey, E. E. and M. P.
El Salvador..........Señor Dr. Don Hector David Castro, E. E. and M. P.
Great Britain........Air Commodore H. N. Thornton, M. B. E., Air Attaché.
Greece...............Col. Sophocles E. Veniselos, Military Attaché.
Guatemala...........Señor Dr. Don Enrique López-Herrarte, First Secretary.
Haiti................Major Roche B. Laroche, Military Attaché.
Honduras............Señor Dr. Don Julian R. Caceres, E. E. and M. P.
Iran.................Major Hassan Aktarcendi, Assistant Military Attaché.
Lithuania............Mr. Povilas Žadeikis, E. E. and M. P.
Mexico..............Lt. Col. P. A. Jose Perez Allende, Ass't Military Attaché for Air.
Netherlands..........Col. F. G. L. Weijerman, Military Attaché.
Nicaragua............Señor Dr. Don León DeBayle, E. E. and M. P.
Norway..............Commander Kristian Östby, Air Attaché.
Panama..............Señor Dr. Ernesto Jaén Guardia, Ambassador E. and P.
Paraguay............Señor Dr. Juan José Soler, E. E. and M. P.
Peru.................Lt. Col. Jorge Sarmiento, Military Attaché.
Poland...............Col. Wlodzimierz Onacewicz, Military and Air Attaché.
Portugal.............Dr. João Antonio de Bianchi, E. E. and M. P.
South Africa..........Maj. J. D. de Villiers Rademan, Assistant Air and Military Attaché.
Spain................Lt. Col. Manuel de la Sierra, Air Attaché.
Sweden..............Capt. Karl Wessel, Military Attaché.
Switzerland...........Mr. Charles Bruggmann, E. E. and M. P.
Thailand.............Lt. Col. Mom Luang Kharb Kunjara, Military and Air Attaché.
Turkey..............Maj. Tekin Ariburun, Air Attaché.
U. S. S. R............Col. Pavel Fedorovich Berezin, Ass't Military Attaché for Air.
Uruguay.............Col. Hugo Molins, Military Attaché.
Venezuela............Col. Juan Jones-Parra, Military Attaché.
Yugoslavia...........Lt. Col. Zivojin Radoychich, Military and Air Attaché.

AERONAUTICAL PERIODICALS OF THE UNITED STATES

AERO DIGEST	515 Madison Avenue, New York, N. Y.
AERONAUTICAL REVIEW	30 Rockefeller Plaza, New York, N. Y.
AIR LAW REVIEW	Washington Square East, New York, N. Y.
AIR LINE MECHANIC	6240 S. Kedzie Avenue, Chicago, Ill.
AIR LINE PILOT	3145 W. 63rd Street, Chicago, Ill.
AIR TRAILS	79 Seventh Avenue, New York, N. Y.
AIRCRAFT YEAR BOOK (ANNUAL)	30 Rockefeller Plaza, New York, N. Y.
AMERICAN AVIATION	1317 F St. N. W. Washington, D. C.
AMERICAN AVIATION DAILY	1317 F St. N. W. Washington, D. C.
AMERICAN AVIATION DIRECTORY	1317 F St. N. W. Washington, D. C.
AVIATION	330 W. 42nd Street, New York, N. Y.
FLYING & POPULAR AVIATION	540 N. Michigan Ave., Chicago, Ill.
JOURNAL OF AIR LAW	357 E. Chicago Avenue, Chicago, Ill.
JOURNAL OF THE AERONAUTICAL SCIENCES	30 Rockefeller Plaza, New York, N. Y.
MODEL AIRPLANE NEWS	551 Fifth Avenue, New York, N. Y.
NATIONAL AERONAUTICS	718 Jackson Pl. N. W. Wash., D. C.
OFFICIAL AVIATION GUIDE	608 S. Dearborn Street, Chicago, Ill.
SOUTHERN FLIGHT	1901 McKinney Avenue, Dallas, Tex.
SPORTSMAN PILOT	515 Madison Avenue, New York, N. Y.
U. S. AIR SERVICES	Transportation Building, Washington, D. C.
WESTERN FLYING	304 S. Broadway, Los Angeles, Calif.

AMERICAN SCREW COMPANY

PROVIDENCE, R. I.

Pioneered in the development of the Phillips Recessed Head Screw

which is now used almost universally by the aircraft industry as a means of providing a more secure fastening . . . saving assembly time . . . avoiding screw driver slippage.

By ordering AMERICAN PLUS Phillips Screws, you get the advantage of our long engineering experience with the Phillips Screw, PLUS a broad knowledge of the aircraft industry's requirements, PLUS our large production facilities, PLUS careful control of all operation, PLUS a method of inspection on a par with your own careful inspection system.

✶

All types of
AIRCRAFT FINISHES
and
INDUSTRIAL FINISHES
made by

THE KAY & ESS COMPANY
DAYTON, OHIO

✶

APEX
TOOLS for
Aircraft Production

- *Universal Joint Socket Wrenches*
- *Power Bits and Hand Drivers for* ***Phillips screws***
- *Power Bits for Slotted Head screws*
- *Specialized tools for drilling, tapping, reaming, boring, stud and nut setting.*
- *Aircraft Universal Joints to A N Drawing 270 and 271*

Prompt Deliveries
Write for Catalogs

THE APEX MACHINE and TOOL COMPANY
Dayton, Ohio.

Flying Facts and Figures

SUMMARY OF AIR CARRIER OPERATIONS

Air Lines in the United States

Corrected by U. S. Civil Aeronautics Administration
Calendar Years

Year	*Operators*	*Planes in Service*	*Miles Flown*	*Total Passengers Carried*	*Total Passenger Miles Flown*	*Express Carried (Pounds)*	*Mail Pound Miles Flown*[1]
1926	11	([2])	4,258,771	5,782	([2])	3,555	([3])
1927	16	128	5,779,863	8,661	([2])	45,859	([3])
1928	31	268	10,400,239	47,840	([2])	210,404	([3])
1929	34	442	22,380,020	159,751	([2])	249,634	([3])
1930	38	497	31,992,634	374,935	84,014,572	359,523	([3])
1931	35	490	42,755,417	469,981	106,442,375	788,059	6,280,409,884
1932	29	456	45,606,354	474,279	127,038,798	1,033,970	5,402,249,740
1933	24	408	48,771,553	493,141	173,492,119	1,510,215	5,135,897,406
1934	22	417	40,955,396	461,743	187,858,629	2,133,191	4,922,822,780
1935	23	356	55,380,353	746,946	313,905,508	3,822,397	8,265,416,188
1936	21	272	63,777,226	1,020,931	435,740,253	6,958,777	11,482,872,622
1937	17	282	66,071,507	1,102,707	476,603,165	7,127,369	13,396,460,117
1938	18	253	69,668,827	1,343,427	557,719,268	7,335,967	14,845,719,671
1939	17	265	82,571,523	1,876,051	749,787,096	9,514,299	17,170,021,595
1940	16	358	108,800,436	2,959,480	1,147,444,948	12,506,176	20,071,275,655
1941	17	358	133,022,679	4,060,545	1,491,734,671	19,209,671	25,111,886,055[4]

[1] Mail pound miles flown are for domestic services and Inter-Island Airways which company holds a domestic air mail contract.
[2] Not available prior to 1930.
[3] Air mail pound miles have been computed by the Post Office Department commencing with January 1931; and are not available prior to that date.
[4] Last 4 months—estimated.

STATUS OF AIR CARRIER OPERATIONS

Compiled by U. S. Civil Aeronautics Administration

January 1, 1942

Route Miles Operated		41,915
With United States Mail	41,100	
With Passengers	40,538	
With Express	41,915	
Airplane Miles Scheduled Daily (Average)		380,292
With United States Mail	344,486	
With Passengers	377,538	
With Express	380,292	
Number of Services in Operation		189
With United States Mail	156	
With Passengers	184	
With Express	189	
Number of Domestic Air Carriers		17

MONTHLY AIR CARRIER OPERATIONS

Domestic Air Lines in the U. S.

Compiled by Civil Aeronautics Administration

1939	*Miles Flown*	*Passengers*	*Passenger Miles*	*Mail[1] Pound-Miles*	*Express Pounds*
January	5,453,093	89,002	38,402,960	1,243,868,119	577,982
February	5,031,767	81,131	35,002,226	1,220,711,135	564,928
March	6,125,164	117,071	49,445,372	1,447,382,546	685,274
April	6,267,595	133,469	53,482,725	1,355,973,784	663,884
May	7,122,347	162,682	63,361,491	1,434,236,026	725,061
June	7,182,963	179,055	70,199,181	1,426,340,778	824,630
July	7,541,305	185,643	72,917,924	1,384,713,526	725,922
August	7,638,796	194,418	75,145,452	1,485,144,967	933,965
September	7,441,690	192,544	75,800,149	1,420,683,215	981,461
October	7,625,880	194,216	77,468,144	1,508,505,443	948,501
November	7,407,864	171,557	67,031,434	1,471,926,931	844,413
December	7,733,059	175,263	71,530,038	1,770,535,125	1,038,278
Total	82,571,523	1,876,051	749,787,096	17,170,021,595	9,514,299
1940					
January	7,271,154	150,102	61,355,485	1,534,408,814	817,633
February	6,672,914	139,816	58,937,141	1,499,673,303	697,385
March	7,930,038	195,062	80,686,124	1,680,965,576	894,581
April	8,331,759	224,852	88,061,683	1,627,442,686	871,317
May	9,266,687	258,451	100,044,047	1,682,136,183	941,810
June	9,549,109	286,272	110,839,615	1,597,006,626	981,884
July	10,120,569	296,539	112,376,882	1,633,804,555	1,056,599
August	10,223,149	320,990	121,602,029	1,718,622,237	1,201,999
September	10,084,445	310,293	118,533,626	1,673,399,938	1,184,249
October	10,635,210	334,386	125,924,103	1,866,008,205	1,329,843
November	9,573,378	239,858	90,697,083	1,667,748,879	1,205,261
December	9,142,024	202,859	78,387,130	1,890,058,653	1,323,615
Total	108,800,436	2,959,480	1,147,444,948	20,071,275,655	12,506,176
1941					
January	8,946,038	197,854	78,339,567	1,761,226,024	1,116,025
February	8,842,795	218,163	84,639,781	1,813,348,177	1,110,098
March	10,017,862	245,924	96,661,662	2,018,484,815	1,215,671
April	10,606,486	308,644	114,748,987	2,061,880,065	1,353,437
May	11,738,282	363,954	133,979,048	2,105,826,655	1,464,029
June	11,537,883	380,990	141,905,987	2,083,039,596	1,545,248
July	12,178,479	398,434	147,418,618	2,212,783,024[2]	1,764,372
August	12,471,701	447,316	158,068,167	2,255,297,699[2]	1,842,858
September	12,127,483	455,647	158,151,061	2,200,000,000[2]	1,962,284
October	12,200,352	420,393	150,919,895	2,200,000,000[2]	1,760,770
November	11,500,667	324,546	115,825,169	2,200,000,000[2]	1,689,093
December	10,854,651	298,680	111,076,729	2,200,000,000[2]	2,385,786
Total	133,022,679	4,060,545	1,491,734,671	25,111,886,055	19,209,671

[1] Includes Inter Island Airways, Ltd.
[2] Estimated.

UNITED STATES AIR TRANSPORT ROUTES

Compiled by U. S. Civil Aeronautics Administration

January 1, 1942

Routes	Airway miles	Schedule (round trips)	Daily mileage	Operator
DOMESTIC				
Pittsburgh-Huntington via Elkins and Charleston, W. Va.	313	1 time daily	626	All American Aviation, Inc.
Pittsburgh-Philadelphia	371	1 time daily	742	"
Pittsburgh-Huntington via Parkersburg	313	1 time daily	626	"
Pittsburgh-Williamsport	202	1 time daily	404	"
Pittsburgh-Jamestown, N. Y.	178	1 time daily	356	"
New York-Washington	214	11 times daily	4,708	American Airlines, Inc.
Newark-Washington	204	2 times daily	816	
New York-Los Angeles via Washington, Nashville and Dallas	2,739	3 times daily	16,434	"
New York-Los Angeles via Nashville and Fort Worth	2,689	2 times daily	10,756	"
New York-Fort Worth via Washington and Memphis	1,458	2 times daily	5,832	"
Dallas-Los Angeles	1,306	1 time daily	2,612	"
New York-Chicago via Buffalo and Detroit	760	6 times daily	9,120	"
New York-Chicago via Buffalo and Detroit	760	1 time daily	1,520	"
New York-Chicago via Buffalo, Detroit and South Bend	763	2 times daily	3,052	"
New York-Chicago (direct)	724	3 times daily	4,344	"
New York-Detroit	486	1 time daily	972	"
New York-Buffalo via Syracuse	328	2 times daily	1,312	"
New York-Syracuse	201	1 time daily	402	"
New York-Boston (direct)	184	12 times daily	4,416	"
New York-Boston via Hartford	186	4 times daily	1,508	"
New York-Boston via Providence	192	5 times daily	1,920	"
New York-Boston via Hartford and Providence	204	4 times daily	1,632	"
New York-Boston via Springfield	120	1 time daily	240	"
New York-Springfield	88	2 times daily	352	"
Boston-Newark (direct)	194	2 times daily	776	"
Boston-Newark via Hartford	196	1 time daily	392	"
Boston-Cleveland via Buffalo	585	1 time daily	1,170	"
Detroit-Chicago	247	1 time daily	494	"
Detroit-Chicago via South Bend	250	1 time daily	500	"
New York-Albany	136	1 time daily	272	"
Albany-Buffalo	265	1 time daily	530	"
Syracuse-Cleveland	320	1 time daily	640	"
Washington-Chicago via Cincinnati	653	3 times daily	3,918	"
Washington-Chicago (direct)	599	2 times daily	2,396	"
Washington-Cincinnati	398	1 time daily	796	"
Washington-Cincinnati via Charleston and Huntington	414	1 time daily	828	"
Chicago-Fort Worth via St. Louis and Oklahoma City	926	3 times daily	5,556	"
Cleveland-Nashville via Cincinnati	488	3 times daily	2,928	"
Cincinnati-Nashville	247	1 time daily	494	"
Chicago-Brownsville via Kansas City and Dallas	1,423	1 time daily	2,846	Braniff Airways, Inc.
Chicago-Dallas via Kansas City and Wichita	920	2 times daily	3,680	"
Dallas-Brownsville	514	1 time daily	1,028	"
Oklahoma City-Amarillo	243	1 time daily	486	"
Dallas-San Antonio	266	1 time daily	532	"
Amarillo-Galveston	605	1 time daily	1,210	"

United States Air Transport Routes (January 1, 1942)—Continued

Routes	Airway miles	Schedule (round trips)	Daily mileage	Operator
Amarillo-Houston	567	1 time daily	1,134	Braniff Airways, Inc.
Chicago-Houston via Kansas City, Wichita and Dallas	1,161	1 time daily	2,322	"
Dallas-Houston via Waco	265	1 time daily	530	"
Dallas-Corpus Christi via San Antonio	390	1 time daily	780	"
Houston-San Antonio	193	2 times daily	772	"
Houston-Brownsville	314	2 times daily	1,256	"
Dallas-Galveston	279	1 time daily	558	"
Wilmington-Avalon	31	2 times daily	124	Catalina Air Transport
Chicago-New Orleans	859	3 times daily	5,154	Chicago & Southern Airlines
Memphis-Houston	441	1 time daily	882	
Denver-El Paso	579	1 time daily	1,158	Continental Air Lines, Inc.
Denver-El Paso via Roswell and Hobbs	812	1 time daily	1,624	"
Denver-Wichita via Pueblo	509	1 time daily	1,018	"
Charleston-Fort Worth via Atlanta	1,084	2 times daily	4,336	Delta Air Corporation
Atlanta-Fort Worth	783	1 time daily	1,566	"
Atlanta-Birmingham	134	1 time daily	268	"
Atlanta-Savannah	250	2 times daily	500	"
Atlanta-Cincinnati via Knoxville	383	2 times daily	1,532	"
New York-Washington	214	8 times daily	3,424	Eastern Air Lines, Inc.
Newark-Washington	204	7 times daily	2,856	"
New York-Richmond	310	1 time daily	620	"
New York-Miami via Orlando	1,213	1 time daily	2,426	"
New York-Miami via Daytona Beach	1,197	3 times daily	7,182	"
Newark-Miami via Daytona Beach	1,187	2 times daily	4,748	"
Washington-Miami via Daytona Beach	972	1 time daily	1,944	"
New York-Raleigh	453	1 time daily	906	"
Jacksonville-Miami via Orlando	326	2 times daily	1,304	"
Jacksonville-Miami via Daytona Beach	330	1 time daily	660	"
Chicago-Jacksonville via Nashville and Atlanta	928	3 times daily	5,568	"
Chicago-Tampa via Louisville, Florence and Tallahassee	1,105	1 time daily	2,210	"
Memphis-Birmingham	232	1 time daily	464	"
Memphis-Tampa via Birmingham and Tallahassee	706	1 time daily	1,412	"
Chicago-St. Louis via Louisville	516	1 time daily	1,032	"
St. Louis-Atlanta	520	1 time daily	1,040	"
Chicago-Atlanta via Louisville and Chattanooga	644	1 time daily	1,288	"
Atlanta-Tampa via Tallahassee	432	2 times daily	1,728	"
New York-Atlanta	795	7 times daily	11,130	"
Atlanta-San Antonio via Birmingham and Montgomery	1,017	2 times daily	4,068	"
Atlanta-Houston via Birmingham	824	2 times daily	3,296	"
Atlanta-Brownsville via Montgomery and New Orleans	1,093	1 time daily	2,186	"
Cheyenne-Great Falls	573	2 times daily	2,292	Inland Airlines, Inc.
Cheyenne-Huron	559	2 times daily	2,236	"
Minneapolis-Minot via Huron	581	1 time daily	1,162	Mid-Continent Airlines, Inc.
Minneapolis-Tulsa via Sioux Falls	743	1 time daily	1,486	
Minneapolis-Tulsa via Huron	895	1 time daily	1,790	"
Minneapolis-St. Louis via Des Moines	519	1 time daily	1,038	"
Omaha-Kansas City	167	1 time daily	334	"
Des Moines-Kansas City	182	1 time daily	364	"

United States Air Transport Routes (January 1, 1942)—Continued

Routes	Airway miles	Schedule (round trips)	Daily mileage	Operator
Des Moines-St. Louis	265	1 time daily	530	Mid-Continent Airlines, Inc.
Jacksonville-Miami via Daytona Beach and Orlando	385	2 times daily	1,540	National Air Lines, Inc.
New Orleans-Jacksonville	510	2 times daily	2,040	"
Jacksonville-Tampa	194	1 time daily	388	"
Tampa-Miami	195	1 time daily	390	"
Boston-Bangor	217	3 times daily	1,302	Northeast Airlines, Inc.
Boston-Caribou	383	1 time daily	766	"
Boston-Burlington	184	2 times daily	736	"
Chicago-Seattle via Madison and Helena	1,817	1 time daily	3,634	Northwest Airlines, Inc.
Chicago-Seattle via Milwaukee and Butte	1,858	1 time daily	3,716	"
Chicago-Seattle via Minneapolis and Butte	1,828	1 time daily	3,656	"
Chicago-Minneapolis via Milwaukee and Rochester	395	1 time daily	790	"
Chicago-Minneapolis (direct)	357	1 time daily	714	"
Chicago-Minneapolis	357	2 times daily	1,428	"
Chicago-Milwaukee	82	2 times daily	328	"
Minneapolis-Duluth	145	2 times daily	580	"
Spokane-Portland via Yakima	296	2 times daily	1,184	"
Norfolk-Detroit via Pittsburgh	547	2 times daily	2,188	Pennsylvania-Central Airlines
Washington-Detroit	402	7 times daily	5,628	"
Washington-Cleveland	311	2 times daily	1,244	"
Norfolk-Washington	145	3 times daily	870	"
Detroit-Milwaukee via Muskegon	260	2 times daily	1,040	"
Cleveland-Detroit	91	1 time daily	182	"
Akron-Detroit	123	1 time daily	246	"
Grand Rapids-Milwaukee	114	1 time daily	228	"
Grand Rapids-Chicago	132	2 times daily	528	"
Detroit-Chicago via Grand Rapids	272	1 time daily	544	"
Buffalo-Washington	329	3 times daily	1,974	"
Washington-Pittsburgh	185	1 time daily	370	"
Pittsburgh-Buffalo	215	1 time daily	430	"
Detroit-Sault Ste. Marie	347	2 times daily	1,388	"
Pittsburgh-Knoxville	435	1 time daily	870	"
Norfolk-Knoxville	473	1 time daily	946	"
Knoxville-Birmingham	222	2 times daily	888	"
New York-Los Angeles via Pittsburgh, St. Louis and Kansas City	2,541	2 times daily	10,164	Transcontinental & Western Air
New York-Los Angeles via Chicago and Kansas City	2,563	2 times daily	10,252	"
New York-Los Angeles via Pittsburgh, Kansas City and Boulder City	2,573	1 time daily	5,146	"
New York-Kansas City via Philadelphia, Pittsburgh and Chicago	1,171	1 time daily	2,342	"
New York-Kansas City via Chicago	1,129	1 time daily	2,258	"
New York-Kansas City via Pittsburgh and St. Louis	1,119	2 times daily	4,476	"
New York-Chicago via Philadelphia, Pittsburgh, Columbus and Ft. Wayne	819	2 times daily	3,276	"
New York-Chicago (direct)	724	1 time daily	1,448	"
New York-Chicago via Philadelphia and Pittsburgh	766	2 times daily	3,064	"
New York-Pittsburgh	348	2 times daily	1,392	"
New York-Pittsburgh (direct)	320	3 times daily	1,920	"
Pittsburgh-Kansas City	825	1 time daily	1,650	"
Pittsburgh-Chicago	471	1 time daily	942	"
Pittsburgh-Chicago (direct)	420	1 time daily	840	"

United States Air Transport Routes (January 1, 1942)—Continued

Routes	Airway miles	Schedule (round trips)	Daily mileage	Operator
Phoenix-San Francisco	683	1 time daily	1,366	Transcontinental & Western Air
Detroit-Cincinnati	241	2 times daily	964	
Pittsburgh-Cincinnati via Dayton	286	2 times daily	1,144	"
Detroit-St. Louis via Cincinnati	562	1 time daily	1,124	"
Chicago-Los Angeles	1,832	1 time daily	3,664	"
Kansas City-Los Angeles	1,456	1 time daily	2,912	"
New York-Chicago (direct)	724	2 times daily	2,896	United Air Lines Transport Corp.
New York-Chicago via Cleveland and Toledo	725	5 times daily	7,250	"
New York-Chicago via Allentown and South Bend	806	1 time daily	1,612	"
New York-Chicago via Philadelphia, Cleveland and Toledo	763	3 times daily	4,578	"
New York-Chicago via Philadelphia, Allentown and Cleveland	806	1 time daily	1,612	"
Chicago-San Francisco via Cheyenne and Salt Lake City	1,876	3 times daily	11,256	"
Chicago-San Francisco via Omaha and Denver	1,899	2 times daily	7,596	"
Chicago-Salt Lake City	1,294	1 time daily	2,588	"
Chicago-Omaha	429	1 time daily	858	"
Chicago-Seattle via Cheyenne and Boise	1,563	1 time daily	3,126	"
Omaha-Lincoln	55	1 time daily	110	"
Cheyenne-Denver	96	3 times daily	576	"
Pendleton-Portland	188	1 time daily	376	"
Pendleton-Spokane	158	2 times daily	632	"
Salt Lake City-Seattle via Portland	773	2 times daily	3,092	"
Oakland-Los Angeles via Monterey	364	2 times daily	1,456	"
Oakland-Los Angeles via Fresno	342	3 times daily	2,052	"
Oakland-San Diego	450	1 time daily	900	"
Seattle-San Diego via Fresno	1,164	1 time daily	2,328	"
Seattle-Los Angeles via Sacramento and San Francisco	1,031	1 time daily	2,062	"
Seattle-Los Angeles via Medford and San Francisco	1,008	1 time daily	2,016	"
Seattle-Portland	138	3 times daily	828	"
Oakland-Los Angeles (direct)	327	2 times daily	1,308	"
Portland-San Diego via Sacramento	1,016	1 time daily	2,032	"
Sacramento-San Francisco	79	2 times daily	316	"
Salt Lake City-Lethbridge via Great Falls	646	1 time daily	1,292	Western Air Lines, Inc.
Great Falls-Salt Lake City	484	1 time daily	968	"
Salt Lake City-San Diego via Los Angeles	713	1 time daily	1,426	"
Salt Lake City-Los Angeles	590	3 times daily	3,540	"
Los Angeles-San Diego	123	2 times daily	492	"
Total Domestic Routes	41,915		380,292	

U. S. DOMESTIC AIR CARRIER OPERATIONS

And Accident Statistics for the Calendar Years 1939, 1940 and 1941

	1939	1940	1941
Miles Flown	82,571,523	108,800,436	133,022,679
Total Passengers Carried	1,876,051	2,959,480	4,060,545
Total Passenger Miles	749,787,096	1,147,444,948	1,491,734,671
Fatal Accidents	2	3	4
Fatal Passenger Accidents	2	3	4
Passenger Fatalities	9	35	35
Crew Fatalities	2	10	9
Miles Flown per Fatal Accident	41,285,762	36,266,812	33,255,670
Miles Flown per Fatal Passenger Accident	41,285,762	36,266,812	33,255,670
Passenger Miles Flown per Passenger Fatality	83,309,677	32,784,141	42,620,991
Miles Flown per Crew Fatality	41,285,762	10,880,044	14,780,298

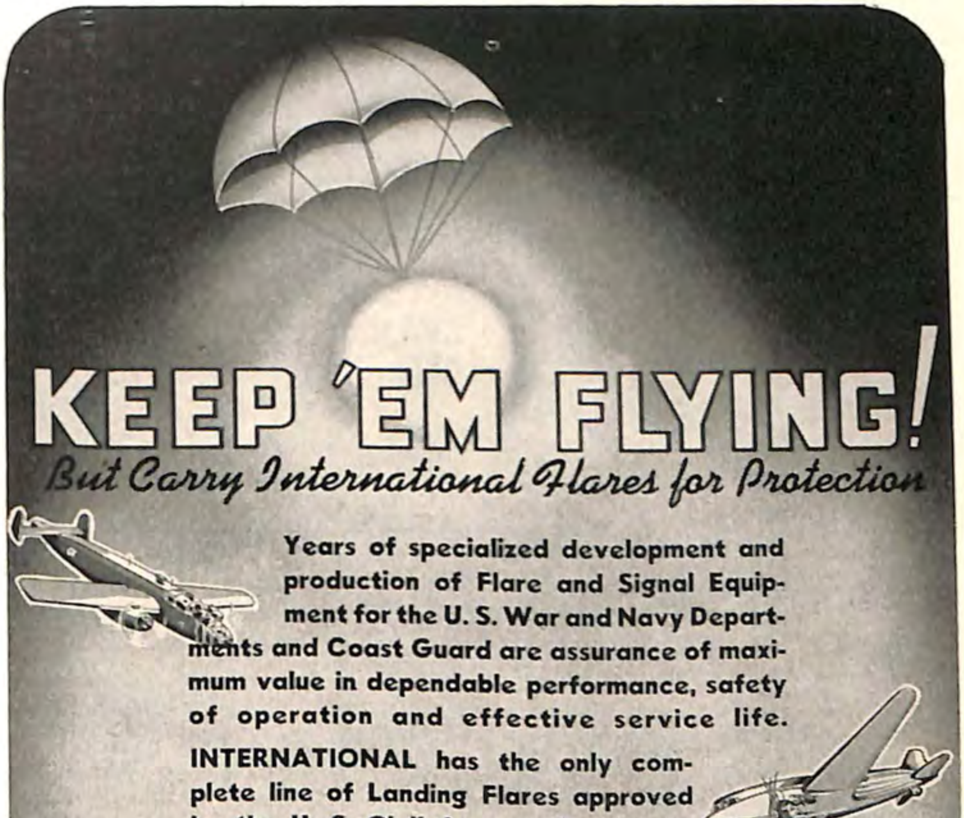
CIVIL AERONAUTICS ADMINISTRATION FUNDS

APPROPRIATIONS FOR FISCAL YEARS 1939, 1940, 1941

	1939	1940	1941
General administration	....	....	$1,078,200
Maintenance of air navigation facilities	....	....	11,896,550
Technical development	....	....	557,000
Enforcement of safety regulations	....	....	2,484,453
Establishment of air navigation facilities	$4,575,000	$7,000,000	5,265,280
Establishment of air navigation facilities, 1941-42	....	....	2,091,000
Civilian Pilot Training	5,675,000	4,000,000	36,814,504
Maintenance and operation, Washington National Airport	....	....	255,650
Development of landing areas	....	....	40,000,000
Construction of hangars	....	....	2,700,000
Emergency relief, Commerce, administrative expenses	325,000	250,000	175,000
Printing and binding, Commerce	....	72,900	72,900
Salaries and expenses, Civil Aeronautics Authority	....	14,144,065	....
Civil Aeronautics Authority fund	[1] 10,437,675	....	....
Total	21,012,675	25,466,965	103,390,537

[1] Includes appropriations consolidated as follows:

Civil Aeronautics Authority Fund, 1939 (supplemental appropriation)	$1,186,195
Salaries, Bureau of Air Commerce	650,000
Maintenance of Air Navigation Facilities	6,758,680
Aircraft in Commerce	1,249,800
Safety and Planning	258,000
Purchase and Maintenance of Aircraft	335,000


KEEP 'EM FLYING!
But Carry International Flares for Protection
Years of specialized development and production of Flare and Signal Equipment for the U. S. War and Navy Departments and Coast Guard are assurance of maximum value in dependable performance, safety of operation and effective service life.
INTERNATIONAL has the only complete line of Landing Flares approved by the U. S. Civil Aeronautics Administration to meet their full range of weight classification requirements for commercial aircraft. The C.A.A. uses INTERNATIONAL Flares on its own planes.
INTERNATIONAL also makes many special types of pyrotechnics to specification for military and commercial aviation, both domestic and foreign.
WRITE FOR COMMERCIAL CATALOG
INTERNATIONAL FLARE-SIGNAL DIV.
of THE KILGORE MFG. CO., Tipp City, Ohio

U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1941

Mileage and cost of service on Government-operated and private-carrier-operated domestic air mail routes and amount of annual appropriation, for the fiscal years 1918 to 1941, inclusive.

Fiscal Year	*Revenue Miles Flown*	*Cost of Service*	*Average Cost per Mile*	*Appropriation*
Government operation:				
1918	16,009	$13,604.00	$ .850	$100,000
1919	160,066	717,177.00	4.481	100,000
1920	549,244	1,264,495.00	2.302	850,000
1921	1,554,985	2,653,882.00	1.707	1,375,000
1922	1,537,927	1,418,146.00	.922	1,425,000
1923	1,590,637	1,897,151.00	1.193	1,900,000
1924	1,522,763	1,498,674.00	.984	1,500,000
1925	2,076,764	2,743,750.00	1.321	2,750,000
1926	2,256,137	2,782,422.00	1.233	2,885,000
1927	2,329,553	2,255,919.00	.968	2,650,000
1928	173,987	166,314.00	.956	2,150,000
Operation by private carriers:				
1926	396,345	89,753.71	.226	500,000
1927	2,805,781	1,363,227.82	.486	2,000,000
1928	5,585,224	4,042,777.16	.724	4,500,000
1929	10,212,511	11,169,015.13	1.094	12,430,000
1930	14,939,468	14,618,231.50	.978	15,000,000
1931	21,381,852	16,943,605.56	.792	18,000,000
1932	32,202,170	19,938,122.61	.619	20,000,000
1933	35,909,811	19,400,264.81	.540	19,460,000
1934	29,111,474	[1]12,129,959.64	.417	15,000,000
1935	31,148,693	8,834,732.43	.284	[2]12,003,291
1936	38,700,643	12,177,682.47	.315	12,247,500
1937	39,958,771	13,165,574.73	.329	13,239,000
1938	46,166,192	14,741,249.42	.319	14,831,403
1939	52,048,627	[1]16,767,934.50	.322	17,240,000
1940	59,177,525	[1]18,855,305.82	.319	19,489,303
1941	74,297,154	[1]20,332,528.00	.274	20,440,199

[1] Subject to final adjustment.

[2] $3,291 of this amount was a special appropriation for the purpose of salary restoration.

Statistical report showing the total mileage of domestic air mail routes, the miles of service scheduled and actually flown, and the cost of air mail service for the fiscal years 1926-41

Fiscal Year	*Miles of Route*	*Miles of Service*		*Percentage of Performance*	*Cost of Service*
		Scheduled	*Actually Flown*		
1926	3,597	411,070	396,345	96.42	$89,753.71
1927	5,551	3,092,016	2,805,781	90.74	1,363,227.82
1928	10,932	5,999,948	5,585,224	93.09	4,042,777.16
1929	14,406	11,032,508	10,212,511	92.57	11,169,015.13
1930	14,907	16,228,453	14,939,468	92.06	14,618,231.50
1931	23,488	22,907,169	21,381,852	93.34	16,943,605.56
1932	26,745	34,509,483	32,202,170	93.31	19,938,122.61
1933	27,679	38,114,425	35,909,811	94.22	19,400,264.81
1934	28,820	31,223,641	29,111,474	93.24	[1]12,129,959.64
1935	28,884	33,770,909	31,148,693	92.24	8,834,732.43
1936	29,198	40,802,141	38,700,643	94.85	12,177,682.47
1937	29,622	42,051,957	39,358,771	95.02	13,165,574.73
1938	33,655	48,735,120	46,166,192	94.73	14,741,249.42
1939	37,080	54,188,438	52,087,028	96.12	16,781,496.25
1940	37,943	60,812,957	59,177,525	97.31	[1]18,855,305.82
1941	43,411	78,750,326	74,297,154	94.34	[1]20,332,528.00

[1] Subject to final adjustment.

U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1941

Domestic air mail pound-miles flown by months for fiscal years 1938 to 1941, inclusive.

	1938	1939	1940	1941
July	1,124,011,779	1,199,405,168	1,385,499,649	1,633,813,933
August	1,151,850,637	1,272,873,777	1,485,990,995	1,718,622,237
September	1,146,872,384	1,235,017,708	1,421,434,001	1,673,399,938
October	1,202,650,061	1,299,263,414	1,509,325,589	1,866,008,205
November	1,121,521,232	1,251,886,341	1,472,644,377	1,667,748,879
December	1,233,749,611	1,430,568,176	1,771,255,973	1,890,058,683
January	1,107,694,279	1,243,868,119	1,535,184,033	1,761,226,024
February	1,057,451,924	1,220,711,135	1,500,226,200	1,813,348,177
March	1,278,562,116	1,447,382,546	1,681,791,500	2,018,484,815
April	1,155,775,372	1,355,973,784	1,628,338,205	2,061,880,065
May	1,302,524,805	1,434,681,315	1,682,614,516	2,105,826,655
June	1,254,696,591	1,426,985,889	1,597,062,402	2,083,004,549
Total	14,137,360,791	15,818,617,372	18,671,367,440	22,293,422,160

New air mail routes started during fiscal year 1941

Route	*Termini*	*Carrier*	*Starting Date*
46	Buffalo, N. Y.-Pittsburgh, Pa.	Pennsylvania-Central Airlines Corporation	Oct. 15, 1940
47	St. Louis, Mo.-Nashville, Tenn.	Eastern Air Lines, Inc.	do.
48	Minneapolis, Minn.-Kansas City, Mo.-St. Louis, Mo.	Mid-Continent Airlines, Inc.	Nov. 1, 1940
49-A	Pittsburgh, Pa.-Huntington, W. Va.	All American Aviation, Inc.	Aug. 12, 1940
49-B	Pittsburgh, Pa.-Huntington, W. Va.	do.	Nov. 12, 1940
49-D	Pittsburgh, Pa.-Jamestown, N. Y.	do.	Aug. 12, 1940
49-E	Pittsburgh, Pa.-Williamsport, Pa.	do.	Dec. 12, 1940
49-F	Pittsburgh, Pa.-Philadelphia, Pa.	do.	Aug. 12, 1940
50	Houston-San Antonio-Corpus Christi, Tex.	Braniff Airways, Inc.	Oct. 15, 1940
51	Norfolk, Va.-Knoxville, Tenn.	Pennsylvania-Central Airlines Corporation	Nov. 1, 1940
52	Great Falls, Mont.-Lethbridge, Can.	Western Air Lines, Inc.	June 12, 1941
53	Houston, Tex.-Memphis, Tenn.	Chicago & Southern Air Lines, Inc.	do.
57	Seattle Wash.-Vancouver, Can.	United Air Lines Transport Corporation	May 12, 1941

U. S. FOREIGN AIR MAIL

From annual report of the Postmaster General For Fiscal Year 1941
Air mail service to foreign countries during fiscal year 1941

Route	Service Scheduled	Service Performed	Percentage of Performance	Compensation
	Miles	*Miles*		
1. New York to Montreal	449,791.0	432,547.0	96.17	$259,528.20
5. Miami to Cristobal (direct)	123,002.0	122,973.1	99.98	231,728.26
Miami to Barranquilla	259,535.1	259,535.1	100.00	519,564.84
Miami to Habana	117,485.5	117,485.5	100.00	234,971.00
Barranquilla to Cristobal	40,237.6	40,237.6	100.00	72,427.68
San Salvador to Cristobal	276,598.1	276,288.6	99.89	497,457.24
Port of Spain to Paramaribo	219,125.2	219,125.2	100.00	382,087.39
Barranquilla to Port of Spain	200,389.2	200,389.2	100.00	360,508.80
6. Miami to San Juan	550,362.3	545,470.7	99.11	960,198.45
San Juan to Port of Spain	264,069.1	263,099.1	99.63	385,955.85
7. Miami to Nassau[1]	25,950.0	25,950.0	100.00	32,437.50
8. Brownsville to Mexico City	338,282.0	338,272.2	99.99	608,889.96
Mexico City to San Salvador	248,928.9	248,882.3	99.98	448,147.20
9. Cristobal to Buenos Aires	1,625,819.2	1,608,862.7	98.96	2,413,027.78
10. Paramaribo to Buenos Aires	1,443,605.6	1,443,529.9	99.99	2,171,576.93
14. San Francisco to Hong Kong/ Singapore[2]	920,996.0	888,542.0	96.48	(3)
15. Juneau to Whitehorse	17,650.5	17,612.1	99.78	27,457.08
16. Fairbanks to Whitehorse	51,628.5	51,615.3	99.97	41,726.32
17. New York to Hamilton, Bermuda[1]	83,142.0	67,680.0	81.40	144,500.00
18. New York to Lisbon, Portugal[1]	539,376.0	371,860.0	68.94	2,418,331.90
19. San Francisco to Auckland[4]	406,266.0	406,266.0	100.00	(5)
20. Seattle to Juneau	214,639.0	174,785.0	81.43	(5)
21. Bangor, Maine, to Moncton[6]	155,372.0	114,576.0	73.74	41,247.36
Total	[7]8,572,250.8	[7]8,235,584.6	[7]96.07	....

[1] One way. [2] Service extended to Singapore—May 3, 1941. [3] No compensation shown since rate of payment is subject to adjustment by Civil Aeronautics Board. [4] Service commenced—July 12, 1940. [5] Compensation not shown as rate of payment is yet to be fixed by Civil Aeronautics Board. [6] Service commenced—Jan. 3, 1941. [7] Subject to final adjustment.

Mileage and cost of service on United States foreign air mail routes and amount of annual appropriation, for the fiscal years 1928 to 1941, inclusive.

Fiscal Year	Miles Flown	Cost of Service	Average Cost per Mile	Appropriation
1928	99,530.0	$147,950.00	$1.49	$150,000
1929	738,712.0	1,150,711.96	1.56	2,050,000
1930	2,503,595.0	4,300,000.00	1.72	4,300,000
1931	3,535,864.0	6,564,858.17	1.86	6,600,000
1932	3,778,729.0	6,962,984.28	1.84	7,000,000
1933	3,775,454.5	6,948,188.77	1.84	7,000,000
1934	3,767,102.0	6,942,375.29	1.84	7,000,000
1935	3,682,621.0	6,828,178.06	1.85	7,000,000
1936	3,754,537.3	6,610,271.15	1.76	8,000,000
1937	4,448,608.3	7,880,001.17	1.77	8,230,000
1938	4,994,557.6	8,579,524.57	1.72	9,905,860
1939	5,357,405.1	9,313,216.48	1.74	10,352,275
1940	5,909,372.0	12,424,721.69	2.10	12,649,520
1941	8,235,584.6	(1)	(1)	16,247,149

[1] Amount not determined because rates are not yet fixed by Civil Aeronautics Board for part of service.

PROGRESS OF CIVIL AERONAUTICS IN THE UNITED STATES

[All statistics are as of Dec. 31 each year]

Compiled by Civil Aeronautics Administration

	1939	1940	1941
SCHEDULED AIR-CARRIER OPERATIONS			
Airplanes:			
In service and reserve:			
Domestic[1]	265	358	360
Airways (domestic, international, and territorial):[1]			
Services in operation	170	211	220
Express mileage	79,562	94,079	93,400
Mail mileage	74,338	90,369	89,100
Passenger mileage	80,109	94,079	93,400
Total mileage:			
Domestic[1]	36,581	41,054	43,400
International and territorial[1]	43,528	53,025	50,000
Total	80,109	94,079	93,400
Accidents:			
Domestic:[1]			
Number of accidents	33	42	33
Miles flown per accident	2,502,167	2,590,487	4,030,990
Fatal accidents	2	3	4
Miles flown per fatal accident	41,285,762	36,266,812	33,255,670
Fatal accidents per 1,000,000 miles flown	0.02	0.03	0.03
Pilot fatalities	1	3	3
Miles flown per pilot fatality	82,571,523	36,266,812	44,340,893
Copilot fatalities	1	3	3
Crew fatalities (other than pilot and copilot)	1	4	3
Passenger fatalities	9	35	35
Passenger miles flown per passenger fatality	83,309,677	32,784,141	42,620,991
Ground crew and third party fatalities	0	0	0
Passenger fatalities per 100,000,000 passenger miles flown	1.20	3.05	2.35
Total fatalities	12	45	44
Fatalities per 1,000,000 miles flown	0.15	0.41	0.33
Express and freight carried:			
Pounds (domestic)[1]	9,514,229	12,506,176	19,209,671
Miles flown (revenue):			
Domestic routes[1]	82,571,523	108,800,436	133,022,679
Passenger-miles flown (1 passenger carried 1 mile):			
Domestic,[1] revenue	677,672,955	1,041,173,558	1,369,784,231
Domestic,[1] revenue and nonrevenue	749,787,096	1,147,444,948	1,491,734,671
Passengers carried:			
Domestic,[1] revenue	1,717,090	2,727,820	3,768,892
Domestic,[1] revenue and nonrevenue	1,876,051	2,959,480	4,060,545
Passenger seat-miles flown (domestic)[1]	1,207,869,577	1,797,329,431	2,316,205,507
Passenger load factor:			
Domestic[1] revenue (percent)	56.10	57.93	59.13
PRIVATE FLYING OPERATIONS (All domestic)			
Airplanes in operation (certificated and uncertificated)	12,274	16,903	21,600

PROGRESS OF CIVIL AERONAUTICS IN THE UNITED STATES —Continued—

	1939	1940	1941
AIRPORTS AND LANDING FIELDS			
Airports:			
Commercial	456	496	930
Municipal	643	788	1,086
Intermediate—C. A. A.—lighted	266	289	283
Intermediate—C. A. A.—unlighted	0	0	0
Auxiliary—marked	665	507	(1)
Army, Navy, Marine Corps, National Guard, Reserve, Private, and miscellaneous airports	250	251	185
Total airports in operation	2,280	2,331	2,484[2]
Lighted, total	735	776	662
FEDERAL AIRWAYS SYSTEM AND AIDS TO AIR NAVIGATION			
Communication:			
Radio broadcast stations	92	111	125
Radio range beacon stations	244	281	312
Radio marker beacons	48	42	48
Weather reporting airway and airport stations: Weather Bureau and C. A. A. operated, longline teletypewriter equipped	298	376	453
Traffic control stations teletypewriter equipped	114	129	139
Miles of weather reporting teletypewriter service	26,803	28,052	55,268
Miles of traffic control teletypewriter service	9,939	12,260	12,621
Airway lighting:			
Beacons:			
Revolving and flashing listed together for 1926 to 1929	....	....	....
Revolving	1,875	2,045	2,274
Flashing	214	216	164
Beacons—privately owned and certified	650	720	....
Intermediate landing fields, lighted	274	289	283
Mileage lighted	27,074	30,480	32,679
Miles under construction at close of year	2,192	496	780
CERTIFICATES			
Certificated (active):			
Airplanes	12,829	17,351	24,836
Gliders	44	39	65
Instructors, ground	446	1,948	4,815
Mechanics	10,296	11,177	14,047
Pilots, airplane	31,264	63,113	100,787
Pilots, glider	170	138	164
Riggers, parachute	425	444	618

[1] Auxiliary are now classified as to ownership, commercial or municipal.
[2] Does not include airports in Alaska.

EXPORTS OF U. S. AERONAUTIC PRODUCTS

Compiled by Bureau of Foreign and Domestic Commerce
Motive Products Division

Year[1]	Aircraft		Engines		Parts and Accessories	Parachutes and Parts	Total Value
	No.	Value	No.	Value			
1912	29	$ 105,805	Not reported prior to 1922; probably included with "other" internal combustion engines or "parts" of aircraft.			"Parachutes and Parts" were not reported until 1932.	$ 105,805
1913	29	81,750			$ 25,802		107,552
1914	34	188,924			37,225		226,149
1915	152	958,019			583,427		1,541,446
1916	269	2,158,395			4,843,610		7,002,005
1917	135	1,001,542			3,133,903		4,135,445
1918	20	206,120			8,877,977		9,084,097
1918 (2nd half)	41	562,600			9,139,781		9,702,381
1919	44	215,300			3,249,226		3,464,526
1920	65	598,274			554,375		1,152,649
1921	48	314,940			157,608		472,548
1922	37	156,630	147	$ 72,819	265,481		494,930
1923	48	309,051	80	65,558	58,949		433,558
1924	59	412,738	146	219,609	165,926		798,273
1925	80	511,282	73	170,793	101,584		783,659
1926	50	303,149	297	573,732	150,329		1,027,210
1927	63	848,568	84	484,875	570,117		1,903,560
1928	162	1,759,653	179	664,826	1,240,244		3,664,723
1929	348	5,484,600	322	1,383,197	2,257,548		9,125,345
1930	321	4,819,669	376	1,634,985	2,363,456		8,818,110
1931	140	1,812,809	307	1,432,229	1,622,649		4,867,687
1932	280	4,358,967	2,356[2]	1,517,682	1,756,421	$ 313,462	7,946,532
1933	406	5,891,493	2,903[2]	1,452,341	2,249,172	87,322	9,180,328
1934	490	8,195,484	1,009	4,458,701	4,860,567	148,186	17,662,938
1935	333	6,598,515	568	2,459,317	5,069,810	163,201	14,290,843
1936[3]	527	11,601,893	933	5,182,469	6,060,488	298,353	23,143,203
1937[4]	631	21,085,170	1,048	5,946,054	12,105,474	267,771	39,404,469
1938[5]	876	37,977,924	1,309	7,899,844	21,948,982	400,939	68,227,689
1939[6]	1,221	67,111,866	1,880	14,120,035	35,798,922	775,389	117,806,212
1940[7]	3,532	196,352,315	4,986	49,873,823	64,462,409	1,068,779	311,757,326
1941 (1st 8 mo.)	3,619	254,548,316	5,231	57,243,148	66,948,249	331,895	379,071,608
Total	14,089	$636,031,761	24,234	$156,856,037	$260,659,711	$3,855,297	$1,057,402,806

[1] Exports of aeronautic products were not reported separately prior to 1912. The data are for fiscal years (ending June 30) prior to 1919; later data are for calendar years.

[2] Russia bought 2,010 engines for $261,334 in 1932 and 2,576 for $255,400 in 1933.

[3] Under "aircraft" are included 24 seaplanes and amphibions at $1,525,540.

[4] Under "aircraft" are included 33 seaplanes and amphibions at $3,386,597.

[5] Under "aircraft" are included 14 seaplanes and amphibions at $607,030 and 1 engineless, heavier-than-aircraft at $600.

[6] Under "aircraft" are included 8 seaplanes and amphibions valued at $873,425 and 1 glider valued at $130.

[7] Under "aircraft" are included 26 seaplanes and amphibions valued at $1,541,156 and 72 engineless planes at $3,436,465 and 9 gliders valued at $5,090.

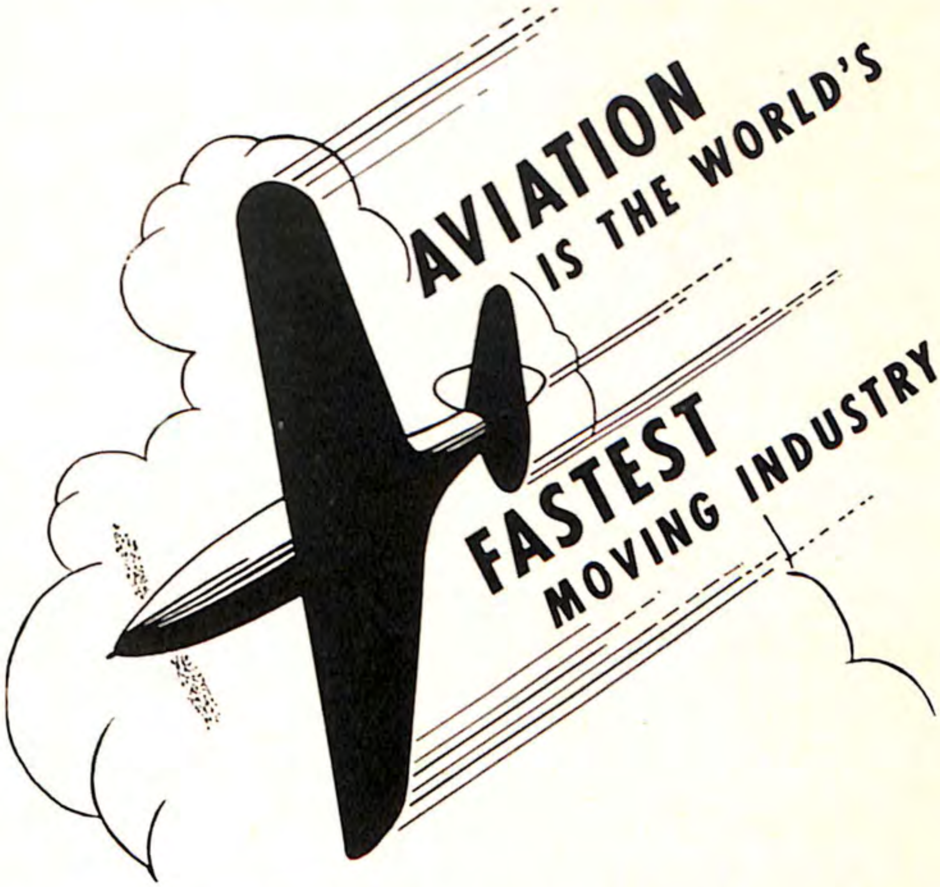
LICENSED PILOTS IN THE UNITED STATES

January 1, 1942

Compiled by Civil Aeronautics Administration

State	Certificated Pilots				
	Jan. 1, 1942	*Jan. 1, 1941*	*Percent Increase*	*Jan. 1, 1940*	*Jan. 1, 1939*
Alabama	977	661	47.8	210	160
Arizona	740	451	64.1	183	125
Arkansas	1,260	603	109.0	124	110
California	12,053	8,285	45.5	5,193	4,207
Colorado	1,495	960	55.7	355	222
Connecticut	930	592	57.1	417	350
Delaware	261	205	27.3	82	64
District of Columbia	816	560	45.7	362	308
Florida	2,500	1,462	71.0	748	580
Georgia	1,550	1,072	44.6	435	215
Idaho	758	523	44.9	185	128
Illinois	5 039	3,033	66.1	1,817	1,353
Indiana	2,060	1,416	45.5	909	585
Iowa	2,299	1,261	82.3	598	384
Kansas	2,399	1,326	80.9	430	281
Kentucky	649	375	73.1	181	117
Louisiana	1,479	1,000	47.9	321	253
Maine	531	330	60.9	184	125
Maryland	1,155	758	52.4	408	280
Massachusetts	2,527	1,728	46.2	1,062	781
Michigan	3,820	2,208	73.0	1,203	935
Minnesota	2,251	1,053	113.8	544	353
Mississippi	774	468	65.4	141	107
Missouri	3,215	2 075	54.9	738	525
Montana	849	544	56.1	159	114
Nebraska	1,365	879	55.3	294	176
Nevada	235	174	35.1	57	34
New Hampshire	410	280	46.4	129	85
New Jersey	2,549	1,630	56.4	976	762
New Mexico	611	364	67.9	69	66
New York	7,395	4,863	52.1	2,636	2,091
North Carolina	1,412	757	86.5	518	222
North Dakota	637	385	65.5	103	72
Ohio	4,251	2,654	60.2	1,471	1,128
Oklahoma	2,612	1,448	80.4	429	290
Oregon	1,601	921	73.8	409	259
Pennsylvania	5,354	3,452	55.1	1,882	1,335
Rhode Island	377	209	80.4	109	71
South Carolina	1,057	627	68.6	208	103
South Dakota	644	442	45.7	136	106
Tennessee	1,646	1,086	51.6	417	285
Texas	6,842	3,918	74.6	1,384	1,002
Utah	930	545	70.6	152	126
Vermont	300	207	44.9	92	75
Virginia	1,459	1,018	43.3	552	412
Washington	2,515	1,709	47.2	875	525
West Virginia	1,129	721	56.6	271	183
Wisconsin	1,690	929	81.9	467	334
Wyoming	396	238	66.4	113	90
Alaska	232	184	26.1	125	95
Canada[1]	180	44	309.1	35	29
Canal Zone	46	37	24.3	37	51
Hawaii	274	254	7.9	157	146
Mexico[1]	8	8	0	6	6
Philippine Islands	33	21	57.1	21	24
Puerto Rico	57	45	26.7	16	12
Foreign, Miscellaneous	153	115	33.0	129	126
Totals	100,787[2]	63,113[3]	59.7	31,264	22,983

[1] Figures for these countries are for pilots registered by the United States.
[2] Includes 3,206 women pilots divided as follows: 184 commercial, 13 limited commercial, and 3,009 private.
[3] Includes 2,145 women pilots divided as follows: 113 commercial, 27 limited commercial, 1,803 private, and 202 solo.


AVIATION
IS THE WORLD'S
FASTEST
MOVING INDUSTRY

LICENSED PILOTS—(Cont'd)

Certificated Pilots Classified by Grades

	Air Line	*Commercial*	*Limited Commercial*	*Private*	*Solo*	*Totals*
January 1, 1942..	1,587	15,142	287[4]	83,771	0[4]	100,787
January 1, 1941..	1,431	9,616	535	47,673	3,858	63,113
January 1, 1940..	1,197	7,292	988	13,452	8,335	31,264
January 1, 1939..	1,159	6,834	1,005	10,676	3,309	22,983

[4] Civil Air Regulations effective May 1, 1940, as amended, provided for discontinuance of solo pilot certificates and of limited commercial pilot certificates on May 1, 1942, which accounts for the drop in number of these two classes of certificates.

U. S. CIVILIAN PILOT TRAINING PROGRAM

Statistics of Flight Training of the U. S. Civil Aeronautics Administration's Civilian Pilot Training Program.

Flight Courses Given by Civilian Pilot Training Sessions

Sessions	*Elementary Trainees*	*Secondary Trainees*
Feb., 1939-June, 1939	330	
Nov., 1939-June, 1940	10,461	84
July, 1940-Sept., 1940	17,318	1,167
Oct., 1940-Jan., 1941	15,132	2,679
Feb., 1941-June, 1941	14,923	4,135
July, 1941-Sept., 1941	9,649	3,413
Oct., 1941-Jan., 1942	7,900	3,176
Total	75,713	14,654

Private Pilots Certificated 57,924
8,000 Elementary Trainees had not taken final flight tests Jan. 1, 1942.

Instructor and Refresher Courses

Course	*Trainees*
Primary Instructor Refresher	4,377
Advanced Instructor Refresher	2,401
Commercial Pilot's Refresher	2,298
Student Apprentice Instructor	1,593
	10,669

Advanced Flight Courses

Course	*Trainees*
Instructor in Cross Country	333
Cross Country Course	2,728
Instructor Course	2,701
Flight Officers Course	49
	5,811

Pan American Phase of 1941

Countries Represented	*Trainees*
13	33

Summary

Total Number of Civilian Pilot Training Courses	106,880
Number of Colleges participating in 1941	717
Number of Non College Centers in 1941	176

U. S. CIVILIAN PILOT TRAINING PROGRAM

Cumulative totals in the Civilian Pilot Training Program of the U. S. Civil Aeronautics Administration, from the beginning of the program to February 1, 1942.

States	Number of Trainees	
	Elementary	Secondary
Alabama	1,235	277
Arizona	609	148
Arkansas	1,364	209
California	8,198	1,802
Colorado	1,431	409
Connecticut	455	69
Delaware	145	49
District of Columbia	*	*
Florida	1,275	276
Georgia	1,193	164
Idaho	642	123
Illinois	2,789	402
Indiana	1,824	402
Iowa	2,137	361
Kansas	2,364	535
Kentucky	495	39
Louisiana	1,507	362
Maine	527	129
Maryland	954	263
Massachusetts	1,712	374
Michigan	2,865	400
Minnesota	1,527	338
Mississippi	887	20
Missouri	2,867	667
Montana	787	235
Nebraska	1,302	208
Nevada	236	31
New Hampshire	378	41
New Jersey	1,316	248
New Mexico	601	93
New York	4,041	910
North Carolina	1,477	190
North Dakota	696	87
Ohio	3,217	457
Oklahoma	2,195	407
Oregon	1,249	282
Pennsylvania	3,152	356
Rhode Island	483	96
South Carolina	1,098	211
South Dakota	587	83
Tennessee	1,439	323
Texas	5,406	1,313
Utah	954	139
Vermont	375	—
Virginia	1,124	141
Washington	2,043	444
West Virginia	988	179
Wisconsin	1,161	241
Wyoming	300	121
State Totals	75,607	14,654
Territories		
Alaska	52	—
Hawaii	43	—
Puerto Rico	11	—
Territory Totals	106	—
Total Elementary and Secondary Trainees	75,713	14,654

* District of Columbia trainees receive their flight training in Maryland and Virginia.

NON-MILITARY AIRCRAFT OF THE UNITED STATES

January 1, 1942

Compiled by Civil Aeronautics Administration

State	Certificated Aircraft				
	Jan. 1, 1942	*Jan. 1, 1941*	*Percent Increase*	*Jan. 1, 1940*	*Jan. 1, 1939*
Alabama	185	119	55.5	88	60
Arizona	156	103	51.5	79	64
Arkansas	211	149	41.6	75	47
California	2,404	1,753	37.1	1,431	1,107
Colorado	248	169	46.7	136	92
Connecticut	274	198	38.4	158	149
Delaware	134	89	50.6	62	54
District of Columbia	311	214	45.3	149	117
Florida	564	389	45.0	293	234
Georgia	380	241	57.7	155	136
Idaho	123	92	33.7	63	51
Illinois	1,370	992	38.1	874	663
Indiana	687	519	32.4	410	314
Iowa	549	381	44.1	245	184
Kansas	501	382	31.2	205	164
Kentucky	176	118	49.2	89	63
Louisiana	284	208	36.5	134	109
Maine	203	134	51.5	113	98
Maryland	373	230	62.2	157	122
Massachusetts	594	406	46.3	322	264
Michigan	1,017	723	40.7	559	428
Minnesota	600	401	49.6	275	194
Mississippi	155	116	33.6	111	94
Missouri	649	505	28.5	331	239
Montana	170	130	30.8	76	55
Nebraska	224	166	34.9	152	119
Nevada	71	50	42.0	28	30
New Hampshire	90	58	55.2	48	39
New Jersey	698	496	40.7	388	273
New Mexico	164	76	115.8	37	31
New York	1,765	1,323	33.4	1,091	932
North Carolina	496	352	40.9	231	166
North Dakota	129	102	26.5	68	48
Ohio	1,286	899	43.0	748	556
Oklahoma	526	362	45.3	243	198
Oregon	334	210	59.0	149	111
Pennsylvania	2,357	1,438	63.9	958	732
Rhode Island	169	135	25.2	97	64
South Carolina	234	160	46.3	102	68
South Dakota	119	87	36.8	71	62
Tennessee	313	226	38.5	157	126
Texas	1,418	980	44.7	612	504
Utah	122	81	50.6	44	36
Vermont	75	59	27.1	39	34
Virginia	402	269	49.4	181	116
Washington	448	296	51.4	221	184
West Virginia	209	146	43.2	130	86
Wisconsin	490	347	41.2	256	204
Wyoming	102	64	59.4	46	36
Alaska	187	149	25.5	94	96
Canada[1]	1	1	0	1	1
Canal Zone	0	0	0	1	0
Hawaii	51	31	64.5	24	24
Mexico[1]	0	1	0	0	0
Philippine Islands[2]	0	0	0	0	2
Puerto Rico	31	21	47.6	17	6
Foreign, Miscellaneous	7	5	40.0	5	14
Totals	24,836	17,351	43.1	12,829	10,000

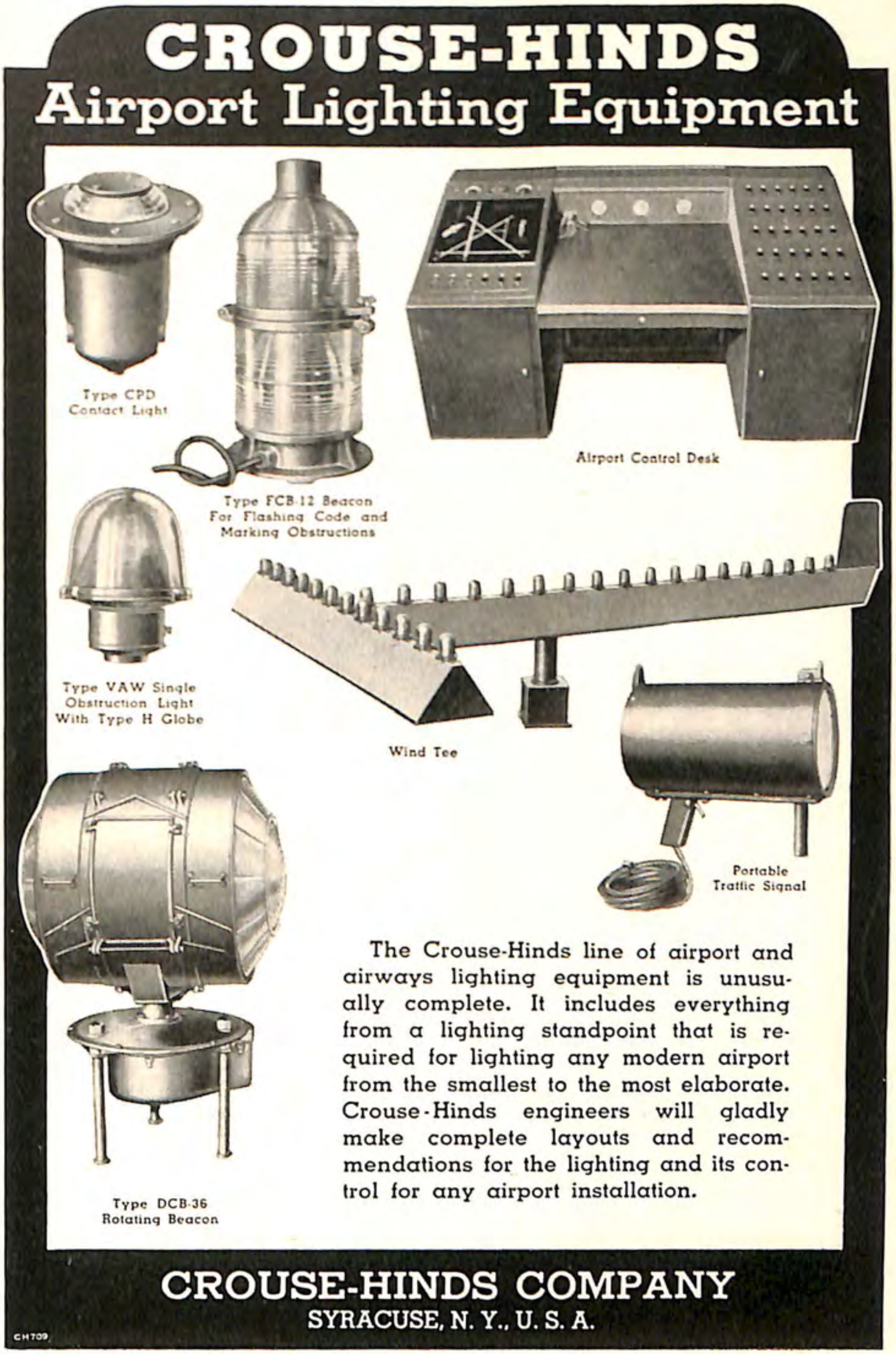
[1] Figures for these countries are for aircraft registered by the United States.
[2] Civil aircraft in the Philippine Islands are now registered with the local Government.

AIRPORTS AND LANDING FIELDS

January 1, 1942

Compiled by Civil Aeronautics Administration

State	*Municipal*	*Commercial*	*Intermediate*	*Navy*	*Army*	*Miscellaneous, Government*	*Private*	*Total*	*Lighted*
Alabama	18	6	4	......	5	......	......	33	14
Arizona	18	23	10	......	1	1	1	54	15
Arkansas	12	15	3	......	......	......	......	30	7
California	72	83	17	4	7	7	4	194	51
Colorado	26	7	4	......	1	......	1	39	8
Connecticut	8	9	1	......	......	......	......	18	6
Delaware	3	6	......	......	......	......	......	9	1
District of Columbia	1	......	......	1	1	......	......	3	3
Florida	77	12	7	10	5	......	1	112	29
Georgia	30	5	12	1	1	......	......	49	20
Idaho	24	6	6	......	......	7	1	44	12
Illinois	16	60	6	1	2	......	......	85	18
Indiana	13	36	6	......	1	......	......	56	15
Iowa	22	23	3	......	......	......	1	49	10
Kansas	27	13	4	......	2	......	......	46	11
Kentucky	7	8	3	......	1	......	......	19	4
Louisiana	16	8	4	2	4	......	......	34	13
Maine	14	1	......	......	......	......	......	15	5
Maryland	2	17	......	......	3	......	1	23	4
Massachusetts	10	26	1	1	2	......	1	41	4
Michigan	87	23	1	1	4	4	5	125	18
Minnesota	19	8	2	......	1	......	......	30	8
Mississippi	23	4	7	......	......	......	......	34	14
Missouri	11	24	11	1	......	......	......	47	19
Montana	40	2	15	......	......	13	1	71	21
Nebraska	31	11	5	......	2	......	......	49	13
Nevada	7	9	8	......	......	......	......	24	10
New Hampshire	8	5	......	......	......	......	......	13	3
New Jersey	7	25	......	3	1	......	......	36	6
New Mexico	19	16	13	......	......	......	......	48	18
New York	29	63	6	1	4	1	1	105	22
North Carolina	19	24	2	1	1	1	......	48	10
North Dakota	21	1	9	......	......	......	......	31	10
Ohio	30	71	11	......	3	......	3	118	24
Oklahoma	26	26	7	......	1	......	......	60	17
Oregon	21	6	6	......	......	1	......	34	14
Pennsylvania	35	68	5	1	1	......	1	111	26
Rhode Island	1	2	......	......	......	......	1	4	1
South Carolina	14	10	4	1	1	......	2	32	10
South Dakota	15	5	1	......	......	......	......	21	4
Tennessee	10	4	8	......	......	......	......	22	13
Texas	77	79	31	1	14	1	4	207	51
Utah	13	4	10	......	......	......	......	27	15
Vermont	8	3	......	......	1	......	......	12	1
Virginia	17	29	8	4	1	......	......	59	16
Washington	30	10	7	4	4	4	......	59	18
West Virginia	10	11	2	......	1	......	......	24	3
Wisconsin	21	22	3	......	1	......	......	47	11
Wyoming	21	1	10	......	......	......	1	33	16
Total	1,086	930	283	38	77	40	30	2,484	662


CROUSE-HINDS
Airport Lighting Equipment
Type CPD Contact Light
Type FCB-12 Beacon For Flashing Code and Marking Obstructions
Airport Control Desk
Type VAW Single Obstruction Light With Type H Globe
Wind Tee
Portable Traffic Signal
Type DCB-36 Rotating Beacon
The Crouse-Hinds line of airport and airways lighting equipment is unusually complete. It includes everything from a lighting standpoint that is required for lighting any modern airport from the smallest to the most elaborate. Crouse-Hinds engineers will gladly make complete layouts and recommendations for the lighting and its control for any airport installation.
CROUSE-HINDS COMPANY
SYRACUSE, N. Y., U. S. A.
CH709

AVIATION GASOLINE TAX SUMMARY

February 26, 1942

Compiled by American Petroleum Industries Committee

States	*Tax Motor Fuel*	*Refund Aircraft*	*Refund Other Than in Motor Vehicles*	*Exemption Aircraft*	*Tax on Aircraft Fuel*	*Disposition of Funds*
Alabama	6				6	Highway purposes
Arizona	5		x			
Arkansas	6½			*		*
California	3		x			
Colorado	4	x				
Connecticut	3		x			
Delaware	4	x				
District of Columbia	2	x				
Florida	7			*		
Georgia	6			*	6	Highways, roads and education
Idaho	5*				2½	Aeronautics Fund
Illinois	3		x			
Indiana	4	x				
Iowa	3	x				
Kansas	3			*		
Kentucky	5				5	Highway purposes
Louisiana	7				7	Highway purposes
Maine	4		3		1	*
Maryland	4	x				
Massachusetts	3		x			
Michigan	3	*			3	Aeronautics Fund
Minnesota	4		x			*
Mississippi	6		5		1	Highway purposes
Missouri	2		x			
Montana	5	x				
Nebraska	5	*			5	20% to State Asst. Fund; 80% to Aviation Fund
Nevada	4		x			
New Hampshire	4		x			*
New Jersey	3	x				
New Mexico	5		*			
New York	4		x			
North Carolina	6			*		
North Dakota	4				*	
Ohio	4	3			1	General Revenue Fund
Oklahoma	5½			x		
Oregon	5	4			1	State Board of Aeronautics
Pennsylvania	4				4	Highways and relief
Rhode Island	3				3	General Fund
South Carolina	6	*			6	State Aviation Fund
South Dakota	4				4	State Aeronautics Fund
Tennessee	7				7	Aviation purposes
Texas	4	x				
Utah	4				4	State Aeronautics Fund
Vermont	4				4	*
Virginia	5	2			*	Aviation purposes
Washington	5		x			
West Virginia	5	*				
Wisconsin	4	x				
Wyoming	4	*			2	*

* See Notes accompanying name of state on page 672.

NOTES ON GASOLINE TAX SUMMARY

ARKANSAS—Aircraft fuel having a rating of not less than 80 octane is not taxed. Regular gasoline when used in airplanes is taxed 6½ cents per gallon and the funds are used for highway purposes.

FLORIDA—Aviation fuel testing 78 octane or higher is not taxed.

GEORGIA—No tax on motor fuel used in planes owned by the U. S. Government in which cadets in the service of the U. S. are trained, irrespective of whether said motor fuels be purchased by a governmental agency or a private agency. (L. 1941 H. R. 44-239B)

IDAHO—Tax of 1 mill per gallon of motor fuel stored, sold, distributed or used for consumption in the state. (L. 1939, c. 223, Sec. 8)

KANSAS—40 gallons or more, for any purpose other than operating or propelling motor vehicles on public highways.

MAINE—⅛ of tax on fuels used for aeronautical purposes shall be allocated to the aeronautical fund. If consumer fails to apply for the 3¢ refund within 9 months the 3¢ is added to the aeronautical fund.

MICHIGAN—A refund of 1½¢ per gallon is made to airline operators operating interstate on schedule operation.

MINNESOTA—Tax money collected on gasoline used for aviation purposes and for which a refund claim is not made shall be expended on marking highways with navigation markers, constructing strip landing fields near highways, and for the maintenance and support of the Aeronautics Commission. (L. 1941, H. B. 942)

NEBRASKA—4¢ refunded on aircraft fuel used only in aircraft in connection with any school of flying instruction approved by the United States of America. (L. 1935, c. 3, sec. 17)

NEW HAMPSHIRE—Any balance of unrefunded tolls on fuels used in aircraft is credited to the commission having jurisdiction over the navigation of aircraft to be used for the promotion of the safety of such navigation.

NEW MEXICO—50 gallons or more purchased at one time.

NORTH CAROLINA—Gasoline designed for and sold and used exclusively in aircraft motors.

NORTH DAKOTA—Under ruling of State Auditor aviation gas is sold tax exempt and must be purchased through a registered dealer.

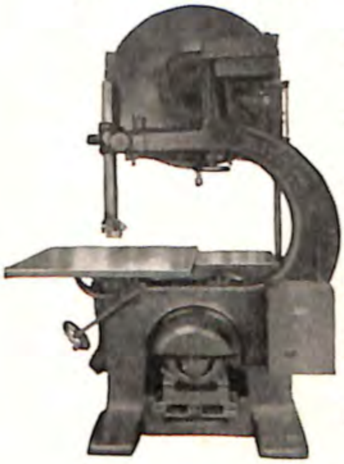
SOUTH CAROLINA—Tax refunded on gasoline sold to any Army Primary Aviation School to be used in planes owned by the U. S. and used by such school in the training of cadets, students or trainees actually enlisted in the United States Air Corps and used under supervision of the army. (L. 1941, H. B. 155)

VERMONT—Law 1939 Appropriation No. 125 p. 156 provides that $2,000 is appropriated annually for aeronautical purposes.

VIRGINIA—1. Intrastate operators—Tax of 3¢ per gallon imposed by reduction from refunds. 2. Interstate operator—Tax of 3¢ per gallon on gasoline purchased for use and used by interstate operators on intrastate operations and within the borders of the state, the amount of tax to be based on the flight logs of each trip and average consumption of gasoline per hour per month. (L. 1940 c. 71)

WEST VIRGINIA—Laws 1939 c. 125—Refunds on quantities of 25 gallons or more when used in aircraft.

WYOMING—2¢ per gallon refund on purchases in excess of 10,000 gallons per month, Law of 1935 c. 72 Sec. 7. Funds paid to city, town or county where air field is located (and from which tax was collected) for maintenance of such air field.



INDEX OF ADVERTISERS

INDEX OF ADVERTISERS

INDEX

INDEX

A

B

D

E

T

U

V

W