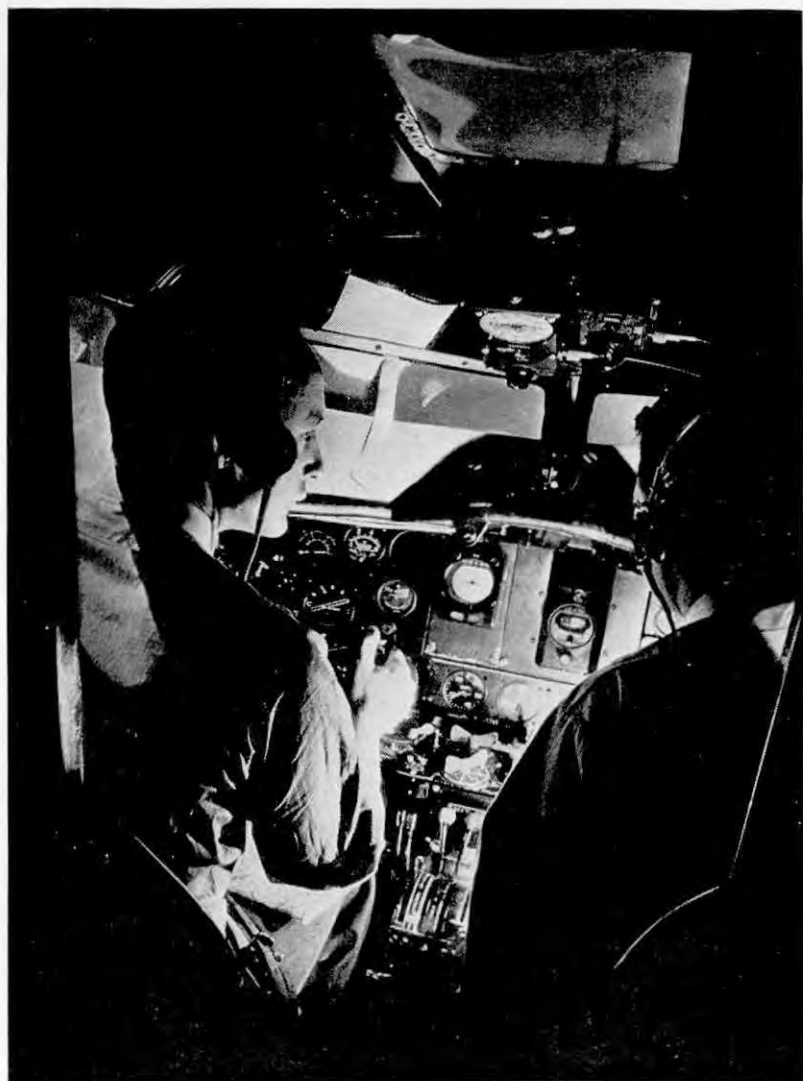


The
AIRCRAFT
YEAR BOOK

For 1940





Dmitri Kessell photo

FLYING BY INSTRUMENTS ONLY

Arthur Weckel is shown here with the Sperry Flight Ray (the lighted dial above his right hand) on a test flight. Note that the cockpit window is covered to prevent seeing outside, thus making the pilot dependent upon instrument flying.

The **AIRCRAFT YEAR BOOK**

(Registered U. S. Patent Office)

For 1940

TWENTY-SECOND ANNUAL EDITION

HOWARD MINGOS

Editor



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A BEECHCRAFT FOR SWEDEN

Interior of the Beechcraft 18, twin-engine ambulance built for the Swedish air force.

CHAPTER I

WAR IN THE AIR

Vital Lessons Taught by the European Conflict—Horrors of Aerial Blitzkrieg—The German Achievement in Transporting Troops by Air—Improvements in Combat Planes—Need for Numerical Supremacy.

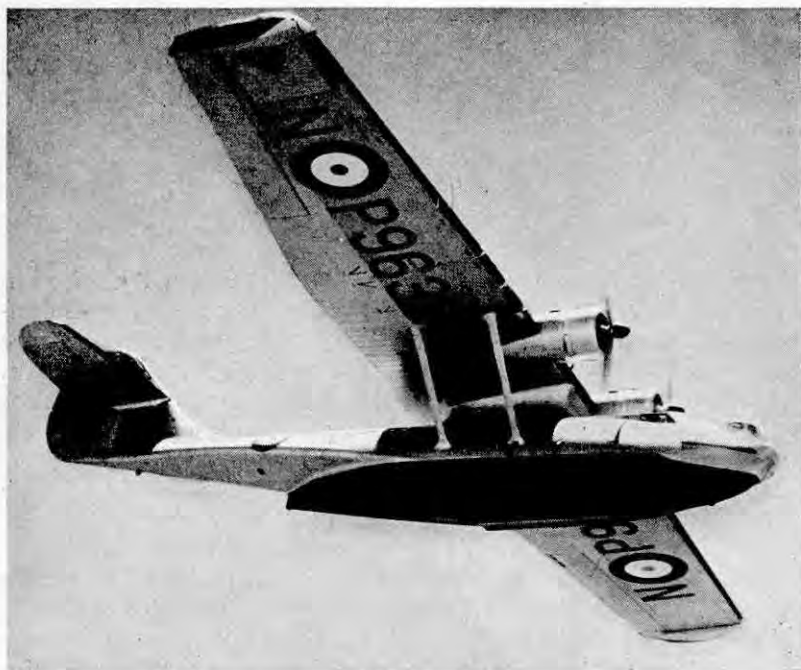
AS this book goes to press early in May, 1940, we have seen more than eight months of the European War. It already has proved conclusively that a nation cannot defend itself without an air force at least the equal of the invader's. It soon will demonstrate that real air power is the ability to keep on using superior air forces through to the end, and that alone will determine the victor.

Thus early in the war there have been three definite developments to prove irrevocably that a nation must have an air force equal to the enemy's in order to defend itself.

One, Germany invaded Poland with her aerial blitzkrieg. She used about 3,000 planes. They swept over every strategic spot in Poland in waves of 50 at a time. In that kind of warfare it was not only troops and military centers that became targets for German bombs. The German method of air warfare in Poland was the old savage method revived with Douhet's modern conception of total war—to strike everywhere, and blast the civilian population into a state of helpless demoralization. Warsaw and other Polish cities were on the aerial front from the first minute. The Polish air force, which had good pilots and hundreds of good planes, was whipped rapidly by superiority of numbers and lack of reserves in equipment, personnel and more than 150,000 separate items that must be on the ground close at hand if an air force is to function. For example, hundreds of Polish fighting planes were grounded and helpless after the first few days through lack of gasoline. The German bombers blew up effective resistance all the way from the battle lines to the last hamlet, and it let the Reich army win that frightful little war in 18 days.

The second significant development took place in Finland. There was a perfectly organized defense system, with able leaders and a whole people fighting with incredible courage, aided by a terrible winter. But the Russian air force, however unwieldy and clumsily handled, was vastly larger than Finland's, had the advantage of immense reserves, and therefore was superior.

"Give us more planes and pilots," cried the harassed Finns. At the end, when the censorship had lifted, there was conclusive evidence



A CONSOLIDATED FLYING BOAT FOR BRITAIN

It was Model 28, Twin Wasp-powered, which made a delivery flight from Botwood, Newfoundland, to Felixstowe, England, in 14 hours, 36 minutes elapsed time.

that the steady bombing of Finnish railways, factories and supply bases in all important centers determined the Russian victory at such an early date. Viborg was rendered useless as a supply base almost from the beginning. The junction of Elisenvaara was bombed all day and night; and lay in ruins, so that reinforcements could not be sent by rail into two of the most bitterly contested sectors. Hangoe and other towns ceased to exist; and when troop and supply trains

were sent through, they invariably were bombed. No large town in all Finland escaped. The truth is that so many civilians were killed or crippled back of the lines that no army could have held out. There was no reserve strength left, on the ground or in the air. Air force broke the will of a nation to continue war.

The third development proving that a nation must have an air force equal to the enemy's in order to defend itself in the air occurred in connection with Germany's invasion of Norway. Until then most observers believed that Germany dared not carry her aerial blitzkrieg too close to the Allies. These observers thought that the Germans would refrain from using their air forces over civilian centers through fear of reprisals; and it was believed that if the Allies should decide to retaliate, they could destroy the most important industrial centers



THE LOCKHEED B-14 HUDSON

A general reconnaissance bomber with Wright Cyclone engines, and in general use by the British Royal Air Force from the opening of hostilities in 1939. Hundreds of these bombers were built for Britain at the Lockheed plant at Burbank, Calif.

in Germany and wreck the military supply system of the Reich so extensively as to cripple the armies.

Others had reasons for believing that the days of the blitzkrieg were over for the period of the war. Military commentators, presumably reflecting official Allied sentiment, discounted the use of air power in several ways. They were inclined to believe that it could not hold the British Navy at bay or prevent its carrying out a mission. They did not believe that the Germans could transport large numbers of troops by air. They did not think that any sizable air force could operate far from its home bases. Lastly, nobody suspected that the German Government would risk losing large numbers of planes in operations other than those on the Western Front. That seemed a good argument in view of the fact that the Allies were known to be increasing their own air strength.

In many respects the lessons of the first World War seemed to hold good in this conflict. Nearly everybody insisted that if aerial warfare should come to the belligerent countries in all the fury of which total war is capable, it would be the Allies, not Germany, who would be able to carry on the war in the air with increasing effectiveness long after the other's aviation lost its full striking power.

The Allies even then were beginning to overtake the Germans in numbers of good combat planes, type for type. They were increasing production rapidly in their own factories. They were buying larger quantities of planes in the United States. By the end of 1940 the Allies would be receiving month by month all the planes required for defense and raids on any scale and on all fronts. The thousands of American planes already bought by the Allies had proved equal to the conditions for which they were sent to war, and superior to



THE DOUGLAS FRENCH BOMBER

The DB-7, one of the American-built combat planes delivered to the French air forces in quantity shortly after the outbreak of hostilities.

similar enemy types in most instances. The larger quantities being ordered for delivery between now and the Fall of 1941 would incorporate the improvements inspired by experience thus far in actual combat, including armored cockpits, heavier guns, leak-proof fuel tanks, greater range and all-round fire power, with rear defense armament for bombers. There was no doubt as to the ability of the Allies to procure all materials necessary. There was a question as to how long the Germans could continue to receive sufficient materials for first class plane production, as well as all the necessary materials for maintenance and operation of a striking air force.

With the war spread into other localities the Germans might face other difficulties. They might have met serious obstacles at the start of the Norwegian campaign.

The German invasion of Norway was one of the most freakish occurrences in the history of modern warfare. The Germans spent weeks preparing for an expedition requiring surface transports. The Allies knew it; but, according to official statements, they did not know which country had been marked for invasion. The Germans had enlisted the help of a remarkably large number of Norwegians in key official positions; and, with their connivance, planned to take the country without meeting resistance. Apparently the Allies did not learn of it in time.

The British Navy, aided by the French, formed a serious obstacle to the German convoys as they worked their way into Scandinavian



WACO AMBULANCE IN NORWAY

One of the Wright Whirlwind-powered Waco ambulance planes in regular service in Norway, equipped with pontoons in summer and skis in winter.

waters. The German losses in ships and men were tremendous. In their fleet operations the Allies were assisted materially by bombers. Yet, probably because of official pro-navy doctrine, the British did not make full use of their air forces, then or later.

Superior Allied naval power, on the other hand, forced the Germans to use planes for transport of troops, while they still had to run the Allied blockade with vessels carrying heavy armament and other supplies. It was the first time in history that troops had been transported by air on a large scale; and it was a magnificent achievement. Yet any home defense, however small, could have blown up the airports, thus preventing most of the troops coming in by air. But

once in control, the Germans were able to use their air power most effectively.

The seasonal storms, high winds, blizzards and fog made detection extremely difficult from Allied vessels or planes. The weather favored the Germans, who had only to navigate to their destinations at the captured airports, while the Allied forces had blinding storm conditions to prevent interception.

After the Allies had been driven out of all but northern Norway, the British Government explained that the Germans had accomplished it because they had all the airports from which to carry on operations. They had bombed the Allied forces which were landing in Norway; and they had carried on merciless bombing operations in con-



VOUGHT-SIKORSKY SCOUT DIVE BOMBER

One of the V-156-F Pratt & Whitney Twin Wasp-powered fighting planes built for the French air forces.

junction with their own troops in the decisive battles. The British explained that lack of landing fields for the Allies prevented their bringing in fighter planes to keep off the German bombers. The Norwegian episode proved that the Allies had to use air power more extensively if they were to hold off the German air forces in any campaign.

On May 8, 1940, defending his Government's policies in the House of Commons, Winston Churchill, then First Lord of the Admiralty and at that time most important British official in the war effort, made this significant statement: "I should like to say a few things about the Norwegian campaign and the general war. In this

war we are frequently asked why we do not take the initiative. The reason for this serious disadvantage of our not having the initiative is one which cannot be speedily removed.

"It is our failure in the last five years to maintain or regain air parity with Germany. That is an old story and a long one.

"In the last two years the Opposition parties came around and gave great and valuable aid. But the fact remains that we failed to achieve air parity, which is considered vital to our security.

"Our numerical deficiency in the air—in spite of our superiority in the quality of both men and materials—condemned us and will condemn us for some time to come to a great deal of difficulty, suffer-



ON THE FRONT IN FRANCE

Camouflaged Curtiss Hawk pursuit planes with the French air forces.

ing and danger which we must endure with firmness until more favorable conditions can be established, as they assuredly will.

"He would be a wise man who knew all about this war. There is no use talking about this war in terms of the last war. The power of the air has greatly affected it. In some ways it has decisively affected the movements of fleets and armies.

"We must not exaggerate this new factor but neither must we refuse to give it its deadly due."

Within a few hours after those remarks Winston Churchill became Prime Minister; and as if to prove him right to the last word, the German legions struck again with unparalleled fury, this time in Holland, Belgium and Luxembourg.

Showing in every conceivable way the effectiveness of years spent in creating an air force with sufficient planes and enough trained personnel to function on any kind of mission, the Germans have thrown thousands of machines into the air day and night. Wave after wave of bombing squadrons have hurled tons of explosives on strategic centers, as swift as lightning and with greater destruction. They have spilled parachute troops over the countryside and in vital sections of key cities and towns, to wreck important parts of the defense system before they could be checked. Attack planes without apparent limit as to numbers have swooped down low at terrific speeds, their crews bombing and machine-gunning troop concentrations, local guards, anybody in fact who might stand in the way of the invaders. They have laid incendiary bombs with fair accuracy.

The result has been a holocaust. For the Allies it has been a sacrifice to unpreparedness in the air. For the Germans it is a terrible tribute to five years of energetic preparedness. For the rest of the world it is a warning. A striking force equal to the enemy's is the first essential; and to be effective it must be maintained by reserve air power providing increasing strength in men, planes and supplies until the end.



NORTH AMERICANS FOR BRITAIN

One of the hundreds of NA-16-1E two-place military planes which the British Air Ministry ordered from North American Aviation in 1938 and 1939. They are powered by Pratt & Whitney 550 h.p. Wasp engines.

CHAPTER II

AIR POWER OF THE UNITED STATES

Its Potentialities—High Performance of American Aircraft—Vast Production Capacity—The World's Largest Civilian Aviation—Training Programs—Industrial Preparedness.

THE war in Europe, the continuously aggravated situation in the Far East and a national desire to be strong enough to keep hostilities from spreading into the Western Hemisphere combine to focus attention on the air power of the United States. It is a very great air power, potentially the greatest in the world—if its rational development is carried on—greatest because it embraces all those essentials which a nation must have without limit if it is to maintain leadership in the air and maintain its economic freedom.

The fact that our Army and Navy air forces do not have the vast numbers of planes and personnel that the belligerent nations employ in active service is not the measure of our real air strength. We have several thousand planes of different types; and we are acquiring more and better machines month by month. The services are training all the personnel required to handle the equipment which those charged with maintaining the national defense believe necessary. The purpose is to have defense aviation capable of expansion into as large a force as any emergency may demand. As far as can be learned from anything brought to light abroad, American fighting planes and personnel are the equals of comparable forces in the war areas; and in some respects, are superior to them.

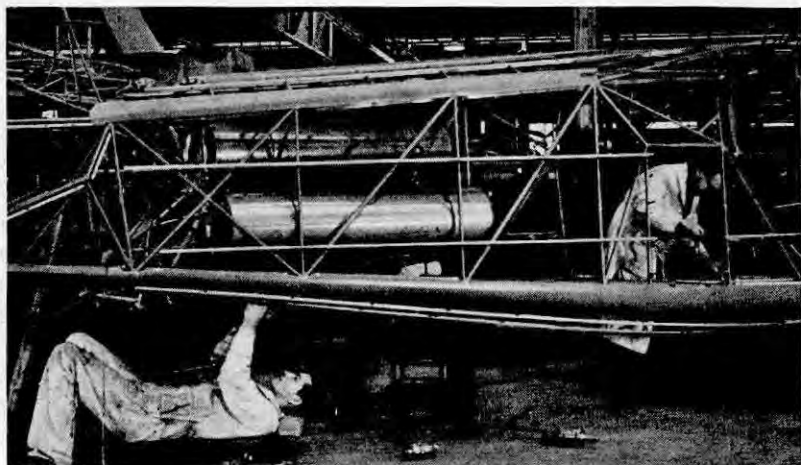
Superiority of flying equipment, marked superiority in certain types, is not enough. To be effective, it must be superior to the enemy machines right up to the end of war. The United States has every opportunity to maintain that superiority in any emergency.

Capacity to produce combat and transport planes in sufficient numbers to meet all requirements of original supply and war attrition throughout any emergency is the mainstay of real air power; and

the aircraft industry of the United States has that capacity. As is shown here, through to the last pages of this book, the industry has access to all necessary raw and fabricated materials, and all the accessories, to render it capable of mass production without precedent.

Besides, we have here vast training programs for civilian personnel, and we have a self-supporting civilian and commercial aviation in transport, private and miscellaneous flying that surpasses in both size and efficiency the non-military activities of all other nations combined. It is a very important branch of our air power.

All this aviation, much of it decisively important to our economic system and the future position of the nation in world affairs, is the



STINSON RELIANTS FOR BELGIUM

Constructing a target-towing plane for the Belgium Government. The metal containers hold the targets which are lowered through a trap door in the bottom of the plane.

third arm of our national defense. Nowhere outside the United States have the three arms received comparable attention by the same people. Unlike England, we have not neglected our army and our air force while maintaining a strong navy. Unlike France, we have not neglected our air force and navy while developing a strong army. Unlike Germany, we have not been forced to curb the size of our navy while building up a strong army and air force. We have all three under comparable stages of development, bearing in mind the fact that a navy must be built up in peacetime to be of service in war. Both Italy and Japan lay claim to such three-way defense

systems; but they are not strong in air power because they lack the material resources which determine productive capacity.

The size of the United States, which is four-fifths of all Europe, its geographical position between the two great oceans, climate ranging from sub-tropic to near Arctic, the need for planes and pilots capable of flying from sea level to high altitudes in every kind of weather both day and night—those are factors which have provided the incentive for development of the world's best flying machines and the manifold activities in everyday American aviation. The development has been progressive because it has taken place under peaceful conditions of private enterprise and individual initiative,



BUILDING BOEING BOMBERS

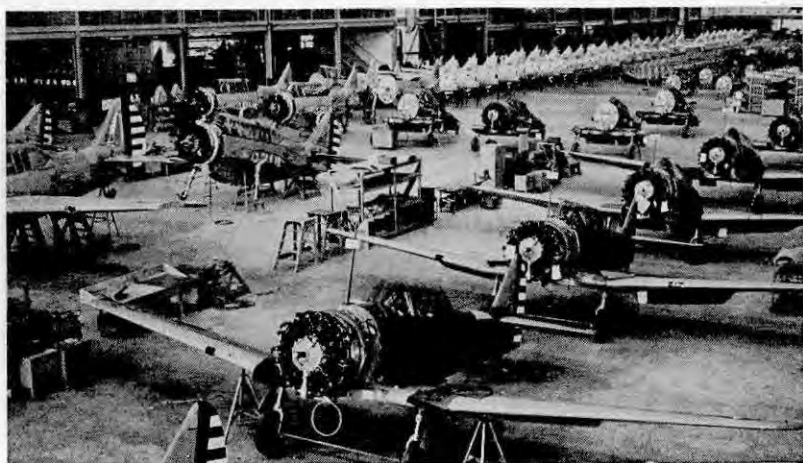
The final assembly floor in the Boeing Plant 2 where one B-17B Flying Fortress was being completed every four days when this photo was taken.

while other Powers have been handicapped by fearful preparations for war. Foreigners using our equipment in the European conflict cannot understand why the American engines require only fuel and oil after a flight; why it is that they need not be sent back for engine overhaul before they have hundreds of hours of flying.

The United States has developed its aviation plant fairly steadily in the 20 years since the World War proved definitely that air power is essential. Unlike the predominant military considerations prevailing abroad, American aviation has held the interest of the public, not only for defense reasons but because of its economic usefulness. The public has invested hundreds of millions of dollars in various

branches of the industry. The public has encouraged the manufacturers to spend millions in experimental work, research and engineering development, year after year, while dividends were rare and scant under the most favorable conditions. The public had the Government spend hundreds of millions, not only on direct air force development, but on air lines, airports and airways, and a great deal of scientific research which private enterprise was in no position to undertake. The result is apparent today.

Nations at war as well as those still living in peace are buying American flying equipment as rapidly as possible. Great Britain and France have placed orders amounting to three-fourths of a



AT THE NORTH AMERICAN PLANT

Partial view of North American Aviation's main assembly floor at the plant in Inglewood, Calif.

billion dollars; and they have announced their intention of buying in increasing quantities. More than 2,000 American planes have been shipped to the Allies, and thousands more are in various stages of production.

John H. Jouett, president of the Aeronautical Chamber of Commerce of America, the manufacturers' trade association, presented this comprehensive picture of conditions after a survey early in 1940:

"Expansion in the American aircraft industry has had a most favorable influence on the employment situation throughout the manufacturing areas. Shop labor in the airplane and engine plants reached 60,000 this month as compared to 30,000 a year ago. This

100 per cent increase was created by large orders for both military and commercial planes that also have caused a rapid upswing in employment throughout the 50 or more allied industries that contribute to the finished flying machine.

"Quantity orders for planes of the same model have brought about a modification of the industry's labor requirements and have permitted adoption of straight line production methods. This simplification of manufacturing technique has reduced the ratio between



GRUMMAN SKY-ROCKET

U. S. Navy photo

A new twin-engine fighter powered by two 1,200 h.p. Wright Cyclone engines. It was developed for the Navy and built by Grumman Aircraft Engineering Corporation at Bethpage, N. Y.

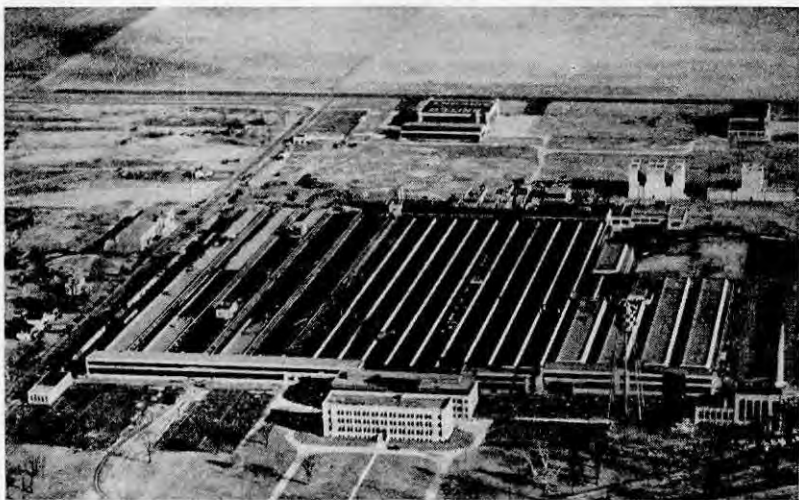
skilled and unskilled labor formerly required when the demand for aircraft limited production to comparatively few machines of the same model at one time. Today the manufacturers find that they can use a much larger percentage of unskilled and semi-skilled labor, which results in a great saving in time required for training personnel. For that reason we do not see any serious shortage in the future, although this year will be the greatest productive period in the history of the industry.

"Under present schedules, production of airplanes and engines

alone should exceed \$500,000,000 during 1940, more than twice that of last year which estimates place at \$225,000,000.

"The current backlog of the industry is approximately \$625,000,000. This compares to \$125,000,000 a year ago. Contrary to the impression in some quarters, not all this business is of a military character. Our own air forces have ordered equipment amounting to more than \$200,000,000. The commercial orders represented in the industry's current backlog show a satisfactory increase, and our export trade has been growing at a rapid rate.

"Our exports of all kinds of aeronautical equipment, including accessories, reached about \$117,000,000 in 1939, as compared to



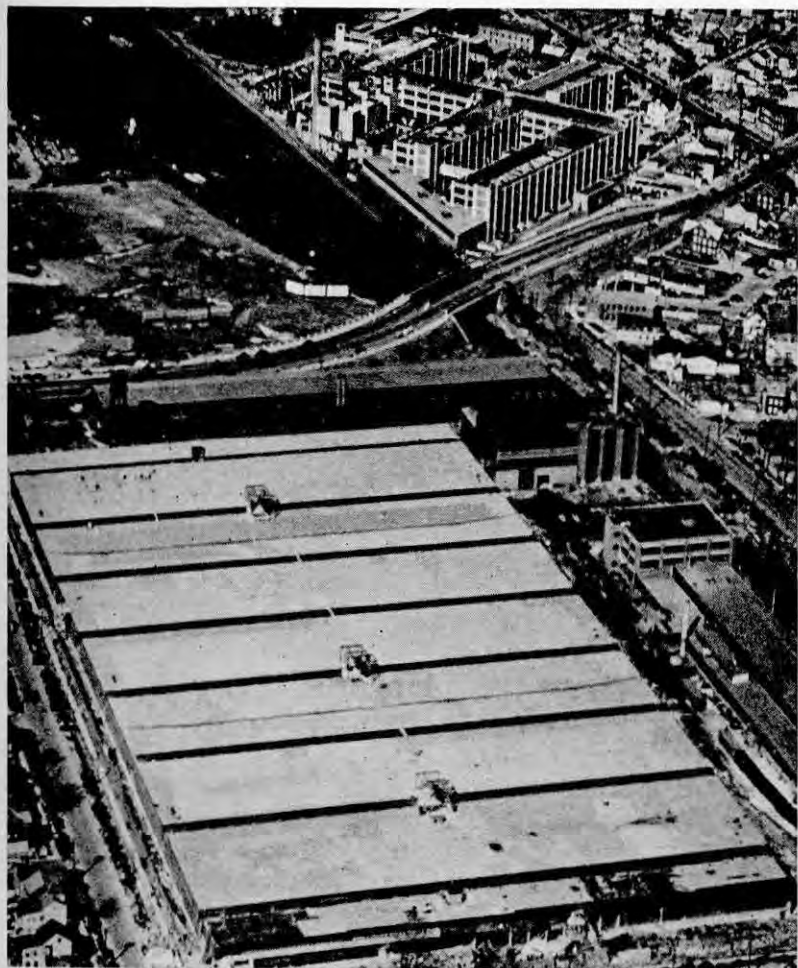
BIRTHPLACE OF HORNETS AND WASPS

The Pratt & Whitney engine plant at East Hartford, Conn.

\$68,000,000 in 1938. That is not only because of war orders from the Allied Governments and some of the smaller neutral nations of Europe, but also because of a substantial increase in orders from Latin America where the superiority of American commercial and military equipment is recognized. We exported to 91 foreign countries, dominions and colonies out of a potential of less than 100.

"If plans for air line equipment both in the United States and in more than 20 other countries are carried out, our manufacturers should have a backlog of approximately \$40,000,000 in transport equipment alone within the next few months. Meanwhile, we have made very real progress in private flying. Our new models are im-

proved in design and performance. The number of new planes produced for the private owner in 1939 was approximately 3,700, slightly more than 100 per cent above 1938. Improved economic conditions and the Civilian Pilot Training Program of the Civil Aeronautics Authority have contributed to a greater demand for private planes of all types, ranging from the light plane to the five-



WHERE CYCLONES AND WHIRLWINDS START

Plants of the Wright Aeronautical Corporation at Paterson, N. J. Plant 1 in the background. The new Plant 2 in foreground.

passenger executive models. We have also noted increased interest in this kind of equipment among the countries of Latin America where we expect to develop large markets for private owner planes.

"Military orders from our air forces are divided among 23 of the 45 airplane plants and nine of the 13 aircraft engine plants. Many companies which can take on more business are receiving subcontracts whereby they supply parts. If necessary, those plants also can take subcontracts for complete equipment. We may expect to see the subcontracting system expand with the growth of business, and it will tend to increase employment in many sections of the country.

"Meanwhile, our manufacturers are increasing their research



LOCKHEED FINAL ASSEMBLY

and engineering development facilities wherever possible. Some are building their own wind tunnels and other laboratory equipment. Whole sections of their engineering departments are developing new planes, engines, propellers and other accessories to make flying even faster, more reliable and more economical. New manufacturing equipment—machines, tools and materials—contributes to our progress. For the last six years the manufacturers have devoted to development work approximately 10 per cent of their gross sales. Reports received by the Aeronautical Chamber in recent weeks show that the industry is continuing to make improvements more rapidly than ever before, because with increased business it can afford greater expenditures for research and engineering."



REPUBLIC EP-1 PURSUIT

It is powered by a Pratt & Whitney Twin Wasp engine.

Some months previously, a survey by the Aeronautical Chamber had revealed that the airplane plants then had a productive capacity of 15,000 planes a year while the engine plants had a capacity of more than 16,000 engines in a like period. As a result of current expansion, however, the plane capacity is increasing considerably. The engine plants before the end of 1940 will be able to produce at an annual rate of 25,000 engines of 1,000 horsepower or more, besides meeting all requirements for lighter engines.

Testifying before the House Appropriations Committee on March 7, 1940, Major General Henry H. Arnold, Chief of the U. S. Army Air Corps, gave the following figures on total production of military and commercial transport planes in the United States during 1939, by months:

<i>1939</i>	<i>Military</i>	<i>Commercial</i>	<i>Total</i>
January	143	14	157
February	163	23	186
March	180	26	206
April	152	28	180
May	180	32	212
June	211	13	224
July	247	18	265
August	256	22	278
September	117	10	127
October	51	19	70
November	104	15	119
December	337	43	380
	2,141	263	2,404

Placing total military plane and commercial transport production at 320 military and 31 transports in January, 1940, General Arnold

said that it averaged about 4,000 planes a year; but that it was increasing rapidly. He also testified that engine production was adequate.

Obviously, production statistics for 1939 offer no real indication as to the vast potential capacity of the industry. Until six months ago, it was working at about 60 per cent of capacity; and that did not take into consideration the new plant expansion of which it was capable. Quantity orders from the Air Corps were not scheduled to come through until 1940. Orders from the Allies have been coming in slowly. Actual production has risen slowly because orders were not placed earlier.

Assistant Secretary of War Louis Johnson made the following



INTERIOR OF DOUGLAS SANTA MONICA PLANT

One of the huge assembly hangers with DC-3 transports and bombers in process of construction.

complimentary remarks about the industry's readiness to supply the air forces in an address on April 6, 1940. Commenting on industrial war mobilization plans, he said: "About 10,000 plants have been earmarked for war work in the event of necessity. Educational orders have been given to the most important of these plants. Thus a start has been made on the process of preparing industry.

"American industry has cooperated and is cooperating with us wholeheartedly," the assistant secretary continued. "The War De-

partment has taken the initiative and our industrial leaders have responded. Patriotism is not the exclusive possession of the fighting man. The worker and the factory manager have shown that they, too, realize their responsibilities and the import of their possible war tasks."

The aviation industry is the one bright spot, Mr. Johnson said, as it is developing by leaps and bounds under the stimulus of military orders from abroad and our own air expansion program.

"Since air power has joined with land and sea power to form a triumvirate for national defense, it is fortunate indeed that our great civil aviation industry is readily adaptable to produce the mili-



U. S. Navy photo

BREWSTER FIGHTER-BOMBER

The SBA-1, Export Model 138, powered by a Wright Cyclone engine, and built for the Navy.

tary aircraft we require," he said. "In fact it already has a vast military experience.

"This fortunate development is due to several factors. Military aviation in this country has always been the best customer of our civil aviation industry. Our military services do not build their own fighting planes. They have bought them always from civil establishments. Our civil aviation industry has therefore had experience during all its existence in building military aircraft.

"Thanks to the President's wise and timely air expansion program, inaugurated about 12 months ago, orders were given for more than 3,000 military planes. That, supplemented by the present demand



U. S. Army photo

THE BELL AIRACOBRA

A one-place pursuit plane with the Allison engine. Note the engine behind the pilot and the third wheel under the nose.

for our airplanes and engines in the war now gripping Europe, we are confident will aid materially in developing and preparing an aircraft industry adequate for our own national needs."

All the other factors which determine the position of the United States as a leader among the nations in the air are explained in detail in the following chapters. They describe the rapidity with which thousands of pilots and other personnel are being trained; development of the airways and airports; the amazing progress being made by the air forces of the Army and the Navy; the work of the various Government bureaus developing aviation; the remarkable record of our air transportation system which has not had a fatal accident in more than 13 months, and has now included the Atlantic in its conquest by establishing regular transocean service; and finally the incredible technical advances in planes and engines and the thousand and one different things that make a completed flying machine. Here are the details of our air power, its expanding usefulness in peace and its readiness for any emergency.

CHAPTER III

THE U. S. ARMY AIR CORPS

Secretary Woodring's Report—Official Policy on Foreign Sale of
American Aeronautical Equipment—Expansion Authorized—
Comments of Assistant Secretary Johnson and Major
General Arnold—The Rearmament Program Gets
Under Way—30th Anniversary of the Air Corps—
Strength of the Air Forces—Research Activi-
ties—Awards of Merit.

IN his annual report for the fiscal year ending June 30, 1939, Secretary of War Harry H. Woodring stated that "At the time of the rendition of my 1938 report, armed conflicts were raging on the Spanish Peninsula and in the Far East. Furthermore, the clouds of war hovered low over Europe where one so-called crisis followed another in continuous, but dread, procession. The entire world was apprehensive of an early outbreak of a second World War. International tension was close to the breaking point. Those factors made essential a reorientation of our military policy."

In three months war had broken out in Europe. The Allied and neutral governments wanted all the latest and most effective combat planes that they could buy in the United States. On March 27, 1940, Secretary Woodring gave the Military Affairs Committee of the House of Representatives a detailed account of the War Department's policy regarding the sale of American military aviation equipment abroad. It follows:

"By way of preamble, gentlemen, let me say that the policies of the War Department regarding the sale of military materiel, and particularly of airplanes to foreign governments, are designed primarily to strengthen our own arrangements for national defense. The fact that these transactions aid business by creating a profitable industry is important, but that is not a military consideration, except for its obvious contribution to the national defense.

"There are two major considerations involved in this present matter relating to national defense in the air. One relates to the modernization of planes now under contract for the Air Corps, and the other pertains to development of our capacity for the construction of planes. Conditions affecting both these considerations have altered greatly within a year. Early in 1938 there was general agreement on the need, not only for a large addition to our strength of active airplanes, but also for the establishment of a large reserve of modern types. At that time, changes in design involved a relatively slow process. Today, one year later, active warfare has greatly speeded up improvements of airplane types. We must now protect our investment with reference to the planes we have under order and yet to be delivered. I mean that we should employ every legitimate means



U. S. Army photo

CONSOLIDATED ARMY BOMBER B-24

This four-engine land plane was undergoing tests early in 1940. It was powered by four Pratt & Whitney 18-cylinder Twin Row Wasp engines of 1,200 h.p. each and 12-foot 3-blade Hamilton Standard hydromatic constant speed propellers. Designed and built by the Consolidated Aircraft Corporation at San Diego, Calif., it had a range of about 3,000 miles and could carry four tons of bombs.

to insure, for our own defense, the delivery of the latest and most modern types rather than passively to await delivery of planes which have already been superseded by more advanced models.

"We are the last people in the world to wish to benefit by the misfortunes of others, but we would be blind if we failed to realize that the war in Europe is a great laboratory in which all types of munitions, and especially aircraft, are being given a critical service test; with the result that many unanticipated weaknesses and deficiencies are becoming apparent.

"With respect to our production capacity, the orders placed in this country by foreign governments, both neutral and belligerent, have resulted in large additions to our airplane factories, and in



U. S. Army photo

THE RYAN PT-20

One of the Air Corps trainers built by Ryan Aeronautical Company at San Diego, Calif.

thousands of mechanics being trained. American production of airplanes, which a year ago was decidedly limited, is now increasing very rapidly. This condition changes last year's picture, because the increase in our productive capacity reduces the emphasis on delivery of planes in excess of operating requirements, and renders it not only permissible but advisable for us to accept delay in the delivery of such

planes, in order to obtain through the medium of change orders, the most advanced types for later delivery.

"Our problem is to meet this change in conditions; to conserve the interests of national defense, and to obtain the best possible equipment for the Air Corps from orders already placed with industry. The present situation is favorable to the solution of this problem, and sound business judgment, consistent with national security and public opinion on the subject, demands that we take advantage of the developments in aircraft and so adjust our policy that we can give our country an air force of the most modern type.

"Authority to permit American manufacturers to export airplanes and munitions of war is vested in the National Munitions Control Board, by the Neutrality Act of 1939. This Board consists of the Secretary of State, who is Chairman, and the Secretaries of Treasury,



NORTH AMERICAN ATTACK BOMBER

It is powered by two Wright Cyclone 1,350 h.p. engines, has a three-wheel landing gear and carries a crew of three.

War, Navy and Commerce. The Board exercises its functions through the Division of Control, State Department, in accordance with the rules incorporated in a document entitled, 'International Traffic in Arms', a copy of which I have here.

"A license from the State Department is required for export shipment of planes and munitions of war, and the State Department will not issue a license until the War and Navy Departments have stated that there is no objection on the ground of military secrecy of the item covered.

"Prior to December, 1939, all matters relating to the release of military items were handled through joint written agreements between the State, War and Navy Departments. Due to the enormous increase in foreign orders, the President, in December, 1939, appointed a Liaison Committee consisting of representatives of the Treasury,

Navy, and War Departments, to coordinate all foreign government purchases in the United States. The operation of this Committee has not altered the responsibility of the War Department in recommending what items should or should not be released.

"The recommendation of the War Department in connection with the release of any item is taken after full consideration of the circumstances in each case, based on its merits. In general, this action is governed by the following policies:

"There are certain items which, by reason of the importance of the military secrecy involved, should not be released under any consideration. With respect to certain other items, it is realized that the creation of substantial additional productive capacity for our industries is of sufficient importance to the national defense to warrant, as a



U. S. Army photo

CURTISS P-40 PURSUIT

It was powered by an Allison 12-cylinder V engine.

justifiable consideration, disclosing some otherwise restricted design.

"Generally speaking, there is little about any plane or airplane engine which can be maintained a military secret for more than a few weeks after tests have been made. Actually, we know a great deal about the latest types of planes being produced by all foreign nations, and it is to be presumed that foreign nations know at least as much about our own planes. While protecting to the best of our ability the secrecy of a few important devices, we must at the same time realize that planes and their engines turned out in quantity production do not fall within the category of secrets which can long be kept. Nevertheless, in the past airplanes and aeronautical equipment have not been released for foreign sale until similar types of superior performance have been tested and are under contract for the United States Government. Also in the release of designs to

manufacturers we have stipulated that the manufacturer shall acknowledge the priority of present and future orders of the United States Government;—the exercise of such priority to be entirely at the discretion of the United States Government agency concerned.

"We have refrained in general from releasing our designs for manufacture or detailed assembly abroad, as this would neither improve our own productive capacity nor contribute to the strengthening of the national defense. Neither, for the same reasons, have we agreed to the release for manufacture or detailed assembly abroad of the designs owned by private manufacturers, if such release could legally be prevented.

"Inquiries have recently been received from foreign governments for the purchase of obsolete or surplus War Department arms and armament. The Secretary of War is charged with the responsibility



MARTIN ATTACK BOMBER 167W

It is powered by two Pratt & Whitney Twin Wasps.

for such sale of surplus War Department materiel, and the following provisions of law and policy which have governed the administration of this responsibility, will, I believe, be of interest to you:

"Sale of War Department property is limited to those items declared surplus by the War Department at prices and under conditions fixed by the War Department. Property is declared surplus only upon advice of the General Staff. No War Department property will be sold to individuals, but only to foreign governments not actually engaged in conflict. Initial negotiations for the purchase of surplus War Department property are made between the foreign government concerned and our State Department. On tentative approval of the transaction by the State Department, the War Department continues negotiations with the accredited representative of the

foreign government and arrives at a tentative agreement as to the terms and details of the sale. This tentative agreement is submitted to the State Department and after formal notification from the Secretary of State that such sale is in conformity with our foreign policy, the War Department completes it.

"As a result of the aircraft procurement policy of which this Committee and I were joint authors, and which provided for design competition and especially competitive bidding, we have today possibly a half dozen types of planes superior to any in the world. This is a gratifying accomplishment.

"We now have a great many planes under contract for delivery to the Air Corps, but because we are acquiring an increasing productive capacity, the necessity for early delivery of other than operating



U. S. Army photo

THE DOUGLAS B-23

Recent development of the Air Corps B-18 bomber. It was powered with two 1,500 h.p. Wright Cyclone engines.

equipment is no longer so pressing. Therefore, we are adjusting the Government's foreign sales policy to conform to the following:

"When it is to the advantage of the national defense the War Department will negotiate for deferred deliveries on contract planes. If manufacturers take advantage of foreign orders, then prior to release for sale abroad, manufacturers shall agree to accept change orders on existing War Department contracts. The Government must be fully protected and any authorized delays must not interfere with the delivery of equipment for units immediately necessary for our defense needs.

"The release policy for foreign sale of our most modern designs will be liberalized to accomplish the foregoing, to further stimulate productive capacity and to insure improved types of planes for our

forces. Each such case must be decided on its merits. Prior to the release of any of our designs for sale abroad, the manufacturer must negotiate with the War Department for such changes in those models which are under contract for the United States Army in order to insure that improved types of airplanes are delivered to the War Department.

"No military secret will be divulged or released to any foreign purchaser of military airplanes.

"Neither designs owned by the War Department nor manufacturer-owned designs over which the War Department has control, will be released for manufacture or detailed assembly abroad.

"Foreign governments must agree to furnish us full and complete



U. S. Army photo

VULTEE BASIC COMBAT

The Wasp-powered BC-3 built for the Army Air Corps.

information on the design, equipment, and combat performance of American-made planes.

"To summarize:—The productive capacity for military planes is of vital importance to the national defense. The Air Corps augmentation of last summer and the war in Europe have increased this capacity, to an extent which makes it desirable for us to accept delays in the delivery of planes in order to secure later models.

"Development of plane types is today so rapid that the acceptance of certain models now being manufactured, involves the possibility of our Air Corps receiving in quantity types which would soon be surpassed in performance by later models.

"As I have already stated—to put the foregoing in simple business terms—we must protect our investment. Coupled with this thought

is the helpful fact that planes available for early delivery at this moment are of more interest to foreign purchasers than are prospectively better models yet to be manufactured.

"It appears not only a safe policy but a highly desirable policy for our government to accept later delivery dates for certain planes in order to secure the advantage of "change orders" which will give our Air Corps improved equipment. It is believed that by taking advantage of the existing market for military planes, we can secure the necessary changes in types by negotiation. Such a procedure should assist in maintaining us progressively in a situation where



U. S. Army photo

NEW BOEING FLYING FORTRESS

One of the Air Corps fleet of four-engine bombers, B-17B, designed and built by the Boeing Aircraft Company at Seattle, Wash. It was powered by four Wright "G" Cyclone engines.

we will have the most modern equipment, whatever the later developments.

"It must be understood in carrying out such procedure that before manufacturers would be permitted to delay delivery of planes for our Army in order to fill foreign orders, they would have to agree to accept the modifications in the contracts which would give us an improved type of plane. Also it should be understood that we should enter into no delays that would interfere with the equipment of units immediately necessary to our defensive needs.

"To make this change in policy fully effective, the War Depart-

ment may find it necessary to ask Congress for authority to extend the time during which present appropriations will be available for obligation and expenditure.

"There are questions honestly asked by many people, to which the public, and particularly the members of Congress, are entitled to have answers, and I should like to reply very frankly on behalf of the War Department that military secrets have *not* been released to foreign governments; that foreign orders have *not* delayed Army aircraft orders, nor have these orders increased the cost of Army planes.

"On January 24, 1939, when I appeared before the House Subcommittee on Appropriations, I stated: 'I feel it my duty to emphasize



STEARMAN ARMY TRAINER

One of the PT-13-A trainers for the Air Corps. It is powered by a Lycoming R-680-7 engine.

the fact—one that is apparent to all of you gentlemen—that regardless of international conditions, technical developments in means of warfare in the past five years now compel a readjustment and reorientation of our plans and preparations for adequate national defense.' I should like to emphasize again that during the past 14 months such rapid strides have been made in the development of military aircraft that a further readjustment and reorientation of our plans appear to be necessary. I have endeavored in this statement to outline the direction which we believe this readjustment should take."

Taking cognizance of the seriousness of the present world situation, the 76th Congress in 1939 authorized the appropriation of

funds for the purchase of a large number of new planes for the Army Air Corps; to provide armament, radio and accessories for them; to expand present bases and build additional ones; to secure, train and administer the additional personnel necessary to operate the airplanes, to organize more than 60 new air squadrons, and build barracks and quarters for additional personnel. The Air Corps expansion program initiated in 1939 greatly extends the Air Corps development begun under the terms of the Baker Board report rendered in 1934.

Major General Henry H. Arnold, Chief of the United States Army Air Corps, in summarizing the principles that had been followed in developing the new air program, stated that "An air force, like a navy, must be in existence when an emergency arises. The air



NEW FAIRCHILD M-62

The military primary trainer, with Air Corps designation PT-19.

force will see action first in any modern war. It requires a long time to build the planes and train the personnel needed in this very essential arm of the service."

Touching upon the same subject in his annual report for the fiscal year ending June 30, 1939, the Assistant Secretary of War, Colonel Louis Johnson, stated: "Special attention has been given to the procurement of Army aircraft. The recently authorized expansion of the Air Corps to an airplane strength of not to exceed 6,000 airplanes has been a matter of primary concern. As a result of continued conferences with the aircraft industry and with its cooperation, production capacity that will permit completion of the program by June, 1941, has been developed."



Legislation passed by the 76th Congress, third session, authorized an additional expenditure of approximately \$300,000,000 for the United States Army Air Forces in 1940, including the purchase of approximately 3,000 additional airplanes of all types, raising the strength of the Air Corps personnel by about 2,200 additional officers and 25,000 enlisted men, further development of existing air stations, and the construction of five new air bases in the continental United States and its insular possessions. This program also contemplates the expenditure of \$3,000,000 for the period ending June 30, 1941, for experimental development and research, as well as additional organizational equipment to outfit a large number of new air squadrons. This expansion program is the most all-inclusive one which



U. S. Army photo

THE WACO F7

The YPT-14 primary trainer for the Air Corps.

has ever been placed on the shoulders of the Chief of a Branch in peace time. General Arnold has pointed out that the contemplated expansion will serve the double purpose of preparing the aircraft industry for war time conditions and of affording the civilian flying schools the requisite experience in training additional pilots for the Army.

An event of considerable interest during 1939 was the observance of the 30th anniversary of the Army Air Corps at Wright Field, O., on August 2. Aviation notables from all parts of the world were in attendance. The Air Corps established six international air records. This accomplishment included speed records both with and without

pay loads, as well as altitude records with pay loads. An altitude record with a payload of 5,000 kilograms (11,023 pounds) was set when Captain E. S. Irvine, piloting a Boeing B-17A, reached an altitude of 33,400 feet. The previous altitude record for an equivalent payload was held by Germany. In connection with this celebration, groups of Army airplanes of the GHQ Air Forces made simultaneous flights over cities and towns in many parts of the country. These planes took off simultaneously at 11:00 A. M., Eastern Standard Time, from nine air stations throughout the United States. The



PACKING ENGINES FOR SHIPMENT

An aircraft engine of high horsepower is worth thousands of dollars. Each is packed in a special case weighing hundreds of pounds. Scene at the Wright plant.

Pacific Coast observance took the form of a wide-spread air defense exercise in which the civilian population took part.

The flying fortress type of bomber has continued during the year to add to its list of noteworthy achievements, its records unmarred by accident or failure of any sort. The most recent of these accomplishments was the good will flight to Rio de Janeiro in November, 1939, on the occasion of the 50th Anniversary of the founding of the Republic of Brazil. This flight was made in seven B-17's of the second Bombardment Group under command of Major General Delos Emmons, Commander of the GHQ Air Force.

The development of the aeronautical research facilities was

hastened, while the scope of existing research activities was broadened to include all the most recent developments.

A "Demonstration Group," known as the 23rd Composite Group, was organized at Maxwell Field, Montgomery, Ala. This Group, composed of Group Headquarters and Headquarters Squadron, the 24th Bombardment Squadron (Light), and the 54th Bombardment Squadron (Medium), will be employed as a laboratory for new tactical theories, airplanes and equipment, and also as a demonstration unit in connection with training of Air Corps officers at the Tactical School.

Three new national aircraft performance records for altitude with various pay loads were established at Langley Field, Va., on July 22, 1939, by a standard Army Boeing B-17 Flying Fortress bomber operated by its regular crew.



TWIN WASPS READY FOR DELIVERY

New engines awaiting packing for shipment at the Pratt & Whitney plant.

Rated pilots and students flew a total of 154,983 hours during the fiscal year ending June 30, 1939, at Randolph Field, Texas, thus exceeding the total flown in the preceding 12 months by approximately 49,000 flying hours. Some 394 students were selected for appointment as Flying Cadets to enter the July 1, 1939, class at certain Civilian Elementary Flying Schools which were selected by the War Department to give elementary training to prospective pilots under the Air Corps expansion program.

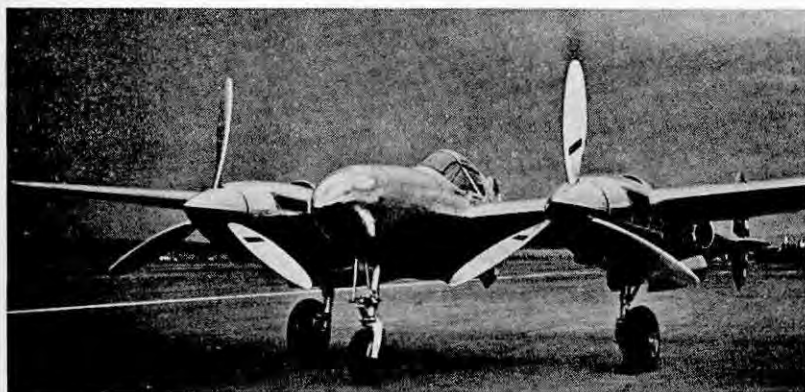
The Distinguished Flying Cross was awarded to Major Caleb V. Haynes of the Army Air Corps on February 14, 1939, for extraordinary achievement in making an aerial flight in a B-15 from Langley Field, Va., to Santiago, Chile, transporting 3,250 pounds of Red Cross medicinal supplies to Chile under conditions which were extremely hazardous and exacting. Major Haynes flew to Chile

in 29 hours and 53 minutes flying time over a distance of 4,933 miles.

Distinguished Flying Crosses were also presented to Major Carl Greene and Captain A. H. Johnson for the development and flight test of the Lockheed pressure cabin plane, and to Captain C. J. Crane and Captain G. V. Holloman for the development and flight test of an automatic landing system.

The Cheney Award was presented to Lieutenant Harold L. Neely, Air Corps pilot at Lowry Field, Col., for risking a forced landing of his plane in a blinding dust storm near Hill City, Kans., on December 18, 1939. On that occasion Lieutenant Neely was forced to choose between a very hazardous landing to save the life of a passenger or bailing out to save his own life. He chose to save the life of his passenger.

The Mackay Army Trophy for 1938 was presented to the Second



U. S. Army photo

THE LOCKHEED ARMY P-38

A twin-engine interceptor pursuit plane, powered by Allison engines, for the U. S. Army Air Corps.

Bombardment Group, Langley Field, on October 31, 1939, in recognition of the efficient and successful flight of six B-17 Boeing flying fortresses from Langley Field, Va., to Buenos Aires, Argentina, and return, during February, 1938. Personnel included 25 officers and 24 enlisted men, commanded by Colonel Robert Olds.

The Frank Luke Trophy was presented to the 94th Pursuit Squadron for attaining the highest gunnery average of the year in the GHQ Air Force. The presentation was made by Colonel Henry B. Clagett, Commanding Officer of the Third Air Base, on January 18, 1940.

The Harmon Efficiency Trophy was presented to the 8th Attack Squadron at Barksdale Field on October 28, 1939, by Brigadier General Frederick L. Martin, commanding the 3rd wing GHQ Air Force. This trophy is awarded annually for the highest general efficiency of the tactical units.

The Soldier's Medal was awarded to Harry M. Hayes, sergeant, air mechanic first class, of the 44th Reconnaissance Squadron, Army Air Corps, for heroism displayed when a B-10-B airplane crashed and was wrecked in the rough sea near Mariata Point, Mala Peninsula, Panama, at 11:00 A. M. on July 2, 1938.

Plans for two new Air Corps stations in Alaska were announced February 12, 1940, one at Fairbanks and the other at Anchorage. The Fairbanks station on a field of 1,000 acres was to be used primarily for experimental operations in cold weather. "All types of planes will be employed. The construction will include a hangar, shops, paved runways, night landing equipment, quarters for thirty officers and twenty-six non-commissioned officers, barracks for three hundred men, a hospital, a central heating and electric light plant and warehouses." The Anchorage station, "which will ultimately include both ground and air units and which will be located just south of that city will comprise 1,400 acres, and is not yet in process of construction."

On June 30, 1939, there were 22,387 personnel on active duty with the Air Corps, including 1,549 officers. There also were 3,222 officers and 457 enlisted men in the reserve.



U. S. Army photo

AN AIR CORPS BEECHCRAFT

High altitude photographic ship built by the Beech Aircraft Corporation at Wichita, Kans. The plane is powered by two Wasp Junior engines.

CHAPTER IV

AIR FORCES OF THE U. S. NAVY

"Increasing Importance" of Naval Aviation as Adjunct of the Fleet
—Improved Shore Stations—New Carriers—Long Flights and
Arduous Duties Over the Sea—The Navy Aircraft Pro-
curement System—Reliability of Planes and Engines—
Progress in Training—Importance of Research—
Recommendations by Rear Admiral Towers.

THE following is an authorized account of the activities of the air forces of the U. S. Navy:

The Bureau of Aeronautics, under the direction of the Secretary of the Navy, is at present charged with and responsible for all that relates to the design, construction, fitting out, testing, repair, and alteration of Naval and Marine Corps aircraft, and, except as specifically assigned to other cognizance, instruments, equipment and accessories pertaining thereto.

On June 1st, 1939, Rear Admiral John H. Towers was appointed Chief of the Bureau of Aeronautics, and he reported that in general, the aircraft program, resulting from the requirements of the treaty Navy, was completed with the last year's procurement.

A definite, orderly plan has been established to provide airplanes and to train aviation personnel for the increased Navy authorized by the Naval Expansion Act. Naval aircraft, for purposes of economy, operate during many of the training periods, from bases ashore. In the interest of efficiency existing shore facilities to support the operating aircraft are being developed, dependent upon funds available.

The rehabilitation of the Naval Air Station at Cape May, N. J., materially assisted in relieving congestion at the Naval Air Station, Norfolk, Va., prior to the "Yorktown" and "Enterprise" reporting to the Fleet for duty. An outstanding contribution towards the relief of congestion at the Naval Air Station, San Diego, will be realized

upon the completion of naval aviation facilities on San Clemente Island, Calif. The improvement of facilities at Terminal Island, San Pedro, Calif., for the use of battleship and cruiser aircraft, also has contributed to the relief of aircraft congestion at San Diego. The aviation development at Alameda, Calif., and the expansion of existing facilities at the Naval Air Station, Seattle, Wash., will contribute materially to the relief of West Coast naval aviation congestion. Additional facilities have also been provided at Guantanamo, Cuba and St. Thomas, Virgin Islands, for use of Fleet aircraft.

The receipt by the Bureau of Aeronautics of \$13,400,000 from



U. S. Navy photo

THE BREWSTER XF2A-2

A single-place Navy fighter with a Wright Cyclone engine, and produced by Brewster Aeronautical Corporation, Long Island City, N. Y.

the Works Progress Administration and the Public Works Administration resulted in the rapid and economical accomplishment of a vast amount of work which otherwise would have been deferred several years.

The need for additional naval aviation facilities on the East Coast, in the Alaskan Area, and in the mid-Pacific Islands, continued pressing. This was recognized by the Hepburn Board and, as a result, the 76th Congress, 1st Session, authorized funds for new facilities and stations. This construction program when completed will pro-

vide aviation facilities in outlying strategic areas, as well as on both continental coasts for increased support of the Fleet. Contracts have been awarded and work has been started on these projects.

During the fiscal year 1939 airplanes were procured to replace those worn out in service or lost by crashes, and to expand the Aeronautical Organization in accordance with the Naval Expansion Act. Aviation units were organized for the "Phoenix," "St. Louis," "Boise" and "Wichita." Patrol Squadrons 20 and 21 were placed in commission and based at the Seattle Naval Air Station. Contracts were placed to provide airplanes for two additional patrol squadrons.

Several new types of aircraft, embodying considerably improved performance, were brought out for service test during the year.



U. S. Navy photo

NEW VOUGHT-SIKORSKY SCOUT

The XSO₂U-1 scout observation seaplane, powered by a Ranger engine, with Edo float.

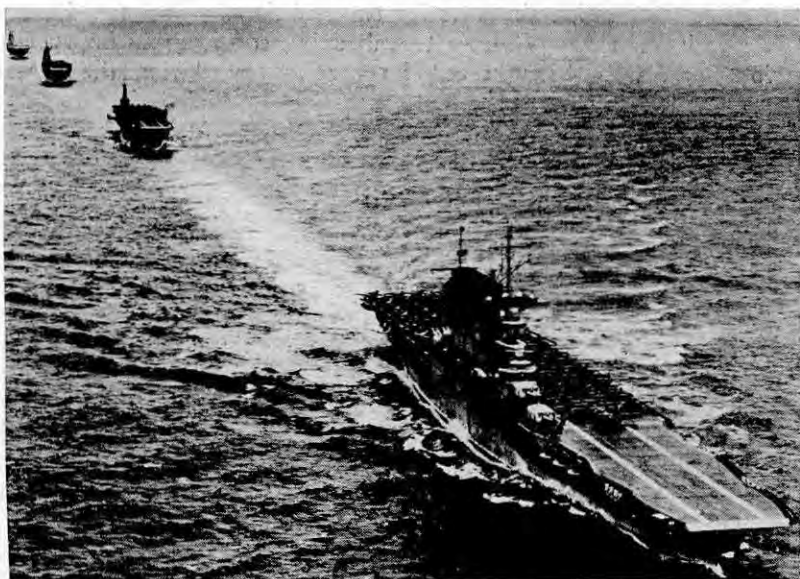
Fleet squadrons were being equipped with those types as rapidly as contract deliveries permitted.

The Procurement Division of the Bureau of Aeronautics initiated and followed through the building up and reorganization of the Bureau's inspection force.

The operation of patrol planes attached to Aircraft Scouting Force continued to be seriously restricted by lack of supporting tenders. Patrol plane performance already reached in present design, and that expected in future developments, accentuated tender needs with the full realization of the type's potentialities. Tender shortage was slightly alleviated by the conversion of the destroyers "Childs" and "Williamson" to small seaplane tenders. The seaplane tender

program will be considerably advanced upon the completion of the large tender "Curtiss," the "Albermarle," a duplicate of the "Curtiss," recently laid down, and two small seaplane tenders, "Barnegat" and "Biscayne." Two small seaplane tenders, "Casco" and "Mackinac," have been authorized.

The aircraft carriers "Yorktown" and "Enterprise" joined the Fleet early in 1939 and participated in the Fleet Problem. A contract was awarded for an additional aircraft carrier, the "Hornet,"



U. S. Navy photo

FOUR U. S. NAVY CARRIERS

The U. S. S. "Lexington" (in the foreground), the "Ranger," "Yorktown" and "Enterprise."

similar to the "Yorktown" and "Enterprise." The "Wasp" was to be commissioned during 1940.

During the annual Fleet Problem, which constitutes the culmination of the Fleet aircraft training activities, "aircraft demonstrated that naval aviation is becoming increasingly important as an adjunct of the Fleet, and also increasingly able to discharge its functions dependably."

Aircraft squadrons and tactical units, including Marine Corps squadrons, have been assigned to and operated with the Fleet. Naval

aircraft also have been based ashore for experimental, training and administrative activities. Patrol squadrons of the Fleet have been attached to Naval District Headquarters on the East and West Coasts for limited periods, and have cooperated with Army forces in connection with local coastal defense exercises. Continued development and improvements have been made in all phases of aircraft tactical training.

The Patrol Wings participated in the Fleet Problems and exercises, together with advanced base operations, as follows:

Patrol Wing 1, based at San Diego, flew to Panama—Guantanamo—San Juan—St. Thomas—Norfolk—Newport and then re-



U. S. Navy photo

CONSOLIDATED PATROL BOMBER

This four-engine XPB2Y-1 with four Pratt & Whitney Twin Wasp engines was in Navy service in 1939.

turned to the West Coast. Those planes [Consolidated] participated extensively in all Fleet exercises. Their long flight from the West Coast to the Caribbean area for participation in Fleet Problem 20, thence to the East Coast and return to the West Coast via the Panama Canal without serious casualty, demonstrated the mobility and excellent state of training among our long-range patrol-bombing squadrons. Patrol Wing 2, based on Hawaii, carried out extensive advanced base operations. Patrol Wing 3, based in the Canal Zone, participated in Fleet Problem 20 and carried out other operations in the Caribbean-Central American waters. Patrol Wing 4 based in the Pacific Northwest continued operation in that area and the Gulf of Alaska. Patrol Wing 5 based at Norfolk operated along the East Coast defense

areas and, in addition, participated in Fleet Problem 20. This wing also conducted training for the midshipmen at the Naval Academy.

During the year, two non-stop flights were made from San Diego to Hawaii, by Patrol Squadron 4 and Patrol Squadron 1. These flights again demonstrated the mobility of Navy patrol-bombing wings to move on short notice into any threatened area.

Utility Wing, Base Force, flew from San Diego to Guantanamo to work with the Fleet while operating in the Caribbean area. Joint air exercises were conducted with the army. Besides routine opera-



U. S. Navy photo

NAVY FLYING CADETS

Before the Operations Board showing the day's flight training assignments at the U. S. Naval Air Station, Pensacola, Fla.

tions of Naval Reserve aircraft throughout the year, the Squantum station acted effectively as a relay unit and operating base for aircraft engaged in rescue and salvage of the submarine "Squalus." Several other units engaged in minor search and rescue operations. Shore stations carried out numerous experimental flights.

More than 400 planes were ferried between the East and West Coasts, either for overhaul or for the delivery of new airplanes from the contractor's plant to operating units.

The tactical squadrons of the First Marine Corps Aircraft Group flew from Quantico, Va., to the San Juan-Culebra area and participated in the Fleet Landing Exercises and Fleet Problem 20. The movement to and from the maneuver area, and the extensive overseas operations, were conducted without incident. Marine Corps Scouting Squadron 3, based at St. Thomas, V. I., also participated in Fleet Landing Exercise and Fleet Problem 20. The tactical squadrons of the Second Marine Corps Aircraft Group, based at San Diego, participated in several tactical exercises in conjunction with the U. S. Fleet and several landing exercises in connection with the operation of the Fleet Marine Force. For the second time in as many years, the entire group embarked in one of the carriers for a week of qualification and group tactics.



U. S. Navy photo

GRUMMAN JRF-1 AMPHIBION

U. S. Navy utility transport powered by Wright Cyclone engines.

The "Langley" on September 7, 1939, left the Hawaiian area for Manila, P. I., to augment the Asiatic Fleet. Patrol Squadron 21 flew from Pearl Harbor to Manila, 5,000 miles, to base in the "Langley."

The Naval Aircraft Factory at Philadelphia, Pa., aeronautical experimental center and supply base of the Navy, also functioned as an industrial plant for the production, overhaul and repair of aircraft, engines and spare parts in limited quantities. Production during the last year proceeded at a normal rate and included an order of scout-observation planes for the Fleet. Funds were appropriated for urgently needed expansion and modernization of the aeronautical materials and engine laboratories, and plans for construction were being completed.

Development of aeronautical material and technology constituted a major effort of the Bureau of Aeronautics, with continuous investigations of possible improvements and new principles along sound engineering lines and with promising application to naval aircraft. In order to keep abreast of the increased size, weight and performance of ship-based units, the work has included improvement of equipment aboard ship for launching, arresting and handling planes. Direct financial support has been rendered so far as possible to other Governmental and to commercial concerns for developments and incidental experimental work, the pursuit of which is the responsibility of the Bureau. The increased funds appropriated for that purpose in 1940 will permit accelerated progress and certain new



U. S. Navy photo

CURTISS XSO₃CO₁ SCOUT

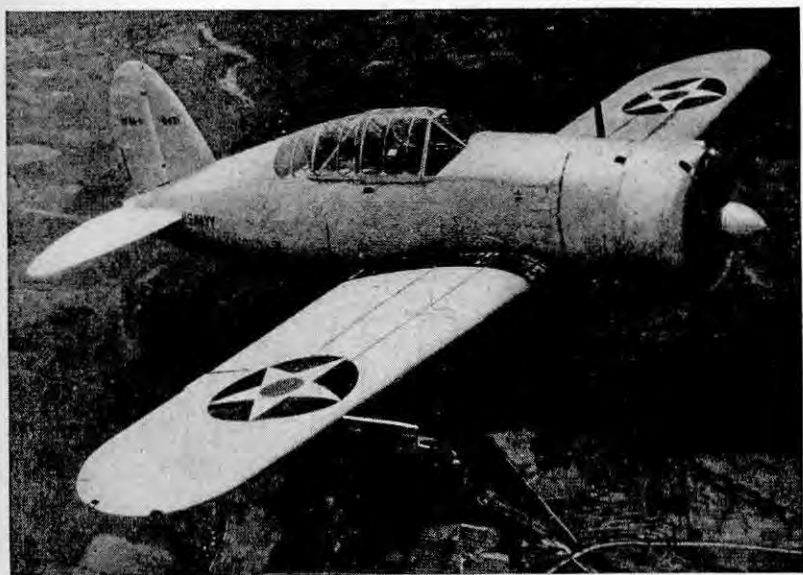
A two-place scout observation plane with a Ranger engine.

lines of development of utmost importance to naval aviation and necessary to keep pace with the technical advances abroad.

The Bureau continued "its policy of procuring experimental airplanes which serve as prototypes for production, through design competitions. The type specification covering the general requirements of a given design is transmitted to all interested and accredited manufacturers. Subject to the availability of funds and the importance of the type to future procurement, the general practice is to give contracts for the construction of one plane to each of the two manufacturers whose designs receive the highest all-around evaluation. Upon completion, the two airplanes are subjected to comprehensive trials in direct competition with each other and thereby adjudged for production in quantity. This procedure has ensured orderly engi-

neering progress and the procurement of service equipment of demonstrated, superior quality.

"It has the disadvantage, however, of discouraging manufacturers from incorporating in their products features of a highly experimental nature which have yet to be proved from a practical standpoint. Since a production order depends upon the successful completion and trials of the prototype, a prospective contractor naturally hesitates to introduce novel or untried features which may jeopardize or unduly delay his design. He, therefore, leans toward conservatism. This has tended to retard, or at least to restrict, the experimental



BREWSTER NAVY FIGHTER IN FLIGHT

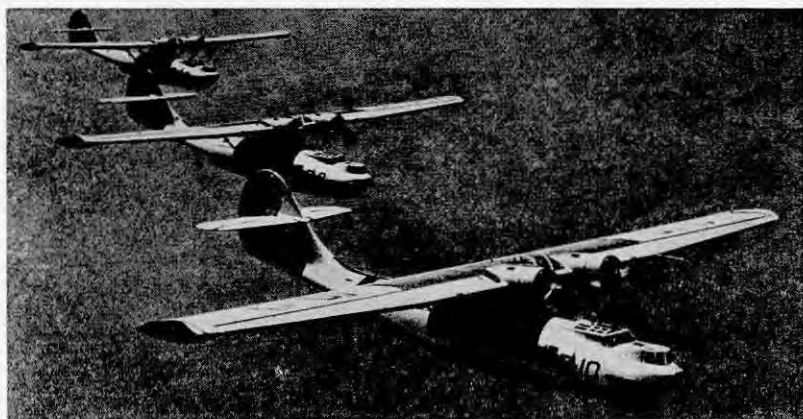
It is the F2A-1, Export Model 239, powered by a Wright Cyclone engine.

application of new principles that have passed the laboratory stage but are awaiting demonstration as to their practicability and value. The increased funds appropriated for experimental airplanes in 1940 will permit greatly accelerated progress in this connection and result in the much earlier application of current technical developments to service aircraft."

"Substantial increases in power output from both single- and double-row radial air-cooled engines have been marked. This type of engine is now in the position of being regarded as the most reliable

and powerful of the accepted service types. Long-distance mass flights are now undertaken as a matter of routine and without incident. Although the major efforts of manufacturers have been devoted to obtaining increased power output both for high altitude and take-off purposes, new types and designs have not been neglected. The latter have been under continuous study and investigation.

"The development and improvement of power plant accessories have proceeded successfully in cooperation with other Government agencies, the airplane manufacturers and the engine builders. The work involves a large amount of engineering effort and arduous testing over a long period of time. One of the most outstanding successes in this field, in which the Bureau of Aeronautics takes con-



U. S. Navy photo

NAVY CONSOLIDATED PBV'S

They are powered by Pratt & Whitney Wasp engines.

siderable pride, is the variable venturi non-icing type of carburetor. Although this project has been under development for several years, details were not released until this year. It has been applied with success to commercial aviation.

"The Aeronautical Engine Laboratory at the Naval Aircraft Factory continues to do excellent work in testing engine accessories and equipment in addition to the routine and experimental proof-testing of engines. Results have proved to be of inestimable value in improving serviceability and reliability of aircraft power plants.

"Greater attention to power plant installation features has resulted in decreasing maintenance and upkeep, increasing reliability, and

effecting a substantial decrease in parasitic drag for cooling. Improvements also have been made in design of power plant installations to facilitate rapid engine change.

"Increasing the octane rating or resistance to detonation of aviation fuels has resulted in improved performance through greater fuel economy and increased power outputs. The development is the result of long-range planning in cooperation with the Army Air Corps and the industry. A reduction in the number of fuels and lubricants also has been accomplished through standardization, permitting a sub-



VOUGHT-SIKORSKY NAVY OBSERVATION SCOUT

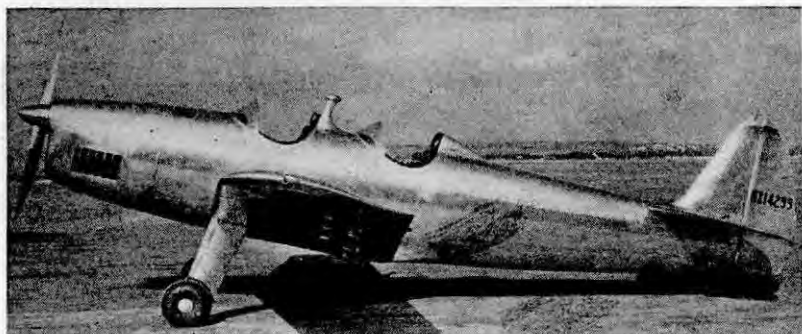
The OS2U-1, a two-place, low-wing Navy land plane with all-metal monocoque fuselage powered by a 400 h.p. Pratt & Whitney Wasp Jr. engine and a Hamilton Standard constant speed propeller.

stantial reduction in stocks for military purposes that need to be carried by refineries.

"Marked progress has been made in establishing standard Army-Navy specifications for power plant accessories and equipment. This work is proceeding satisfactorily and promises to effect future economies. The Permanent Working Committee of the Aeronautical Board, established during the year 1938, is now functioning in an effective manner. A number of standardization projects have been not only initiated but completed during the year. It is believed that the standardization program as now set up will be far more effective than the scheme heretofore followed and will result in a greater reduction in

procurement and maintenance costs than has been possible previously. While a certain amount of standardization was effected during past years, the establishment of the Permanent Working Committee, with personnel specifically delegated to coordinate and direct standardization between the Army Air Corps and the Bureau of Aeronautics, has resulted in marked progress and efficiency. The prime objective of the present Army-Navy standardization scheme is to develop joint specifications for the materials, processes and equipment which they cover.

"The materials and equipment projects under development far exceed in number and importance those of any period since the Bureau was organized. This has been the natural result of the increased performance demanded of airplanes currently being delivered and



NORTH AMERICAN PRIMARY TRAINER

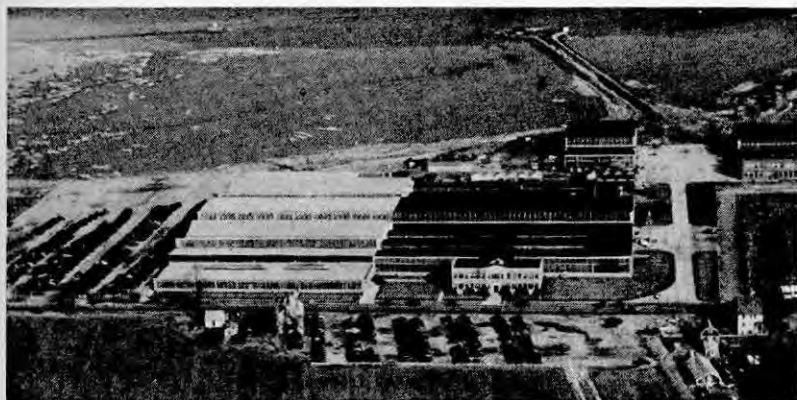
Powered by a 150 h.p. Menasco engine.

under development, and of the new operational and maintenance problems which accompany higher performance airplanes. Significant in the last year's accomplishments in this field is the extension of the use of lighter alloys and protection thereof against corrosion, higher strength steels, improved methods of fabrication to meet low drag requirements, new finishes and hull-bottom protection and non-destructive methods for inspecting materials for defects. Marked advances also have been made in the reduction of corrosion problems for sea-going aircraft. A non-proprietary type of fuel and oil line fitting has been designed by the Bureau and adopted as standard for new airplanes."

Training of student pilots was continued at the Naval Air Station, Pensacola, Florida. The training of Aviation Cadets, Naval Reserve, is relieving the shortage of commissioned officer pilots

available for duty in the Naval Aeronautical Organization. Student training activities at Pensacola, as well as training activities at the operating units in the Fleet, have been intensified and have contributed to the improving standards.

Annual 14-day periods of training duty were conducted for all members of Class A-O of the Naval Reserve. In order to augment the complement of regular naval aviators required at the Naval Air Station, Pensacola, for the training of aviation cadets, a large number of Naval Reserve aviators were placed on extended active duty. Thus funds were available for the provision of 14-day periods of training duty for a number of the officers of the volunteer Naval Reserve who were associated with Naval Reserve aviation squadrons. This training duty not only served to stimulate the interest of



THE VOGHT-SIKORSKY PLANT

Where that division of United Aircraft Corporation builds planes at Stratford, Conn.

the volunteer group, but also proved decidedly in the best interests of the Government. Inspection of the various Naval Reserve Aviation activities revealed that the required syllabus of flight training for members of the organized Naval Reserve had been excellently carried out, and that all activities were most efficient in the execution of the assigned missions.

Definite progress in aircraft armament has been made, particularly along the lines of refinements and modifications of standard service aeronautical equipment, the supply of new and improved armament equipment in installation, the design and development of new and more effective aircraft weapons and accessories, and their installation in the aircraft of the latest experimental and service

design. This progress has been due in a large measure to excellent cooperation received from the Bureau of Ordnance and the aircraft industry and to close liaison with the Army Air Corps.

The Navigational Instrument Section of the Naval Aircraft Factory functioned as a research and testing laboratory for navigational instruments. A light-weight gyro-stabilized automatic pilot was developed for small aircraft and optical drift sights designed for all types. An absolute altimeter was made available and a meter to measure the quantity of fuel used, having the remarkable accuracy of one-fourth of one per cent, is being procured. In addition, time and altitude averaging devices for octants were developed and are being procured.

Airship activities continued to be concentrated at the Naval Air



CONSOLIDATED XPBY-5A AMPHIBION

Consolidated Aircraft Corporation Model 28 flying boat with wing tip floats was the basic design to which the 3-wheel landing gear was added to make this long range amphibion.

Station, Lakehurst. Acceptance was authorized of a new non-rigid airship of 400,000 cubic feet volume, which shows promise of being a useful type for along-shore patrols. Through the use of mobile and portable mooring masts, the operations of non-rigid airships have been extended to cover a wide range of severe weather conditions.

Experimental and research work especially relating to airships was carried forward under the guidance of the Special Airship Committee of the National Academy of Science. This research entered the field of structural analysis, aerodynamics and fabric developments. Several noteworthy contributions to technical data have resulted.



THE STEARMAN 76-D1

An advanced trainer with Pratt & Whitney Wasp Junior engine.

The following table shows the Navy aviation appropriations for fiscal years:

	1939	1938	1937
Navigational, Photographic, Aerological and Radio Equipment	\$ 968,700	\$ 750,000	\$ 700,000
Maintenance and Operation, Aircraft and Air Stations.	19,069,800	18,796,000	14,408,270
Experiments and Develop- ments	2,903,500	4,768,000	2,500,000
Aircraft Construction	24,633,000	27,186,000	20,980,000
Rigid Airship	500,000	.....	.....

Total, "Aviation, Navy" ..\$48,075,000 \$51,500,000 \$38,588,270

The following recommendations were made by Rear Admiral Towers in his annual report to the Secretary of the Navy for the fiscal year 1939:

"1. Provide new aircraft, of best possible performance, in sufficient numbers to replace obsolescent or damaged airplanes, and as required in the expansion program.

"2. Continue the planning and development of increased shore facilities adequate for the growing needs of the Fleet.

"3. Provide an adequate number of suitable tenders for patrol planes.

"4. Incorporate in new construction of surface craft, where applicable, best possible features for efficient aircraft operations.

"5. Procure and train personnel adequate for the expansion of naval aviation.

"6. Cooperate to the fullest extent possible with other Government agencies: (a) To explore the experimental fields of aircraft design. (b) To further standardization of materials and equipment. (c) To provide a source of efficient reserve personnel.

"7. Continue the development and improvement of shipboard facilities for handling aircraft.

"8. Pursue a moderate airship building program and continue training personnel in non-rigid airships.

"9. Amend the law in such manner as to allow qualification of naval aviators (airship) on the basis of non-rigid airship experience.

"10. Provide new wind tunnel as part of the hydrodynamic laboratory to permit the conduct of routine design tests without interference with research development.

"11. Make every effort to obtain adequate funds for a well-considered and comprehensive experimental program to effect continued improvement in aircraft and aircraft engine reliability and performance, and to forestall our falling behind other countries in these respects."



U. S. Navy photo

GRUMMAN XF4F-3

A Navy fighter powered by a Pratt & Whitney Twin Wasp engine.

CHAPTER V

U. S. GOVERNMENT CIVIL ACTIVITIES

The Civil Aeronautics Authority—Coast Guard Aviation—Bureau of Fisheries—Bureau of Foreign and Domestic Commerce—Division of Controls—Division of International Communications—Geological Survey—Federal Communications Commission—National Advisory Committee for Aeronautics—National Bureau of Standards—U. S. Office of Education—Tennessee Valley Authority—U. S. Coast and Geodetic Survey—U. S. Forest Service—U. S. Weather Bureau—U. S. Public Health Service.

THE many departments and bureaus of the Federal Government concerned with aeronautics supplied the following interesting accounts for this edition of The Aircraft Year Book.

Civil Aeronautics Authority

The Civil Aeronautics Authority completed the task of confirming, through the so-called "grandfather" certificates of convenience and necessity prescribed in the law, the operation of those air lines, domestic and foreign, with performance in adequacy and efficiency shown to serve a public need. It adjudicated the mail rates for most of those lines upon the formulas set forth in the Act in such fashion that no carrier appealed its decisions to the courts. Other mail rate cases were still pending at the year's end and, on its own initiative, the Authority began inquiry into the mail rates of the carriers which did not seek to have rates changed or where special conditions seem to warrant adjustment.

Given such a firm economic basis, the Authority and the industry cooperated towards attainment of an improvement, justly characterized as sensational, in the product—air transportation—which the

industry had to sell the public. By the first of January, 1940, the Authority was able to report that the safety of the domestic scheduled air lines was four times greater than it had ever been before, along with a tremendous growth of patronage and of miles flown. By the long-to-be-remembered date of March 26, 1940, it was able to announce a perfect safety record—the domestic air lines had on that date flown an entire year without fatal accident to passenger or crew.

According to reports the C.A.A. believed that increases in public acceptance of air transportation during 1940 "would put all air carriers so comfortably into the profitable field as to justify an early and radical reconsideration of the whole structure of air transportation costs and rates."

The Authority in its first annual report to the Congress, in its



DOUGLAS ENGINEERS

The engineering department at the El Segundo, Calif. plant of the Douglas Aircraft Co.

statements at the first of the year and in its comments, official and otherwise on March 26, was generous in attributing these achievements to the personnel of the air lines themselves—from field boy to air line president, as President Roosevelt expressed it in his letter of congratulation. The Authority frequently pointed out that this improvement in safety and patronage cannot be attributed to any single cause.

"The record shows, however, that the early, frequent, forceful and public insistence by the Authority and its spokesmen on the possibility of safety produced results not only moral but actual. In the autumn of 1938, the Authority, then under the chairmanship of Edward J. Noble, told the operators in no uncertain terms that they must stick to their mutual cancellation agreements during the winter of 1938-1939.

The operators effectively honored that pledge. As a result, during that winter, the domestic airlines had but a single fatal accident and, on the three transcontinental lines and the principal north-south line, a record for the winter of 50,000,000 passenger miles was attained without so much as a forced landing."

Shortly after that achievement, Mr. Noble, appointed Under Secretary of Commerce, was succeeded as Chairman of the Authority by Robert H. Hinckley, and Edward P. Warner was named to the vacancy. Under Chairman Hinckley the Authority was equally vigorous in insisting on the observation of all safety measures, and in open and public praise of the record as it developed to its perfect climax a year later.

Details of the C.A.A. activities in the civilian pilot training pro-



U. S. Army photo

NORTH AMERICAN O-47A

One of the three-place observation ships powered by 1,000 h.p. Wright Cyclones, which North American Aviation built for the Air Corps.

gram and its airways development work will be found in those respective chapters.

Coast Guard Aviation

The following was received from Coast Guard headquarters: "The fiscal year 1940 has been an important period in the history of the Coast Guard. The transfer of the former Lighthouse Service to the Coast Guard made necessary a general reorganization of the whole Service. Aviation, which had been a Division of Headquarters, was on April 1, 1940, split up and its functions transferred to the Division of Operations and the Division of Materiel. This was in line with the reorganization of the Service as a whole. Aviation personnel will be

assigned on the staff of the Chief Operations Officer. In the Materiel Division there will be an Aviation Engineering Section. The decision to abolish the Aviation Division was based on the belief that Coast Guard Aviation is now a going concern and is sufficiently well established to require no special administrative organization of its own."

Bureau of Fisheries

Maintenance of aerial patrols over the Alaskan fisheries was continued throughout 1939 by the Bureau of Fisheries, U. S. Department of the Interior. Six companies furnished chartered airplane service, during which 6,859 miles were covered in a total flying time of $64\frac{1}{3}$ hours spread over 31 days. Chartered airplane service was used also



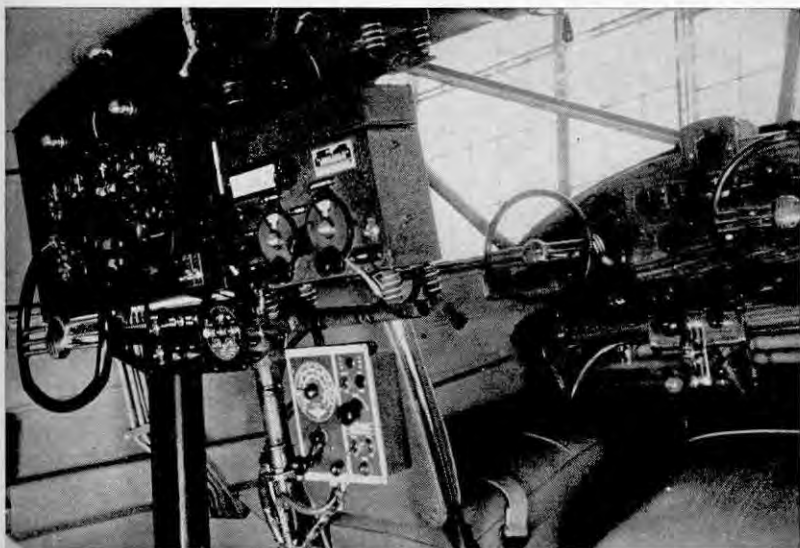
THE 1940 STINSON RELIANT

One of a fleet maintained by Pan American Airways at several stations for instrument flying instruction. It has a 300 h.p. Lycoming engine.

for survey and photographic work in connection with scientific investigations of the salmon conducted in the Bristol Bay region, in western Alaska, from May to October. Transportation was provided on 67 days during this period, the total flying time was 206 hours, and the distance flown was 20,645 miles.

Successful experiments in planting fingerling trout by plane, conducted in Idaho, proved that these fish could be dropped from a height of 500 feet without injury. In order to stock some of the more inaccessible lakes, located in the Sawtooth Mountain range of Idaho, an agreement was reached between members of a local sportsmen's organization, officials of the Idaho Fish and Game Commission, and personnel of the Bureau of Fisheries station at Hagerman. It was agreed that the organization was to direct the planting, the Commission pay for

chartering the plane, and the Bureau to furnish the fish. Transportation between Hagerman and the landing field was accomplished with tank trucks supplied by the State and the U. S. Forest Service. A specially constructed tank with a large, quick-opening gate in the bottom that permitted draining of water and fish in 10 seconds, was installed in the cockpit of the plane. This tank was equipped with a pump operated by a small windmill for aerating the water. The first load, consisting of 3,750 five-inch rainbow trout, was liberated in two plane trips. The second planting, made some days later, consisted



FOR INSTRUMENT FLIGHT TRAINING

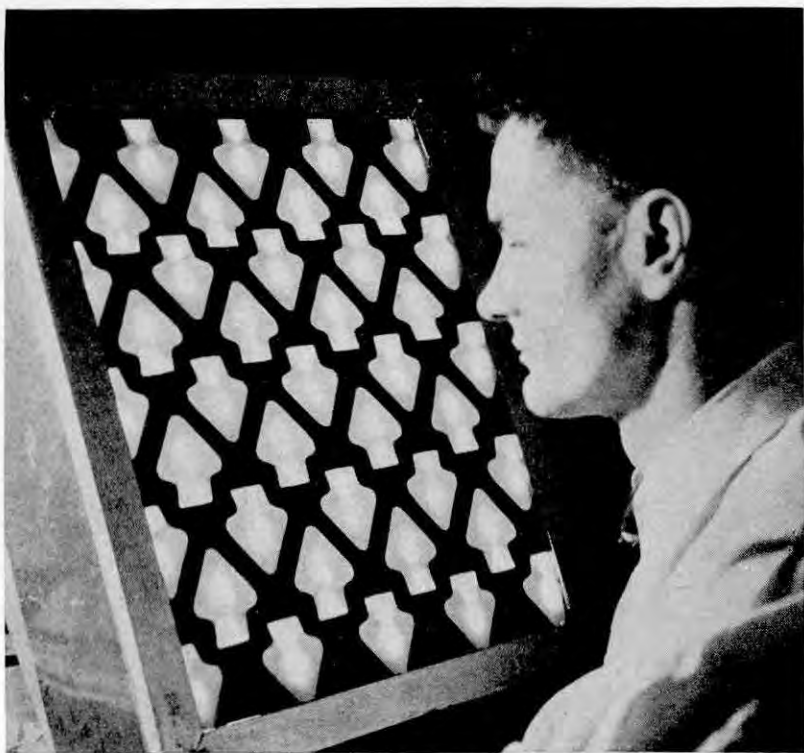
One of five Stinson Reliants equipped for training Pan American Airways personnel in instrument flying. Photo shows a third set of controls and radio where the pilot taking instruction and the radio operator are placed. A curtain drawn across the forward part of the cabin simulates "blind flying" conditions.

of 60,000 eastern brook trout and 14,000 three-inch rainbow trout. A total of nine lakes were thus planted. The average time for a round-trip between landing field and waters to be stocked was 20 minutes. It is estimated that 5,000 fish could be safely carried for half an hour in this special type of tank, by plane.

Bureau of Foreign and Domestic Commerce

All elements of the aeronautics industry are concerned with information from abroad. In accordance with United States Statutes,

the functions of promoting the export trade in aeronautic products and the collection, preparation and dissemination of information on aeronautics abroad are charged to the Automotive-Aeronautics Trade Division of the Bureau of Foreign and Domestic Commerce. In its foreign trade informational and promotive work, the Bureau uses the facilities of the Foreign Service of the United States with which the



LOCKHEED X-RAY INSPECTION

The technician is studying an x-ray print of scores of small parts, including forgings, castings and similarly stressed materials.

former Foreign Commerce Service was consolidated on July 1, 1939. At home the work is done in cooperation with the many district offices of the Bureau and cooperative offices (in chambers of commerce) in business centers; with the Aeronautical Chamber of Commerce of America, the Air Transport Association of America and other aeronautical organizations, public and private.

The official statistics on aeronautic exports are published in the "Aeronautical World News." This periodical, issued twice a month, also carries information from official and other sources on all phases of aeronautics abroad. Similar information is disseminated through the trade and daily press, other publications, the Aeronautical Chamber of Commerce of America, correspondence and otherwise. Much information is supplied regularly to other agencies of the Government as well as to civilian organizations.

Division of Controls

The Division of Controls of the Department of State continued to administer the registration and licensing provisions of the new Neu-



THE WACO D

For the Uruguay Army Air Corps.

trality Act of November 4, 1939, as it administered the corresponding provisions of the preceding acts. These provisions require that all persons engaged in either the manufacture, the export or the import of any of the articles enumerated in the President's Proclamation of May 1, 1937, shall register with the Secretary of State. The articles listed in this proclamation include aircraft of all kinds, aircraft engines, certain essential aircraft parts, such as wings, hulls, fuselages, undercarriage units and tail units, and a number of items of aircraft armament. Licenses must, moreover, be obtained for the export and

import of each individual shipment of any of these articles. Such licenses may be issued only to those persons who are registered with the Secretary of State, as described above. An additional provision of the new act of 1939 stipulates that each application for a license to export or import shall be accompanied by a statement of the terms of sale in the particular transaction.

Full information in regard to persons registered under this act and in regard to export and import licenses issued is found in the reports of the National Munitions Control Board, of which the Sec-



STEARMAN TRAINERS FOR CUBA

A fleet of Model 73B1 primary trainers powered by Wright Whirlwind engines. The Stearman planes are built at Wichita, Kans.

retary of State is Chairman and Executive Officer. These reports are prepared by the Division of Controls and are presented to Congress on January 1 and July 1 of each year. The value of the aircraft and aircraft equipment licensed for export during the year 1939 was \$197,838,784.39.

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 interpretation 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



AERONAUTICAL ENGINEERS

Commercial and military planes get their start here in the engineering department of the Boeing Aircraft Company.

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 handles arrangements for foreign

flights of United States civil and military aircraft, and is charged with certain other miscellaneous duties pertaining to various phases of international aviation.

Geological Survey

The Geological Survey of the U. S. Department of the Interior conducted extensive operations in aerial photography in connection with planimetric and topographic mapping during the fiscal year 1939. The report of the Survey follows: The Geological Survey began using aerial photographs in 1919 in connection with its mapping activities. Both multiple-lens and single-lens photographs are used, the type selected depending upon the character of the area to be mapped and the



REPUBLIC 2-PA GUARDSMAN

Pursuit and convoy fighter with a Pratt & Whitney Twin Wasp engine.

relative difficulty in expanding control surveys in the area to tie in and adjust photographic details to map locations. A line map incorporating all of the details of drainage, culture, and woodland that can be identified is compiled in the office on the scale of the photographs for each quadrangle area to be mapped. A photographic reduction from the compilation scale to the scale on which the map is to be completed by ground survey methods is made and printed in light blue on map sheets. The topographic survey is then completed on these sheets on which most of the details of location are already shown.

Graphical methods are employed generally in the compilation of planimetric details from aerial photographs, chiefly because the amount of stereophotogrammetric equipment now available is inadequate for

handling the volume of work required by the Survey's mapping program. However, stereophotogrammetric instruments and methods provide greater and more uniform accuracy in map locations and are employed to the extent that the increasing equipment of the Survey will permit. During the fiscal year 1939 the Geological Survey developed topographic maps of 2,209 square miles for the Tennessee Valley Authority by stereophotogrammetric methods; completed the compilation of planimetric details by graphical methods of 1,980 square miles for preliminary publication without contours as planimetric maps; and completed the mapping of 24,003 additional square miles by plane-table methods, largely by the addition of contours to line maps compiled by graphical methods from aerial photographs. Of the photographs procured for photomapping, covering areas totaling 34,278 square miles, those covering 22,426 square miles were pur-



VULTEE V-11 ATTACK BOMBER

It was powered by a Wright Double Row Cyclone.

chased from commercial organizations, and those covering 11,852 square miles were purchased from other Federal agencies or prints were made from negatives borrowed from such agencies. A large number of these photographs were used in the field in conjunction with ground surveys to add details of the terrain. Such use of them, when it is not practicable to construct planimetric bases, results in a saving of time to the field engineer in mapping minor features, in accurately delineating meanders of drainage, the shore lines of lakes and ponds, and the boundaries of wooded areas.

In addition to the foregoing photogrammetry, the Alaskan Branch of the Geological Survey photographed 5,000 square miles in 1938 in the Tanana Valley, Alaska, with a 4-lens camera. Compilation of

planimetry from the pictures is now going forward by the use of the radial-line method of aerial triangulation. Oblique photographs were also taken, in 1938, of various areas in Alaska. Complete topography is obtained from them, using the Wilson photoalidade. Approximately 1,600 square miles have been mapped on reconnaissance scales, 1:96,000 and 1:180,000, by this method in the past two winters. Vertical multiple-lens photographs taken in southeastern Alaska during 1926 and 1929 are now being used by Survey geologists for the investigation of mineral resources of that region.

Field mapping of geologic details is usually done on contact prints with vertical control obtained by plane-table methods or from a topographic map if one is available. The geologic data are later transferred from the contact prints to a mosaic, to a planimetric base map constructed from the photographs, or to a topographic base map when available.

Federal Communications Commission

The Federal Communications Commission in 1939 completely revised its rules governing the aviation service. These rules, printed as



BEECHCRAFT D17R

An ambulance plane powered by a 450 h.p. Wright Whirlwind engine.

a separate pamphlet, are known as Part 9 "Rules and Regulations Governing the Aviation Service." For the most part, the rules continue the previous policies of the Commission. The following changes merit special mention: The "Day Only" restriction was removed from 6210 kc; 3105 and 6210 are now being designated national and international calling and working frequencies and their use is restricted to communications pertaining solely to aircraft operation and the protection of life and property. The frequency 140,100 kc was designated as a national calling and working frequency in anticipation of the occupancy of the ultra high frequencies by domestic aviation.

The frequencies 130,860, 131,420 and 131,840 kc were additionally

designated for airport control frequencies to eventually replace 278 kc. In order to provide for a transition period, the Commission's Rules require that new applicants for airport control stations must, in addition to specifying 278 kc, specify one of the designated frequencies above 130 mc and, further, that beginning January 1, 1941, existing stations must equip themselves with apparatus to use one of these frequencies.

Provision was made for the use of radio in handling public mes-



SOUNDPROOFING A STRATOLINER

Workmen inside a high altitude Boeing 307 transport installing soundproofing material.

sages between passengers and the ground; and frequencies were set aside for the experimental development of the public air-ground aviation communication service. A new class of station known as "flying school station" was recognized with four frequencies made available lying between 30 and 40 mc. This class of station was opened to soaring societies to provide a means of communication during glider meets.

In cooperation with the Civil Aeronautics Authority, frequencies remain available for instrument landing systems in order to make possible the collection of data by practical operation as to the value and needs of such systems. Considerable interest was manifest in the possible application of frequency modulation to aviation communications.

National Advisory Committee for Aeronautics

The year 1940 marks the 25th anniversary of the establishment of the National Advisory Committee for Aeronautics. During the last quarter of a century aeronautical research has served as an indispensable basis for the development of new and improved aircraft by the



U. S. Army photo

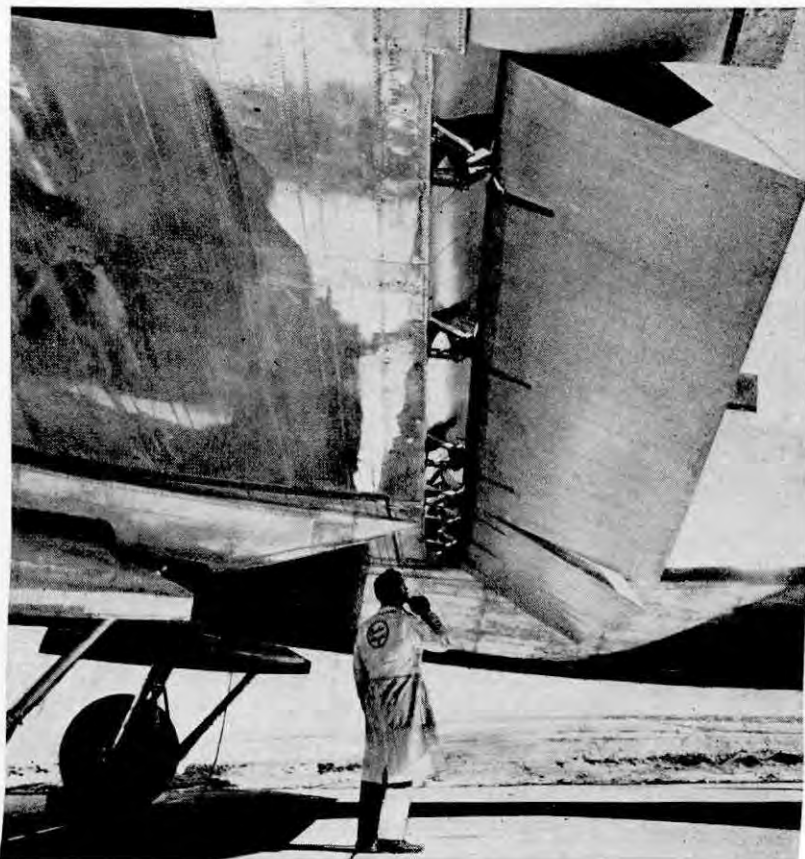
CURTISS P-42 PURSUIT

A single-place plane with a Pratt & Whitney Twin Row Wasp engine equipped with a special cowl to improve streamlining and cooling.

manufacturing companies. The remarkable improvements in airplane performance, efficiency and safety today are outstanding examples of the fact that the relatively new science of aeronautics is progressing upon a strong foundation of organized scientific research. The N.A.C.A., center of the Government's aeronautical research activities, has exerted a profound influence on the progress of aeronautics by continuous research on the problems of flight, and it is entitled to much of the credit for the present world leadership enjoyed by American aviation. The Committee consists of 15 members appointed by the President and serving without compensation. They comprise two representatives each from the War and Navy Departments and from the

Civil Aeronautics Authority, one each from the Smithsonian Institution, the Weather Bureau, and the National Bureau of Standards, and six other persons from private life "who are acquainted with the needs of aeronautical science, either civil or military, or skilled in aeronautical engineering or its allied sciences."

The Committee's headquarters, including its offices of Aeronautical Intelligence and Aeronautical Inventions, are located in the Navy Building, Washington, D. C. In addition to its laboratory at Langley Field, Va., the Committee maintains a Technical Assistant in Europe with headquarters at the American Embassy in Paris. It is his duty,

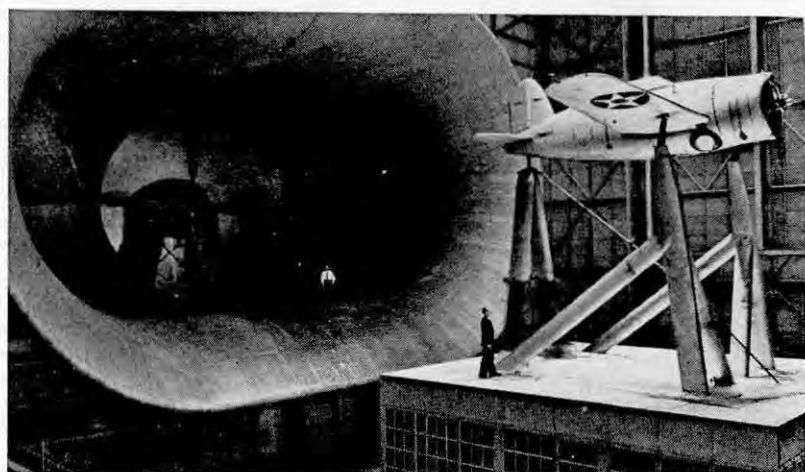


FLAP ON THE CURTISS-WRIGHT

One of the new full trailing edge, rearward-moving slotted type flaps on the Curtiss-Wright transport.

by frequent visits to European aeronautical centers to assist in the collection of current scientific and technical information and data.

At its laboratory at Langley Field, the Committee operates numerous wind tunnels of various size, several of which are noted for their unusual characteristics. This laboratory, started in 1916, is known as the Langley Memorial Aeronautical Laboratory, and at the present time comprises the following units: the 8-foot 500-mile-per-hour wind tunnel; the full-scale wind tunnel with a throat 60 by 30 feet; the 20-foot propeller-research tunnel; the 5-foot variable-density wind tunnel; a 7 by 10-foot wind tunnel; a 4 by 6-foot vertical wind tunnel; a 15-foot free-spinning wind tunnel; two high velocity



N.A.C.A. WIND TUNNEL

A Brewster XF2A-1 Navy fighter in the full scale wind tunnel at Langley Field, Va.

jet-type wind tunnels of 11 and 24-inch throat diameters respectively; the 2,900 foot N.A.C.A. tank; a small engine research laboratory; and administration and service buildings.

The Committee has recently placed in operation its three newest pieces of equipment: a 19-foot pressure wind tunnel that permits the investigation of the characteristics of large models under conditions much more nearly paralleling those of free flight than can be obtained in any other existing wind tunnel; a refrigerated wind tunnel with a throat $7\frac{1}{2}$ by 3 feet for investigations of ice formation on aircraft; and a free flight wind tunnel 12 feet in diameter for studying the stability and control characteristics of airplanes.

Aware of the fact that the Committee's research facilities must be expanded in order that the United States aircraft development may keep pace with foreign nations, Congress in 1939 provided for the construction of a second major research station at Moffett Field, Calif. The planning and construction of the research facilities and equipment of this vitally important addition are progressing rapidly. Construction is also proceeding at Langley Field on five new important research facilities: a structures research laboratory, a two-dimensional flow wind tunnel, a stability wind tunnel, a 16-foot high-speed wind tunnel, and a 20-foot free-spinning wind tunnel. This new expansion should enable the National Advisory Committee for Aeronautics to follow



DOUGLAS SANTA MONICA (CALIF.) PLANT

Showing the recent additions in the factory space. Douglas has another large plant at El Segundo, Calif.

even broader lines of research than those that have yielded such valuable results in the last 25 years.

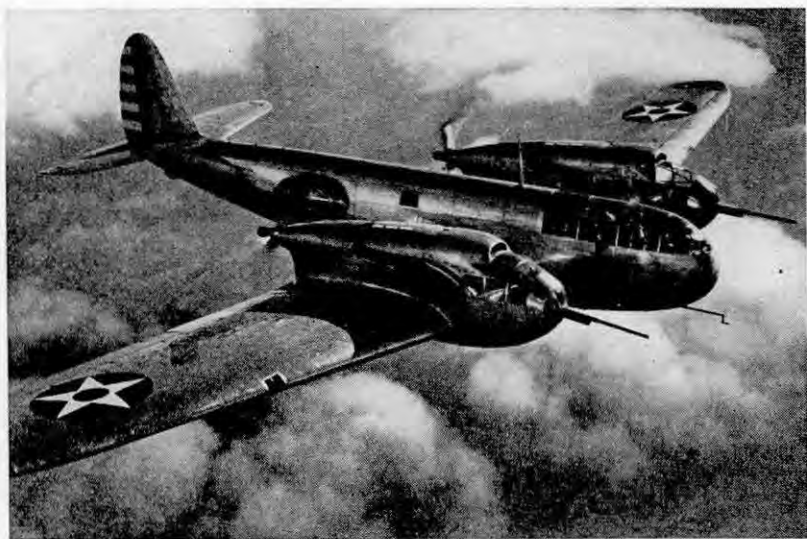
National Bureau of Standards

Following is part of a report on the aviation work of the National Bureau of Standards: "The studies of wind tunnel turbulence and of flow in boundary layers have been continued in cooperation with the National Advisory Committee for Aeronautics. With the progress of wind tunnel and flight research at Langley Field, interest has shifted to turbulence levels of the order of 0.1 per cent. Numerous improvements have been made in the 4½-foot wind tunnel (first placed in operation in October, 1938), each one successively reducing the turbulence, and further reductions are in prospect as the sources and behavior of wind tunnel turbulence are better understood.

"The Bureau, in cooperation with various Federal agencies, has continued its study of metallic materials used in aircraft construction.

Much of this work has been undertaken after service failures of these materials. Long-time weathering tests have been continued to find the possible service deterioration of aircraft metals, particularly those used in sheet form. A report (NACA Technical Note 736) was published summarizing the results obtained with riveted and welded members of aluminum, magnesium and stainless steels after prolonged weathering in sea air and intermittent wetting by sea water. Two reports completed during the year dealt with the elastic properties of structural metallic materials which depend upon cold working for their useful properties, such as austenitic corrosion-resistant steels and some nonferrous alloys.

"The effect of continued fatigue-stressing, approximating service



U. S. Army photo

BELL AIRACUDA IN FLIGHT

Showing gunners in the nacelles of this Air Corps multi-engine fighter.

stressing, on the properties of aircraft steel was investigated as a major project. Attention has been centered on the extent to which important properties of the metal may be affected by continued fatigue-stressing, short of failure. Fatigue-stressed metal when tested in impact, has exhibited unusual characteristics, the significance of which is not yet fully apparent. Results of companion tests, in which steel was in one case continuously fatigue-stressed and in the other fatigue-stressed for the same length of time but in short in-

tervals followed by rest periods, are very reassuring as to the beneficial effect of the periodic resting of the metal. Investigations of aircraft failures in service have shown that such failures can usually be traced to fatigue-stressing, the severity of which was intensified by improper mechanical design.

"Plastic material for aircraft structures: In an investigation requested by the N.A.C.A., 18 synthetic resins have been tested to determine their suitability for impregnating and bonding wood veneers to form a reinforced plastic of the requisite strength and stability for aircraft construction. Nine hot-pressed and three cold-pressed phenol-formaldehyde resins, one phenol-furfural resin, four urea-formaldehyde resins and one vinyl acetal resin were investigated. Great differences were observed in the temperatures and pressures required



BELLANCA AIRCRUISER

It is powered by a Wright Cyclone engine.

for obtaining satisfactory bonds, and in resistance to delaminating when alternately wetted and dried. On the basis of these data three of these resins have been selected as bonding and impregnating agents in the preparation of laboratory samples of reinforced plastics for strength tests. These are a phenol-formaldehyde resin which requires hot pressing to obtain a good bond and cure, a phenol-formaldehyde resin which cures at room temperature by catalytic action, and a vinyl acetal resin which is permanently thermoplastic and requires heat to make it flow and effect a bond. These are representative of the resins required for investigating three different methods of molding reinforced plastics, namely (1) use of heat and pressure accompanied by thermal curing of the resin, (2) application of pressure at room temperature accompanied by catalytic curing of

the resin, and (3) use of heat and pressure with a permanently fusible resin. The preparation of curved and tubular specimens by methods adaptable to the fabrication of large numbers is now being investigated.

"Tensile and comprehensive strengths, moduli of elasticity, and water absorption also have been determined for plastics which have been proposed by various commercial sources for use in building propellers, floats, spars, wings, and fuselages of airplanes. The reinforcing agents in these products included wood veneer, pressed wood, flax, jute and sisal. The results indicate that maximum strength and stiffness are attained with well oriented fibers and thermosetting resins.

"Resistance of transparent plastics to impact: The problem of developing a windshield for aircraft which will withstand the effect of bird impacts during flight was considered in N.A.C.A. Technical Note 718. Measurements of the comparative impact strengths of



U. S. Navy photo

GRUMMAN F4F-3

A single-place fighter powered by a Pratt & Whitney Twin Wasp engine.

various plastics were presented. Three different methods of evaluating the impact resistance of the plastics were used, namely, the standard pendulum type of impact testing apparatus, drop tests with elastic and relatively non-elastic bodies, and high velocity impacts produced by projecting a body from a gun by air or powder. The resistance of the plastics to fracture in these tests was observed to be markedly dependent upon the relative deformability of the striking object.

"The effects of these different laboratory accelerated aging conditions upon various types of transparent plastics were evaluated by measurements of light transmission and haze, and by visual examination of the specimens for crazing, fusing, blooming, discoloration and warping. These results were compared with data obtained for specimens of the same plastics exposed to the weather in Wash-

ington. On the basis of these tests a method of accelerated aging of transparent plastics has been developed which gives results correlating well with actual behavior of the materials in outdoor exposure tests.

"Cellulose acetate propionate and cellulose acetate butyrate were found to be the most promising film-forming bases for a relatively nonflammable airplane dope to replace the hazardous cellulose nitrate. The hydroxyl content of these mixed esters is an important factor in their suitability for this purpose; the hydroxyl content recommended as a result of this work is about 0.2 equivalent. Optimum solvent formulas are listed for various cellulose derivatives; these produced marked improvement in the tautness and aging of the dopes when



VULTEE VALIANT 54

A basic trainer with a Pratt & Whitney Wasp Junior engine.

compared with those used in the original group of exposure panels described in the first report. The tautness of some dopes formulated with cellulose mixed esters and aryl phosphate plasticizers compared favorably with that of cellulose nitrate dope plasticized with glycol sebacate. The similarity in electronic structure of the phosphate and nitrate groups is advanced as a possible explanation of this correlation in the behavior of these two types of dopes.

"Special aircraft fuels: The N.A.C.A., the Bureau of Aeronautics, and the Air Corps have cooperated with the Bureau in an investigation of the properties of paraffin hydrocarbons within the boiling range of aviation gasoline in order to determine which of these compounds have promise as constituents of the optimum synthetic avia-



tion fuel. A number of hydrocarbons have been isolated from industrial synthetic crudes by fractionation in the Bureau's high-efficiency columns which operate continuously with automatic control. Compounds which cannot be obtained in this way are being prepared synthetically, involving in certain cases the development of new methods of synthesis. Some compounds, the properties of which were completely unknown, have been isolated or prepared in this work, which will be completed in 1940. As several of these hydrocarbons have less tendency to knock than iso-octane, new methods of evaluating knock characteristics above 100 octane number are being developed.

"Radio sonde: Aviation has greatly benefited from a recent advance in weather forecasting, based on the routine collection of upper-air data to heights of 15 miles by means of radio soundings.



CONSOLIDATED MODEL 31

A twin-engine flying boat powered by Wright Cyclone engines.

These are made by an instrument called the radio sonde, developed at the Bureau, and which has supplanted the use of calibrated recording instruments carried by airplanes. The radio sonde system employs weather instruments and a radio transmitter attached to a small unmanned balloon, and ground-station receiving and recording equipment. The balloon carries elements for measuring barometric pressure, temperature and humidity; a radio transmitter and power supply; and means for impressing on the radio transmitter modulation frequencies which have predetermined relationships to the temperature and humidity. At the ground station, the frequencies of the received signals are measured and recorded automatically, thereby providing a plot of temperature and humidity against pressure.

"An improved form of the radio sonde was developed at the

Bureau in 1939 and introduced at nine of the stations. It is equipped with a new device for measuring humidity, which utilizes the phenomenon of variation in conductivity of a hygroscopic salt when exposed to different relative humidities (Research Paper RP1265). In its operation as a resistor—the value of which varies with relative



FOR WRIGHT ENGINES

Making the intricate sand mould for a Wright Cyclone cylinder head. When the aluminum alloy cylinder head casting has cooled enough to permit being cleaned and prepared for machining, the baked sand mould is broken away and destroyed.

humidity—it is like the temperature element used in the radio sonde, which functions as a resistor varying in accordance with the ambient temperature. The two measuring resistors and two fixed reference resistors are switched into the modulating oscillator of the radio sonde by a switch responding to changes in the ambient pressure.

The modulation frequency is thereby controlled and produces graphical records of pressure, temperature and humidity."

U. S. Office of Education

Like all Government divisions concerned with aviation, the U. S. Office of Education, transferred by Presidential order from the Department of the Interior to the Federal Security Agency during 1939, has participated in numerous aviation activities. The current expansion of the aircraft industries, especially aircraft manufactur-

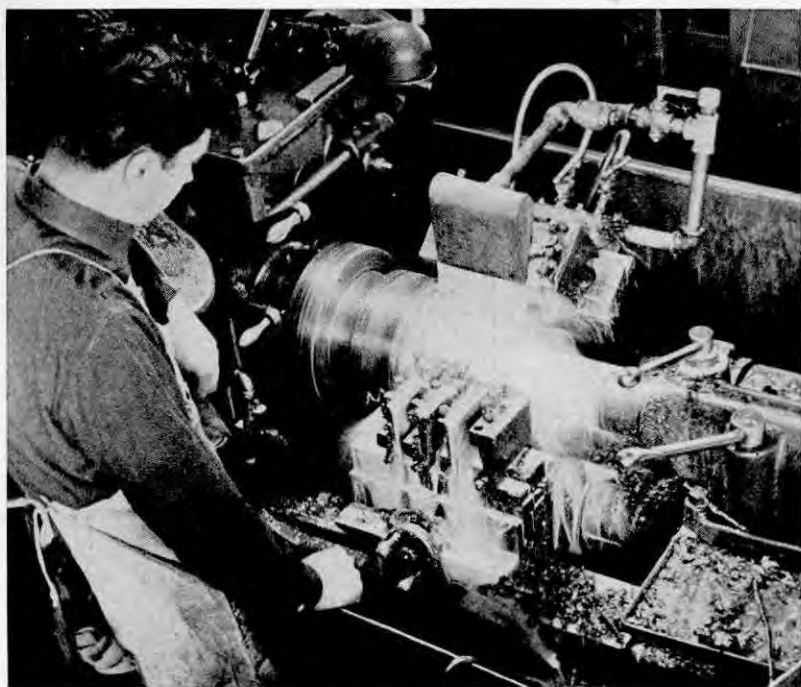


WHY ENGINES ARE EXPENSIVE

Rough grinding and machining of cylinder barrels in the Wright plant. This is only one of the intricate precision processes in the manufacture of aircraft engines.

ing, brought to light an urgent need for additional aviation personnel. Early in 1939, some observers believed that it would be difficult to increase the number of those employed in aircraft manufacturing from 36,000 to 100,000. However, by securing men from related trades in other industries, by retraining persons with certain employment assets, and through the securing of students and graduates from public and private aviation courses, the situation has presented no great problem, and employment has increased steadily.

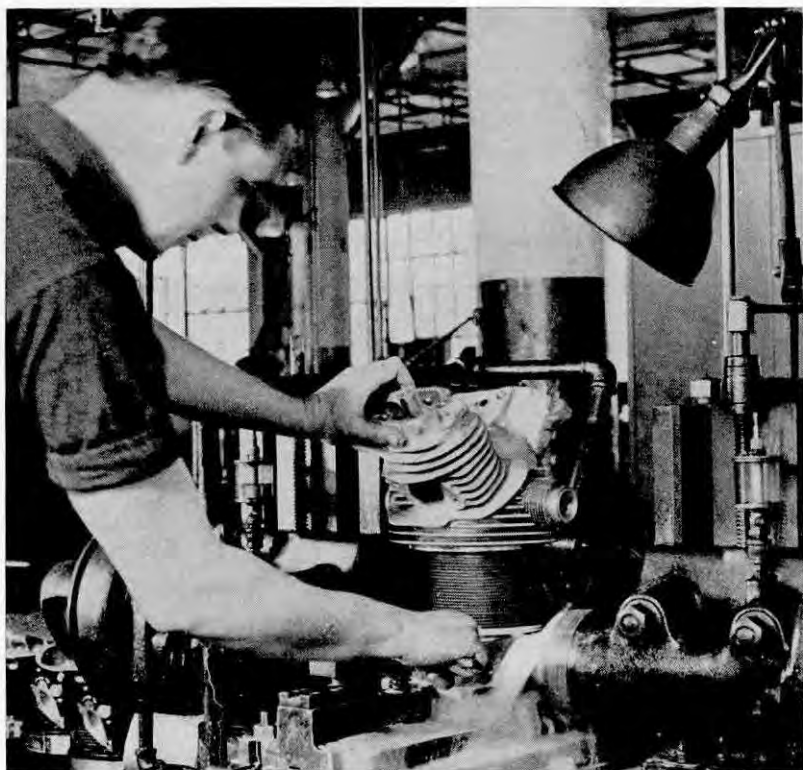
Reports from the States show that, at the end of the school year in June, 1939, 68 communities (an increase of 15 over 1938) offered Federally-aided courses in aviation subjects in public schools. A map indicating these communities reveals an interesting distribution, apparently not related in any great measure to the locations of aircraft centers. More recently, however, courses have been generally developed in areas adjacent to aircraft plants. These courses have included a number of short units to prepare individuals for jobs per-



ROUGH MACHINING A CYLINDER BARREL

Prior to this step, the inside has been nitrited to harden the ring surface. Cyclone engine building at the Wright plant.

formed by those requiring only minor skills. This has come in consequence of larger aircraft orders, making possible the manufacturing of parts in larger numbers. In addition, courses of varying duration have been organized in aircraft manufacturing localities for workers already employed, who wish to secure instruction in such subjects as blueprint reading, template layout and development and trade mathematics.



MACHINING WRIGHT ENGINE CYLINDERS

Another process in building aircraft engines.

The latest figures available, through reports from the States to the U. S. Office of Education indicate enrollments for 1939 in Federally-aided courses as follows: 5,551 in Evening Trade Extension; 1,120 in Part-Time; and 5,814 in Preparatory; a total of 12,485 enrollments.

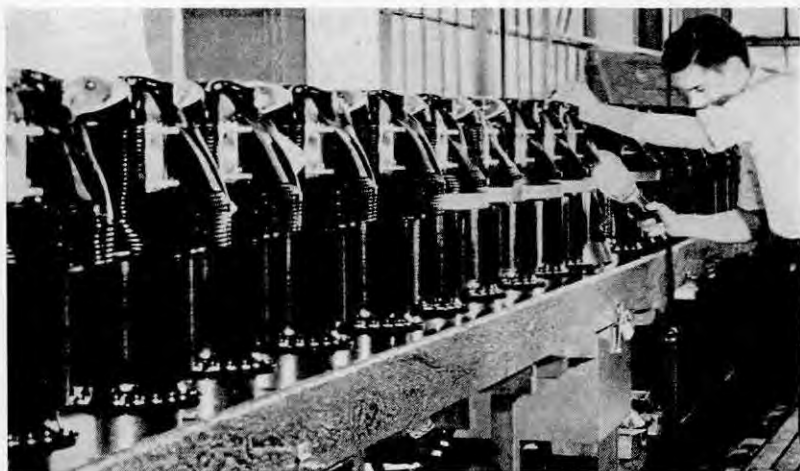
Tennessee Valley Authority

Early in 1940 the Tennessee Valley Authority was operating three airplanes, a Lockheed and two Stearmans. The Stearmans were used in the control of malarial mosquitos and in reconnaissance surveys, and the Lockheed was used in general reconnaissance work and for official passenger service. Charged with the long range development of the Tennessee River drainage area, embracing a territory

of 41,000 square miles, the Authority has found that necessary information about the rivers, forest growth, soil, erosion and other physical features can be determined by plane more feasibly than by surface methods.

U. S. Coast and Geodetic Survey

The U. S. Coast and Geodetic Survey publishes a series of 87 Sectional Aeronautical Charts on a scale of 1:500,000 or about eight miles to the inch. These charts cover the entire United States and are for use primarily in contact flying. They include approximately 30,000 miles of lighted airways and nearly 2,500 airports. The many



INSPECTION OF CYLINDER ASSEMBLY

One of the inspectors at the Wright plant examining completed assemblies before permitting them to go into engines.

changes in the aids, in addition to the completion of new topographical surveys, make frequent revisions and new editions necessary, as it is the intention to maintain these charts to show existing conditions accurately for safe navigation.

To meet the needs of high-speed long distance instrument flying, as distinguished from flying by reference to visible landmarks, an additional series, known as Regional Aeronautical Charts, is in progress. This series is on a scale of 1:1,000,000, or about 16 miles to the inch. Ten charts have been published of this series and others are in preparation.

A series of radio direction finding charts, designed especially for



PRATT & WHITNEY'S NEW TEST CHAMBER

Looking toward the rear of one of the four test chambers in the new Pratt & Whitney engine test house, showing the cable method of suspension.

use in all forms of radio navigation, have been constructed on the scale of 1:2,000,000, or about 32 miles to the inch. Their smaller scale and wide extent make it possible to plot bearings from radio stations that frequently would be outside the limits of the local chart when using either of the other larger scale series.

U. S. Forest Service

Parachuting fire fighters down to forest fires in remote territory was an outstanding development in the use of airplanes by the U. S. Forest Service during 1939. Experiments in landing fire fighters by parachute were conducted in the Chelan National Forest, Wash., during October. Men wearing special helmets, masks and protective clothing of padded, tough material were dropped safely in tests con-

ducted on mountain meadows, on rough slopes and ridges, and even in dense forests. These "smoke-jumpers" were followed in their descent by parachuted fire tools and supplies. Properly equipped, they were ready to tackle a fire in record time, and then report to their forest station by means of a small light-weight, short-wave, portable radio.

In the experiments to determine whether men could be landed safely in rough, forested terrain, dummies weighing 180 pounds,



Photo U. S. Forest Service

U. S. FOREST FIRE FIGHTERS

At work in the Chelan National Forest, Washington, the two parachute jumpers wear special equipment, including masks to save their faces when coming down through trees.

attached to condemned Army parachutes, were first dropped at various elevations over different types of cover and topography. These tests proved successful and the jumping of men began. The first jumps were made by professional parachuters. They were followed by two local men of fire-fighting experience who had never seen a parachute before. All jumps were successful.

The method developed for delivering a jumper to a fire was as

follows: The airplane pilot and the jumper flew across the spot of smoke and, at what they believed the proper moment, let go a small burlap test chute with a ten pound bag of sand attached. Then the pilot circled and estimated the wind drift by watching the flight and landing of the test chute. Approaching the mark for the second time, he corrected his course and timing and gave the "go-ahead" signal. Jumpers landed within 50 to 200 yards of the desired spot. The pilot, circling again, watched the jumper land and, approaching the target for the third time, released a burlap parachute with a fire fighting pack containing tools, lamp, two days rations, first aid kit, water canteen and other small articles. The entire delivery time required not more than five to 10 minutes.

Parachutes were of a specially developed type—30 feet in diame-



THE BARKLEY-GROW

The ship in which the Gallino brothers made their long flight from New York to Peru.

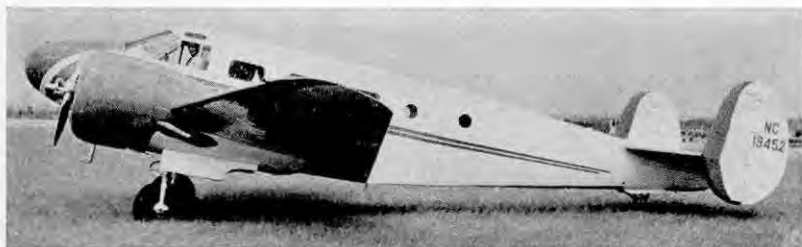
ter, constructed with a wide scalloped periphery for slow rate of descent and minimum oscillation, and equipped with two long flaps for steering. The jumper carried a rope to lower himself to the ground in case he landed in a tree.

The parachute method of delivering supplies by airplane to fire crews was undertaken in the Northwest in 1936. Prior to that time the tight package and the loose package or bean bag methods had prevailed. In both the latter cases packages were dropped without parachutes or retarders. Although with careful packaging it was possible to drop some kinds of supplies without retarders, too high a percentage of breakage resulted. With simple home-made parachutes devised by the Forest Service even fragile materials, eggs for

instance, can now be dropped without damage. The flight crew consists of the pilot and the dropper. The pilot signals the dropper when to "bail out" the bundle. The dropper, using a telephone lineman's safety belt, ties himself to a fuselage brace of a doorless airplane and leans out in safety to locate the target and shove the bundles clear of the plane.

Some 10,000 pounds of water and food supplies were chuted to fire fighters entrenched on top of a bluff in the rocky, rough country of the 1939 Bald Mountain fire on Los Padres National Forest in California. The plane delivered about 1,500 pounds per two hours as against 300 pounds per six and one-half hours by pack mule (round trip). This saving in time often makes the difference between quick victory over a fire and a long, costly siege.

The use of airplanes as an aid in the management of wildlife, is still in an experimental stage. Aerial stocking of fish by dropping



BEECHCRAFT 18S

A twin engine transport with 450 h.p. Pratt & Whitney Wasp Junior engines.

cans of fish into lakes has been tried by game management men, with indications that this may prove a feasible method of stocking isolated back-country waters. In some primitive areas of the National Forests, elk, deer, bighorn sheep, and mountain goats have pawed deep holes and caves in the natural salt licks. The deepness of the holes indicates the animals made long and frequent trips to lick this salt. Airplanes occasionally aid nature by dropping the salt blocks from the skies. The Idaho Fish and Game Commission cooperated with the Forest Service in conducting experiments in 1938 and again in 1939 to distribute salt for game in inaccessible interior regions. The 1939 project included the distribution of 88 tons of salt throughout most of the big game areas of the State where truck transportation was impossible.

An annual estimate of big game populations is necessary as a basis for intelligent wildlife management plans and also to indicate

cases of overcrowding of range or depletion by disease, predators and starvation. Air surveys have proven extremely valuable in indicating when and where supplemental ground work should be done in connection with game counts. The airplane method of arriving at accurate game estimates is also proving important in the Forest Service game management program. The Nebo elk herds on the Uinta National Forest in Utah, for example, were air-counted in February of 1939. Tracks of the animals in the snow were clearly distinguishable from above. By circling over them the census takers in airplanes could locate and count the animals.

The Forest Service has constructed 76 landing fields to date in the National Forests, and is currently clearing trees and levelling ground for more. These landing fields are maintained to facilitate



THE CESSNA AIRMASTER

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

forest protection and administration, and are available in emergencies for air lines and private fliers.

U. S. Weather Bureau

During the year 1939 important advances were made in practically all phases of the Weather Bureau's meteorological service in aid of air navigation. To keep its personnel abreast of developments in the science and applications of meteorology, the Weather Bureau inaugurated a program of "In Service Training." The program comprehends the preparation and analysis of weather maps, the making of forecasts, and studies in the theoretical and practical aspects of synoptic and dynamic meteorology. Under this training program it is expected that within a few years all professional and sub-profes-

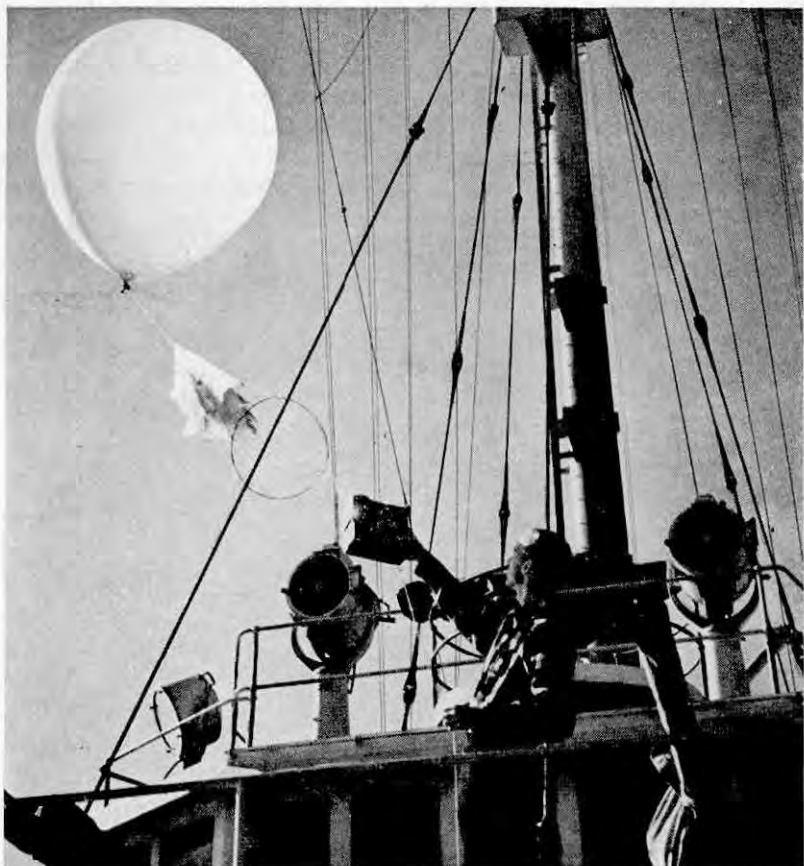
sional employees of the Bureau will have the benefits of training in modern meteorological methods.

New airway forecast centers and general supervising stations were established at Albuquerque, N. M., and Billings, Mont., permitting greater attention to the meteorological needs and development of aviation in those sections. Approximately 20 new stations manned by five Weather Bureau Civil Service employees were estab-



THE CURTISS-WRIGHT TRANSPORT

The retractable landing gear of the 38,000-lb. air liner.



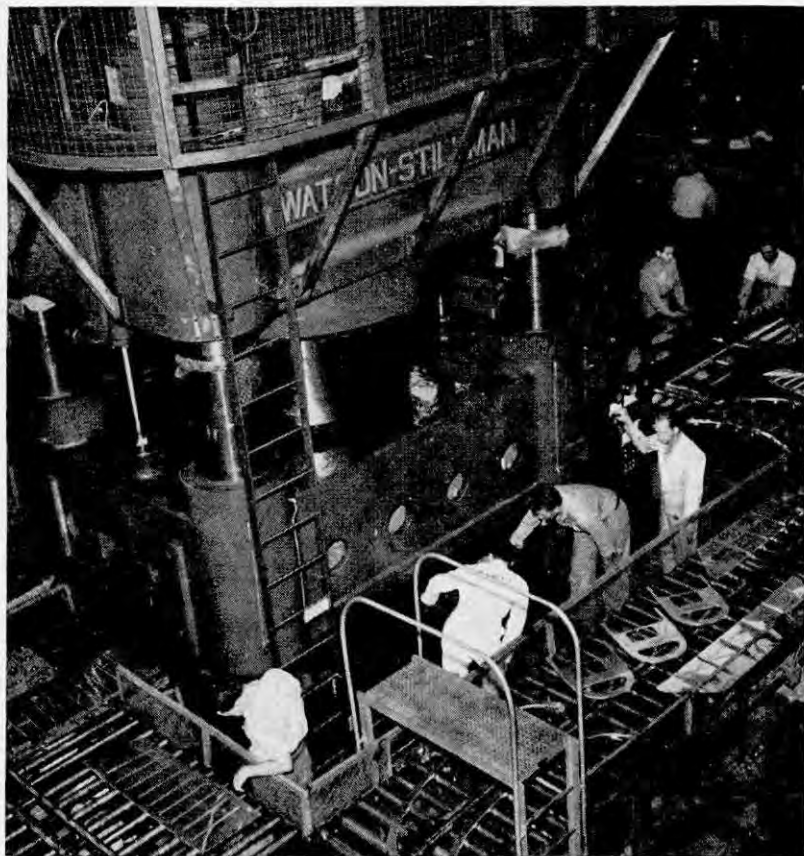
THE RADIOSONDE

The miniature weather broadcasting station being sent up from the bridge of the U. S. Coast Guard Cutter "Duane."

lished at important locations throughout the country, where urgent need for additional meteorological service had developed. Weather reporting service was also provided for the new Memphis-Tampa, Pueblo-Wichita, Houston-San Antonio, and Jacksonville-Mobile airways. About 12 new off-airway stations reporting every six hours were established for map and forecast purposes. Intermediate three-hourly reports at 4:30 and 10:30 a.m. and p.m. were started at 10 stations to provide forecasters with weather trend information to **serve as a basis for special forecasts and warnings in event of sudden**

and unanticipated changes in weather conditions affecting the safety of aeronautical operations. In addition, to protect operations over the inland airways paralleling the West Coast, arrangements were made for reports every three hours from stations immediately along the coast and for special reports during periods of unfavorable flying conditions. Along the Atlantic coast, in cooperation with the Coast Guard, 10 stations were established between Nantucket Island, Massachusetts and Cape Hatteras, N. C., to report every six hours for protection of transatlantic and coastal air line operations.

Through further cooperation with the Coast Guard, in develop-



METAL FORMING PRESS

This huge machine in the Lockheed plant can exert a pressure of 4,500 lbs. in forming the various parts of an airplane.

ing adequate transatlantic weather service the Weather Bureau has arranged for daily radiosonde, pilot balloon and surface observations from Coast Guard vessels assigned to fixed positions on the Great Circle route between Bermuda and the Azores in such manner as to divide this distance into approximately three equal sectors. These reports are transmitted by radio to coastal stations, one of these being the new Civil Aeronautics Authority point to point transatlantic communication station at Sayville, Long Island, N. Y. From the communication station the reports are distributed to Weather Bureau, air line and other personnel needing information.

To provide the meteorological aid required for transatlantic aviation, such as the preparation of maps and the issuance of forecasts and advices, the Bureau has assigned personnel to the operational base at the new New York Municipal Airport at La Guardia Field.



MENASCO-POWERED REARWIN

It is known as the Speedster.

Eventually it is planned to transfer the Weather Bureau general supervising and inland forecasting personnel from Newark to La Guardia Field, thus centralizing all airway weather and supervising work at the one station.

In July, 1939, the Weather Bureau replaced airplane observations by radiosonde observations. The total number of Weather Bureau stations making upper-air observations of temperature, pressure, and humidity was increased from 12 (six airplane and six radiosonde) to 27. The latter included two radiosonde stations in Alaska, one at San Juan, Puerto Rico, and one at Swan Island, West Indies, the latter two being operated only during the hurricane season, July-November. The Navy Department furnished radio equipment and personnel at Swan Island.

Radiosonde observations are made daily at about 1:00 a.m.,

E. S. T., and these data, together with similar observations from five Navy and two Army stations, provide valuable information to the forecasters in analyzing meteorological conditions.

Four southern stations, Atlanta, Charleston, Miami and San Antonio, as well as San Juan and Swan Island, were supplied with extra radiosondes for making frequent (three hourly) observations during the passage of a hurricane. As no hurricanes occurred in the vicinity of the four southern stations, three-hourly observations were made on several occasions during pronounced low pressure areas.

Two United States Coast Guard cutters made daily radiosonde observations from April through June, 1939, while on International Ice Patrol duty off the Grand Banks. These reports were promptly transmitted to the Weather Bureau and placed on the airway teletype circuit for their final distribution.



THE STINSON RELIANT

A private owner plane powered by a Lycoming engine.

U. S. Public Health Service

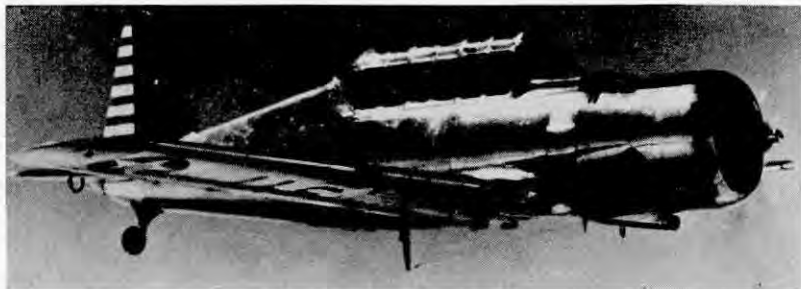
Primary among objectives of the United States Public Health Service is the prevention of entry into this country of quarantinable diseases—anthrax, cholera, smallpox, plague, exanthematous typhus, leprosy, and yellow fever. This last—yellow fever—receives emphatic current attention by the service, and it is in this connection that airplanes enter extensively into the picture.

During 1936 it definitely was established that there exists in monkeys, and possibly other animals of the Brazilian jungles, a reservoir of yellow fever virus, which may be expected to persist for many years. The rapid passage of planes from South American countries to the United States, and the specific possibility that mos-

quitoes infected with yellow fever may be transported in such carriers make it necessary for quarantine officers in domestic ports to keep a sharp lookout for dangerous insect stowaways. That insects are conveyed in airplanes and a source of potential danger has been proved.

The flying time from such ports in South America as Santos and Rio de Janeiro, both of which lie adjacent to infectible territory, to Miami, Fla., has been shortened to four days. A further reduction of this time is in prospect by the anticipated inauguration of night flying. Thus it is evident that the United States is faced with the possibility of aircraft passengers from localities infected with yellow fever arriving in highly infectible territory in this country while still within the six-day incubation period of the disease.

In an effort to meet this contingency, control measures, 100



VULTEE VALIANT 51

Basic combat and advanced trainer with Pratt & Whitney Wasp engine.

per cent efficient, have been instituted by the Public Health Service in cooperation with those corporations operating aircraft between North and South America:

- (1) Immunization of aircraft personnel by vaccination against yellow fever.

- (2) Frequent disinsectization of aircraft at points enroute and just prior to landing at United States ports.

- (3) The institution of a system of surveillance of air-travelers by means of certificates showing the area from which their travel originated, and the further determination of their itinerary after arrival, to complete nine days from their departure from infected territory.

There is also under way a definite campaign to secure as far as possible by airplane "dusting" the eradication of mosquitoes and

other insects, which might constitute potential vectors for the transmission of yellow fever from regions surrounding the airports of entry located in infectible territory in the United States. Aerial photography has been employed by the Public Health Service in this connection, to get a "working" view of such regions around quarantine stations, and especially where the Public Health Service has work in progress, control of, or an interest in the surrounding territory.

During the fiscal year 1939, 5,363 airplanes carrying 65,568 passengers arrived at the 37 airports of entry in the United States from foreign countries. Of these, 1,878 planes, carrying 25,842 passengers, 8,521 of whom were aliens, were subjected to quarantine inspection. Aliens certified for disease numbered 96. The remainder entered the country from Canada under circumstances rendering quarantine inspection unnecessary.



CURTISS-WRIGHT INTERCEPTOR-FIGHTER

Model 21, claiming a climbing speed of more than a mile a minute, carries four machine guns and is powered by a Wright Cyclone engine.

Airplanes of the Coast Guard enter the Public Health Service program: that is, for those who are sick on ships at sea.

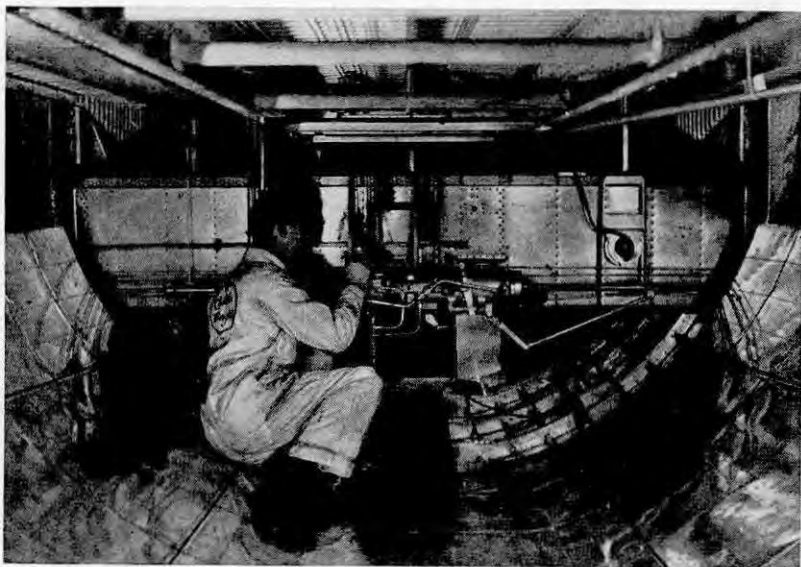
"Upon receipt (by radio) of a request for medical advice in any given case," reads an order to officers and employees of the Service, "you are directed to furnish promptly whatever advice seems indicated (calling upon your consulting staff if necessary), couched in language intelligible to a layman."

Such medical advice, radioed back free through the courtesy of certain cooperating companies to every ship requesting it, comes mainly from designated, most accessible marine hospitals and relief

stations maintained by the Public Health Service on every coast, the Great Lakes, and in territorial possessions.

The requesting ship, which may have aboard no doctor (or, if it does, wishes the advice of another physician in consultation about a particular case), radios details and symptoms of the patient in distress. The advice coming back in one message may save a life or put the patient out of danger. There may be, however, a whole series of radiograms flashed back and forth, during and even after the patient's illness.

If the sufferer's condition indicates an emergency, however, the Public Health Service's physicians may advise his immediate transfer to a land hospital. In such cases, contact is made with the nearest Coast Guard station, and a plane is sent out to get the patient.



FOR C-W TRANSPORT CARGO

The rear cargo hold in the Curtiss-Wright transport.



CHAPTER VI

AIR LINES OF THE UNITED STATES

A World Record for Safety—12 Months Without a Fatality—Growth of the Air Transportation System—Chairman Hinckley's Comments—Increased Traffic—Air Express—Pan American Airways Starts Transatlantic Service—Effects of the War—Another Ocean Service Plan—Domestic Air Lines.

WITH superior flying equipment and operations personnel unexcelled the world over, the air lines maintaining regular service in the United States on March 26, 1940, had passed 12 months without serious accident to passengers or crews. Chairman Robert H. Hinckley of the Civil Aeronautics Authority dramatized the significance of that safety record in a speech of which the following paragraphs are of especial interest, because they show the progress made in American air transportation. At the beginning of 1940 about 3,000 persons were riding in air line transports over the United States at any time that one might pick out of a 24-hour period.

Said Mr. Hinckley: "It was not done by shackling air transport with unnecessary and useless regulations. It was not accomplished at a sacrifice of the services offered by the air lines to the American public. Quite the contrary. During the 12 months just ended our common carriers of the air flew more than 87,000,000 miles. That is equivalent to flying ten times around the world at the equator every day of the year. It is roughly equal to the total of air line flying logged during the same period in all the rest of the world put together. It is 16,000,000 more miles of flying than was ever done in this country in any preceding year. The domestic air line system of the United States is the only one in the world that flies as much by night as by day. This past year it flew almost as many miles each 24 hours during the winter as during the best weather of last summer. In fact, it set its all-time monthly record in December.

"Basically," Chairman Hinckley continued, "it is not because of any recent introduction of any new invention or new operating practice that we have reached this goal. We are able today to celebrate this year of safety because the entire air transport profession holds no other achievement on earth so much worth striving for. The painstaking devotion to duty, the meticulous attention to detail that the people who man our air lines display in their daily work is almost unbelievable. There is no praise we could devise that



THE BOEING 307 STRATOLINER

One of the 33-passenger high altitude transports with supercharged cabins supplying passengers with normal low altitude air pressures up to 20,000 feet. It was powered by four Wright Cyclone engines. Photo shows it flying past Mt. Rainier.

could be more than they deserve. As President Roosevelt has indicated, this safety record has been achieved through the team work of many thousands of individuals. It is particularly significant because it required the complete cooperation between an entire industry and the governmental agency set up for its assistance.

"Clinton Hester, the Administrator of the Civil Aeronautics Authority, undertook to bring the system of Federal aids to air navigation to as high a state of perfection as it was humanly possible to reach. It would be difficult to overstate the importance of these

aids to American flying. Along 25,000 miles of airways, some 2,800 technical experts work on the operation, maintenance and extension of this system. They must serve some 2,100 beacon lights; 237 radio course beams; 273 lighted intermediate fields. They operate 30,000 miles of teletype circuits to make hourly weather reports available to all principal airports. Through radio, they control the movement of every plane flying on a Federal airway. A defect in the functioning of a single one of these items at a crucial moment



Pan American Airways photo

HIGH FLYING TRANSPORT

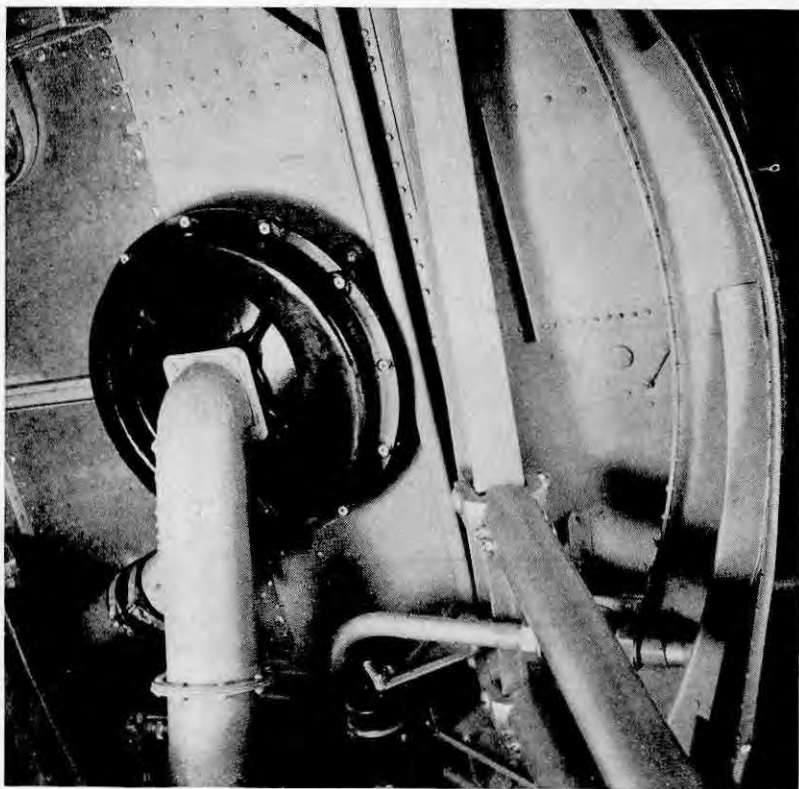
Size of a Boeing Stratoliner cabin. Interior of the Pan American Airways "Flying Cloud."

could be as dangerous as a defect in the plane itself. It has been largely due to the growing effectiveness of this system that our air lines could simultaneously set new records of safety and intensity of flying. By day, by night. Through winter, spring, summer and fall.

"Our Bureau of Safety Regulation keeps in constant touch with every air line operation and with every advance in airplane, engine

or accessory design steadily forthcoming from this nation's splendid aircraft factories and superb research laboratories. Thus we make sure of following up every possible lead toward technological progress. Our own Technical Development Division undertakes important developments in instrument landing systems, fire prevention and airport lighting.

"The results have been more and more encouraging. During



Pan American Airways photo

STRATOLINER'S CABIN SUPERCHARGER

Here is the supercharger, a unique feature of Pan American Airways' Boeing Strato-Clippers. The biscuit-shaped object is a blower, which sucks in the rarefied atmosphere at high altitudes, compresses it, passes it through an air conditioner and a heater, and pumps it into the cabin. Used air passes out through a valve at the tail of the plane. There are two of these blower units. Ordinarily they work together, but if for any reason one should stop, the other is more than adequate to provide the occupants with air of proper density.

the winter of 1938 and the early spring of 1939 only three fatal accidents occurred in domestic air line operations. That in itself was a new all-time record, but neither the air lines nor the Authority were satisfied to rest there. Following each of these accidents, the Air Safety Board of the Civil Aeronautics Authority instituted immediate and thorough investigations. From their reports, and from the studies of the Authority's Bureau of Safety Regulation, the Authority studied constantly to shape air line safety practices to the highest levels of effectiveness.



PAN AMERICAN'S BOEING STRATOLINER

A convertible compartment in one of the supercharged sealed cabin, high altitude transports which Pan American Airways has named Strato-Clipper "Flying Cloud."

"But, and this is typical of the formula upon which this safety record has been built, regulations have been worked out with constant reference to the industry itself for opinion and advice. As a result, in many cases regulation was unnecessary. Frequently, the results we aimed for had already been effected by the air lines themselves.

"At exactly 2:45 A.M., on March 26, 1939, an accident occurred which cost the lives of eight persons. Since that time, month has followed month without mishap. Today we can stand before the

world and substantiate our conviction that air travel is inherently one of the very safest means of transportation. We cannot say that there will never henceforth be any more air line accidents. But we have operated for one entire year and transported 2,000,000 passengers with absolute safety. That sets the standard! I can promise the American public that the men in the air line industry who have achieved this goal, and the personnel in the Civil Aeronautics Author-



Pan American Airways photo

BRIDGE OF BOEING STRATOLINER

Aboard a Pan American Airways Strato-Clipper. Four of the six crew members at their posts. The captain forward on port side, wearing cap, is flying the plane at the moment. The first officer, opposite the captain, is wearing his earphones and is using the interphone, probably to talk to either the navigator or the steward, neither of whom shows in this picture. In left foreground the radio officer is listening to a ground station or transmitting. In right foreground is the engineering officer.



Pan American Airways photo

AFT ON THE STRATOLINER'S "BRIDGE"

In the left foreground, the engineering officer is noting on his log readings from the dials in front of him. The flight engineer's post is directly behind that of the first officer, the back of whose chair may be seen at the engineer's left hand.

Beyond the engineer is the pilot-navigator working on his charts.

ity who have worked with them towards its attainment, will never consciously relax the eternal vigilance that made it possible.

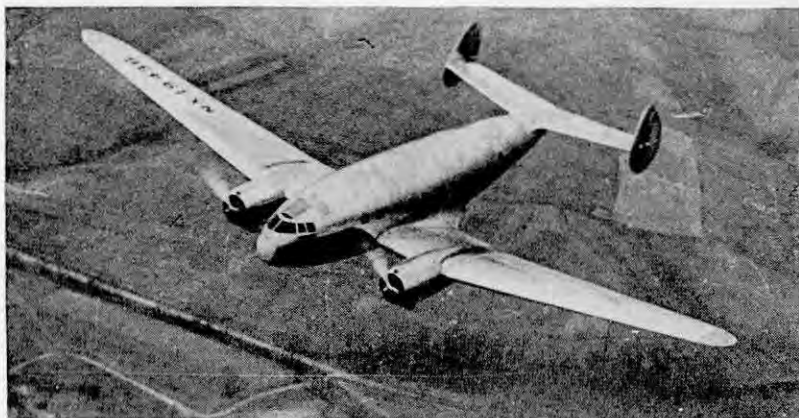
"What these new standards of safety mean to the future of air transportation is already evident in the traffic records of the last 12 months. During the 12 months following March 26, 1939, 2,029,000 passengers availed themselves of air line services. That is an increase in a single year of 46 per cent in public acceptance. What the gain of the next 12 months over the last year will be I cannot exactly tell you. But the domestic air lines have already placed orders for new equipment which will increase the number of their planes by 26 per cent during 1940. And as these planes are, on the average, bigger than the ones that have been operating, they are increasing their seat capacity by 33 per cent.

"You hear much talk of new industries and of their importance to the nation's economic health. This is such an industry. Together with U. S. air lines beyond our borders, it gives direct employment to 15,000 persons and indirect employment to many thousands more. Its gross revenues in 1935 were barely \$21,000,000, whereas in 1939 they had increased to over \$46,000,000. By most conservative estimates our domestic air lines by 1942 should be carrying 4,000,000 persons a year."

Statistics giving passenger, mail and express traffic in detail will be found in the section Flying Facts and Figures.

Air Transport Association of America

The Air Transport Association of America during 1939 represented virtually the entire air carrier industry of the United States,



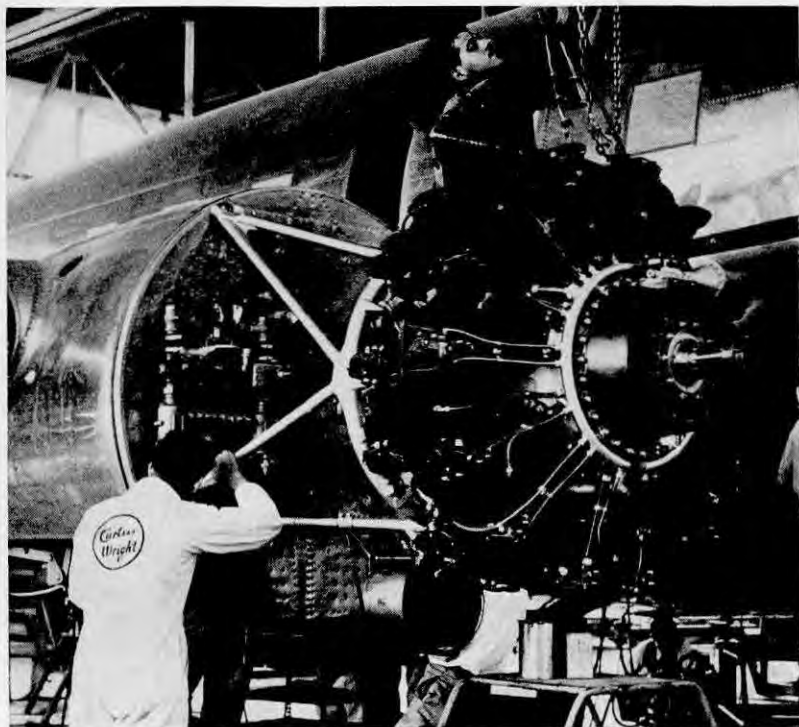
THE CURTISS-WRIGHT TRANSPORT

On her first flight near St. Louis, Mo., on March 26, 1940, this 36-passenger air liner was powered by two 1,700 h.p. Wright Double Row Cyclones and Curtiss propellers.

including those operators in international service. Its functions were divided into three parts: (1) representing the industry before the Civil Aeronautics Authority on matters in which all air lines were interested, including revision and simplification of civil air regulations, (2) traffic and sales promotion, and (3) operations, engineering and personnel problems.

Engineering and Maintenance Conferences of the Association were held in New York and Los Angeles where a combined total of 600 engineers, maintenance superintendents, engineering repre-

sentatives of aircraft manufacturers and the Army and Navy exchanged technical knowledge and laid plans for the future. An air carrier arbitration agreement was signed by all member lines through the Association in collaboration with the American Arbitration Association. The Air Traffic Conference of America Division of the Association functioned by means of frequent meetings at which agreements, approved by the Civil Aeronautics Authority, were entered



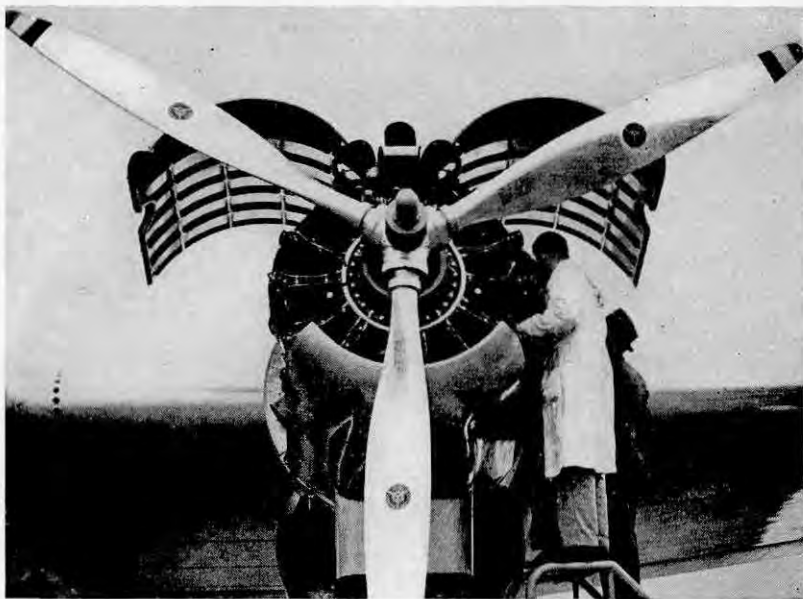
CYCLONE INSTALLATION

Close-up of one of the two 1,700 h.p. Wright Cyclones being installed in the Curtiss-Wright transport.

into in connection with traffic and sales promotion matters. A joint tariff of combination fares was published for public and air line use. In September the "It Pays to Fly" joint advertising campaign of the Association materialized. Sixteen air lines participated with \$150,000, and aeronautical manufacturers contributed \$110,000.

The Operations Committee and its subcommittees held frequent

meetings on operations, meteorology, pilot and dispatcher training and other subjects relating to the technique of air carrier flight. The Meteorological Committee announced an award during the year for the best research in 1940 having a practical application to dispatching and weather forecasting. This is open to pilots, dispatchers and meteorologists of the air lines. The Association announced a research fellowship for graduate students in meteorology during the year. The Purchasing Committee held two meetings during the year for the exchange of data on purchase procedures, forms and stock room



CURTISS-WRIGHT'S POWER PLANT

One of the Wright Double Row Cyclones and Curtiss Electric full feathering propellers on the new C-W Transport.

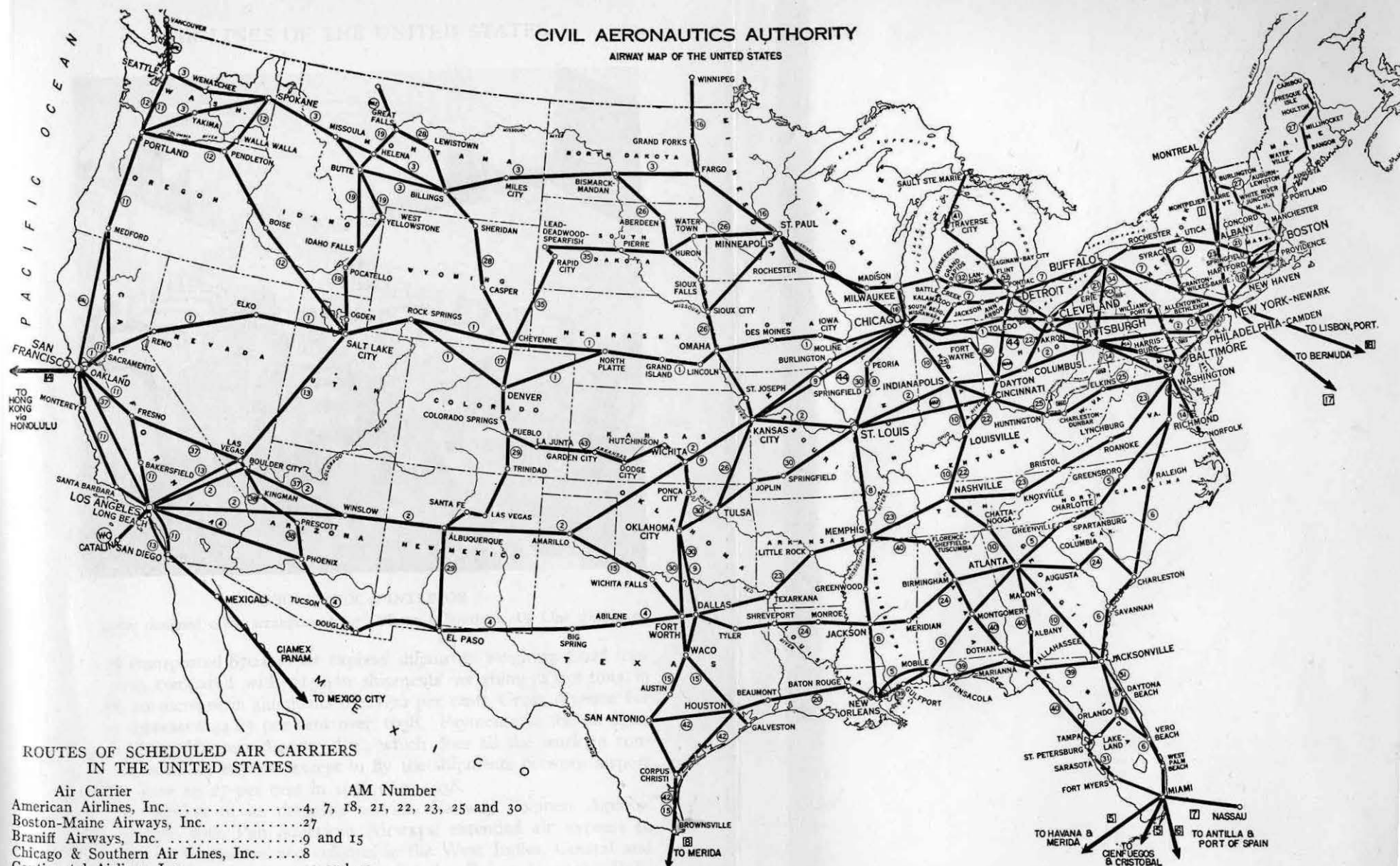
facilities. In this they had the collaboration of manufacturers and suppliers. Throughout 1939 the Air Transport Association cooperated with the Aeronautical Chamber of Commerce of America on engineering and other subjects of mutual interest to both branches of the industry.

Air Express

Regularly scheduled airplanes of 18 major air lines flying an average of 248,000 miles daily over 40,787 miles of domestic air-

CIVIL AERONAUTICS AUTHORITY

AIRWAY MAP OF THE UNITED STATES



ROUTES OF SCHEDULED AIR CARRIERS IN THE UNITED STATES

Air Carrier	AM Number
American Airlines, Inc.	4, 7, 18, 21, 22, 23, 25 and 30
Boston-Maine Airways, Inc.	27
Braniff Airways, Inc.	9 and 15
Chicago & Southern Air Lines, Inc.	8
Continental Airlines, Inc.	29 and 43
Delta Air Corporation	24
Eastern Air Lines, Inc.	5, 6, 10, 20, 40 and 42
Inland Air Lines, Inc.	28 and 35
Inter Island Airways Ltd.	33
Marquette Airlines, Inc.	Mar.
Mid-Continent Airlines, Inc.	26
National Airlines, Inc.	31 and 39
Northwest Airlines, Inc.	3 and 16
Pennsylvania-Central Airlines Corp.	14, 32, 34 and 41

Air Carrier	AM Number
Transcontinental & Western Air, Inc.	2, 36, 37, 38 and 44
United Air Lines Transport Corp.	1, 11, 12 and 17
Western Air Express Corp.	13 and 19
Wilmington-Catalina Airlines Ltd.	W-C

Canadian Colonial Airways, Inc. ....1	FAM Number
Pan American Airways, Inc. ....5, 6, 7, 8, 10, 14, 15, 16, 17 and 18	
Pan American-Grace Airways, Inc. ....9	

AM—Domestic Air Mail Contract
FAM—Foreign Air Mail Contract



DOUGLAS DC-3 INTERIOR

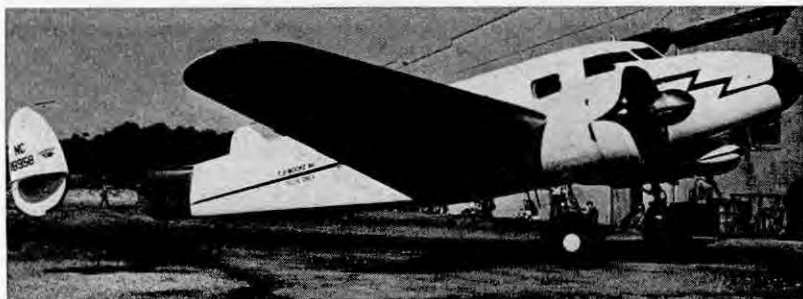
A newly designed cabin arrangement for Chicago & Southern Air Line transports.

ways transported 870,806 air express shipments weighing 2,925 tons in 1939 compared with 715,410 shipments weighing 2,362 tons in 1938, an increase in shipments of 21.72 per cent. Gross revenue for 1939 increased 24.23 per cent over 1938. Payments to the air lines by Railway Express Agency, Inc., which does all the work in connection with air express except to fly the shipments between airport cities, were up 27 per cent in 1939 over 1938.

In addition to its domestic service, Railway Express Agency, by contract with Pan American Airways, extended air express to and from 47 countries and colonies in the West Indies, Central and South America, the Pacific islands and the Orient in 1939. Railway Express sold the service in the United States, made out the international waybills and handled shipments to and from the international airports in Miami, Brownsville, Los Angeles and San Francisco. Shipments in the international air express service totaled 79,338 in 1939, an increase of 27 per cent over 1938.

Shipments by air express for December, 1939, totaled 103,150 compared with 81,519 in December, 1938, an increase of 26.5 per cent. This was the first time in the 12 years history of the service that shipments exceeded 100,000 for one month. Gross revenue for December, 1939, increased 29.9 per cent over December, 1938. Railway Express Agency made an exhaustive analytical breakdown of air express handled in April, 1939. Contrary to the general belief that only light articles of an emergency nature were carried in air express, the study revealed machinery as the greatest revenue producer of any class making regular use of the service. Printed matter was second, merchandise third.

The express company had been experimenting with air express for many years before the service on a comparatively large scale was started in 1927 over four air lines with a total mileage of 4,450. At



THE LOCKHEED 12

A light transport for either the private owner or for regular air line use.

the end of 1939, Railway Express Agency had uniform contracts, individually executed, with 18 domestic air lines to perform all services in air express except the actual flying of the shipments, and a contract with Pan American Airways entered into in August, 1934, for handling international air express. In the first 12 years of operation air express rates were reduced two-thirds and airplane speed was doubled.

Frequency of plane departures and coordination of air and rail services, together with lower rates and higher speed, contributed to the increased utilization of air express in the first decade of service. Between New York and Chicago at the end of 1939 there were 48 regularly scheduled flights, 24 in each direction, by three major air lines. That gave the company a wide range of routes over which to forward its shipments, as well as a huge carrying capacity. Coor-

dination of services between planes to airport cities and trains to off-air line points extended the air-rail service to 23,000 offices of Railway Express. About 30 per cent of all air express shipments either started or finished or both started and finished by rail or were carried part way by rail to expedite their movement. In its coordinated air-rail service Railway Express in 1939 covered 213,000 miles of railroads as well as 40,787 miles of airways. This service was handled by 57,000 employees. Night and day and holiday pick-up and delivery were expedited by 11,300 ever available motor vehicles.

Further to speed up service, Railway Express had an agreement with Western Union whereby hurry calls to a telegraph office brought boys, without extra cost to the shipper, to pick up air express packages. Profits due to speed were an important incentive to the



THE LOCKHEED LODESTAR

A 14-passenger commercial transport powered by Pratt & Whitney Hornet engines.

increased use of air express. Thousands of dollars in depreciation, rents and taxes were saved by manufacturers and merchants in 1939 by reducing inventories and depending upon air express to make overnight deliveries of goods from distant points. The president of a successful Chicago bearings supply house said that without the aid of air express he never could have built his business to the high state of efficiency and money return it had reached in 1939.

Pan American Airways

The opening of the airway over the North Atlantic between the United States and Europe to regularly scheduled mail and passenger air service was one of the outstanding achievements to the credit of

American aviation in the year 1939. In other years not only air services of the United States but also those of European countries had surveyed routes across this most important and valuable of the world's trade lanes, and for a brief period in 1939 Imperial Airways operated a temporary air mail service from England to this country, but with the advent of war in Europe that operation was suspended, leaving the United States represented by Pan American Airways alone and supreme in the field. Beginning with mail service on May 20, 1939, and passenger service on June 28, Pan American Airways Boeing clippers at the end of 1939 had logged a total of 100 crossings between this country and Europe, and had flown a total of 393,214 route miles and 5,451,873 passenger miles in regular twice



BOEING CLIPPER TAKES OFF

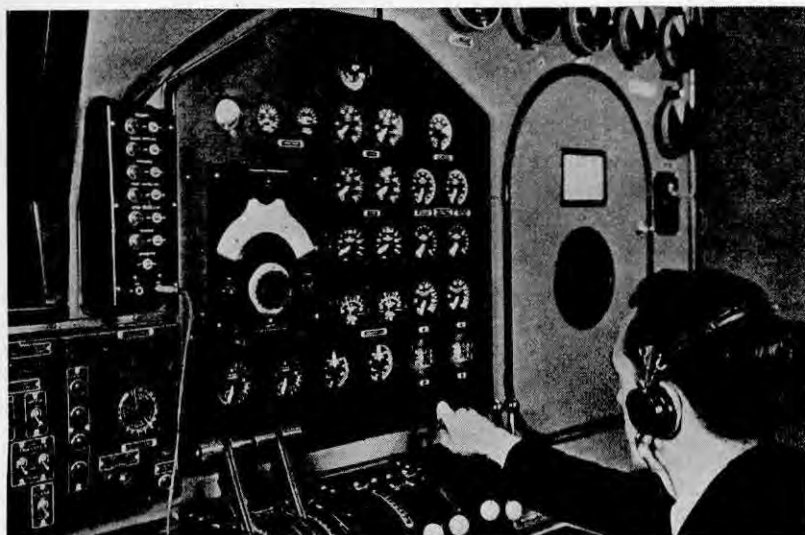
One of the 74-passenger 42-ton Pan American Airways transports in transatlantic service. It was powered by four Wright Cyclone engines.

weekly service over the Atlantic. Of this grand total 85,334 route miles and 1,538,790 passenger miles were flown on a northerly route which originally terminated at Southampton, later at Foynes, Ireland; while 307,880 route miles and 3,913,083 passenger miles were flown on a southern route to Lisbon, Portugal, by way of the Azores.

The opening of the Atlantic service climaxed 10 years of preparatory and survey work on the U. S.-European route by Pan American. It added, in the case of the New York-Lisbon route 4,247 miles to America's international air transport system. This brought

to 62,305 miles of air routes under operation through the use of 131 airplanes by Pan American during the year. On this system during 1939, 253,480 passengers were carried, an increase of 11 per cent over 1938; 14,386,968 miles were flown, for an increase of 7 per cent; while passenger miles—the real indication of air line performance—were increased 25 per cent to 109,643,273. A total of 4,600,000 pounds of air express was carried on the system in 1939, representing a 21 per cent increase.

In the files labeled "future development" was Pan American's own "five year plan," for 22 multi-engine air liners of various types and advanced design.



THE HEART OF THE CLIPPER

Flight engineer's station on one of Pan American Airways Boeing 314 flying transports in ocean service.

But prior to the public announcement of this far-reaching program, as 1939 opened, Pan American had yet to close the final gap in the world's globe-circling network of international air lines with the successful culmination of 10 years of plans and progress looking toward scheduled flying over the world's richest trade route, the Atlantic Ocean to Europe.

Through the major portion of the year 1938 the aircraft scheduled to do this job—the great four-engine, 6,000 h.p. Boeing B-314 flying boats, had been going through intensive trial in the hands of

the manufacturers, the Civil Aeronautics Authority, and Pan American Airways own engineering and flight personnel. First such scheduled service, after an 18,000-mile "proving" flight to China and back by "California Clipper," was on March 29 when the "California Clipper," again headed westward over the 9,000-mile Pacific airway to Hongkong with passengers and United States mail. On the Atlantic, the as yet unnamed P.A.A. 20 (which later became "Atlantic Clipper") went into service over the two-year-old ocean airway between the United States and Bermuda, to meet the pressure of traffic resulting from Bermuda's popular Easter season.

Earlier, on March 3, the proud P.A.A. 17—first off the Boeing assembly line and the new flagship of Pan American's Merchant Marine of the Air—was christened "Yankee Clipper." Later that same month, on March 26, "Yankee Clipper" headed eastward across the Atlantic from Baltimore on an 11,000-mile final inspection flight of routes and bases prior to scheduled transatlantic air service. Twenty-two days later, Captain Harold E. Gray again touched the Clipper's keel to the dark waters of Baltimore's Patapsco River, and pronounced the Atlantic route ready for service.

In making application to the Civil Aeronautics Authority for its Atlantic route certificate, Pan American based its plans on an operating schedule of four weekly round-trips between the United States and Europe.

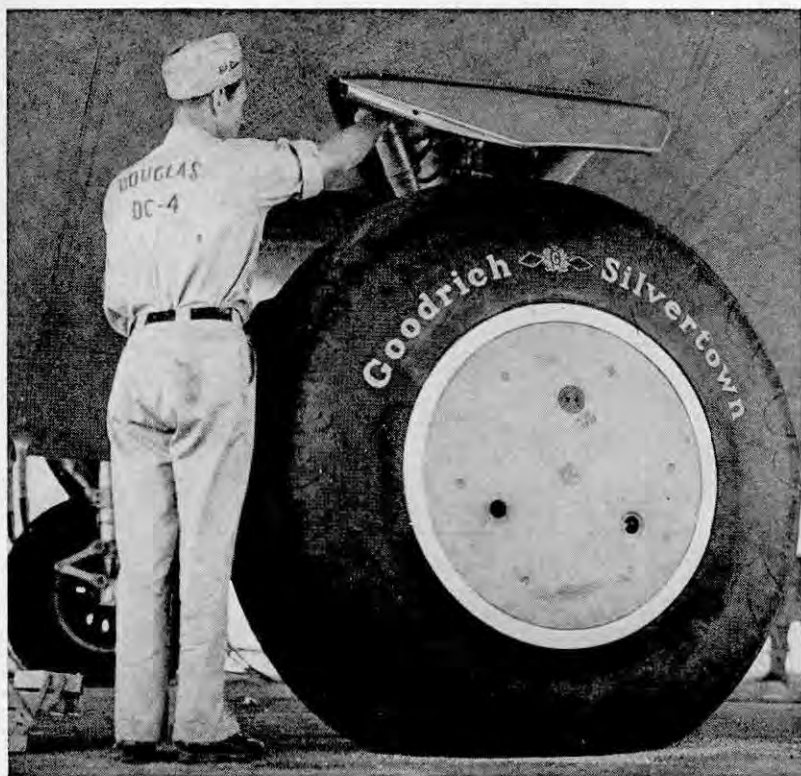
Finally, on May 19, came the C.A.A. answer; the basic route certificate for Pan American to start scheduled flying across the Atlantic, carrying passengers and United States mail, on two routes—a "northern" route to England via Shediac, New Brunswick; Botwood, Newfoundland; Foynes to Southampton; a "southern" route to France via the Portuguese-owned Azores Islands; and Lisbon to Marseilles. Authorized were two of the requested four weekly round-trips, one each to France and England, or two to England or two to France.

Within 24 hours of the C.A.A. decision, Pan American, geared and manned for months in readiness, was prepared to go. The "Yankee Clipper," flagship of the Pan American fleet, Capt. A. E. La Porte commanding, was at her Port Washington dock ready to go. It was an auspicious anniversary. Twelve years before, on May 20, 1927, Charles A. Lindbergh had pointed his little airplane eastward over the ocean for Paris.

At 1:08 P.M. on that historic Saturday, the "Yankee Clipper" left the waters of Manhasset Bay bound for Marseilles with a crew of 14 and 1,600 pounds of first-flight transatlantic air mail, to the cheers of the crowd and the telegraphed good wishes of President

Roosevelt. Between that date and June 17 four more such routine scheduled transatlantic trips were completed. The fifth trip, June 17, performed by the "Atlantic Clipper," was, in addition to being a scheduled flight, a preview of the route and service, prior to scheduled passenger service, for 16 representatives of the press and radio.

Thereafter this newest of the world's major air lines settled rapidly into its stride. On June 24, the "Yankee Clipper" pointed toward new waters to open the so-called "northern" route to England via Newfoundland and Ireland. Aboard, in addition to 2,500 pounds of mail matter, were 20 official observers of the United States Government and Pan American Airways. The biggest day



GOODRICH AIRPLANE TIRE

Weighing 360 lbs., this 65-inch tire was developed by The B. F. Goodrich Company for the Douglas DC-4 transports and planes of similar size. Each tire contains 45 miles of tire cord and four miles of beaded wire. This landing gear carries a weight of $16\frac{1}{2}$ tons.

of all was June 28, when proud Master Pilot R. O. D. Sullivan, commanding the flying boat "Dixie Clipper," left Port Washington for Marseilles on the first scheduled passenger flight across the Atlantic, carrying 22 revenue passengers culled from a list of some 500 eager "first flight" applicants.

At the outset of passenger service Pan American operated a weekly round-trip to France, a semi-weekly round-trip to England. By the end of July, both routes were on a full one-a-week schedule,

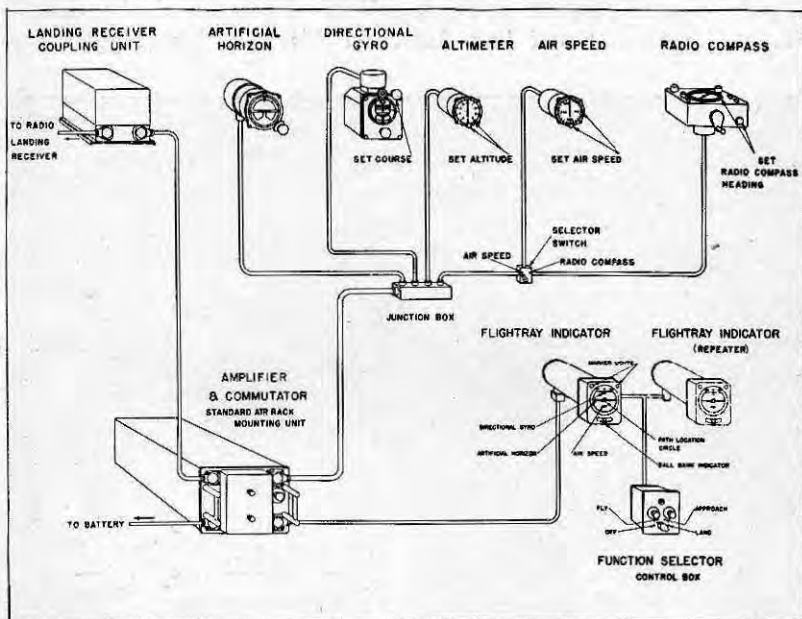


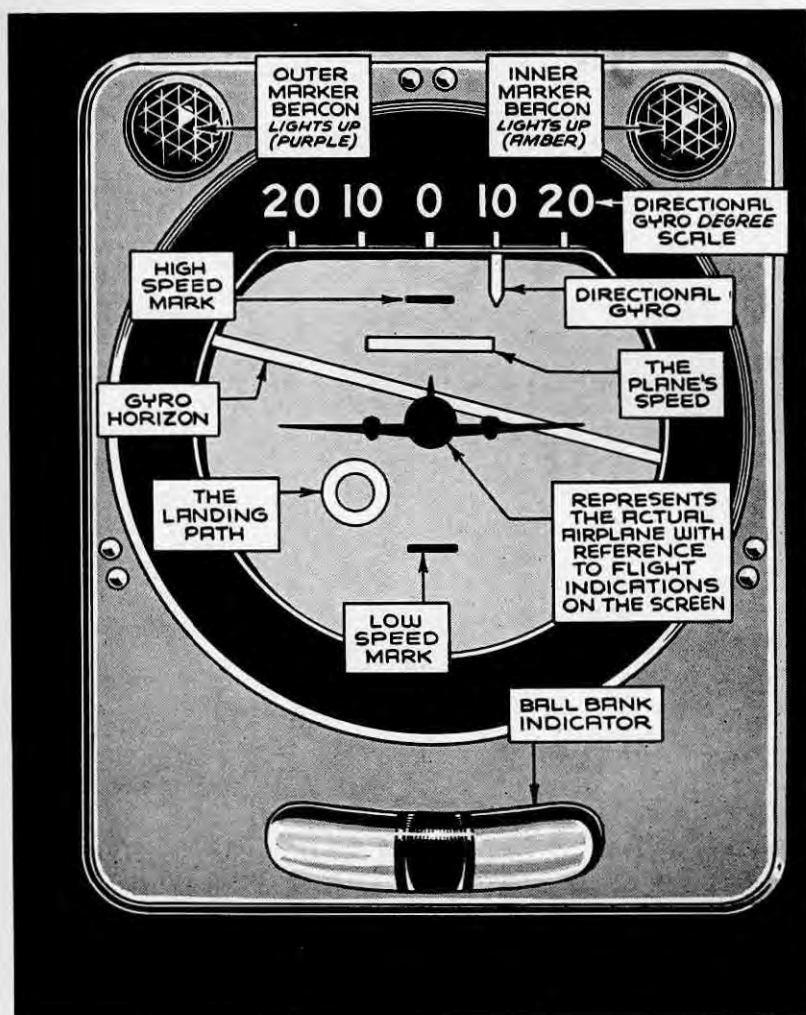
DIAGRAM OF SPERRY FLIGHTRAY

with the demand for space growing ever more insistent and the loads of international air mail increasing trip by trip.

Then on September 3, Europe went to war, and Pan American, seeking to maintain complete neutrality in a tense world situation, promptly curtailed its European service to avoid flying in belligerent territory. First the terminus at Southampton was shifted to Foynes; then Marseilles was abandoned as a terminal point in favor of neutral Lisbon.

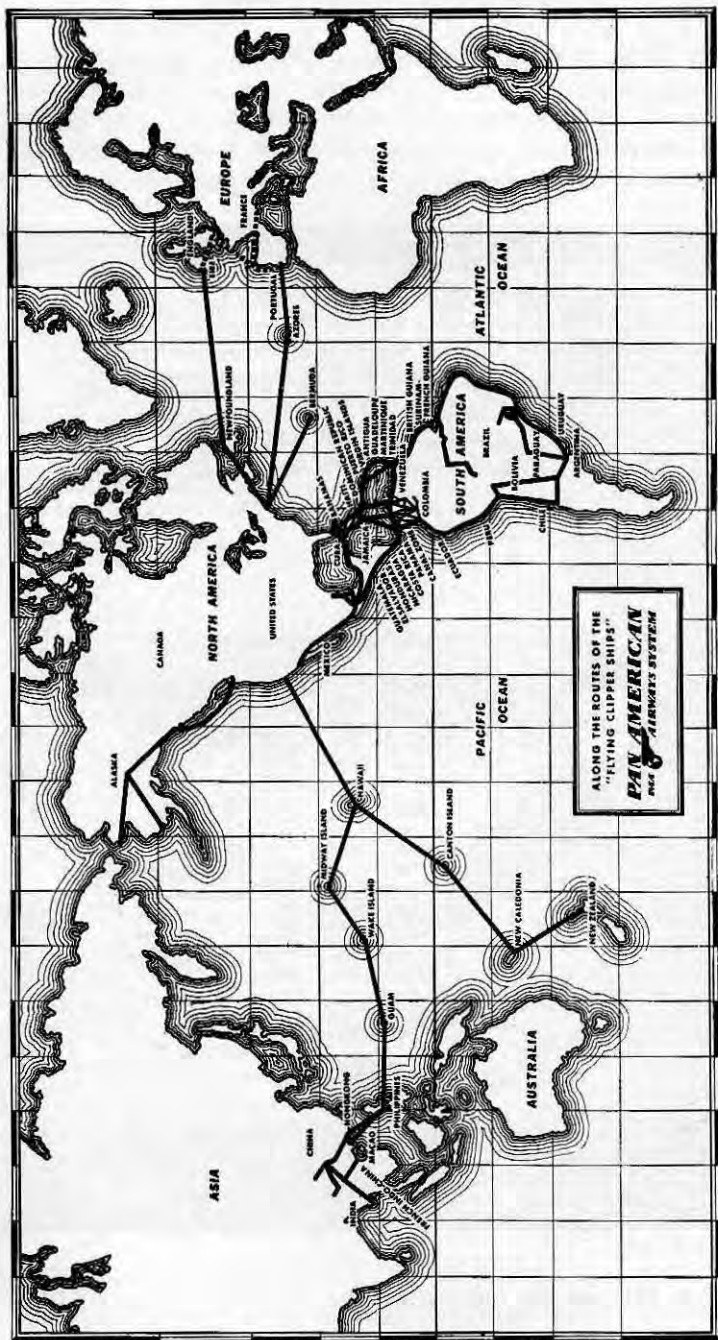
Europe's war, however, proved conclusively the commercial and national importance of this newest scheduled intercontinental air

service. With the declaration of war between Britain and Germany mail loads began to mount sharply. So great was this rush of mail users to the Clippers, due partly to the curtailment of all the Atlantic's surface shipping, partly to the added feeling of security the public felt in the air service, partly to the urgent necessity for rapid



THE SPERRY FLIGHTRAY

Indications from necessary flight instruments are combined on the 3-inch face of the Flightray on the panel before the pilot.



communication caused by the war, mail loads jumped from the average 600-800 pound levels, which were the rule at the service's start, to loads averaging some 2,800 pounds each trip.

On December 20, scarcely six months after the start of service, the "American Clipper," fourth of the Atlantic Division's Boeing sisterships, arrived back in the United States from Europe to complete the 100th scheduled Atlantic crossing, with a record of achievement for international air service that spoke eloquently to the world of America's aerial leadership.

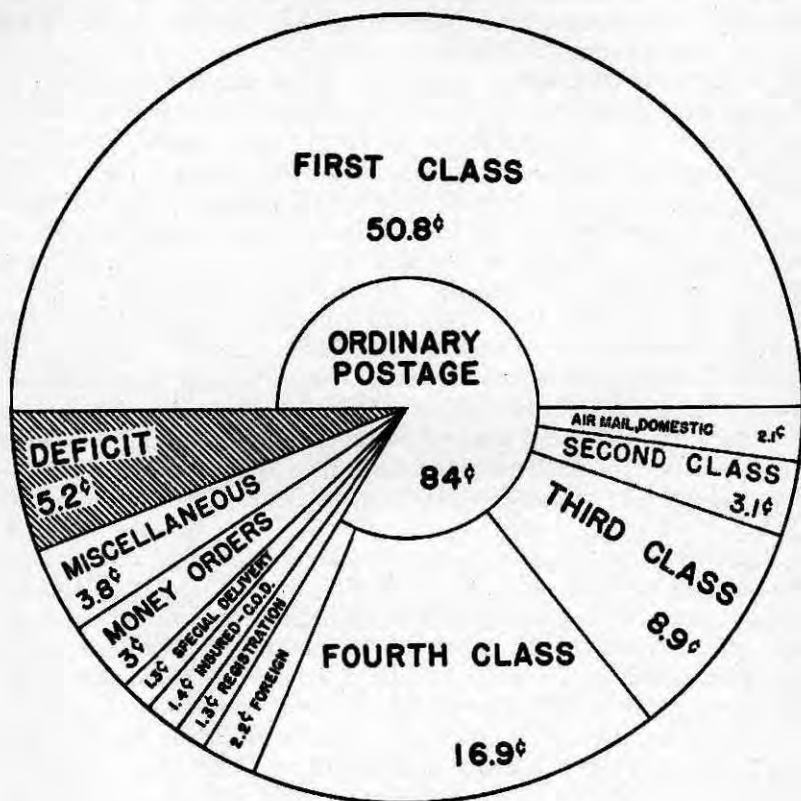
Reduced to its practical figures, the record was one which no European air line, however well subsidized, however important a "chosen instrument" of its Government, could begin to equal. Those 100 trips piled up a total of nearly 400,000 plane miles; carried nearly 1,800 passengers; and transported better than 80,000 pounds of mail. Even before the war, Britain had recalled from their accustomed New York-Bermuda service the luxury liners "Queen of Bermuda" and "Monarch of Bermuda" which left Bermuda dependent almost entirely on the twice-weekly schedules of Pan American's "Bermuda Clipper" for her communications with the mainland. Promptly, the island's Trade Development Board requested Pan American to re-route its twice-weekly transatlantic clippers to include a stop at the Islands. Pan American asked for and received permission for this change from the Civil Aeronautics Authority, and since then Bermuda has had four-time-weekly air connections with United States, twice weekly with Europe.

Institution of the fourth, fifth and sixth schedules were to take effect as units in the new fleet of Boeing Super-Clippers (B-314A) became available, beginning early in 1941. Separate summer and winter schedules will be set up to take advantage of maximum traffic accommodations in the Clippers during the season of the year when "normal" weather conditions may be expected over the ocean.

Significant among the proposals outlined in the air line's formal application is that embodying a request for a "fair and reasonable" rate of pay for the carriage of transatlantic air mail which would entail no Government subsidy whatever, inasmuch as the rates asked for the additional schedules are lower than the actual postage revenue being returned to the U. S. Treasury by the transatlantic service.

But the year's events in the international flying world were not confined to the Atlantic. Across the continent, at San Francisco, western gateway to the Orient, Pan American's Pacific Division was laying the foundations for a new transoceanic route to far-off New Zealand. Again, repeating the drama of 1935, when the present North Pacific airway was blazed through the desert islands of Midway and

Wake, an airway building expedition, aboard the veteran freighter "North Haven," set its course out of the Golden Gate for tiny Canton Island, 1,900 miles southwest of Hawaii. There, repeating the saga of the construction of Wake Island, the group of veteran colonizers set up a complete airway station, with all the comforts of home included, for the coming of the Clippers, on their later scheduled flights



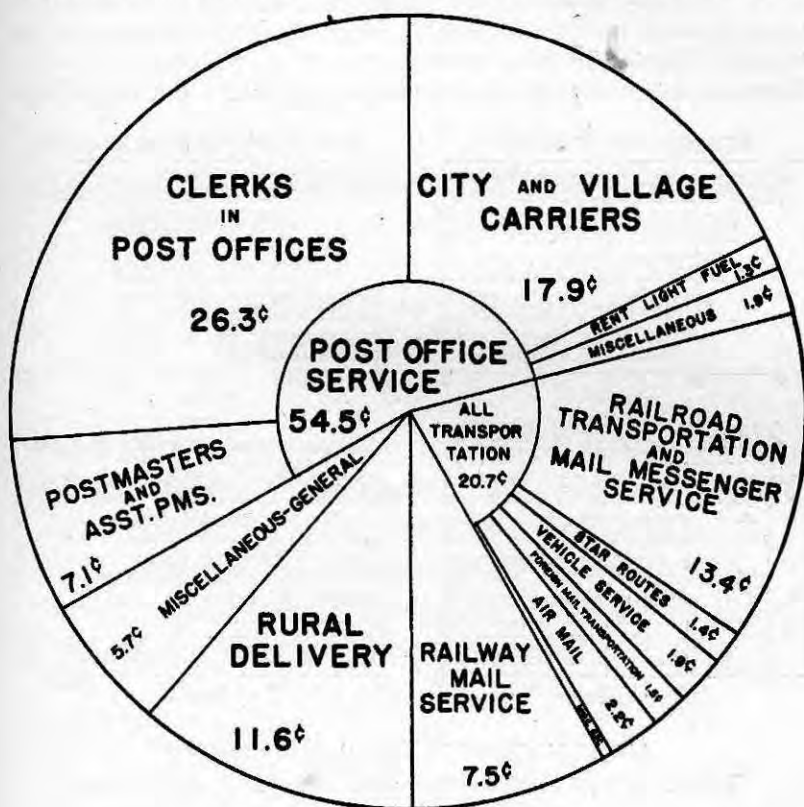
THE POSTAL DOLLAR

Whence it came, fiscal year 1939.

to the United States' fourth largest world market. The next stop on the projected route was to be Noumea, in the French colony of New Caledonia. Here, too, an airway base was installed, complete with all the necessary facilities for servicing Clippers and housing their passengers and crews.

The original route to New Zealand, surveyed and flown in 1937,

became impracticable from a technical operations standpoint with the coming of the Boeing-built Super-Clippers. The harbor at Pago Pago in American Samoa was inadequate for the take-off and landing runs which those great 41-ton flying boats required. Started in May, the mid-ocean base at Canton was a finished project within a few brief weeks, the construction crew being for the most part the same as that



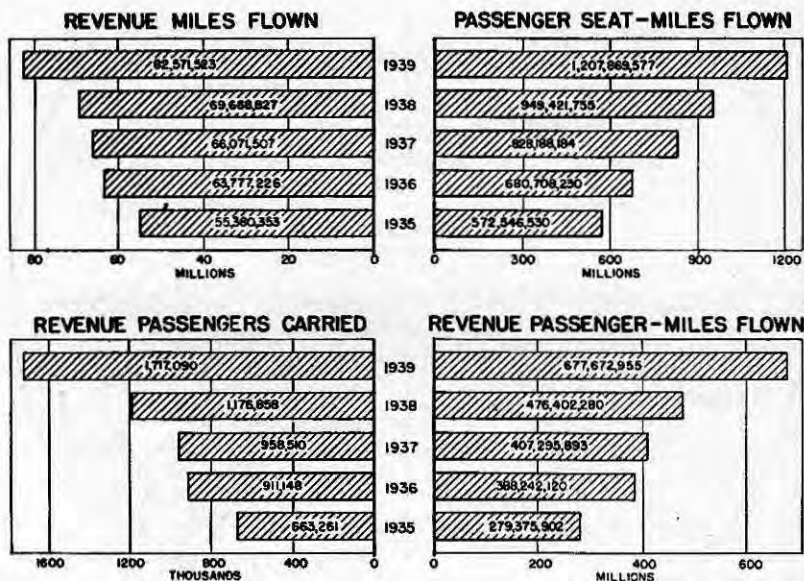
THE POSTAL DOLLAR

Whither it went, fiscal year 1939.

which built the famous bases at Midway and Wake. Between mid-August and the end of November, Pacific Division's two Super-Clippers, "California Clipper" and "Honolulu Clipper," each had completed a 16,000-mile round-trip survey and base inspection flight from San Francisco to Auckland. In Washington, application to the C.A.A. for a certificate of convenience and necessity for operation of

the route had been filed, the extensive hearings held, all the evidence presented, and at the beginning of 1940 the airway organization stood ready at its bases waiting for the word "go." In the San Francisco Post Office, awaiting the coveted official stamp that would designate them "first flight," were about 100,000 philatelic air mail "covers."

Keystone of the Pan American System is its Latin American network. Through the development of fast and efficient air transport in Latin America through 12 exciting years, the sister-republics in the Western Hemisphere have assumed an ever more important role to American shippers, business and pleasure travelers. But all through



C.A.A. graph

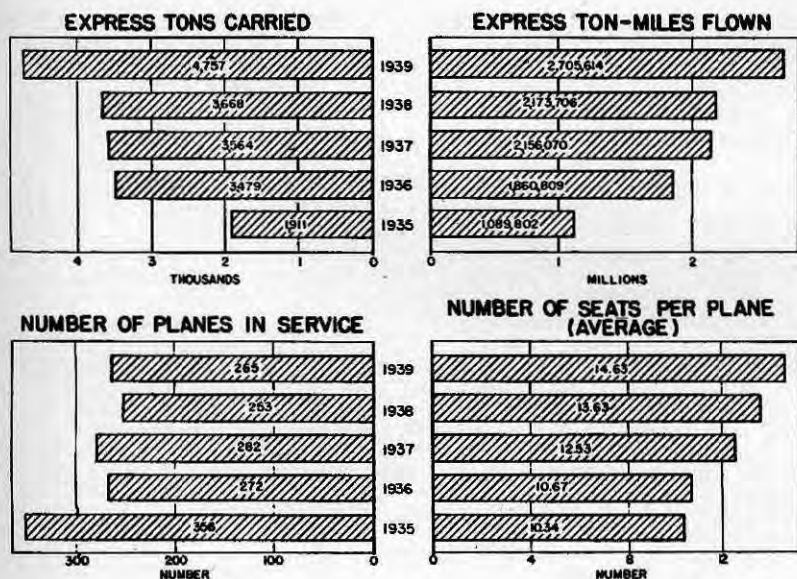
AIR TRANSPORT IN THE UNITED STATES

Five-year progress graph by fiscal years ending June 30, each year.

that period, while Pan American was improving schedules and frequencies, blazing new routes, rendering better service to U. S. mail, industry and travelers, increasingly aggressive competition of German, French and other European subsidized air lines on the South American continent put more imperative demands on America's own international air line system. To combat that competition, and keep the American flag first on the airways of the Americas, Pan American Airways started a second direct weekly service between the United States and the west-coast countries of South America and, via the

Andes, to Buenos Aires. Primarily, the new service entailed an addition of a new direct transcaribbean service by Pan American from Miami to the Canal Zone, where direct connection is made with the fast multi-engine air liners of Pan American-Grace Airways down the west coast. Simultaneously this doubled through service was named the "South Amerairican," a name denoting both the geographical destination and the means of getting there.

The objectives of Pan American's "five-year plan" for the Americas are, one, a speed-up of schedules aimed at eventual 48-hour express schedules via both South American coasts to Buenos Aires;



C.A.A. graph

AIR TRANSPORT IN THE UNITED STATES

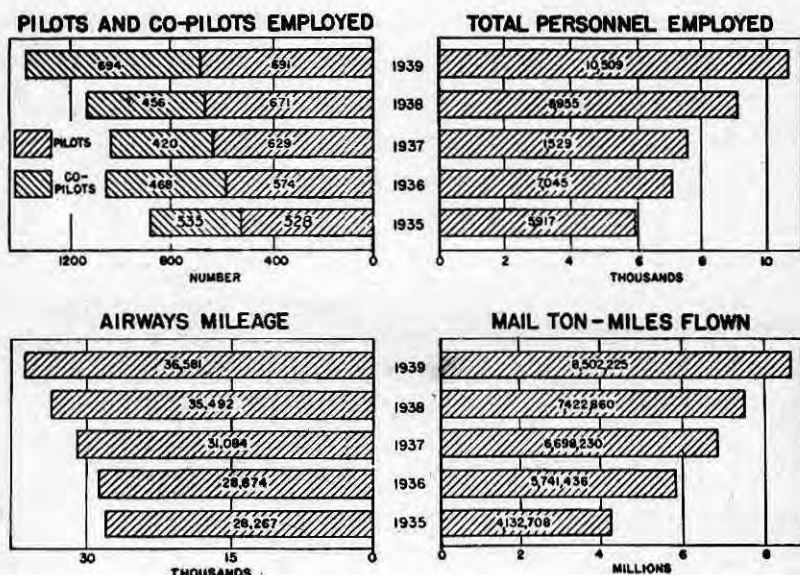
Five-year progress graph by fiscal years ending June 30, each year.

and two, maintenance of Pan American's long step ahead of foreign competitive air lines on the key ocean trade routes.

American Export Airlines

American Export Lines, with a surface fleet of 21 steamships—17 freighters and four combination passenger and freight vessels—planned regular Atlantic air service by its subsidiary, American Export Airlines. As opposed to American Export Lines and the few other American flag companies serving Europe, there are the big

steamship lines of Europe with their huge super-liners, such as the British "Queen Mary," French "Normandie" and Italian "Rex." Like other flag steamship companies, under the encouragement given it by the U. S. Maritime Commission some years ago, the American Export Lines had to face the question of equipment, modernization and replacement, so that as an American flag operator the company could offer more competitive service than foreign rivals and increase travel under the American flag. It was at this juncture that American Export instituted an international survey to determine what vehicle of commerce, be it luxury-liner or flying boat, would be most adaptable



C.A.A. graph

AIR TRANSPORT IN THE UNITED STATES

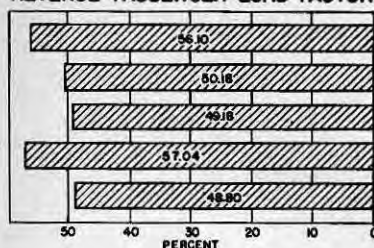
Five-year progress graph by fiscal years ending June 30, each year.

to its expansion program. The survey resulted in favor of the flying boat; and that was the beginning of American Export Airlines.

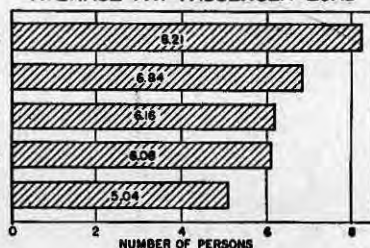
Late in 1939, the company filed an application with the Civil Aeronautics Authority for a certificate of convenience and necessity to operate a transatlantic air line between the United States and Europe, and during those hearings which lasted more than two months, it produced scores of witnesses in efforts to prove itself "fit, willing and able" to render that type of public service. Before the hearings opened, however, six transatlantic survey flights were made

by American Export during July and August, 1939 using a Consolidated 28 Flying Boat. These flights were made on schedule, leaving New York on alternate Fridays, with no interruption. The first and second flights were eastbound and westbound over the New York-Marseilles route via Horta, Azores, and Lisbon, Portugal, and Biscarrosse, France. The third flight was from New York to Marseilles via Botwood, Newfoundland, Foynes, Ireland, and Biscarrosse. The fourth flight was from Marseilles to New York via Biscarrosse, Foynes and Halifax, Nova Scotia. The fifth flight was from New York to Biscarrosse, via Botwood, and the sixth flight was from Biscarrosse to New York via Lisbon and Horta.

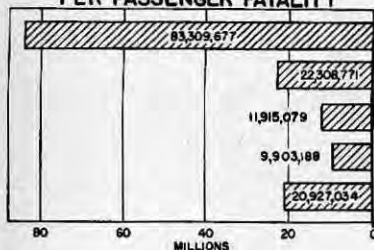
REVENUE PASSENGER LOAD FACTOR



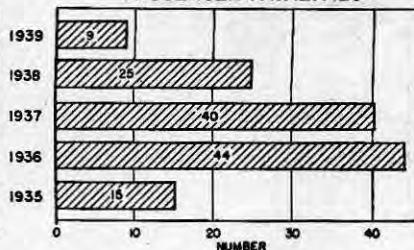
AVERAGE PAY PASSENGER LOAD



PASSENGER MILES PER PASSENGER FATALITY



PASSENGER FATALITIES



C.A.A. graph

AIR TRANSPORT IN THE UNITED STATES

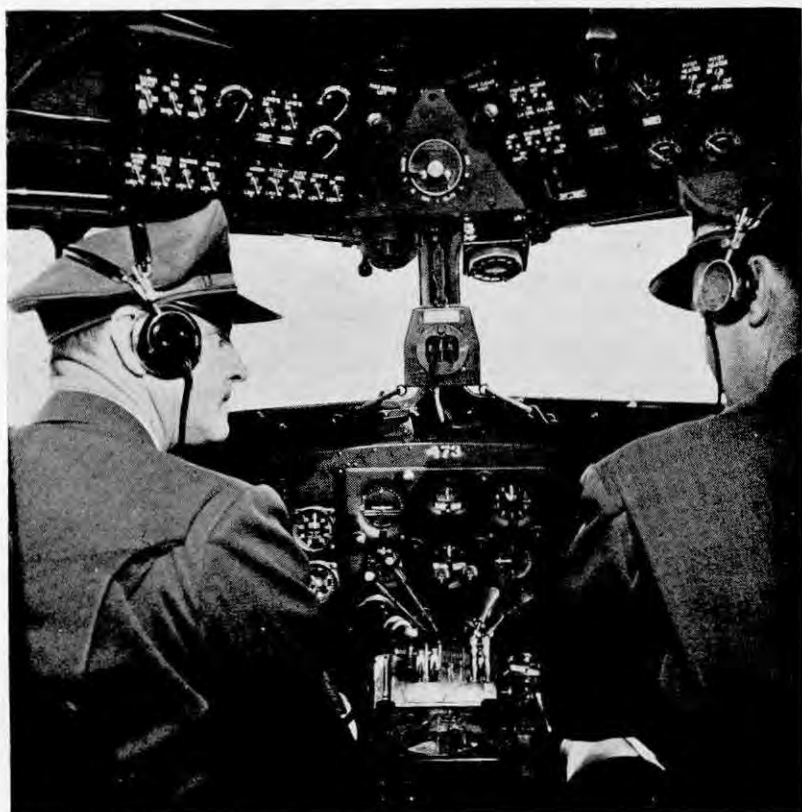
Five-year progress graph by fiscal years ending June 30, each year.

The survey flights proved that the navigational aids organized and utilized for the dispatch of the survey ship were adequate, and with certain refinements could be extremely satisfactory. The \$200,000 Consolidated flying boat used was purchased from the Consolidated Aircraft Corporation of San Diego, California. The ship was released by the Navy from Consolidated's production of long range patrol planes in order that American Export might obtain an early delivery.

Plans of American Export Airlines are to operate non-stop

service across the Atlantic, the company stated. An order has been placed with United Aircraft Corporation for the construction of three giant long-range commercial flying boats capable of flying the Atlantic to Europe non-stop at a cruising speed of 175 miles an hour, with a full crew and payload. The new flying boat is a commercial version of the U. S. Navy Vought-Sikorsky Flying Dreadnaught.

American Export Airlines claims that the planes will include every modern improvement, with sleeping accommodations for 16 passengers and a crew of 11, plus a substantial load of mail and express. They will have a wing span of 124 feet, an over-all length of 79 feet three inches and a height of 27 feet seven inches. They will be powered



SPERRY AUTOMATIC DIRECTION FINDER

The Sperry Automatic Radio Direction Finder, lower center, on a Douglas DC-3 transport.

by four Pratt & Whitney twin row Wasp engines, rated at 1,200 horsepower for take-off. Fuel will be carried in three separate tanks built into the wings, permitting a total fuel capacity of 3,900 gallons. This great fuel capacity makes the non-stop flight across the Atlantic, with adequate reserve, "entirely feasible and with a higher degree of safety and comfort." The long-range ability of these flying boats will make it possible for American Export Airlines to eliminate delays occasioned by intermediate stops such as Bermuda and the Azores, and thereby insure dependability of schedule.

American Export's original application for a certificate of con-



AMERICAN AIRLINES COMMUNICATIONS

At the New York Municipal Airport American's teletype and radio system covers operations.

venience and necessity asked authority to operate once a week service to England and once a week service to France on separate routes. After the Neutrality Act of 1939 was passed, and the President had issued his proclamation barring American steamships and airplanes from the European combat zones, American Export applied for permission to operate a twice a week service to Italy, via Portugal and Spain.

American Airlines

American Airlines in 1939 established new world records for revenue passengers carried and revenue passenger miles flown. During

the year the company ordered 20 new 21-passenger Douglas DC-3 Flagships. Early in 1940 six additional Flagships of the same passenger capacity were ordered to handle the rapidly expanding passenger traffic. In January, 1940, the line ordered 15 DC-4 40-passenger Flagships from Douglas.

The American Airlines new plant at New York Municipal Airport included three hangars (each about as large as Madison Square Garden) fronted by a connecting office building. In addition to hangar, shop and office space, they provided accommodations for a pilot training school, stewardess training school, medical department, cafeteria, directors' room, stewardess lounge, pilots' lounge and many other facilities. Early in 1940 American Airlines train-



E.A.L. PASSENGERS

New York to Miami in eight hours is the schedule with the Douglas DC-3 transports in Eastern Air Lines service.

ing program for personnel started at the airport, with classes for pilots, stewardesses, reservations and agent personnel, apprentice mechanics and radio operators.

Chicago and Southern Air Lines

During 1939 Chicago and Southern Air Lines increased its revenue passenger miles 34.3 per cent and passenger miles 22.68 per cent. In 1940 Chicago and Southern planned to move general offices and maintenance shops from St. Louis to Memphis, Tenn. Construction of a new \$175,000 hangar and office building was to be completed in August. It was estimated that the company, when it moved to Mem-

phis, would have spent \$750,000 for its expansion program, which included new equipment.

Eastern Air Lines

Eastern Air Lines served 47 cities in 16 States. On July 6, 1939, the first autogiro air mail service ever operated between a metropolitan area and the roof of a post office was started by Eastern Air Lines, from Camden, N. J., to the Philadelphia Post Office roof, the shortest air mail route in the world—six miles.

During 1939, 48.7 per cent of Eastern Air Lines passengers traveled only between adjacent stops, being strictly short-haul passengers, and 7.5 per cent were transported from one terminal of the system to another terminal, being long-haul passengers. The rest, 43.8 per cent, traveled intermediate distances. Five Douglas DC-3 21-passen-



THE DOUGLAS DC-5

A three-wheel 19-passenger transport for light traffic on the air lines. It is powered by two 1,200 h.p. Wright Cyclones.

ger planes were added to the company's fleet, with spare engines, aircraft communication equipment, airway communication equipment and miscellaneous flying equipment at an approximate cost of \$850,000.

In February, 1940, three Douglas DST 14-passenger full sleeper planes were placed in service between New York and Brownsville, Texas, making it possible to go to bed aboard the plane in New York or Washington in the evening and arrive in Brownsville the next morning at 8 o'clock without change of planes.

Eight Douglas DC-4 four-engine airplanes were ordered. The cost of the eight transports with spare engines, spare parts, radio equipment and ground equipment approximated \$3,000,000. The benefits derived by both parties to the arrangement by which Eastern Air Lines leased airplanes from United Air Lines during the winter of





KELLETT AUTOGIRO

Eastern Air Lines autogiro taking off from the roof of the Philadelphia Post Office for rapid mail transfer to Camden airport.

1938-39 were of such value that a similar rental contract was renewed during the winter of 1939-40 for four Douglas 21-passenger airplanes, which supplemented The Great Silver Fleet during the peak season and were to be returned to United Air Lines during the latter part of April, 1940.

Pennsylvania-Central Airlines

Pennsylvania-Central Airlines in 1939 increased revenue passengers 43.07 per cent and revenue passenger miles 35.17 per cent. In January, 1940, traffic was up 83.47 per cent over January, 1939. A hostess school under the direction of Chief Air Hostess Adele Jenkins was conducted at Detroit in December. Fourteen air hostesses were employed. Commissaries and hostess material stockrooms were set up at Detroit and Washington.

Transcontinental and Western Air

The 1940 plans of Transcontinental and Western Air, Inc., called for an impressive program of expansion, including the acquisition of five four-motored Boeing Stratoliners and an increase in the line's average monthly flying miles from 1,000,000 to 1,500,000. The line planned on a 50 per cent increase in passengers. The TWA Boeings, largest planes ever used by any domestic air line, were built with pressurized cabins, were able to operate at high altitudes and made a substantial cut in transcontinental flying time. They had a cruising speed of 210 miles an hour and carried 33 passengers. The expansion program also called for the development of new air routes. TWA in 1939 increased passenger miles 36 per cent. In a single day's record traffic, 510,000 passenger miles were flown. TWA carried about 2,900,000 pounds of air mail in 1939.

United Air Lines

United Air Lines concluded its 13th year of scheduled transport operation in 1939 with a record of unusual progress in increases in



THE LOCKHEED FACTORY

Airview of the Lockheed Aircraft Corp. plant at Burbank, Calif.

air mail, express and passengers transported, in technical development and in expansion of facilities.

Following the successful demonstration flight of the first Douglas DC-4, United ordered 10 production models for service on its coast-to-coast route. Those transports, revised to reduce their weight to 50,000 pounds, were being constructed at the Douglas factory and were to go into service on United in 1941.

A number of important technical developments were made. A static suppressor was developed and installed on United's entire transport fleet. The reliability of radio navigation formerly was seriously impaired by occasional loss of reception for long periods because of precipitation static, caused by rain, snow, hail, ice crystals and dust clouds. Shielded loop antennas proved only partially effective. During a flight research program seeking a method of correcting this troublesome factor in aircraft radio, United engineers discovered that static interference did not result directly from electrically discharged particles striking the antenna structure and other components of the airplane, but rather from the uncontrolled discharge of accumulated static electricity from the surfaces of the airplane. That discovery resulted in the development of a unique system by which static electricity was discharged from the airplane in flight almost simultaneously with its accumulation on the airplane surfaces, but in such a manner as to render the discharge aperiodic with the important result that it no longer caused interference with radio communication.



TWIN TAIL VOUGHT-SIKORSKY AMPHIBION

An amphibion powered by two Pratt & Whitney Hornet engines.

CHAPTER VII

AIRPORTS AND AIRWAYS

Increase in Landing Places—Development of the Federal Airways System—Record Traffic at New York Municipal Airport—C.A.A. Report on Airport Development—A New Airport for the Nation's Capital—Improvements on the Airways—Extensions

ON January 1, 1940, there were 2,451 airports and other established landing places in the United States, an increase of 77 in 12 months. The air lines had 200 regular station stops. The Federal Airways System embraced a network of 25,500 miles of regularly operated aerial highways.

In the total of 2,451 landing places there were included 643 municipal and 456 commercial airports, 266 C.A.A. intermediate landing fields, 665 auxiliary fields, 21 Navy air stations, 59 Army fields, and 170 miscellaneous Government, State or private airports. Of the total 735 were fully or partially lighted for night operations. There also were 171 seaplane bases.

New York City's new municipal airport, La Guardia Field, in point of every detail except total acreage—Cleveland's airport covering more ground—was the nation's greatest flying center early in 1940. About 200 transports either were bringing in or taking out an aggregate of 2,000 passengers a day, at least half of them at night; and the traffic figures were mounting rapidly. All lines serving New York, including Pan American Airways, used the airport as a terminal. For that reason the following description is of interest.

When opened for operations the airport embraced 558 acres, mostly filled-in land on Flushing Bay. There were more than 9,000 concrete piles, 135 miles, under the buildings. There were 160 miles of duct lines, 200 miles of cable, 400 miles of wire, 25 miles of underground piping, 12,000 gallons capacity in the fire pumps, a half million gallons gasoline storage capacity; 90 acres—nearly four miles—

of runways and taxi strips, 53 acres of concrete aprons, enough electric power for 700 miles of street lighting, 467 trees planted in 375 acres of seeded area. That was the magnitude of the metropolitan airport.

A total of 23,000 WPA employees were at work on the airport just prior to completion. There are four great runways for land planes, with a surface of asphalt macadam to provide for the further settling of the man-made ground beneath them. The longest of these runways, running northwest and southeast is 6,000 feet long and 200 feet wide, a veritable pilot's dream for a landing surface. Running northeast and southwest is runway number two, 5,000 feet long and 200 feet wide.



OPENING NEW YORK'S AIRPORT

Thousands attended the dedication of the great metropolitan air terminal, La Guardia Field, in October, 1939.

In these two runways, one over a mile in length and the other just under a mile, are to be found two of the finest landing strips in the world. Supplementing them, and of equal value in the handling of arriving and departing aircraft, are runways numbers three and four. Number three runway is 4,500 feet in length and 150 feet wide, running east and west. Running north and south is number four, 3,532 feet in length and 150 feet wide.

The runways were designed in strict accordance with the "wind-rose" or diagram constructed from the meteorological records showing prevailing winds at the site, the longest runway being built in the line of direction of the most frequently prevailing winds, and so on down the line. Taxi runways, 100 feet wide, intersect the runways, connecting them with one another and with the apron 400 feet wide and 6,200 feet in length, which extends in an arc in front of the land-plane hangars and buildings.

This apron, of concrete construction, in front of the administration building provides ample space for the loading and unloading of 15 huge transport planes at the same time. The apron is illuminated by flood lights mounted on hangars, five on each hangar. When a plane has landed on a runway, the flood lights and runway contact



THE LUSCOMBE 8A

A light plane, with Continental or Lycoming engine, produced by the Luscombe Airplane Corporation, West Trenton, N. J.

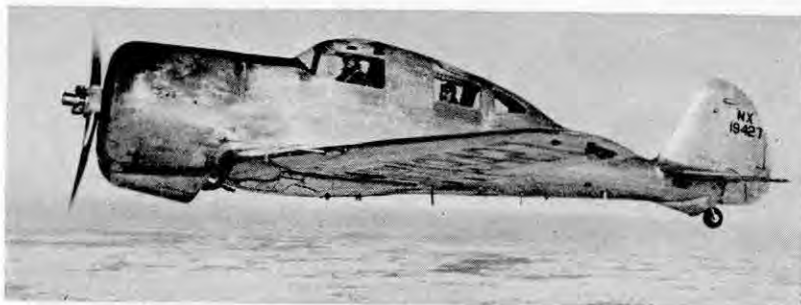
lights go out and the taxi lights go on, showing the pilot the best taxi lane to the apron.

The land plane administration building, the physical hub of the airport and an outstanding example of modern transportation architecture, is larger in size than many a union railroad terminal in American cities that rank among the first 10 in population. Three stories in height, surmounted by the most up-to-date and modern equipped control towers, for the policing of plane traffic in and out of the boundaries of the airport, the administration building, like all other buildings at the field, is constructed of soft buff-colored face brick, trimmed with black brick. The doors at both the ground level and main floor are of stainless steel. Above the marquee of stainless steel is a simple

facade with high wrought-iron framed windows in the center and high, narrow windows with stainless steel grilles at the side.

All hangars are designed to provide heating and electrical devices for the comfort of employees and speeding up maintenance of aircraft. The buildings, attached to the hangars, house offices, employees cafeteria, commissary department, pilot's training facilities, pilot's and stewardesses' lounges, shops, stock rooms, hospital and repair bases.

Occupying the extreme western portion of the airport is the marine terminal. The marine terminal building, harmonizing with the administration building in materials and design, is a two story, circular structure, approached by a landscaped driveway. It houses the transoceanic air line ticket and administrative offices, immigration inspector's counters and quarters, detention room and quarters for the U. S. Public Health Service, and a separate weather bureau. To the south and



THE CURTISS-WRIGHT 23

A basic combat type with seven machine guns, powered by a Wright Cyclone engine.

west of the marine terminal building is a marine terminal hangar, a five-sided building so large that two regulation-sized football fields could be laid out on its floor and games played on both fields at the same time. The roof of the building is supported by an unusual system of trusses radiating from a single pillar in the center of one side of the structure. Under this system, the entire interior of the hangar is free from any obstruction, thus greatly facilitating handling.

Giant flying boats arriving or departing land or take-off on Long Island Sound. The Sound is reached by the planes through a taxi-strip of water extending from the marine terminal harbor, and the unloading ramp is directly in front of the marine terminal building.

Facilities are also included in this marine base for hauling big flying boats from the water, on miniature railroad flat cars and wheeling them into the hangar, on tracks, for repairs or maintenance. The

master plan of the airport provides space for a second marine hangar, of the same size and design as the first, at the western edge of the field.

To the pilot of an incoming plane at night, the airport appears dark, the edge of the field and the runway he is directed to use outlined by lights, with powerful flood lights separating from the ends of that one runway. Buildings are marked out by red lights. The runways are bordered by contact lights, spaced 200 feet apart. The ends of the four runways are marked by green range lights; and at the end of each runway there are two narrow-beam flood lights, each of seven and a half million candlepower. The field is outlined by approxi-



THE WACO N

This three-wheel ship for private owners is powered by a Jacobs 285 or 330 h.p. engine.

mately 85 boundary lights, spaced 250 feet apart. Thousands of other lights—boundary lights, taxi-strip lights, flood lights, etc.—are installed about the field.

Following are abstracts from the 1939 report of the Civil Aeronautics Authority relative to airports:

"Section 302 (c) of the Civil Aeronautics Act required that: 'The Authority shall, through the Administrator, make a field survey of the existing system of airports and shall present to the Congress not later than February 1, 1939, definite recommendations (1) as to whether the Federal Government should participate in the construction, improvement, development, operation, or maintenance of a

national system of airports, and (2) if Federal participation is recommended, the extent to which, and the manner in which, the Federal Government shall so participate.'

"In accordance with this mandate of the Act the Administrator, immediately upon entering office, organized a special staff, formulated a survey program and inaugurated studies which were pressed with the utmost diligence. On February 1, 1939, the Authority, as a result, was able to submit a preliminary report to Congress and to follow this on March 23, 1939, with a completed study. This final report, covering some 130 pages, presented the Authority's findings and recommendations as of the date of its submittal.

"At the time the Authority made its national airport survey the



N. A. ATTACK DIVE BOMBER

Developed by North American Aviation it is a two-place machine powered by a Wright Cyclone engine.

Federal Government was expending large sums for relief purposes and had for several years devoted a sizeable portion of these funds to airport construction and improvement. With the relief problem still acute and the apparent certainty that Congress would for some time continue to provide appropriations for relief, the Authority thought it would be wise to allocate a definite sum of relief funds for airport construction and it specifically recommended an allocation of \$100,000,000 of the 1940 relief appropriations for airports. In addition, it recommended that a supplemental appropriation of \$25,000,000 be appropriated for the nonlabor costs of airport projects which could not be provided for from relief funds because of limitations specified in the Relief Appropriations Acts. It was the Authority's recom-

mendation that this sum of \$125,000,000 be expended to improve existing airports now on the Federal Airways System to a point where they would be fully adequate for the increasing needs of air transportation and the national defense. The Authority indicated that upon completion of this task future long-term programs intended eventually to furnish the country with a system of airports completely adequate for all practical national needs might then be adopted.

"On September 27, 1938, about a month after the Civil Aeronautics Authority assumed office, the President approved a project calling for the construction of a 750-acre air terminal at Washington, D. C.

"An Airport Committee was formed representing the Authority, the Air Safety Board, and the Administrator, and applications were prepared and submitted to the Works Progress Administration and the Public Works Administration, with the result that allocations to the amount of nearly \$10,000,000 were made available by these agen-



AT MEMPHIS AIRPORT

Headquarters of Chicago & Southern Air Lines, and a stop on the American and Eastern Systems.

cies to carry out the project at the selected site at Gravelly Point, three and a half miles from downtown Washington on the west side of the Potomac River.

"The Washington National Airport when completed will have a landing area of some 565 acres, crisscrossed with paved runways amply adequate for the take-off and landing of the largest airplanes in prospect for many years to come. One of its main features will be a north and south runway of no less than 6,500 feet in length, with approaches, especially from the south, completely unobstructed. When equipped with radio landing aids such a runway holds an eventual promise of permitting day and night all-weather operations into this terminal with the utmost safety.

"Plans for the airport's buildings call for six large hangars and

a model passenger terminal, complete with waiting rooms, restaurants, post office, administration offices, and traffic-control tower. An outstanding feature of this building and of the lay-out of the adjacent territory to the westward of it will be unparalleled facilities to provide sightseeing visitors with a full view of activities on the airport without interference with its working functions."

The Civil Aeronautics Authority made the Administrator, Clinton M. Hester, supervisor of safety regulations and enforcement, combining those duties with responsibility for developing the Federal Airways System. Under Mr. Hester, the divisions of the old Bureau of Air Commerce, formerly charged with such duties, were reorganized and strengthened to enable them to handle the increased tasks imposed by the growth of the industry. This organization was able

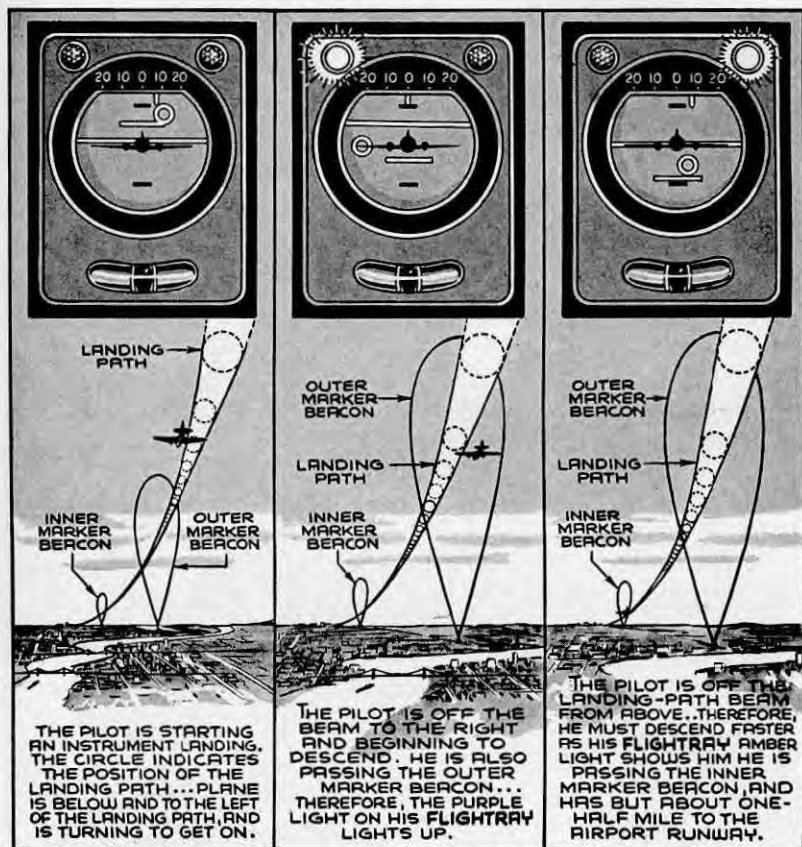


THE CAPITAL'S NEW AIRPORT

Model of the Government's civil air terminal for Washington, D. C.

during the year, thanks to appropriations of about \$15,000,000 made available since 1937, to extend the Federal Airways System to 25,500 miles. Its 333 radio beam and communication stations were modernized and provided with reliable automatic stand-by generators. Besides the new stations built, all principal stations were converted to the simultaneous voice and range type, and equipped with ultra high frequency cone of silence markers. A 100 ultra high frequency fan markers were either in operation or being installed for traffic control and hazard marking. Teletype circuits for traffic control and weather reporting were increased by 12,000 miles and by 80 new teletype stations. By increasing the number of airway traffic control centers to 12, about 45 per cent of the airways mileage was brought under the

dispatching system to handle 375,000 airplane movements a year, an increase of 28 per cent. While this program represented an addition of about 1,500 miles to the airways system, and included the improvement and relocation of emergency landing fields to conform to straight-



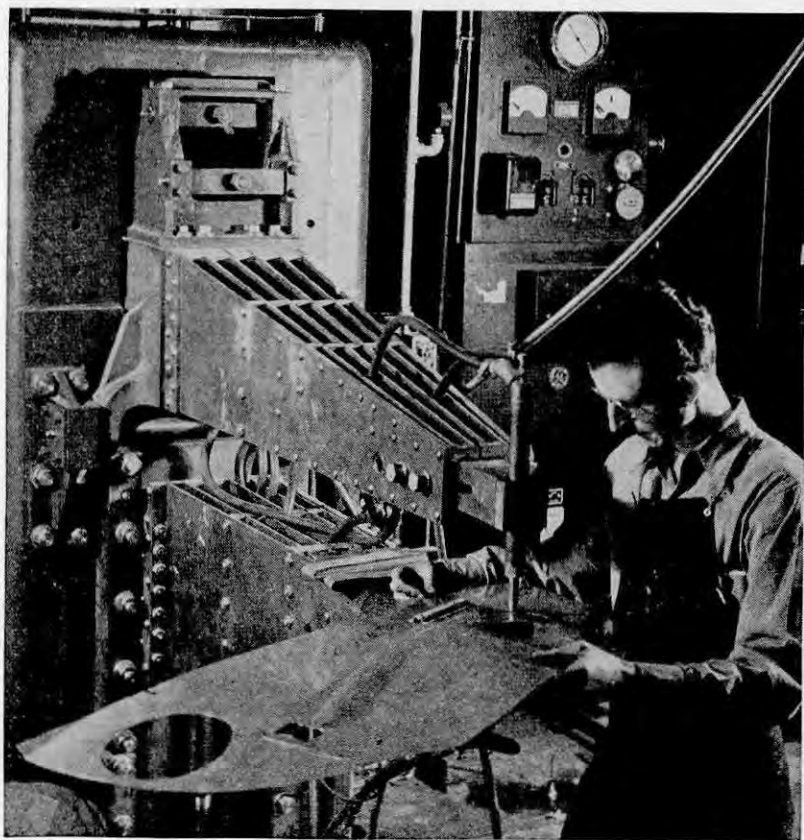
THE SPERRY FLIGHTRAY

Three stages of an instrument approach for landing, using the indications combined on the face of the Flightray.

ened courses, the second program for improvement and addition of another 5,000 miles of fully marked, lighted and radio-equipped airways was well under way.

In the domestic field 10 blind landing sets were ordered built for service testing on 10 active airports following the approval of the

C.A.A. system, developed at Indianapolis, by a committee of the National Academy of Sciences to which the matter was referred by President Roosevelt. An ultra-high frequency airway was also under construction between New York and Chicago for service testing in comparison with the normal frequency radio aids on that busy air route.



ONE OF THE WELDING MACHINES IN THE LOCKHEED PLANT
Spot welding leaves a smooth surface finish.

CHAPTER VIII

PRIVATE FLYING

Private Flying Becomes More Popular—Increase in Light Planes—
Improvements in Private Owner Machines—Alfred B. Bennett's
Record for Commercial Sales—Insurance Rates Reduced—
Annual Soaring Contest—Intercollegiate Flying.

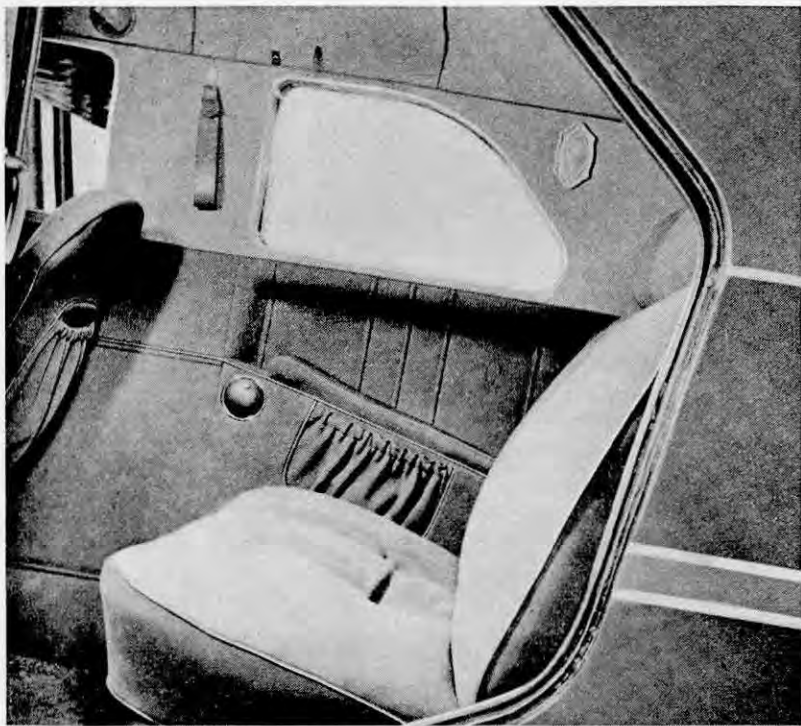
MORE popular attention was devoted to private flying in 1939 and early in 1940 than ever before in the history of American aviation. Licensed pilots increased by 8,281 in 1939, making a total of 31,264 at the beginning of 1940. There were about 50 different licensed models—and 20 others in an experimental stage—for the customers to choose from in buying a plane made in the United States for private flying operations.

Both the so-called "lightplane" and planes for the private owner in the higher weight categories, accommodating three to 12 persons enjoyed favor with the public. The Civil Aeronautics Authority made public some illuminating figures on the growth in student training and in private flying, as reflected by plane manufacture. As against 1,363 "Class 1" airplanes weighing not more than 1,300 pounds manufactured in 1938, there were 3,042 in 1939. A total of 348 single-engine planes in the 1,300-4,000-pound weight category were made in 1938 and 513 in 1939. Similar increases occurred almost uniformly in the heavier planes powered by more than one engine. The greatest gains in 1939 production were shown in the category comprised of small land planes. In all private-owner planes models were further streamlined and better outfitted as to interior decorations. Upholstery became as much of a selling point for potential women buyers as climbing ability or landing speed.

Of the total of 31,264 licensed pilots on January 1, 1940, 43 per cent were termed private pilots and 26.7 per cent solo pilots. At the same time the total number of certificated aircraft numbered 13,772. For purposes of comparison, on January 1, 1939, licensed pilots

numbered 26,144 and airplanes 12,210. Chairman Hinckley of the C.A.A. took cognizance of the relatively small number of privately-owned aircraft in an address early in the year when he said an effort was being made to determine why a rapid and unaccountable turnover was occurring in aircraft ownership. One press association discovered during the year that women aviators, as old as 61 and as young as 16, were nearly twice as numerous in the United States as they were 30 months previously. The number of women holding licenses increased from 712 to 902 in 1939.

California held its comfortable lead with 5,193 licensed pilots, including those with air line, commercial, limited commercial, private and solo ratings. In token of the importance of non-scheduled flying in California, all but 162 of that number were out of the air line pilot category. New York State was second with 2,636 licensed pilots, Pennsylvania third with 1,882, and Illinois fourth with 1,817. Cali-



WACO INTERIOR

Rear seat detail of the Model E.

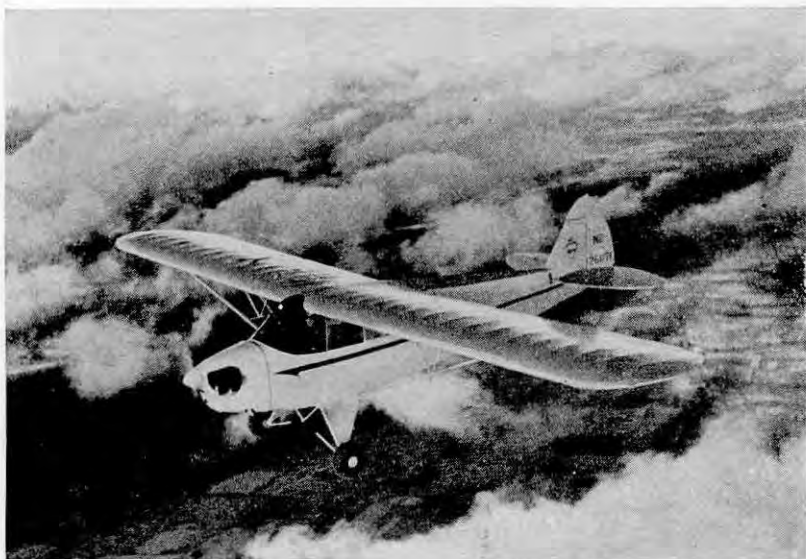


THE CONSOLIDATED 28

The "Guba," used by the Richard Archbold expedition to Netherlands New Guinea, which in returning to the United States completed a flight around the world. It was powered by two Pratt & Whitney Twin Wasp engines.

California also led with the greatest number of certificated aircraft, 1,281. New York was second with 991, Pennsylvania third with 888, and Minnesota, nosing out Illinois by one airplane, fourth with 775.

Private airplane merchandising, a field barely touched since the "boom" days following the Lindbergh flight to Paris, received new attention. Distributors increased. Typical of the men developing fresh sales appeal for the general public was Alfred B. Bennett of Hightstown, N. J., who studied the problem of airplane sales as a part of his college course. Distributor over a wide area in New Jersey, Pennsylvania and New York for one make of light plane, in 1939 he was credited with selling more commercial planes than any other individual in the world. Explaining private plane sales, Mr. Bennett reported: "The problem must be solved either from the standpoint of more private airplanes to create the demand for more



THE PIPER CUB CRUISER

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



HE SOLD 100 CUBS IN 1939

Alfred B. Bennett, of Hightstown, N. J., delivering title papers to the 100th Cub plane that he sold in 1939. The customer is Dr. J. Meredith Smith, of Hackettstown, N. J.



THE STINSON 105

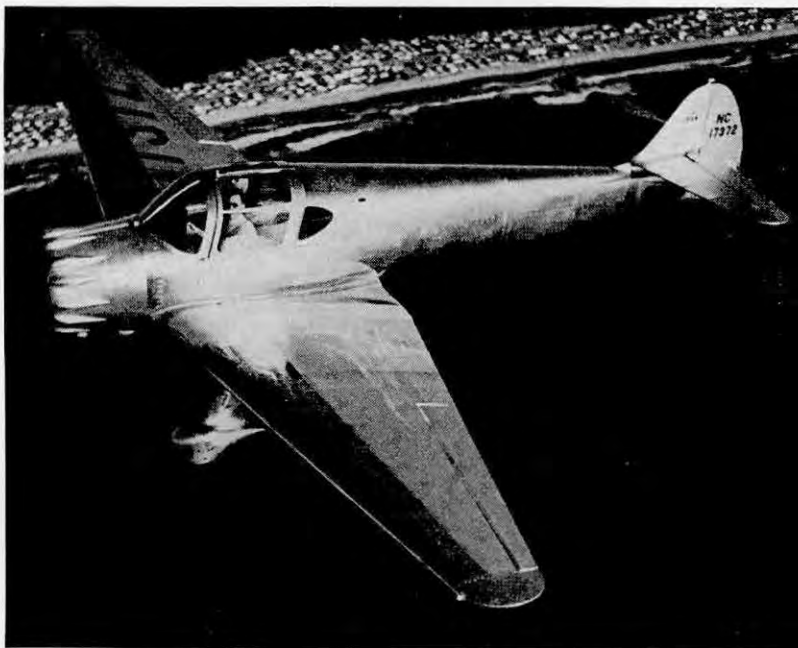
Hunters taking home their deer after an outing in Michigan.

airports, or from the standpoint of more airports to provide the merchandiser with a selling point. An airplane for the private owner is only as useful as the number of airports at his disposal. The demand for highways was created by an increasing number of automobiles. It is logical to assume that the demand for more airports will be created by mass ownership of planes. Private flying, as such, needs no subsidy from anybody. It is in the midst of its own boom. But private flying, in terms of maximum utility, must find an earlier avenue of expansion than would be provided by the normal course of events as typified by the slow, gradual growth of motoring."



THE BARKLEY-GROW "EXPLORER"

A Wasp Junior-powered transport with the Byrd Antarctic Expedition.



RYAN S-C CABIN PLANE

A metal plane with 145 h.p. Warner engine.



THE LUSCOMBE 8A ON SKIIS

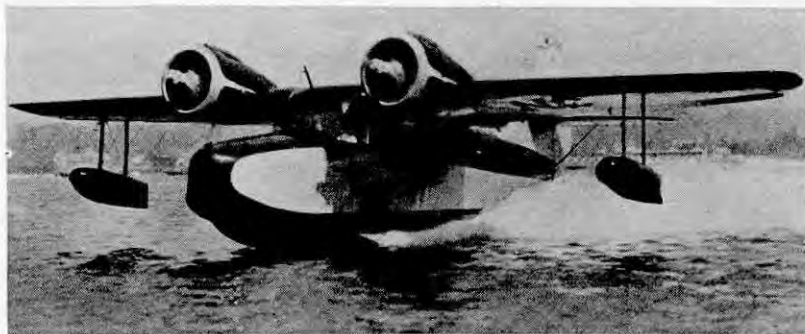
It was powered by a Continental engine.



WARNER-POWERED FAIRCHILD 24

In pursuit of a definite sales plan, Mr. Bennett, with 10 years experience as an airplane distributor, progressively sold whole communities on flying by demonstrating the ease of airplane operation. With the help of civic bodies he offered rides to entire populations of small communities on weekends, using ordinary hay fields at the town limits as improvised airports.

On the subject of safety Jerome Lederer, of Aero Insurance Underwriters, New York, prepared the following for this edition of the Aircraft Year Book: "During 1939 Aero Insurance Underwriters participated in the Civil Aeronautics Authority's civilian pilot training program by writing the insurance on over 5,000 students. Because of the systemized and controlled instruction required by the C.A.A., the rates for Student Personal Accident Insurance were reduced from \$20 to \$14 and the \$14 policy gave a broader coverage than the



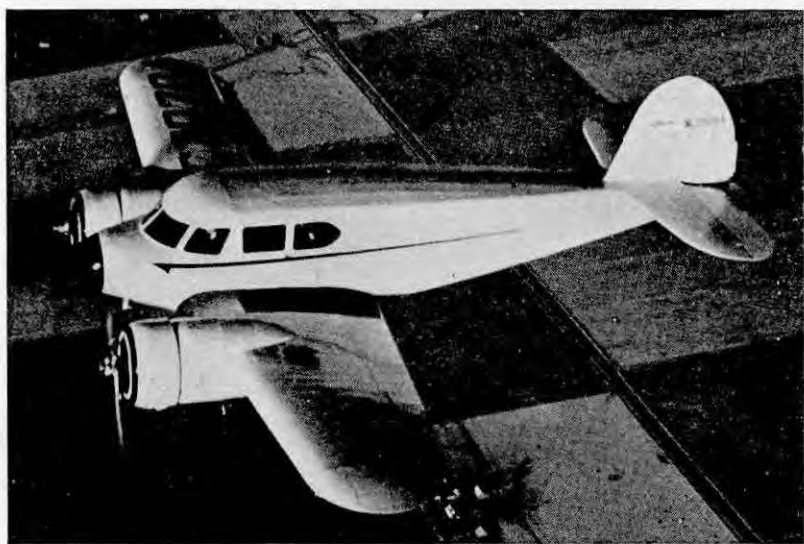
GRUMMAN COMMERCIAL AMPHIBION

The G-21A, eight-place commercial amphibion powered by Pratt & Whitney Wasp Junior engines.



FLEETWINGS SEABIRD IN FLIGHT

The Jacobs-powered stainless steel amphibion is designed for private owners.



THE CESSNA T-50

A twin-engine personal transport with Jacobs engines. It is manufactured by the Cessna Aircraft Company, Wichita, Kans.

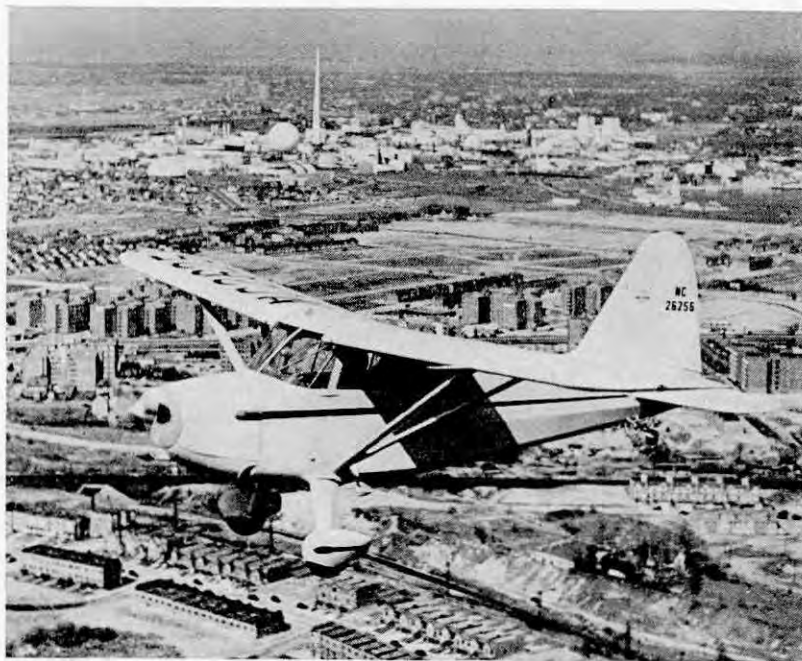
**NEW BEECHCRAFT F17D**

It is powered by a 330 h.p. Jacobs engine.

previous \$20 policy. During 1939 the accumulative loss ratio in certain lines of insurance was favorable enough to justify, in 1940, broader coverage with lower rates for liability insurance and all ground risks. Experience during the year also indicated that crash insurance rates should be reduced for certain categories of airplanes. Those reductions will go into effect in 1940. To help its insured owners fly more safely, the Engineering Department made over 3,000 inspections on aircraft. Sixteen per cent of the inspections showed hazardous conditions of which six per cent were dangerous."

**THE TAYLORCRAFT DE LUXE**

It was powered by either a 65 h.p. Continental or Lycoming engine.



NEW YORK WORLD'S FAIR 1940

A Stinson 105 affords this view of the gigantic exposition.



THE CULVER L-CA

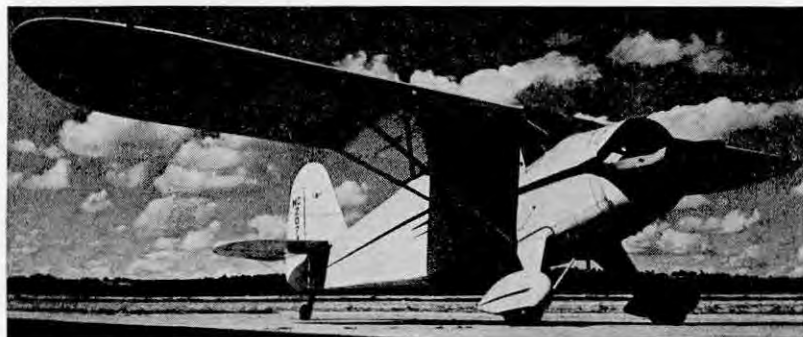
A light plane powered by a 75 h.p. Continental engine.



THE AERONCA CHIEF

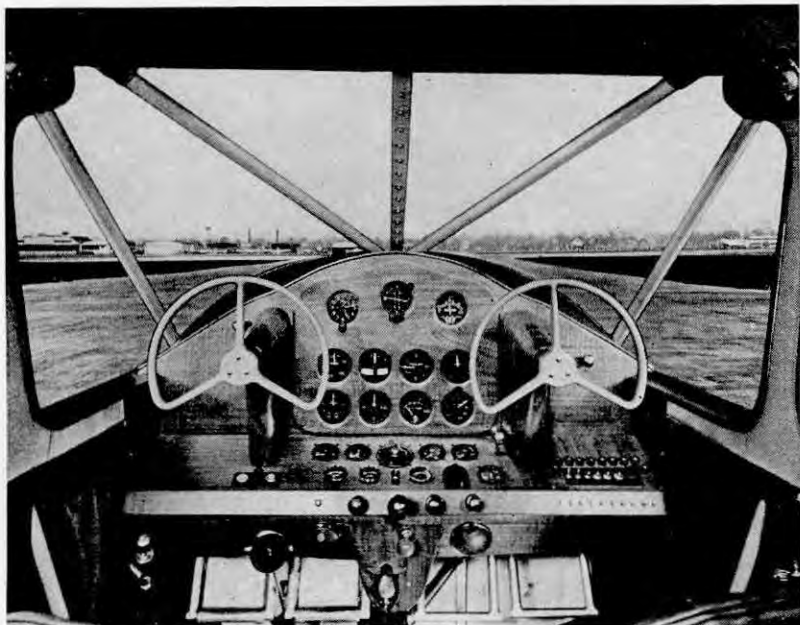
It is Model 50-F powered by a 50 h.p. Franklin engine.

The 10th Annual National Soaring Contest at Elmira, N. Y., June 24 to July 9, 1939, conducted by the Soaring Society of America, drew an attendance of 88 pilots and 36 gliders. Take-offs during the meet numbered 687, and the total mileage was 6,808. The Edward S. Evans National Soaring Championship Trophy went to Chester J. Decker, veteran soaring pilot. The A. Felix DuPont altitude awards went to Robert M. Stanley, John Robinson and Mr. Decker. Four new American records were established: 17,264 feet of altitude above point of release, by Mr. Stanley; 6,560 feet above point of release in a two-seater, by Lewin B. Barringer; 40-mile round trip, for distance and return, by Mr. Decker, and 233-mile distance flight, also won by Mr. Decker.



THE REARWIN CLOUDSTER

A two-place plane with 90 h.p. Ken-Royce engine.



THE HOWARD AIRPLANE

Instrument panel on the 1940 model private-owner plane produced by the Howard Aircraft Corporation, Chicago, Ill.



THE SPARTAN EXECUTIVE 7W

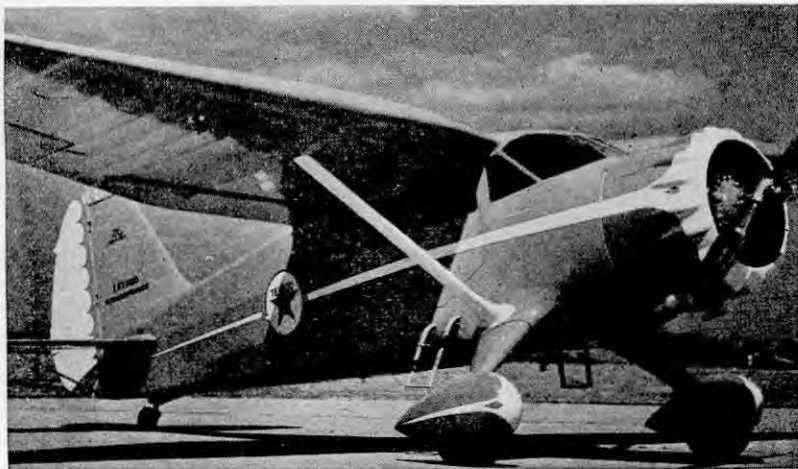
A five-place all-metal private owner plane with a 450 h.p. Pratt & Whitney Wasp Junior engine.



PORTERFIELD 35-W

A two-place cabin plane with a 90 h.p. Warner engine.

The National Intercollegiate Flying Club was organized under the sponsorship of the National Aeronautic Association in the fall of 1934 to promote college flying. Each spring it has held an annual Intercollegiate Flying Conference in Washington and later in the year a National Intercollegiate Air Meet in some location decided by the delegates to the Annual Conference. Regional Air Meets are also sponsored by the N.I.F.C. By such intercollegiate conferences and



TEXACO'S STINSON

The Wasp-powered private-owner Stinson operated by the Texas Oil Company.

contests, by the exchange of Club ideas and news through the medium of a monthly news bulletin, and by other group activities, the N.I.F.C. acts to publicize and promote college flying. At present, there are 39 College Flying Clubs affiliated with the N.I.F.C., totaling more than 750 individuals. The Loening Intercollegiate Trophy was presented during the 1939 Conference to the Stanford University Flying Club for the second consecutive year. Award of the Trophy was based in part on general activity of individual clubs during the curricular year and in part on points won during the annual intercollegiate meet. The Fifth Annual Air Meet of the National Intercollegiate Flying Club was held at Gambier, O., site of Kenyon College, June 27-28, 1939. First place was won by the Kenyon College Flying Club with a total of 24 points; second went to the University of Minnesota Flying Club which totaled 9 points and the University of Akron Flying Club which accumulated 8 points.



BELL AIRACOBRA IN FLIGHT

An Allison-powered pursuit plane developed for the U. S. Army Air Corps.

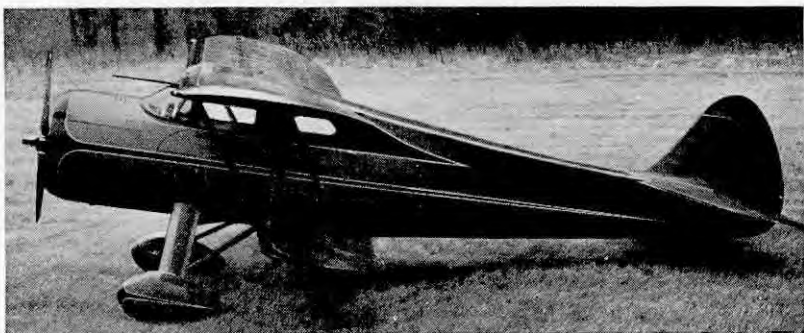
CHAPTER IX

MISCELLANEOUS ACTIVITIES

Aerial Service Operations—Work of the Aeronautical Chamber of Commerce of America—Aircraft Owners and Pilots Association—Institute of the Aeronautical Sciences—Manufacturers Aircraft Association—The National Aeronautic Association.

THE majority of civilian-owned airplanes in the United States during 1940 were operated in miscellaneous flying activities, in some form of aerial service for hire. In the aerial service field there were thousands of planes used for countless purposes. They made emergency trips of every description, carrying food, clothing, medicines and other supplies to places isolated by storm, flood or fire. Sick and wounded were brought into larger centers from outlying districts lacking hospital facilities. Game was counted from the air in recurrent surveys of the wild life in different sections; and in winter, when snow or ice made feeding impossible, animals and birds were fed with food dropped from low-flying planes. Machinery and other articles were transported by the aerial service operators—anywhere that it was needed in a hurry. Speed, the superlative speed of the flying machine, was the commodity that these operators had to sell, when and where it was needed most urgently—invariably in some dire emergency that would have meant the loss of life or property had there been no “aerial taxi” for immediate hire. Nearly all the larger aerial service operators were distributors and sales agents for the manufacturers of aeronautical equipment.

In many cases, however, there were separate aerial service organizations, such as the Fairchild Aerial Surveys. During 1939 that group of operators mapped about 55,000 square miles from the air, in flying activities spread over three continents. All phases of aerial photography were involved in 1,500 individual contracts and transactions. From the files of 70,000 airviews covering nearly every cor-



THE WACO MODEL E

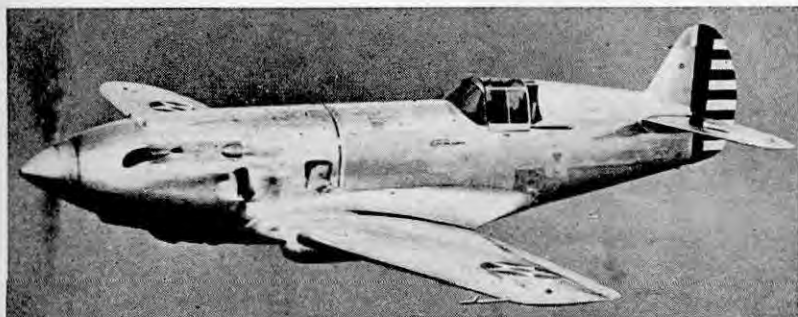
A private owner plane available with five different engines. The Waco is manufactured by Waco Aircraft Company, Troy, O.

ner of the earth, pictures were supplied for advertising, illustrative publicity, engineering progress, murals, et cetera. Precise planimetric and contour maps were produced for both private and Government clients. Mosaic maps for oil companies pushed back the fringes of civilization to bring to light many heretofore dark corners of the earth. The company now has available three completely equipped mobile expeditionary units scattered around the world and available for work in any quarter.



BELLANCA SENIOR SKYROCKET

It is used as an aerial photographic plane, and is powered by a Pratt & Whitney Wasp engine.



THE CURTISS YP-37

One of the new pursuit planes of the U. S. Army Air Corps. It is powered by an Allison engine with Curtiss electric full-feathering propeller and General Electric supercharger.

Work of the Aeronautical Chamber

Of utmost value to the operators of aircraft in every field of aeronautical activity is the work of the Aeronautical Chamber of Commerce of America, the trade association of the aircraft manufacturing industry in the United States. The Chamber maintains headquarters in Washington, D. C., and a branch office and information library in New York.

With its background of more than 20 years of service, the Aeronautical Chamber is the recognized spokesman for the aircraft manufacturing industry in all matters of an institutional character that are of public interest, or which come before Federal and State official bodies or other industrial and business groups. It represents the industry before Congressional committees and Government bureaus. It is a clearing house of information on all legislation, proposed or passed, affecting the industry. It is the statistical agency for the industry and its allied interests.

The Chamber cooperated with the Treasury and War Departments in setting up methods of accounting in connection with Government contracts; and it also cooperated with Government agencies in surveying the productive facilities of the industry.

With this edition of *The Aircraft Year Book*, the Aeronautical Chamber publishes for the 22nd consecutive year this officially recognized standard work on all branches of American aviation.

Early in 1940, it published a loose-leaf *Aeronautical Export Directory*—with descriptive data, illustrations, drawings and specifications of our aeronautical products—which was distributed to all foreign markets.



THE CURTISS HAWK 75

One of the Air Corps P-36 type pursuit planes which the Curtiss Aeroplane Division of Curtiss-Wright Corporation built for the French air forces at its plant at Buffalo, N. Y. The French Curtiss Hawks were powered by Pratt & Whitney Twin Wasp engines.

The Chamber also publishes complete lists, with periodic supplements, of planes and owners, pilots and student pilots—and those lists are available to all for small fees.

During 1939, the Aeronautical Chamber distributed 199 bulletins providing essential data and analysis on matters of importance to the various branches of aviation. It added to the facilities of its information library in New York, and the services which it was able to render increased 25 per cent.

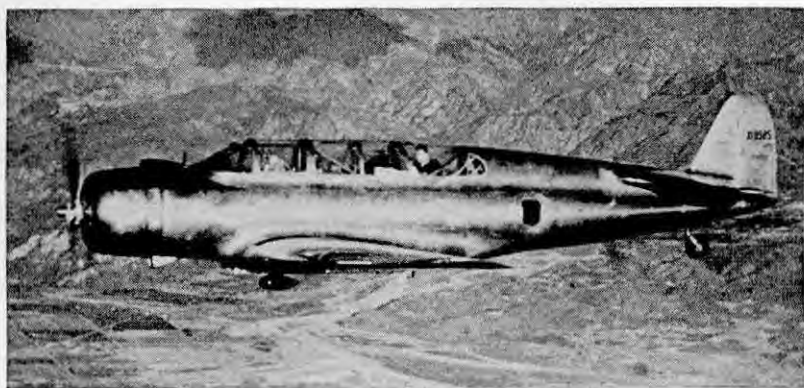
Early in 1940, the Chamber set up a private flying department to work with a committee from that branch of the manufacturing in-



U. S. Army photo

THE REPUBLIC XP-41

A military single place pursuit ship produced by Republic Aviation Corporation at Farmingdale, N. Y. It is powered by a Twin Wasp engine.



VULTEE V-12 ATTACK BOMBER

It was powered by a Wright Cyclone engine.

dustry in promoting the use of planes by private owners. This augments the services which have been rendered to the private flying branches by the technical, statistical, public relations and export departments of the Chamber. Much of the work has been directed to popularizing civilian flying, developing safety and performance characteristics and reducing costs of manufacture, to the ultimate benefit of the purchaser.

Efforts of the Aeronautical Chamber in recent months have brought about changes in Government requirements for analyses and checking analyses on light planes, thereby reducing maintenance expense on the manufacturer's stress equipment. The Chamber also inspired revision of Federal regulations, which cut the cost of meeting flight requirements and increased payload and performance. It secured a change in light engine test requirements, thereby reducing costs to both manufacturer and purchaser. It secured nine definite changes in engine installation requirements, which also eliminated as many items of maintenance cost. Numerous other changes in Federal regulations were brought about through the Chamber on the principle that the privately-owned plane should be put, as far as possible, under as few restrictions as the motor car, letting competition bring about the major advances.

Standardization of parts and accessories for the private owner is a major activity of the chamber in cooperation with the Society of Automotive Engineers. It also has worked with the Government in eliminating a plan to combine the X and R licenses. It also brought about a decision to permit extrapolation of engine test data. It accom-



THE STEARMAN ATTACK BOMBER

Excellent visibility and high speed feature this twin-engine military plane produced by the Stearman Aircraft Division of the Boeing Airplane Company at Wichita, Kans. It is equipped with two Pratt & Whitney Twin Wasp engines.

plished a great deal for private flying by combating propaganda seeking to bar civilian operators from the Federal Airways System and controlled airports. That was done in cooperation with the Aircraft Owners and Pilots Association and the Private Fliers Association. With those organizations, it also brought to the attention of the U. S. Weather Bureau the needs of the private owner for adequate meteorological information.

As originally drafted the 1940 Congressional measure providing additional funds for the U. S. Export-Import Bank would have prevented the use of the Bank's capital for financing commercial aircraft sales abroad. As a result of the Chamber's presentation be-



U. S. Army photo

NORTH AMERICAN BASIC COMBAT

The Air Corps BC-2, with Pratt & Whitney Wasp engine.



VULTEE VANGUARD 48

An interceptor pursuit with Pratt & Whitney Twin Wasp engine.

fore the House Committee on Banking and Currency, the bill was revised, and authority granted for loans on foreign sales of non-military aircraft equipment. See Appendix.

Through the efforts of the Chamber, Federal procedure was revised to expedite permits for foreign pilots to fly in the United States; and also the regulations were changed to permit foreign students to take flight training here without being required to read, write and speak the English language—a move which eventually should broaden the market for American planes.

Through the coordinating efforts of the Chamber, the aircraft industry vigorously voiced its opposition to changes in freight classification and increases in rates proposed by the American railroads, to apply on shipments of airplanes, engines and parts, and its work resulted in withdrawal by the carriers of all the changes set forth in a special docket, dated March 2, 1940. It saved the manufacturers and purchasers as much as 25 per cent on freight charges for planes and up to 300 per cent on freight charges for engines.

The Chamber has taken steps to bring about the reduction of tariffs on American planes in those countries where the United States has no trade agreements.

The Chamber continuously receives messages from abroad from foreign sales prospects, and the leads are passed on to members. It receives and supplies credit ratings, sales and financial information on foreign distributors and dealers, so that American manufacturers may have contact with reputable representatives abroad. It assists in securing information from Government bureaus, obtains export licenses, advises on rulings and regulations regarding exports to belligerents and neutrals, and interprets Departmental rulings on



CURTISS-WRIGHT FALCON

Model 22 advanced combat trainer with a Wright Whirlwind engine.

all legislation both in general and specific cases. Information on owners and types of civil aircraft in foreign countries is made available to American manufacturers to use as possible sales leads and general market prospects.

Aircraft Owners and Pilots Association

In the interest of civilian flying and the non-scheduled flier, a national association was formed early in 1939 and incorporated on May 15, 1939, under the laws of New Jersey, as the Aircraft Owners



VULTEE VANGUARD 61

A pursuit plane powered by a Pratt & Whitney Twin Wasp engine. Vultee planes are manufactured at the company's plant in Downey, Calif.



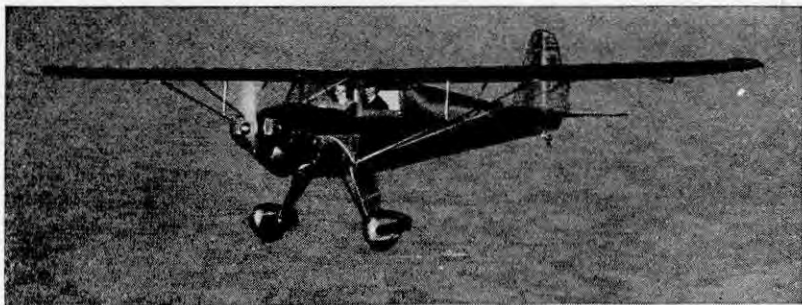
NORTH AMERICAN FIGHTER

The NA-50, a single seat fighter, powered by a Wright Cyclone engine.

and Pilots Association. Membership was restricted to present and former owners and pilots of non-air line, non-military aircraft.

The group was organized to include the so-called miscellaneous operators and fixed base operators, private pilots and commercial pilots other than those operating on the scheduled air lines. Also included are those pilots with military affiliations other than pilots flying in the regular or active air forces. That category of aviation personnel had never previously been served as a unit continuously and by a professional staff paid to do the work.

It was felt desirable to treat this association as a non-profit but self-supporting business project, and with sufficient income to employ a full time staff to service the needs of members. Charter membership, at the rate of three dollars a year for the first two years, was provided, and in less than 10 months more than 5,000 qualified persons had become members, thereby giving reasonable assurances of future success. To date the activities of the organization have been two-fold, on the one hand enrolling members, and on the other, providing service. In that direction the Aircraft Owners and Pilots Association has already contributed important work. Among the projects in which it has participated are the following; prevented a mid-western city from instituting a system of discriminatory taxes against non-scheduled fliers; explained to A.O.P.A. members the proper method of eliminating gas tax refund red tape; aided in reducing amount of medical fees charged to pilots; helped secure return to geographical sequence in weather teletype reporting, for the

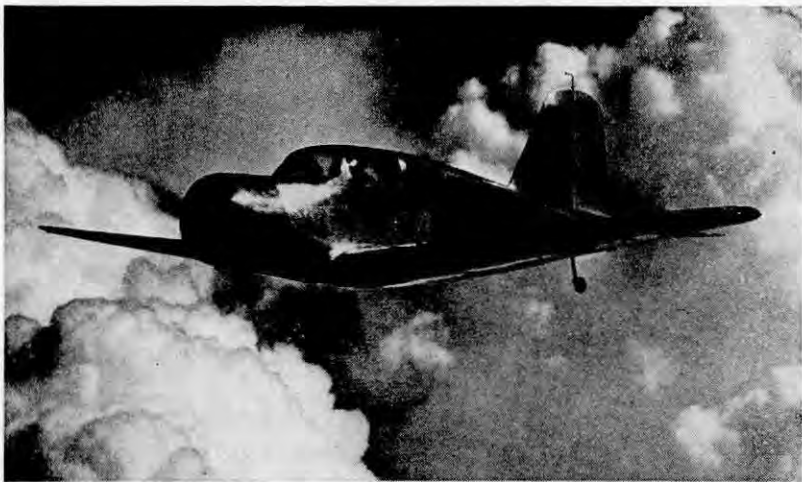


LUSCOMBE 1940 METAL PLANE

A 2-place plane powered by a 75 h.p. engine.

benefit of non-scheduled fliers; eliminated high tension wire hazards around certain airports; worked on program for landing strips along highways; established the A.O.P.A.-N.A.C.A. committee for research on Class 1, 2, and 3 private aircraft; conducted the largest breakfast flight activities in history—71,000 miles flown, 1,408 persons; influenced design of two different types of aviation radios at reduced cost; organized 114 A.O.P.A. city units by April 1, 1940.

Popularization of flight activities among private fliers, with the intention of benefiting not only those of its members who are private



THE HARLOW PJC-1

It is powered by a Warner Super Scarab engine.



THE WACO S

A five-place private owner plane with Continental or Jacobs engine.

fliers, but also fixed base operators and the industry, is part of the 1940 program.

The staff sat in with the Aeronautical Chamber of Commerce of America, the Air Transport Association, and other bodies when necessary for the interests of its members, as part of its program in achieving greater safety, increased landing facilities, lower insurance costs, additional research in connection with private aircraft and elimination of unnecessary regulations.

Institute of the Aeronautical Sciences

At the beginning of its eighth year, the Institute of the Aeronautical Sciences had a membership of 3,000, including student branches in 27 colleges and regional branches in Dayton, Philadelphia, Los Angeles, San Francisco and Seattle. Two hundred meetings, both local and national, were held in 1939. Many of the technical papers presented at these meetings are published in the Institute's monthly Journal of the Aeronautical Sciences. At the local meetings, the monthly illustrated branch lectures are read, augmented frequently by motion pictures and lectures by local speakers. At the Pacific Coast Annual Meeting in Pasadena, June 15-17, 1939, technical papers were presented on aerodynamics, structures, meteorology, and power plants. A joint meeting with the Soaring Society of America was held in Elmira, N. Y., June 30-July 2, 1939, at the conclusion of the 10th Annual National Soaring Contest. Papers and discussions on meteorology and sailplane design and operation were presented. The second Annual Rotating-Wing Aircraft Meeting, at which 14 papers were given on this subject, was held by the Phila-



TAYLORCRAFT TRAINER

It was powered by a 50 h.p. Lycoming engine.

delphia branch of the Institute, November 30-December 1, 1939. The third Wright Brothers Lecture was delivered in New York, December 16, 1939, by Dr. Clark B. Millikan of California Institute of Technology, on "The Influence of Running Propellers on Airplane Characteristics." The Eighth Annual Meeting and the Honors Night and Annual Dinner in New York, January 24-26, 1940, occasioned a larger attendance than that at any previous Institute meeting. Over 40 papers and discussions were presented at the technical sessions on aerodynamics, airplane design, air transport, aviation medicine, meteorology, power plants, radio and instruments.

The Institute presented honors and awards as follows: The Daniel Guggenheim Medal to Donald W. Douglas, president of the Douglas Aircraft Co., "for outstanding contributions to the design and con-



THE AERONCA TANDEM TRAINER

Powered by a Continental, Franklin or Lycoming engine.



FAIRCHILD 24 R-40

It is powered by a Ranger engine.

struction of transport airplanes;" the Sylvanus Albert Reed Award to George J. Mead, vice chairman of the National Advisory Committee for Aeronautics, "for the design and development of high output aircraft engines for military and commercial services;" the Lawrence Sperry Award to Charles M. Kearns, Jr., Project Engineer, Hamilton Standard Propellers Division, United Aircraft Corporation, "for the successful application of methods of measuring propeller vibration stresses in flight;" the Octave Chanute Award to Edmund T. Allen, Director of Flight and Research, Boeing Aircraft Company, "for his outstanding contributions to methods and procedure in flight research in connection with airplane design and operation."

The Aeronautical Archives, founded by the Institute, was made possible by the loan of W. A. M. Burden of his collection of aeronautical books, magazines, photographs, reports and clippings. To that was added the Aeronautical Index which the Institute has had in process for four years with personnel paid by the W.P.A.

Manufacturers Aircraft Association

The primary function of the Manufacturers Aircraft Association since organizing in July, 1917, has been to administer cross-license agreements and license contracts under which the aircraft manufacturing industry has operated since that date. The Association has received the reports of the patents and granted all the patent licenses, including licenses to the United States Government, provided for by the terms of such agreements. It has served as a collecting and disbursing agency for payments required under provisions of agree-

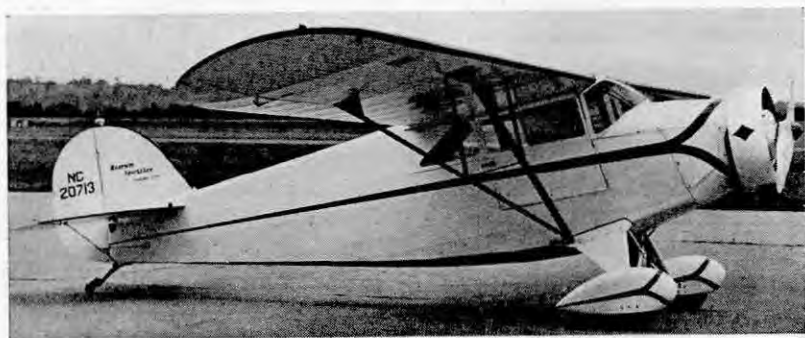


THE HOWARD DGA-15J

A private-owner plane with 330 h.p. Jacobs engine.

ments and license contracts. It has developed a specialized procedure which has enabled it to conduct without dissension or disagreement all the arbitration proceedings required in connection with claims for compensation on patents reported by members, and in the settlement of the relatively few disputes on patents. Now that the payments on account of the original patents have expired the only royalty payments currently required are those resulting from the appraisal of new patents issued to member companies.

In 1939, 70 new patents relating to aircraft were acquired by members of the Association; and it was estimated that over 90 per cent of the total sales volume of airplanes manufactured in the United States were licensed under the 1,023 aircraft patents owned or controlled by members, thereby continuing to carry out the original



REARWIN SPORTSTER

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

policy of making licenses at the same terms available to all manufacturers who desire to enter the field. As in previous years, the primary 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 in 1940.

As a necessary incident to the administration of the Cross-License Agreement and also to supplement the other services rendered to members, the Association has had the foresight to acquire throughout the last 20 years, and now maintains, a private library devoted to engineering research and technical developments in the field of aeronautics. This library is acknowledged to be second to no other source of such specialized information at present in existence. Over 400 volumes of books and periodicals were acquired during 1939, either by purchase or by gifts from companies and individuals. In addition, a complete file of the aircraft patents issued in the United States, as well as in Great Britain, France and Germany is main-



SPENCER-LARSEN SL-15

An amphibion powered by a Ranger engine.



U. S. Army photo

NORTH AMERICAN BASIC TRAINER

An Air Corps BT-14 plane with Wright Whirlwind engine designed and built by North American Aviation at Inglewood, Calif.

tained by the Association, including an independent classification and indexing system, which is not only unique from the point of view of research in the patent art, but is peculiarly adapted to the needs of the members.

During the early years, although it was recognized throughout the industry that the facilities of the Association might be utilized to advantage in connection with the development of worthwhile inventions, and to obtain the protection afforded by patents and recognition of design rights, little was actually accomplished in this direc-



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.



U. S. Army photo

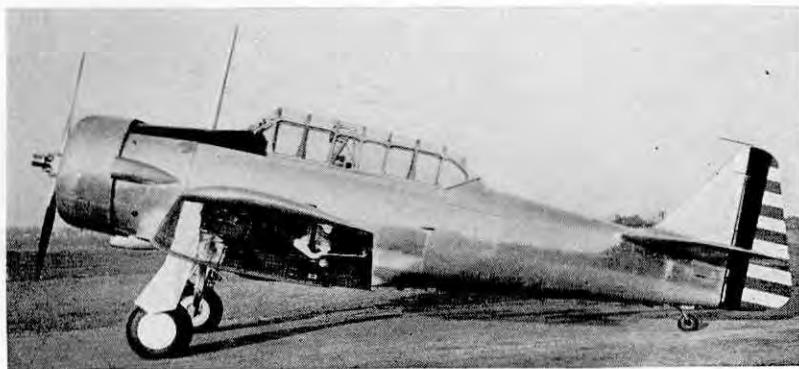
THE RYAN S-T MILITARY TRAINER

It was powered with a 125 h.p. or 150 h.p. Menasco engine.

tion until the formation of the Patent Research Division shortly after the adoption of the Amended Cross-License Agreement. Since then, however, the services rendered by this Division have been developed and expanded until it now comprises one of the most important functions of the Association. The publication of a comprehensive Digest of all current American and British aircraft patents, including abstracts of the specifications and official drawings, keeps members informed regarding patented developments in the United States and foreign countries.

The Patent Research Division also advises members of the Association regarding the trend of technical development in the United States and abroad, 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 are also made available in preparation and filing of patent applications on inventions which otherwise would be the subject of abandonment by member companies but might eventually have considerable value to the membership from a defense standpoint. Thus wasteful patent litigation has been avoided, and advancement of the art has been encouraged by making the important technical progress available to all aircraft manufacturers.

The offices of the Association also have provided a facility for maintaining relations with non-member patent owners. Submissions of outstanding developments by all inventors in the field of aviation are given careful consideration and may be called to the attention of the membership, or kept on file to be readily available in case of



U. S. Army photo

NORTH AMERICAN ADVANCED TRAINER

The Air Corps BC-1A utility type with Pratt & Whitney Wasp engine. The manufacturer's model number was NA-16-3.

inquiry. Some inventors feel disposed to file complete data such as blueprints, photographs, and experimental and test records about 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. It is likewise of advantage from the same point of view that the Association be advised of terms which would be acceptable to the respective patentees. At the same time, no submission of a confidential nature is solicited or received from others than members of the Association. A further service rendered in connection with non-member patent owners has



THE PIPER CUB TRAINER

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



PORTERFIELD COLLEGIATE TRAINER

A two-place plane with a 65 horsepower Continental or Lycoming engine.

been friendly arbitration proceedings substituted 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 has also succeeded in establishing a somewhat similar situation as regards the relationship with non-member patent owners who wish to make worthwhile inventions available to the industry.

The advantages of the Cross-License Agreement to the industry, to the Government and to the public have been manifest. By continuing to make important technical progress available to all manufacturers, the Association has encouraged engineering development and research in this country until the premiere position now held in world leadership has been reached without interference from wasteful litigation or hardship due to any monopolistic tendency within the industry. Membership in the Association never has been restricted. No qualified applicant ever has been refused the right to acquire licenses under the terms of the Agreement, and there never have been any withdrawals from the Association, except in the case of companies which either have gone out of business or have ceased to manufacture aircraft.

It is interesting to note that as a direct effect of operations under the Cross-License Agreement, there has been 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 have been licensed free of charge, while 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, have been made available at rates of royalty which have permitted unlimited use by every member of the Association.

National Aeronautic Association

The annual convention of the National Aeronautic Association in January, 1940, revised its by-laws to streamline the organization to meet service demands of air progress. For many years the N. A. A. has faced in every direction. No specialized organizations existed for particular service to special phases of aviation.

The new plan of organization may be thought of as a spearhead. The broad base of the spearhead is composed of the air-minded American public. They come into the N. A. A. through membership in chapters or as members-at-large registered at headquarters. The middle of the spearhead is composed of specialized organizations serving some particular component of aviation. They are affiliated with N. A. A. to advance the common basic objectives. The tip of the spearhead is composed of N. A. A. Councilors who are leaders drawn from all phases of aviation or correlated interests. To this leadership the American public will look for guidance and advice in the aeronautical field. The effect of the reorganization is to bring about a unity within aviation backed up by a wide-spread interest.



STINSON RELIANT SEAPLANE

The Lycoming-powered Reliant, with Edo floats, used by the New York Police Department.

CHAPTER X

STATE AVIATION

Program of the National Association of State Aviation Officials—
Airport Construction—Cooperation with the Federal
Government.

THE National Association of State Aviation Officials, with 24 active members as incumbent State officials in aviation bureaus, made this report for the Aircraft Year Book, through its president, D. O. Langstaff, Alabama Director of Aviation:

"The object of the Association is to foster aviation as an industry and as an arm of the national defense; to join with the Civil Aeronautics Authority, the Aeronautical Chamber of Commerce of America and other agencies in research pertaining to aeronautics; to develop uniform air laws and regulations, and encourage cooperation between the several States.

"The Association bent its effort toward the creation of the Civil Aeronautics Authority and has been instrumental in launching other aviation activities and legislation. At its 1939 meeting in New Orleans it unanimously supported a resolution toward obtaining Federal funds for a national airport construction program. Further promotional activities of the National Association of State Aviation Officials are reflected in the following resolution adopted at the same time: That upon the completion of any repairs to a properly certificated aircraft by a certificated repair station, and the certification by such certificated repair station that such repairs are made in accordance with the regulations and specifications of the Authority, said aircraft should be permitted to operate for a period of at least 30 days, during which time it shall be the duty of the owner to present his aircraft for inspection to a proper C.A.A. inspector to secure final approval for continued operation of such aircraft.

"It was the general belief that this would eliminate the delay caused the owner of a repaired aircraft while awaiting the arrival of an in-

spector. As the repair station has been certified by the Authority as being competent to make such repairs, it was felt that the aircraft owner should be entitled to fly his plane without further delay.

"The Association went on record as endorsing the appointment by the Authority of a State Coordinator and, at the same time, urged the C.A.A. to give serious consideration to information gathered and to any recommendations made by him.

"It is apparent that the States as a whole and individually are endeavoring to cooperate with the C.A.A.; however, some of them find that due to lack of sufficient personnel, they cannot cooperate as effectively as they would like. In many instances the State director must act as investigator, inspector, engineer, promoter, counselor, contact man and in many other capacities; and he must maintain contact with the many branches of the C.A.A. to coordinate effectively the aviation activities in his State. However, in view of his many and varied activities, the state director is opposed to the inauguration of a Federal program in his state without his being consulted in the matter.

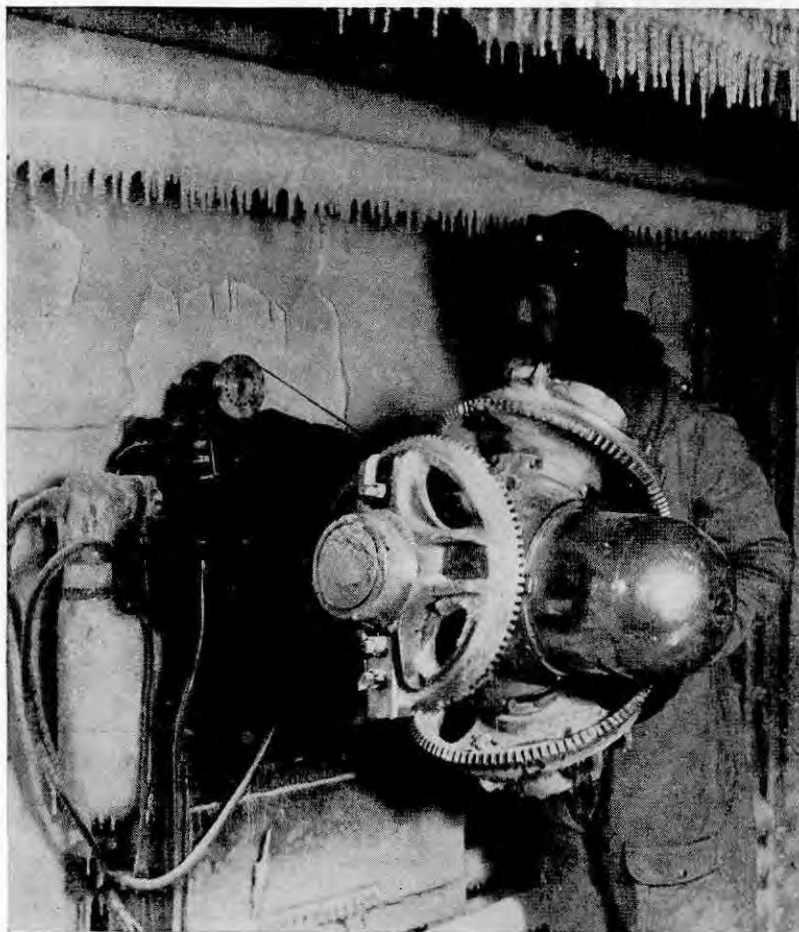
"The enormous cost of airport construction; the burden of additional taxes; the inability of cities to sponsor projects; the unstable regulations of the C.A.A. in regard to airport size and runway length; the safety factor of over 300 per cent on existing runways of 3,500 feet in length has resulted in the adoption of a resolution by the N.A.S.A.O. as being opposed to regulations permitting an increase in the take-off distance on landing speed of aircraft. It also recommended the abolition of the regulation permitting provisional overloading. It is the opinion of the National Association of State Aviation Officials that runways of 3,500 feet in length, having clear approaches, based on a glide ratio of 20 to one, constitutes an adequate and safe facility for the operation of any type of airplane under normal sea level conditions.

"The N.A.S.A.O. being of the opinion that the so-called feeder line type of air transportation is necessary for the orderly development of aviation in the towns and cities not justifiably served by the present existing scheduled air lines, strongly favors the issuance of at least one certificate of Public Convenience and Necessity by the C.A.A. in order to determine the feasibility of this type of operation. Feeder line operation is also necessary as a justifiable reason for the continued operation and maintenance of some of our existing airports and will serve as a stimulus for further airport development.

"In summarizing, the N.A.S.A.O. has bent its efforts toward securing Federal aid for airport construction; easing the burden of regulations on the aircraft owner; promoting a coordinated plan of action with the C.A.A.; protecting the State's sovereignty; standard-

izing airport runway lengths and urging the establishment of feeder line service."

Connecticut's Aeronautical Development Commission made a detailed analysis of products, services and sources of supply for the manufacturers of airplanes, aircraft engines and accessories. The Commission, working with the Connecticut Manufacturers' Association and other groups, provided the aircraft industry with informa-



PROPELLER TEST

A Hamilton Standard hydromatic propeller hub in the refrigerated test room, with temperatures as low as 50 degrees below zero, at the company's plant in East Hartford, Conn.

tion as to those plants which could make any of the thousand and one parts that enter into a completed flying machine.

A preliminary list of the character of services and supplies which Connecticut could provide ranged from eyelets for parachutes to aviation engines, both light and heavy machinery for the manufacture of all kinds of products, from ferrous and non-ferrous metals, fabrics, plastics and other materials, to machine tools, precision instruments and marine equipment.

The principal object of the Connecticut Aeronautical Development Commission was to aid in bringing new aviation industries into the State and satisfy all those at present in the State that the agencies of the commonwealth were at the disposal of the aviation and allied industries. Early in 1940 the Commission reported that more than 60 plants were working on aviation material.



THE SPERRY AIR LAB

The special Lockheed with Wright Cyclone engines which the Sperry Gyroscope Co. uses as a flying laboratory in its research and development program.

CHAPTER XI

TRAINING AND EDUCATION

Increase in Training and Educational Facilities—Magnificent Record of the Civil Aeronautics Authority's Civilian Pilot Training Program—Work of the Leading Aviation Schools
—Lists of Colleges Reporting Courses.

AT the beginning of 1940 there were so many different kinds of training and education in hundreds of aeronautical schools and other organizations that almost anybody, anywhere in the United States, by meeting minimum normal requirements could prepare for a career in aviation. The very large number of privately owned and operated flying and ground schools, some with fine records extending back nearly 20 years, provided every kind of aeronautical training, from flying to engineering, from commercial aviation executive courses to mechanics courses. Thus one could have his choice of serious, practical training in any of the hundreds of different professions and trades in the steadily growing branches of aviation. The Army and Navy had their own training systems, of course, headed up in their "West Point and Annapolis of the Air." The aircraft manufacturing companies operated their own training systems in connection with their plants—training their own employees for better jobs, and paying them while learning. The air lines, too, had their own training facilities. An increasing number of technical schools and colleges gave aeronautical courses leading to degrees. Most comprehensive of all, however, because it embraced the entire country, was the Government's Civilian Pilot Training Program managed by the Civil Aeronautics Authority. It had progressed to such a satisfactory stage, that the aviation industry, as with a single voice, voted it one of the outstanding achievements in the history of American aeronautics.

The problem was attacked by education and example. In the last half of the school year of 1939, in 13 widely scattered colleges, 330

students were put through a controlled instruction course. It involved, first, sound ground school instruction and, second, a requirement that upon reaching the solo stage, half of the further time must be logged as check flying, with the instructor actually in the plane with the student and prepared to correct his mistakes as and when he made them.

The results were excellent. A total of 313 students in that course were certificated as private pilots. There was but a single fatal accident. In all the colleges where the courses were given the college authorities found it a thoroughly desirable student activity. In each instance there were hundreds of applicants that could not be accommodated.

Upon that showing, Congress in August, 1939, passed the Civilian Pilot Training Act which appropriated \$4,000,000 for the training of approximately 10,000 students in some 460 colleges and with the requirement that at least five per cent of the trainees be non-college students.



AT CURTISS-WRIGHT TECH

One of the "classrooms" at Curtiss-Wright Technical Institute, Glendale, Los Angeles, Calif.



AT RISING SUN SCHOOL

Students inspecting a Lycoming-powered Stinson plane at the school in Philadelphia.

Early in 1940 Chairman Hinckley was able to announce that more than half of all students had reached the solo stage and that they had logged a total of 200,000 hours with but a single fatality. Figuring the training planes at the modest speed of 70 miles an hour, that would mean a total of 14,000,000 plane miles flown by these students with but one fatality—the equivalent of the safety record of which the air lines had been proud but a scant year before and a safety record better by almost 20 times than that ever logged for non-scheduled flying as a whole.

That showing induced the committees of Congress to recommend an increase to \$5,000,000 in the appropriation for the continuance of the program into 1940-41, and enabled the C.A.A. to lay plans for its extension to some 50 more institutions and to provide advanced training, leading to commercial certificates, for considerable numbers of the graduates of the 1939-40 courses.

Tables showing the 1940 program by States and the questionnaire results of the 1939 program will be found in the section Flying Facts and Figures.

Hundreds of aviation schools made training relatively simple for



young Americans desiring a profession or trade in aeronautics. Among the leading schools submitting reports for the Aircraft Year Book were the following:

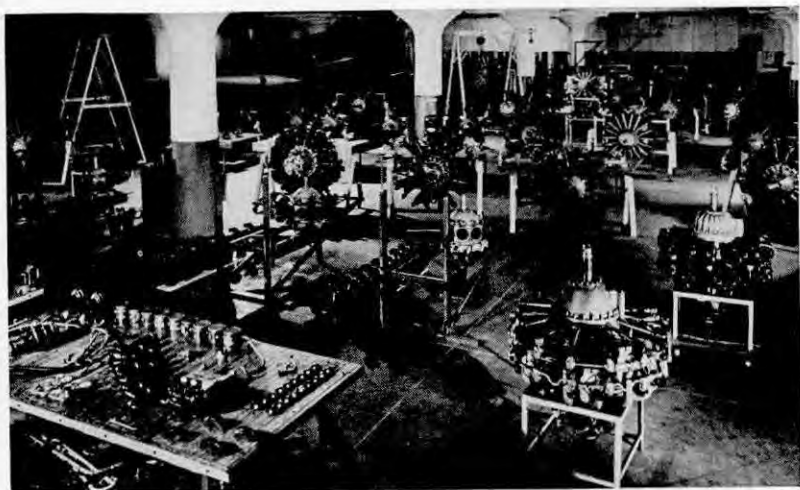
The Curtiss-Wright Technical Institute of Aeronautics, at Grand Central Air Terminal, Glendale, Calif., was under the personal supervision of Major C. C. Moseley and it had more than 1,000 students.

Notable among its achievements was selection of the big school by Army authorities as the only far western school to train its enlisted personnel as Air Corps mechanics. Since July, 1939, nearly 300 regular Army men, chosen from the ranks by competitive exam-



THE CURTISS PROPELLER

Test Pilot H. Lloyd Child inspects the Curtiss electric propeller on the Hawk 75A pursuit plane in which he dived at a speed of 575 m.p.h. in January, 1939.



AT THE CASEY JONES SCHOOL

Part of the engine shop.

ination, were enrolled as students at Curtiss-Wright Tech. As these soldiers completed their studies and dispersed to various Air Corps fields to take up the work of servicing and repairing new fighting airplanes, others replaced them for similar instruction.

Because of the rapid growth of Curtiss-Wright Tech, great expansion in shops and classrooms was effected during 1939. Perhaps the most spectacular feature of this growth occurred when a major transcontinental air line had to be asked to find a new Los Angeles terminal because Curtiss-Wright Tech needed for classrooms the 35,000 square feet of space its offices occupied.

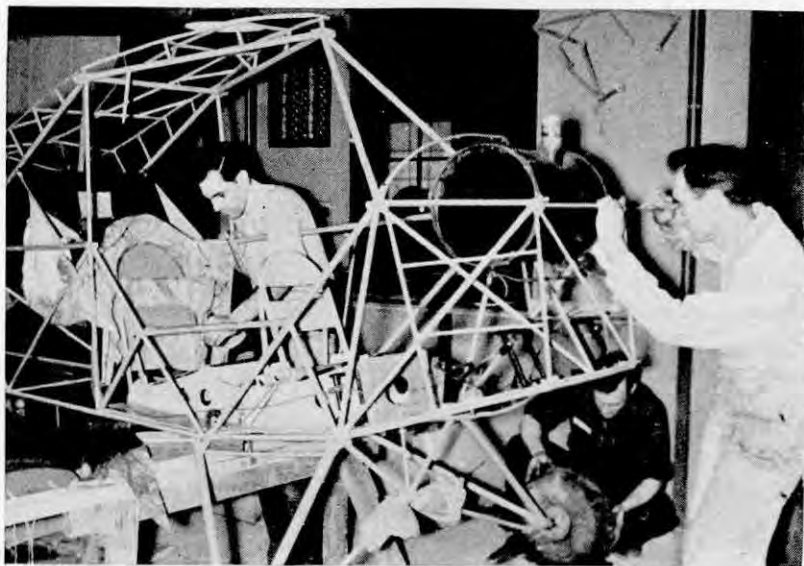
New buildings erected by the Institute included a large engine test laboratory, housing 10 rooms of airplane engines. This laboratory is for the use of advanced students of airplane mechanics. Instructors put "bugs" in the engines daily. The students then go to work to put the motors back in perfect running condition.

The school's Aeronautical Engineering division also saw great expansion, so much that most of the huge waiting room formerly used by air line passengers at Grand Central had to be commandeered and remodelled into classrooms for engineering students.

Curtiss-Wright Tech offered two general courses: Master Aviation Mechanics, based on 40 working weeks of 40 hours each; and Aeronautical Engineering, requiring 50 working weeks of 42 hours each. Supplementary and post-graduate courses were available.

The Luscombe School of Aeronautics, West Trenton, N. J., a division of the Luscombe Airplane Corporation, reported rapid expansion in courses, student enrollment, personnel and floor space. A course in aircraft engines was added, as were night school courses in aircraft welding and sheet metal work. Four classes of students were admitted during the year with a limited enrollment. Future plans called for addition of several thousand feet of shop space, additional instructors and equipment so that larger classes could be accommodated. In May, the school was issued a Letter of Authority from the Civil Aeronautics Authority which provided students with the opportunity of taking their C.A.A. examinations for licenses as airplane and engine mechanics. James L. Hainsworth, former member of the U. S. Army Air Corps and graduate of the Army Technical School at Chanute Field, Ill., was added to the instruction staff and placed in charge of the engine department, while Walter Hancock was put in charge of the airplane maintenance and repair shop.

The New England Aircraft School, Boston, Mass., moved from Boston Airport to 29 Brookline ave., Boston, where more than 25,000 square feet of well-lighted and ventilated shops were available for classrooms and work on aircraft and engines. A new building was



AT THE LUSCOMBE SCHOOL

Students re-building a plane.



AT PARKS AIR COLLEGE

The power plants department.

to be erected at Boston Airport in 1940 to help train the increased civilian student body and the 120 men under War Department enrollment as Army Air Corps mechanics.

The Casey Jones School of Aeronautics, Newark, N. J., reported a total enrollment of more than 1,000 students taking courses in aviation mechanics and aeronautical engineering. Expansion in courses and enrollment forced the school to move to larger quarters which provided 80,000 square feet of floor space in the heart of Newark. Day and evening classes were held, with 200 Government-enrolled Army men in aviation mechanics courses. More equipment was added, as well as instructors, to handle the expanded enrollment and additional shop space.

Parks Air College, East St. Louis, Ill., reported that its enrollment increased in 1939 from 300 to 430 students, with the training given to flying cadets and enlisted men schooled in aviation mechanics in cooperation with the U. S. Army Air Corps largely responsible for the expansion. Three new buildings were constructed, including two dormitories accommodating 54 men each, and a third structure, 60 by 100 feet, which provided classroom and laboratory space. Faculty personnel increased from 32 to 47. The college continued to offer only major courses requiring from two to two and one-quarter years to complete, except for the 12 weeks and 28 weeks

provided Air Corps flying cadets and mechanics, respectively. It was the policy of the school to offer only such courses as would attract the serious student of aviation. Such courses provided basic, special and practical training in professional flight and executive; aviation operations and executive; maintenance engineering, and aeronautical engineering. Standards for entrance to the school were raised, requiring applicants to be graduates of a high school with grades in the upper two-thirds of their class. Aeronautical engineering students were required, in addition, to present high school credit in not less than two and a half years of mathematics and one year in some other science. Parks Air College received recognition from accredited sources during 1939 when the University of Illinois accepted the College's credits in 21½ hours of subjects which parallel those subjects offered by the University. The College also was included in Accredited Higher Institutions issued by the Department of the Interior. The Army and Navy also accredited Parks Air College graduates for appointment both to the Air Corps as flying cadets and



AT SAFAIR FLYING SCHOOL

Classroom instruction in the Scintilla magneto.

to the Naval Reserve for flight training. Plans for 1940 included further raising of standards by improvement of curricula, training equipment and personnel in order to maintain the institution's excellent position as a supplier of personnel for the industry and other branches of aviation.

Pratt Institute, Brooklyn, N. Y., in September, 1939, started courses in pilot training in conjunction with the Civil Aeronautics Authority, with flight instruction at Roosevelt Field, L. I., and theoretical training at the Institute. Seventy-two hours of ground training and from 25 to 50 hours in the air were instituted, with students from 18 to 25 eligible for the classes held in the afternoons and evenings.

The Safair Flying School operated by Safair, Inc., at Hangar "B," Roosevelt Field, Mineola, N. Y., through its president, O. P. Hebert, contracted during the Fall of 1939 with the U. S. Government to provide flight training for the students of New York University, St. John's University, Adelphi College, Hofstra College, St. Francis College and Pratt Institute on the Civilian Pilots Training Program. Safair in addition to expanding its ground school at the hangar had also increased its facilities at the ground school operated in conjunction with the School of Education, New York University, in the new quarters located in the Bonney Building at 34 Stuyvesant Street in New York City under the direction of Roland H. Spaulding.



PARKS AIR COLLEGE

The School owns its own airport and the 18 buildings at East St. Louis, Ill.

The Flying School was designated as an advanced flying school operating under air agency certificate No. 8 issued by the Civil Aeronautics Authority and was equipped to give land or seaplane training. Fourteen re-rated pilots were added to the flying personnel and Safair was selected to train pilot instructors for re-rating under the government program for re-rating all instructors in the United States by October 1, 1940.

The Rising Sun Aircraft School, Philadelphia, Pa., expanded so steadily during 1939 that three distinct increases in floor space were noted after an initial transfer from 856 East Luzerne street to 191 West Roosevelt boulevard, where a modern, three-story, well-lighted building with floor space six times that of the older quarters was occupied early in the year. At first, it was necessary to use only the first floor, but it soon became necessary to add another floor, which provided a complete layout of 15,000 square feet for the aircraft and sheet metal department and an equal amount of space for the engine and propeller department. More equipment was added, including Pratt and Whitney Twin-row SB-3G Wasps, Wright RG-1820 F-11 Cyclones and Pratt and Whitney S1H1-G geared Wasps, and a Fairchild 22, Grumman XSF-1 and Vought O2U. Late in 1939 it was necessary to add a third floor to the school where the entire sheet metal, rigging and welding departments were established. Plans for 1940 include a large hangar built in the rear of the present school for use as a doping and finishing shop, more test stands and other equipment and supplying the Grumman and Vought with an F-11 Cyclone and S1D1 Wasp, respectively, for testing purposes.

The Robertson Aircraft Corporation, operating an aircraft school at Lambert-St. Louis Municipal Airport, Robertson, Mo., reported that plans for 1940 called for expansion of the mechanics school with greater floor space, equipment and an enlarged curriculum.

The Roosevelt Aviation School, Roosevelt Field, Mineola, N. Y., offered modern courses in various phases of aviation, including



AT SPARTAN SCHOOL

The hangars of the school.



U. S. Army photo

AIR CORPS CADETS AT RYAN SCHOOL

The planes are also Ryan PT-20 and YPT-16 trainers.

private pilot, commercial pilot, aircraft sheet metal, master airplane and engine mechanic and combination flight mechanic. The school reported a steady expansion in student enrollment.

The Ryan School of Aeronautics, Lindbergh Field, San Diego, Calif., reported that it expanded rapidly in 1939 in training facilities and personnel, increasing its student enrollment from 100 in 1938 to more than 200, divided into 75 flying cadets, 25 commercial flight students, 25 aeronautical engineers and 90 mechanics students. It was under the active management of T. Claude Ryan, the school's founder. Training of Air Corps flying cadets was started at the Ryan School in July, 1939, and 35 were graduated every six weeks. Capt. John C. Norton and Lieut. Lloyd P. Hopwood, both from Randolph Field, Texas, were assigned to train the cadets with Major H. B. Porter as medical officer. Paul Wilcox, director of flying at the Ryan School, was in charge of pilot training, assisted by 14 other instructors who had completed special training in Army flight operations.

Departing from a 30-year precedent of biplane training planes, the Air Corps began giving primary instruction in monoplane trainers to flying cadets at the Ryan School. The first planes used were the Army's Ryan YPT-16 and PT-20 low-wing metal fuselage trainers, a military version of the Ryan S-T planes. After three months of intensive instruction under Air Corps supervision at the Ryan School, which included 65 hours of flying and 225 hours of technical aviation

study, cadets who successfully completed the course were advanced to Randolph Field, Texas, for three months of basic flying training.

The Stinson School of Aviation, Long Island City, New York, reported that placements in the aeronautical industry had been provided for every one of its graduates. As a student entered the school, he went into the beginning department where he learned elementary layout, bench, fitting, wood, cable and tubing work. Next he went to the wing and drafting departments and continued his training through the tool room, sheet metal, welding, fuselage covering, doping and finishing, inspection and engine departments. The school was conducted like a well-regulated airplane factory, with efforts made to dispel school-room atmosphere. Larger quarters comprising 40,000 square feet were acquired for increased enrollment.

Spartan School of Aeronautics, Tulsa, Okla., was one of the popular flight-training institutions, with years of experience and an expanding enrollment in courses which included all the classifications for a pilot's license up to and including commercial.

The State Trade School at Putnam, Conn., had a comprehensive course in aviation subjects, including mechanical classes, drafting and blueprint reading.

The School of Aeronautics—Stewart Technical School—New York City, reported capacity classes in its aircraft, design, drafting, master mechanic and sheet metal courses. It found a better type of young man seeking a career in aviation than ever before, probably due to the fact that high school graduates have had an opportunity to plan for a career in aviation and to study related subjects while in high school. The Stewart school occupied its own seven-story build-

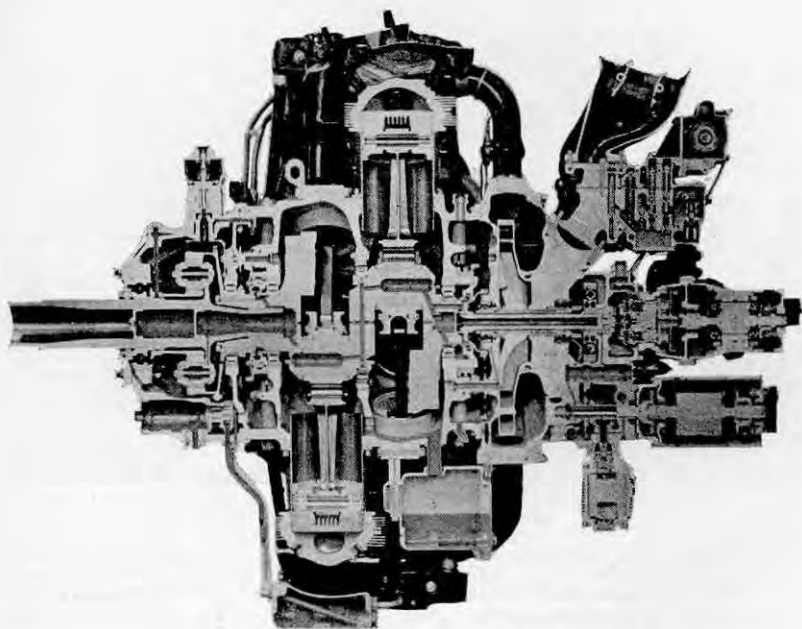


AT STEWART TECHNICAL SCHOOL

Metal fabrication instruction.

ing which was designed and constructed in 1927 with all the necessary facilities for school use. Early in 1940 much new and up-to-date equipment had been installed to keep pace with the rapid development in the aviation industry, and new members were added to the faculty. Entrance requirements were maintained at a high standard and all applicants' qualifications were thoroughly analyzed and approved before admittance. Graduates of the school were being absorbed readily by various branches of the industry.

The Washington Aircraft and Transport Corporation Flying School, Boeing Field, Seattle, Wash., continued to enlarge its training facilities at Lake Union, with 10 University of Washington students given seaplane training with a Fleet B-5, Aeronca K and an Aeronca 65 Chief. Future plans called for the addition of another Aeronca Chief and a four-five cabin plane for passenger and charter work in 1940. At the main branch of the flying school at Boeing Field, 10 other University students took training in a Stinson 105. Nearly 100 other students were trained in Aeroncas, a Stinson Reliant, Fleet K-5 and the Stinson 105. A new 80 h.p. Stinson 105 was to be



PRATT & WHITNEY TWIN WASP ENGINE

A 14-cylinder, 1,200 h.p. Pratt & Whitney Twin Wasp engine cut in half along the center line showing compact design and intricate details.

equipped with two-way radio and instruments necessary for detailed instrument training, and a new Army-approved trainer for advanced instruction was to be acquired for the Civilian Pilot Training Program.

Universities and colleges which reported as offering engineering courses or commercial courses in aeronautics, as well as pilot training facilities under the Civilian Pilot Training Program, included Cornell University, Ithaca, N. Y.; New York University, New York City; Pennsylvania State College, State College, Pa.; Purdue University, Lafayette, Ind.; Stanford University, Stanford University, Calif.; State University of Iowa, Iowa City, Ia.; University of Detroit, Detroit, Mich.; University of Florida, Gainesville, Fla.; University of Kansas, Lawrence, Kans.; University of Michigan, Ann Arbor, Mich.; University of Minnesota, Minneapolis, Minn.; University of New Hampshire, Durham, N. H.; University of Washington, Seattle, Wash.



R.C.A. AIRCRAFT RADIO

(1) Antenna Drag Unit (2) Rear Guide Fairlead (3) Antenna available for ground communication (4) Weatherproof entrance fairlead (5) AVT-15 Transmitter Unit (6) Symmetrical Radio Beacon Antenna (7) AVA-41 Antenna Reel (8) MI-5883 Transmitter Remote Control Panel (9) AVR-15 Receiver (10) Ship's storage battery (11) Flexible antenna conduit.

CHAPTER XII

THE AIRCRAFT MANUFACTURING INDUSTRY

Technical Progress in Recent Months—Details of New Aircraft—
Products of the Aircraft Engine Builders—New Developments
in the Accessories Branches of the Industry.

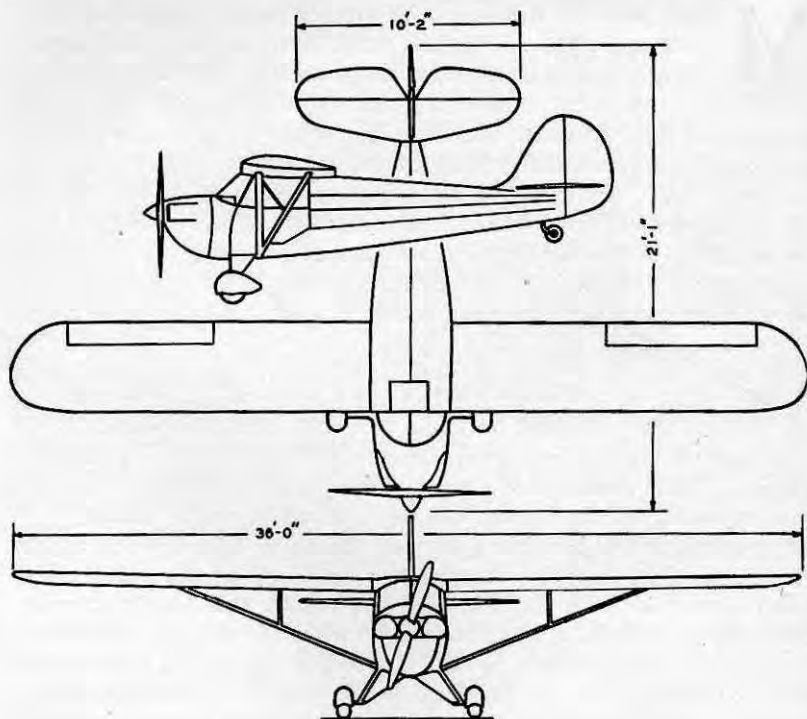
MORE powerful aircraft, with greater performance made possible by improved engines, propellers, variable speed superchargers, advanced wing design, better wheels and brakes and a thousand other minor refinements, characterize the recent products of the American industry. The trend toward mass production has caused considerable plant expansion, and also has encouraged the practice of letting subcontracts, so that increased business is being distributed generally throughout the manufacturing branches of the industry. The following details of activities among the companies supplying planes, engines and accessories are based on reports received from the individual companies. Theirs is a story of amazing progress.

Manufacturers of Aircraft

Aeronautical Corporation of America, Cincinnati, O., early in 1940 was testing its new tandem trainer, and was preparing for production. The Tandem had a wing span of 35 ft., length 22 ft. 4 in., wing area 169 sq. ft., loading 6.8 lbs. per sq. ft., power loading 17.7 lbs. per h.p. with 65 h.p. engine, useful load 480 lbs., gross weight 1,150 lbs., fuel capacity 12 gallons; standard performance, high speed 92 m.p.h. with 50 h.p.; and 100 m.p.h. with 65 h.p.; range 250 miles. Aeronca also continued production on two light two-place models, the Aeronca Scout, powered by the 40 h.p. Continental engine; and the Aeronca Chief, powered by 50 h.p. Lycoming, Continental, Menasco or Franklin engines. The Scout had a wing span of 36 ft., length 21 ft., weight empty 670 lbs., and a stated cruising speed of 90 m.p.h. Aeronca reported export sales in Puerto Rico,

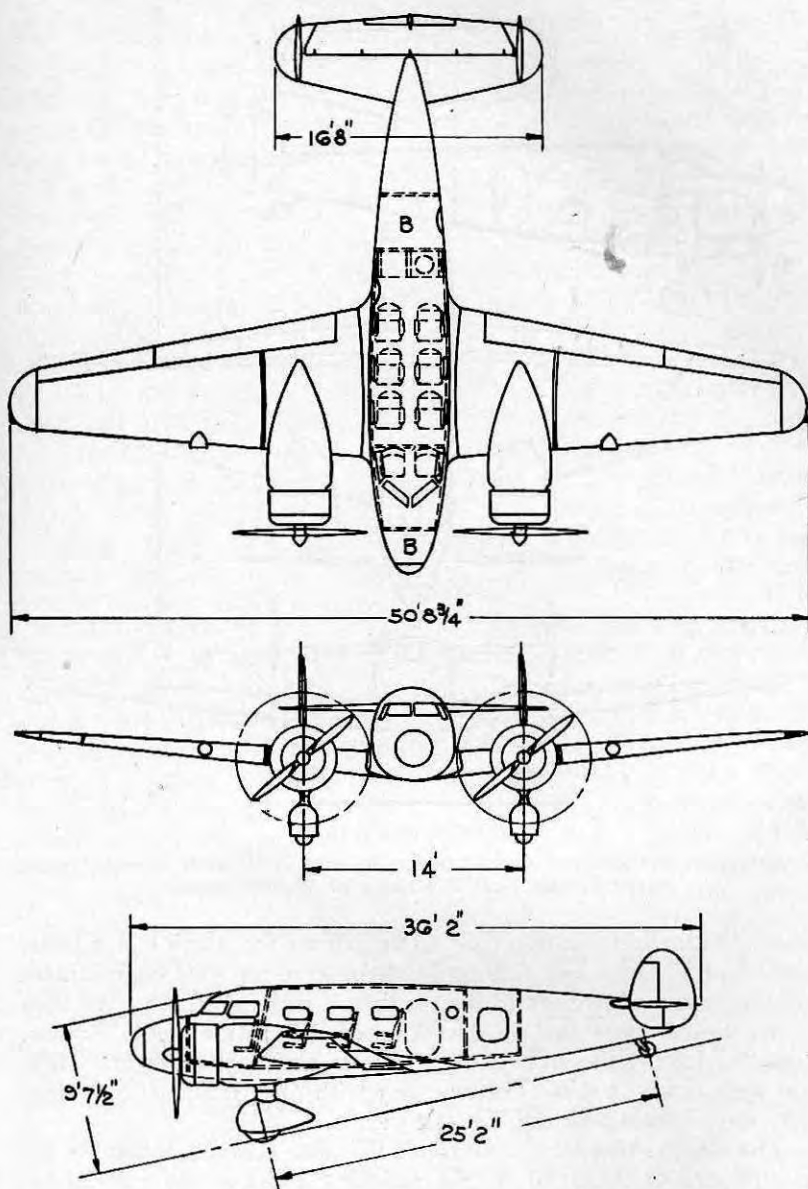
Portugal, South Africa, Hawaii, Denmark, England, Australia, France, Switzerland, Brazil, Peru and Canada.

Barkley-Grow Aircraft Corporation, Detroit, Mich., produced its 10-place twin-engine monoplane transport, the T8P-1, powered by 400 h.p. Pratt & Whitney Wasp Junior engines, wing span 50 ft. 8¾ in., length 36 ft. 2 in. Three ships were in use by Yukon Southern Air Transport operating with wheel, ski and float equipment. Rear Admiral Richard E. Byrd took a T8P-1 on his new Antarctic expedition. The gross weight of T8P-1 was 8,750 lbs. as a land plane and 9,200 lbs. with Edo floats. The company also had a twin-engine bomber trainer design, BT-2, which it planned to develop in 1940. On October 29, 1939, Commander Humberto Gallino and Captain Victor Gallino, brothers and officers of the Peruvian Air Force, took off in a Barkley-Grow T8P-1 from Floyd Bennett Field, New York, on a non-stop flight to Lima, Peru, about 4,000 miles



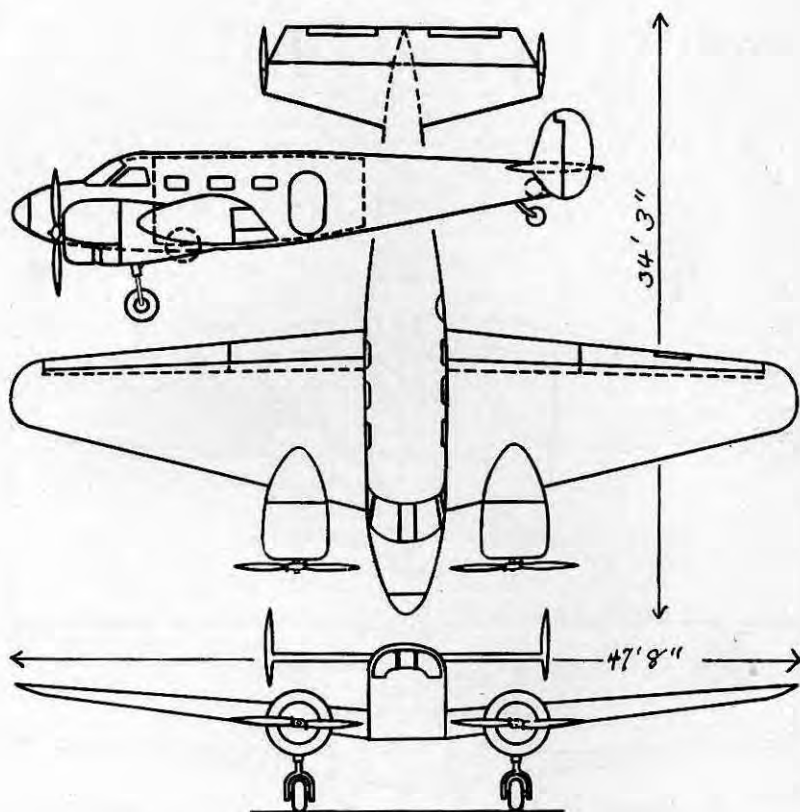
THE AERONCA CHIEF

A two-place private owner light plane with a 50 h.p. engine.



BARKLEY-GROW MODEL T8P-1

A 10-place transport powered with two Pratt & Whitney Wasp Junior engines of 400 h.p. each.



BEECHCRAFT 18

A twin-engine transport for from six to 10 persons, with a choice in power plants among Jacobs, Pratt & Whitney or Wright engines.

away. With the fuel supply of 1,150 gallons the plane had a gross load of 14,200 lbs. The Gallino brothers were reported over Miami, and then came silence for 48 hours; then it was found they had been forced down out of fuel on the island of Salinas De Punta Arenas, Ecuador, 3,300 miles from New York. It was a great flight. Their time was 25 hrs. 5 min. The next day with their fuel supply replenished the Gallinos flew the T8P-1 to Lima.

The Beech Aircraft Corporation, Wichita, Kansas, continued the manufacture of its E17B, F17D, and D17 series of commercial biplanes during 1939. Negative wing stagger, retractable landing gear, and low wing loading characterized those models, all of which were closed 5-place biplanes with a wing span of 32 ft., height 8 ft.,

and overall length approximately 26 ft. The E17B Beechcraft, powered with a 285 h.p. Jacobs engine, had a gross weight of 3,350 lbs. The gross weight of the F17D model, with a 330 h.p. Jacobs engine, was 3,550 lbs. In the D17 series, the D17R and D17S Beechcrafts of 4,200 lbs. gross weight, powered respectively with the 450 h.p. Wright Whirlwind and the 450 h.p. Pratt & Whitney Wasp Junior engines, were continued. A new model, the D17A Beechcraft, was introduced. Powered with a 350 h.p. Wright Whirlwind engine, the D17A had an empty weight of 2,465 lbs. and a gross weight of 4,200 lbs. It was designed for maximum load-carrying capacity, or extended cruising radius. The all-metal twin-engine series 18 Beechcraft monoplane was further developed and manufactured in quantity. All models of that series had a span of 47 ft. 8 in., height 9 ft. 5 in., and an overall length of 34 ft. 3 in. Adoption of new type engine cowling and cowl flaps increased the cruising speeds of the 18A and 18D models, powered by two 350 h.p. Wright Whirlwind and two 330 h.p. Jacobs engines respectively, to 200 m.p.h. The gross weight of those models remained at 7,200 lbs. with useful loads of 2,544 and 2,569 lbs. available for each model respectively. Redesigning of rudders increased the ease of lateral control.

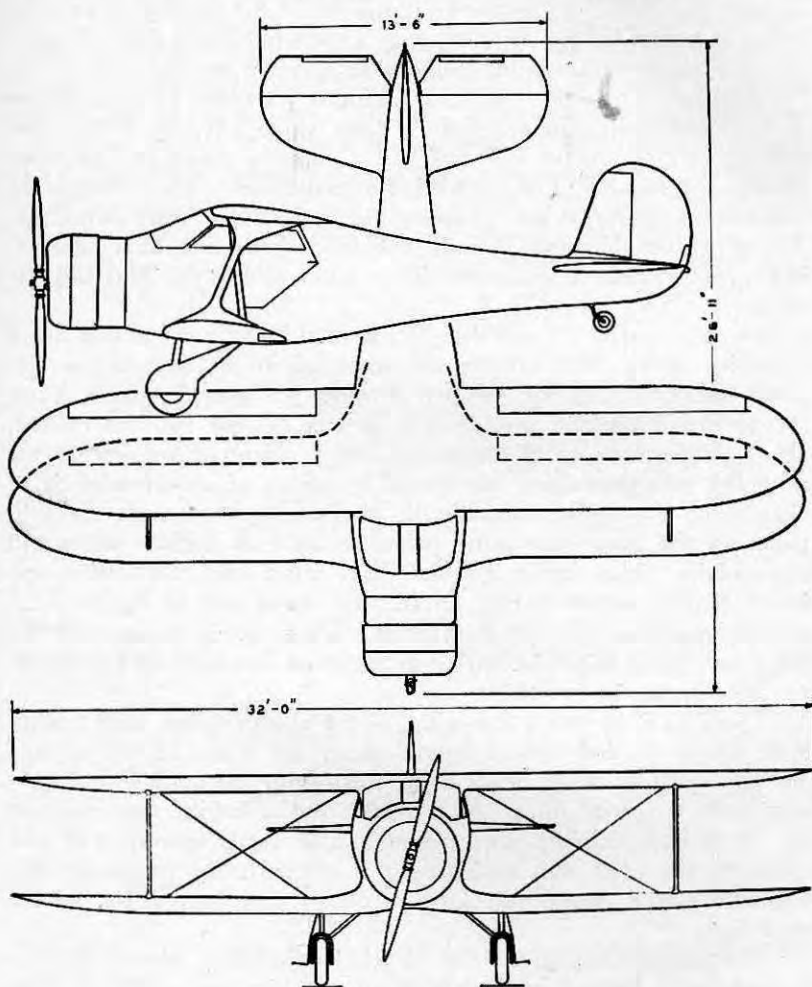
The series 18 Beechcraft seaplane, available also as a skiplane, was continued in manufacture. The 18A and 18D seaplanes had a take-off time of 17 seconds from flat, calm water with a full load, a stated climb of 1,060 ft. a minute, and a cruising speed of 175 m.p.h. Two new models were added to the 18 series of Beechcrafts during 1939. The Model 18S monoplane, powered by two 450 h.p. Pratt & Whitney Wasp Junior engines, was granted an Approved Type Certificate for a gross weight of 7,500 lbs., with a useful load of 2,469 lbs., stated cruising speed of 220 m.p.h., rate of climb of 1,850 ft. per minute. Also completed was the Model 18R monoplane, powered by two Wright Whirlwind 450 h.p. engines. Its performance approximated that of the 18S Beechcraft. Further developmental work was undertaken on military versions of the 18R and 18S Beechcraft. The stated top speed of the military Beechcraft was 230 m.p.h., its rate of climb from 1,700 to 1,850 ft. a minute, and its service ceiling from 26,000 to 29,000 ft., depending on the load carried. Provision was made for a crew of four, 1,000 lbs. of bombs, and six machine guns, covering all angles of attack. That loading allowed a range of more than 1,000 mi. at a stated speed of 212 m.p.h. With fuel for a 600-mi. range, a stated maximum of 1,400 lbs. of bombs could be carried in addition to the crew of 4 and the armament of 6 machine guns. Designs were prepared for the use of that plane as a photographic-observation airplane, personnel trans-

port, advanced training, attack and ground-strafig plane, or an aerial ambulance. A military version of the 18A and 18D models was also designed for use as a training and general utility plane. Production of all models of Beechcrafts, both biplane and twin-engine, was greatly accelerated during 1939. Increases in factory and engineering space and equipment, and an increase in personnel from 321 employees in January, to 780 at the end of 1939, more than doubled production capacity. Increasing commercial sales of Beechcrafts, both in the United States and abroad, were partly responsible for the expansion. Repeat orders for biplanes were received from a number of users, including the Indian National Airways of New Delhi, India; the Controller of Civil Aviation of Canada; the Barahona Company, of Santo Domingo, and others. The twin-engine Series 18 Beechcraft also gained popularity in the commercial market, and planes of this type were delivered to the Hudson's Bay Company; the Royal Swedish Air Force; E. W. Wiggins Airways; the Continental Can Company and others.

Beechcrafts also entered the service of the U. S. Army Air Corps, and the U. S. Navy Bureau of Aeronautics in 1939. Following an evaluation competition at Wright Field, Dayton, a contract was awarded for a number of standard D17S Beechcraft biplanes, for use as personnel transports by military attaches of the American embassies abroad, and at the various Naval air stations. Later in the year, the Bureau of Aeronautics reordered additional Beechcrafts of this type. Performance of the twin-engine Model 18S Beechcraft in another evaluation competition won a substantial contract for a quantity of monoplanes, equipped for use as high-speed personnel transports by high officials of the War Department and Army. Another contract was negotiated for a quantity of photographic airplanes, which were described by the Air Corps as follows:

"The first photographic airplane of an order placed with the Beech Aircraft Corporation has been delivered to the U. S. Army Air Corps at Wright Field. Assigned the designation F-2, it is the only airplane especially designed to carry 2 tactical mapping cameras in tandem. This Beechcraft is an all-metal, 3-place, 2-engine, low-wing monoplane especially built for use in rapid and accurate mapping of large areas. The design is such that the maximum possible visibility is afforded the pilot and photographer, and take-off and landing can be accomplished on the relatively small airdromes which frequently must be used in mapping the mountainous sections of the United States. Two Pratt & Whitney 9-cylinder engines furnish power. Propellers are two-blade with a diameter of 8 ft. 3 in. The wing span is 47 ft. 7¾ in. Besides the tactical mapping

cameras mounted in tandem, arrangements are made to include a single rapid reconnaissance mapping camera, an additional tactical mapping camera, mosaic and spotting high altitude camera, an oblique spotting camera and a night spotting camera. The airplane, which



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 E-17 version has a strut-braced tail group and is available with either a Jacobs 225 h.p. or a 285 h.p. engine, while the F-17 is offered with a 330 h.p. Jacobs.

is similar to the commercial type developed by the Beech Aircraft Corporation, is equipped with a radio and automatic pilot."

Bell Aircraft Corporation, Buffalo, N. Y., late in 1939 delivered to the U. S. Army Air Corps the first of an order of new type pursuit planes which embodied marked departures from conventional design. The Bell P-39, as known in the Army Air Corps, or the Airacobra as named by the company, was a tricycle landing gear, cannon-carrying single-seat fighting plane with a stated maximum speed of "around 400 m.p.h." in straight, level flight. Powered with an Allison V-12 liquid-cooled engine of more than 1,000 h.p., the P-39 could operate "above 36,000 ft." and had a cruising speed of "approximately 325 m.p.h." Fully loaded, the plane had a gross weight of "approximately 6,000 lbs." Closely guarded by the Army Air Corps during its development period, a limited discussion of characteristics, performance and construction was released by the War Department.

The plane purposely was designed around its 37 mm. cannon firing explosive shells. The cannon was mounted in the nose of the airplane and fired directly forward through the propeller hub. Four synchronized machine guns,—two .30 caliber and two .50 caliber, also fired forward from the nose. The problem of connecting the propeller with the engine was solved by means of an extended drive shaft from the engine, beneath the pilot's compartment to the propeller in the nose—the same principle used in surface ships and automobiles. The engine and its drive shaft had more than 500 hours of full power testing on the test stand and in flight. That adaptation of the drive shaft forecast a new trend in design whereby the power plant might be buried in wings or fuselages and at points removed from the propeller.

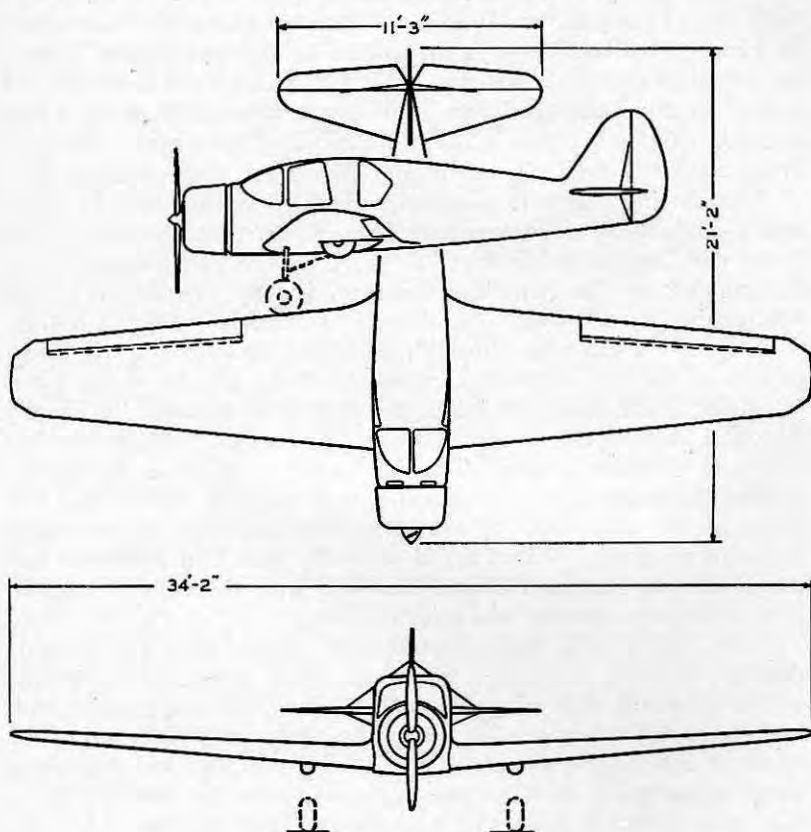
The Bell P-39 was a low-wing, all-metal monoplane with a wing span of 34 ft. and overall length of 29 ft., 9 in. It had a very smooth finish, all rivet heads being flush with the surface and covered with a special filler. As a result of the engine arrangement, the P-39 had visibility forward and downward, upward and aft, although the pilot was enclosed in a compartment provided with automobile-type doors, roll-down windows and heated for winter operation.

The pilot, the engine and the tricycle landing gear, when it was retracted, were located in the center of the airplane. Concentration of those weights at one central point, was intended to give the plane a high degree of maneuverability, at the same time reducing the physical strain on the pilot while engaging in violent maneuvers.

The Bell P-39 had a stalling speed of less than 70 m.p.h. due to

the relatively low wing loading of 28.3 lbs. per sq. ft. and the large wing flaps. The fuselage structure was made of 2 sections, bolted together in a manner to permit rapid disassembly for shipment or repair. The aft section extended from behind the engine to the tail.

Coincidental with the development of the Airacobra (P-39), Bell Aircraft developed and delivered to both the Army and Navy air services two types of machine gun adapters to dampen the recoil on .30 and .50 caliber aviation machine guns. The adapter for the .50 caliber gun employed hydraulic shock dampeners, while the shock unit in the .30 caliber adapter was a combination pneumatic and spring device mounted rigidly under the gun between the tubular



BELLANCA CRUISAIR

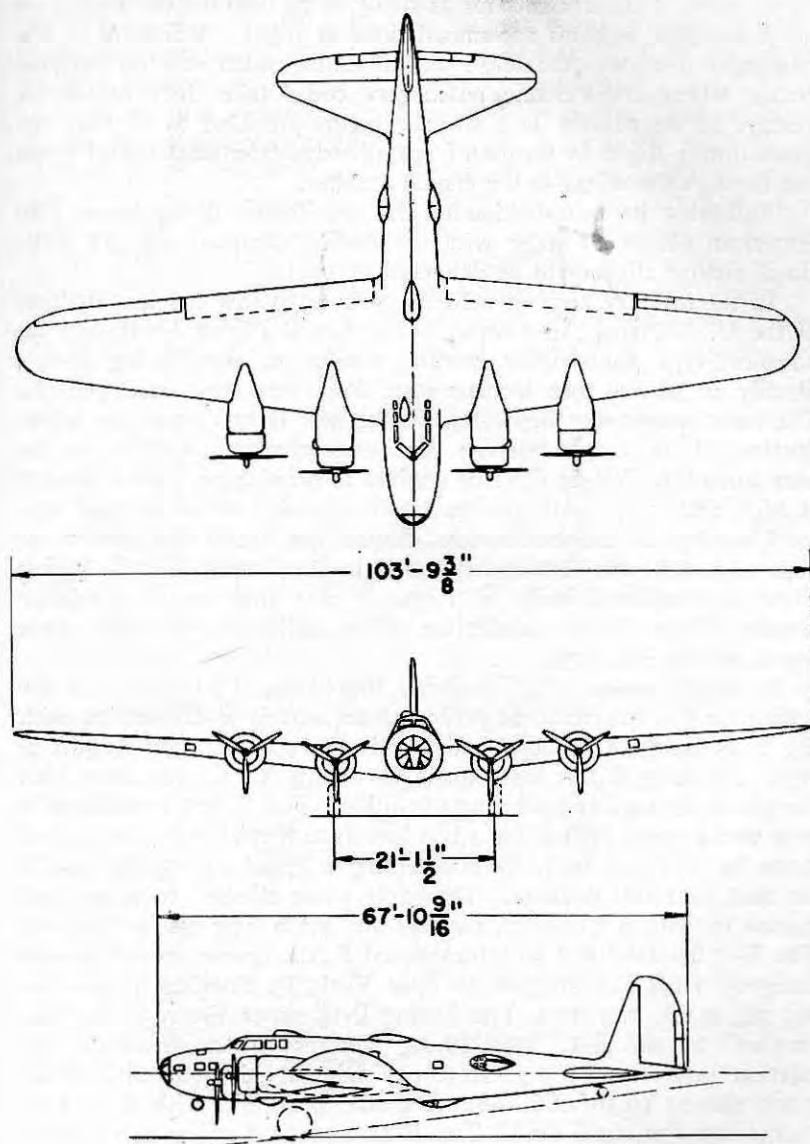
Powered with a Ken-Royce 90 h.p. engine, this plane for the private flyer carries three.

frame members. The adapters were accepted as standard equipment by both Army and Navy air forces on the grounds that they greatly increased accuracy in firing and also made it possible to save structural weight in the gun mounts. Bell Aircraft early in 1940 had begun work on a special airplane project for the Navy.

Bellanca Aircraft Corporation, New Castle, Del., continued development and sales of its current models. Model 14-7 was equipped with a 70 h.p. Ken-Royce engine and Model 14-9 with a 90 h.p. Ken-Royce. The plane was a low-wing monoplane, wing span 34 ft. two in., height six ft. three in., length 21 ft. three in., wing area 140.2 sq. ft., weight empty 912 lbs., payload 412 lbs., useful load 738 lbs., gross weight 1,650 lbs., and stated cruising speed 105 m.p.h. for Model 14-7, and 110 m.p.h. for Model 14-9. Bellanca produced a number of its Flash type Model 28-90, a monoplane bomber and fighter, reporting the 28-90 capable of making 270 m.p.h. with a bomb load of 2,000 pounds or when equipped with four 30-cal. fixed guns in the wings and a 30-cal. flexible gun in the rear cockpit. The company also produced its Pacemaker, Skyrocket and Aircruiser commercial models.

The Boeing Aircraft Company, Seattle, Wash., was in high-speed production on four-engine Flying Fortresses for the U. S. Army Air Corps, the delivery of an initial fleet of 74-passenger model 314 clippers to Pan American Airways, and the completion of the four-engine model 307 Stratoliners, the world's first "altitude-conditioned" transports. Boeing's highlight of 1939 was the completion of the Pan American clipper project. All six of the giant 314 flying boats under the initial contract were delivered during the first half of the year and immediately placed in service on the Pacific and Atlantic routes. The inauguration of Pan American's regular passenger service to Europe, made possible by the size and range of the new Boeings, was an epochal landmark in air transportation progress. Before the close of the year Pan American had completed 100 regular Atlantic crossings with these ships in addition to the large number of Pacific crossings.

The Boeing 314 boats, considerably larger than any aircraft that had formerly been placed in service on the world's airways, were 41-ton all-metal high-wing monoplane flying boats, equipped with four 1,500 h.p. Wright two-row Cyclone engines. They had a top speed of 190 m.p.h., a cruising speed of 165 m.p.h., and a cruising range of 3,100 mi. with 40 passengers aboard. The Boeings had a wing span of 152 ft. and a length of 109 ft. Their spacious hulls were divided into two full decks, the upper deck being devoted to an unusually large control room for six flight officers and to cargo space and crew sleeping accommodations, while the lower deck was divided into



BOEING FLYING FORTRESS

This model B-299Y (Air Corps type B-17B) has four Wright Cyclone engines and carries a crew of seven to nine.



commodious compartments for as many as 74 daytime passengers or 40 passengers in berth accommodations at night. A feature of the passenger deck was the large central dining salon and recreational center where transoceanic passengers could take their meals. A feature of the control deck was the access provided to all four engines during flight by means of passageways from the control room out through the wings to the engine nacelles.

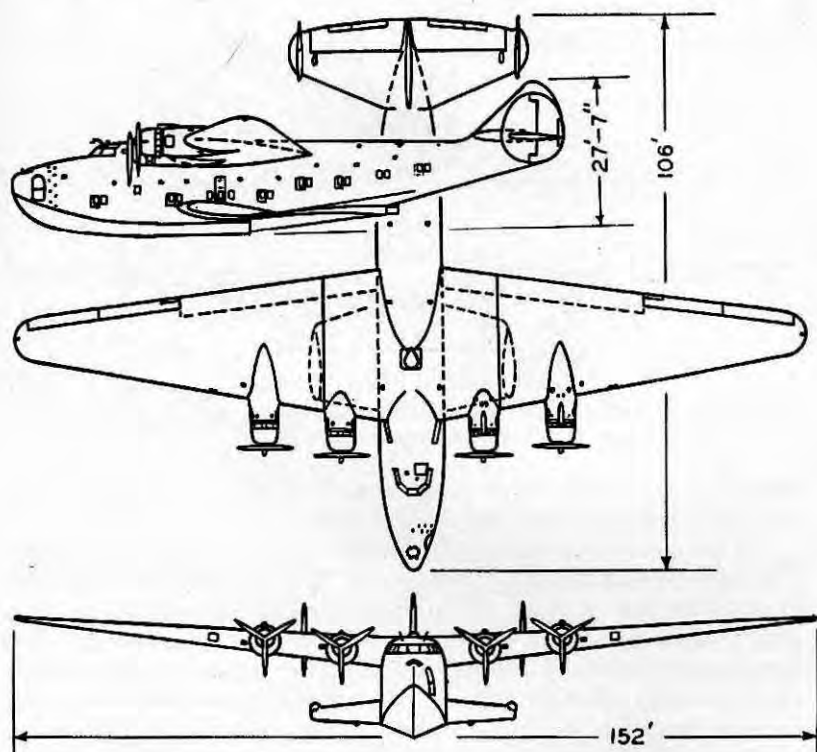
Following its introduction of the six Boeing flying boats, Pan American placed an order with the Boeing company for six additional similar clippers to be delivered in 1941.

In the military aircraft field the year 1939 saw the introduction of the U. S. Army Air Corps Boeing B-17B Flying Fortresses, an advanced-type four-engine bomber similar to the Boeing B-17's already in service, but incorporating important new developments. The most noteworthy innovation in the new B-17B's was the introduction of an exhaust-driven turbo-supercharging system on the four 1,000 h.p. Wright Cyclone engines to provide peak performance at high altitudes. That system, which supplied air of normal sea-level density to the carburetors despite the decreasing density at high altitudes, was first incorporated in the Boeing B-17A Flying Fortress completed early in 1939. It was then made a regular feature of the B-17B production series, deliveries of which were begun in August, 1939.

A notable news event involving the Flying Fortresses was the setting of five international performance records in connection with the U. S. Army Air Corps' 30th Anniversary Celebration August 4, 1939. All those flights were made by Army Air Corps crews with the planes in regular operating condition. The B-17A established a new world speed record for 1,000 km. (621.4 mi.) with payload of 5,000 kg. (11,023 lbs.), by maintaining a speed of 259.396 m.p.h. for that load and distance. The same plane climbed to more than 34,000 ft. with a 5,000 kg. payload and set a new altitude record. The B-17B established an international F.A.I. course record, second category, from Los Angeles to New York, by clocking a speed of 265.383 m.p.h. non-stop. The Boeing B-15 super Fortress, the "big brother" of the B-17 type Flying Fortresses, established a new international record for greatest payload carried to an altitude of 2,000 meters (6,561.666 ft.). It made this flight with a load of 14,135 kg. (31,167.6 lbs.). The B-15 also chalked up a record in the category "greatest speed with a payload of 2,000 kg. (4,409.244 lbs.) for a closed course distance of 5,000 km. (3,107 mi.)"—a category in which no airplane had previously qualified. On this long-distance-with-payload flight the B-15 averaged 166.321 m.p.h.

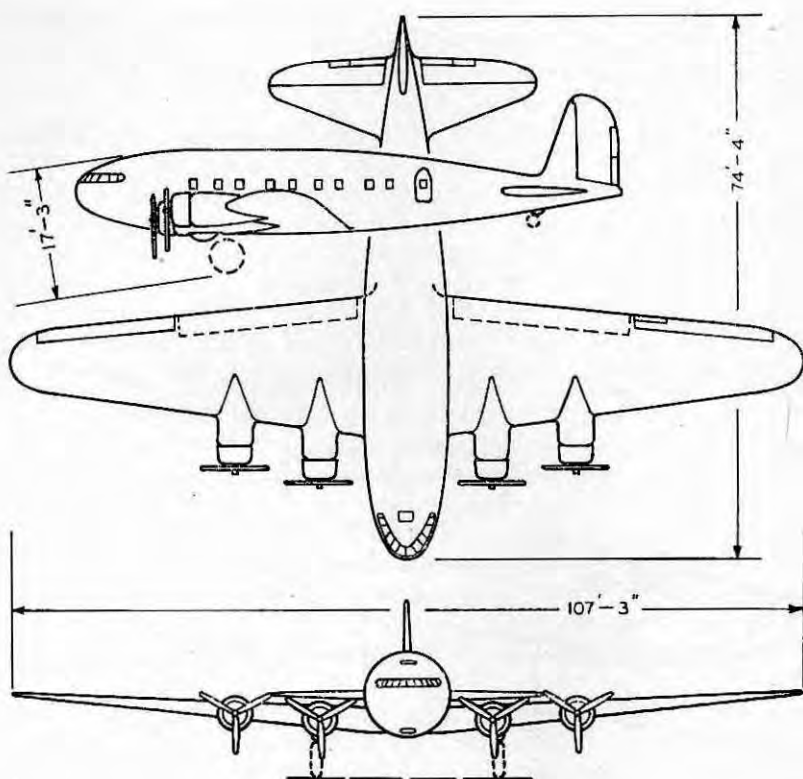
In its production of the B-17B Flying Fortresses, the Boeing factory introduced during the year a new production-line arrangement which resulted in the completion and delivery of the 22-ton modern bombers at the rate of one every four days.

Incidental to its increased production, the Boeing company added to its floor area in December, 1939, by leasing the plant of the Fisher Body Corporation in Seattle, which was designated as Boeing Plant No. 3. The new factory unit increased the company's floor area by one-third, from 574,000 sq. ft. to a new total of 764,000 sq. ft. The new unit was used for sub-assembly processes, while the Boeing Plant No. 1 was used for primary parts construction and Plant No. 2 for major sub-assembly and final assembly. During 1939 the Boeing Aircraft Company's payroll was doubled. In



THE BOEING 314

Pan American Clipper ship for ocean passenger service, powered by four 1,500 h.p. Wright Cyclone engines.

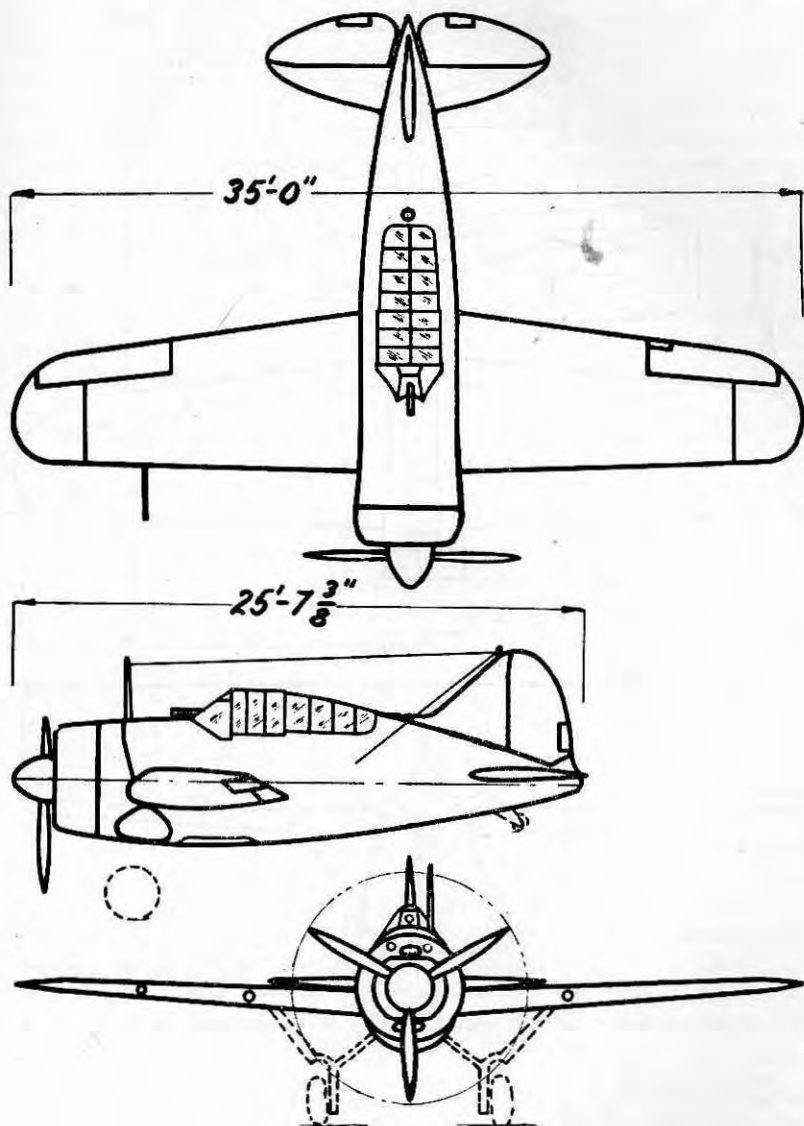


THE BOEING STRATOLINER

A 33-passenger transport for substratosphere operations. It is powered by four Wright Cyclone engines.

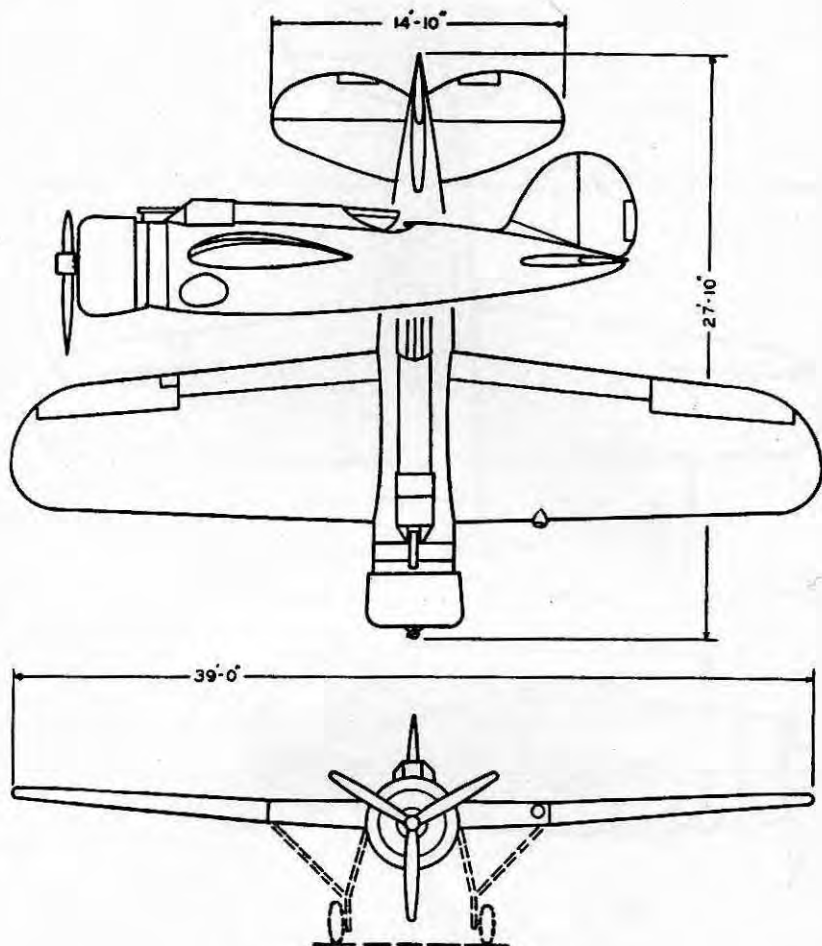
January 1939, Boeing employees numbered 3,000, and at the close of the next 12 months they had increased to 6,000.

In the commercial transport field, Boeing toward the end of 1939 was flight-testing the new 33-passenger four-engine Model 307 type Stratoliners for T.W.A. and Pan American Airways. The company's flight-testing of the new air liners was followed by Civil Aeronautics Authority testing, which carried through to conclusion early in 1940. The Stratoliner had supercharged cabins for comfortable operation at high altitudes, from 14,000 to 20,000 ft. above sea level. That was accomplished by increasing the density of the high-altitude air with engine-driven superchargers before the air was introduced into the cabin ventilating system. Thus the atmosphere circulating through the cabin remained the same as normal



BREWSTER FIGHTER

Offered in four different models, XF2A-2, Navy type F2A-2, export versions 339 and 449, this single-seat fighter is powered with a Wright Cyclone engine.

**BREWSTER SCOUT-BOMBER**

Powered with a Wright Cyclone engine, Model SBA-1, designed for the Navy, is also known as Export Model 138.

low level atmosphere as the plane climbed to higher altitudes. Actual testing of the supercharging system in flight began in June, 1939.

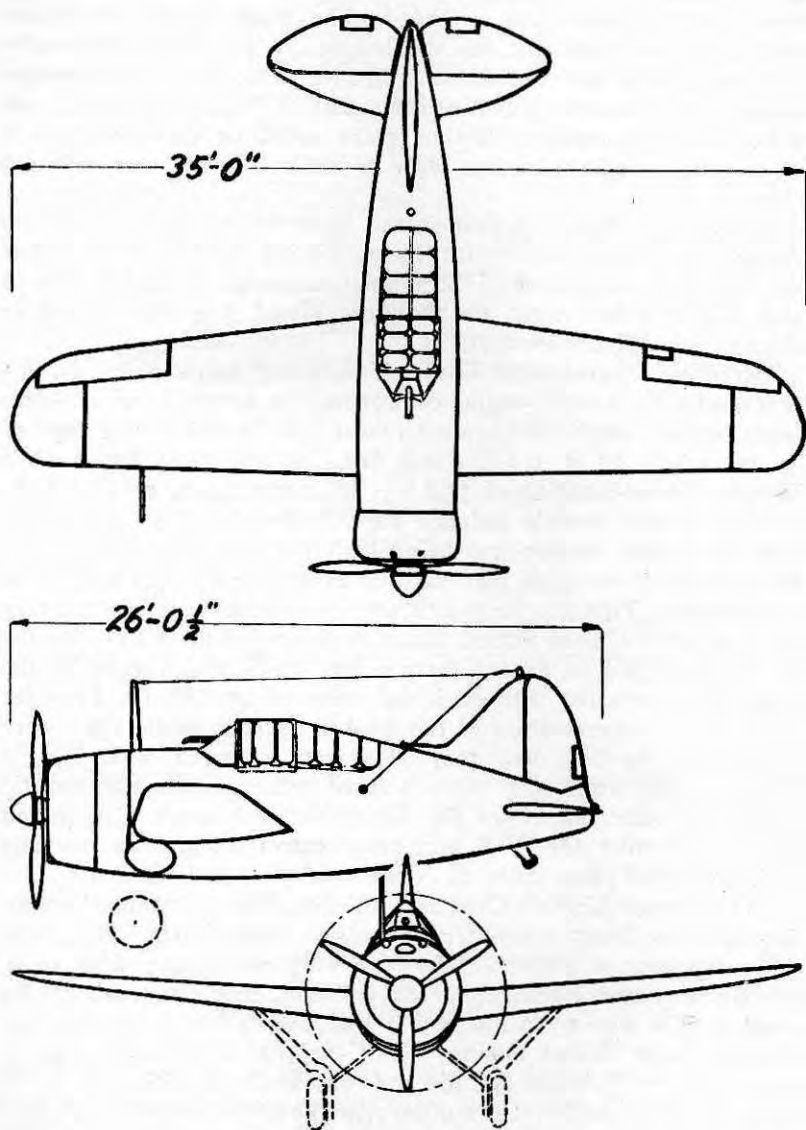
The Pan American and T.W.A. Stratoliners were low-wing streamlined monoplanes with four 1,100 h.p. Wright Cyclone engines and three-bladed Hamilton Standard hydromatic full-feathering propellers. Like the four-engine clippers, they could fly on any two of the four engines. They had a top speed of over 240 m.p.h.,

and cruising speed of 215 m.p.h., with a cruising range of 1,675 miles with 25 passengers on board. The gross weight was 45,000 lbs., the wing span, 107 ft., the length, 74 ft. The luxuriously-furnished passenger section was divided into four six-passenger lounge compartments, plus nine individual reclining chairs along one side. The 33-passenger daytime plane could be converted into a 25-passenger night transport, with 16 berths and the nine reclining chairs.

Boeing production activities for 1940 included an \$8,000,000 Army Air Corps contract for B-17C Flying Fortresses to follow the B-17B's; completion of Stratoliner deliveries to Pan American and T.W.A.; and work on the new Model 314 Pan American clippers for delivery in 1941.

Brewster Aeronautical Corporation, Long Island City, N. Y., produced several single-engine combat models, among them a 2-place scout bomber, the SBA-1, export model 138. It had a wing span of 39 ft., length 27 ft. 9.5 in., and gross weight 5,381 lbs., with a Wright Cyclone engine of 750 h.p. at 2,100 r.p.m. at 15,000 ft. Other Brewster models included the XF2A-2 for the U. S. Navy with the export version 339 being built for England in 1940, and the F2A-2 for the U. S. Navy and its export version 439 being built for Belgium. This was Belgium's first production order for military aircraft in the United States. Other models were the F2A-1 for the U. S. Navy and its export version 239 which was bought by the Finnish Government with an initial order of 40. All the Brewster models with the exception of the SBA-1 (export model 138) were single-place fighters, and they also were powered with Wright Cyclones. Brewster also manufactured outer wings, ailerons, tip floats and outer braces for the Consolidated Aircraft Corporation on a Navy order for PBV long-range patrol boats. The company took additional plant space at Newark Airport early in 1940.

The Cessna Aircraft Company, Wichita, Kans., continued manufacture of its C-145 Airmaster monoplanes during 1939. 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 2,350 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 miles. During the year the C-165 model of the Airmaster was introduced, 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 485 to 725 miles. Take-off

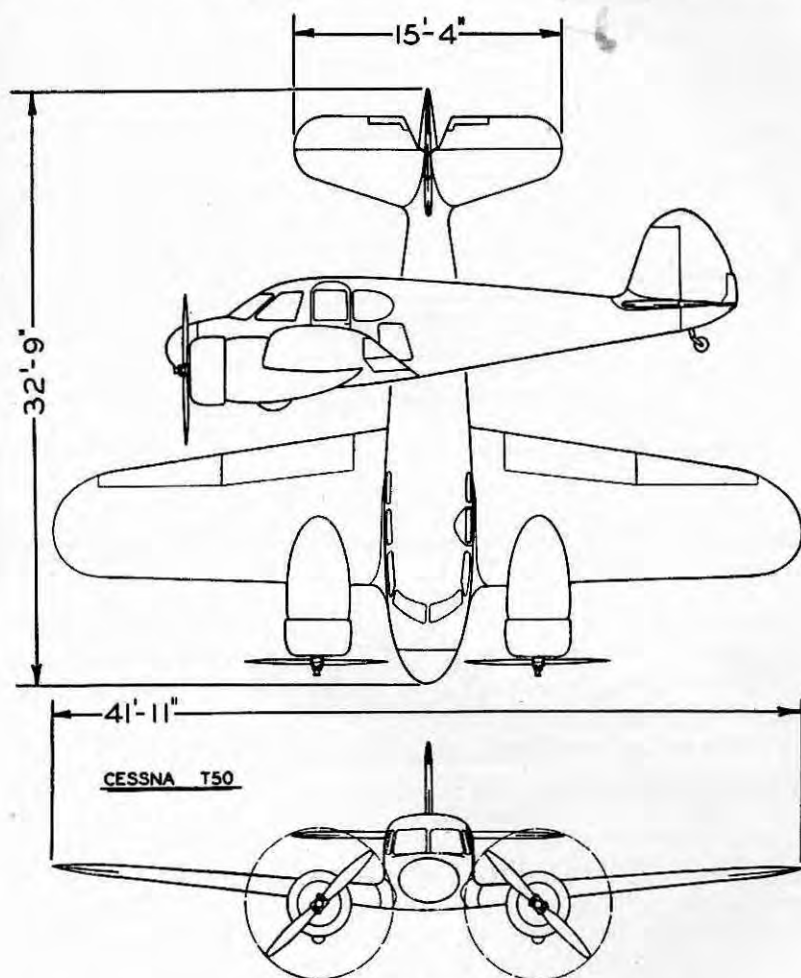


BREWSTER MODEL F2A-1

Also designated as Export Model 239, this fighter is Wright Cyclone powered.

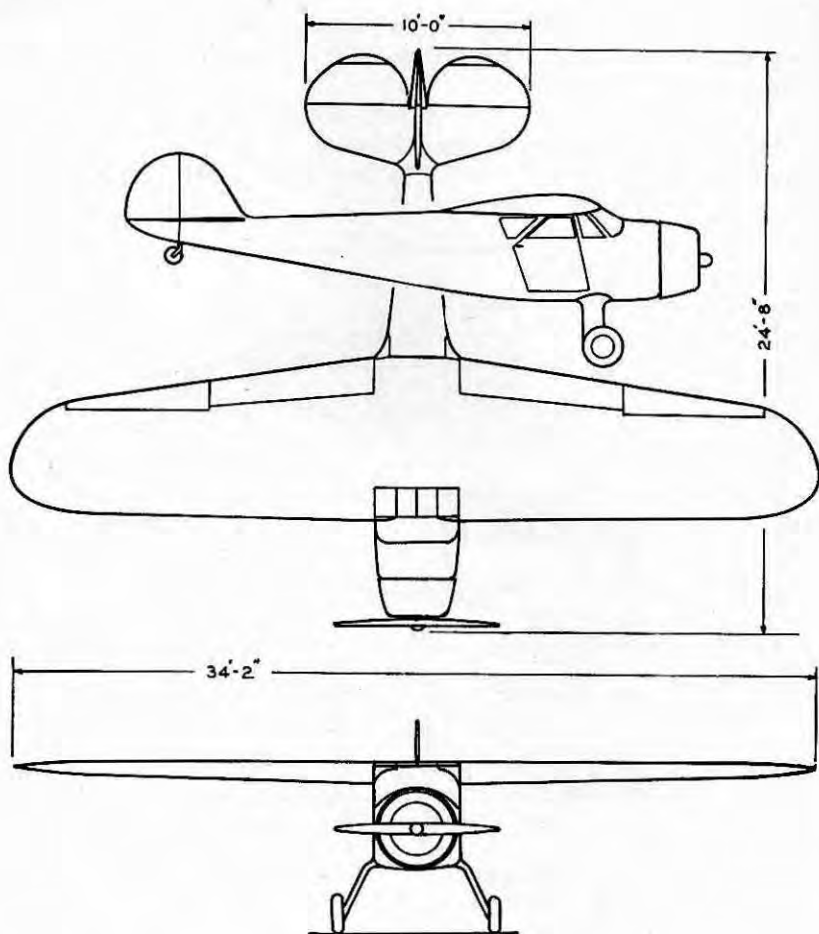
and climb were improved by the increase in horsepower. The 4-place Airmaster had a span of 34 ft. 2 in., length 24 ft. 8 in., and gross weight of 2,350 lbs.

Following a year of development, the Cessna T-50 twin-engine cabin monoplane was tested and licensed by the Civil Aeronautics Authority late in 1939. Powered by two Jacobs L4MB engines rated



CESSNA T-50

A twin-engine personal transport, carrying five, and powered with two Jacobs engines of 225 h.p. each.



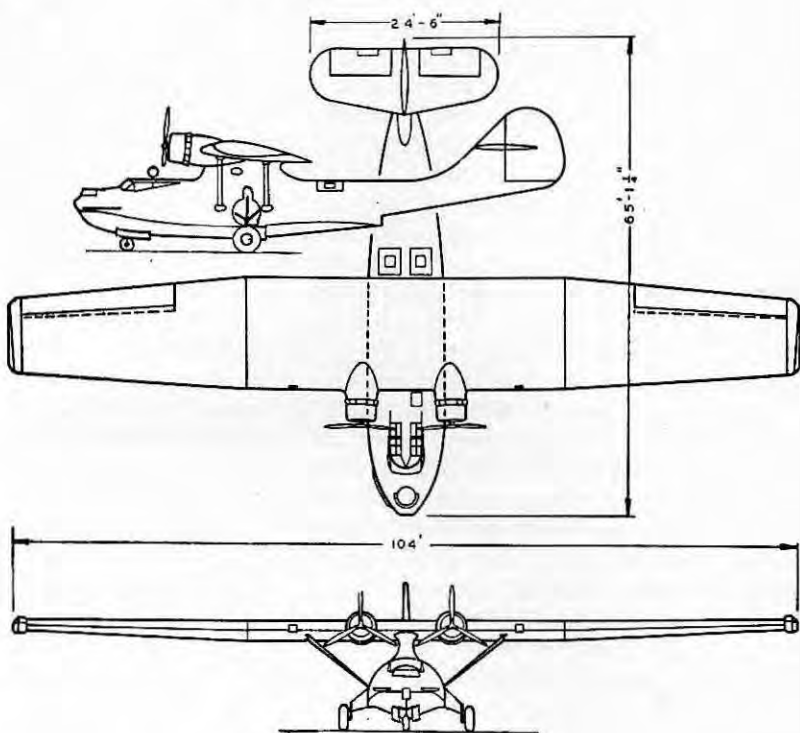
CESSNA AIRMASTER

A four-place plane for the private flier powered with either a 145 h.p. or 165 h.p. Warner Super Scarab engine.

at 225 h.p. each with 245 h.p. available for take-off, the T-50 carried five persons and baggage, with a range of 750 to 1,000 miles. 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 lends 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 5,000 lbs. The T-50 was also available as a military airplane, a trainer, ambulance, personnel transport or photographic airplane. Flight tests and inspection were completed at Wright Field, Dayton, O., by the U. S. Army Air Corps. Both versions of the Cessna Airmaster and also the Cessna T-50 were available on floats or skis.

Consolidated Aircraft Corporation, San Diego, Calif., in 1939 built up its backlog of business to over \$40,000,000. In this business was included a Navy contract for \$20,016,699., the largest order ever placed for aircraft by the U. S. Government with a single company. Consolidated completed a program of installation of new production equipment and alterations amounting to approximately half a million dollars early in the year, taking advantage of the lull between contracts; and acquired additional acreage in leased and option holdings, swelling the potential plant area from 32 to 64 acres. By the end of the year plans were under way for a program of expansion to enlarge its manufacturing facilities by 87 per cent. Personnel, which reached a low of about 1,200 in the spring of 1939, was increased steadily so that a peak of 7,500 was to be reached by mid-summer of 1940. Consolidated Aircraft Corporation has, in the immediate past, focused almost its entire attention upon its Model 28 twin-engine flying boats (Navy PBY). Over 200 had been purchased by the U. S. Navy, and they had an impressive record of performances. An additional number of that type was included in the record order from the Navy. Richard Archbold's Model 28, the "Guba" in 1939 completed its journey around the world, establishing several records, including the first circumnavigation of the globe by a flying boat, longest flying boat over-water hop, first plane to travel around the world at its maximum diameter, and the first crossing of the Indian Ocean by air. Another Model 28, built for the British Air Ministry, made the first flight delivery of a military aircraft across the Atlantic Ocean. This occurred just prior to the outbreak of war in 1939. A third Model 28, built for American Export Airlines, made numerous crossings of the Atlantic surveying commercial air routes. As a military flying boat the 28 was a 5- to 9-place patrol bomber with two Pratt & Whitney Twin Wasp engines of 1050 h.p. each at 2,550 r.p.m. at 7,800 ft. It had a wing span of 104 ft., length 65 ft. 1¾ in., height 17 ft. 11 in., gross weight 27,413 lbs., service ceiling of 24,000 ft., and range of 4,000 mi. Its stated cruising speed was 179 m.p.h. on 75 per cent power at 7,800 ft. The commercial version of the 28 could be arranged for 24 persons for day service or fitted with 12 berths for night service. The Consolidated 28-5A Amphibion utilized



CONSOLIDATED AMPHIBION

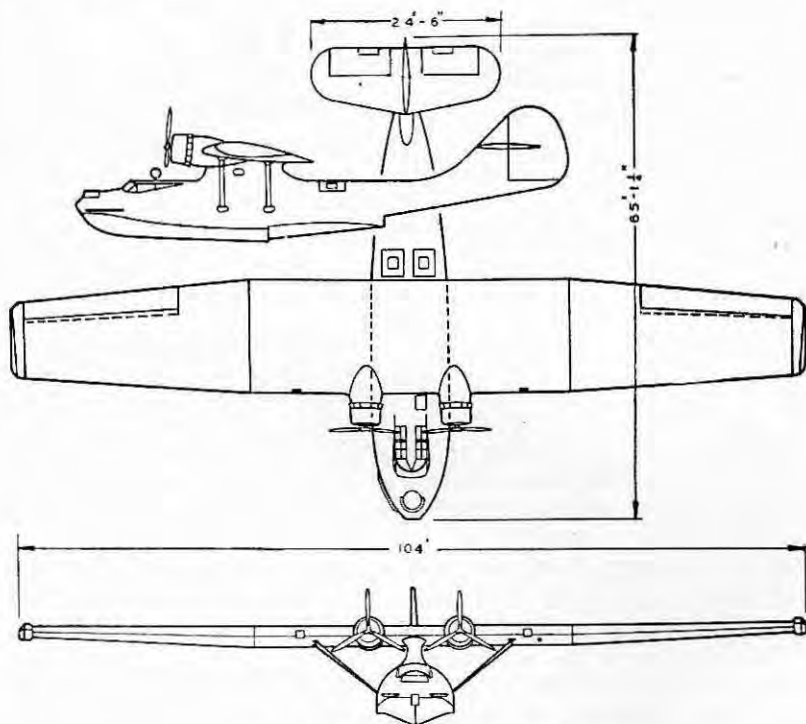
Model 28-5A carries 20 and is powered with two Pratt & Whitney Twin Wasp engines

the basic structure of the 28 flying boat modified to incorporate the amphibion landing gear. The landing gear was of the tricycle type, the wheels controlled normally by hydraulic gear, but capable of being operated by hand while in flight.

Consolidated in 1939 produced its model 31 twin-engine flying boat, with greater speed, range and load-carrying capacity. It was equipped with two 2,000 h.p. Wright Cyclone engines.

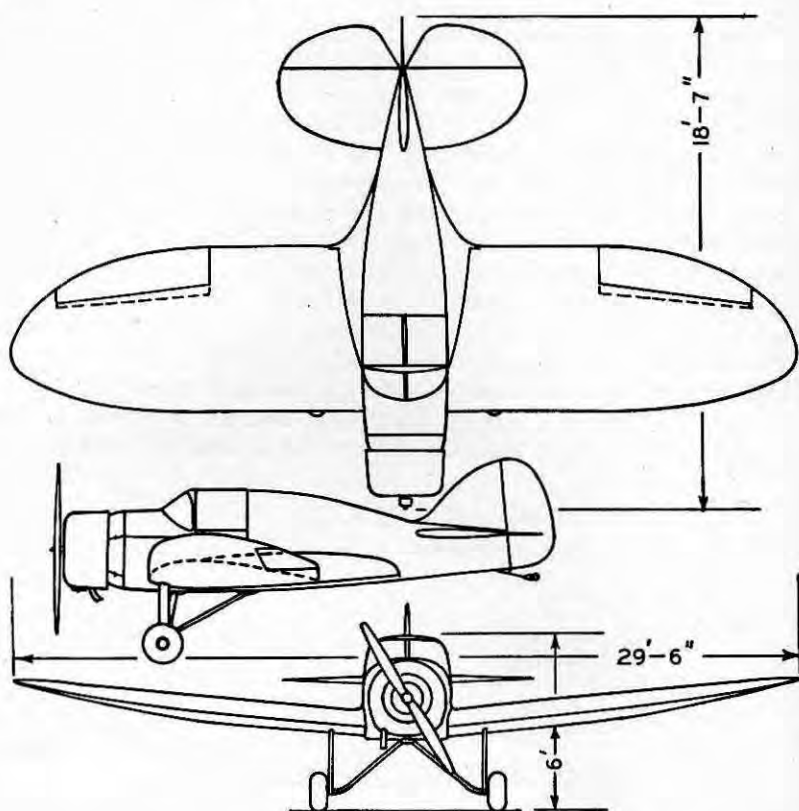
Consolidated's 4-engine U. S. Navy flying boat XPB2Y-1 was the basic model for a commercial version, model 29, described by the company as being able to carry 62 passengers by day or 36 at night. It was offered as an ocean transport with a wing span of 115 ft., overall length 79 ft. 3 in., height 25 ft. 4 in., wing area 1,780 sq. ft., gross weight 65,000 lbs., wing loading 36.5 lbs. per sq. ft., stated maximum speed 226 m.p.h. at 7,800 ft., cruising on 75 per cent

power at 210 m.p.h. at 10,000 ft., landing speed 70 m.p.h., maximum range 5,200 statute miles, take-off time 50 secs., with four Pratt & Whitney Twin Wasp engines, each having 1,200 h.p. for take-off. Consolidated re-entered the land plane field with its new U. S. Army Air Corps 4-engine bomber, the XB-24 (company model no. 32) described officially in the following statement: "It is of high-wing, all-metal construction. The wing is a full cantilever type of high aspect ratio with four tractor engine nacelles mounted flush to the upper surface of the center section. Fowler type flaps extend inboard of ailerons. Power is furnished by four Pratt & Whitney 18-cylinder twin-row Wasp radial air-cooled engines rated at 1,200 h.p. each. The propellers are Hamilton Standard 3-blade hydromatic constant speed types, 12 ft. in diameter. The gross weight of the airplane is 40,000 lbs., wing span 110 ft., length of fuselage 64 ft., and overall height 19 ft. Tactical requirements are for a crew of from 6 to 9,



CONSOLIDATED MODEL 28

A 20-place flying boat powered with two Pratt & Whitney Twin Wasp engines.



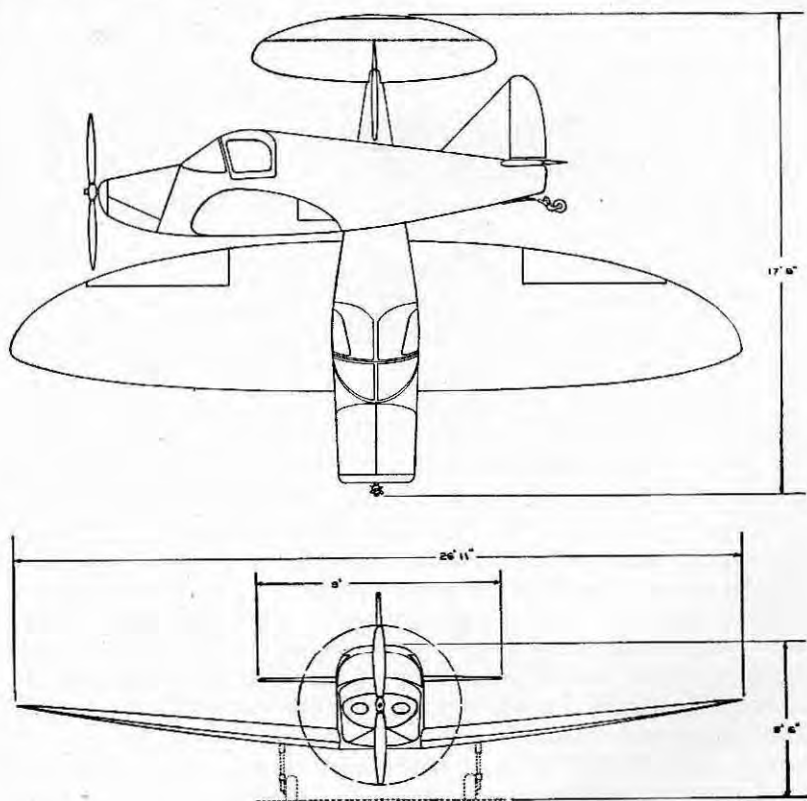
THE CULVER DART GW

A two-place plane with a Warner engine. This private owner machine is manufactured by the Culver Aircraft Corporation.

depending on the mission to be performed. Control surfaces are fabric covered and fully counterweighted. A full cantilever horizontal stabilizer has twin fins and rudders mounted at the tips. The all-metal stressed skin fuselage is equipped with hatches and windows in the nose, tail, turtledeck, back and bottom. The landing gear is of tricycle type with single wheel forward. This retracts into the fuselage. The rear or main landing wheels retract into wing wells. This airplane, from preliminary examinations, gives evidence of living up to the advancements in aerodynamic and performance characteristics predicted. These include a speed of over 300 m.p.h., range approximately 3,000 mi. and bomb carrying capacity of approximately 4 tons."

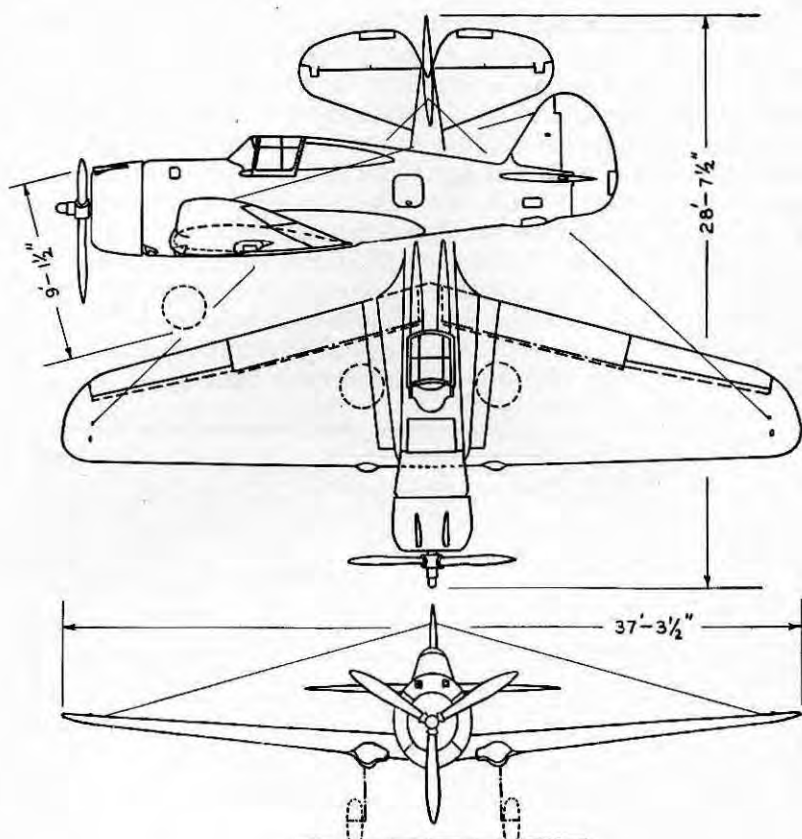
Culver Aircraft Corporation, Columbus, O., announced that it had increased production to 3 Dart airplanes a week. The Dart Model GW was given final approval by the C. A. A. The Dart Model GS was developed. Culver also developed a new 2-place, closed, low-wing, cantilever, monoplane with a retractable landing gear, the Culver Model L-CA. It was first flown in trial flight on December 2, 1939, at Columbus. Distributors were appointed in various sections of the country which were not already represented.

Curtiss Aeroplane Division of the Curtiss-Wright Corporation, Buffalo, N. Y., in 1939 completed its expansion program with the addition of 3 new buildings—an experimental building for new development projects, a final assembly shed which doubled the available space for that work and a metal surface building for the con-



CULVER DART MODEL L-CA

A Continental-powered two-place plane for the private owner.

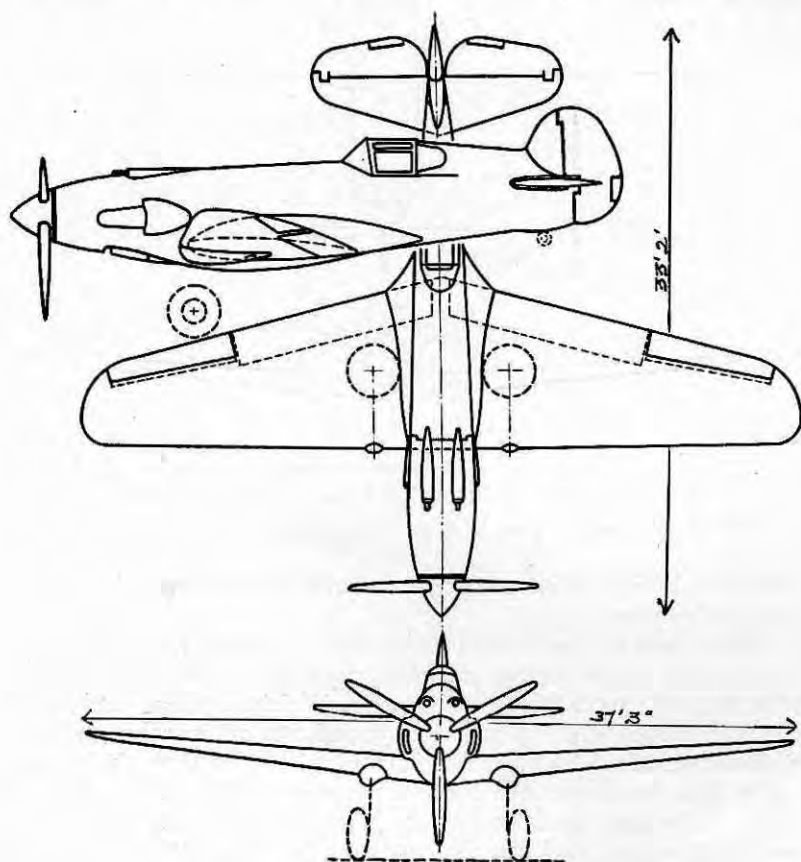


THE CURTISS P-36 PURSUIT

A single-seat fighter with Pratt & Whitney Twin Wasp engine.

struction of units for tail assembly. During the year Curtiss completed a contract for 210 P-36 pursuit planes for the U. S. Army Air Corps. Another large contract for Scout Bombers of the SBC-4 type was completed for the Navy to supplement Curtiss planes already in service aboard the carriers of the Fleet. Foreign business included 2 contracts for Hawk 75-A pursuit airplanes for the French and they gave satisfactory service in action against the German air forces. The XSO3C-1 scout observation was designed and built for the Navy. Another plane in the Hawk series, known as the Hawk 75A-4, powered with a G-205 Cyclone engine, was also added to the Curtiss line. Employment rose considerably in the last three months

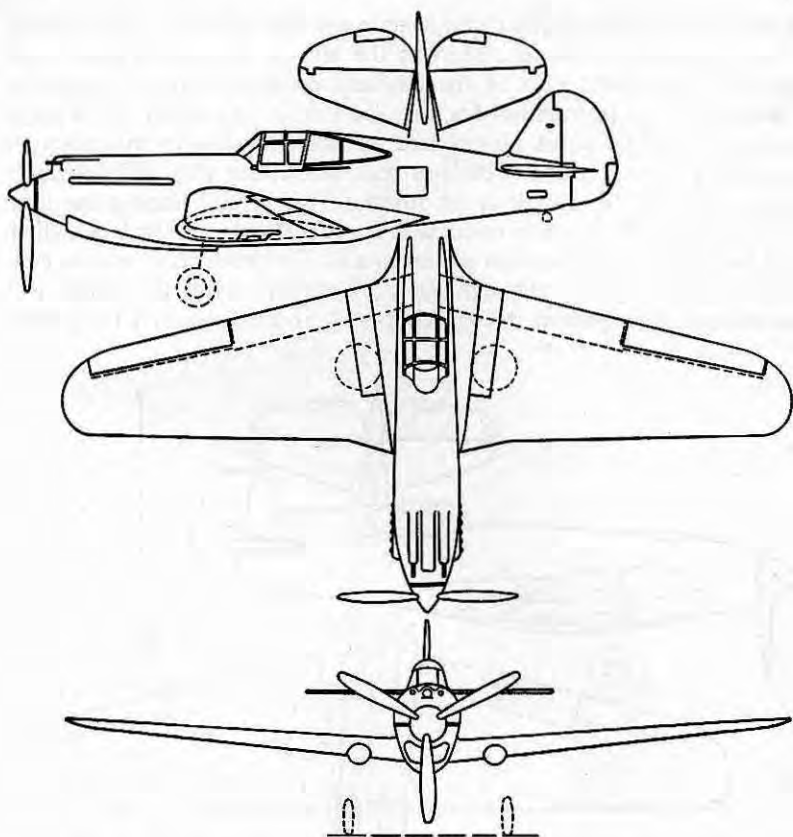
of the year and the original operating figure was doubled. The number of airplanes delivered in 1939 was the largest in Curtiss peace-time history. The major part of the business on hand early in 1940 was an order for P-40 pursuits for the Air Corps. An order for a large quantity of O-52 scout observation planes was also in progress. A contract for Navy Scout Bombers was well under way and deliveries begun. It was the fourth order for the SBC type, bringing the total to over 200. Production continued on the Hawk 75 airplane which had been sold to six foreign governments. Its production was to continue at peak capacity through 1940. A new model of the Hawk was announced. Designated the Hawk 75-A5, it was powered by a more



CURTISS P-37

An Allison-powered, single-place pursuit.





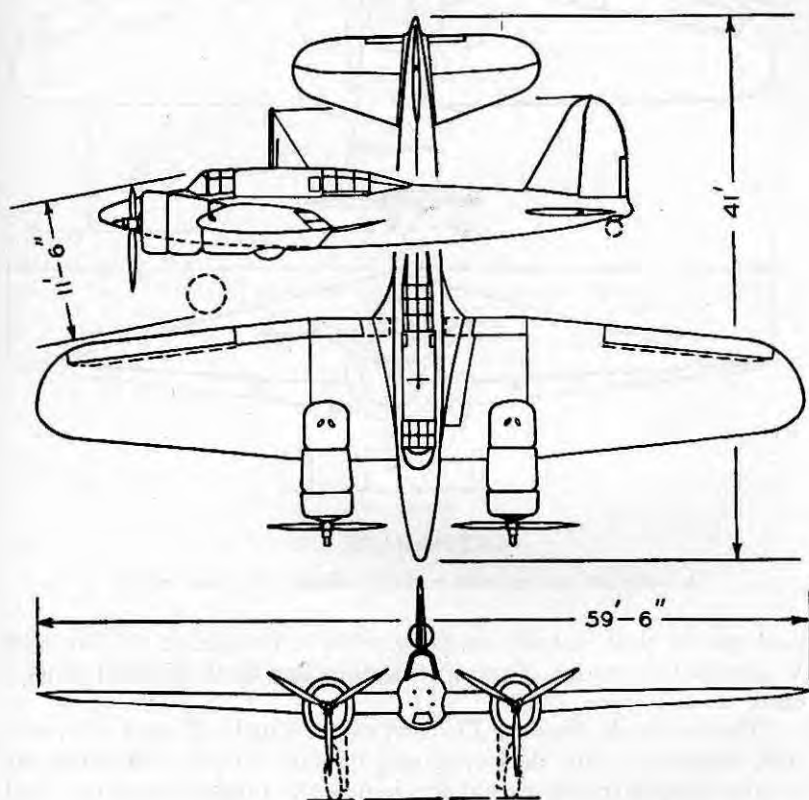
CURTISS P-40

This single-place pursuit is powered with an Allison engine.

powerful Wright Cyclone engine. Several experimental projects were under way.

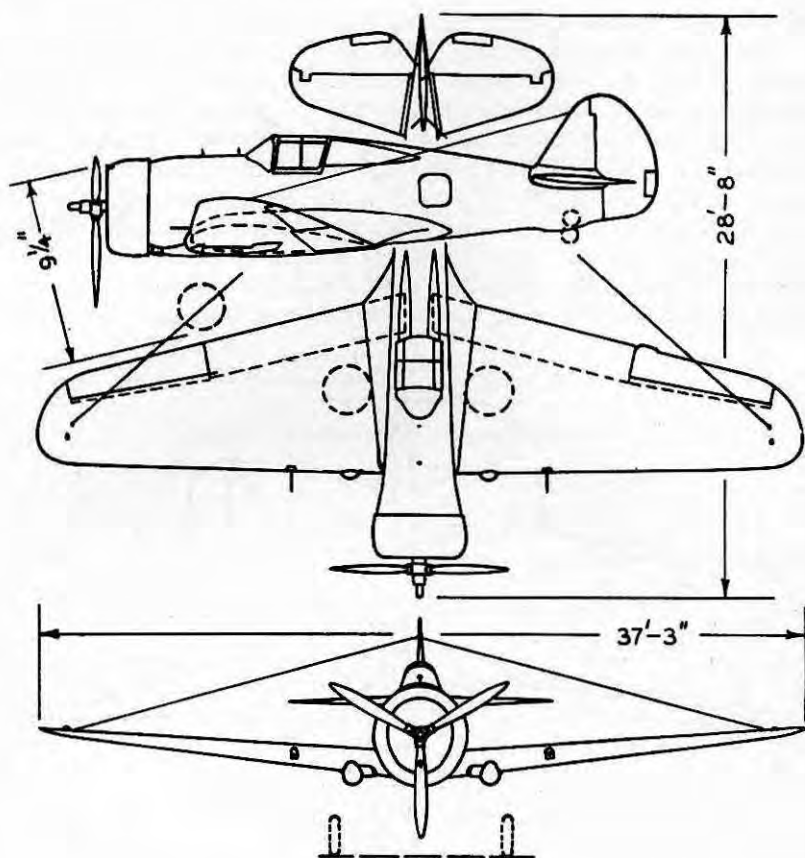
The export version of the Curtiss Army P-36 was the Hawk 75-A, a one-place, single-engine, low-wing pursuit ship of all-metal construction with retractable landing gear, Wright Cyclone engine and Curtiss constant speed propeller. A 30 and a 60 cal. machine gun were mounted on the fuselage and synchronized to fire through the propeller disc. Provision was made for heavier caliber guns and bomb racks. The wing span was 37 ft. 3 in., length 28 ft. 8 in., gross weight 5,750 lbs., fuel capacity 105 gal., stated maximum speed 323 m.p.h., cruising at 262 m.p.h. at critical altitude. Among the exten-

sive line of Curtiss military models were the following: the YP-37, a low-wing, all-metal pursuit plane with retractable landing gear, span 37 ft. 3 in., length 33 ft. 2 in., Allison V liquid-cooled engine, General Electric turbo-supercharger and Curtiss electric propeller; the P-40 low-wing, all-metal pursuit with retractable landing gear, Allison 12 cyl. V liquid-cooled engine, Curtiss electric propeller, span 37 ft. 3 in., length 31 ft. 8 in.; the P-42 low-wing, all-metal pursuit with retractable landing gear, powered by a Pratt & Whitney Twin Row Wasp with special cowl for streamlining and cooling, with Curtiss constant speed propeller; the Curtiss XSO₃C-1 scout observation, all-metal, of mid-wing design, crew of two, interchangeable with



THE CURTISS 76D

A twin-engine attack plane powered by two Wright Cyclone engines, 850 h.p. each.



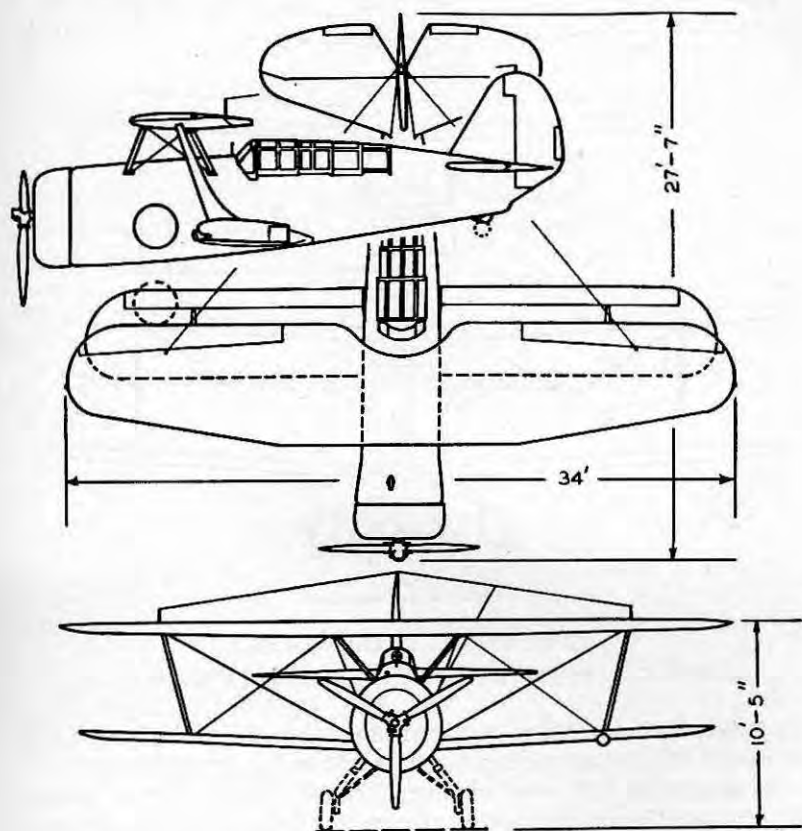
CURTISS HAWK 75A

A one-place pursuit with 1,200 h.p. Wright Cyclone engine.

land gear or float installation, powered by a Ranger 12 cyl. inverted V aircooled engine of Navy specification, for battleship and cruiser observation service.

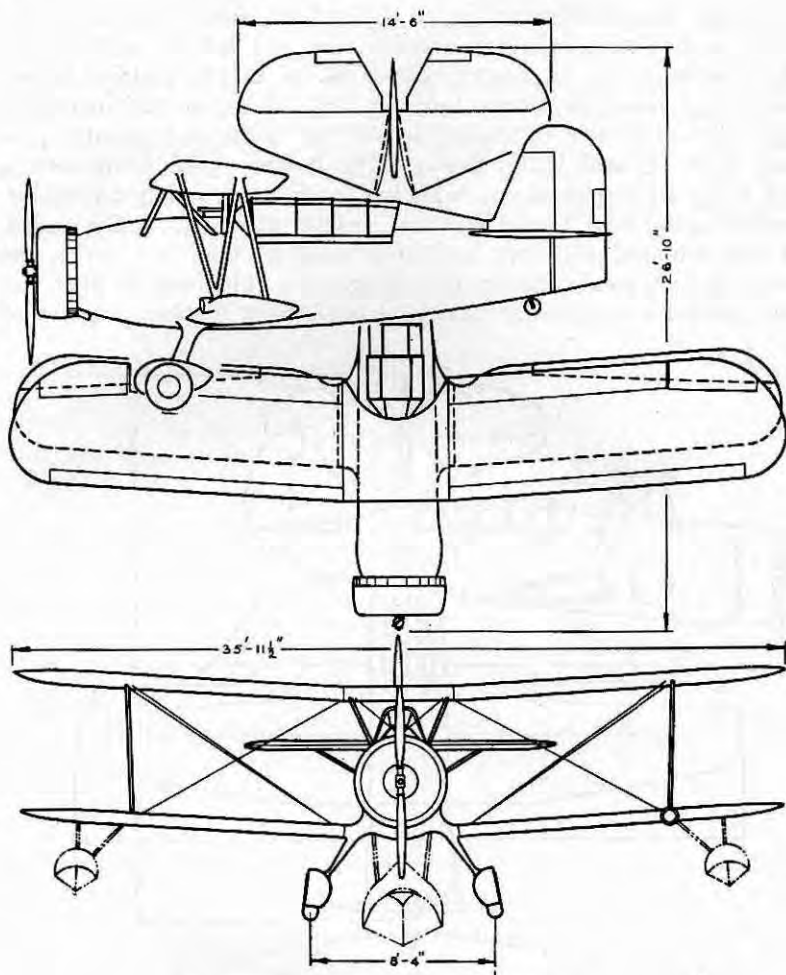
The St. Louis Airplane Division of the Curtiss-Wright Corporation, Robertson, Mo., developed new military models, completed the Curtiss-Wright transport, and was in quantity production on its 1 and 2-place military planes for the export market. The Curtiss-Wright transport, which was designed by Curtiss-Wright engineers working in close conjunction with technicians and pilots of the major air lines, was designed for safety and economy combined with high speed,

luxurious accommodations, heavy payload, maximum operating simplicity and advanced aerodynamic efficiency. Its flexible load-carrying characteristics, 36 passengers, 5,200 lbs. of cargo, qualified it for long-range non-stop service between large cities, or for short-hop, high payload service. Dwarfing in size any air liner regularly operated in the United States during 1939, it was 75 ft. from nose to tail, had a wing span of 108 ft., height 19 ft. 2 in., weight 24,750 lbs. empty, useful load 13,250 lbs., and weight 38,000 lbs. fully loaded. It was equipped with two fuel tanks in each of its two wings, the four having a total capacity of 1,000 gallons. The new air liner had two powerful 14-cylinder Wright Double-Row Cyclone engines of



CURTISS HELLDIVER 77

A two-place scout bomber with 850 h.p. Wright Cyclone engine.



CURTISS OBSERVATION SCOUT

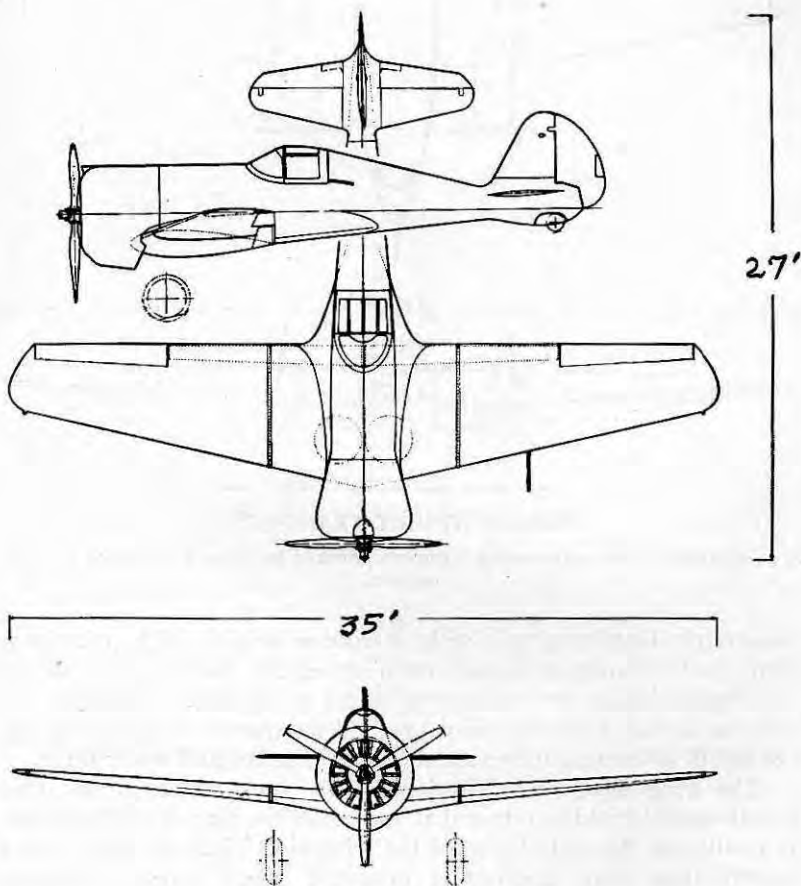
Model SOC, a two-place plane powered with a Pratt & Whitney Wasp.

1,700 h.p. each, calculated to give it a maximum speed of 243 m.p.h. at 13,000 ft., and a cruising speed of 210 m.p.h. at 10,000 ft.

Anticipating that some air line operators might want to increase the transport's payload and performance, Curtiss-Wright engineers so designed the new ship that it could be equipped with power plants of considerably greater power than those installed. The power plants were equipped with 15-ft. Curtiss electric "full-feathering" propellers,

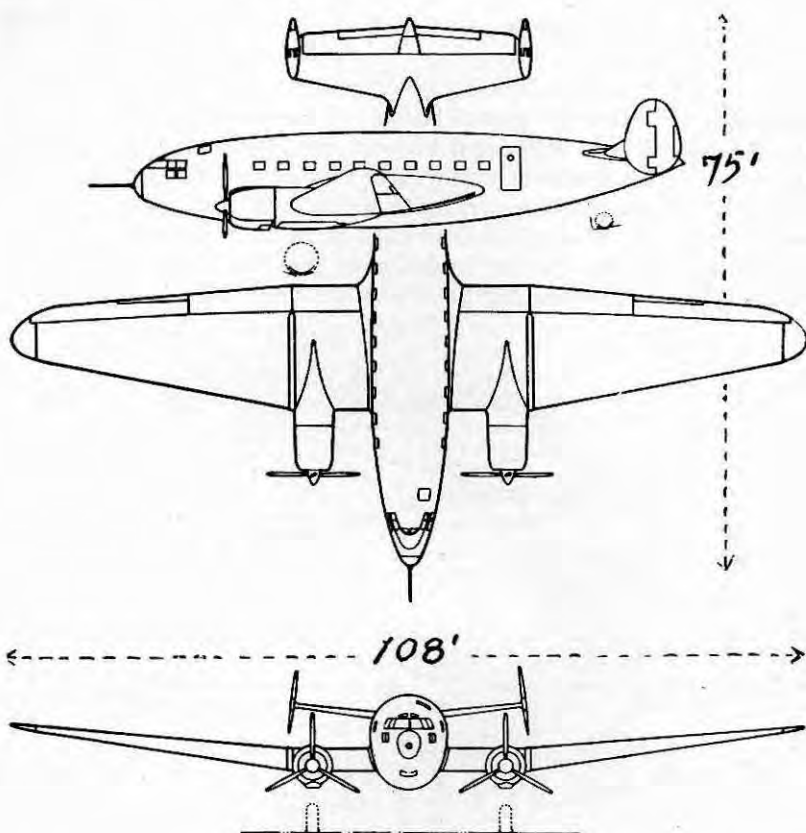
the largest ever manufactured for air line operations in the United States.

To permit normal cruising at 20,000 ft. with equivalent "cabin altitude" of 6,000 ft., pressurization of the fuselage was obtained by the use of two centrifugal blowers installed in the engine compartment. The fuselage employed a new cross-sectional design of two eccentric circles, intersecting in such a way that the floor joined their points of contact. The floor thus acted as a tension tie to withstand loads caused by the tendency of the two circles to separate under pressure. Above the floor was a roomy, luxurious passenger



CURTISS-WRIGHT 21-B

A single-place interceptor fighter, Wright Cyclone powered.



CURTISS-WRIGHT TRANSPORT

A 36-passenger twin-engine sealed transport powered by 1,700 h.p. Wright Cyclone engines.

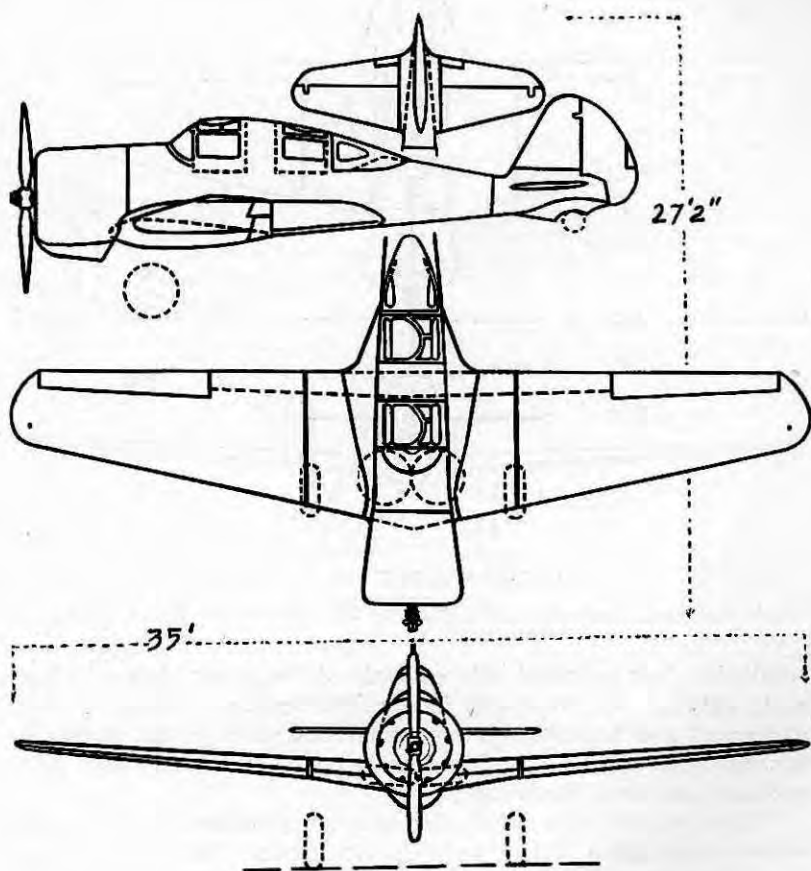
cabin 6.9 ft. high by 9.75 ft. wide at window height and 35.3 ft. long, with fixed-reclining or swivel reclining chairs for as many as 40, or sleeping berths for 20. Below was a cargo hold of 550 cu. ft. accommodating 5,200 lbs. of cargo and a separate compartment of 137 cu. ft. to contain such accessories as batteries and water tanks.

The wing design was developed after tests which proved that lateral control could be retained at and below the plane's stalling speed by modifying the airfoil toward the wing tip. Thus the plane could execute three-point landings at minimum speed without chancing "falling off on one wing," according to the builders.

While the use of only two engines relieved the pilot of the extra

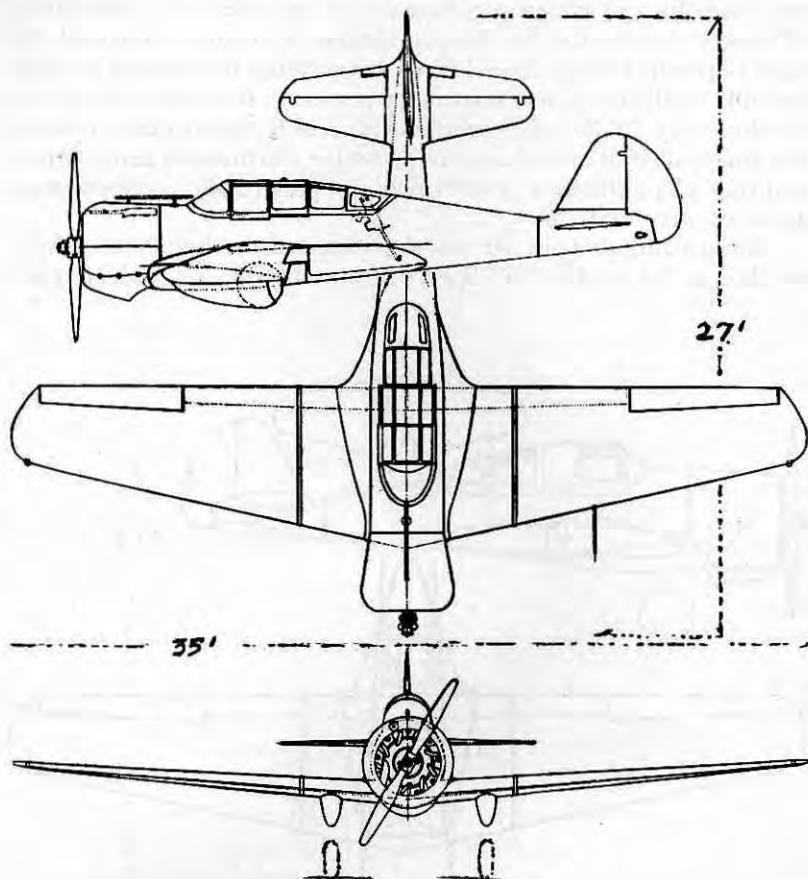
responsibility and effort attendant on the presence of a multiplicity of power plants, Curtiss-Wright engineers further simplified the pilot's operation of the new skyliner by reducing the number of flight controls in the modern transport 33 per cent; they also perfected a revolutionary "Tell-Tale" safety device which automatically checked the functioning of approximately 50 major instruments and controls, and thus was virtually a "fourth pilot." Special radio communication facilities were devised.

Recognizing that the air traveler expected the luxury of a hotel or club in the modern air liner, Curtiss-Wright installed adequate



CURTISS-WRIGHT 23

This two-place basic combat is powered with a Pratt & Whitney Wasp.



CURTISS-WRIGHT FALCON 22

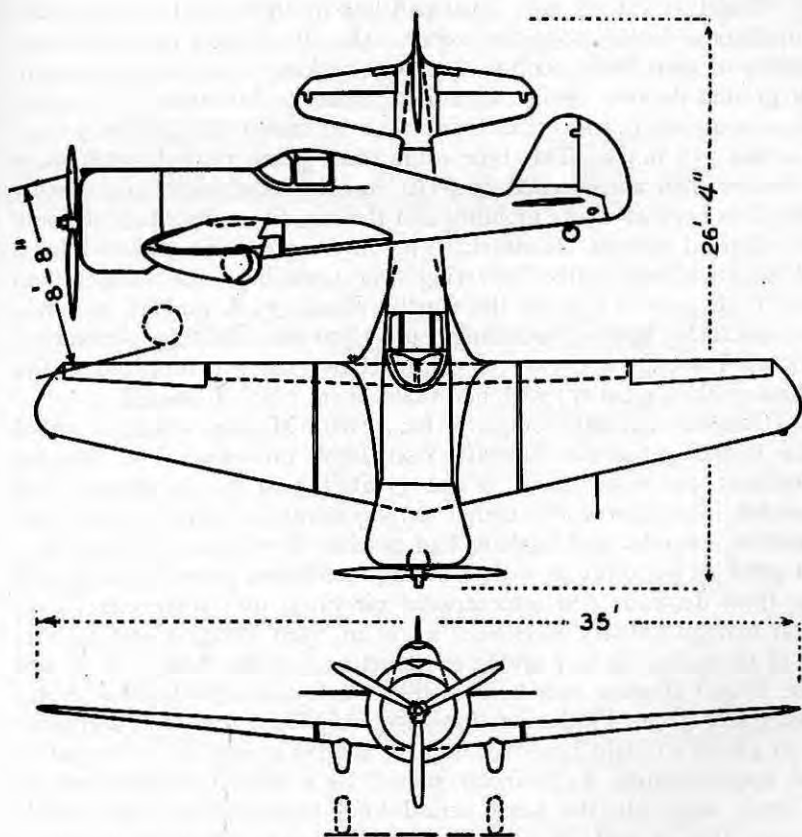
A two-place advanced trainer with 420 h.p. Wright Whirlwind engine.

ventilation, heat provided independently of the power plants, indirect cabin lighting, fully equipped food galley, accommodations for both a steward and hostess, separate washrooms and private lavatories for men and women, complete soundproofing, a heated cargo compartment and other innovations.

Three experts in American air transport operations were in charge of the construction. They were C. W. France, vice president and general manager, and once operations manager of Eastern Air Lines, Inc.; George A. Page, chief engineer, who has been flying and designing airplanes for over 25 years; and Dean Smith, who left the post

of senior pilot of American Airlines, Inc. to join the Curtiss-Wright Corporation. Specialists active in its development included Raymond Loewy, stylist; Dr. Stephen Zand, sound expert; Dr. John A. Younger, expert on pressurization for high altitude flying; and Dr. Albert E. Lombard, aerodynamicist and vibration and flutter expert. California Institute of Technology conducted the wind-tunnel tests.

Aside from the construction and test program of the big transport, Curtiss-Wright's factory was active in the military field. Early in 1939 the Falcon 22 advanced trainer was developed, and several months later a quantity order on this model was placed by a foreign government. It was a 2-place, low-wing, all-metal plane, powered by



CURTISS-WRIGHT 21

An interceptor fighter, Wright Cyclone-powered.

a Wright Whirlwind 420 h.p. engine, stated high speed 215 m.p.h., cruising at 195 m.p.h. The Falcon 22 could carry combinations of equipment for gunnery, bombing, aerial photography, long-range observations, radio communications, photographic gunnery or blind flying missions.

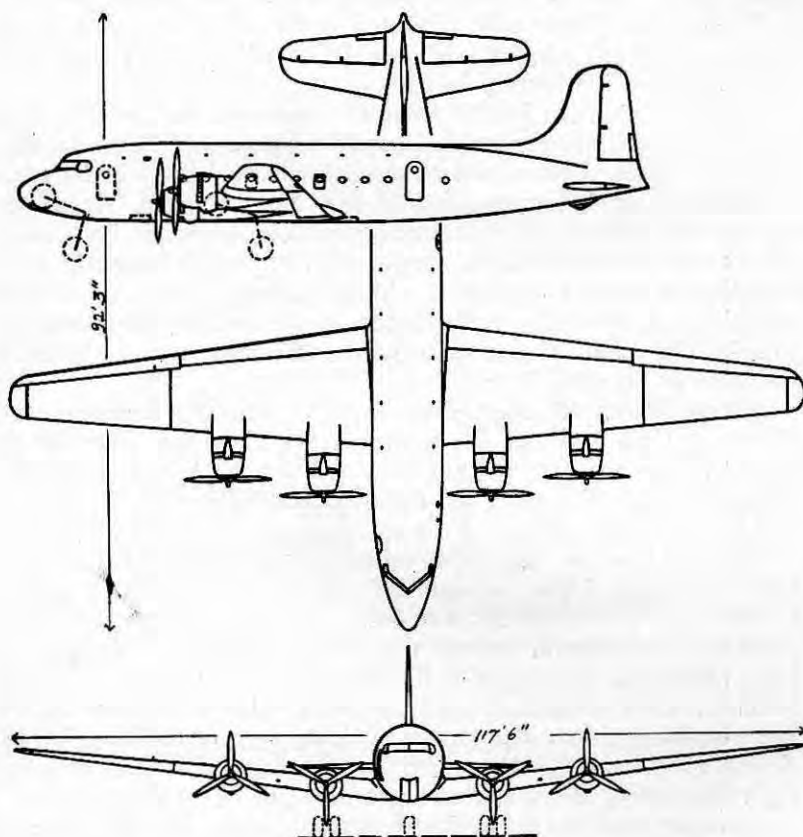
Another new development was the Model 23 basic combat. Built to U. S. Army Air Corps requirements, it was a single engine, 2-place, all-metal low-wing monoplane with fully retractable landing gear. Powered by a Pratt & Whitney 550 h.p. Wasp engine, stated maximum speed was 254 m.p.h. Equipped with a Wright Cyclone the airplane was available as a 2-place fighter with a stated top speed of 330 m.p.h.

Model 21 Interceptor, developed late in 1938, went into quantity production during 1939 for export sale. It claimed rapid climbing ability of more than 5,000 ft. a minute, making it an ideal instrument of ground defense against invading bombers. An altitude of 20,000 ft. was attained in less than 6 minutes. Its stated top speed at 17,000 ft. was 315 m.p.h. This type of military plane proved much more effective than anti-aircraft batteries in combating high-flying enemy bombers because of its mobility and the rapidity with which it could be directed against an attack. The Interceptor was powered by a Wright Cyclone engine delivering over 1,000 h.p., was smaller than the P-36 pursuit type or the Curtiss Hawk 75-A pursuit, and was considerably lighter, weighing but 4,350 lbs. loaded. Armament included two .30 and two .50 cal. machine guns synchronized to fire through the propeller; with additional wing guns if desired.

Douglas Aircraft Company, Inc., Santa Monica, Calif., reported the following for the Aircraft Year Book for 1940: The Douglas company put 1939 down as the greatest year in its history, and headed into 1940 with further achievements in sight. Sales, production, payrolls and backlog had reached new peaks. Output was stepped up smoothly as orders of unprecedented proportions poured in from domestic and international air lines, the Army and Navy, and foreign military missions. Early in 1940 Douglas was authorized to disclose it had under construction for the Army Air Corps the largest airplane ever built in this country, a super-bomber designated the B-19. Production for 1939 included commercial and military planes of eight types. A backlog at the close of the first quarter of approximately \$33,100,000 soared to a record \$97,000,000 by March, 1940. In the same period total employment at the firm's Santa Monica and El Segundo, Calif., plants rose from 6,225 to well over 15,000. Plans called for orderly increase in personnel until mid-summer 1940, when it would touch 17,000 with a \$28,000,000

annual payroll. Orders for air line transports at home and abroad were booked in record-breaking volume during 1939, and the 400 mark in production of the renowned "DC" series was passed. Forty giant 4-engine DC-4 land transports, worth \$14,000,000 were on order. At the end of March, 1940, 33 were already under contract for American Airlines (15), United Air Lines (10), Eastern Air Lines (4), and Pan American Airways (4), in addition to a number being negotiated by leading carriers abroad.

Refined and improved, the production DC-4 surpassed in everything but size the famous prototype developed by Douglas and five air lines at a cost of nearly \$3,000,000. Equipped with super-charged



DOUGLAS DC-4

This 42-place transport is powered with either four Pratt & Whitney Twin Wasps or four Wright Cyclones.

cabin for upper-level flight, the new ship varied from 40 to 42 passengers as a day air liner and 20 to 22 as a sleeper, with crew of five or six. Like its predecessor it had a retractable "tri-safety" (tri-cycle) landing gear. With capacity for 4,500 lbs. of cargo and 1,700 gallons of gasoline, the huge craft's gross weight was 50,000 lbs. It had a stated top speed of 262 m.p.h., cruising at 229 m.p.h. at 15,000 ft. with cruising range under some conditions exceeding 2,000 miles.

Completed and put through extensive flight tests was the new DC-5, a 16-passenger, high-wing transport designed for short route operations. In the last six months of 1939 Douglas made record contracts to build 82 skyliners costing \$10,000,000, all in addition to DC-4 orders. These sales consisted of the 21-passenger DC-3, the 14-passenger DST sleeper, and new DC-5. Sixty DC-3 transports were scheduled for delivery in 1940.

Domestic air lines buying Douglas equipment for the first time were Northwest, Pennsylvania-Central, Chicago and Southern and Delta Air Lines. Others who returned for more equipment included American, United, Eastern, Braniff and Pan-American. Outstanding was the role played by Douglas products in the air line safety record announced in March, 1940, when 17 major domestic lines completed a year of operations without a single fatality or serious injury to any person. Of the 815,000,000 passenger-miles covered, Douglas DC-2 and DC-3 transports were estimated to have accounted for about 85 per cent.

As of March 28, 1940, there were in domestic operation 117 DC-2, 25 DST and 139 DC-3 transports. They had given actual service of 551,227 hrs., 263,724 hrs., and 533,529 hrs., respectively. Prototype of the DC series and the only plane built of the DC-1 type was believed still active.

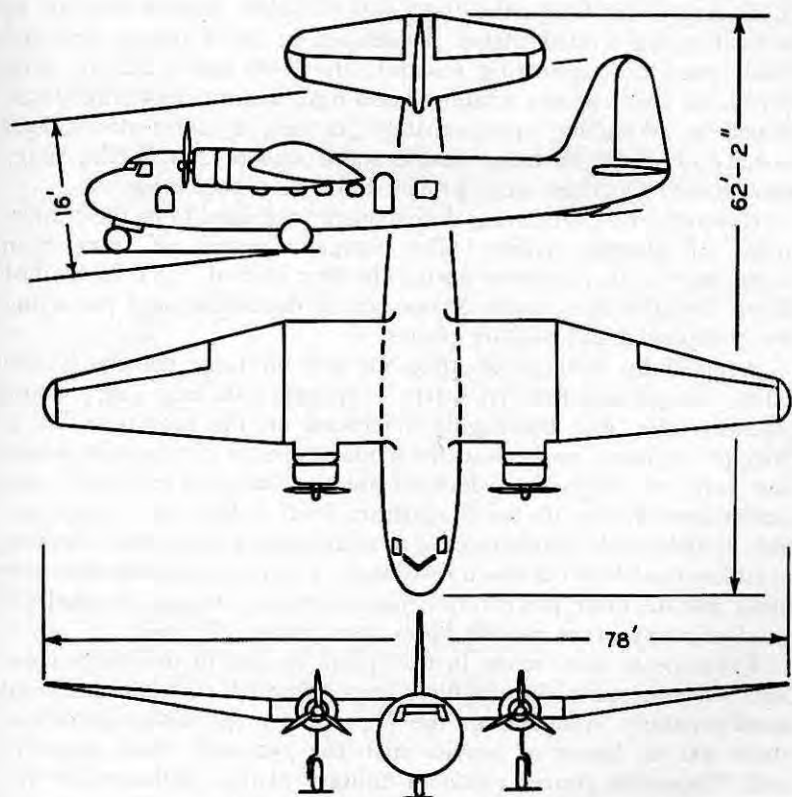
Foreign lines in 1939 were substantial purchasers of the company's transport ships. Canadian Colonial Airways, new to Douglas, ordered several DC-3 planes, and asked for more in 1940. For commercial air line use in Europe the Fokker organization bought 10 DC-3 planes, one to be used in the Irish Free State. K.L.M., Royal Dutch Airlines, contracted for four DC-5 ships to be used on its West Indies division. Air France took delivery on a DC-3 for its difficult run between Buenos Aires and Santiago, Chile. Its delivery flight was among the longest on record, requiring 10 days.

Speedier and more formidable military ships for the nation's defense in the air continued to flow from the two Douglas factories. In 1939 the U. S. Army Air Corps was taking delivery on a standard reconnaissance bomber, the B-18A, of which series it put more than

350 into service. The Air Corps received its first B-23, improved successor to the B-18A, under an order for 30. It also signed large contracts for the new A-20 and A-20A high-wing attack-bombers. Delivered at the start of 1939 were 37 C-39 ships, a version of the commercial DC-3 specially adapted for use as an Army transport.

The U. S. Navy took up an option on TED dive-bombers, bringing the total to 129. Later, it contracted for a large quantity of the swift new SBD scout-bombers, and four DC-5 planes as cargo and transport craft.

The European war brought to Douglas more military buyers from abroad. France already had ordered 100 DB-7 attack-bombers worth \$20,000,000, a type similar to the U. S. Army's A-20. When war



THE DOUGLAS DC-5

A 19-place transport powered by two Wright Cyclones or two Pratt & Whitney Twin Wasps.

began the French placed another substantial order for DB-7 ships, soon following with an allotment for DB-7A bombardment craft. The Royal Canadian Air Force ordered 20 DB-280 bombers, a modification of the B-18A series, costing \$3,000,000. Early in 1940 Great Britain signed for \$20,000,000 worth of DB-7B and A-20 attack-bombers. The DB-7 was an all-metal, twin-engine, high-wing monoplane for crew of three. Each wing was built in four units, the fuselage in three and the tail surfaces in seven, thus simplifying both assembly and shipping.

Peru took delivery during 1939 on 10 8A-3P low-wing attack-bombers, while the Netherlands received 18, and the Kingdom of Iraq ordered 15.

In the spring of 1940 Douglas had under construction for the U. S. Army Air Corps the B-19 super-bomber, largest airplane to be built in the United States. Developed in secret during two and a half years of engineering research, the B-19 had a 212 ft. wing spread, its four engines totaling 8,000 h.p., with 16-foot three-blade propellers. Weighing approximately 70 tons, it had a useful load capacity of about 28 tons. Stated speed was to 200 m.p.h., range 6,000 miles. Quarters were provided for a 10-man crew.

Research and engineering development continued to be the cornerstones of Douglas policy. The company wrote off more than \$1,000,000 for that purpose during the first half of 1939. In the last decade Douglas spent some \$9,000,000 in developing and perfecting new commercial and military planes.

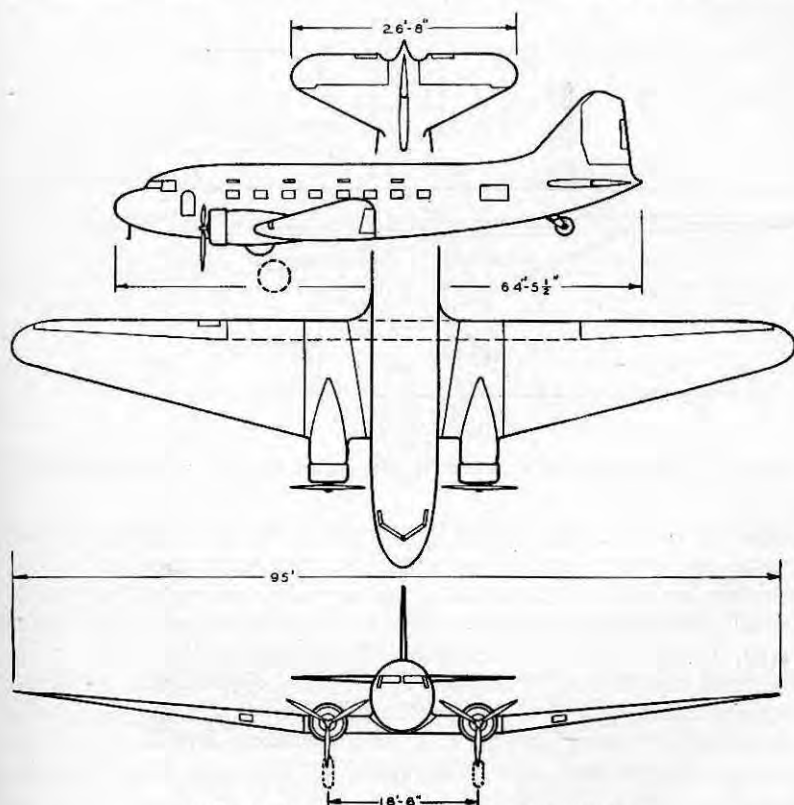
Adopted by Douglas in 1939 for use on large transports and military ships was the "tri-safety" (tricycle) landing gear, whose practical value was thoroughly evidenced on the prototype DC-4. Douglas engineers worked out the modern version of this gear during four years of study. To reduce weight the "integral gas tank" was accepted, employing the wing structure itself, rather than a separate tank, to hold fuel. Flush riveting was adopted for external surfaces on all late models to cut down resistance. With aerodynamic improvements and the more powerful engines available, Douglas boosted the speed of many of its models into upper 300 m.p.h. levels.

Refinements were made in transports to add to passenger comfort. Greater quiet during flight was achieved through improved sound-proofing. Adopted for the DC-4 was a 3,500-watt generator which was no larger or heavier than the 750-watt model formerly used. To enable clearer vision in military planes, methacrylate was substituted for the transparent plastics previously used for purposes such as cockpit enclosures.

While the company installed much new equipment and machinery

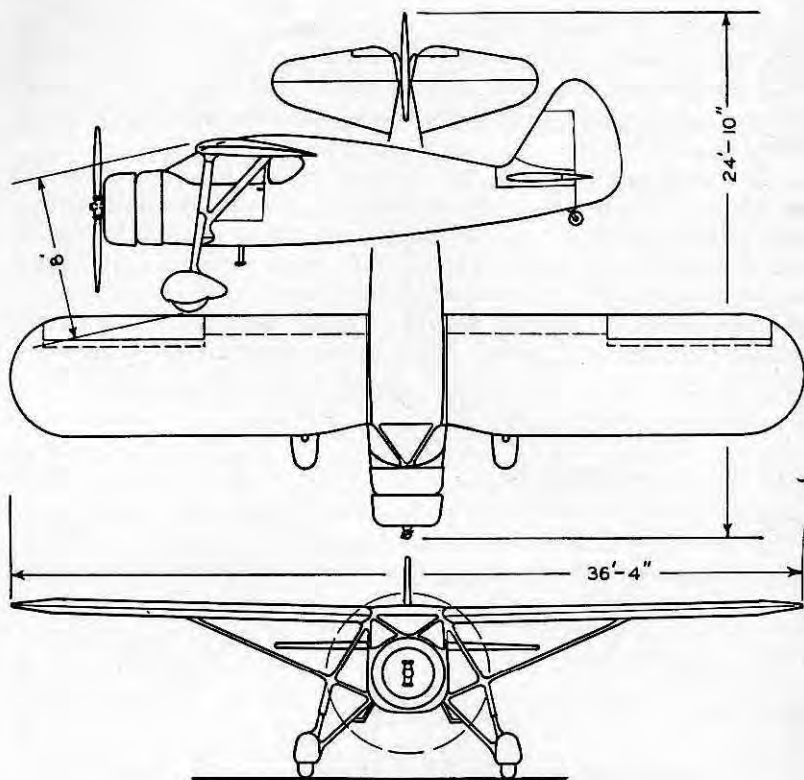
to facilitate its steady advance in production, recourse to costly building expansion was avoided. As the first quarter of 1940 closed, with three shifts employed in both plants, the company's working area covered approximately 2,000,000 sq. ft., utilizing in all some 28 acres.

The corporate set-up of the Fairchild Aircraft Corporation and the Ranger Engineering Corporation in 1939 was changed so that both units became part of the same corporation—Fairchild Engine and Airplane Corporation. The aircraft manufacturing unit located in Hagerstown, Md., was known as the Fairchild Aircraft Division of the Fairchild Engine and Airplane Corporation. Its personnel and policies remained unchanged. Many major items of equipment 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 Wasps or Wright Cyclone engines.



THE FAIRCHILD 24

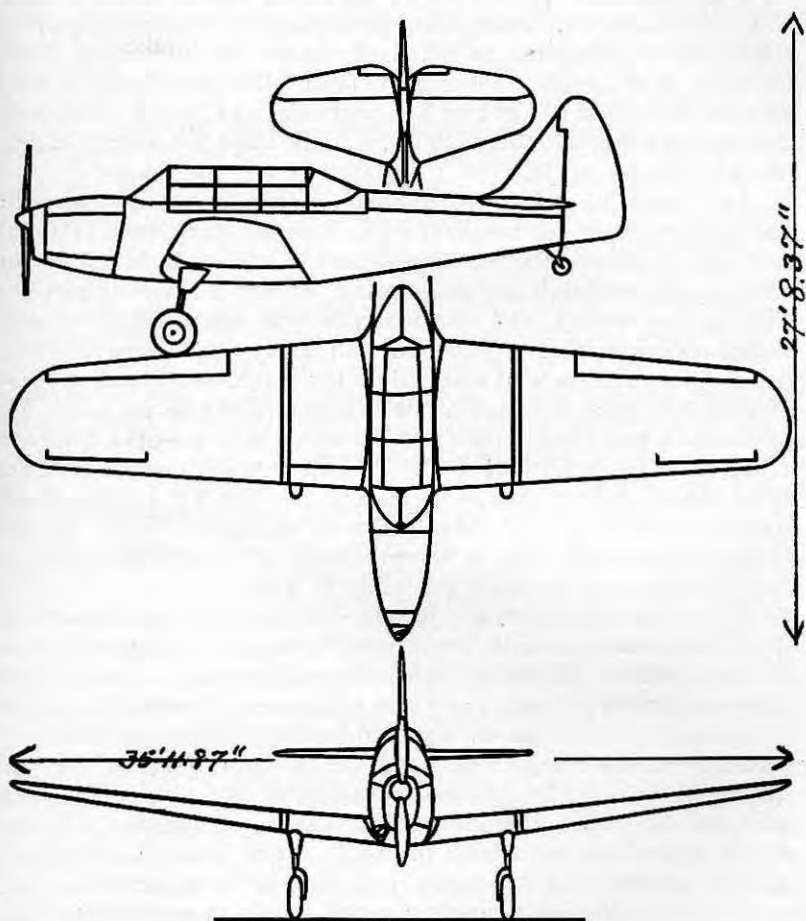
A private owner plane with Warner or Ranger engine. Above is Warner installation.

added to the factory, including a 750-ton hydraulic press, punch presses and lathes. Factory personnel was tripled to meet expanding business for the commercial and military ships being manufactured as well as for the sub-contract parts business which had been undertaken. Commercial airplanes included 4 models of the 4-place cabin Fairchild 24. Ten were shipped to the Civil Aeronautics Authority to supplement a fleet of 23 purchased in 1938. In addition, sales were made to many foreign countries, including Brazil, Venezuela, France, Switzerland, Australia, Siam, Alaska and the Philippine Islands.

In July, 1939, Fairchild's new military primary trainer the M-62 was entered in an Air Corps competition at Wright Field. As a result of this competition an order was obtained from the U. S. Army

Air Corps for over \$1,500,000 worth of these trainers, powered with Ranger 6-cylinder engines. The ships were to be used in the various training centers. The M-62 was picked because, as a low-wing type, it permitted easier transition to the more advanced types. Furthermore, its power of 175 h.p. and gross weight of 2,450 lbs. gave the student the "feel" of larger types.

The Fairchild 24 continued along the same lines as previous models. The Ranger-powered model was offered with 175 h.p. to give the plane better performance. A rate of climb of 830 ft. per



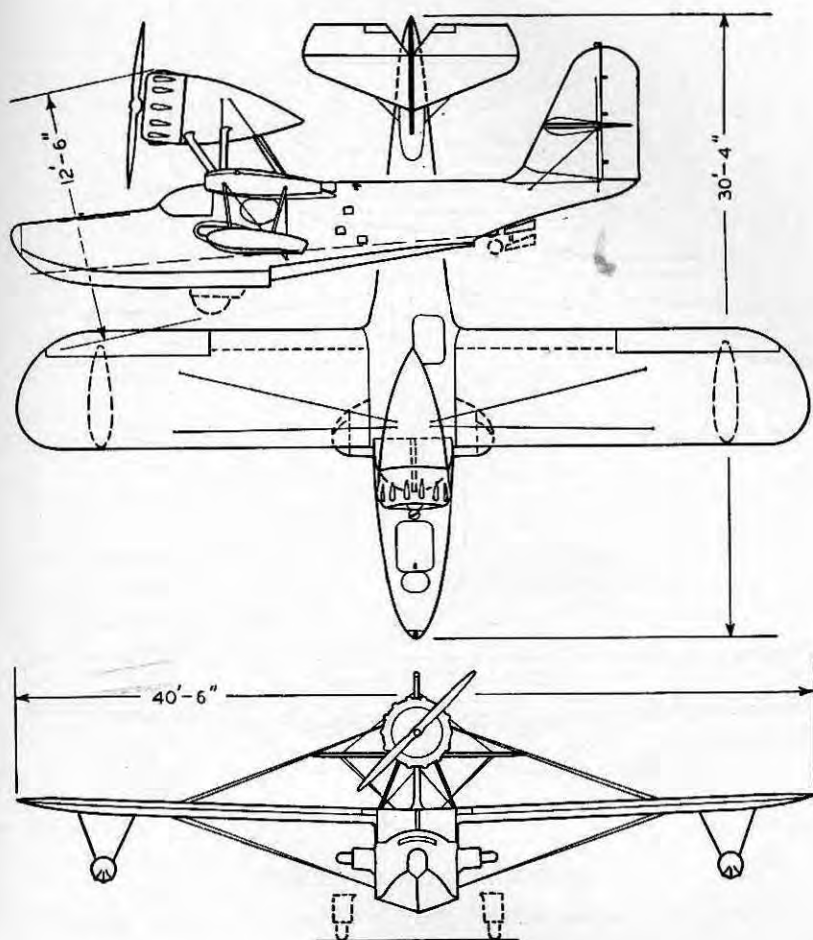
FAIRCHILD M-62

A Ranger-powered two-place military trainer.

min. was attained with full load, and the stated cruising speed at optimum altitude was 130 m.p.h. The Warner-powered 24 had the 145 h.p. Super Scarab engine. In this model fuel tanks of 60 gallons capacity were offered as regular equipment, giving the ship a cruising range of over 6 hours. Other items of equipment which were supplied as standard included wing flaps, hydraulic brakes, steerable tail-wheel, bonding for radio and glass door windows. The Fairchild 24 land planes were licensed to a gross weight of 2,550 lbs. The weight empty of the Warner model was 1,482 lbs., allowing for a useful load of 1,068 lbs. The useful load in the Ranger model was 989 lbs., the reduction being due chiefly to the addition of an engine-driven generator as standard equipment, and other items, including wheel pants and high gloss finish. Both models had a wing span of 36 ft. 4 in., height of 8 ft. and length of 23.9 ft. The wing area was 174 sq. ft. so that with full load the ships had a wing loading of 14.65 lbs. per sq. ft.

The Fairchild M-62 was a military primary trainer especially designed and built for use by the U. S. Army Air Corps (PT-19) and other military services. It was first test flown in March, 1939, after a year's research and engineering. It was a low-wing airplane with tandem seating, and was available with open cockpit or with sliding cockpit enclosure. Powered with the 175 h.p. engine, the ship had a stated high speed at sea level of 135 m.p.h. and a landing speed of 48 m.p.h., with flaps and a rate of climb of 835 ft. per min. The M-62 had a gross weight of 2,450 lbs. which with a weight empty of 1,749 lbs. left a useful load of 701 lbs. That useful load provided for 45 gallons of fuel, 4 gallons of oil and 400 lbs., for instructor and student, parachutes and other military equipment. Built to Air Corps requirements with a strength factor of 10, the ship had an overall span of 36 ft. and length of 27 ft. 8 in.

Fleetwings, Incorporated, Bristol, Pa., applied new features to its stainless steel Sea Bird Amphibion, Model F5. It continued to use the two-position Hamilton Standard variable-pitch propeller. The plane was licensed to seat 4 or 5 and was powered by a Jacobs engine. The company's activities during 1939 besides building Sea Birds, included contracts from the U. S. Government for restricted types of ships. Fleetwings also received considerable business for stainless steel and aluminum fixed and movable surfaces, together with hydraulic valve equipment from the U. S. Navy, Coast Guard, Glenn Martin, Curtiss-Wright, Stinson, Bell, Brewster and Republic. During the year appreciable increases were made in shop equipment, and the company had a potential production capacity of \$900,000 to \$1,000,000 a month. Plans for 1940 contemplated an intensified pro-

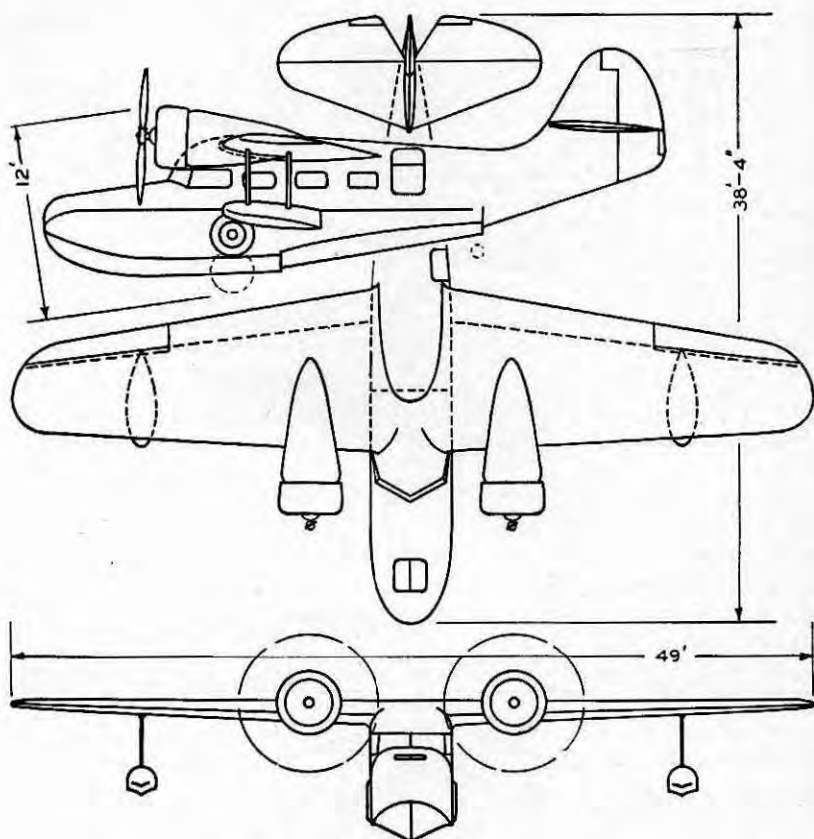


THE FLEETWINGS SEABIRD

It is powered by a Jacobs engine.

duction of work similar to that of the past. The company was equipped not only for the fabrication and manufacture of either complete planes or airplane parts, but its engineering department had been greatly augmented. Fleetwings also developed a line of hydraulic equipment which is rapidly being standardized in the industry; and the valve equipment was being used on both U. S. Navy and foreign fighting warships.

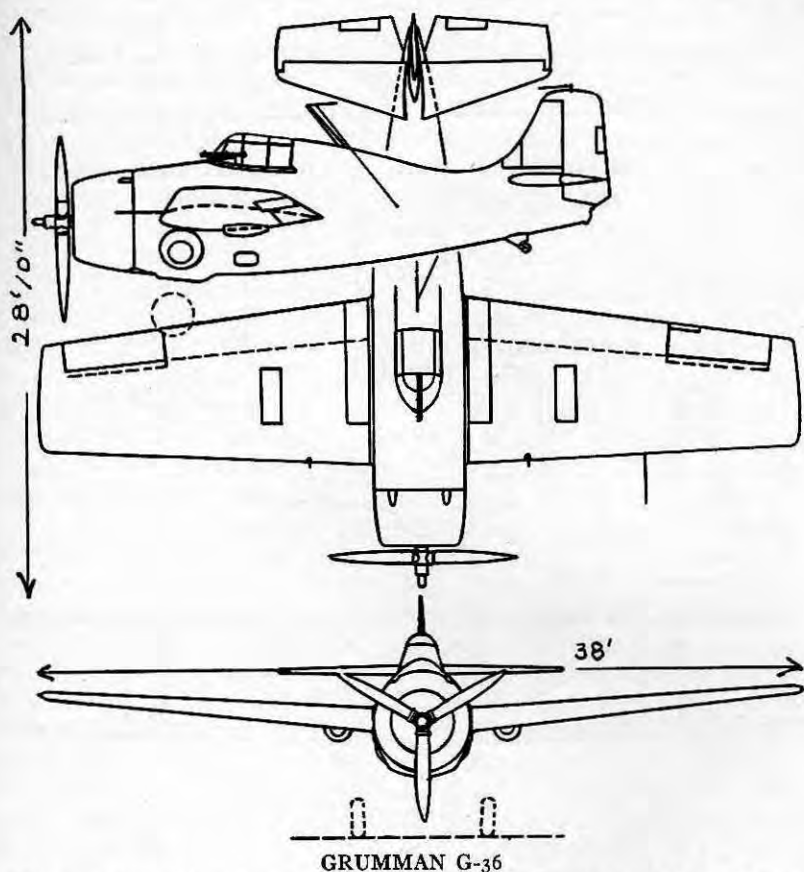
Grumman Aircraft Corporation, Bethpage, N. Y., in April, 1940,

**GRUMMAN G-21A AMPHIBION**

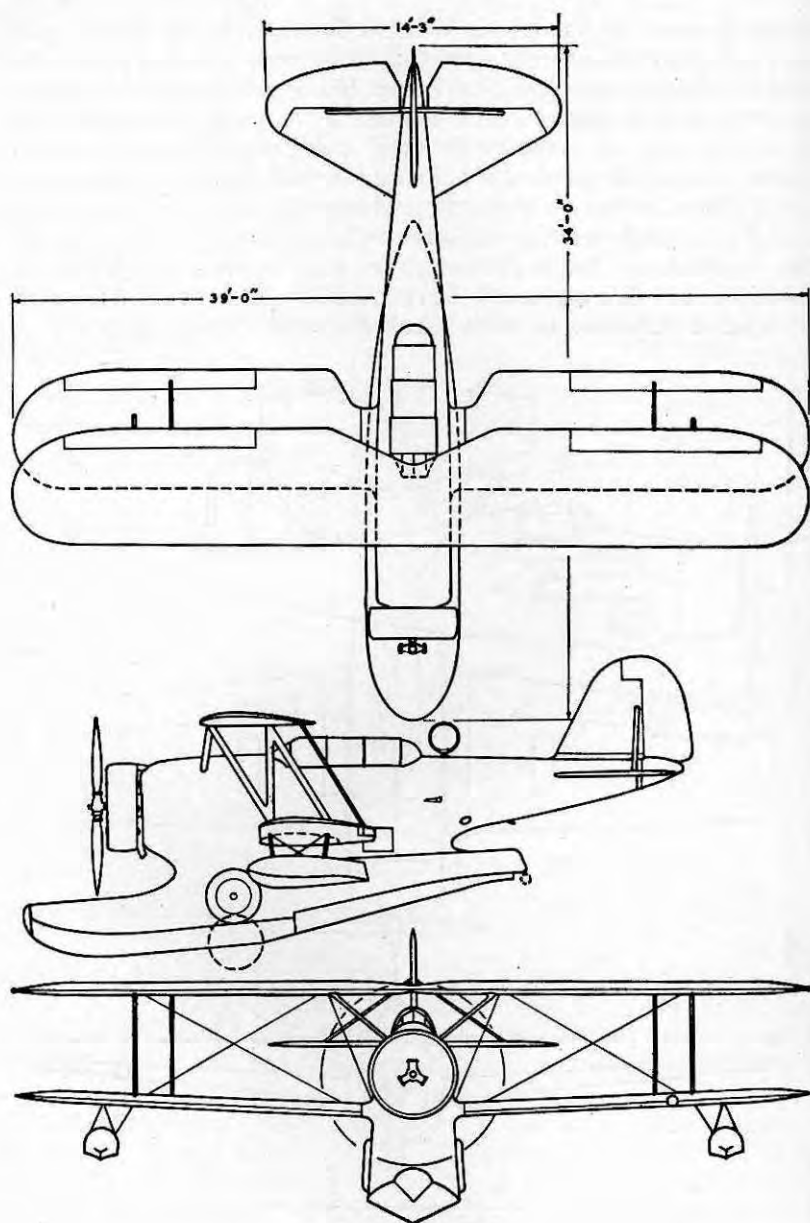
An eight-place machine with two Pratt & Whitney Wasp Junior engines.

introduced its twin-engine fighter Sky-Rocket which it had developed for the U. S. Navy. The machine had a single wing span of about 42 ft., length of about 28 ft. 6 in., and was powered by 2 Wright Cyclone engines of 1,200 h.p. each. Under test it showed high speed and fast climbing ability, its high speed being at about 16,000 ft. altitude. The engines were on the leading edge of the wing and the pilot's cockpit was in a nacelle extending back and supporting the double rudder tail assembly. A statement from the company, released with Navy approval made the following comments about the plane. "Its rate of fire is unrestricted by the usual handicap of firing through the propellers. It can pour an uninterrupted stream of fire

from its nose. Events on the Western Front show that heavier guns are necessary because planes already have been armored against the lighter caliber guns. The Sky-Rocket has an additional fuel capacity over its normal military load to increase its range so that it may act as a convoy for the bombers on their long-range missions." Meanwhile, Grumman continued building single-seat fighters and utility amphibions for the U. S. Navy. Delivery was completed on an order for F3F-3 single-seat fighters and also on an order for J2F type utility amphibions. An additional order was received for J2F-4 amphibions, and delivery was to be completed early in 1940. Eleven additional commercial G-21A's were delivered during 1939 and an



This one-place fighter may be powered with a Pratt & Whitney Twin Wasp or a Wright Cyclone engine.

**GRUMMAN J2F-1**

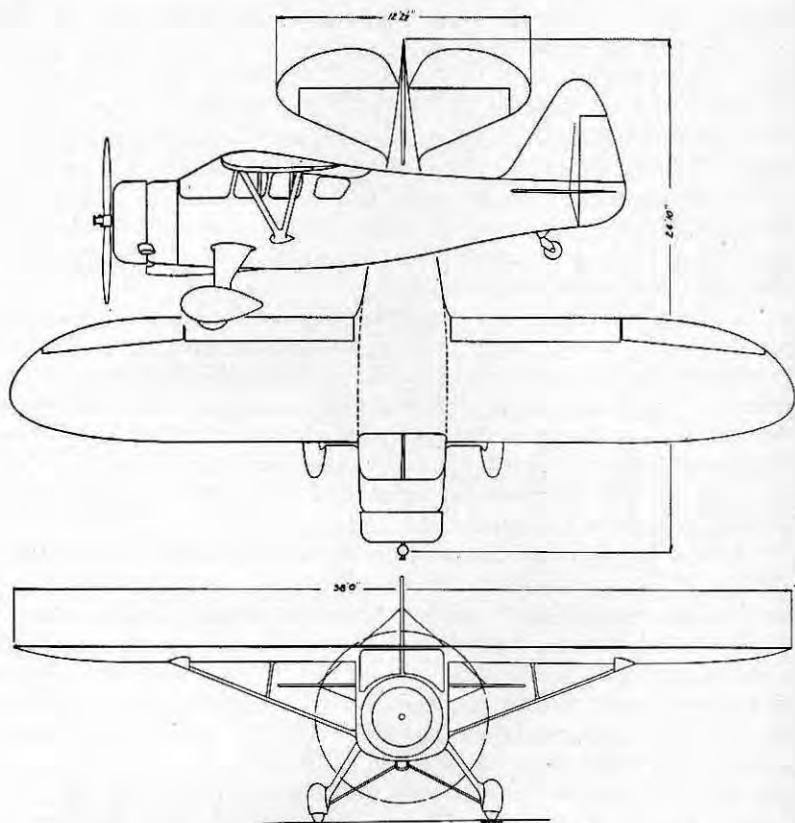
A two to four-place military plane powered with a Wright Cyclone engine.

order for JRF-1's for the U. S. Navy was completed. Delivery was completed on an order of JRF-2's for the U. S. Coast Guard, and more were ordered. The JRF-1 and JRF-2 were modified versions of the G-21A. A number of OA-9 (Army version of the G-21A) were delivered to the Air Corps. G-21B planes were ordered by Portugal. The G-21B was a military version of the G-21A, and had provision for mounting machine guns and bomb racks. It also carried an extra gas tank for increased range; and was manufactured either as a flying boat or an amphibian. Elimination of the landing gear effected a substantial weight saving.

A Grumman single-seat monoplane fighter F4F-3 was developed for the Navy, and an order was in production early in 1940. An export version of the F4F-3 was the Grumman G-36. Outward appearance of the two planes was the same, the only notable difference between the two being in the type of engines used. The F4F-3 was the newest fighter for the U. S. Navy, and was to be placed in service in 1940. It was designed for shipboard operation as a light dive bomber as well as a fighter.

Harlow Engineering Corporation, Alhambra, Calif., produced the Harlow PJC-1, a two-place commercial monoplane powered by a 145 h.p. Warner Super Scarab engine. It had retractable landing gear.

Howard Aircraft Corporation, Chicago, Ill., in 1939 went through a re-organization, re-financing and re-engineering program. Facilities were doubled and personnel increased to expand the production of the 1940 Howard DGA-15 series. It was a high performing 5-place high-wing cabin monoplane, built for private, business or commercial flying purposes. It was the outgrowth of 5 years of continuous effort directed toward producing an airplane that would serve the widest possible field of usefulness. To this end Howard engineers made provision for easy installation of a Multi-Use door so that conversion might be conveniently made when necessary to use the airplane for other than personal transportation, such as carrying cargo, mail, express, stretcher patients or camera equipment. The two models in production were identical up to the motor mount; therefore, both had the same features throughout with the exception of motor, propeller and certain accessories, which were reflected in performance. The construction was rugged and simple, combining service-proven features with advanced manufacturing methods. Considerable attention was devoted to both pilot and passenger requirements. As a consequence, improved pilot vision, convenient grouping of instruments, scientific soundproofing, tasteful styling of interior, and adequate ventilation and heating featured the Howard DGA-15. While 120 gallon gasoline capacity was standard on both models, it



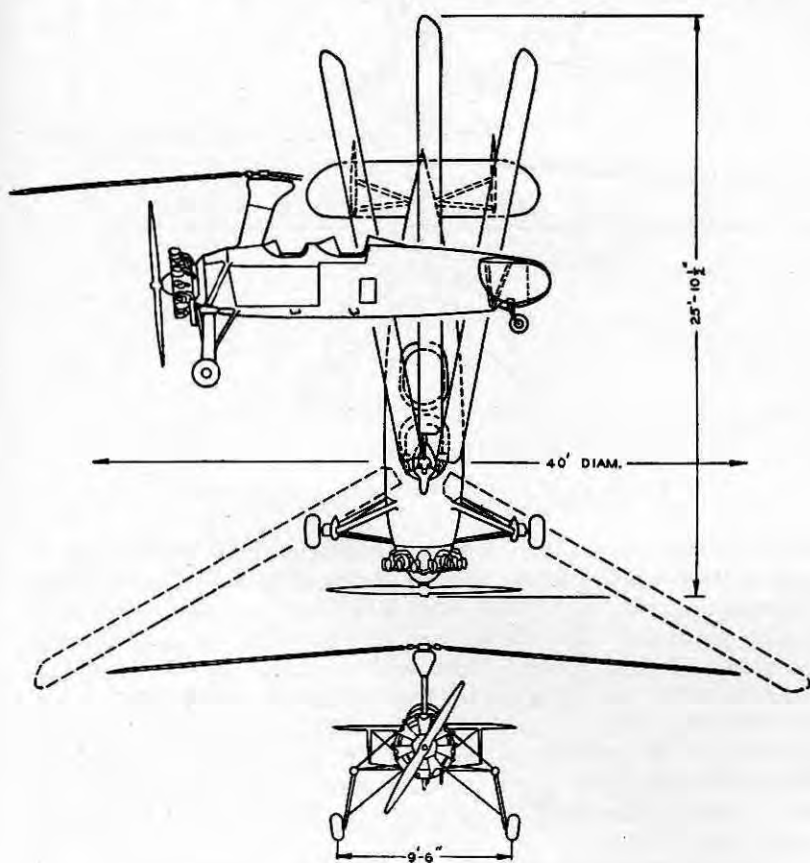
HOWARD DGA-15P

A five-place plane powered with a Pratt & Whitney Wasp Junior. The DGA-15J version is powered with a Jacobs engine.

could be increased to 150 gallons to obtain extreme cruising ranges of well over 1,000 miles. Gasoline was carried in tanks beneath the cabin, which together with high-wing design and heavy wing loading, gave super-stability to flight characteristics and the ability to fly through rough air smoothly. Take-off performance was assisted and landing speed decreased by means of electrically operated spring loaded "high lift" flaps of unusually efficient design.

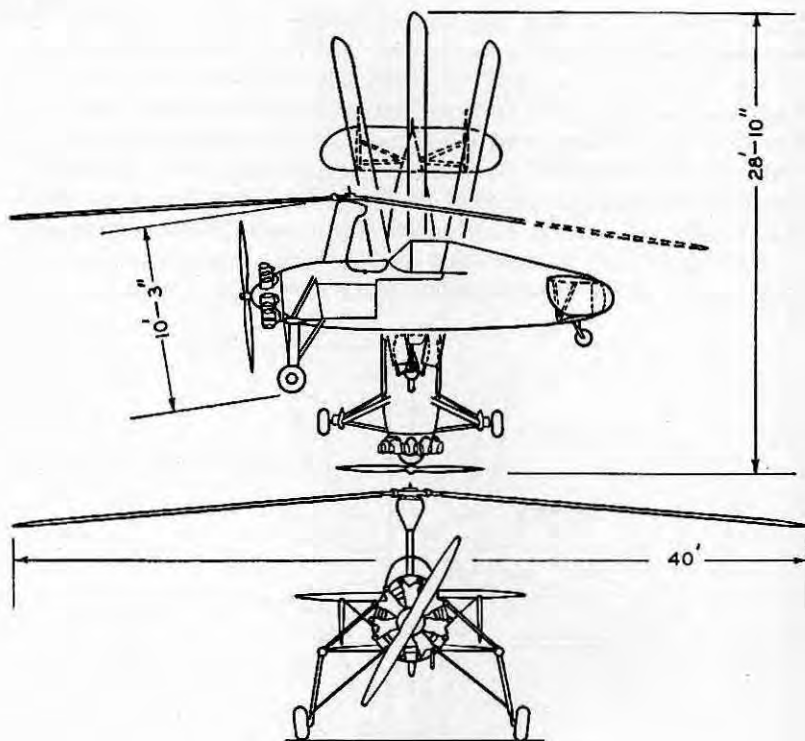
Kellett Autogiro Corporation, Philadelphia, Pa., in 1939 participated in two significant events in the history of rotorplanes, when one of its products began daily service between Central Airport, Camden, N. J. and the roof of the General Post Office in Philadel-

phia, and the U. S. War Department held a design competition to make available giro-type aircraft with greatly increased range and performance. Early in 1940, the Philadelphia-Camden mail shuttle, which was started on July 6, 1939, had made more than 800 trips and more than 400 landings and take-offs from the rooftop without incident. Postal authorities pronounced the experiment an outstanding success. More than 90 per cent of the scheduled flights were completed during the period. Eastern Air Lines was the contact carrier, and had established an operating system which contributed greatly to the success of the novel service. Many saw in the service a prom-



KELLETT KD-1

A two-place autogiro for private operations powered with Jacobs engine.



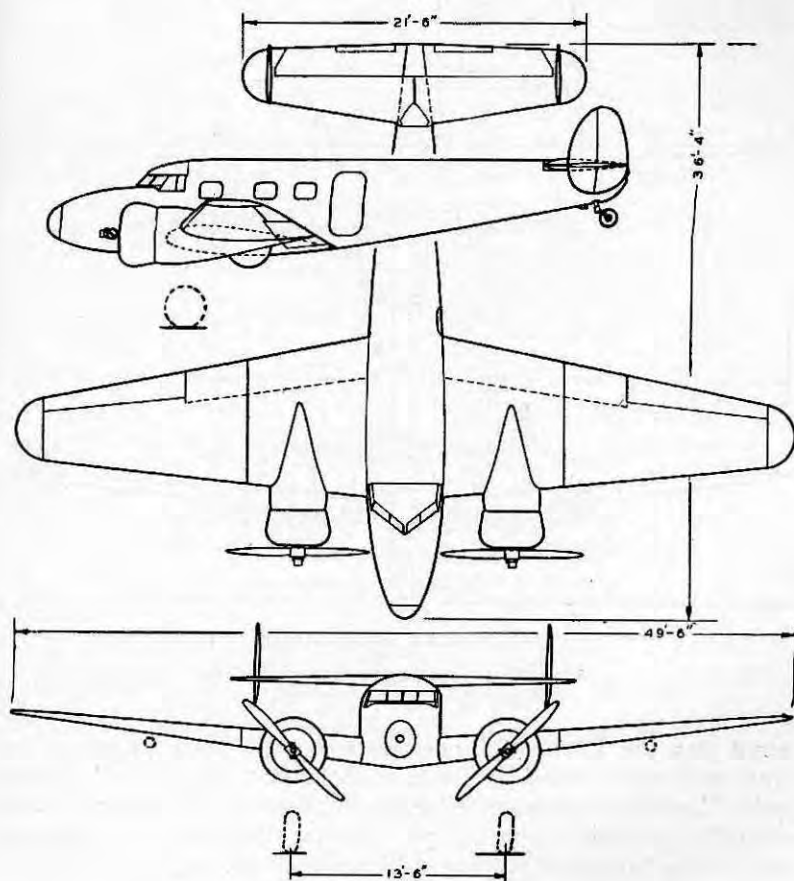
KELLETT KD-1B

It is powered by a 225 h.p. Jacobs L-4MA engine.

ise of the day when autogiro ferry services would be functioning in most metropolitan centers, linking them with suburban airports. Commuter service by private fliers also could use city rooftops as landing platforms. The Kellett company believed that new developments should lead to giroplanes with payloads up to 1,400 lbs., widening the value of the type for both military and civil utilities. Additionally, the Kellett organization had taken an important place as subcontractor to various primary aircraft manufacturers, supplying them with sheet-metal parts, engine mounts, seats and landing gear units. That activity doubled the company's business, and consequent expansion.

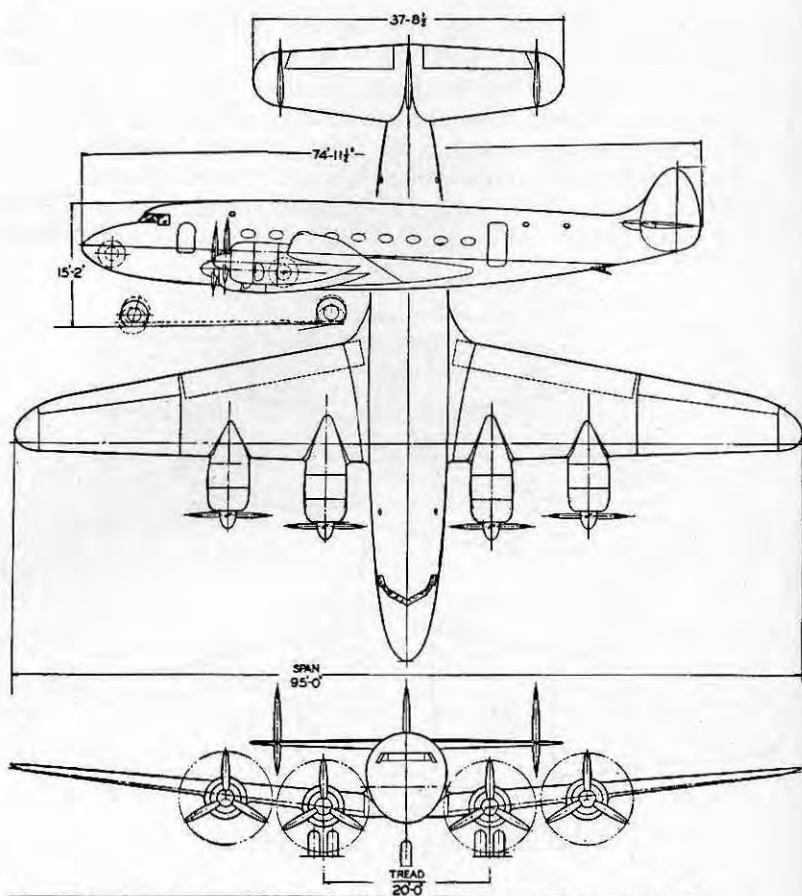
Lockheed Aircraft Corporation, Burbank, Calif., with 3,000 employees early in 1939, reached a mid-year peak of more than 7,500, and the monthly payroll exceeded a million dollars. The pre-

ponderance of business during 1939 was the fulfillment of large contracts with the British Air Ministry for reconnaissance bombers; and 250 were delivered several weeks ahead of the contractual delivery schedule. During 1939 the total floor area of the Lockheed factory was increased from 330,000 to 668,000 sq. ft. at the end of the year. One of the foremost projects was the development of a fleet of single-seat, twin-engine interceptor pursuit planes for the United States Army Air Corps, the P-38. A new transport develop-



LOCKHEED 12

An eight-place, twin-engine transport powered with Pratt & Whitney Wasp Junior engines.

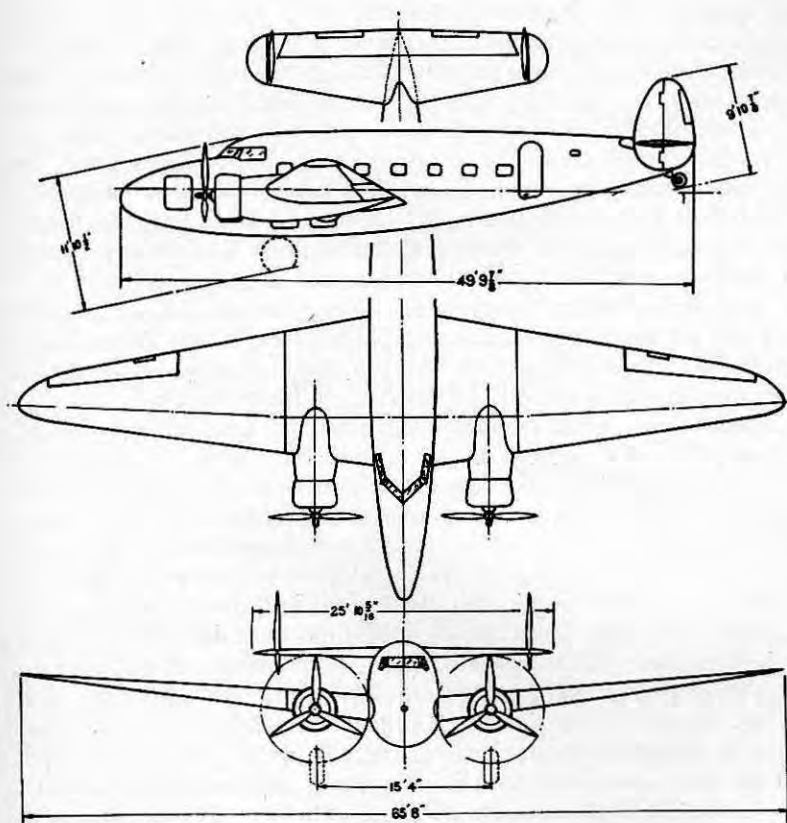
**LOCKHEED EXCALIBUR**

A 36-place, four engine transport plane.

ment was the Lockheed Lodestar, a 14-passenger commercial air liner with stated cruising speeds of more than 275 m.p.h. Air lines using Lockheed equipment were increased to 36. Of much practical value to Lockheed during the year was the operation of a subsidiary unit, Vega Airplane Company, which was developing the Vega Starliner, a 5-passenger commercial plane powered by the Menasco Unitwin engine. Vega also manufactured component parts for Lockheed and several other large airplane companies. Lockheed's labora-

tory for testing and inspecting aeronautical structures and materials was expanded. New X-ray and photographic equipment, with special testing apparatus, was installed.

Lockheed announced the development of a 4-engine model, the Excalibur. It was designed as a fast, large commercial plane with a top speed of about 300 m.p.h. Pan American Airways had ordered a fleet of Excalibur transports. Trans-Canada Air Lines enlarged its fleet of Lockheeds. During 1939 more than 2,500 employees voluntarily attended the training school program offered by the company. Lockheed also installed an apprenticeship program. In the



LOCKHEED LODESTAR

This twin-engine transport carries 17 and is powered with 900 h.p. Wright Cyclone engines.

annual report to stockholders Lockheed announced plans for expenditure of approximately \$1,000,000 for new buildings and machinery, if indicated requirements of present and future commercial orders warranted.

The three major commercial models in production were the Lockheed 12, Lodestar and Excalibur. The military types included the B-14 reconnaissance bomber, the P-38 interceptor pursuit and the Lockheed 212, a fighter.

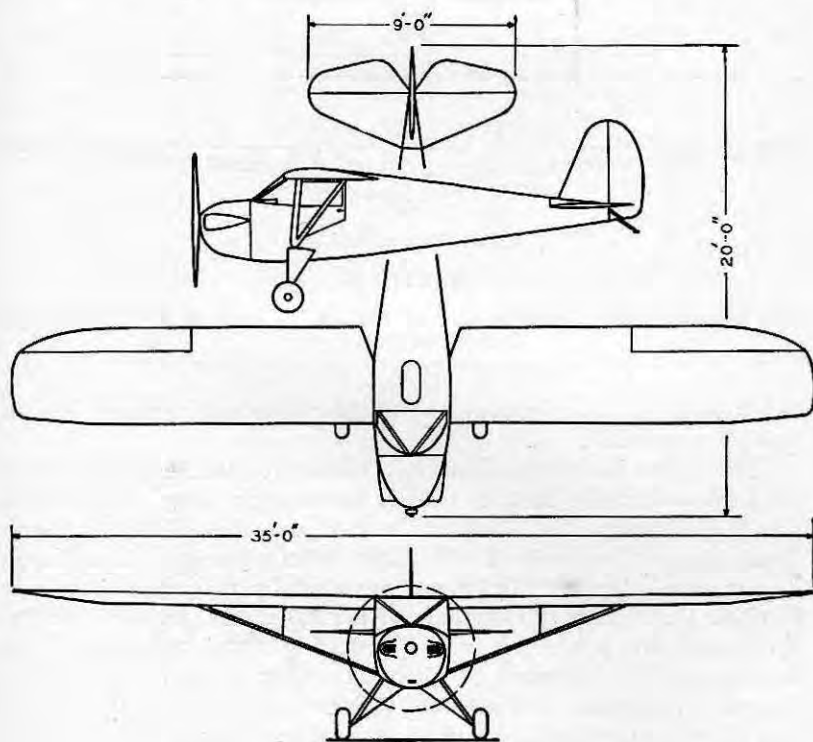
Specializing in production of engine cowling, collector rings, entire power nacelles and many other component parts, Vega Airplane Company, Lockheed subsidiary, in April, 1940, announced that it had installed all equipment, established shop procedure and effected considerable reorganization in personnel at its new plant in Burbank. An 88 per cent increase in personnel brought the total number of Vega employees to just above 950, more men in highly skilled crafts were being added daily and the backlog of orders in component parts and secret projects of a military nature had increased to \$2,500,000. The new plant, with $23\frac{1}{2}$ acres of land, had several large buildings with a total floor area of 158,000 sq. ft. Among the Vega projects, besides the Unitwin Starliner, were special armament for military aircraft in power turrets, fixed guns and bomb rack installations.

Luscombe Airplane Corporation, West Trenton, N. J., produced and sold the first light, all-metal airplane in the United States late in 1938. This plane was so well received that it was necessary for the company to add 9,200 sq. ft. of factory space in 1939. The new addition to the plant contained an assembly line. The plane was adapted to mass production because it was made up entirely of standard parts which were die cut, preformed and predrilled before assembly. The fuselage was a monocoque structure of .032 Alclad sheets riveted to Dural bulkheads. The Luscombe wing had metal spars of Dural extrusions as did the wing rib cap strips. Other novel features were the single oleo shock unit within the fuselage; the gasoline tank away from the engine behind the cabin; the newly designed double rubber bushed "Vibra-damp" motor mount and full cantilever stressed skin tail group. The plane was used for private flying, student instruction, both primary and advanced, and miscellaneous flying activities such as aerial survey and photography. About 300 Luscombes were sold in 1939, the company reported.

Luscombe airplanes were powered with 50 or 65 h.p. Continental engines. The plane had a stated cruising speed of 104 m.p.h., landing at 37 m.p.h. The all-metal Luscombe was also available as a seaplane with Edo 1320 floats. Because the Alclad covering skins of the airplane are naturally corrosion resistant, this airplane makes an

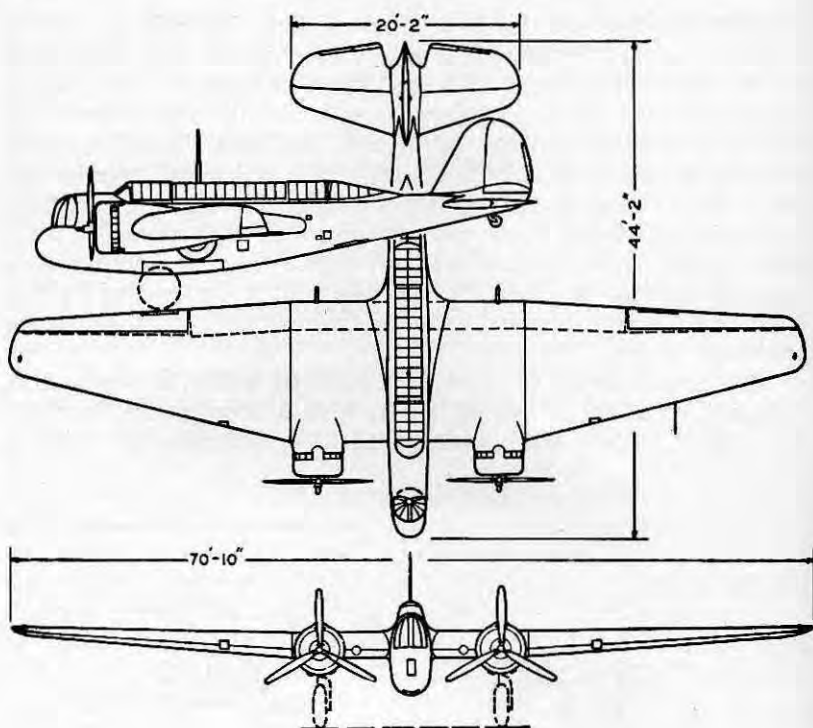
excellent seaplane and can be left out of doors indefinitely. During 1939 the company installed full new shop equipment, including metal sheers, punch presses, air drills and air rivet hammers, die making equipment, heat treating equipment and miscellaneous other items employed in the manufacture of all-metal airplanes. Forty Luscombe planes took part in the Lightplane Cavalcade which on December 29, 1939, flew to Florida. On January 30, 1940, the standard Luscombe equipped with wheel pants and an adjustable pitch propeller set a new 100-km. speed mark of 118.746 m.p.h. Further improvements planned for 1940 included the installation of a Continental 75 h.p. engine and approval with Luscombe direct-drive 65 h.p. Lycoming engine.

McDonnell Aircraft Corporation, Robertson, Mo., in April, 1940, occupied a factory of 36,000 sq. ft. with 6 acres at the Lambert, St. Louis, Airport and was engaged in subcontract and military



LUSCOMBE 50

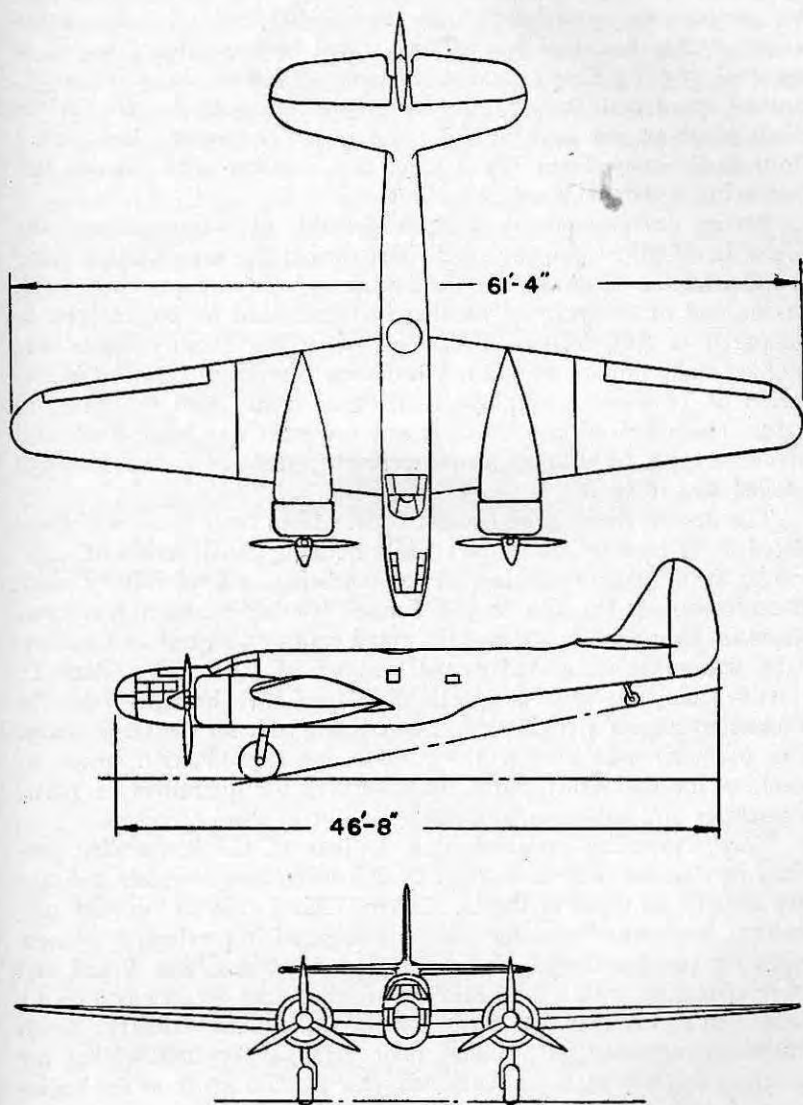
A two-place plane powered with a Continental 50 h.p. engine.

**MARTIN 166**

This bomber carries a crew of four or five, and is powered with two Wright Cyclones of 850 h.p. each.

development work, planning to enter the commercial plane field as quickly as possible.

The Glenn L. Martin Company, Baltimore, Md., expanded plant production facilities to take care of increasingly large orders from the U. S. Army and Navy air forces and the Allied air forces which required hundreds of twin-engine Martin bombers. The Martin export attack bomber 167W was reported by the manufacturer to combine three primary essentials of tactical utility, maneuverability, speed and fire power. It was a low-wing metal monoplane with fuselage of semi-monocoque aluminum alloy riveted construction, channel type frames and extruded stringers with smooth skin covering, 3-sectioned—nose, tail and center section integral with the center wing panel. The wing was N.A.C.A. 23014 airfoil section tapering to N.A.C.A. 23008.3 at tip, full cantilever. The 167W had a wing



MARTIN 167W

A twin-engine bomber carrying a crew of three and powered with two Pratt & Whitney Twin Wasps.

span of 61 ft. 4 in., length 46 ft. 8 in., height 10 ft. 1 in., wing area 538.5 sq. ft., wing loading 28.4 lbs. per sq. ft., power loading 7.28 lbs. per h.p., empty weight 10,586 lbs., useful load 4,711 lbs., gross weight 15,297 lbs., fuel 255 gallons, stated high speed 275 m.p.h. at sea level, 305 m.p.h. at 14,000 ft., cruising at 248 m.p.h. at 11,500 ft., landing speed with flaps 71 m.p.h., service ceiling 29,500 ft., rate of climb 1,790 ft. per min., range 1,300 mi. The power plant was 2 Pratt & Whitney Twin Wasp 1,050 h.p. engines, with Curtiss full feathering constant speed propellers.

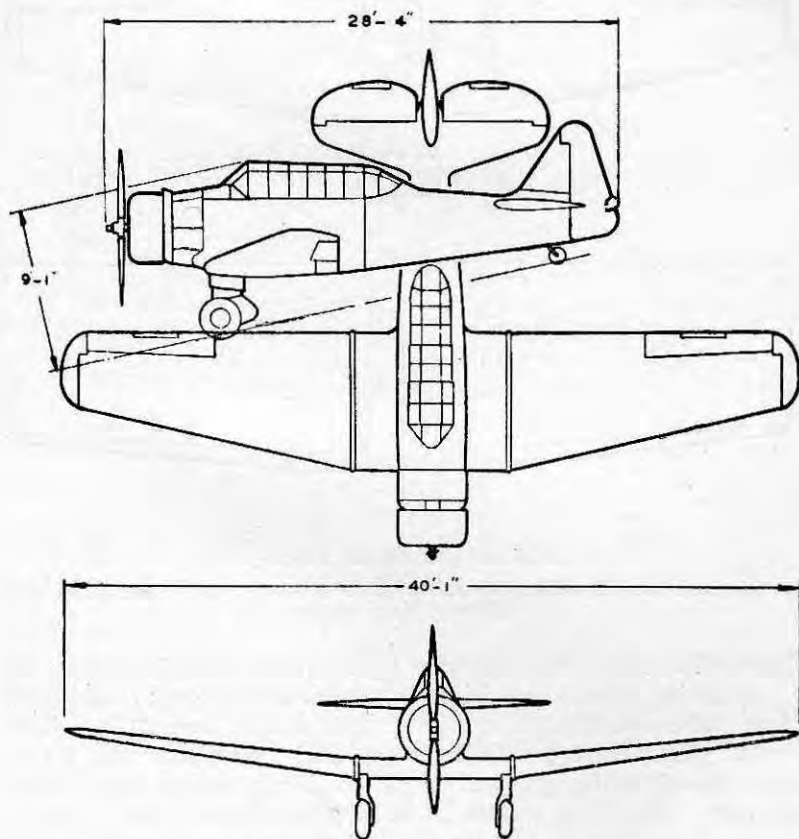
Record development of plant and backlog of orders featured the Glenn L. Martin Company's activities during the months just prior to and after the declaration of the European War in September, 1939. At the end of the year its backlog had increased to \$49,241,515 as compared to \$13,903,006 at the end of 1938. Factory space was doubled and a million dollars worth of new equipment installed in one period of 11 weeks. Employees increased from 3,600 to 13,000 in 1939. The research and development program was intensified, and advanced types of military planes were projected. Net sales for 1939 totalled \$24,169,468.

The first of three large bomber orders from the French was completed in 10 months and 3 days while building construction of 440,000 sq. ft. of plant was being carried on, bringing total factory space to 1,100,000 sq. ft. The second French bomber contract was completed in February, 1940, and the third contract, signed in October, 1939, was to be completed in the summer of 1940. The Glenn L. Martin Company also designed, developed and brought into the production stage a 4-engine long-range flying boat for the U. S. Navy. The company was also working on a large production order of bombers for the Army Air Corps. Orders for quantities of parts, accessories and sub-assemblies were let out to subcontractors.

North American Aviation, Inc., Inglewood, Calif., excelled previous production records in 1939 by delivering 800 complete military airplanes of all types to the U. S. Army Air Corps and export customers. Year-end found the company engaged in production of new types for the Air Corps, Navy, England, France, China, Brazil and other countries, with a total backlog of more than \$50,000,000 on its books. In a year that saw expansion throughout the industry, North American increased its available floor area 54 per cent, giving the company 654,000 sq. ft. as compared with 425,000 sq. ft. at the beginning of 1939. Transfer of certain operations into the new factory units was begun late in the year and completed in February, 1940. North American Aviation introduced a number of new designs during 1939. It developed a twin-engine bombardment airplane, the

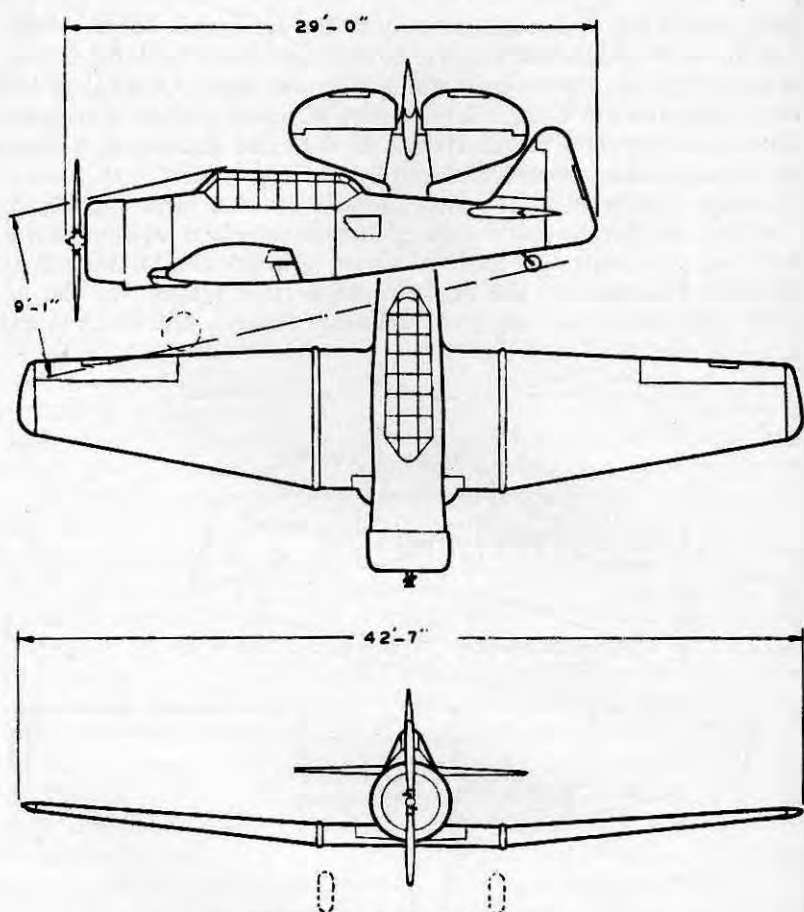
B-25, which was ordered in quantity by the Army Air Corps. Marking North American's first entry into the light plane field, the NA-35 primary trainer was brought out late in the year. Original orders from England and France for trainers were completed. Work was started on large new orders from both the allied nations, as a result of the satisfactory service rendered by the NA trainers.

Planes delivered to the Air Corps included a large number of O-47A and O-47B observation planes as standard equipment for both the Air Corps and National Guard squadrons, also BC-2 basic combat airplanes, and the first few of a large number of BC-1A basic combat and BT-14 basic training planes. The O-47A and



NORTH AMERICAN NA-16-1

A Wright Whirlwind 420 h.p. engine powers this two-place basic trainer.



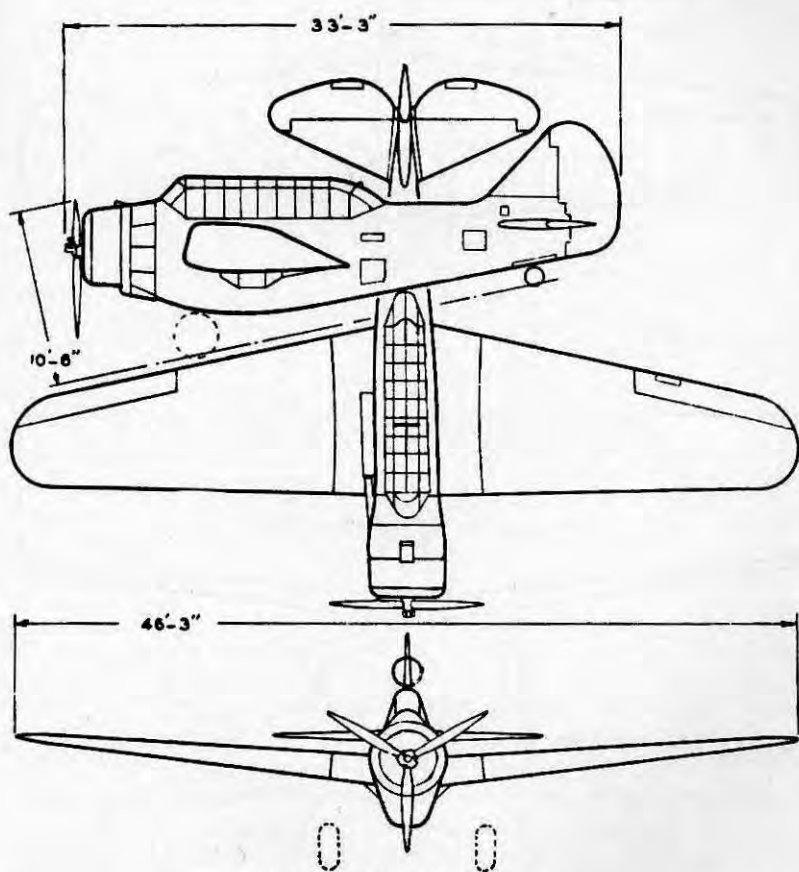
NORTH AMERICAN NA-16-3

An advanced combat trainer and liaison plane powered with a 550 h.p. Pratt & Whitney Wasp engine.

O-47B observation were mid-wing 3-place planes of high performance incorporating special provisions for aerial photography and long range radio facilities. The BT-14 basic trainer and BC-1A basic combat planes were 2-place low-wing land monoplanes, the BT-14 using a fixed landing gear and the BC-1A incorporating fully retractable gear. The BT-14 was the latest Air Corps basic trainer, designed for the same function in Air Corps training as the earlier North American BT-9. Maintenance features of the BT-9 and subsequent similar models were preserved in the BT-14, although the design was

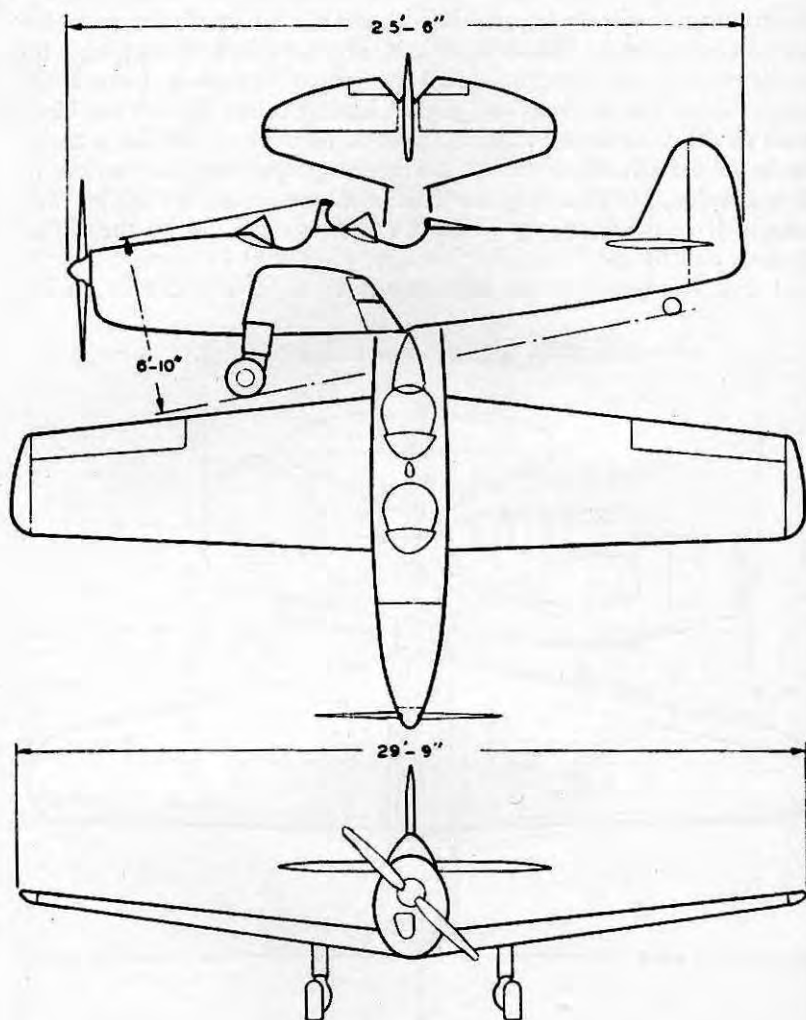
essentially new in all details. BC-1A basic combat planes were for Air Corps command liaison work and advanced tactical training with comparatively low landing speeds to permit operation from small fields. Other North American planes, similar to the BC-1A but identified as AT-6 advanced trainers, were to be used at Air Corps training bases for advanced combat instruction preparatory to transfer to tactical types. Substantially the same airplane designated SNJ-2 was being delivered in quantity to the U. S. Navy for use by the Naval Reserve and by the Naval Air Training Center at Pensacola.

Large Air Corps orders necessitated an unprecedented expansion



NORTH AMERICAN NA-25

This three-place observation plane is powered with an 840 h.p. Wright Cyclone engine.

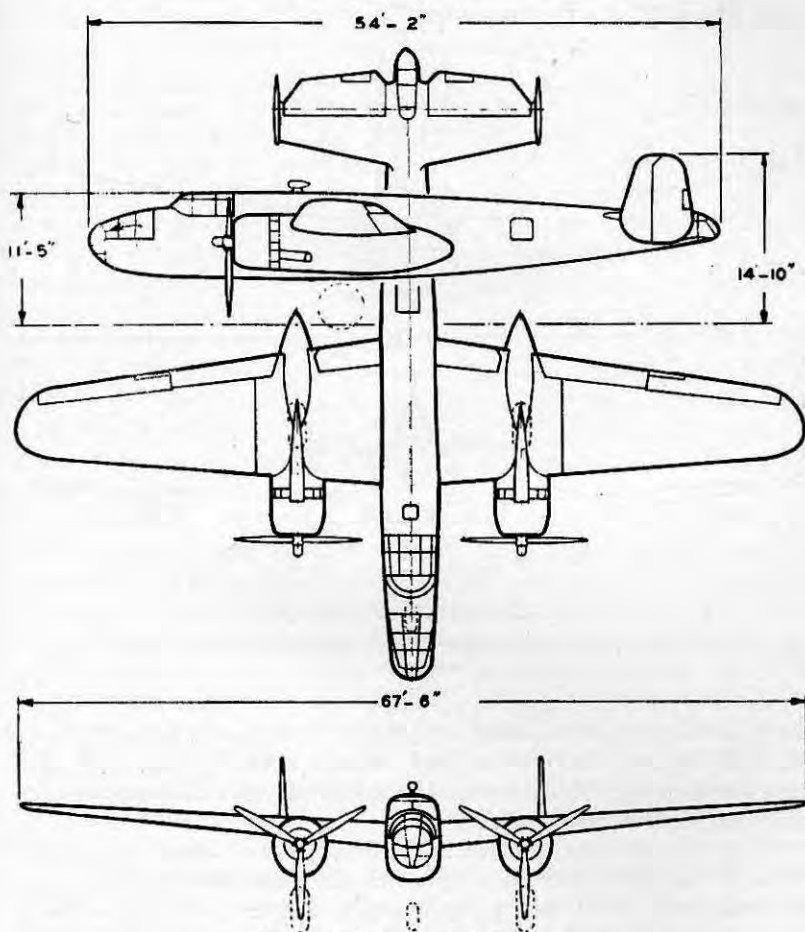


NORTH AMERICAN NA-35

A two-place primary trainer with Menasco 150 h.p. Pirate engine.

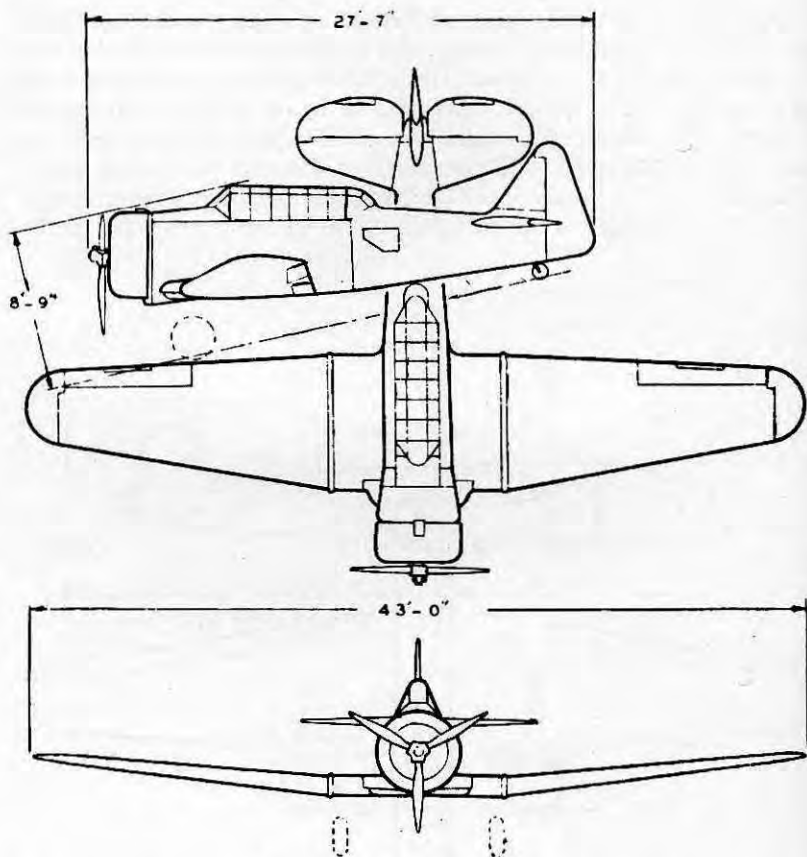
of manufacturing facilities at North American's plant on the grounds of the Los Angeles Municipal Airport. The expansion program, comprising five units, was begun late in 1939 and completed in February of 1940. With the original factory planned to permit smooth future expansion, transfer of work into the new units was accomplished without interruption of production activity in existing units.

Unit No. 1, the main factory addition connecting at the west wall, was 325 ft. wide and 420 ft. long, and housed the main assembly line of Army Air Corps bombers. The unit included an additional paint shop room 90 ft. by 100 ft. next to a 10 ft. by 20 ft. hydro-electric elevator. The elevator linked the mezzanine and main floors with the paint storage basement, and completely eliminated the electric hoists previously used for movement of parts and materials. Atmospheric conditions required for aircraft paint spraying were provided for by



NORTH AMERICAN NA-40A

Powered with two Wright Cyclones totalling 2,550 h.p., this bomber carries a crew of five.



NORTH AMERICAN NA-44

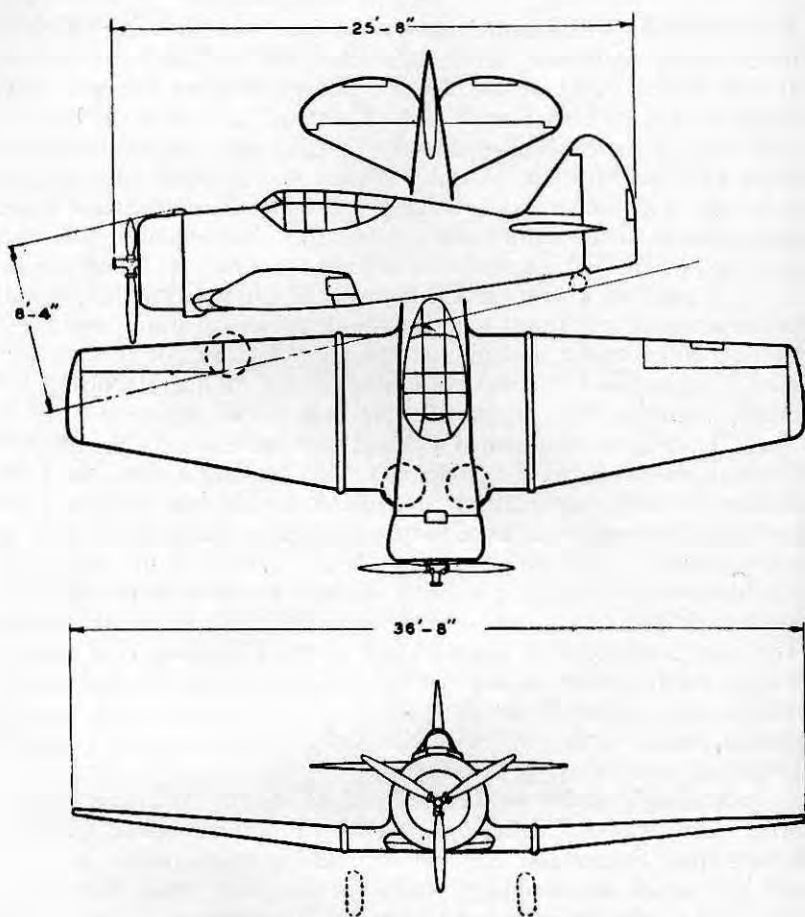
This two-place light attack-dive bomber is powered with a 745 h.p. Wright Cyclone engine.

special heating and ventilating equipment. Unit No. 1 included mezzanine floors for wing and control surface assembly jigs, and also house the shipping department on the main floor as well as engine and wing final assembly sections.

Plant Unit No. 2 included a 40 ft. by 60 ft. extension on the west end of the present utility building which accommodated all drop-hammer equipment. Unit No. 3, the foundry, was erected west of Unit No. 2. It measured 40 ft. by 140 ft. In that building were located all die manufacturing, foundry work and plaster cast molding, with space for storage of plaster casts. Unit No. 4, 50 ft. by 96 ft. was a wood

frame building with painted, galvanized iron walls housing all plant maintenance equipment, motor generator sets and air compressors. It was located west of the former factory between the personnel building and the transformer pad. Unit No. 5, a 40 ft. by 220 ft. expansion of the drafting room over the alleyway between the warehouse and factory at the southeast corner, was suspended by hangers from the saw-tooth trusses, leaving a clear span on the first floor. Enlargement of the flight ramp adjoining the Municipal Airport also was completed and the paved area extended to 1,025 ft. Other phases of the expansion program included paving of additional parking areas, construction of additional roads to handle personnel traffic, and erection of police traffic buildings at the main factory entrances. Personnel expansion kept pace with enlargement of manufacturing facilities, resulting in a payroll of more than 5,000 employees early in 1940. That figure represented a 70 per cent increase over the number of employees on January 1, 1939, and a 150 per cent increase over the number of employees January 1, 1938. A 50 per cent additional increase in personnel was expected by mid-1940, bringing the total to approximately 7,500 employees. A large portion of the expanded manufacturing facilities was being devoted to manufacture and assembly of Model B-25 twin-engine bombers for the Army Air Corps. The new bombardment airplane was of the high-wing type with a tricycle landing gear of improved design. Although detailed information was restricted, the B-25 bomber was reported to be an advanced design in keeping with Air Corps requirements for speed, range and load-carrying capacity.

Increasingly active in the export field, North American's large orders early in 1940 included, in addition to unprecedented quantity orders from France and England for training types, orders for pursuit and attack dive-bombing planes for the Thai Royal Air Force, advanced combat trainers for China and Venezuela and light-attack bombers for Brazil and Chile. The order from the British Air Ministry for 600 Model NA-16-3 Harvard (modified) trainers for service in the Royal Air Force was the largest single export order in quantity of planes on record in the United States. The airplane was a 2-place, low-wing monoplane of all-metal construction, incorporating many improvements over the Harvard type previously delivered to the Royal Air Force. Deliveries of the new type were to continue through 1940, with schedules pointing to an unusually high monthly production. The Harvard I was used in Royal Air Force training stations in England, and the new Harvard II was to be used principally at Canadian training establishments. With 400 Harvard I ships in service, the Royal Air Force expressed satisfaction with the



NORTH AMERICAN NA-50

A single-seat fighter with an 840 h.p. Wright Cyclone engine.

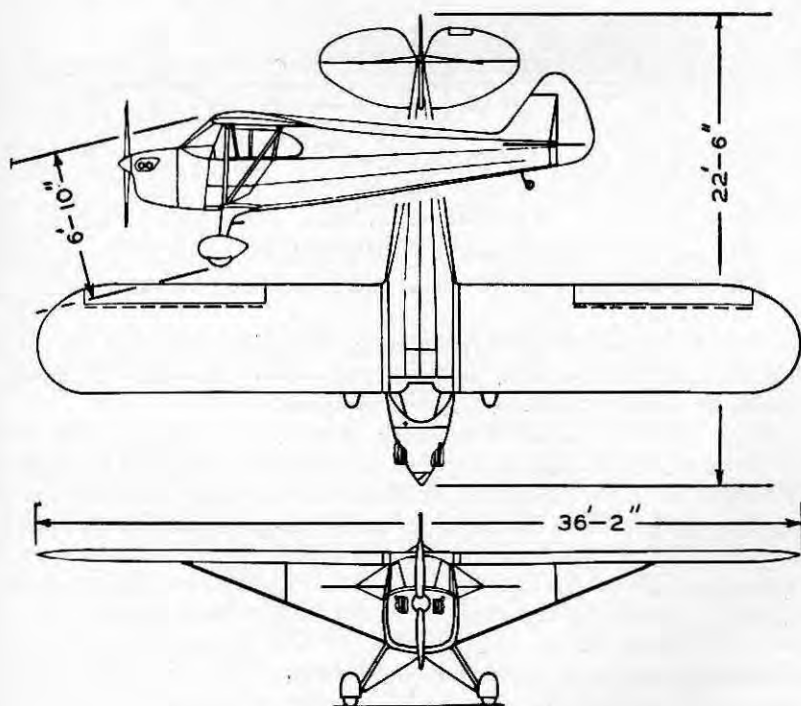
plane's rugged versatility, economy of operation and suitability for combat training.

The new trainer ordered for service in the French air force was designed for basic training, and was the same general type as the new Army Air Corps BT-14. A two-place low-wing monoplane with fixed landing gear, it differed from the trainer previously delivered to France principally in the construction of the fuselage, which was all-metal in the new NA-64. The former type used a fuselage consisting of chrome-molybdenum tubular steel frame and fabric fair-

ing panels, and the latest type incorporated a semi-monocoque aluminum alloy rear section and chrome-molybdenum steel frame with metal panels in the front section. In addition, new developments in empennage and wing design were incorporated in the NA-64, resulting in improved handling characteristics.

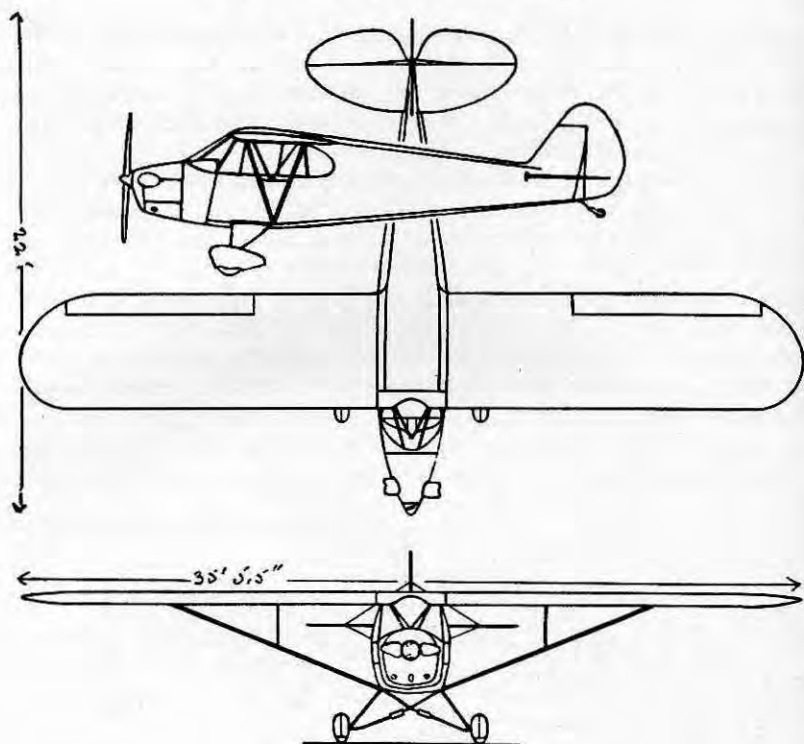
Widespread use of North American trainers in most of the major air forces of the world demonstrated conclusively the versatility and adaptability of the designs under all climatic conditions and types of service. NA-16 series trainers were in service with the air forces of the U. S. Army and Navy, Britain, France, Argentine, Brazilian Army and Navy, Chile, Honduras, China, Canada, Siam and Australia. Careful investigation of service problems arising in these various countries and correlation of service reports enabled North American to improve its basic designs progressively.

Northrop Aircraft, Inc., Hawthorne, Calif., early in 1940 had its new plant completed and was installing machinery and other facili-



THE PIPER CUB COUPE

It is powered by a Continental 65 h.p. engine.



PIPER CUB CRUISER J5

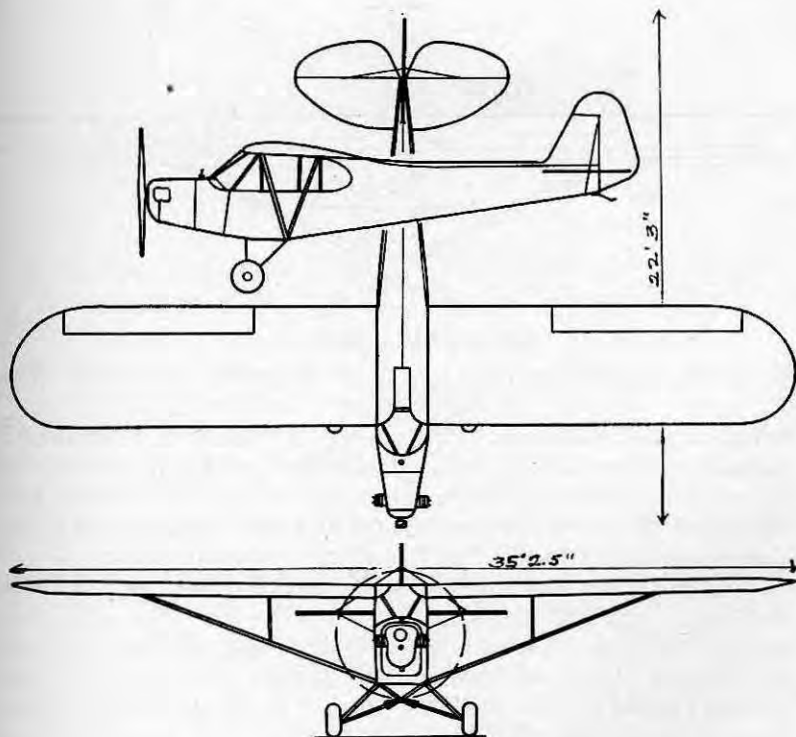
A three-place plane with Continental or Lycoming 75 h.p. engine.

ties, including a wind tunnel, preparatory to manufacturing a line of airplanes designed by John K. Northrop. The new plant included 3 buildings with 175,000 sq. ft. of floor space.

Piper Aircraft Corporation, Lock Haven, Pa., reported that it had produced 1,806 Cubs in 1939, as compared to 737 Cubs in 1938. Two basic models were offered by Piper during 1939. Most popular was the Cub trainer intended primarily for student instruction. More than 75 per cent of the C.A.A. college flight students were training on Cubs. The Trainer was a tandem airplane available with 40, 50, 55, 60 and 65 h.p. engines, adaptable to wheels, skis or pontoons. The other Cub model was the Piper Cub Coupe, with side-by-side seating and more speed than the trainer. The Cub Coupe was improved by the installation of 65 h.p. engine in place of the 50 h.p. formerly used. Increased range, baggage space and comfort helped to increase private owner sales. At the beginning of 1940, Piper was

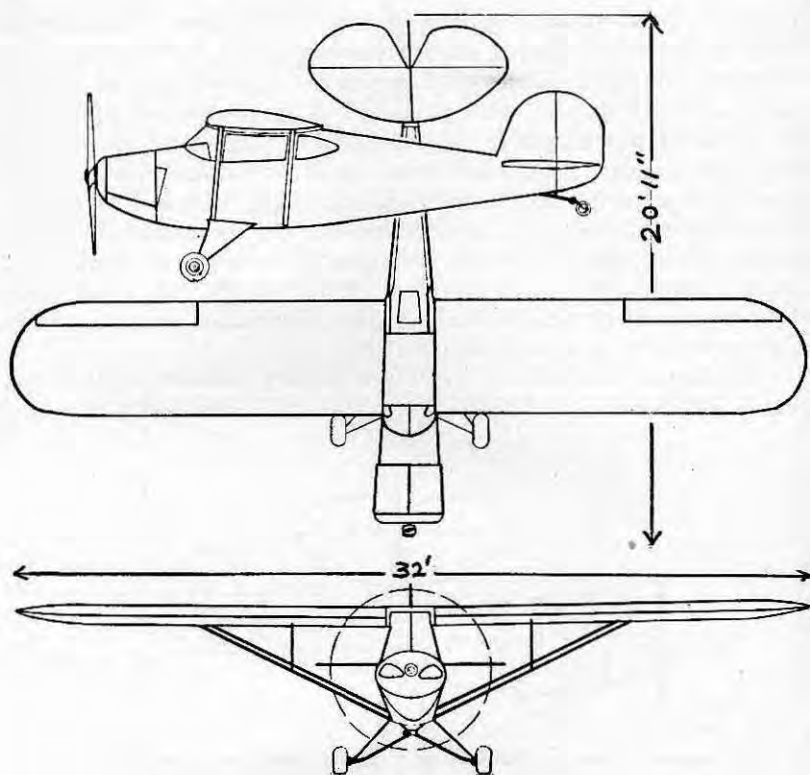
making a third model, a 3-place general utility plane. Basically the same as previous Cubs, it seats 2 passengers aft, with the pilot up forward. Powered with a 75 h.p. engine the ship had a stated cruising range of nearly 700 mi. with 37 gallons of gas as optional equipment. The Cruiser was adaptable to passenger carrying or advanced training. The Coupe for 1940 had some major alterations to improve its speed and attractiveness. Styled entirely along the trend of modern automobiles, the outstanding development was the muffler to reduce noise. Piper also completed preliminary development work on a 2-place amphibion, powered with a 75 h.p. engine and a full flying boat type with retractable landing gear and rubber wing tip floats. Delivery was to be started during 1940.

Production facilities at the Piper factory were expanded, with increased floor area and addition of considerable machinery calculated



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.



PORTERFIELD MODEL 75

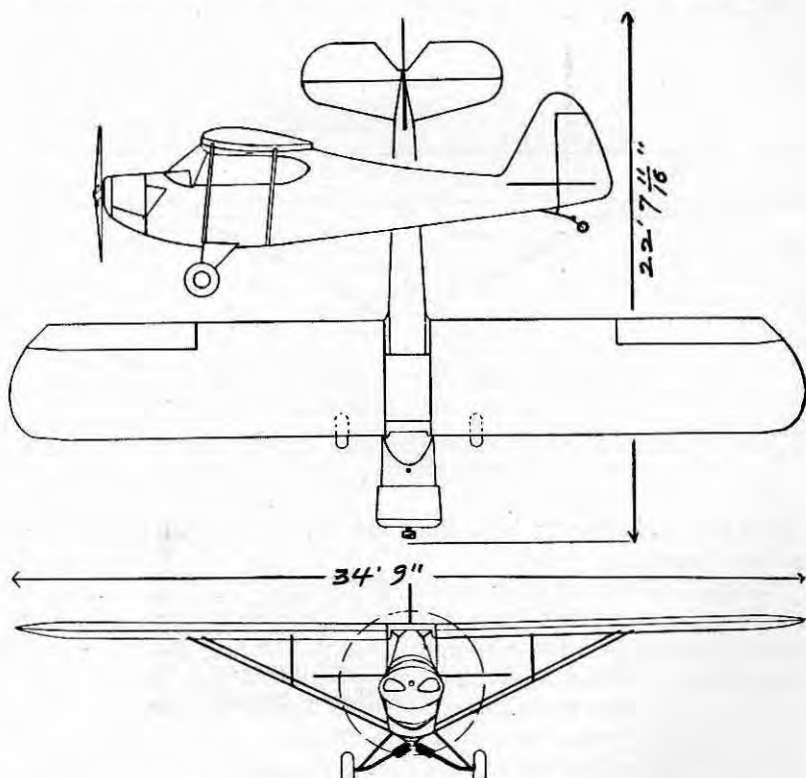
A two-place private owner plane with 75 h.p. Continental or Lycoming engine.

to reduce production costs. Piper claimed a capacity of 3,000 aircraft annually. Approximately 500 persons were employed. Because of improved production facilities, substantial list price reductions were effected on all Cub models, and for the first time in history the 40 h.p. Cub trainer was advertised at less than a thousand dollars.

Porterfield Aircraft Corporation, Kansas City, Mo., was refinanced in March, 1939, and started work on new models. The CP-50 was put in production, and orders were filled for domestic customers and also those in Brazil and Hawaii. Development work on the LP was started, and the CP was produced with 50, 55, 65 and 75 h.p. engines early in 1940. Porterfield also planned to make a complete line of side by side models, at the same time completing development work on the 145 biplane trainer.

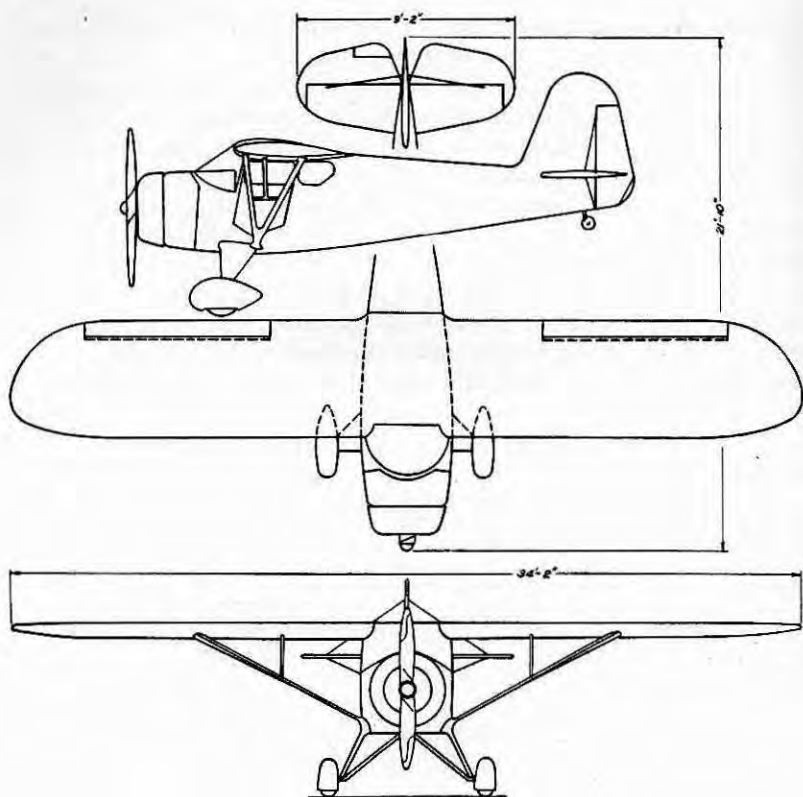
Rearwin Aircraft & Engines, Inc., Kansas City, Mo., was formed

to take over Rearwin Airplanes, a partnership, and Ken-Royce Aircraft Engine Company, also a partnership. The new corporation continued development work. The Rearwin Cloudster 8090 was equipped with a 90 h.p. Ken-Royce engine and the 8125 with a 120 h.p. Ken-Royce engine. The 8000 series was also changed so that in December the Model 8135 Cloudster equipped with 120 h.p. engine successfully passed A.T.C. tests as a 3-place plane. Many changes were made in the Sportster model. The cowling was re-designed and the windshield was better streamlined and formed from one large sheet of material. As a result the Sportster had 7 m.p.h. better performance with the new cowling. Work was started on an inexpensive light airplane which would be a Class 2S ship with a gross weight of 1,350 lbs. It was to have wing tanks, wing slots, provision for flaps, power



PORTERFIELD COLLEGIATE TRAINER

It may be powered with a choice of Continental or Lycoming engines from 50 to 65 h.p.



REARWIN CLOUDSTER

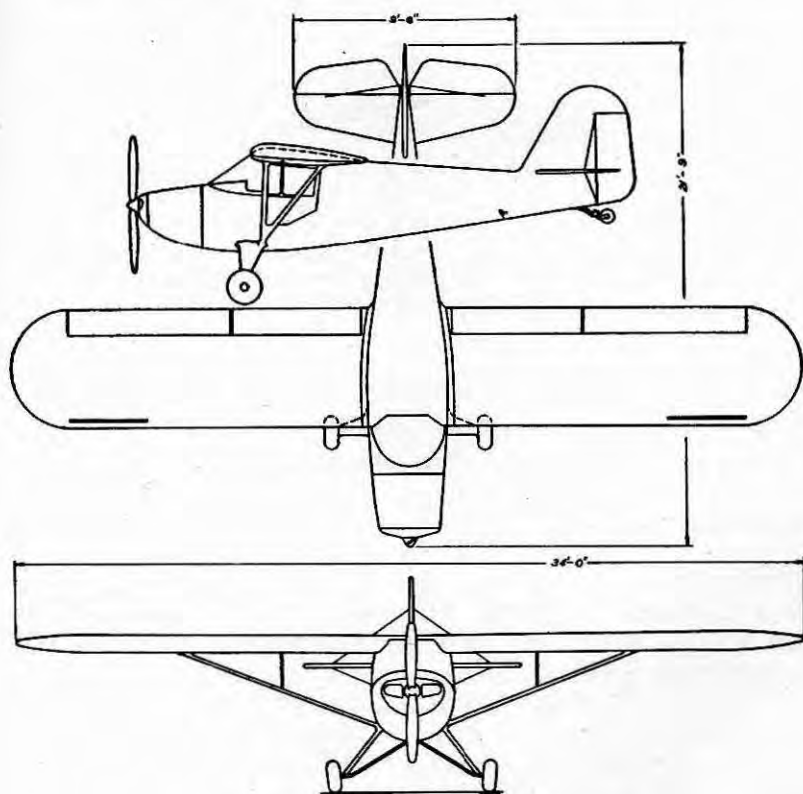
A two to three-place private owner plane with a choice of Ken Royce engines from 90 to 120 h.p.

up to and including 75 h.p., allowance for 125 lbs. of baggage and extra equipment.

Republic Aviation Corporation, Farmingdale, N. Y., was known as Seversky Aircraft Corporation until October 13, 1939, when the name was dropped for corporate reasons. During the year, under management reorganization, the company's backlog of unfilled orders rose from less than \$100,000 to more than \$15,000,000 and, in the last quarter of the year, the corporation reported the first profit in its history. Principal orders on the books of Republic Aviation Corporation as the year ended were from the U. S. Army Air Corps and the Royal Swedish Air Force. Twelve Republic EP-1 pursuit airplanes had been delivered to Sweden before the year ended, with

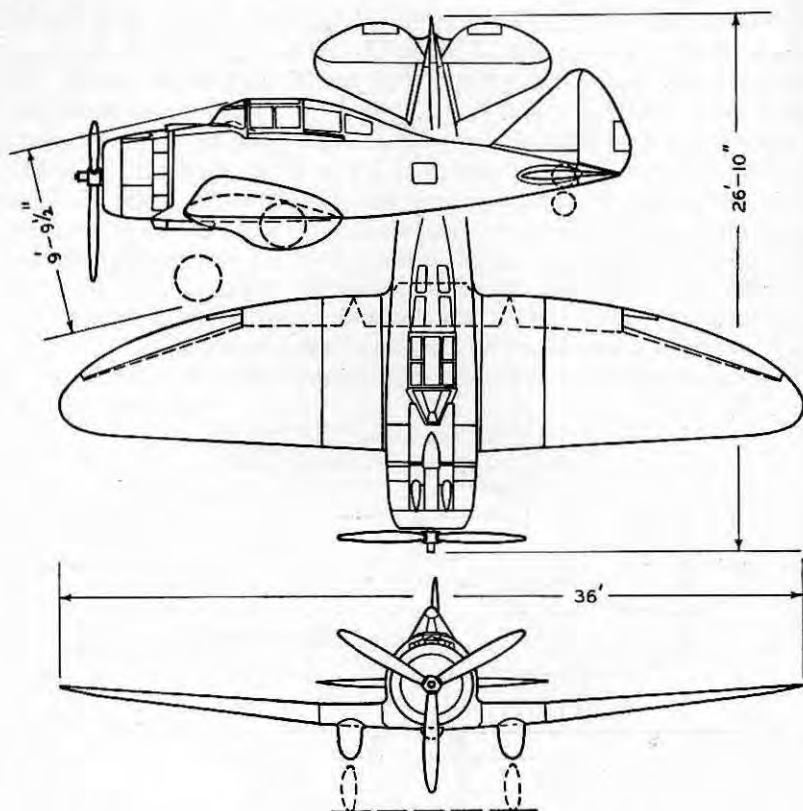
deliveries continuing at an accelerated rate into 1940. Air Corps types, developed from the Republic Army XP-41, were in production in 1940, among them the YP-43 and P-44 pursuit planes. In addition to the single-seat EP-1, Republic Aviation produced the 2-place 2-PA type (Guardman) for Sweden. Both models were powered by Pratt & Whitney 950 h.p. Twin Wasp engines. The Air Corps Republic P-35 pursuit was the prototype for these models, but marked changes were incorporated. The Republic Warrior type was under development. Employment was at an all-time high at the Republic Aviation plant at the beginning of 1940. More than 1500 employees were working in two shifts on current contracts and factory and office area had been extended to 250,000 sq. ft.

Ryan Aeronautical Company, San Diego, Calif., to accommodate



REARWIN MODEL 175

A two-place private plane Continental powered.



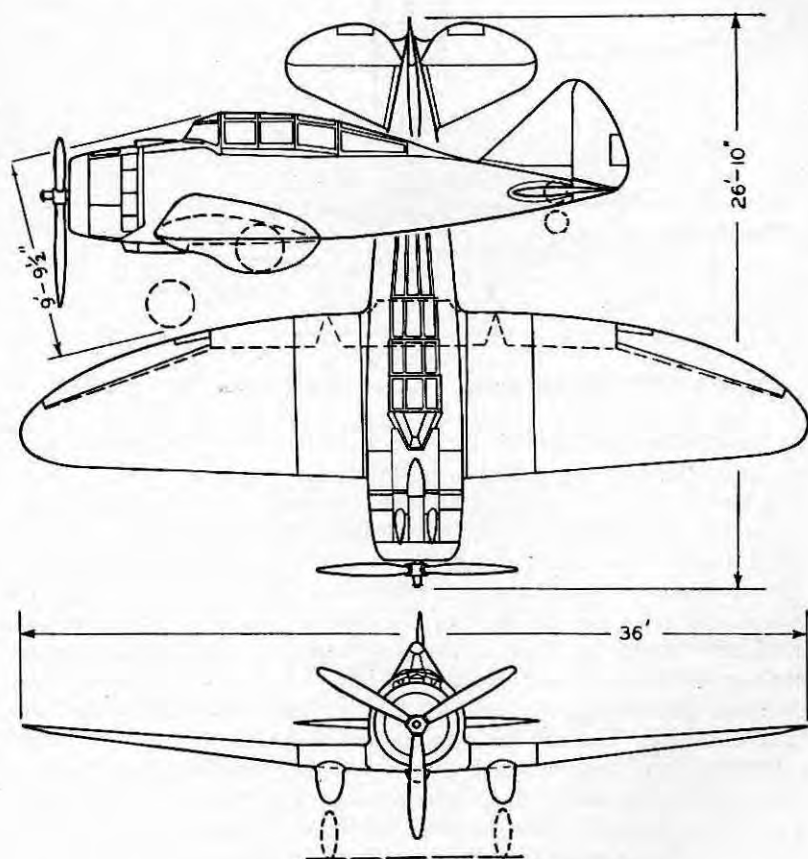
THE REPUBLIC EP-1

A single-seat fighter with a Pratt & Whitney Twin Wasp engine.

the increased volume of business, expanded its plant facilities, and on July 1, 1939, moved into a new 55,000 sq. ft., \$150,000 factory on Lindbergh Field, San Diego's municipal airport. Provision was made for further expansion. The year marked an important milestone for the Ryan company in that it became an Air Corps contractor during that period, completing a number of contracts for training planes. For six years Ryan had been a pioneer in the low-wing trainer field with its S-T models, powered with engines of over 100 h.p. The Ryan S-T became the first low-wing primary trainer which satisfied the Air Corps sufficiently for it to break away from a 30-year precedent of biplanes for initial flight instruction of flying cadets. A number of Ryan planes of the S-T type, designated by the

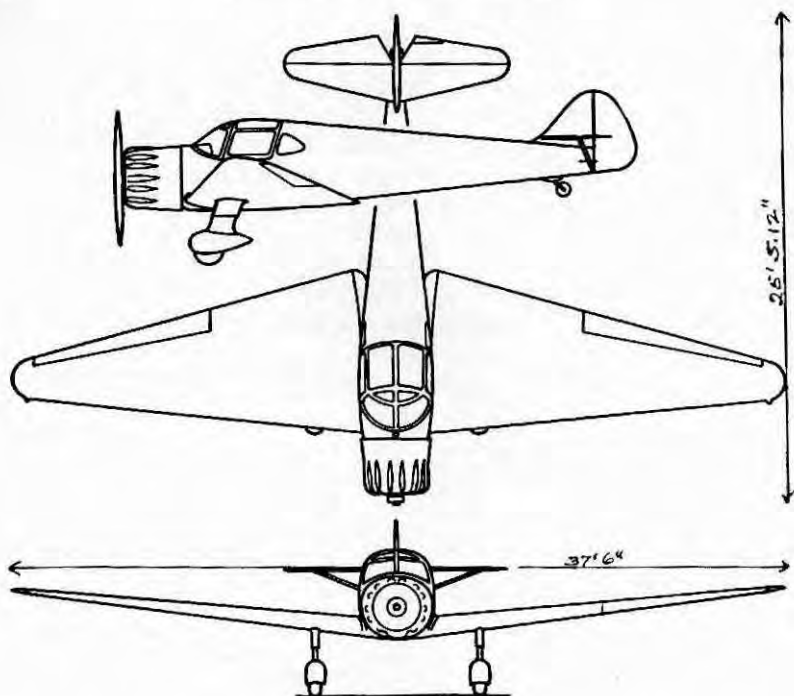
Air Corps as XPT-16, YPT-16 and PT-20, were being used for cadet flight instruction at the company's subsidiary training institution, the Ryan School of Aeronautics. In addition to its training planes, the Air Corps contracted with the company for a new-type liaison observation plane, the YO-51. In addition to Army contracts totalling \$800,000, the company received orders from China for Ryan S-T primary trainers amounting to \$550,000. The company also continued to supply other aircraft companies with specialized products, including exhaust collector rings and tail pipes, seats, cowling, exhaust silencers and carburetor pre-heaters.

Southern Aircraft Corporation, Houston, Texas, in 1939 started



THE REPUBLIC 2PA

A two-place pursuit plane with a Pratt & Whitney Twin Wasp engine.



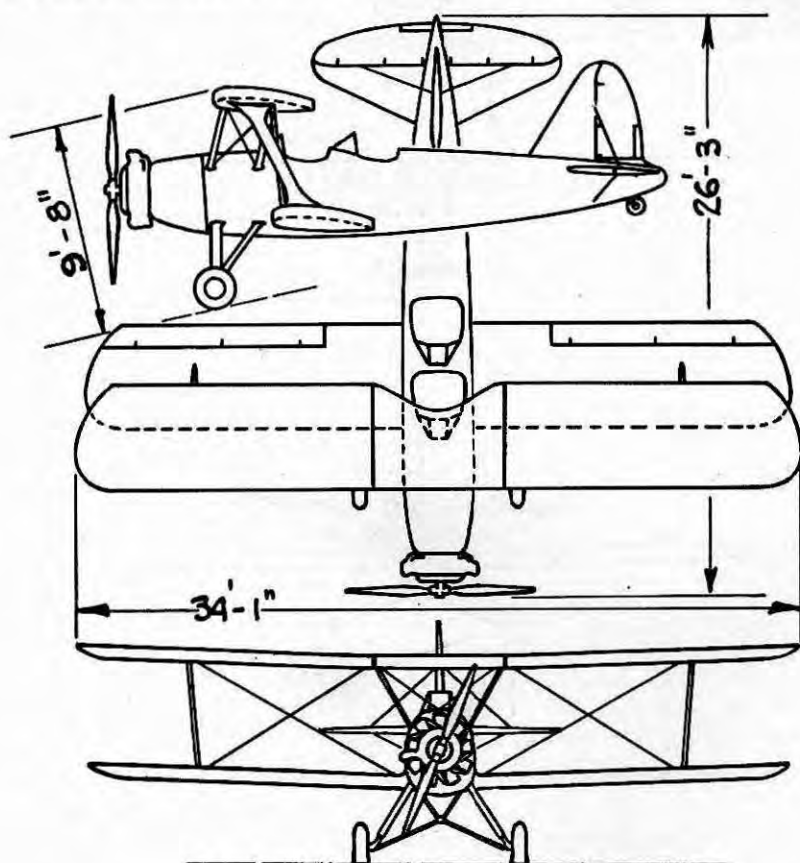
RYAN SC

A three-place cabin plane with a Warner Super Scarab 145 h.p. engine.

to manufacture its Model BM-10, a 2-place, open cockpit, highly staggered biplane, specifically designed for training military pilots. Engineering of the design had been completed earlier in the year, following organization of the corporation under a Texas charter in May, 1939. It was the only aircraft manufacturing plant in Texas. The company was prepared to take sub-contract work from other manufacturers. The fuselage of the Southern BM-10 was a welded steel tube structure, built in three separate sections, engine mount, cockpit section, and rear fuselage section. The separate sections were complete structural units joined through bolted fittings into the complete fuselage. The cockpit section of the fuselage, and the engine mount section, were covered with detachable cowling plates to provide ease of inspection and maintenance. The rear fuselage section was fabric covered, with a metal tail cone. Wings, tail group and control surfaces were fabric covered, over either wood frames or metal frames, the internal construction being optional. Interchangeable engine mounts were provided to accommodate any of the 225

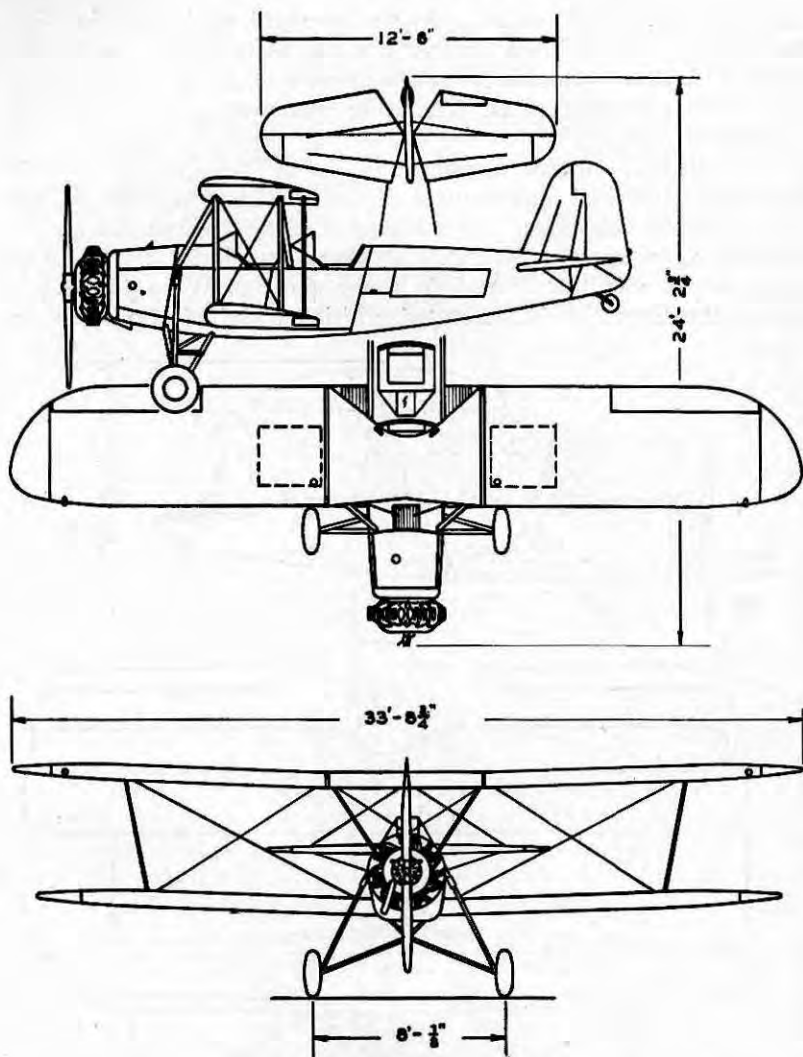
h.p. aircooled, radial engines. In the standard equipment was included oil-air hydraulic struts; 24-in. streamline wheels equipped with hydraulic brakes; steerable tail wheel; dual controls, dual instrument panels and adjustable seats. The wing span was 34 ft. 1 in., and length 26 ft. 3 in.

The Spartan Aircraft Company, of Tulsa, Okla., continued with the manufacture and improvement of the Spartan Executive, Model 7W, a 5-place, all-metal, single-engine, low-wing cantilever monoplane, of 4,400 lbs. gross weight. Carrying a useful load of 1,413 lbs., and powered with the Pratt & Whitney 450 h.p. Wasp Junior SB engine, the Executive had a stated cruising speed of 200 m.p.h. at



SOUTHERN AIRCRAFT BM-10

This two-place military primary trainer may be powered with a Continental, Jacobs, Lycoming or Wright engine.



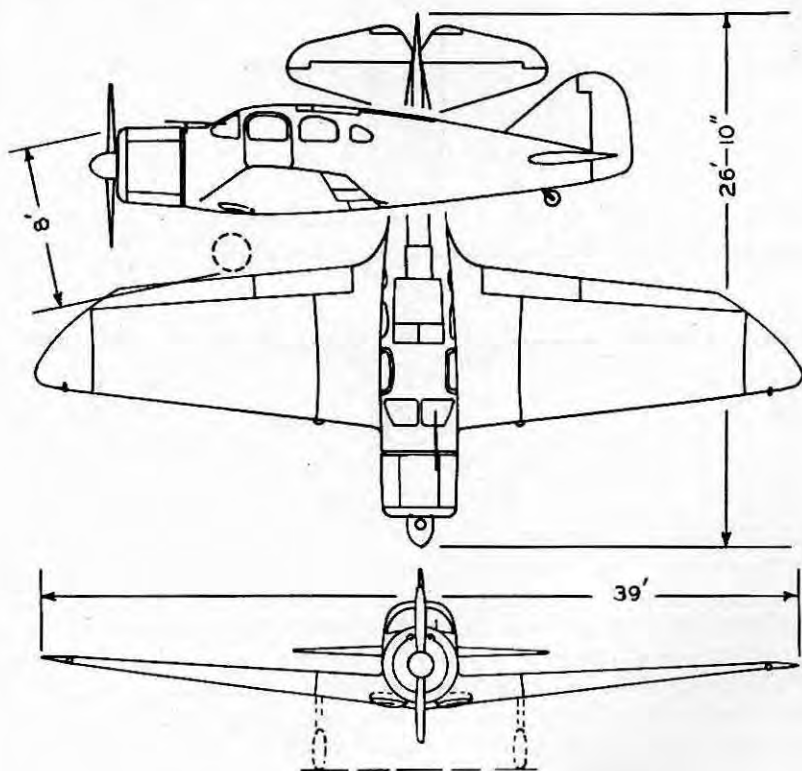
SPARTAN NS-1

A two-place military trainer powered with a Lycoming 220 h.p. engine.

altitude, and a cruising range of 900 mi. Sea level cruising speed was 185 m.p.h. and landing speed 65 m.p.h. A feature of the Executive was its basic structural design. It had internal structure of steel tubing, in both fuselage and wings, in addition to regular bulkheads,

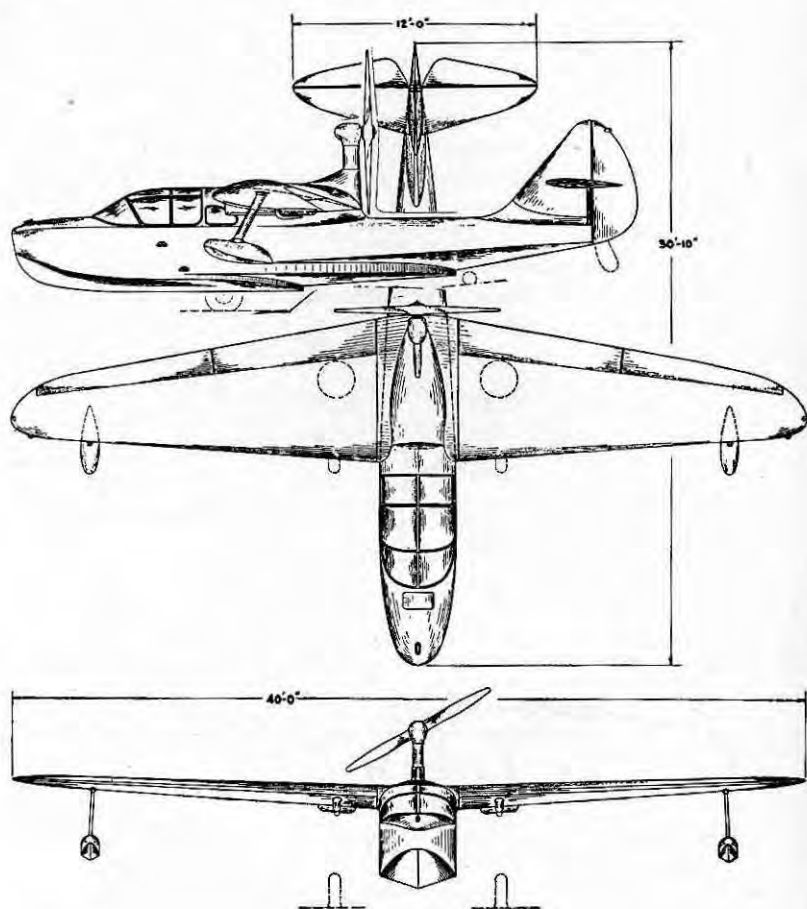
stringers and external skin. Structural strength was more than adequate to withstand all loads incident to maneuvers for this type of ship, and the all-metal construction insured ability to withstand severest weather conditions without deterioration.

The Spartan primary trainer, Model NS-1, was developed for military use and to the structural requirements of the Army Air Corps. It was a 2-place biplane with a wing spread of 33 ft. 8 $\frac{3}{8}$ in., height 9 ft. 4 $\frac{1}{4}$ in., length 24 ft. 7 $\frac{3}{4}$ 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



THE SPARTAN 7W

A 5-place transport powered by a 450 h.p. Pratt & Whitney Wasp Junior engine.

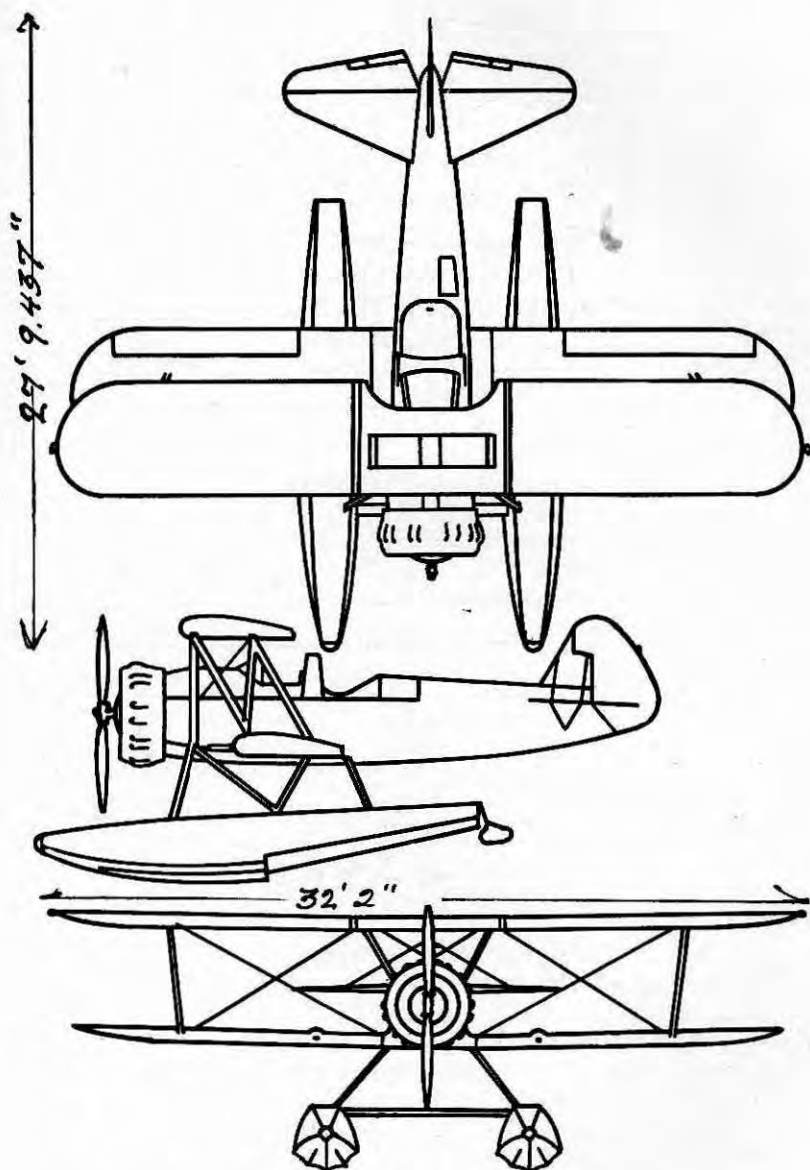


SPENCER-LARSEN

This four-place amphibion is powered with a 200 h.p. Ranger engine.

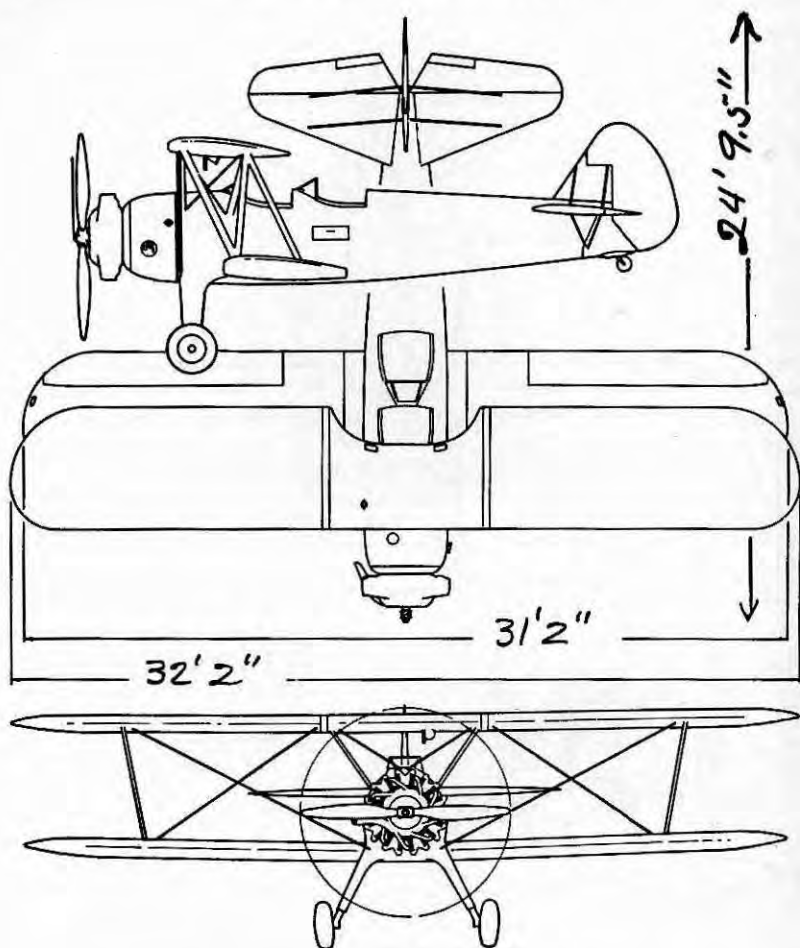
aluminum alloy construction with fabric covering. The fin and stabilizer were of stressed skin aluminum alloy construction, and the elevator and rudder of riveted dural frame work fabric covered. A single tab controllable from the cockpit provided horizontal trim. The landing gear, of the split axle type, and the swiveling tail wheel unit were equipped with oleo shock absorbers. The plane had a 220 h.p. Lycoming engine.

Spencer-Larsen Aircraft Corporation, Amityville, N. Y., had a new plant and was in production on its new SL-15 4-place amphibion.



STEARMAN 76D1

This two-place military trainer is powered with a Pratt & Whitney Wasp Junior engine.



STEARMAN A75L3

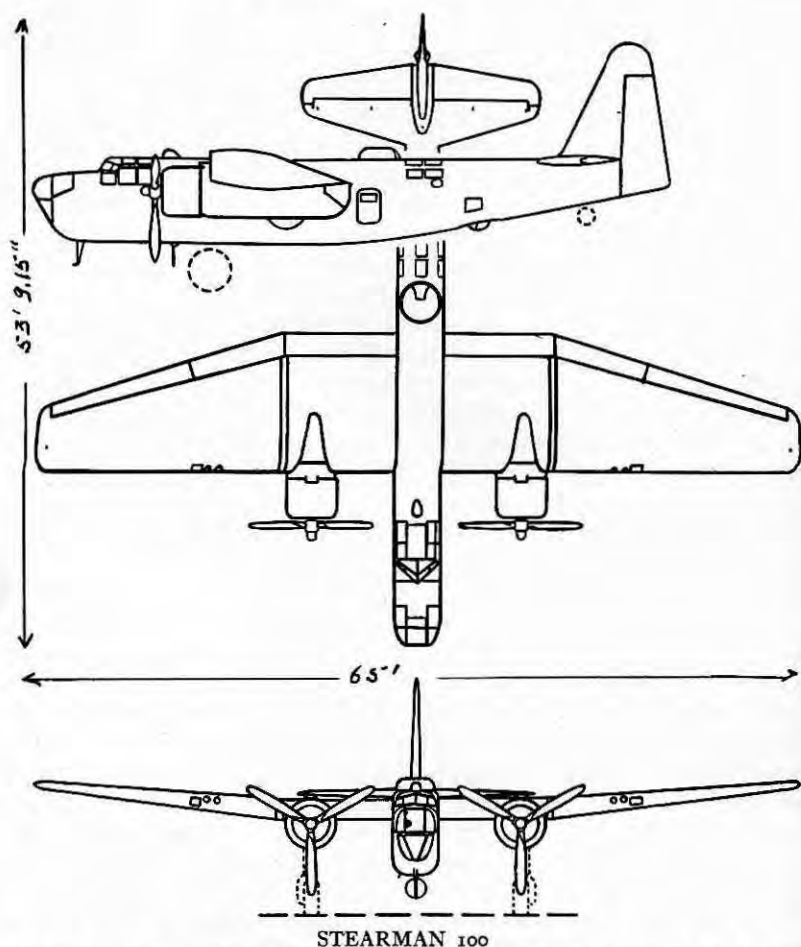
A Lycoming-powered two-place military trainer.

Based on the SL-12, previously completed by the company for test flights and developed after three years of original research, the plane was a single motor amphibian in which parasite drag was reduced to a minimum by the elimination of an engine cowling above the hull or superstructure. It was a high-wing full-cantilever monoplane of the flying boat type with retractable landing gear. The principle of the spiral bevel gear, widely accepted for propeller reduction gears, was utilized to provide a right angle drive propeller amidship, directly

over an engine mounted within the hull to the rear of the cabin. Through that location of the power plant and propeller, an unusually low center of gravity was obtained, and the plane removed from the turbulent area of the propeller to travel outside its own slip stream. With a Ranger 6-440C-5 200 h.p. engine the SL-15 had specifications showing a top speed of 140 m.p.h.; cruising at 125 m.p.h., landing at 50 m.p.h.; range 500 mi., rate of climb of 800 ft. per min., gross weight of 2,860 lbs. and weight empty 1,730 lbs. Construction of the plane was entirely of plastic bonded mahogany plywood with no fabric used on any part of the ship. The hull was the N.A.C.A. 35B slightly modified. In addition to the development of special designs for military type plane, the company undertook special subcontract work in machine tool and sheet metal operations.

Stearman Aircraft, Wichita, Kans., Division of Boeing Airplane Company, produced primary and advanced training airplanes which are now in service in the U. S. Navy, U. S. Army Air Corps, the Argentine Naval Aviation Service, the Brazilian Army Air Corps, the Philippine Army Air Corps, and the Cuban Air Corps. During the years of 1937 and 1938 Stearman delivered to the Air Corps a total of 118 primary trainers, Model PT-13 and PT-13A for use in primary training at Randolph Field, San Antonio, Tex. Under the new Air Corps training program, the 118 trainers were distributed to the various civilian flying schools throughout the United States where they continued to serve in training students for the Air Corps. In August, 1939, the Air Corps awarded Stearman the largest peacetime order for primary training equipment ever placed with a Government contractor. Sixty days after receiving the contract Stearman delivered to the Air Corps the first 20 PT-13B planes of the new contract. They were ferried by Air Corps personnel to the Spartan School of Aeronautics at Tulsa, Okla.

Stearman PT-13, PT-13A and PT-13B models, similar to the Stearman NS-1 in the Navy, were 2-place biplanes with a wing spread of 32 ft. 2 in., height 9 ft. 4½ in., length 24 ft. 9½ in., empty weight 1,997 lbs., useful load 689 lbs., gross weight, 2,686 lbs. They had a fuselage of welded steel frame, fabric covered; wings of spruce spars, spruce ribs and aluminum alloy channel drag struts, all fabric-covered; inter-plane and cabane struts of streamline aluminum alloy tubing and ailerons of riveted aluminum alloy construction, fabric covered. Welded steel tubing construction was used in the tail group, with fixed stabilizer and with horizontal trimming provided by means of an elevator tab. Landing gear was of the full cantilever type, equipped, as is the tail wheel, with oleo shock absorbers. The plane was powered by a 220 h.p. Lycoming R-68-11



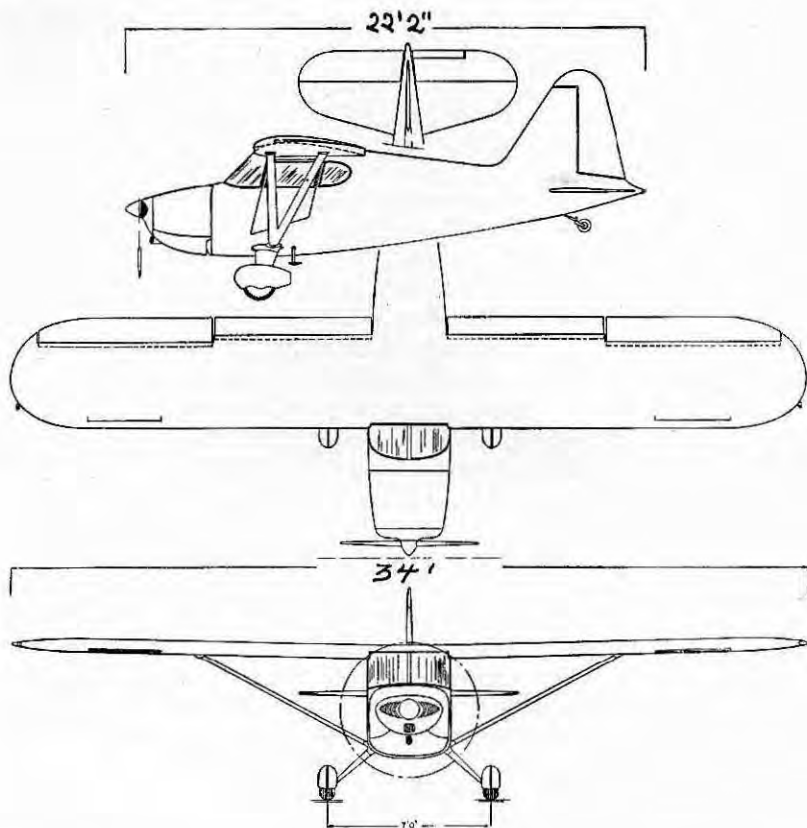
This twin-engine attack-bomber carries a crew of four and is powered with Pratt & Whitney 1,400 h.p. engines.

engine. Stearman A73B1 primary trainers were delivered to the Cuban Air Corps in 1939. They were similar to the PT-13B airplanes except for the power plant. The A73B1 was equipped with a Wright Whirlwind engine. An order of 76D3 planes was delivered to the Philippine Army Air Corps. The 76D3 was an advanced training and expeditionary type and while similar in general construction to the primary trainer, had provisions for the installation of one flexible and 2 fixed machine guns, bombing equipment, 2-way radio, flares and camera installation. They were characterized by extreme

visibility, being adaptable to long-range observation, aerial photographs, scouting, attack bombing and advance training. The power plant of the 76D3 was a Pratt & Whitney SB Wasp Junior developing 400 h.p. at 5,000 ft. The wing span was 32 ft. 2 in., length 24 ft. 4 in., height 9 ft. 2 in., empty weight 2,435 lbs., useful load 850 lbs., gross weight 3,250 lbs.

All the above Stearmans were variations of 2 basic Stearman training plane designs the 73, including the U. S. Navy NS-1, Army Air Corps PT-13, the Philippine 73L3, and the Cuban A73B1, a primary trainer; and the 76, including the model 76D1, the 76D3, and the 76C3, an advanced training and expeditionary type plane. The general performance characteristics of the 73, varying somewhat in accordance with the equipment employed on different models, were reported as maximum speed 125 m.p.h., cruising speed 103 m.p.h., landing speed 51 m.p.h., service ceiling 13,500 ft., absolute ceiling 15,400 ft., rate of climb at sea level 820 ft. per min., range at cruising speed 320 mi. The general performance characteristics of the 76, also varying according to equipment installed, were maximum speed 153 m.p.h., cruising speed 135 m.p.h., landing speed 56 m.p.h., service ceiling 16,700 ft., absolute ceiling 18,600 ft., rate of climb at sea level 1,000 ft. per min., range at cruising speed 472 mi. Contracts were signed late in 1939 with the Venezuelan Air Corps for delivery early in 1940 of a fleet of Stearman A75L3 planes, and a repeat contract with the Cuban Air Corps for an additional quantity of Model A73B1. The Air Corps contract for primary training planes added two new models to the Stearman list; namely, the PT-17 and PT-18, which were identical in structure and arrangement to the PT-13B except for the power plant. The Model PT-17 had the Continental 220 h.p. and the PT-18 the Jacobs 225 h.p. engine.

The Stearman 100 twin-engine attack bomber was produced early in 1939 at the Wichita plant, as an experimental model for entry in the Air Corps attack bomber design competition. In 1940 it was in daily service at Wright Field. The plane was released for export and in addition to its initial purpose as a twin-engine attack bomber, it was available as a high speed medium bomber. It was an all-metal high-wing monoplane, having a span of 65 ft., length 53 ft. 9 in., height 12 ft. 5 in., empty weight 12,760 lbs., useful load 5,470 lbs., gross weight 18,230 lbs. The fuselage was of all-metal monocoque construction with longitudinal stringers and transverse frames and bulkheads. The wing was of stressed skin type, flush riveted, all-metal, full cantilever construction, three web box spar, with N.A.C.A. slot-lipped type flaps of all-metal construction and fabric covered. The elevators and rudder were all-metal structure, fabric covered,



STINSON 105

A Continental-powered three-place plane for the private owner.

and the stabilizer and fin were of full cantilever, all-metal stressed skin construction. The landing gear and tail wheel were fully retractable, and the flaps electrically operated. While alternate power plants could be selected, the 100 was equipped with 2 Pratt & Whitney 1,400 h.p. Twin Wasp engines, using Hamilton Standard 3 blade constant speed full feathering propellers. A substantial program of factory expansion was undertaken by the Stearman Division near the close of the year 1939, involving the construction of enlarged plant facilities, rearrangement of shop layout, and installation of new equipment for straight-line quantity production of Stearman trainers. The new additions to the factory totalled approximately 50,000 sq. ft., bringing the total Stearman plant area to 157,755 sq. ft.

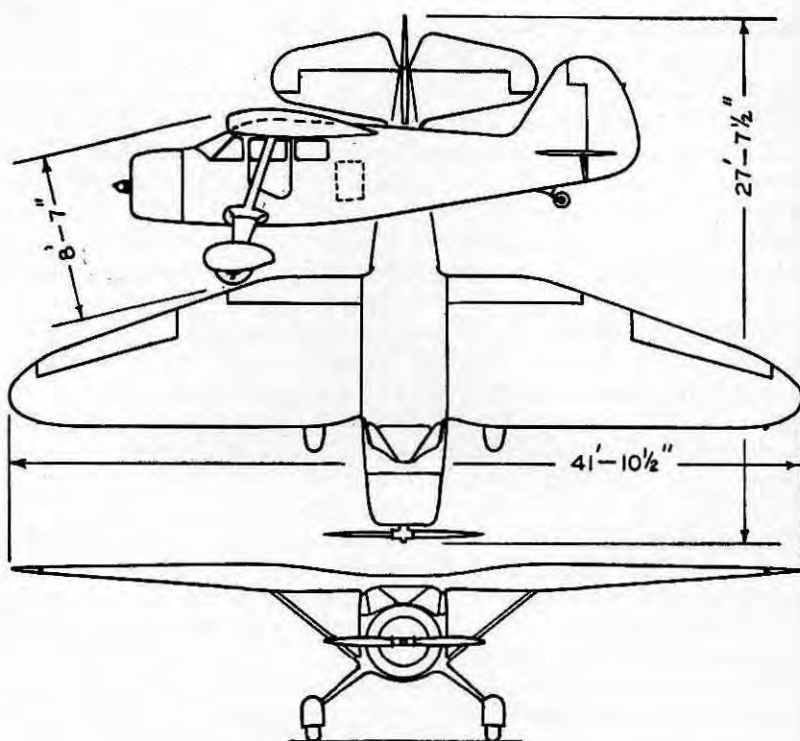
Stinson Aircraft Division of Aviation Manufacturing Corporation, Wayne, Mich., and Nashville, Tenn., early in 1940 was producing its line of 4 to 5-place Reliants, its 3-place 105 and an order from the U. S. Army Air Corps for approximately 100 liaison observation planes designed for operating in and out of small fields. The Air Corps Stinson was officially designated O-49, a short range Army cooperation plane for contact work with infantry. It was a high wing 2-place monoplane for a pilot and an observer in an enclosed cockpit with 2-way radio. It was equipped with slots and flaps, enabling it to take off easily from a short runway and land in a restricted area.

The 1940 Reliants offered 8 different power installations, including Lycoming, Pratt & Whitney Wasps and Wright Whirlwinds. The Reliant had a wing span of 41 ft. 10½ in., length 27 ft. 7½ in., gross weights ranging from 3,875 lbs. to 4,650 lbs., depending on size of the power plant. The cruising speed also varied with the power plant from 143 m.p.h. to 176 m.p.h. The useful load ranged from 1,365 lbs. to 1,605 lbs. Stinson also continued to produce its multi-purpose Reliant for ambulance, fire and police patrol and other utility missions. Many air lines used Reliants for instrument flight training. The New York air police bought Reliants for emergency patrol work; and similar models were purchased by several Federal Bureaus and foreign governments.

The Stinson 105, introduced in 1939, was further streamlined and refined in the 1940 model, while retaining the fixed wing slots, 3-position flaps and hydraulic brakes and other characteristics which had led to the sale of several hundred 105 planes during its first year on the market. The 1940 Stinson 105 had a choice of 3 different power plants—the 75 h.p. Continental, 80 h.p. Continental and the 75 h.p. geared Lycoming. The 105 with 80 h.p. Continental had a stated cruising speed of 111 m.p.h. at 4,800 ft., 20 gal. fuel capacity, range at cruising h.p. 3¼ hrs., wing span 34 ft., length 22 ft. 2 in., wing area 155 sq. ft., wing loading 10.2 lbs. per sq. ft., power loading 19.8 lbs., per h.p., weight empty 923 lbs., useful load 657 lbs., gross weight 1,580 lbs., landing speed, flaps down, 43 m.p.h., landing roll 150 ft., service ceiling 12,000 ft.

The Stinson plant at Wayne early in 1940 contained a large quantity of new machines, including a 500-ton press and drop hammers. The company also had completed a new modern plant at Nashville with 145,000 sq. ft. of manufacturing space, with facilities for experimental and development work.

Taylorcraft Aviation Corporation, Alliance, O., had two models for the 1940 light plane market. The Taylorcraft De Luxe was an externally braced high-wing, 2-place, cabin monoplane with a wing



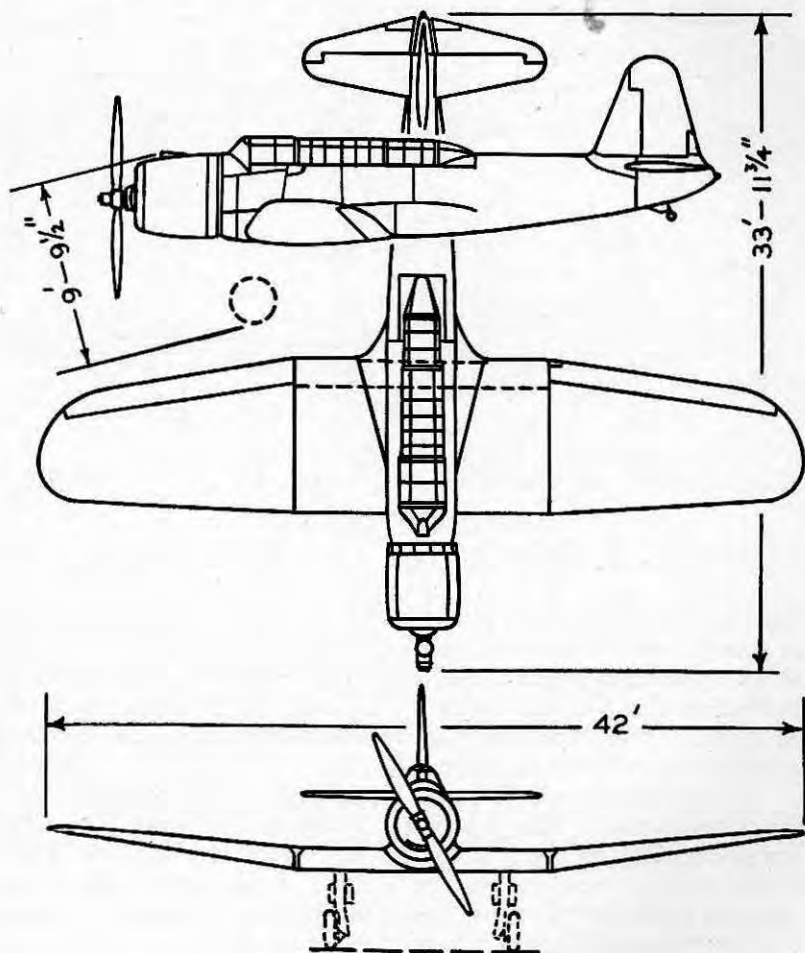
THE STINSON RELIANT

One of the 1940 Series five-place planes with six different engine installations.

span of 36 ft., length 22 ft., height 6 ft. 8 in., wing area 167 ft., wing loading 6.5 lbs. per sq. ft., power loading 17.7 lbs. per h.p., weight 640 lbs., useful load 510 lbs., payload 268 lbs., gross weight 1,150 lbs. and fuel capacity 12 gal. The stated maximum speed was 105 m.p.h., cruising at 95 m.p.h., landing with flaps at 35 m.p.h., service ceiling 15,000 ft., rate of climb 640 ft. a min., cruising range 250 mi. The De Luxe was powered by 65 h.p. Continent or Lycoming engines. The Taylorcraft Trainer was similar in exterior dimensions, and was powered by a 50 h.p. Lycoming engine.

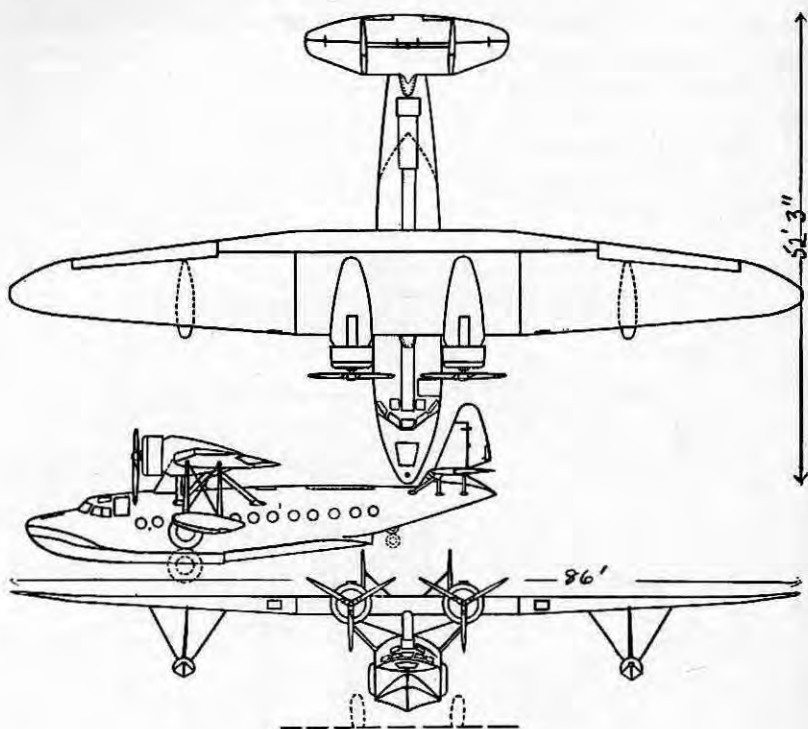
Vought-Sikorsky Aircraft at Stratford, Conn., a division of United Aircraft Corporation, was a combination of two former divisions, Chance Vought Aircraft and Sikorsky Aircraft, both of which had long been widely known in aeronautical circles. The division was housed in the former Sikorsky plant at Stratford, and it was enlarged to twice its former floor area to meet the increasing de-

mands for both military and commercial planes. Vought-Sikorsky Aircraft in 1939 was in production on a quantity order of OS2U-1 scout-observation planes for the U. S. Navy. It was a low-wing monoplane with metal monocoque fuselage, characterized by the extensive use of spot welded aluminum alloy construction. The power was a Pratt & Whitney Wasp Junior engine with a Hamilton Standard constant speed propeller. The OS2U-1 was convertible either as a



VOUGHT-SIKORSKY V-156

A two-place dive bomber with Pratt & Whitney 750 h.p. Twin Wasp Junior engine



VOUGHT-SIKORSKY S-43

A 19-place amphibian powered with two Pratt & Whitney Hornets.

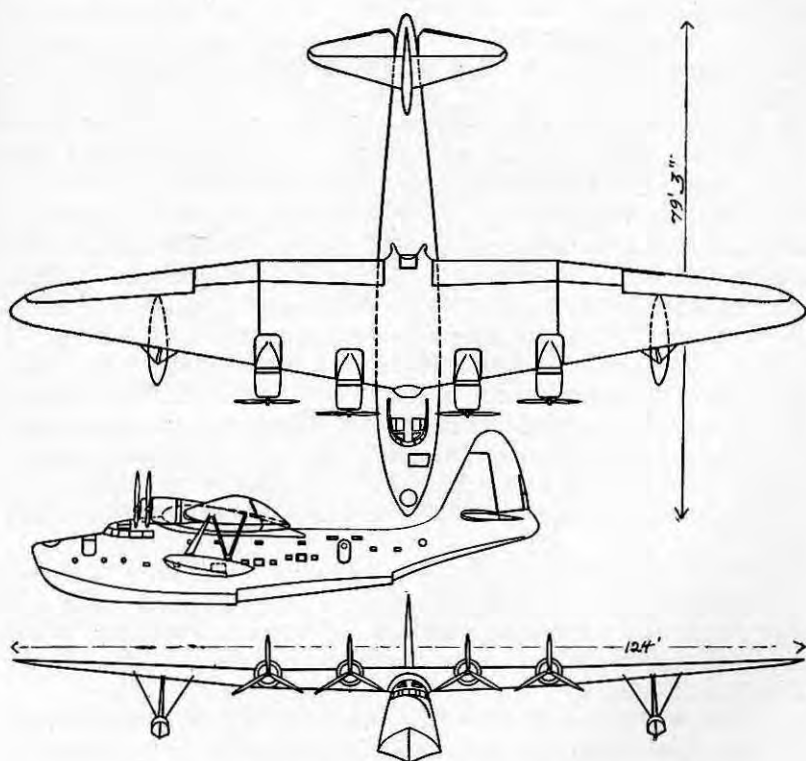
land plane or single-float seaplane, but its chief function was that of a seaplane operating from battleship or cruiser catapults and used to direct gunfire or conduct long-range observation-scouting missions. Production was also under way on an order for SB2U-3 planes for the Navy. These were improved versions of the monoplane SB2U-2 scout-bombers already in service.

For the French air forces a quantity of V-156 scout-bombers was manufactured. The V-156 was a 2-place, low-wing, internally braced monoplane, powered by a Pratt & Whitney Twin Wasp Junior engine. Provision was made for 2 fixed guns in the wings outboard of the propeller disc, and a flexible gun in the rear cockpit. Various types and sizes of bombs could be carried.

An experimental model of a new scout-observation plane for the U. S. Navy was test-flown. It was designated XSO2U-1, a 2-place midwing convertible type monoplane in which attention had

been focused on maximum speed and visibility without compromising other desired factors of low landing speed, excellent water handling qualities as a seaplane, notable climb and endurance and economical operation. Basic requirements were met in the XSO2U-1 by employing a full cantilever wing and tail group, sleek streamlining to meet high speed requirements, a swept-forward and highly placed wing, together with optimum crew-spacing, to provide maximum visibility; deflector plate flaps and "drooping" ailerons for low landing speed with minimum wing area, and placement of the fuselage close to the float, thereby lowering the center of gravity and giving highly superior water handling characteristics.

Equipped with a 12-cylinder Fairchild Ranger V-type aircooled engine developing approximately 450 h.p. at altitude and a Hamilton



VOUGHT-SIKORSKY VS-44A

This 28 to 40 place ocean transport is powered with four Pratt & Whitney Twin Wasps.

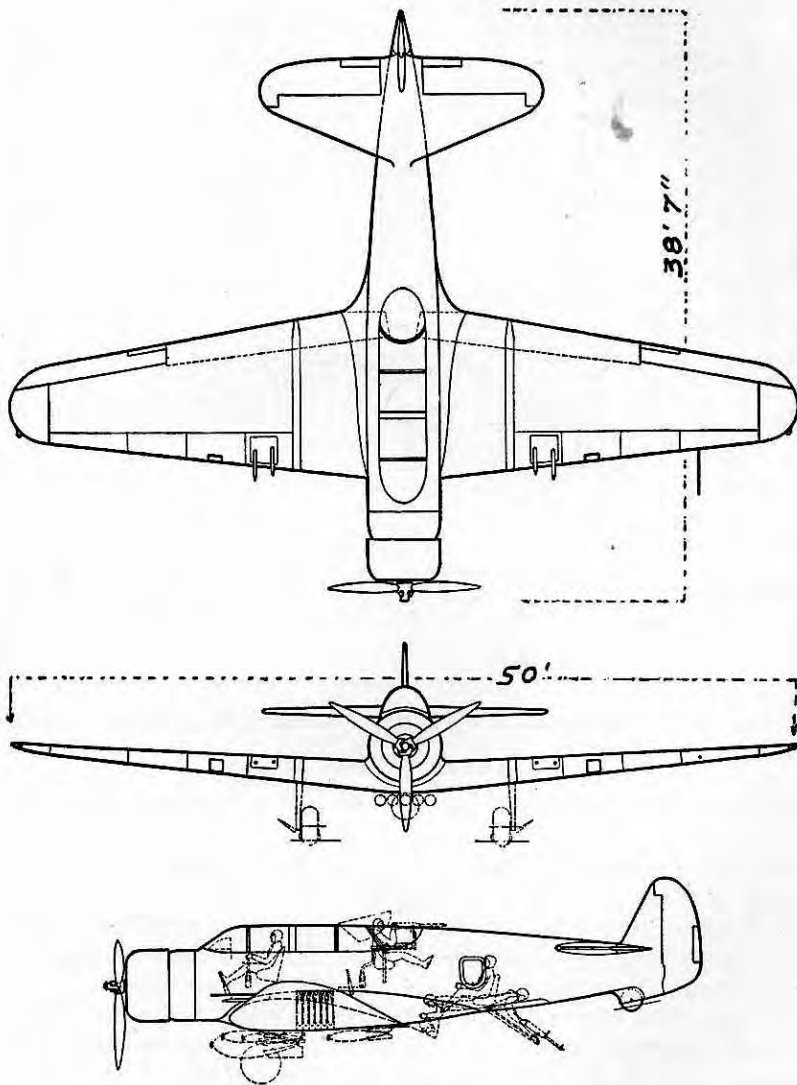
Standard constant speed propeller, the XSO₂U-1 was of an exceptionally clean design, made possible by the small frontal area of the fuselage, the use of resistance welding and flush riveting on all external surfaces, application of the Vought-Sikorsky smooth fabric-attaching method where fabric covering was employed, the fitting of gap covers ahead of the deflector plate flaps, and utilization of a new design streamlined float having considerably reduced air and water drag. Compact, sturdy and lightweight, the XSO₂U-1 was built to withstand the severe conditions encountered at sea in rough water landings, as well as to meet the problems of handling both ashore and aboard ship. Measuring approximately 36 ft. in length as a seaplane and 34 ft. as a landplane, the fuselage was of all-metal Vought-Sikorsky type monocoque construction. It included 2 cockpits, one for the pilot located ahead of the leading edge of the wing and the other considerably aft of the trailing edge, an arrangement providing almost ideal vision for both crew members. Interchangeable float and land type landing gears made the plane convertible. The main float was of the pointed, faired step design and was braced to the fuselage by 2 short full cantilever struts. Single cantilever struts attached the wing tip floats to the wing. For conversion to a land plane, a split axle type landing gear could be installed.

The 38-ft. wing was a single spar-leading edge torque box type full-cantilever structure consisting of a center section and 2 outer panels, the latter of which could be folded back alongside the fuselage. The leading edge of the wing was metal-covered, and the aft portion fabric-covered, while the wing tips were protected from damage by rubber "bumpers." Deflector plate flaps were fitted to the trailing edge of the wing inboard of the drooping type ailerons. The tail surfaces were of the full cantilever type. Fixed surfaces were metal-covered, and movable surfaces fabric-covered. Weighing approximately 5,200 lbs. as a landplane and 5,500 lbs. as a seaplane, the XSO₂U-1 was designed primarily for catapult operation from Navy cruisers.

In the commercial field, Vought-Sikorsky delivered to Inter-Island Airways an S-43 amphibion of the latest type, with twin tail, and fitted with Hamilton Standard hydromatic propellers. Work also was begun on two S-43 transports for K.N.I.L.M., in the Dutch East Indies.

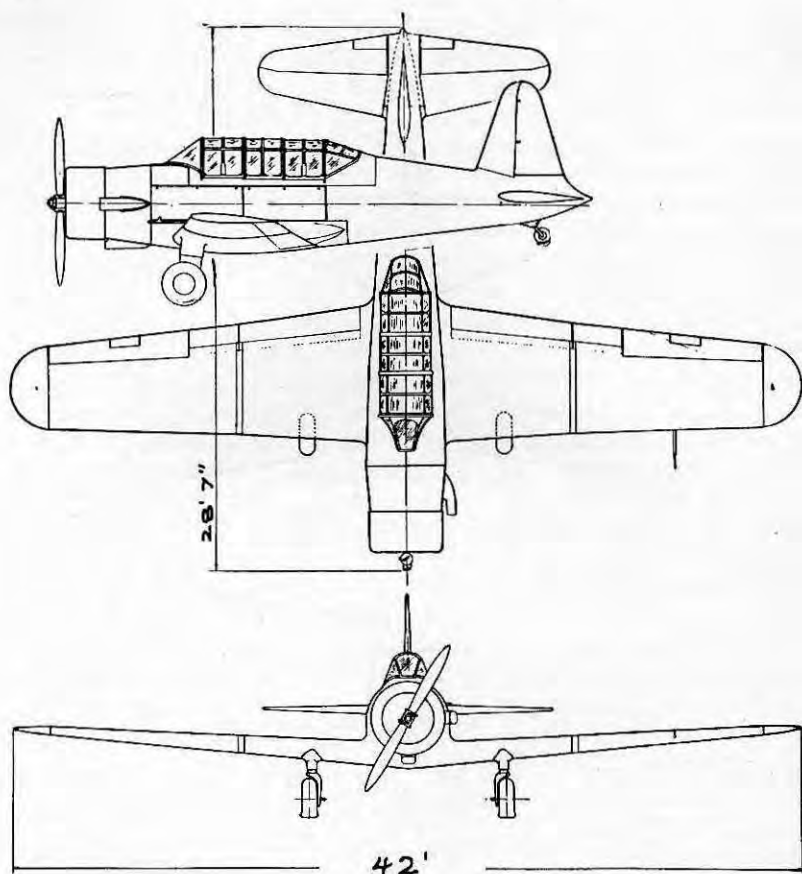
Work was begun on a new long-range commercial flying boat, the VS-44A, 3 of which were expected to be used in ocean operations by American Export Airlines. A modification of the "Flying Dreadnaught" built for the U. S. Navy, the VS-44 was a high-wing, cantilever monoplane, with a semi-monocoque hull, the construction

being of metal throughout. It was designed to carry 16 overnight passengers, in addition to mail and express. To meet modern requirements for transoceanic operation, the VS-44 was to have a



VULTEE V-12

A three-place attack-bomber powered with a Wright Cyclone 1,600 h.p. engine.



VULTEE VALIANT 54

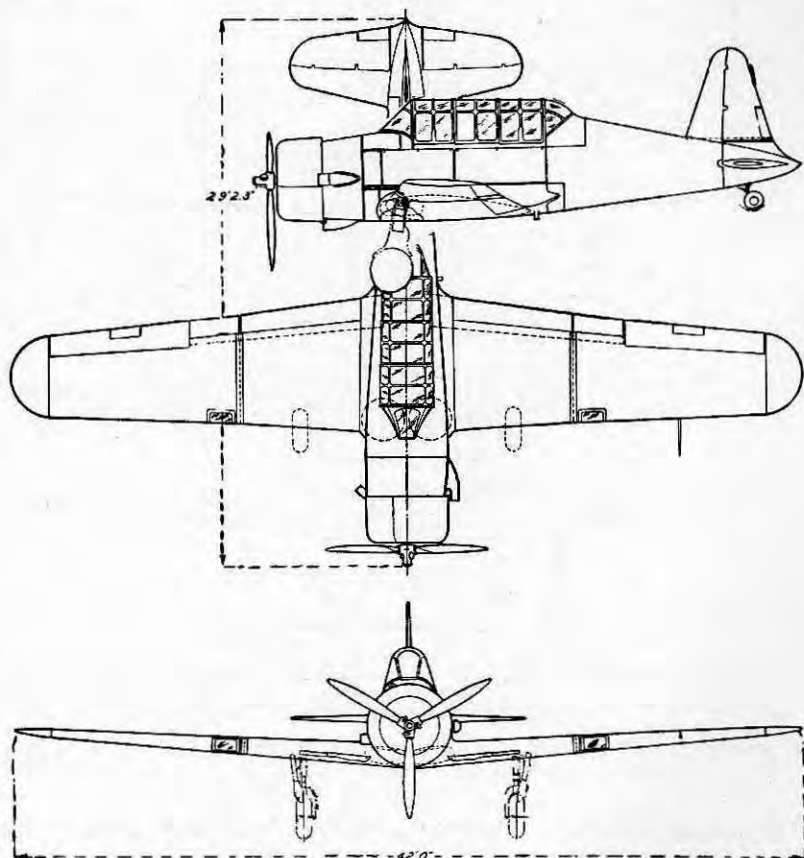
A two-place basic trainer with Pratt & Whitney Wasp Junior 450 h.p. engine.

range of 3,800 mi. at a speed of 150 m.p.h., carrying a payload of 5,000 lbs.

Vultee Aircraft, Inc., Downey, Calif., entered 1940 with a modern aircraft factory and production system. The plant of approximately 335,000 sq. ft. of floor space had a straight-line production system and the latest type of high-speed manufacturing equipment. Parts moved from 25 to 50 per cent less distance during the manufacturing process than in the old style systems. The backlog of orders was about \$16,000,000, including a \$3,000,000 U. S. Army Air Corps order for Vultee Valiant basic trainers (Army designation BT-13)

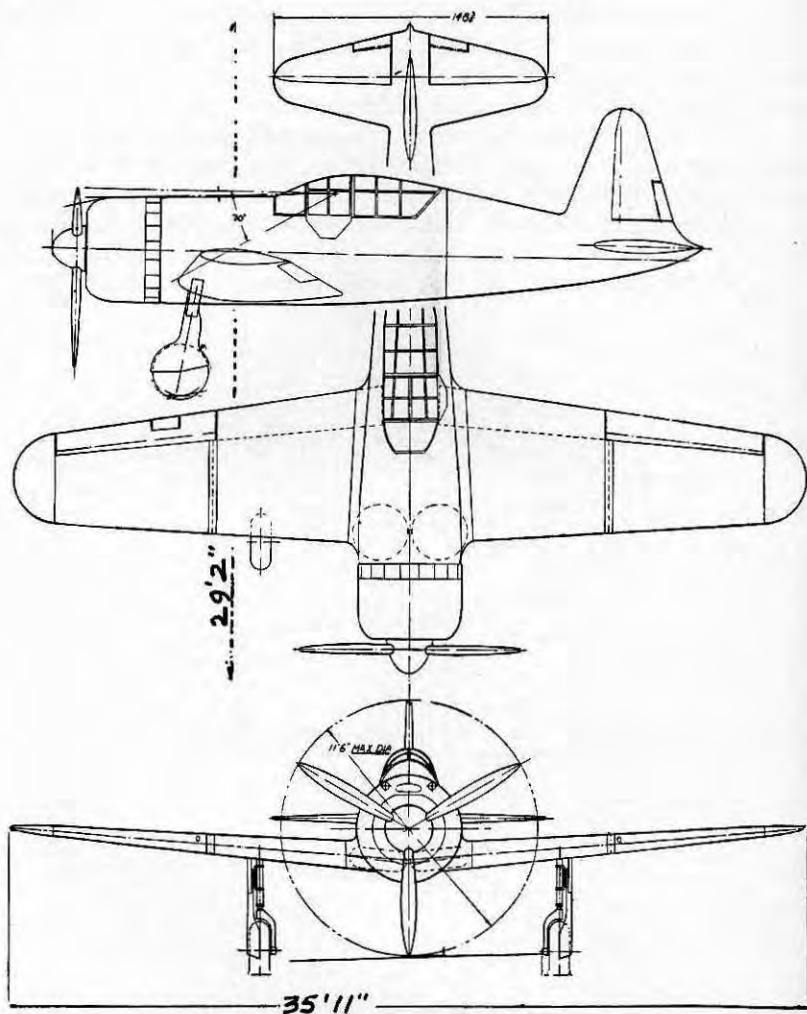
about \$9,000,000 worth of Vultee Vanguard pursuits for Sweden, \$2,500,000 worth of V-12 attack bombers for England and the balance in spare parts for the above customers besides orders for Brazil and Turkey where Vultee attack bombers were in use.

The Vultee Vanguard pursuit, with a stated speed of 385 m.p.h., powered with a 1,200 h.p. Allison engine, was considered its most outstanding development by the company. On normal fighter missions, the plane carried 6 machine guns, but for special missions could carry up to 10. The installation included three 30-cal. machine guns in each wing, two 50-cal. and two 30-cal. mounted under the cowl.



VULTEE VALIANT 51

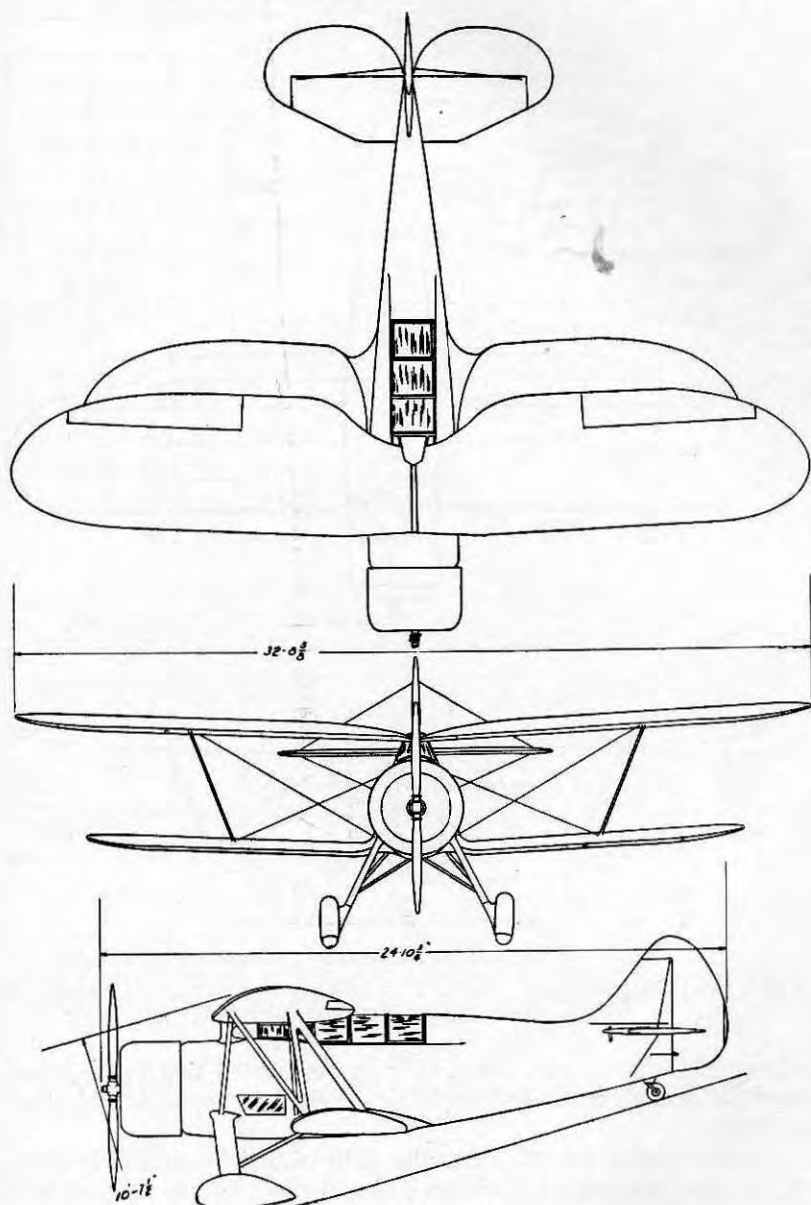
This two-place plane may be used either as a basic combat or advanced trainer and is powered with a 550 h.p. Pratt & Whitney Wasp.



VULTEE VANGUARD 48

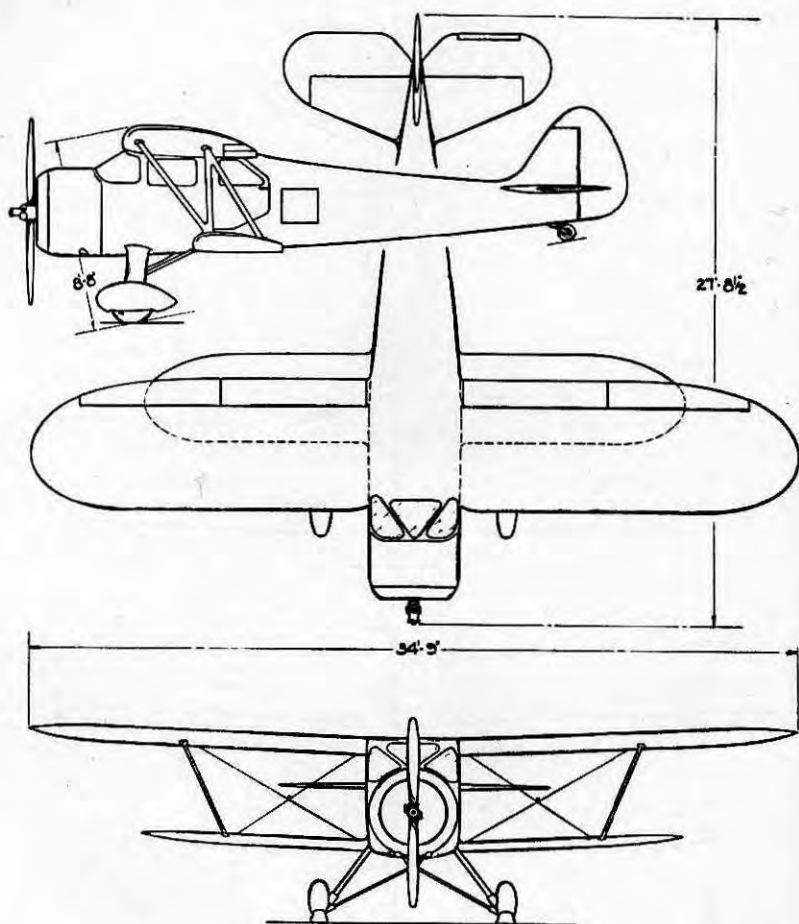
A one-place pursuit powered with either a 1,200 h.p. Pratt & Whitney Wasp or a 1,600 h.p. Wright Cyclone.

The 10 guns fired approximately 4,500 rounds of ammunition. The Vanguard pursuit also could be equipped with two 20 mm. cannons, each firing 75 rounds of explosive shells. A feature of the airplane was its simplicity of construction and the ease with which it could be serviced in the field. Four mechanics could strip all cowling and



WACO MODEL D-7

A two-place military trainer available with either Pratt & Whitney or Wright engine in a power range from 365 to 420 h.p.



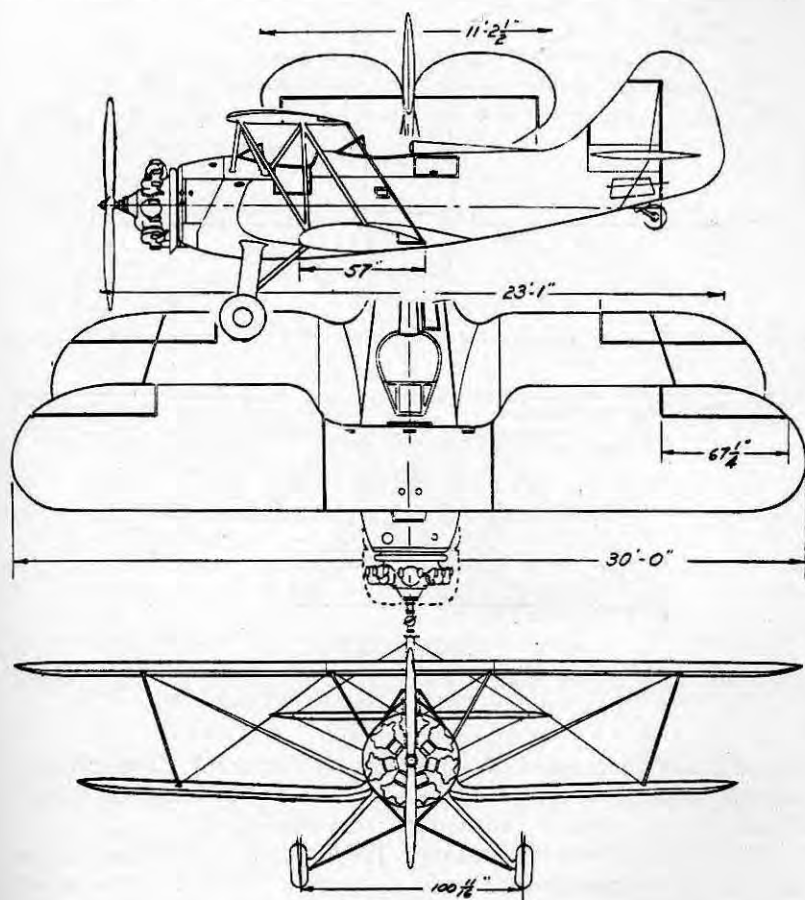
WACO MODEL E

A four-five place plane with a choice of Jacobs, Lycoming, Pratt & Whitney or Wright engine, ranging from 300 to 420 h.p.

side panels in 2 minutes flat, and it was estimated that plane armament installation could be completely serviced in approximately half an hour.

Other models incorporating the same simplicity in construction and ease of maintenance were the Vultee Valiant 51 basic combat and advance trainer powered by a 550 h.p. engine and the Vultee Valiant 54 basic trainer, with a 450 h.p. engine. The V-12, latest model of the Vultee attack-bomber, was a high performance single-engine air-

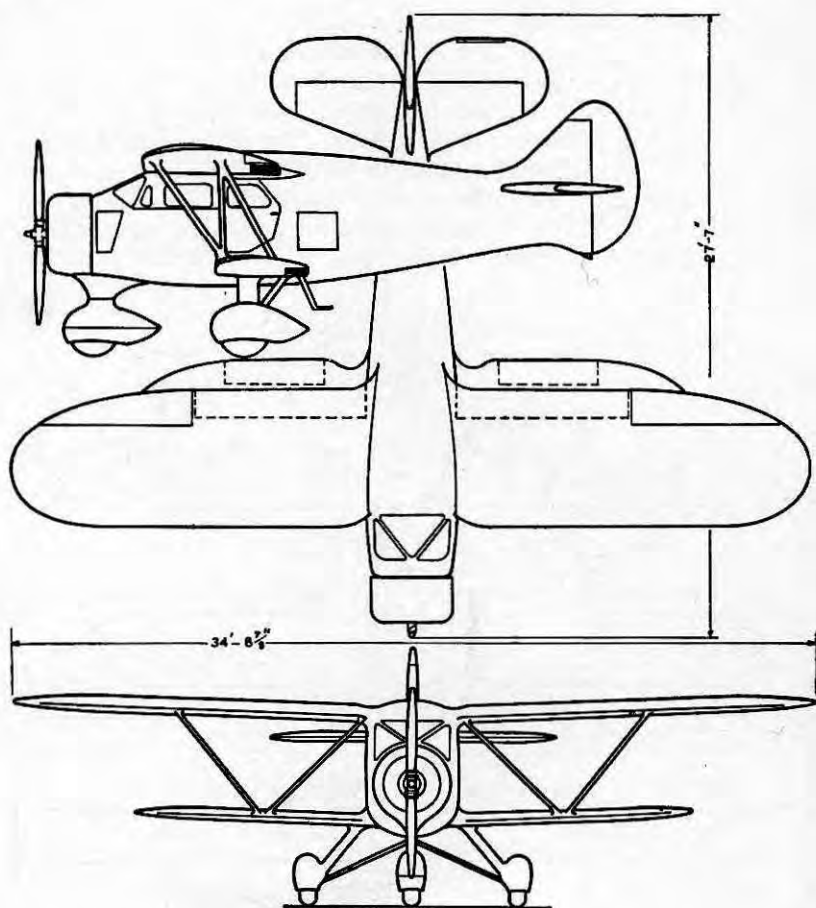
plane of wide versatility. On attack missions it carried 6 machine guns and also light bombs. On bombardment missions it carried up to 3,000 lbs. of bombs, ranging in size from 50 to 1,000 lbs. An internal bomb cannister could be equipped to carry 30 bombs of 20 lbs. each or 9 bombs of 100 lbs. each. The plane carried 3 men as a crew. It was of semi-monocoque construction. Butt joint and flush riveting were used throughout, considerably increasing the plane's top performance. With an engine rated at 1,200 h.p. for take-off the V-12 had a top speed of 262 m.p.h. Powered with a 1,600 h.p.



WACO MODEL F-7

A two-place military trainer with a choice of Continental, Jacobs or Lycoming engines of 220 or 225 h.p.





THE WACO N

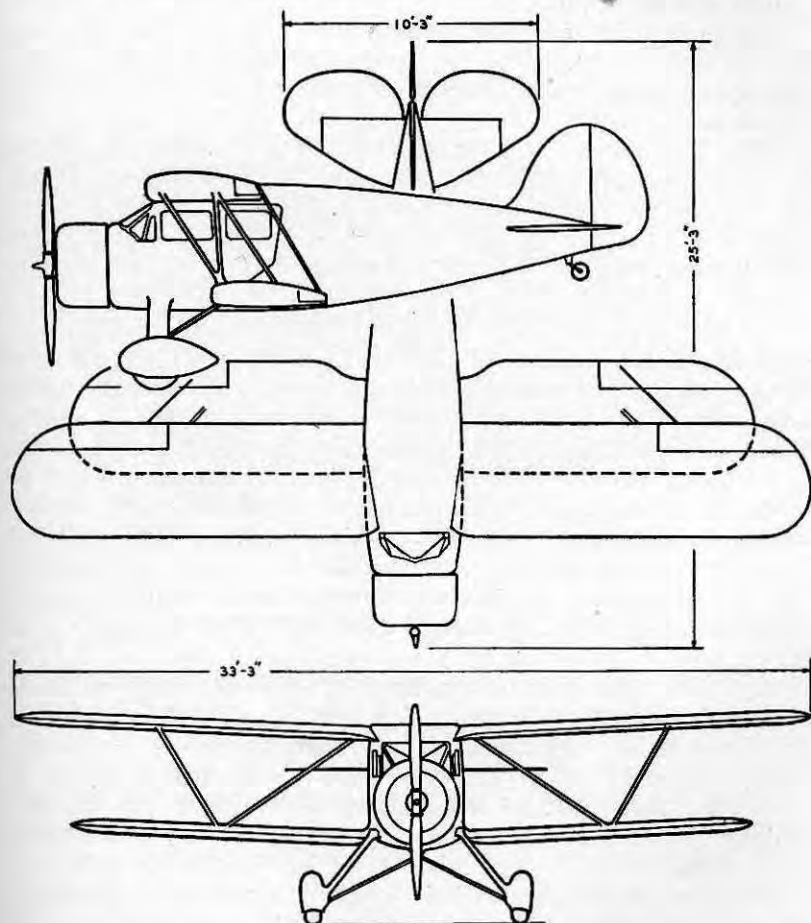
A four-five place private owner plane with tricycle landing gear and 300 h.p. Jacobs engine.

engine it had a top speed of approximately 290 m.p.h. The company recently acquired an option on 46 acres of land adjoining the factory to take care of possible future expansion requirements.

The Waco Aircraft Company, Troy, O., reported that 42 per cent of its airplane production in 1939 was exported to customers abroad, the largest single foreign order being 30 custom cabin planes to the Brazilian Army Air Corps for air mail use. Waco D light fighters were sold to Nicaragua, and YPT-14 type (Waco F-7)

trainers to Venezuela. A late private owner model was the Waco E. For 1940 Waco was offering 5 models, as follows:

The Waco F-7 trainer series, of which 13 were bought by the U. S. Army Air Corps, and designated YPT-14, was a 2-place, tandem, open cockpit biplane for primary and second stage military training. It had a stated maximum speed of 138.6 m.p.h., cruising at 123 m.p.h., span 30 ft., length 23 ft. 1 in., and was powered by 220 h.p. Continental, 225 h.p. Jacobs or 220 h.p. Lycoming engine.



THE WACO MODEL S

A four- to five-place private owner plane, powered by a Jacobs or Continental engine, with a power range from 225 h.p. to 285 h.p.

The Waco D was a 2-place, tandem, high performance, open or closed, advanced trainer or light military tactical biplane, span 32 ft. 8 $\frac{3}{8}$ in., length 25 ft. 6 $\frac{1}{2}$ in., stated maximum speed of 170 m.p.h., cruising at 155 m.p.h., power plant 365 h.p. or 450 h.p. Wright Whirlwind or 420 h.p. Pratt & Whitney Wasp Junior engine.

The Waco N was a 5-place private owner or executive cabin biplane with tricycle landing gear, wing span 34 ft. 9 in., length 27 ft. 7 in., stated maximum speed 161 m.p.h., cruising at 151 m.p.h., Jacobs 300 h.p. engine.

The Waco S was a 5-place private owner cabin biplane with 240 h.p. Continental, 225 h.p. or 285 h.p. Jacobs engine; span 33 ft. 3 in., length 25 ft. 4 in., stated maximum speed 145 to 152 m.p.h., cruising at 136 to 144 m.p.h.

The Waco E was the latest development of the company. It was a 5-passenger cabin private owner biplane powered by a 300 h.p. Jacobs, 400 h.p. Wasp Junior or 420 h.p. Wright Whirlwind engine; wing span 34 ft. 9 in., length 27 ft. 10 in., stated maximum speed 185 to 204 m.p.h., cruising at 177 to 200 m.p.h.

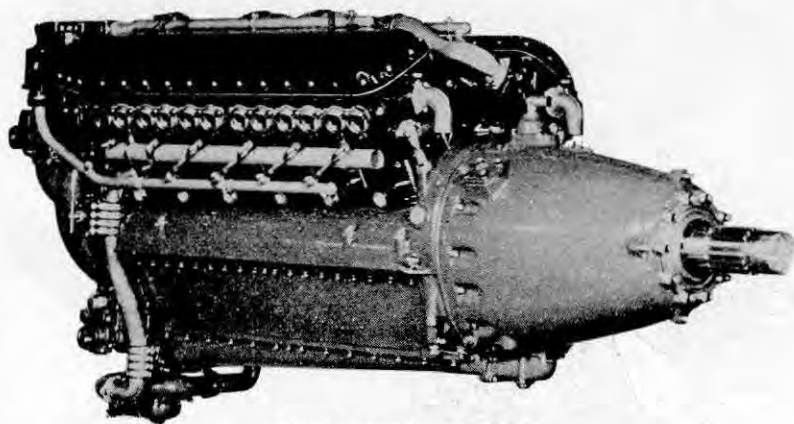
Aircraft Engine Manufacturers

The Allison Division of General Motors Corporation, Indianapolis, Ind., concentrated on development and production of engines adaptable for high speed installations. It has in production a 12-cylinder, geared, Ethylene Glycol cooled V-type engine known as the V-1710-C15 aircraft engine. This engine, being dimensionally no wider or higher than a seated pilot, lends itself particularly to high speed military pursuit ships with a minimum frontal area and low drag, thus making effective more available horsepower for obtaining speed. It is rated at 960 h.p. at 2600 r.p.m. at 12,000 ft., 1090 h.p. 5 minute rating at 13,200 ft., and a take-off rating of 1090 h.p. at 3000 r.p.m. Compression ratio is 6.65:1, blower gear ratio 8.77:1, bore 5.5 in., stroke 6 in., displacement 1710 cu. in., length 98 17/32 in., width 29 9/32 in., height 41 $\frac{7}{8}$ in., dry weight 1325 lbs., weight per h.p. 1.22 lbs., fuel consumption at rated horsepower .60 lbs. per brake h.p. per hr., using 90 octane fuel C.F.R. method.

Other Ethylene Glycol cooled type models now on the restricted military list are also in production. The use of Allison V-1710 engines with special extension shaft drive for pusher installation in the Bell YFM-1 two engine fighters is indicative of one type of interesting possibility for advanced type ships for specialized performance. The engine is readily adapted to the use of exhaust driven turbo superchargers, which provide it with maximum sea level horsepower available to any practical altitude resulting in a very high rate of climb

speed as well as high cruising economy. The Bell P-39, equipped with a V-1710 model with special extension shaft drive for tractor installation, indicated the flexibility of design for unconventional engine locations possible with this type of engine. The Curtiss YP-37 and P-40, equipped with Allison V-1710 model engines, during recent months claimed interesting high speed performances and fuel economies. The Lockheed YP-38 with two Allison engines has shown the possibilities available for long range high speed interceptors with engines that streamline into the general high speed design.

Allison completed a new production manufacturing plant, air conditioned throughout. No daylight enters the plant. That demands a superior lighting installation. It is provided by modern fluorescent

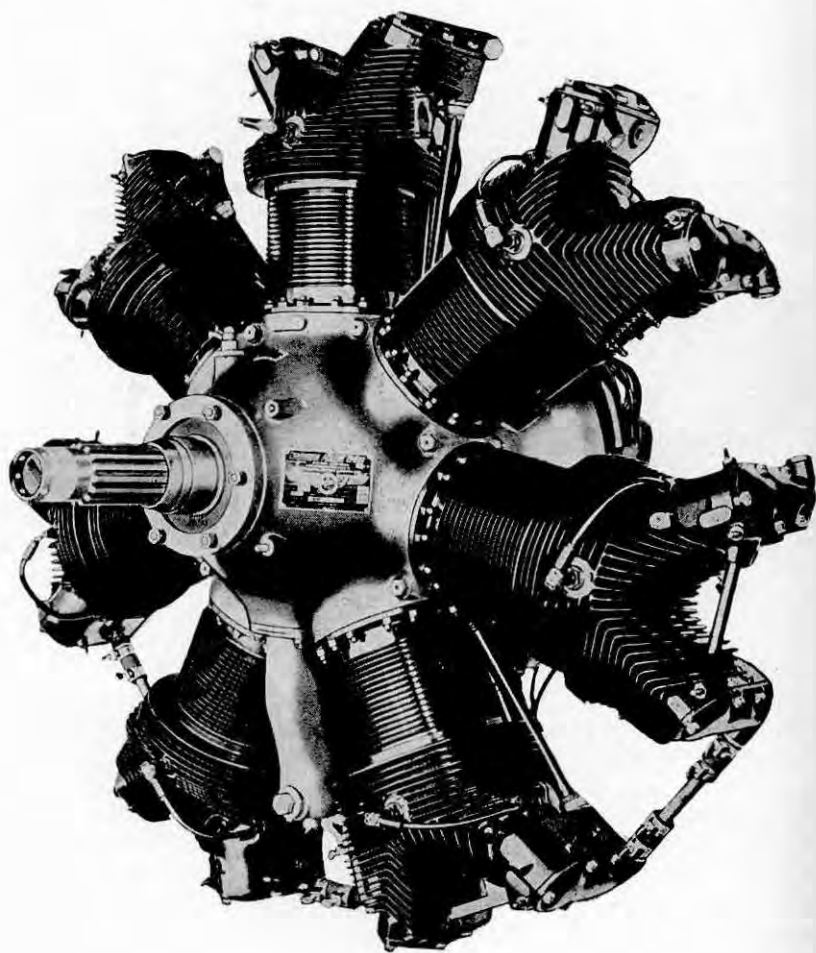


THE ALLISON ENGINE

Model V-1710-C15—a geared liquid-cooled engine with normal rating of 960 h.p. at 2,600 r.p.m. at sea level; 1,090 h.p. at 3,000 r.p.m. at 13,200 ft.

lights which give, without shadows, a north light illumination suitable for the precision operations necessary in aircraft engine manufacture. This type of lighting adapts itself to air conditioning because heat radiation from the light is very small. This plant was in production on V-1710 engine, and was being enlarged to provide additional facilities.

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. In October, 1939, a plane with the Continental A-50 remained up 726 hrs., or 30 days and nights, in continuous flight. Continental also developed an "exclusive" fuel injection system for the A engine. The fuel injector replaced the

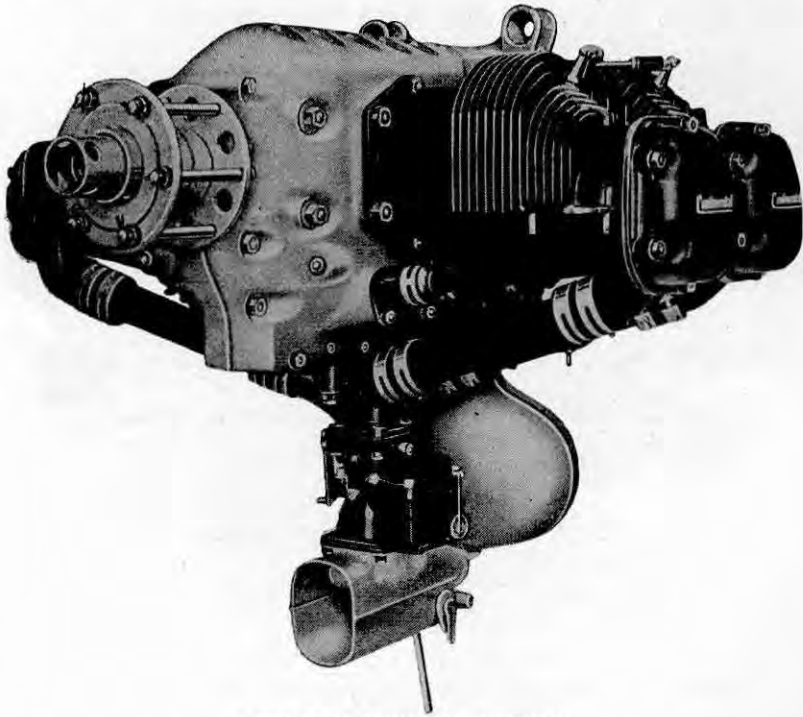


THE CONTINENTAL W-670

A seven-cylinder radial aircooled engine rated 225 h.p. at 2,175 r.p.m. and 250 h.p. at 2,200 r.p.m.

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., continued pro-

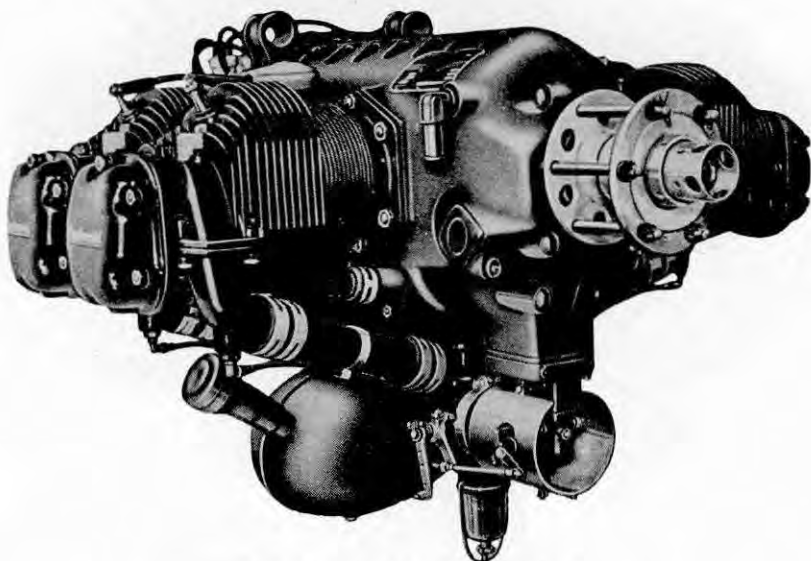


THE CONTINENTAL ENGINE

Showing carburetor type in A-50, A-65, A-75 and A-80 models.

duction of its L-4, L-5 and L-6 series, 7-cylinder, air-cooled, radial engines. The L-4 series, Models L-4MB, L-4M and L-4MA, with a displacement of 757 cu. in., was rated 225 h.p. at 2,000 r.p.m. at sea level. The L-5 series, Models L-5MB and L-5M, with a displacement of 831 cu. in., was rated 285 h.p., at 2,000 r.p.m. at sea level. The L-6 series, Models L-6MB, L-6M and L-6MBA, with a displacement of 914 cu. in., was rated 300 h.p. at 2,100 r.p.m. at 3,700

ft. altitude, with a take-off rating of 330 h.p. at 2,200 r.p.m. at 26 in. manifold pressure. The L-4 and L-5 series ratings were with 73 octane fuel and the L-6 series with 80 octane. The MB models were equipped with one Scintilla magneto and one Scintilla battery distributor, while the M models carried two Scintilla magnetos. All models carried an Eclipse 15-ampere generator as standard equipment and could be equipped with various combinations of extra accessories, including direct electric starter, fuel pump, vacuum pump, hydraulic pump and machine gun synchronizer. All models could be equipped for fixed pitch, controllable or constant speed propellers.

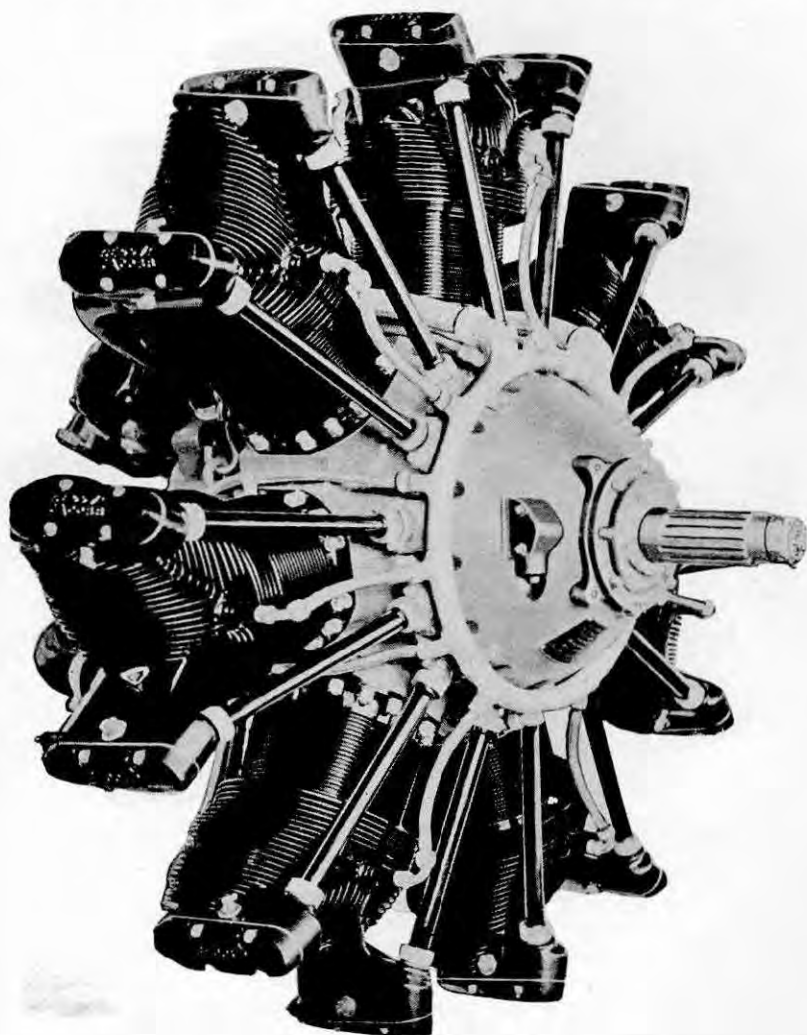


THE CONTINENTAL ENGINE

Showing fuel injector type in A-50, A-65, A-75 and A-80 models.

All models had sodium filled exhaust valves, forged aluminum pistons and four crankshaft bearings, two roller and two ball. All crankcase sections were magnesium alloy castings, except the front half of the main crankcase which was an aluminum casting. No basic changes were introduced during the year, though various design improvements were incorporated in all models.

A new model of the Jacobs L-4 series incorporated automatic valve gear lubrication and other modifications to comply fully with the latest Army-Navy specifications, and the company received a

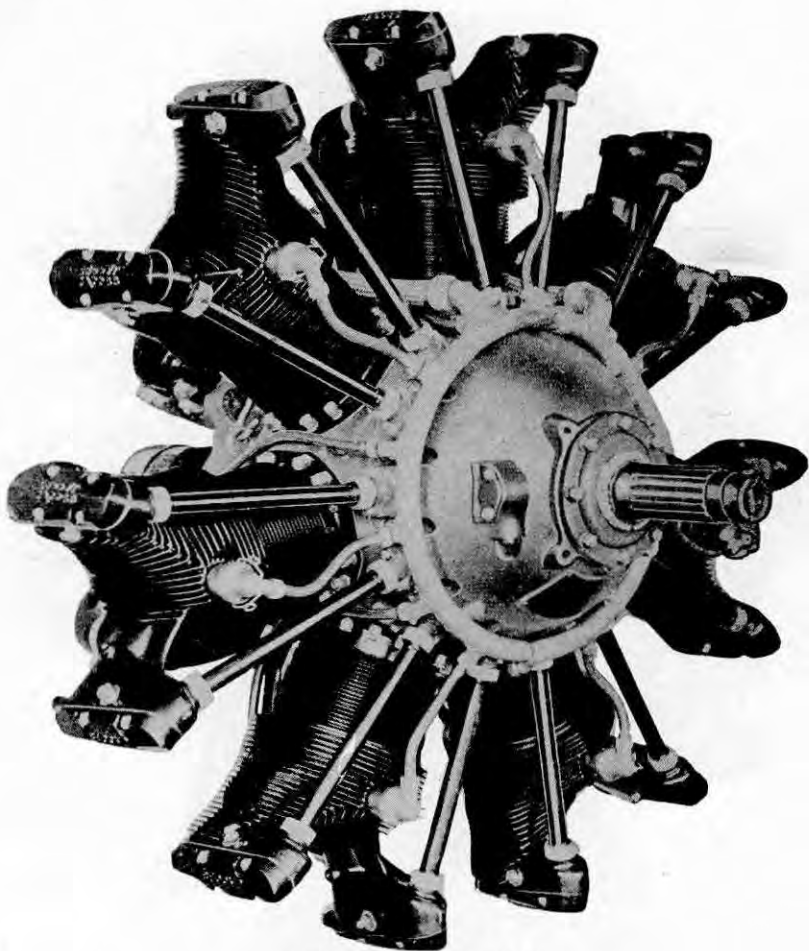


JACOBS L-6MB ENGINE

It is rated at 300 h.p. at 2,100 r.p.m. at 3,700 ft., and 330 h.p. for take-off.

contract from the Air Corps to supply a quantity of that new model for installation in Stearman PT-18 primary trainers.

Jacobs commercial models powered a large percentage of the 4- and 5-place cabin planes produced in the United States. Jacobs-powered planes included single-engine Waco and Howard models,

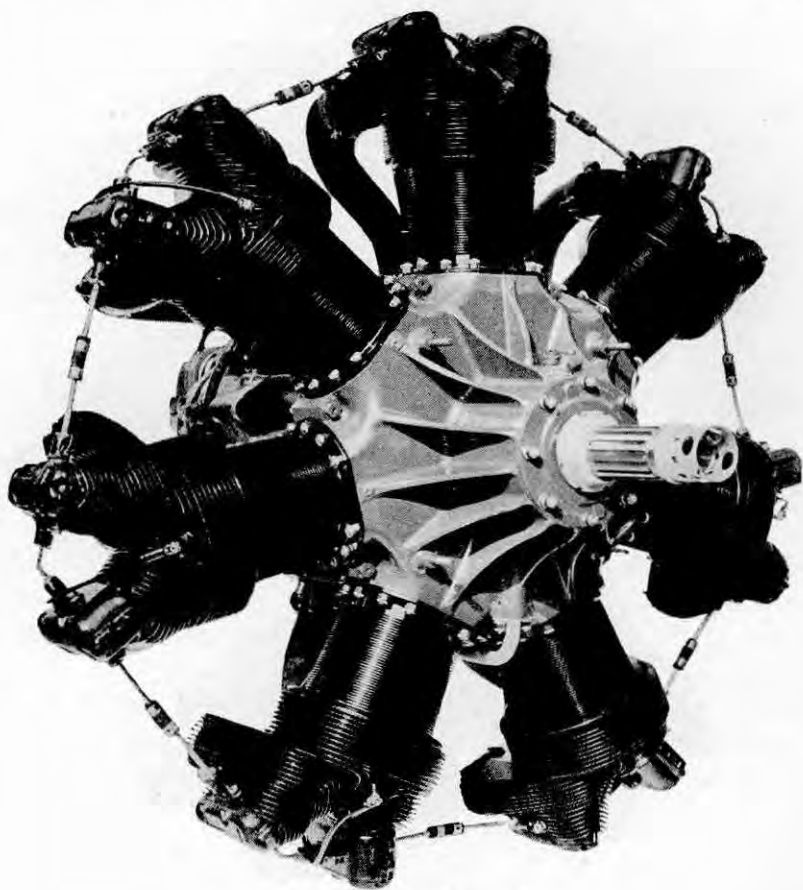


JACOBS L-4MB ENGINE

Rated at 225 h.p. at 2,000 r.p.m. at sea level.

single and twin-engine Beechcraft, the Fleetwings stainless steel amphibion, Kellett direct control autogiro and the Cessna twin-engine personal transport. They also powered the Canadian built Fleet freighter and Fleet service trainer, and were installed in foreign-built airplanes by several Governments for air line and military training operation.

Kinner Motors, Inc., Glendale, Calif., a new company with new policies, was organized in January, 1939, for the purpose of purchas-

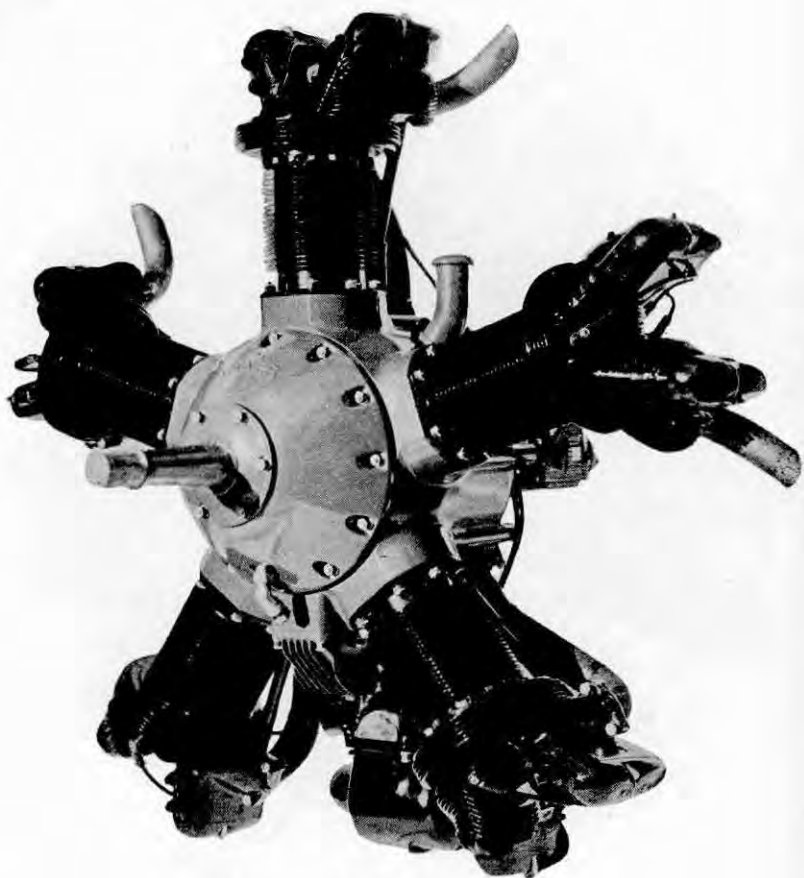


KINNER SC-7 ENGINE

Rated 350 h.p. at 1,900 r.p.m. at 5,000 ft.

ing for cash the name and business of the former Kinner Company. In July, 1939, Kinner Motors, Inc., took over the operation of the company and a statement of income and expense for the six months period ending December 31, 1939, showed that these operations were carried on at a net profit of \$22,832.59 for the last six months of the year, which was the first six months of the company.

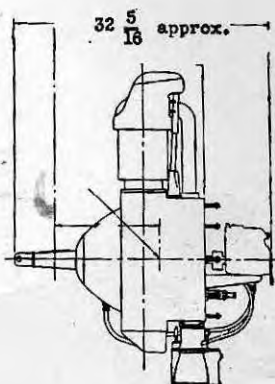
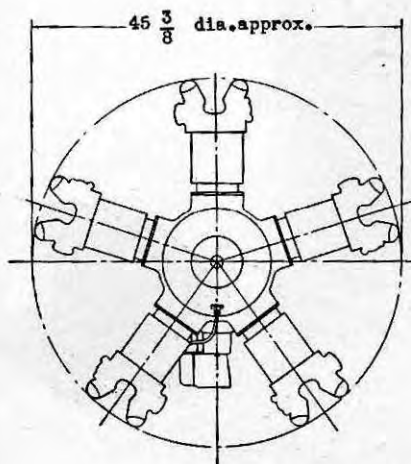
The company devoted its resources and activities to the development and manufacture of aircraft engines for use in military and civil training planes. Many improvements were incorporated in Kinner engines to bring them up to date, including new light weight



KINNER K-5 SERIES 2 ENGINE

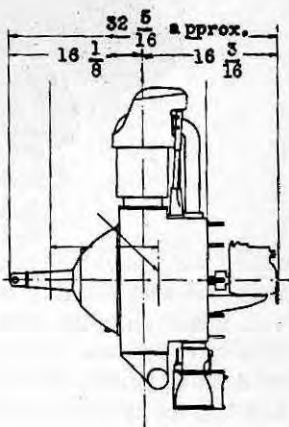
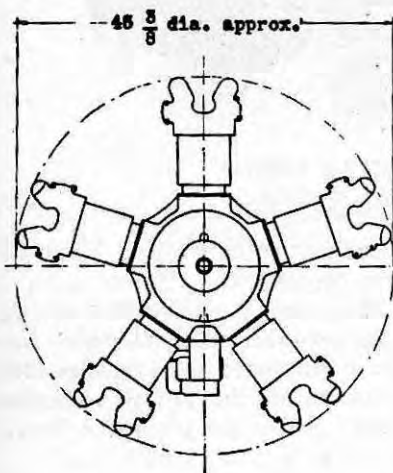
Rated 100 h.p. at 1,810 r.p.m.

magnetos, new type rear exhaust cylinder heads (with more cooling area and greater strength than earlier type heads), new type front crankcase cover and improved type bearings and valves. All models were equipped with drives and adapter for electric starter. The B-5 and R-5 engines could be supplied with fuel pump drive. Optional equipment for the R-5 engine included vacuum pump drive, generator drive and gun synchronizer drives, as well as starter and fuel pump drives. Spline shaft was available for Kinner engines if desired. The company had approximately 600 engines on order, deliveries being scheduled over 20 months. It claimed facilities for producing



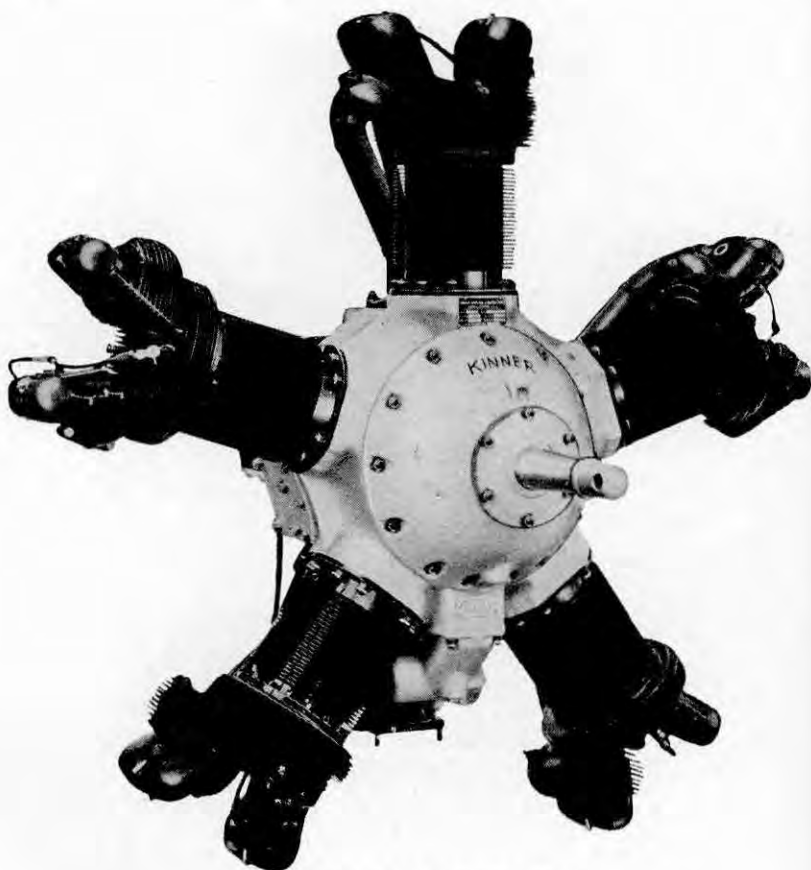
KINNER B-5 AND K-5

Model K-5 is rated at 100 h.p. and the B-5 at 125 h.p. Both are five-cylinder radial aircooled engines.



KINNER R-5

This five-cylinder aircooled radial engine is rated at 160 h.p.



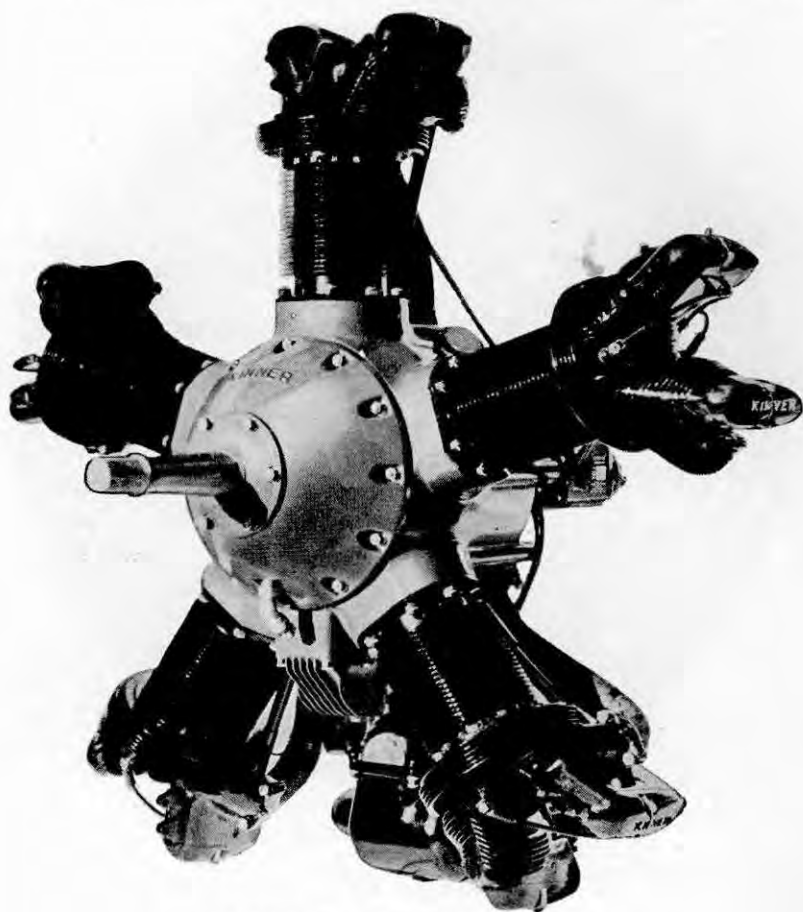
KINNER R-5 SERIES 2 ENGINE

Rated 160 h.p. at 1,850 r.p.m.

more than 3,000 engines a year without further expansion. The company was also working on a new type engine.

Lenape Aircraft Motors, Inc., Matawan, N. J., finished tooling up for production on its 95 h.p. Brave, a 5-cylinder radial engine featuring magnesium alloy crankcase, accessory case and propeller hub. The Lenape company continued production on the 50 h.p. 3-cylinder radial Papoose; with specifications the same as the 5-cylinder Brave, except for compression ratio and weight of 140 lbs.

Lycoming Division, Aviation Manufacturing Corporation, Williamsport, Pa., manufacturers of aircraft engines and controllable propellers, continued production on the R-680-E series 265 to 300 h.p.

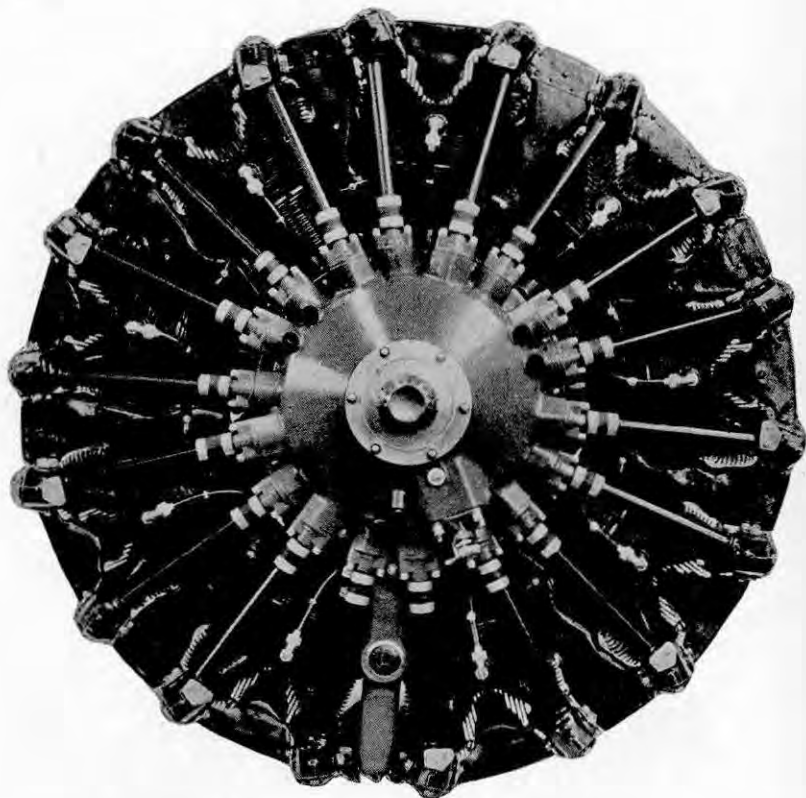


KINNER B-5 R SERIES 2 ENGINE

Rated 125 h.p. at 1,925 r.p.m.

engines, the R-680-D series 245 to 260 h.p. and R-680-B4C 225 h.p. 9-cylinder radial aircooled engines, as well as the R-530-D series 200 to 220 h.p. 7-cylinder radial aircooled engines. In the light plane engines, Lycoming also continued production on the O-145 series 50, 55, 65 and 75 h.p. 4-cylinder horizontally opposed aircooled engines.

The R-680-D and E series engines were installed in Stinson Reliants and other private and commercial airplanes. Some of the E series engines were shipped to South America for installation in dusters. Lycoming R-680-D 260 h.p. engines installed in Stinson

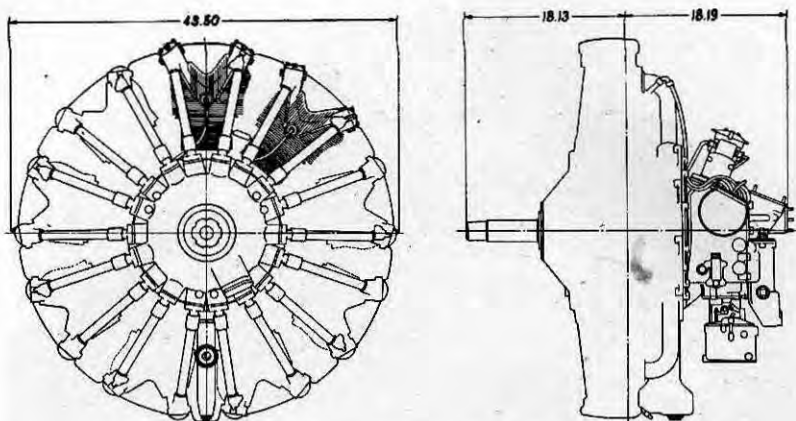


LYCOMING SERIES R-680-D and E

A nine-cylinder engine rated at 240 to 260 h.p. for the R-680-D and 280 to 300 h.p. for the R-680-E.

Reliants were used in the air mail pick up service and proved very satisfactory. Quite a number of the R-680-B4C engines, which were the commercial version of the training engine used by the U. S. Army Air Corps, were installed in Stearman PT-13 training planes and shipped to Brazil, Venezuela and the Philippine Islands. The O-145 series engines were installed mostly in Taylorcraft, Aeronca and Piper light planes. Early in 1940 Lycoming engines were approved by the C.A.A. in Luscombe and Porterfield light planes.

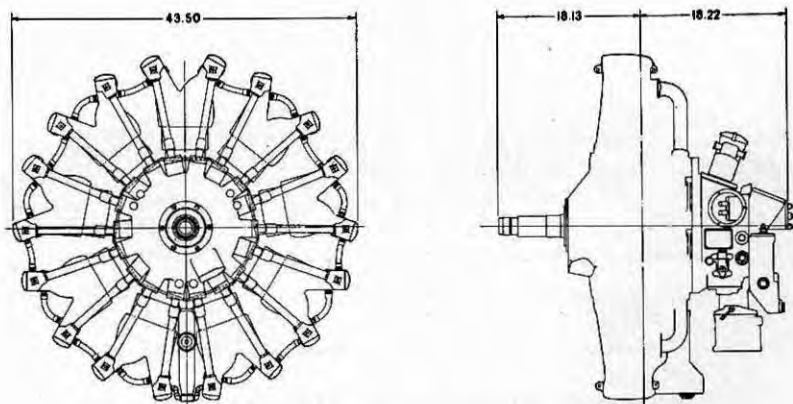
During 1939, Lycoming developed and received an ATC on a 75 h.p. geared engine. Believed to be the first geared engine to be manufactured in this horsepower class, the engine, which was designated the GO-145-C series, was of the same basic design as the O-145



LYCOMING SERIES R-680-D AND R-680-E

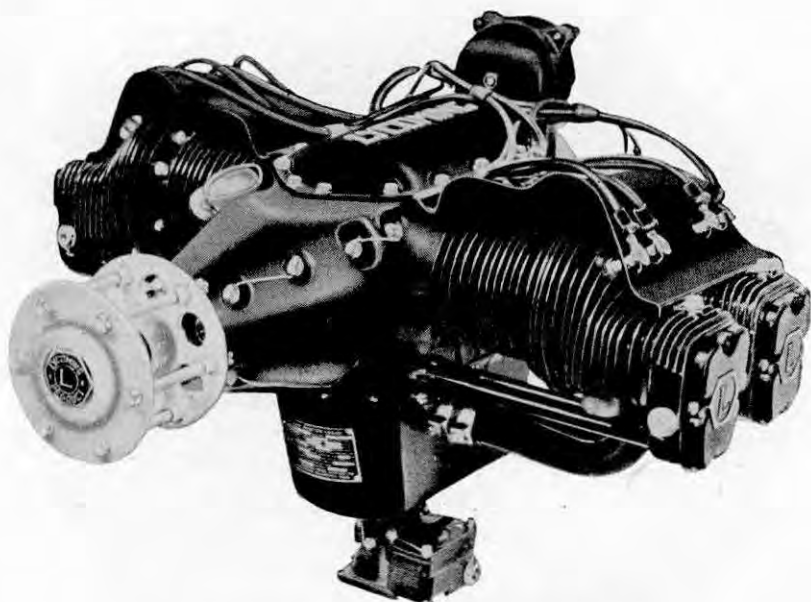
A nine-cylinder radial aircooled engine; D models are rated 240 to 260 h.p. for take-off; and E models are rated 280 to 300 h.p. for take-off.

series direct drive with the reduction gear of the internal gear and pinion type added. Having a displacement of 145 cu. in. and designed for operation at efficient propeller speeds, the GO-145-C series developed 75 h.p. at 3,200 r.p.m. with a gear ratio of 27:17 and a propeller speed of 2,015 r.p.m. at rated power. Engines were also equipped with dynamic dampers of the same type as used in engines of the higher horsepowers. Five hundred engines were purchased by the Piper Aircraft Corporation for installation in the Piper Cruiser.



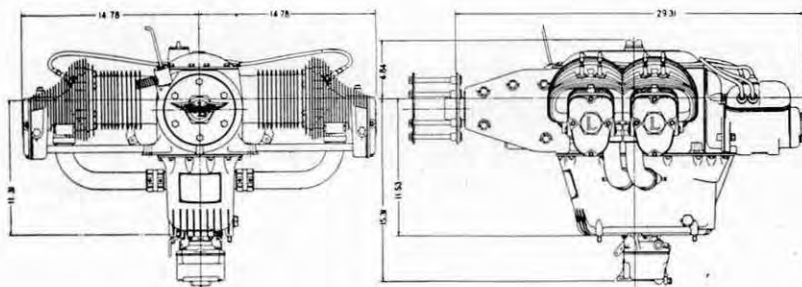
LYCOMING R-680-B4C

A nine-cylinder radial aircooled engine rated at 225 h.p. at 2,100 r.p.m.



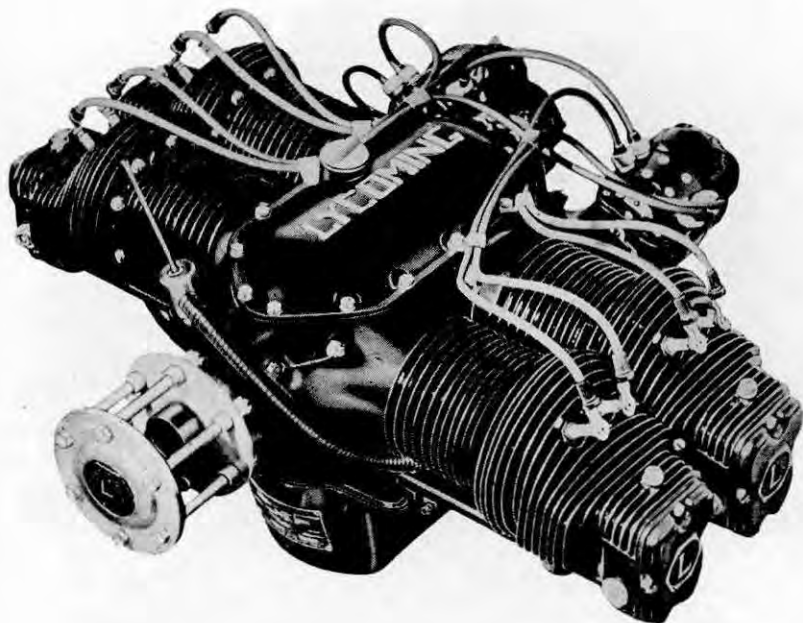
LYCOMING GO-145-C SERIES ENGINE

The four-cylinder, air-cooled, horizontally opposed engine, geared 27:17, 75 h.p. at 3,200 r.p.m.



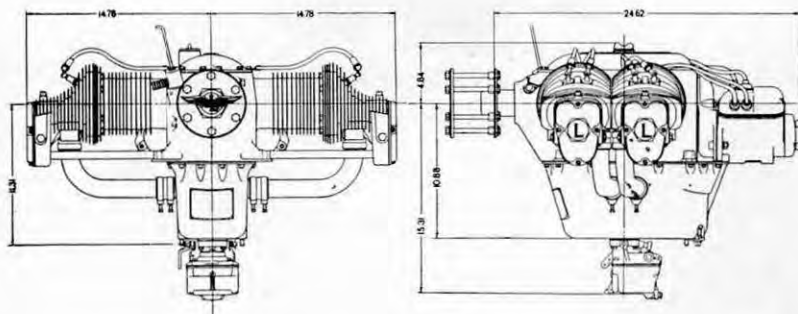
LYCOMING GEARED GO-145-C SERIES

A four-cylinder aircooled horizontally opposed engine, geared 27:17, and rated at 75 h.p. at 3,200 r.p.m.



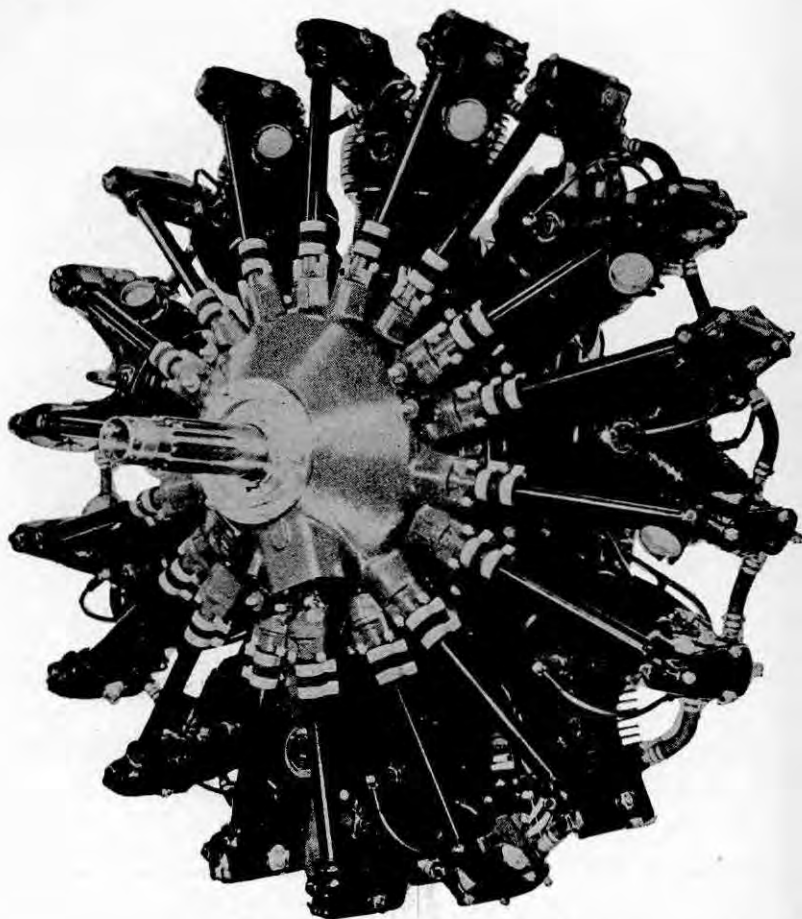
LYCOMING O-145 SERIES ENGINE

A four-cylinder, air-cooled, direct drive, horizontally opposed engine with ratings of 50 to 75 h.p.



LYCOMING SERIES O-145

A direct drive, four-cylinder aircooled horizontally opposed engine with a range from 50 to 75 h.p.

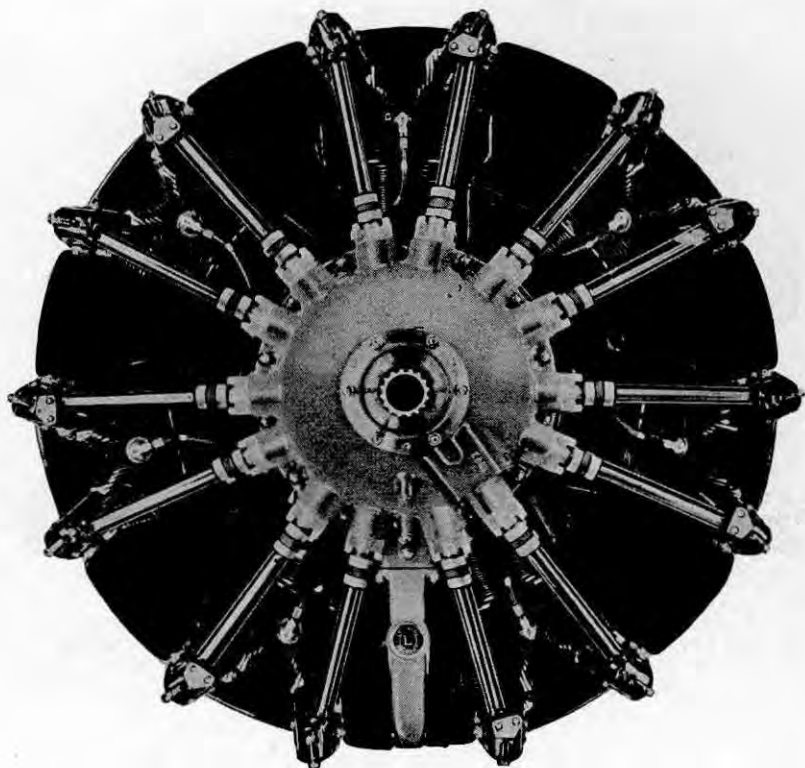


LYCOMING R-680-B4C ENGINE

A nine-cylinder radial, 225 h.p. at 2,100 r.p.m.

In the military field the Air Corps purchased a considerable quantity of training engines for installation in Stearman primary training planes. This engine develops 220 h.p. Lycoming 295 h.p. engines were also purchased by the U. S. Army Air Corps for installation in the Stinson liaison observation airplane. This engine was equipped with constant speed propeller governor drive, radio shielding and complete accessory drives.

In the propeller field the U. S. Army Air Corps purchased a quantity of the Lycoming Model F-220 two-blade 8 ft. 6 in. diameter



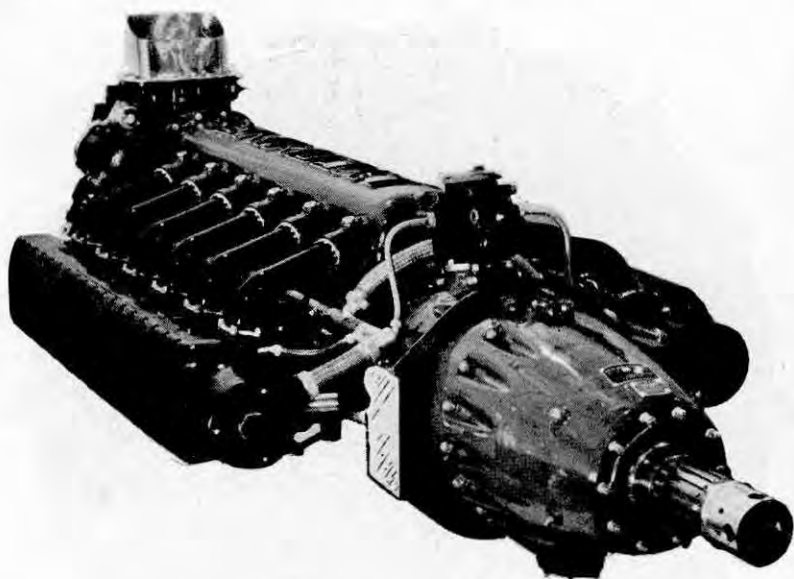
LYCOMING R-530-D SERIES ENGINE

A seven-cylinder radial with ratings of 200 to 220 h.p.

ground adjustable propellers equipped with Lycoming hollow steel blades for service test. The hollow steel blades were under development for the last two years and blades in the larger diameters were also being developed for the Army and Navy.

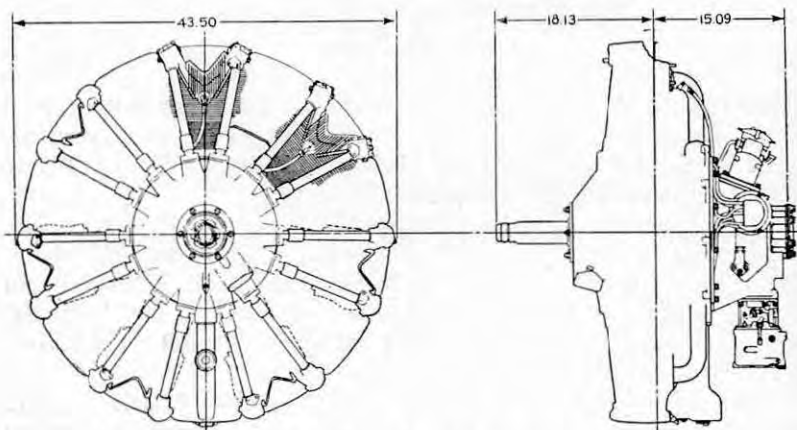
The Lycoming Division, Aviation Manufacturing Corporation, acquired as of January 1, 1940, the assets of the Lycoming Manufacturing Company, manufacturers of automotive, industrial and marine engines. It planned to dispose of the marine and industrial equipment in order to provide additional space required for the manufacture of engines and propellers.

The Menasco Manufacturing Company, Los Angeles, Calif., during 1939 underwent a change of management. A number of orders for engines for foreign governments as well as domestic manufacturers were received and completed during 1939. Up to date engin-



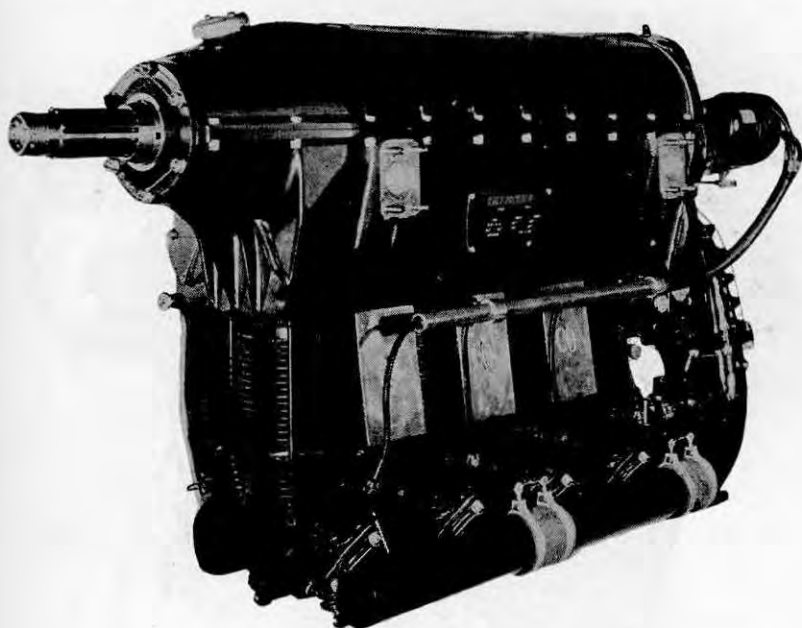
THE LYCOMING FLAT ENGINE

The first Lycoming O-123 O, a 12-cylinder, liquid-cooled engine for commercial and military planes. It was designed for installation inside the wing. Weight 1,325 lbs., displacement 1,230 cu. in., height 37 in., 1,200 horsepower.



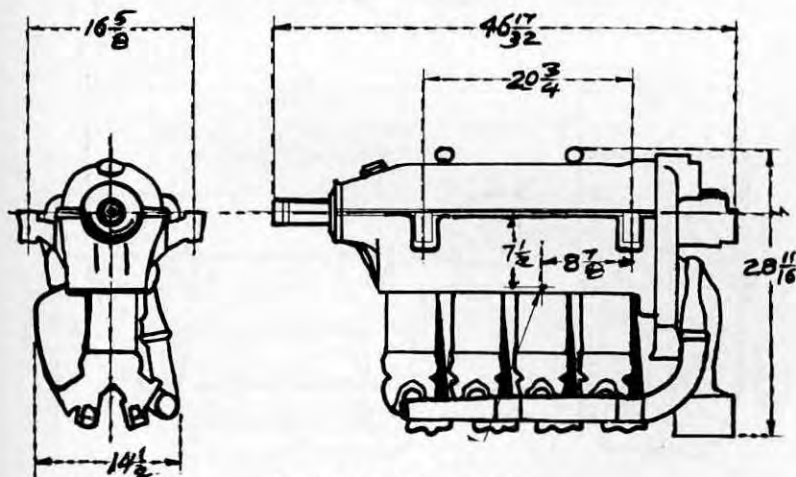
LYCOMING SERIES R-530-D

A seven-cylinder engine rated at 210 to 220 h.p.



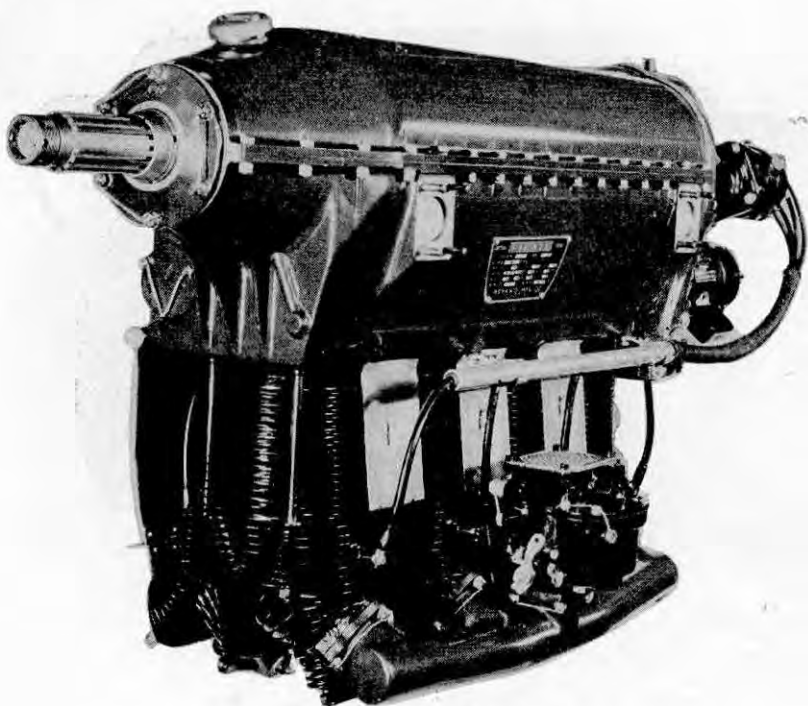
MENASCO C4-S

With a rating of 150 h.p. at 2,260 r.p.m.



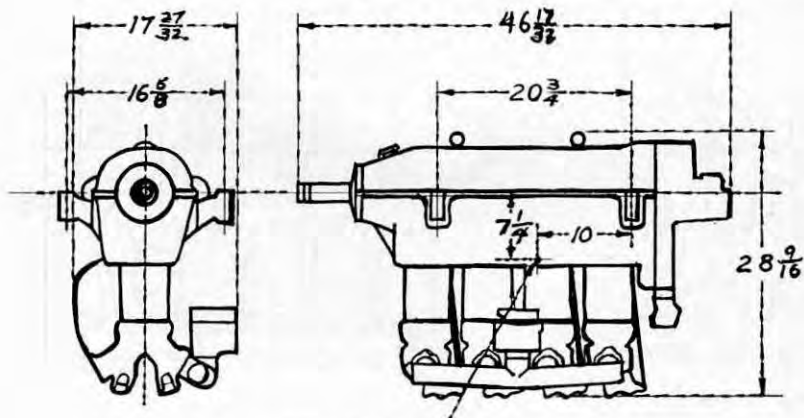
MENASCO C4S PIRATE

A four-cylinder in-line engine, inverted and aircooled rated at 150 h.p. at 2,260 r.p.m. at 3,000 ft.



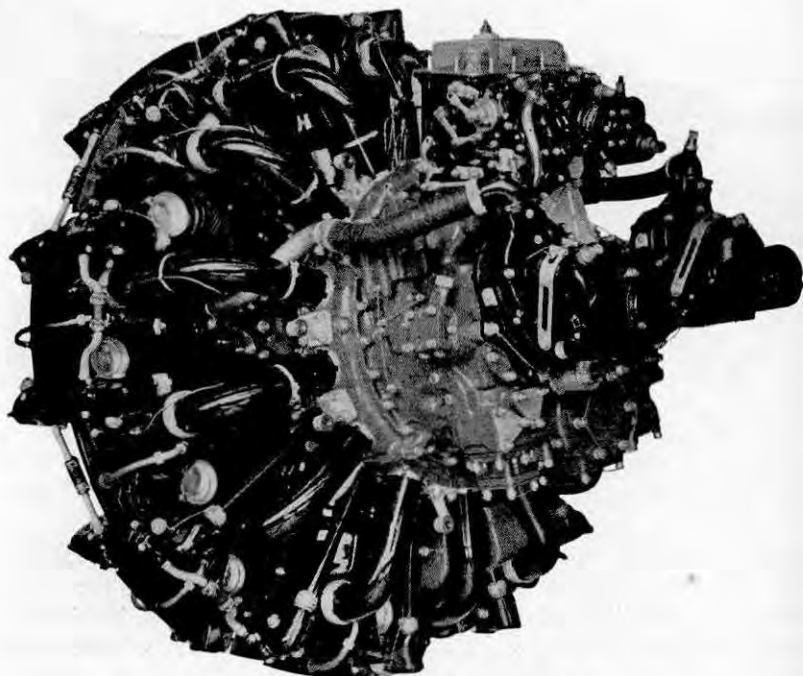
MENASCO C4

The 125 h.p. Pirate engine.



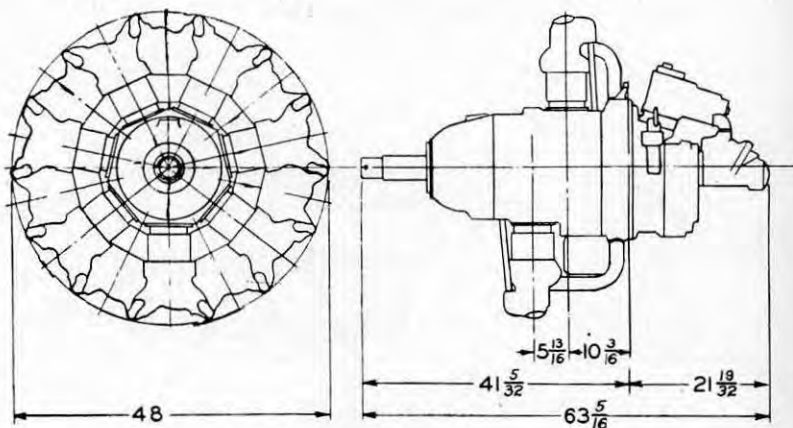
MENASCO C4 PIRATE

A four-cylinder inverted in-line engine rated 125 h.p. at 2,175 r.p.m.

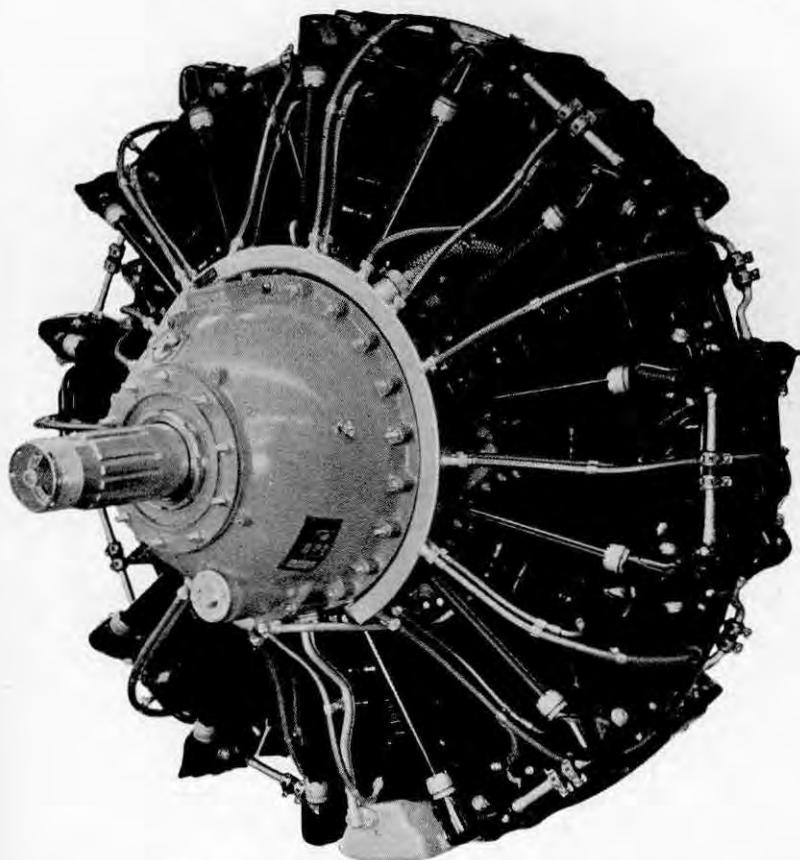


PRATT & WHITNEY TWIN WASP

A 14-cylinder double row engine equipped with P. & W. two speed supercharger in three geared models: S₃C₄-G and S₄C₄-G rated 1,200 h.p. at 2,700 r.p.m. for take-off, and S₂C₄-G rated 1,050 h.p. at 2,700 r.p.m. for take-off.



PRATT & WHITNEY TWIN WASP SERIES C₄-G

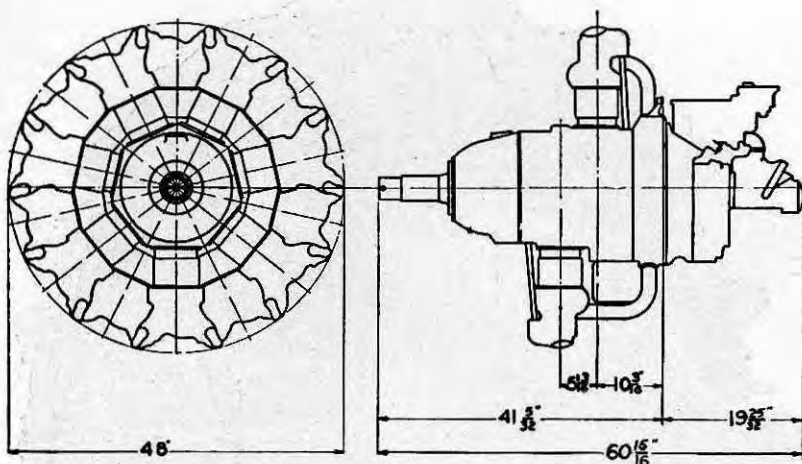


PRATT & WHITNEY TWIN WASP SERIES C₃-G

A 14-cylinder two-row engine in three geared models; SC₃-G rated at 1,050 h.p. at 2,700 r.p.m. for take-off; S1C₃-G rated at 1,200 h.p. at 2,700 r.p.m. for take-off; and S3C₃-G rated at 1,100 h.p. at 2,700 r.p.m. for take-off.

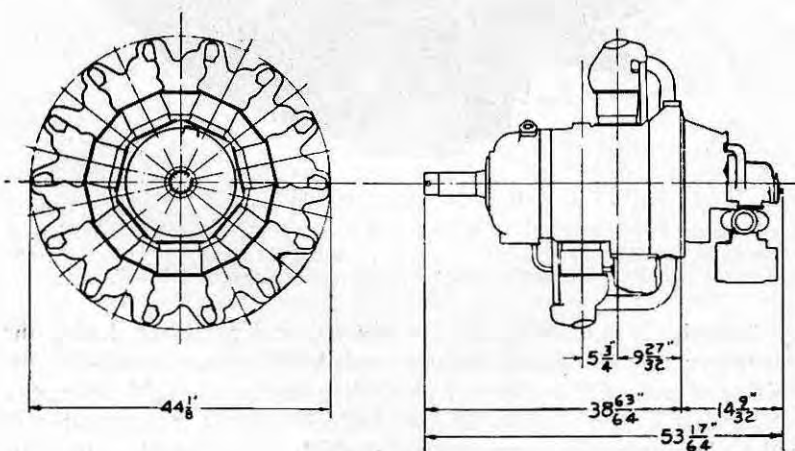
by Antioch College at Yellow Springs, O., and perfected during the last ten years. Aluminum castings made by this process combine the finish and accuracy of die-cast castings with the physical properties of sandcast castings. Also by the Antioch process it is possible to make aluminum or bronze castings which are impossible to pour by other recognized processes. The material required "practically no machining before installation in aircraft."

Pratt & Whitney Aircraft at East Hartford, Conn., one of the three manufacturing divisions of United Aircraft Corporation, ex-



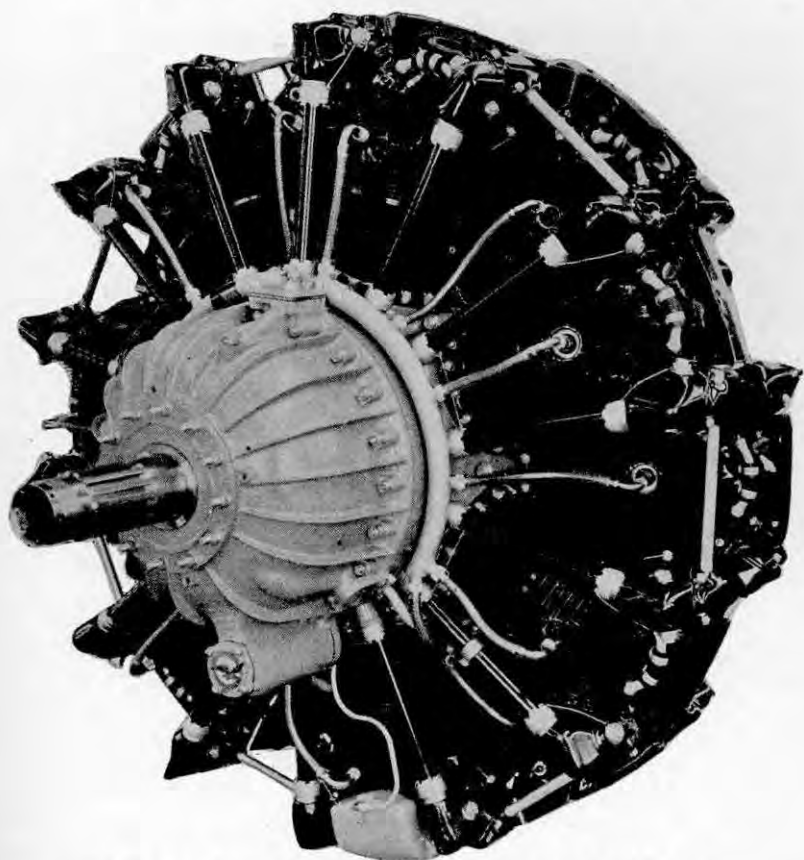
PRATT & WHITNEY TWIN WASP SERIES C3-G

A 14-cylinder radial aircooled engine, 1,050 h.p. at 2,700 r.p.m. for take-off.



PRATT & WHITNEY TWIN WASP JUNIOR SERIES B4-G

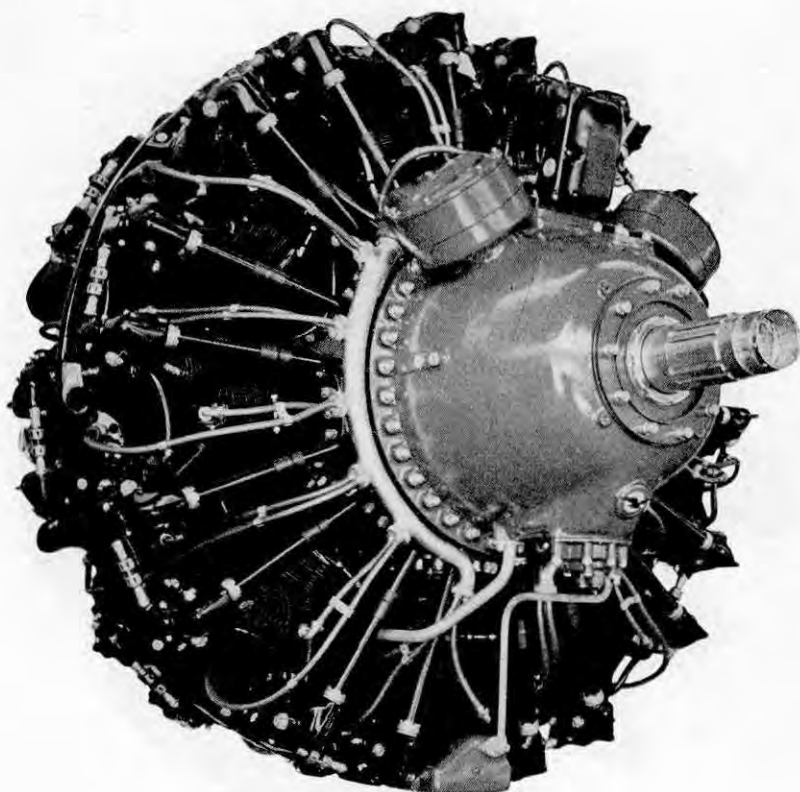
A 14-cylinder two-row geared engine with a take-off rating of 825 h.p. at 2,625 r.p.m.



PRATT & WHITNEY TWIN WASP JUNIOR SERIES B4-G

A 14-cylinder two-row geared engine with a take-off rating of 825 h.p. at 2,625 r.p.m.

panded its production facilities rapidly during the year to meet the greatly increased requirements of both the domestic and foreign markets for aircraft engines. Large orders were received from the U. S. Army and Navy for engines of different models ranging from the 9-cylinder Wasp Junior to the big new 18-cylinder Double Wasp. Those engines were for use in the fleets of formidable new aircraft purchased under the new Army and Navy procurement programs, which included a wide variety of types; trainers, pursuits and fighters, observation and scouting planes, and patrol and bombardment machines. Other orders were received from several European governments for large quantities of engines to augment their own pro-



PRATT & WHITNEY DOUBLE WASP

An 18-cylinder, two row engine in four geared models rated at 2,600 r.p.m. for take-off as follows: S1A6-G, 1,850 h.p.; S2A6-G, 1,625 h.p.; and models S1A4-G and S2A4-G with same take-off ratings but equipped with P. & W. two speed supercharger for increased altitude performance.

duction during the war. In addition, the production of engines for air lines and for other commercial and private uses continued to grow despite world conditions.

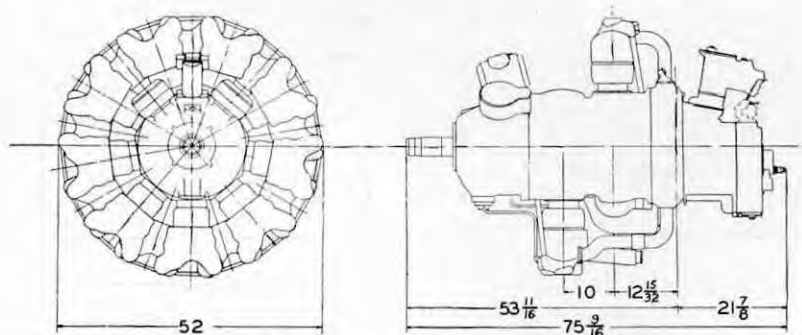
Two expansions of the Pratt & Whitney factory, which more than doubled its productive capacity, made it possible to meet these heavy demands. Early in 1939, Pratt & Whitney expanded into the factory immediately adjacent to its own, formerly occupied by the Hamilton Standard Propellers division, with an area of approximately 120,000 sq. ft. Later in the year, because of heavy foreign demands, a much larger addition was constructed on the north side of the existing Pratt & Whitney plant. With full knowledge on the



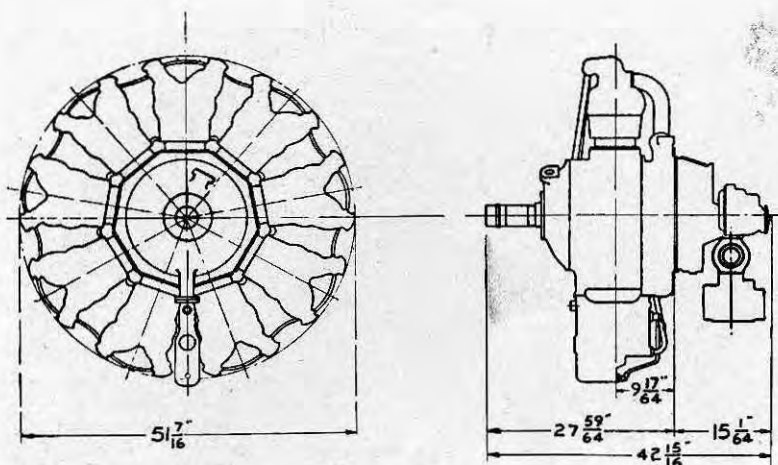
BLACK TULIPS?

No. They are cylinders ready for assembly into the Wasp and Hornet engines of the Pratt & Whitney Division of United Aircraft Corporation, East Hartford, Conn.

part of the foreign purchasers, the cost of this additional manufacturing space was substantially covered in the cost of the products manufactured for foreign sale. Thus, it was expected that upon restoration of normal operating conditions, annual depreciation charges would be little, if any, heavier than before this expansion.

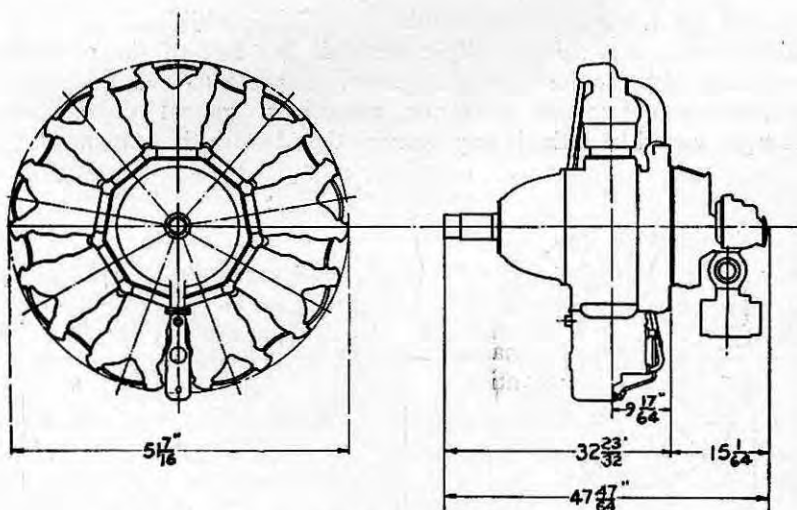


PRATT & WHITNEY DOUBLE WASP SERIES A4-G AND A6-G



PRATT & WHITNEY WASP SERIES H₁

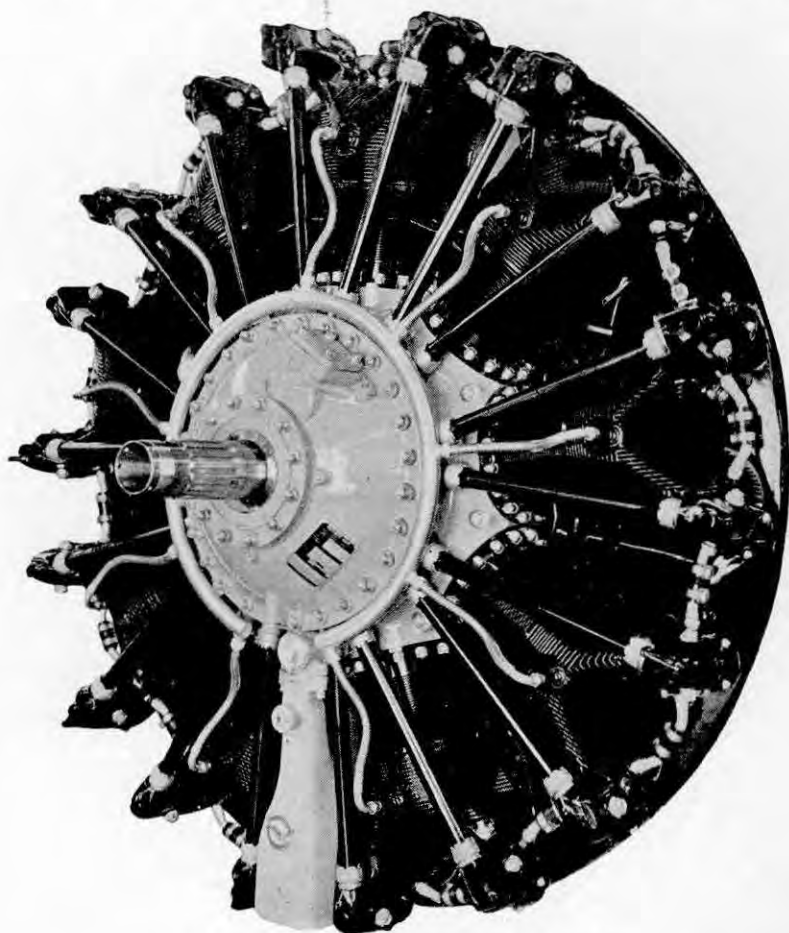
The nine-cylinder single-row direct drive S₁H₁ rated at 600 h.p. at 2,250 r.p.m. for take-off.



PRATT & WHITNEY GEARED WASP SERIES H₁-G

A 600 h.p. nine-cylinder radial aircooled engine.

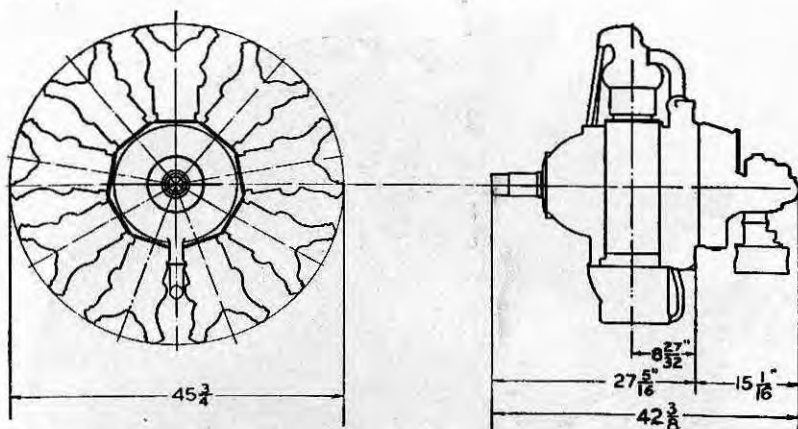




PRATT & WHITNEY SERIES H1 WASP

A nine-cylinder single row engine in three direct drive (photo) and three geared models; S₁H₁ and S₁H₁-G; S₂H₁ and S₂H₁-G; and S₃H₁ and S₃H₁-G, all rated at 600 h.p. at 2,250 r.p.m. for take-off.

The expansion, however, was not by any means confined to manufacturing space. Continuing the corporation's policy of emphasis on technical development and research, substantial additions were made to engineering and laboratory facilities. These included a third floor drafting room added to the engineering building, the construction of new dynamometer and carburetor test buildings, enlargement of chemical and physical testing laboratories, and the construction

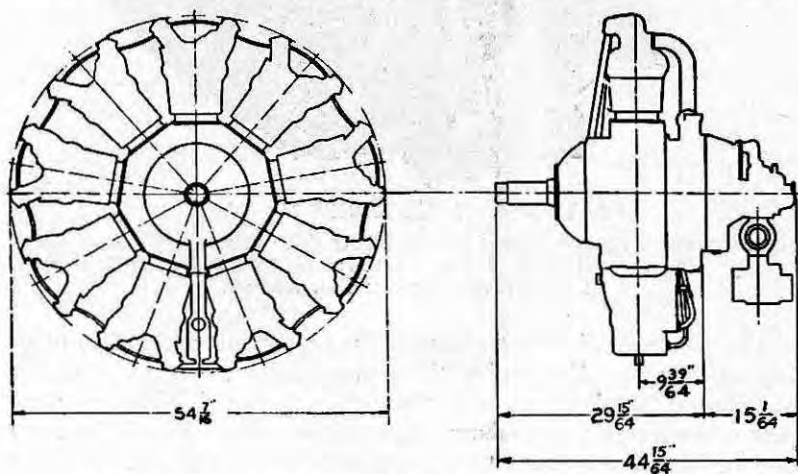


PRATT & WHITNEY DIRECT DRIVE WASP JUNIOR SERIES B₂

A 450 h.p. nine-cylinder radial engine, aircooled.

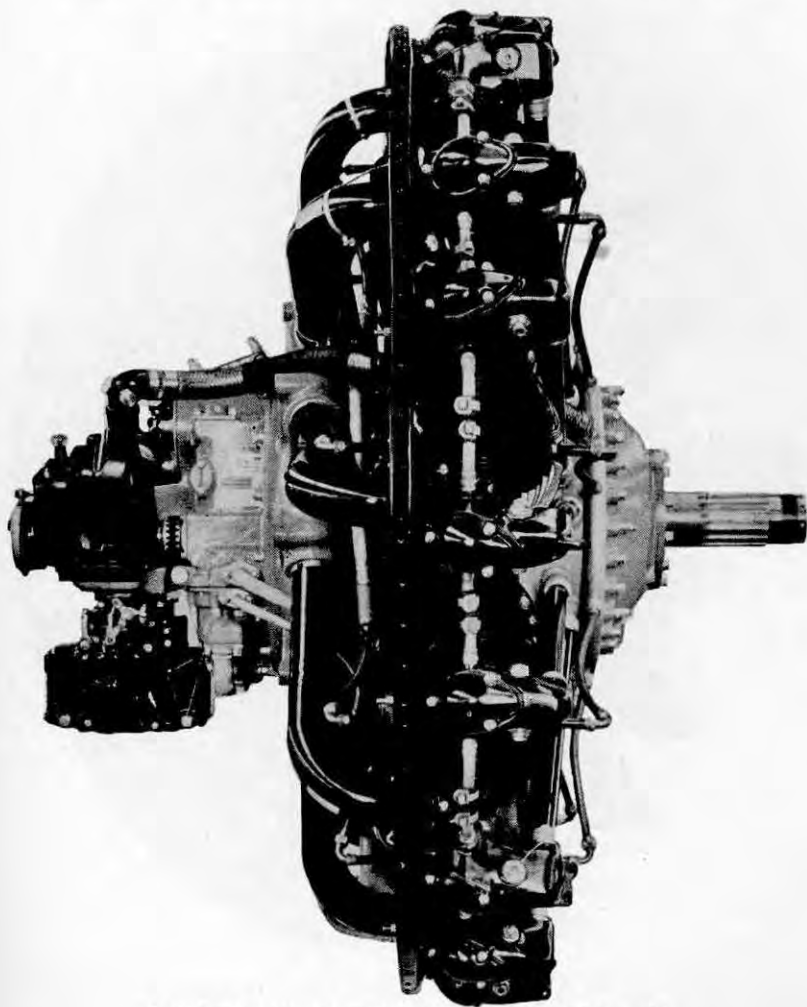
of a new engine test house with four chambers capable of accommodating engines up to 3,000 h.p. in size. In the beginning of 1940, the Pratt & Whitney factory covered more than 1,000,000 sq. ft. of space, employed approximately 7,000 persons, and was producing engines at the highest rate in its history.

Two basic types of aircooled engines were in production. One was the 9-cylinder single row radial which included the Wasp Junior,



PRATT & WHITNEY DIRECT DRIVE HORNET SERIES E

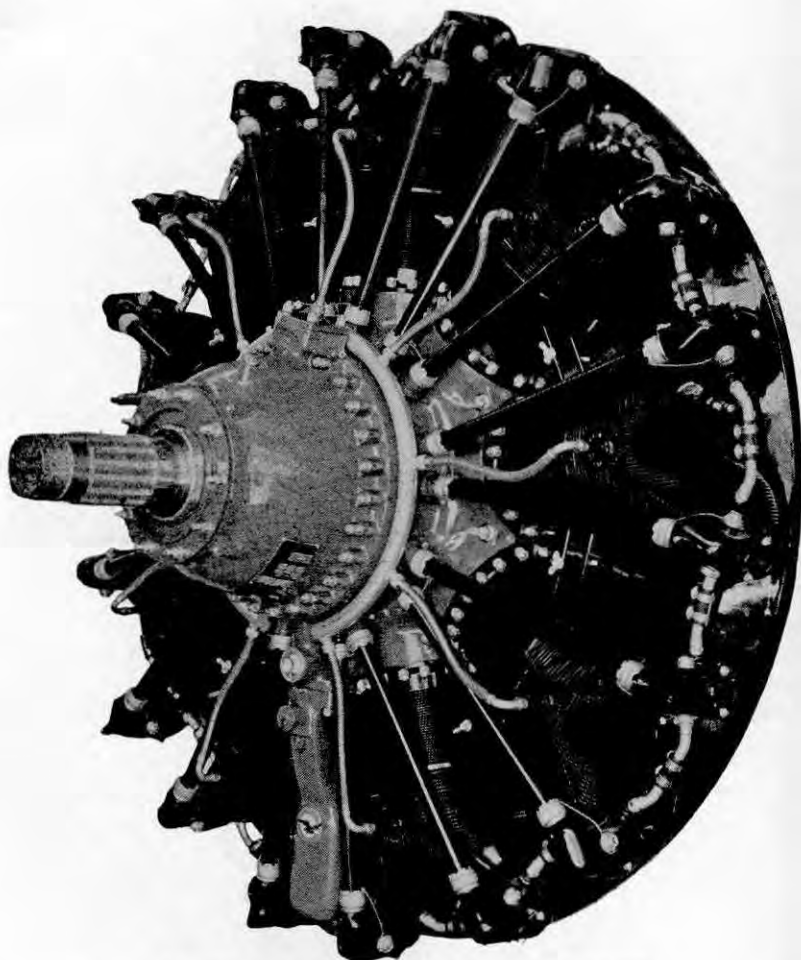
An 875 h.p. nine-cylinder radial aircooled engine.



PRATT & WHITNEY SERIES B₂ WASP JUNIOR

A nine-cylinder single row engine in three models, all direct drive; SB₂ and T₁B₂ rated 450 h.p. at 2,300 r.p.m. for take-off; and TB₂ rated 440 h.p. at 2,300 r.p.m. for take-off.

Wasp, and Hornet models, used in a long list of commercial and military airplanes both in the United States and abroad. The other was the 14-cylinder two-row radial, first produced in the United States by Pratt & Whitney in 1933. This type included the Twin Wasp Junior and the Twin Wasp. They were in large fleets of



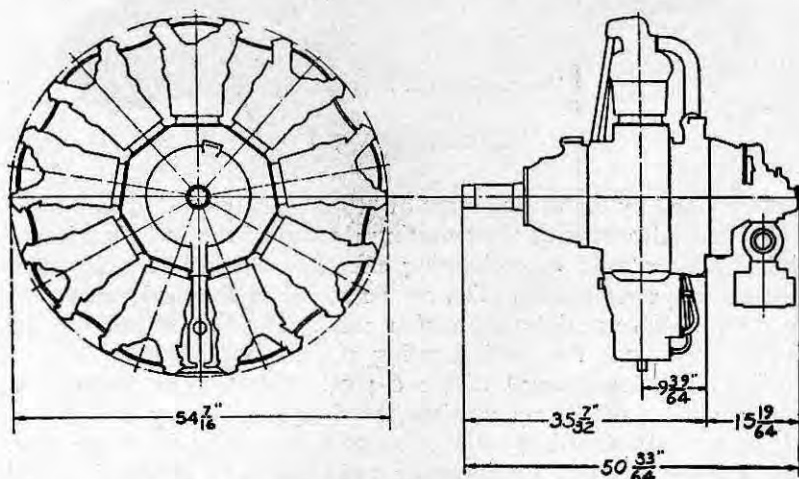
PRATT & WHITNEY SERIES E3-G HORNET

A nine-cylinder single row engine in one geared model, S1E3-G, rated 875 h.p. at 2,300 r.p.m. for take-off.

transports on air lines both in this country and abroad, as well as in military aircraft of various types, from fighters to bombers.

In addition, production was begun on a new model two-row engine, the 18-cylinder Double Wasp, rated as one of the most powerful aircraft engines in the world at high altitudes. The Double Wasp was selected to power some of the sleek new fighters and long-range bombardment airplanes for the expanding American air forces. In

all, 23 models of Pratt & Whitney engines were in production. In the nine-cylinder single-row class, there were three models of the Wasp Junior, with maximum take-off ratings of 450 h.p., all being direct drive engines. No less than six models of the popular 600 h.p. Wasp engine were being built, three being direct drive and three geared engines. The Hornet was represented by three models with maximum rating of 875 h.p. for take-off, two being direct drive, and one geared. In the 14-cylinder two-row class, one model of the Twin Wasp Junior, a geared engine rated at 825 h.p. for take-off, was in production; and there were six models of the Twin Wasp, with maximum take-off ratings of 1,200 h.p. All were geared engines. Three models were equipped with two-speed superchargers provid-

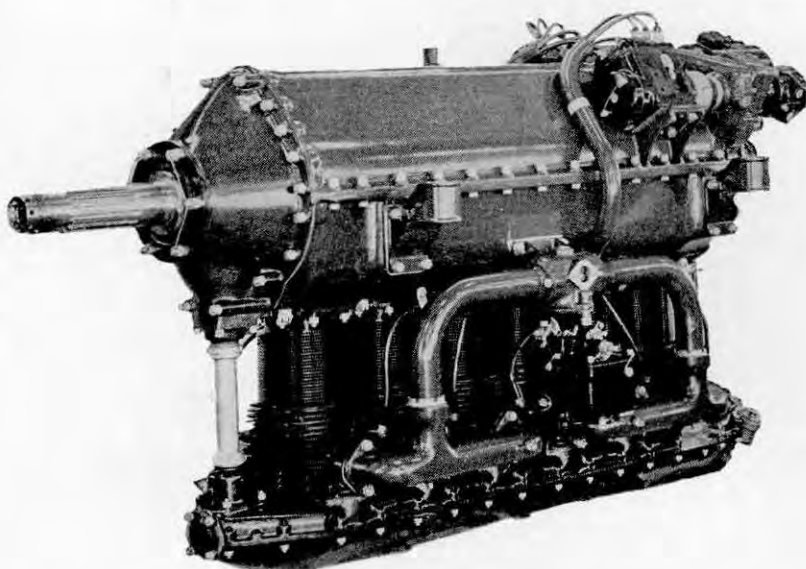


PRATT & WHITNEY GEARED HORNET SERIES E3-G

An 875 h.p. nine-cylinder radial aircooled engine.

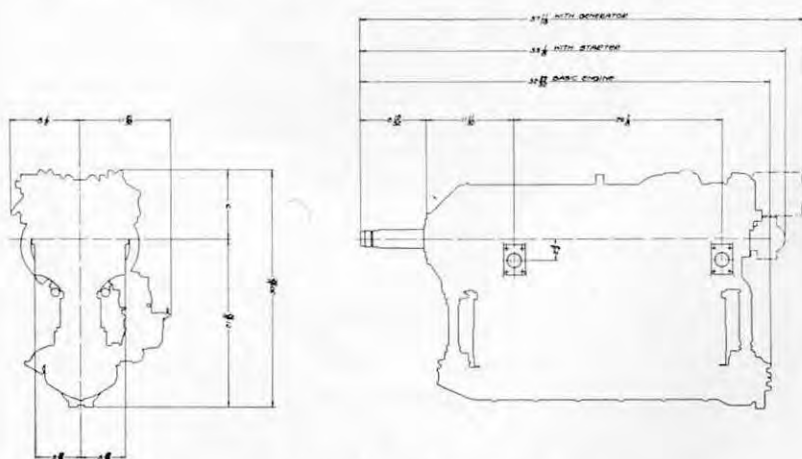
ing increased performance at altitude. Four models of the Double Wasp were in production, the maximum take-off rating being 1,850 h.p. All were geared models, two equipped with two-speed superchargers.

Ranger Aircraft Engines, Farmingdale, N. Y., a division of Fairchild Engine and Aircraft Corporation, continued production on the 6-410B-2 model rated at 165 h.p. at 2,450 r.p.m. using 80 octane fuel. The 6-410B-3 was a logical outgrowth of that model, and was introduced late in 1939. It developed 175 h.p. at 2,450 r.p.m. with the same bore and stroke as the 6-410B-2. The increase in power was developed by changes made in the camshaft, intake valve seat



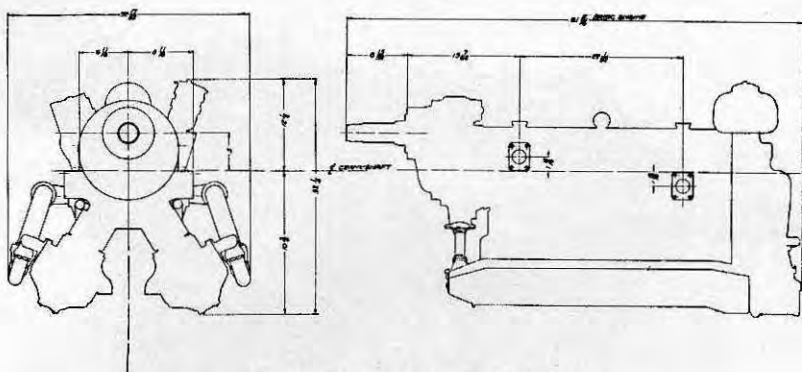
THE RANGER 6-440C

in general dimensions to the 6-410B-3, but several changes and refinements had been incorporated, including increase of stroke from $5\frac{1}{8}$ in. to $5\frac{1}{2}$ in., installation of a No. 20 spline crankshaft, changes



RANGER MODEL 6-440-C

A six-cylinder in-line engine rated at 175 to 200 h.p.

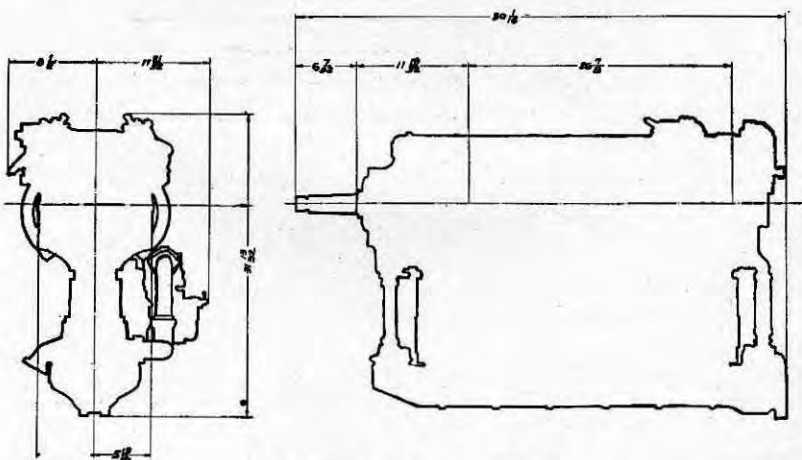


RANGER MODEL SGV-770B

A 12-cylinder in-line engine rated at 405 to 450 h.p.

in the nose section shape to accommodate the new crankshaft, specially tuned intake manifolds, improvements in the valve gear train, announcement of policy of no valve clearance inspections between overhauls.

The 6-440C engine was available in other models, the 6-440C-3, 180 h.p. at 2,450 r.p.m. using 73 octane fuel; the 6-440C-4, 190 h.p. at 2,450 r.p.m. using 80 octane fuel; and the 6-440C-5, 200 h.p. at 2,450 r.p.m., using 87 octane fuel. This latter group of models was identical in general specification with that of the 6-440C model

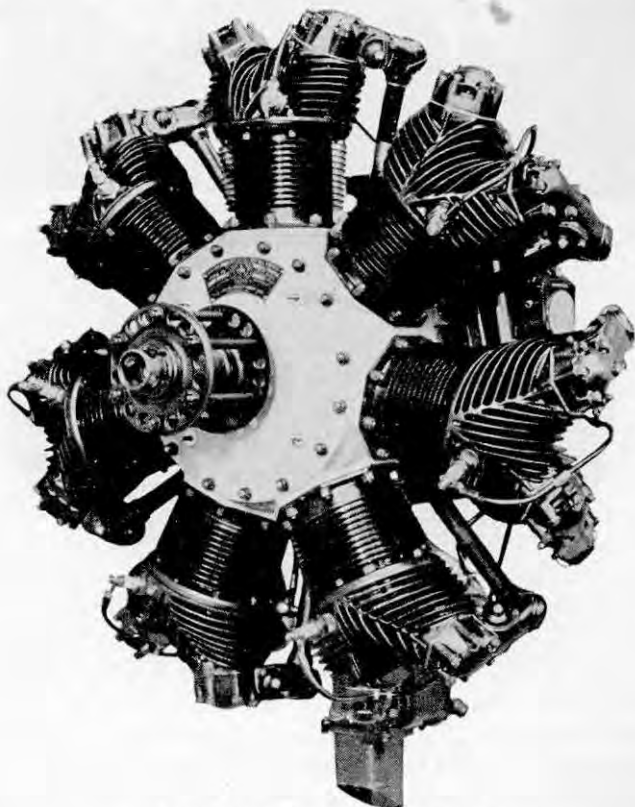


RANGER MODEL 6-410B-3

A six-cylinder in-line engine rated at 175 h.p. at 2,450 r.p.m.

excepting compression ratio and torsional vibration dampers. The production of the torsional vibration damper culminated three years of exhaustive study and experiment of vibration characteristics. It added greatly to the reliability and long life of the engines. It was standard equipment on the 6-440C-3, 4 and 5 models.

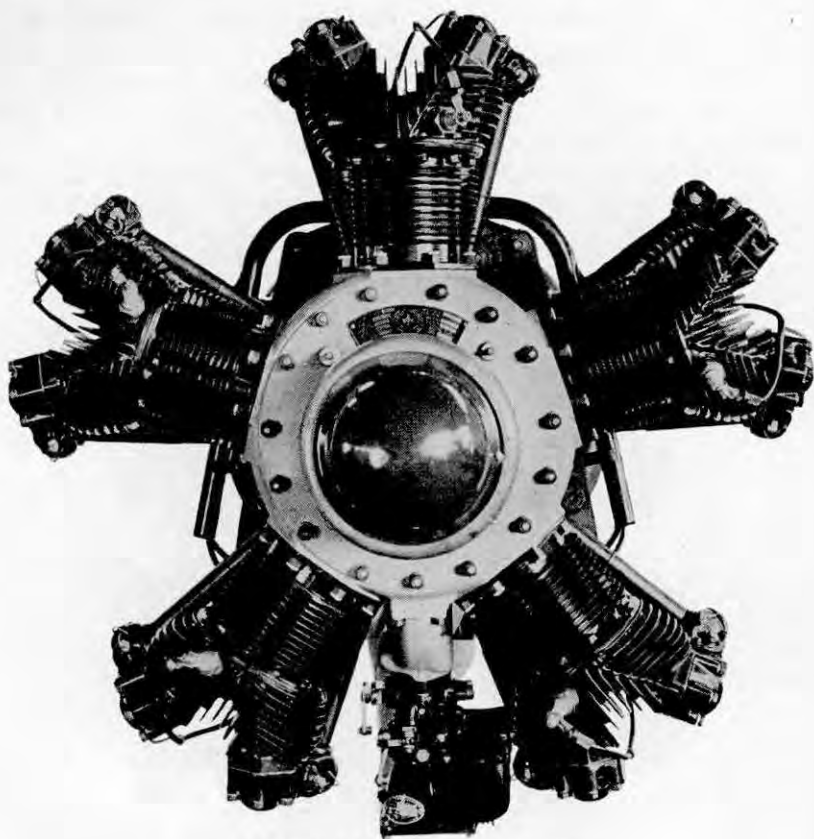
Development of the V-880C-1 model, rated at 405 h.p. at 2,400 r.p.m., was to be completed in 1940. It was an outgrowth of the



THE KEN-ROYCE 7F ENGINE

earlier V-770B-4 model. The new engine has a bore of 4.125 in. and a stroke of 5.500. The compression ratio is 7.5:1, using 87 octane fuel. The weight within 1 per cent is 610 lbs. or 1.5 lbs. per h.p. In general specification, this model is identical to the V-770B-4, differences consisting principally of crankshaft, cylinders and pistons.

Production and development of the SGV-B3, 5 and 6 models

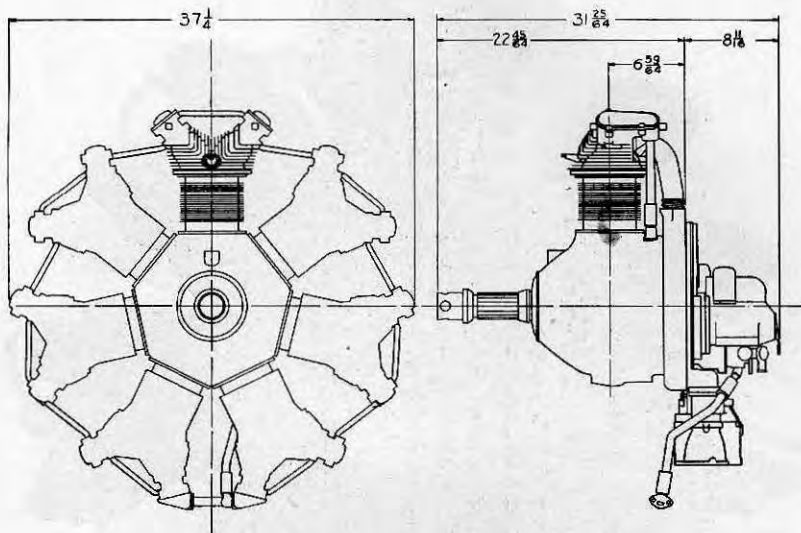


THE KEN-ROYCE 5E AND 5F

of the SGV-770 series continued. The models were similar in all respects, except blower gear ratios and detail changes. All models have a propeller reduction gear ratio of 3:2 and use 87 octane fuel.

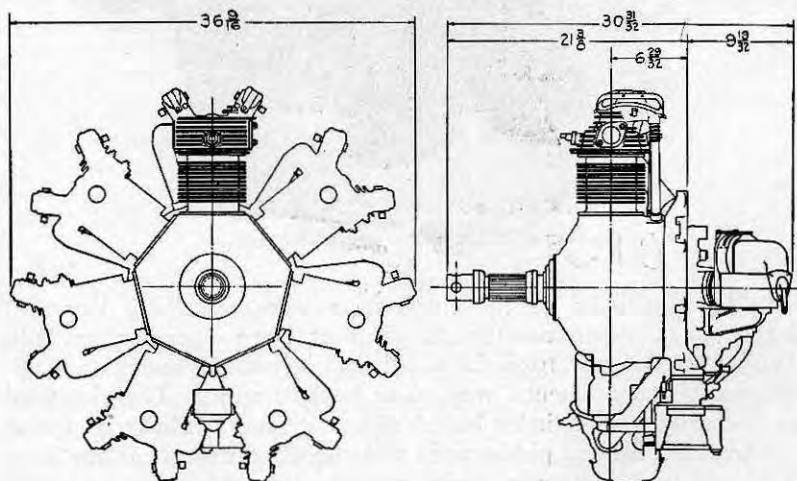
The 6-410B-3 engine was installed in the 1940 Fairchild 24 prototype. The 6-440C-2 model was to power the Fairchild M-62 trainer, developed for the Air Corps training program. The SGV-770 models were installed in both Vought and Curtiss scout observation models. Other SGV-770 installations are scheduled in the Bellanca YO-50 liaison observation type for the Air Corps. Late in the year an SGV-770 installation was made in the Bellanca Racer, which came in second in the Bendix Trophy race of 1939.

Rearwin Aircraft & Engines, Inc., Kansas City, Mo., described its engine production as follows: The production facilities of the



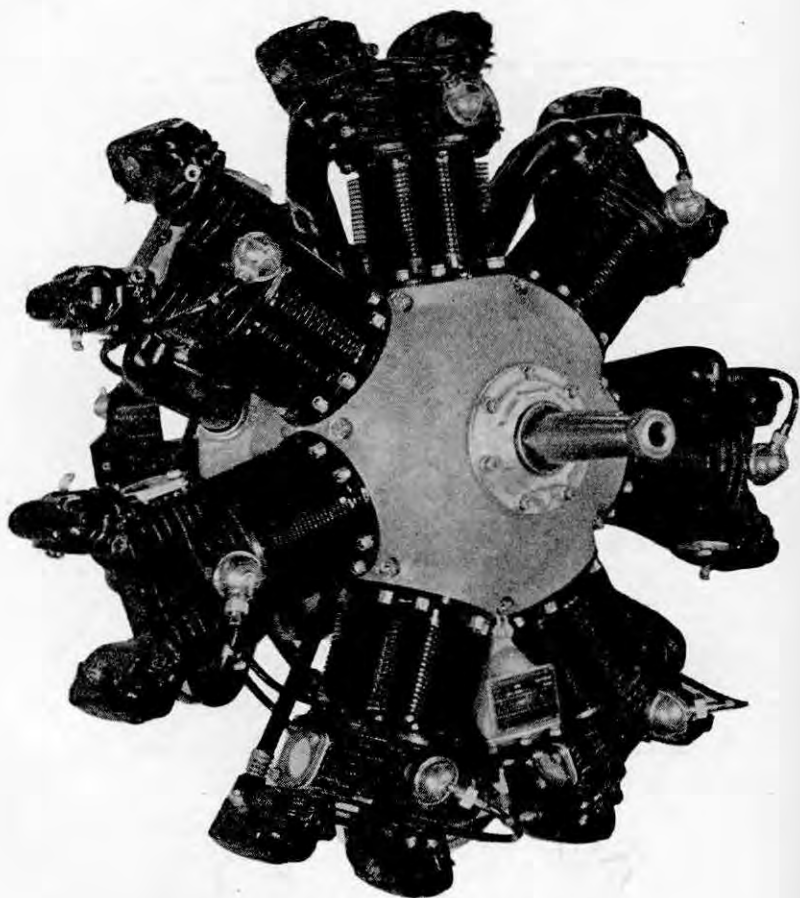
WARNER SUPER SCARAB MODEL 165

A seven-cylinder radial aircooled engine rated at 165 h.p. at 2,100 r.p.m.



WARNER SCARAB

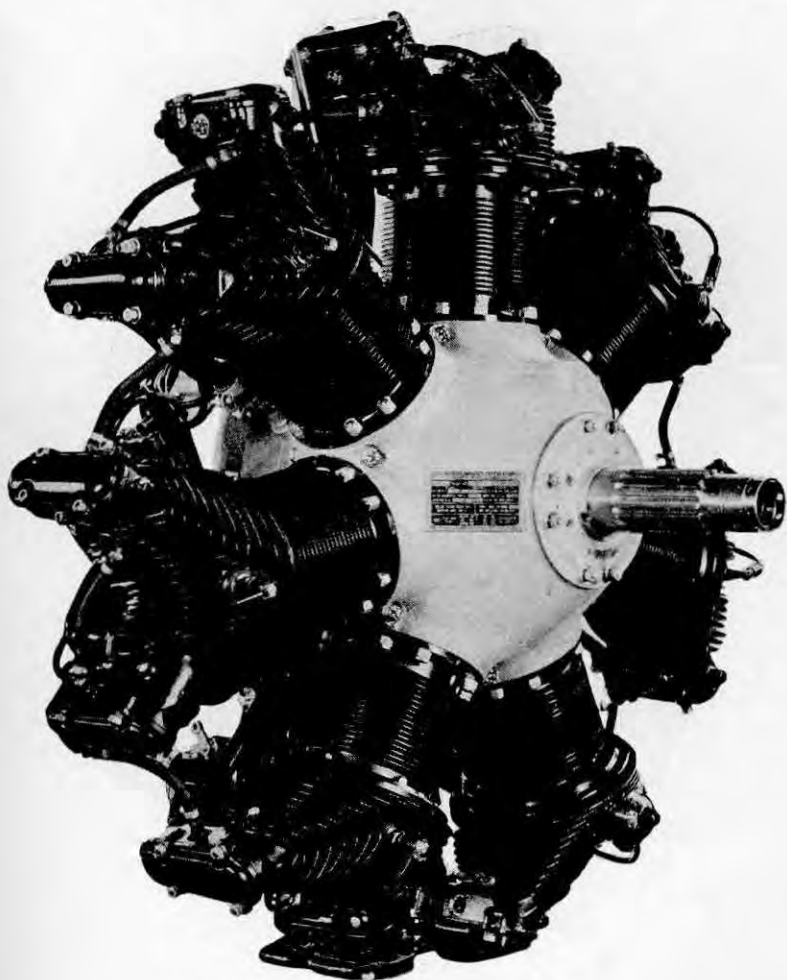
A seven-cylinder radial aircooled engine rated at 125 h.p. at 2,050 r.p.m.



WARNER SUPER-SCARAB ENGINE

A seven-cylinder model developing 145 h.p.

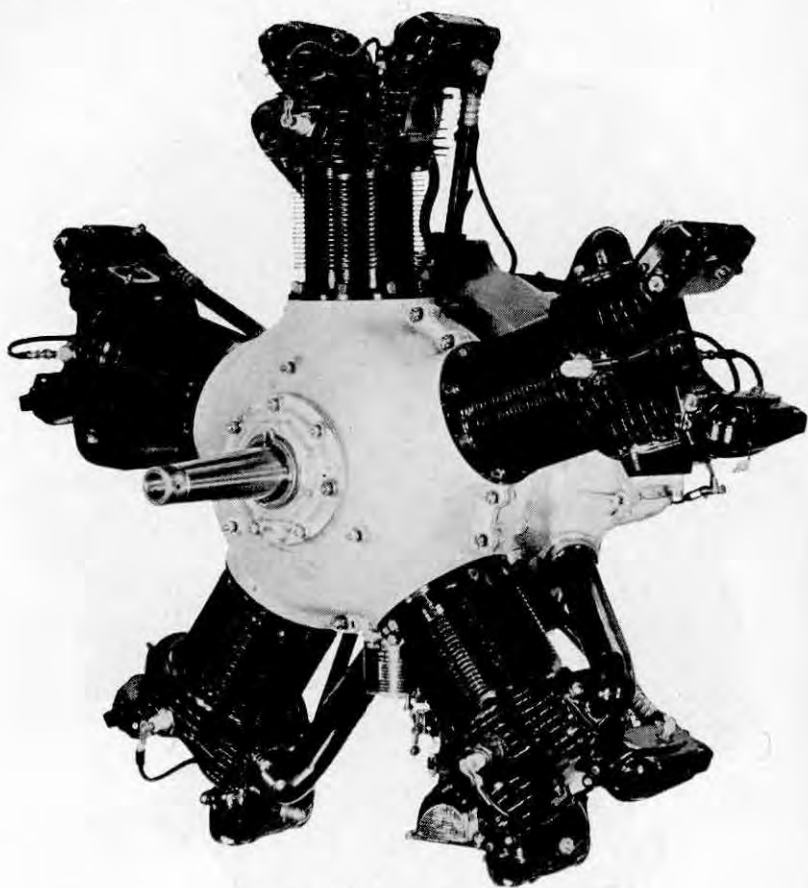
Ken-Royce division of the corporation were materially increased during 1939. Approximately 50 per cent more engines were built than during the year 1938. In addition to increased production facilities, many improvements were made in the engines. They included an unusually hard cylinder barrel with a Brinell hardness of almost 400 degrees. Special piston rings and slightly different pistons were developed by the company, giving much better service than any other before used. Owners with engines having the newly designed steel barrels, together with the new pistons and piston rings, reported as



THE WARNER SUPER SCARAB 165

many as 700 hours before needing major overhaul, an increase of from 50 to 100 per cent compared with former engines. Other changes doubled the flow of oil through the engine for better lubrication.

The Warner Aircraft Corporation, Detroit, Mich., continued production of the Scarab Junior 5-cylinder radial aircooled engine rated at 90 h.p. at 2,025 r.p.m. The Scarab and Super Scarab engines rated at 125 and 145 h.p. respectively were also continued in production. In addition to these three engines, production was started



THE WARNER SCARAB JUNIOR

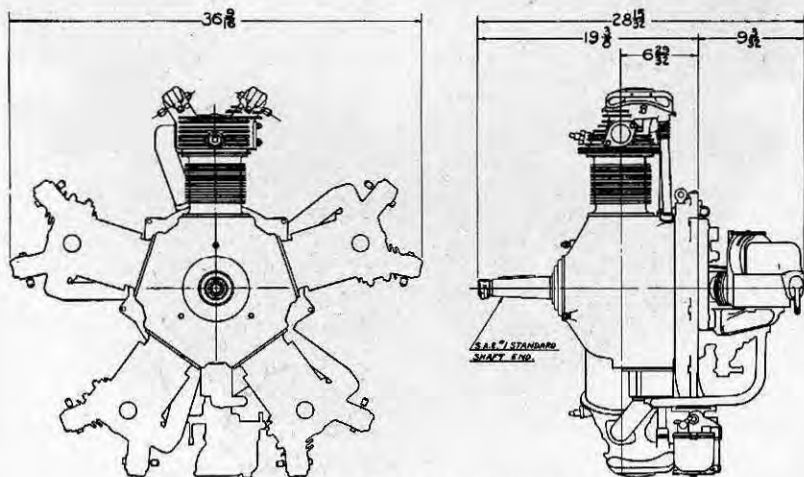
A 90 h.p. engine.

and deliveries made to aircraft manufacturers of the Super Scarab Model 165 engine with 165 h.p. It also had a take-off rating of 175 h.p. with a controllable pitch propeller. In addition to aircraft engines, the Warner Aircraft Corporation manufactured wheels, brakes, shock struts and a hydraulic brake control unit. The hydraulic brake control unit was manufactured in large quantities and supplied to manufacturers of military and naval aircraft.

Wright Aeronautical Corporation, Paterson, N. J., engine manufacturing division of the Curtiss-Wright Corporation, increased its manufacturing facilities from approximately 1,000,000 to 1,800,000

sq. ft. during 1939 and the early part of 1940 to accommodate increases in business resulting from commercial and military orders for its Whirlwind and Cyclone aircraft engines. The erection of a modern, new single-story plant, adjacent to the Wright foundry, and other construction added 695,000 sq. ft. to the Wright factory while the purchase of the plant of the Textile Piece Dye Company provided 250,000 ft. more.

During 1939, the Wright Aeronautical Corporation continued production of high-performance Wright Whirlwinds of 7 to 9-cylinders covering a power range of 235 to 420 h.p., Wright Cyclones of 9 cylinder construction covering a range of 770 to 1200 h.p. for take-off; Wright Double-Row Cyclone 14's of two-row, 14-cylinder

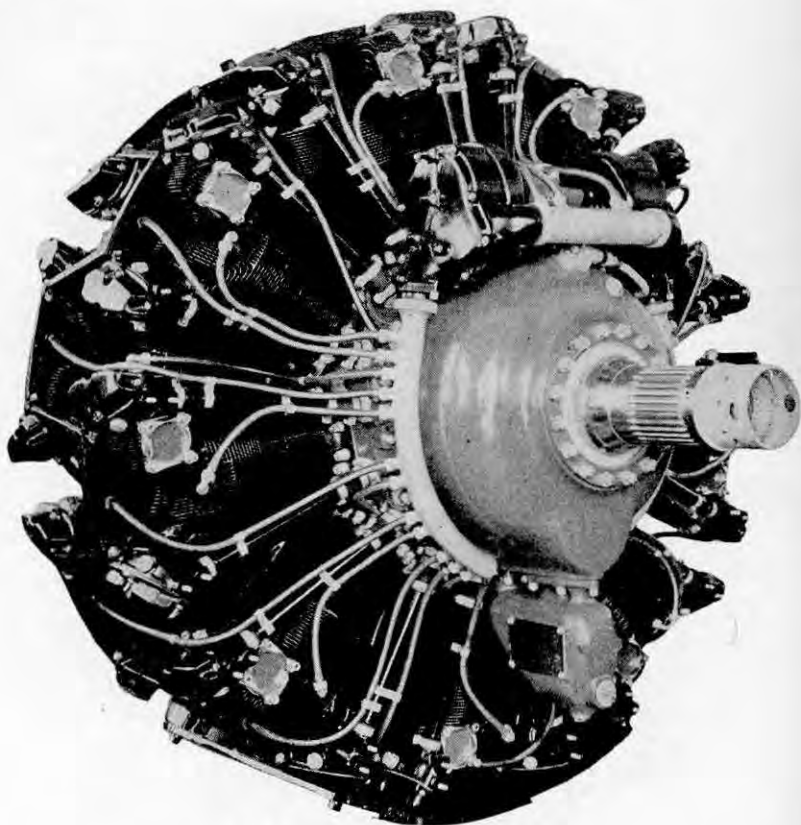


WARNER SCARAB JUNIOR

A five-cylinder radial aircooled engine rated at 90 h.p. at 2,025 r.p.m.

construction covering a range of 1600 to 1700 h.p. for take-off, and the Wright Duplex-Cyclone, a two-row, 18-cylinder engine rated at 2000 h.p. for take-off.

As was the case in 1938, the majority of engines produced were Wright Cyclones ranging in power from 1000 to 1200 h.p. which are used extensively in the naval and military fields in Douglas Army B-18 twin-engine bombers, Boeing B-17 four-engine Army bombers, North American Army O-47 observation ships, Curtiss Hawk 75 pursuits, Grumman Navy fighters, Curtiss Navy SBC-4 scout observation ships, Lockheed-Hudson twin-engine bombers, and the Douglas Northrop Attack bomber; and commercially in the Douglas air liners

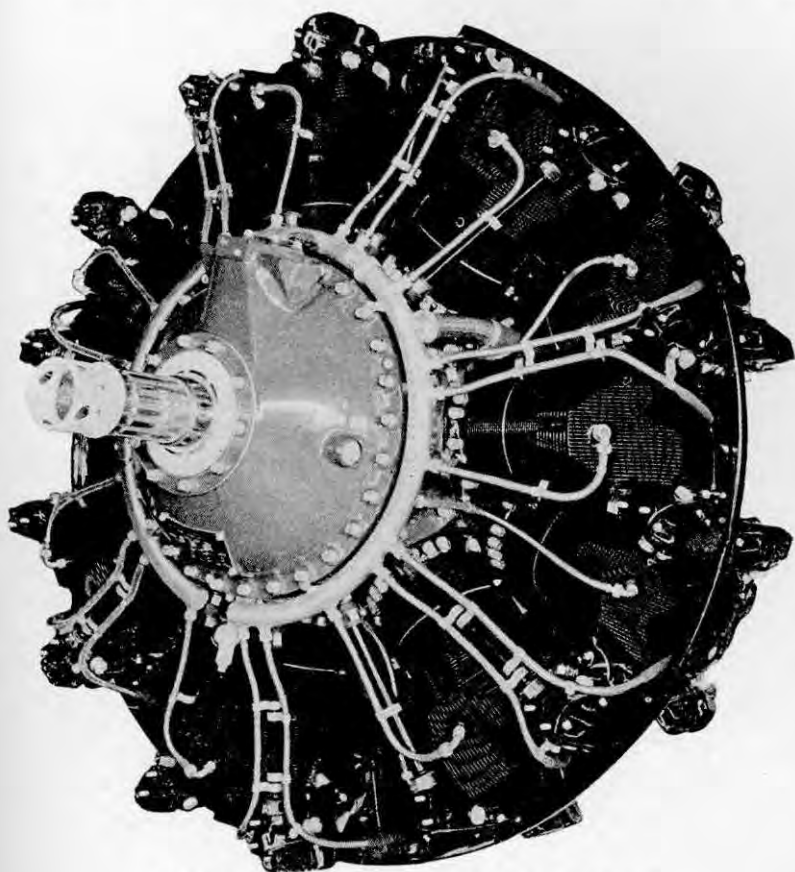


WRIGHT DUPLEX CYCLONE

An 18-cylinder double-row engine with a rating of 2,000 h.p. for take-off.

in service on American Airlines, Eastern Air Lines, Trancontinental and Western Air, Braniff Airways, Pennsylvania-Central Air Lines, Chicago and Southern Air Lines, Royal Dutch Airlines, Pan American Airways System, and other leading air transport companies throughout the world. Cyclones rated at 1100 h.p. were installed in the new Boeing 307 Stratoliners which were to be placed in service by Pan American Airways and Transcontinental and Western Air early in 1940.

The 1200 h.p. Wright Cyclone, designated as the G-200 Series, was approved by the Civil Aeronautics Authority for the highest power rating ever accorded a 9-cylinder radial aircooled aircraft engine. First commercial installation of the G-200 Cyclone was made

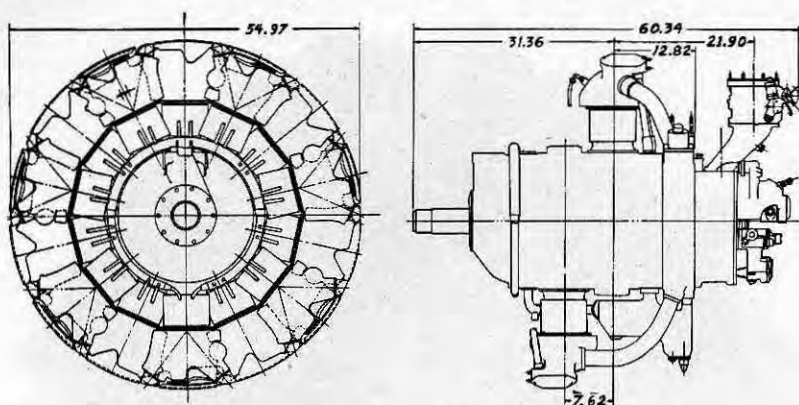


WRIGHT DOUBLE-ROW CYCLONE ENGINE

A 14-cylinder radial rated from 1,600 to 1,700 h.p. for take-off.

in a new fleet of Douglas DC-3 transports placed in service by Chicago and Southern Air Lines between Chicago and New Orleans. An outstanding military use of the same engine is its installation in the twin-engine Grumman F5F-1 fighter, said to be one of the fastest ships of its type in the world.

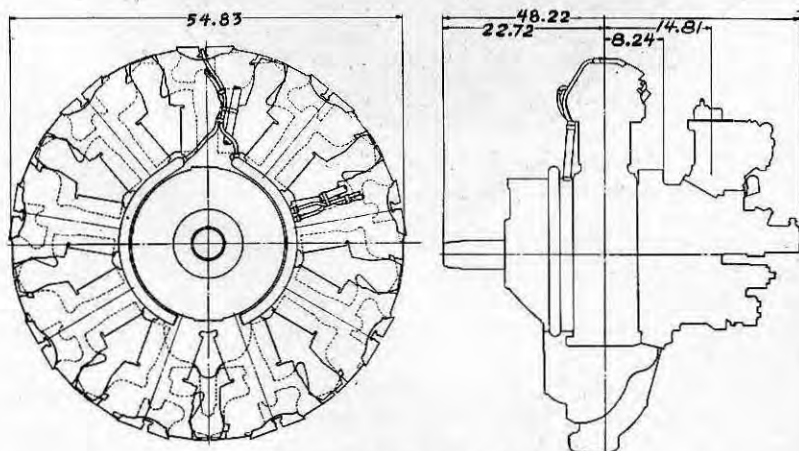
The Wright Double-Row Cyclone 14, which powers the four-engine Boeing 314 Clipper ships of the Pan American Airways System on its transatlantic and transpacific routes, turned in a spectacular record of performance for continuous operation of that type during 1939. During the year the take-off rating of this engine was increased from 1600 to 1700 h.p. and the latest model installed in



WRIGHT DOUBLE ROW CYCLONE 14

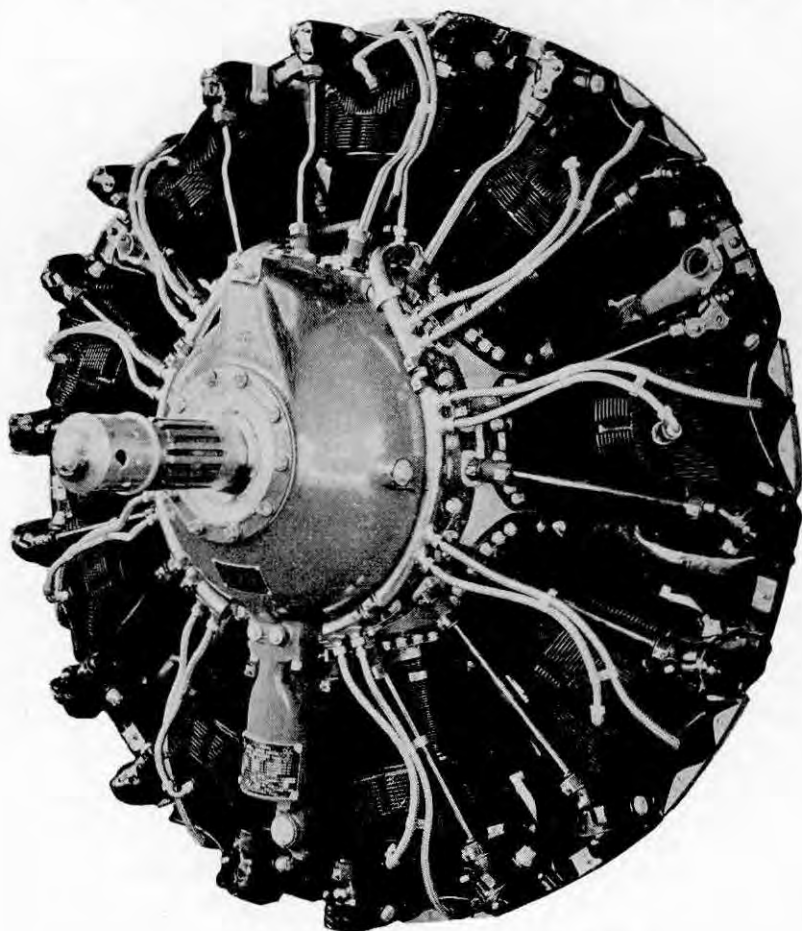
A 14-cylinder double row aircooled engine with a rating of 1,600-1,700 h.p. for take-off.

the new twin-engine Curtiss-Wright Transport undergoing flight tests at the St. Louis Airplane Division of the Curtiss-Wright Corporation. The Double-Row Cyclone 14 also was selected to power such outstanding military and naval types as the North American B-25 Army twin-engine bomber, one of the most advanced types in the Air Corps expansion program; the Douglas Army B-23 bomber,



WRIGHT CYCLONE G 200

A nine-cylinder single-row radial aircooled engine with a rating of 1,200 h.p. for take-off.

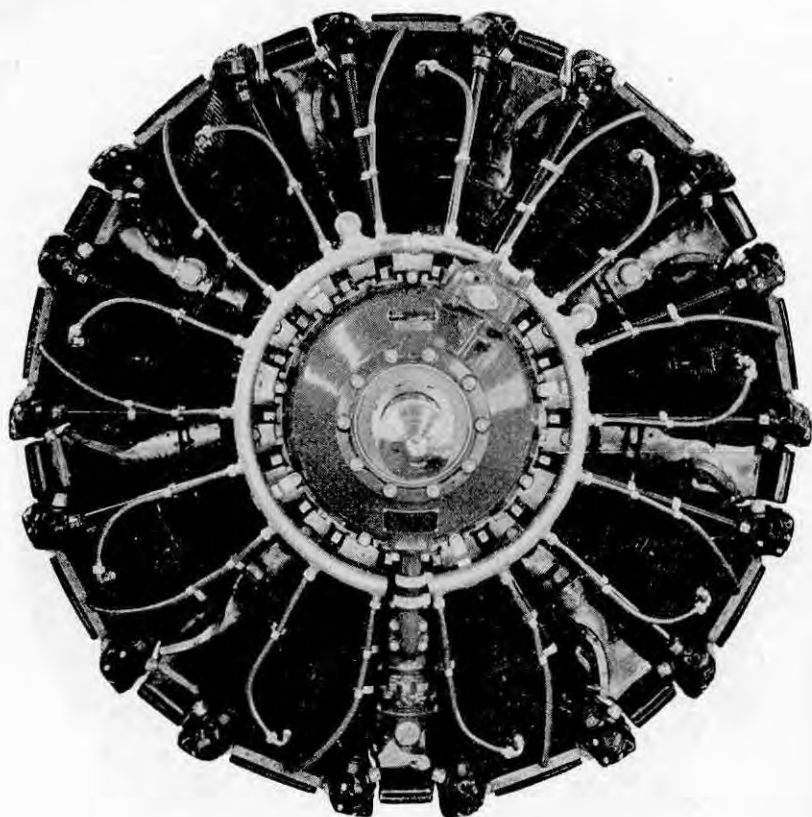


WRIGHT G₂₀₀ CYCLONE ENGINE

It is rated 1,200 h.p. for take-off, and incorporates a new steel crankcase.

the Douglas Army A-20 twin-engine attack, and the Martin Navy twin-engine patrol bomber.

The 18-cylinder, 2000 h.p. Wright Duplex-Cyclone, which had the highest C.A.A approved rating of any two-row radial air-cooled engine then manufactured in the United States, was developed with the cooperation of the U. S. Army Air Corps. It was selected to power the four-engine Douglas B-19 bomber under construction for



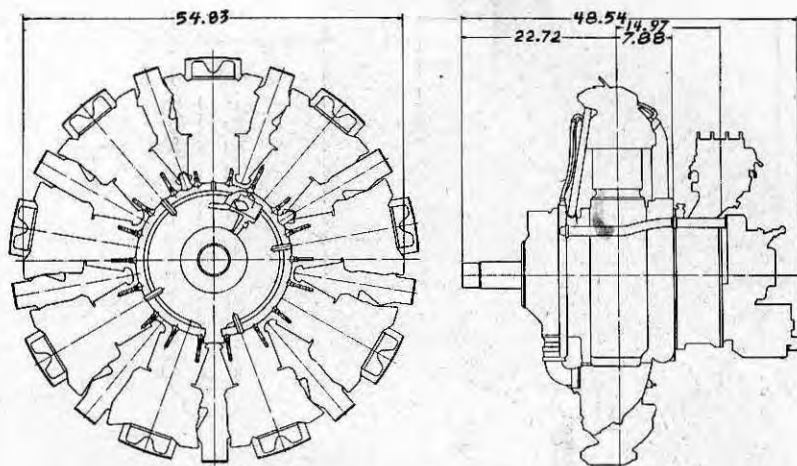
WRIGHT G-100 CYCLONE

A nine-cylinder single row engine rated at 1100 h.p. for take-off.

the Air Corps at the Douglas Aircraft factory. It also powered the Consolidated twin-engine Model 31 long-range flying boat.

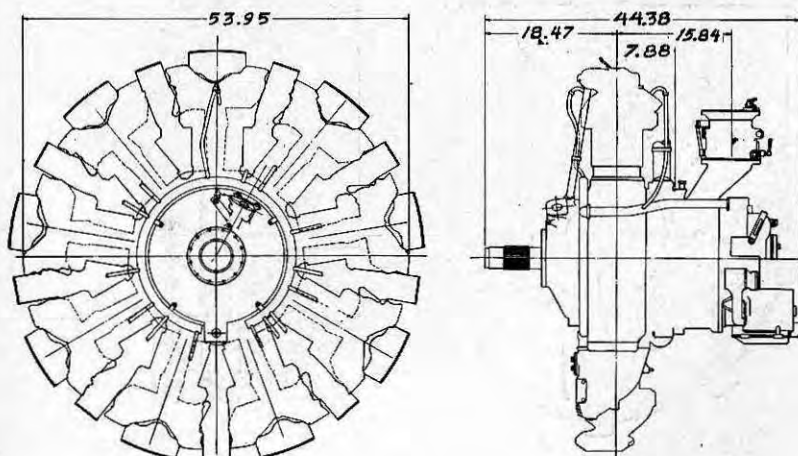
Both the G-100 and G-200 Cyclones have steel main crankcase sections. All Cyclones are equipped with the Wright Dynamic Damper crankshaft, nitrided cylinder barrels, internal valve gear lubrication, full pressure baffling, and provision for either constant speed or full-feathering propellers. All the single-row Cyclones are basically similar in design. They have a displacement of 1823 cu. in., a bore of 6.125 in. and a stroke of 6.875 in.

The use of the Wright Two-Speed Supercharger, which may be applied to any single or double-row Cyclone, provides the above engines with higher performance characteristics at high altitudes.



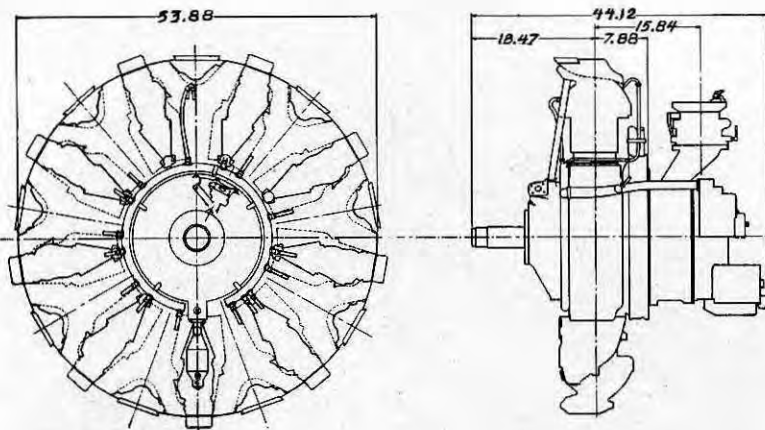
WRIGHT CYCLONE G 100

A nine-cylinder radial aircooled engine with a rating of 1,100 h.p. for take-off.



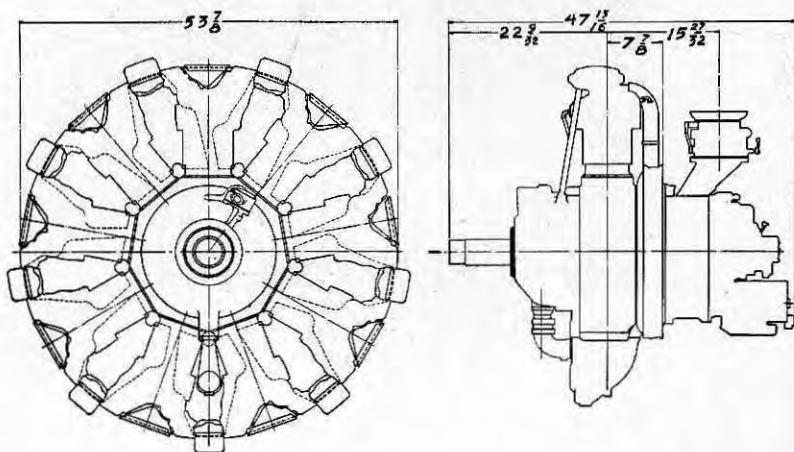
WRIGHT CYCLONE G DIRECT DRIVE

A nine-cylinder radial aircooled single-row engine rated at 1,000 h.p. for take-off.



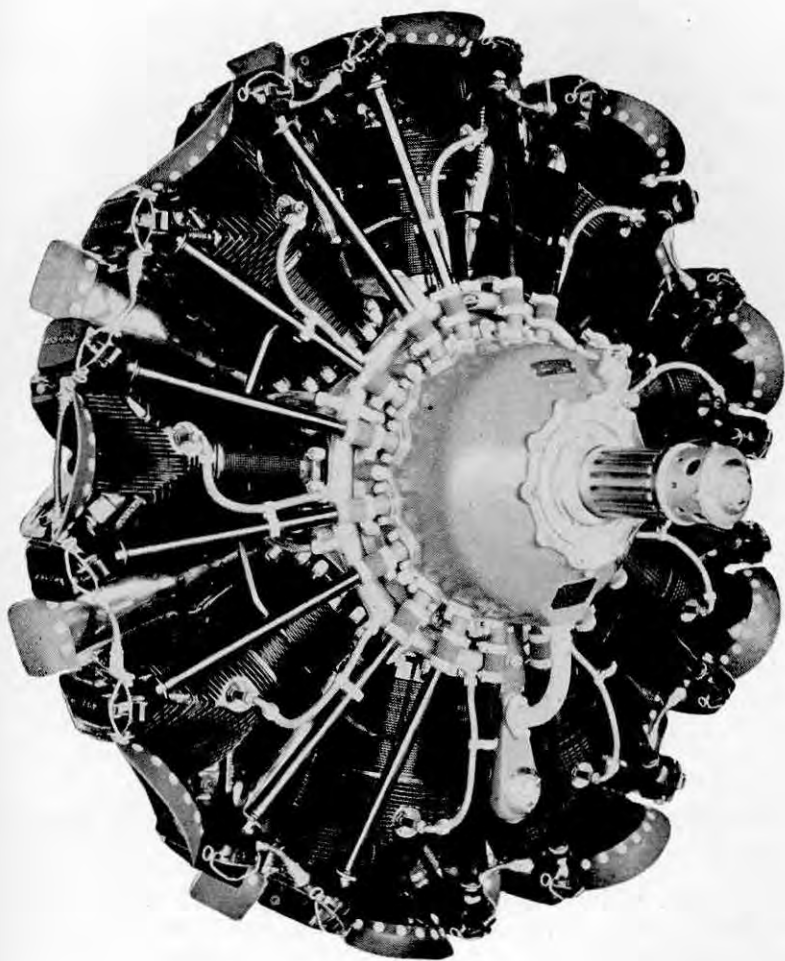
WRIGHT CYCLONE F-50 AND F-60 DIRECT DRIVE

A nine-cylinder single-row radial aircooled engine with a rating of 900 h.p. for take-off.



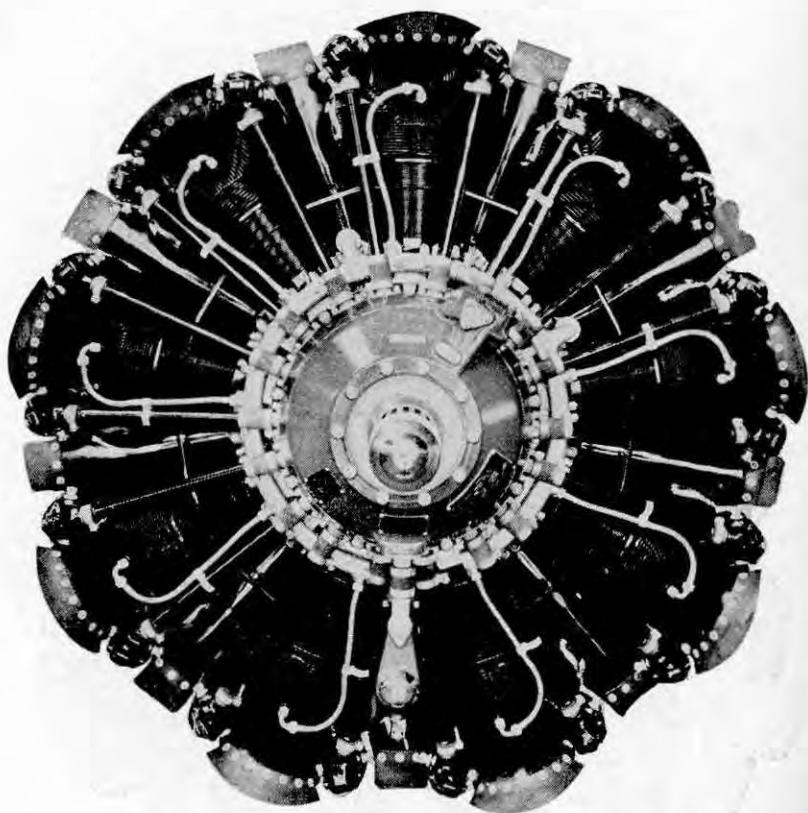
WRIGHT CYCLONE F-50 AND F-60 GEARED

A nine-cylinder single-row radial aircooled engine with a rating of 900 h.p. for take-off.



WRIGHT F-50 AND F-60 CYCLONE

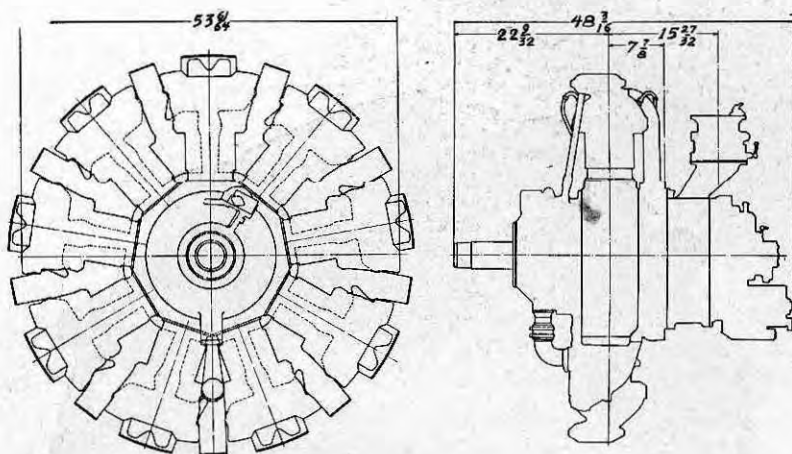
A nine-cylinder single-row engine rated from 770 h.p. to 900 h.p. for take-off; also available in either geared or direct drive models.



WRIGHT G CYCLONE

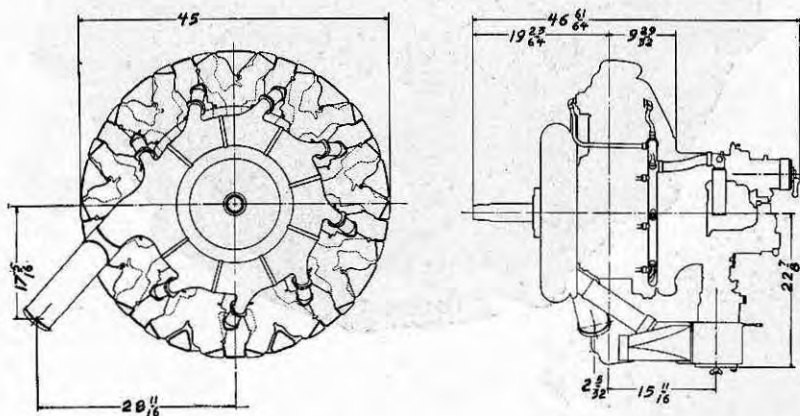
A nine-cylinder single-row engine rated at 1000 h.p. for take-off. This model is available in either geared or direct drive.

This device, which was developed by Wright engineers with the cooperation of the Army Air Corps, provides two blower gear ratios, making possible the use of a moderate degree of supercharging for take-off and sea level operation and the higher degree of supercharging required for high performance at high altitudes. The Two-Speed Supercharger mechanism adds only a few lbs. to engine weight. It replaces the solid lay shaft used in the conventional supercharger mechanism. Changing from low to high blower or high to low may be accomplished by a simple control installed in the pilots cockpit.



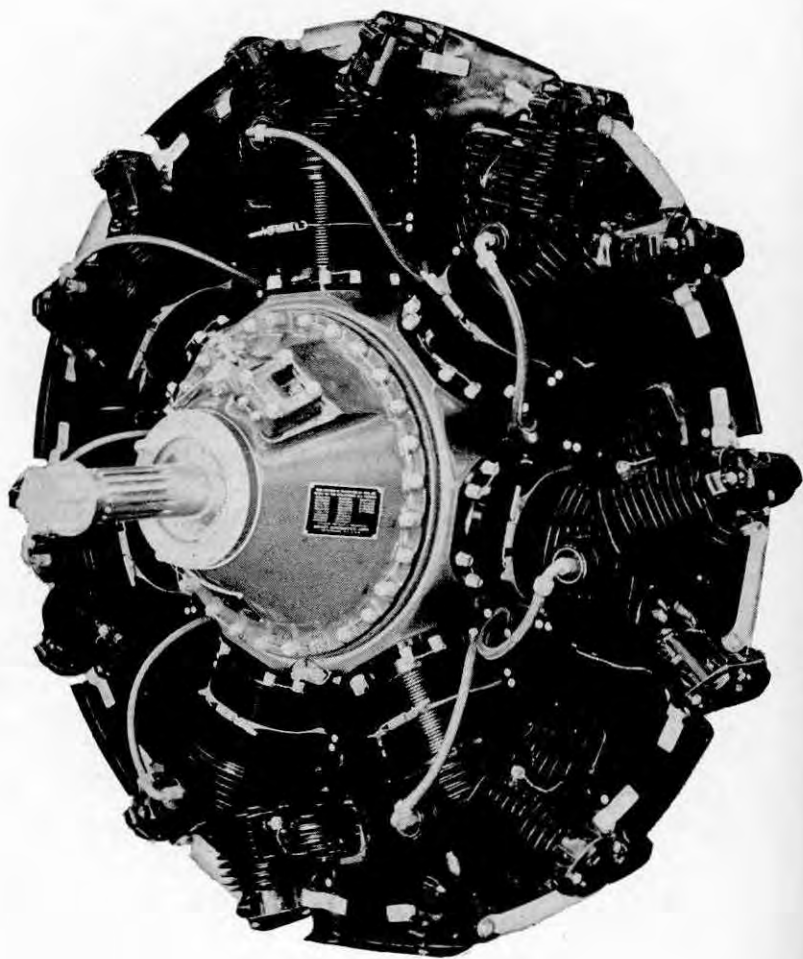
WRIGHT CYCLONE G

A nine-cylinder single-row radial aircooled engine with a rating of 1,000 h.p. for take-off.



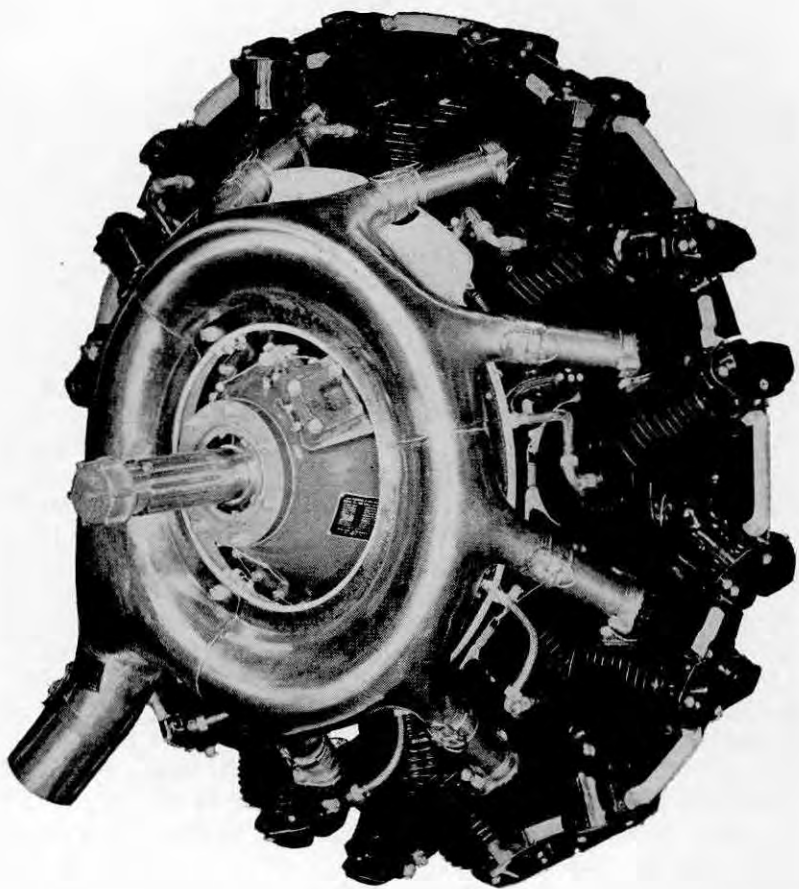
WRIGHT WHIRLWIND NINE CYLINDER

A nine-cylinder radial aircooled engine rated at 450 h.p. for take-off.



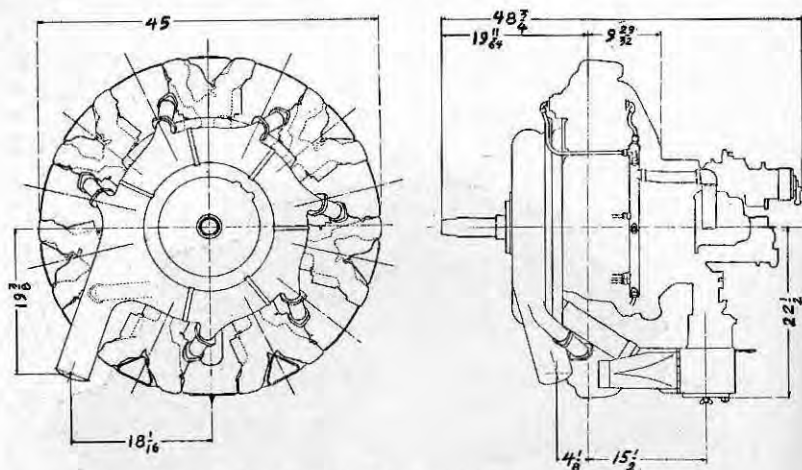
WRIGHT WHIRLWIND R760 ENGINE

A 7-cylinder direct drive radial rated from 235 to 350 h.p.



WRIGHT WHIRLWIND R975 ENGINE

A 9-cylinder direct drive radial rated from 365 to 450 h.p.



WRIGHT WHIRLWIND SEVEN CYLINDER

A seven-cylinder radial aircooled engine rated at 350 h.p. for take-off.

Manufacturers of Accessories

Acrotorque Company, Cleveland, O., manufactured a new line of hydraulic propeller controls.

Aero Supply Mfg. Co., Inc., Corry, Pa., manufactured a complete line of engine controls, hand and power drive fuel pumps, fuel valves, strainers and armament accessories.

Air Associates, Garden City, N. Y., manufactured or distributed numerous types of material, accessories and equipment required for the construction or maintenance of aircraft. The company operated factory branches at Glendale, Calif., Chicago, Ill., and Dallas, Tex. Engineering and manufacturing facilities were expanded to fill the demand for accessory and equipment units of its own design, and for the manufacture of standard AN Specification parts and materials. Among the products developed was a complete line of aircraft hydraulic equipment including hand pumps, unloading valves, accumulators, control valves, relief valves, check valves, strainers and hydraulic actuating cylinders of many sizes and types. Also in demand in 1939 was the Air Associates anti-icer equipment including nose spinners, slinger rings and the newly developed propeller anti-icer fluid metering pumps. A line of wheels, with hydraulic and mechanical brakes, was manufactured and large orders were completed for propeller brakes.

Aircraft Accessories Corporation, Glendale, Calif., manufactured a long line of hydraulic controls for landing gear, flaps, armament,

floats, doors; and also relief, control and check valves, besides other hydraulic accessories. One was a power brake valve incorporating several noteworthy advantages, and it was produced in single or double types. Another was a hydraulic actuating cylinder packed by a special method developed by the company allowing for the free action of the pistons at all times. The "Airaco" relief valve was designed to relieve pressures accurately at any predetermined setting



FOUR-WAY SELECTOR VALVE

Produced by Aircraft Accessories Corp., it operates under 1,000 lbs. to the square inch of hydraulic pressure with only 6 lbs. of pressure on a $2\frac{1}{2}$ in. handle.

between 500 and 1,500 lbs. to the square inch. The company also had developed a line of self-sealing firewall hydraulic couplings. Another item was the automatic pressure regulator designed to handle pressure loads up to 1,500 lbs. per square inch. Aircraft Accessories Corporation selector valve operated under 1,000 lbs. to the square inch of hydraulic pressure with only 6 lbs. of pressure on a $2\frac{1}{2}$ inch handle.

Aircraft Radio Corporation, Boonton, N. J., produced its line of radio receivers and transmitters.

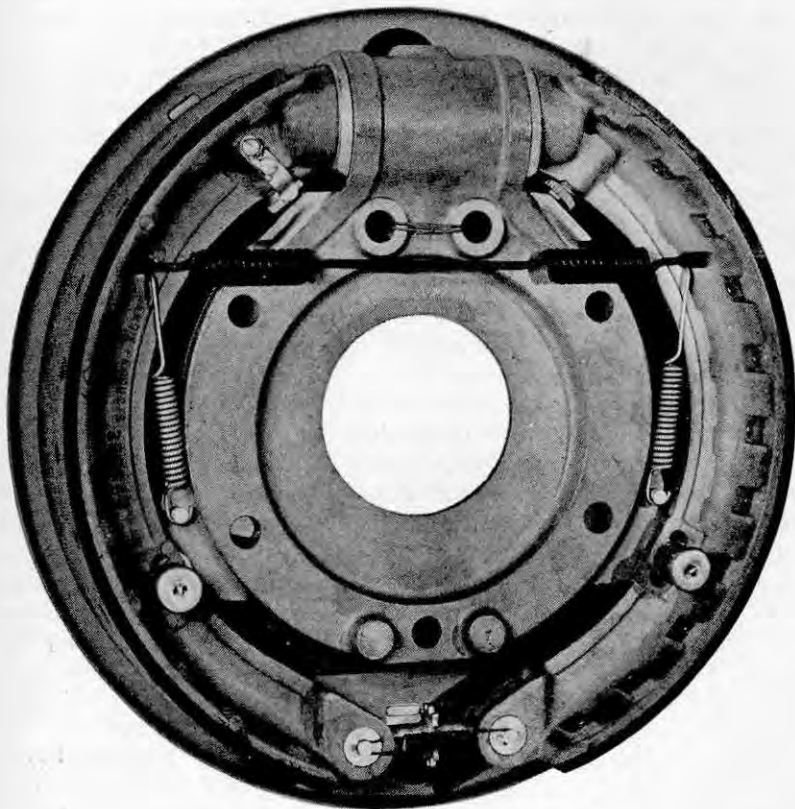
Aluminum Company of America, Pittsburgh, Pa., continued to produce its line of aluminum and aluminum alloy materials for aircraft construction. A wider application of Alclad sheet was noted in the aircraft industry. Superior resistance to corrosion of this material has been an important factor in extending its popularity. This company continued its program of research, development and service activities, cooperating actively with the aircraft industry, private and Government aircraft activities.

American Bosch Corporation, Springfield, Mass., in 1939 was in production on 9, 14, and 18-cylinder magnetos, and planned to produce a 7 cylinder model in 1940.

The Aro Equipment Corporation, Bryan, O., developed an air vapor eliminator for fuel lines, fuel selector valves (manual and automatic), fuel pumps, Hi-Draulic pumps, and fuel segregators for refueling systems. Its automatic fuel selector valve automatically shut off fuel line from the empty tank and cut in fuel line from a tank containing fuel without manual attention. The fuel segregator was designed especially for use during refueling operations, to serve with equal effectiveness in fuel transfer operation, rejecting substandard or contaminated fuel.

The B G Corporation, New York, N. Y., developed a number of new model aircraft spark plugs and exhaustive laboratory and actual flight work was completed, including the acceptance tests necessary for engine manufacturers' approval. The new models, which were adopted by many of the operators, were in current production. In addition, the introduction of many engineering and production refinements in numerous existing models resulted in improved performance. The project involving the incorporating of the design changes, re-tooling, and the necessary laboratory and field tests required to produce the military standard specifications covering spark plugs and ignition harness attaching parts were completed. Engineering research facilities were expanded. The engine test laboratory was modernized with the latest equipment and a substantial increase in equipment and personnel was made in the research laboratory. The expansion of the test and research facilities permitted maintaining the extensive development program necessary to meet the rigid requirements of the engine manufacturers' high output engine developments. In conjunction with the program, extensive service tests were carried on to meet the military and commercial operators' demands for increased dependability, and more economical spark plug service cost. The addition of trained and experienced personnel to the field engineering

and service staff made it possible for the departments to pursue a more intensive field of activity. Through the cooperation of the commercial air lines it was possible to conduct extensive studies and analyses covering every phase of the service and maintenance procedure involved in the handling of spark plugs for large scale sched-



THE BENDIX DUO SERVO BRAKE

A recent development of Bendix Aviation Corporation's Bendix Products Division with primary and secondary shoes identical, and equally effective backward or forward.

uled operation. The result was improvement in performance and dependability and an appreciable reduction in maintenance costs. B G designed and developed a new ignition harness testing unit.

The Bendix Products Division of Bendix Aviation Corporation, South Bend, Ind., made improvements in the design of landing gear

equipment. Among many developments the most important was that of the duo servo type brake for airplane use. The brake, while somewhat similar in appearance to the Bendix single servo brake, which was standard airplane equipment for many years, differed from the single servo brake in its fundamental design and operation. Smooth performance and ease of control with simplified service were essential characteristics of the duo servo brake. It was equally effective backward and forward, thereby eliminating left and right hand brakes. The primary and secondary shoes were identical, further simplifying servicing. The brake incorporated a "floating shoe" arrangement which allowed the brake to compensate for out-of-round drums and maladjustments without causing erratic braking. The duo servo brakes were supplied in large quantities, both for military and commercial service.

Many variations in shock strut design were added to the list of struts supplied for military and commercial use. The sizes of struts increased as well as the extent of the strut function, until in some cases practically a complete landing gear unit of wheel, brakes, axle and strut was supplied. New sizes of wheels, both single and dual brake, were produced in large quantities. A greater proportion of the wheels were made from magnesium alloy.

Bendix Radio Corporation, Baltimore, Md., developed the MN-26 radio compass equipment. The design, based on experience in the field of left-right indicator radio compass equipment, incorporated many new features. The mechanical design was combined with a straightforward circuit layout to permit quantity production with uniformity. It included 5 main units, the MN-26 radio compass proper containing the radio and audio frequency circuits and the dynamotor power supply, the MN-20 rotatable low impedance loop antenna, the MN-28 compass remote control unit, the IN-4 left-right indicator unit, and the MN-22 loop azimuth indicator unit.

Bendix also developed its Type RA-10 receiver equipment with aural-null direction finding accessories. The RA-10 receiver unit housed all radio frequency and audio frequency circuits as well as the dynamotor power supply unit. The MR-9 remote control provided for the reception of radio telephone and telegraph signals. When used for aural-null loop direction finding the MN-20 9 in. or MN-24 18 in. loop was used with MN-52 azimuth indicator unit. Another development was the TA-6 aircraft transmitter, a small compact unit providing 2 crystal controlled telephone and telegraph transmitting frequencies in the frequency range 2,800 to 12,000 kc. The installed weight of the transmitting equipment with accessories was less than 30 lbs.

L. F. Benton Company, Vergennes, Vt., designed and marketed a line of mica insulated spark plugs.

Berry Brothers, Inc., Detroit, Mich., in 1939 finished considerable development work in the perfection of dopes to eliminate blushing, and it was found possible to produce dopes with far greater blush resistance and longer life than was believed possible a few years ago, yet at no increase in cost. In the pigmented dope line various pigments were perfected, enabling Berry Brothers to produce colored dopes that would retain color and lustre without fading or chalking. A new zinc chromate primer for all types of metal surfaces was developed, filling the exposure and non-corrosion requirements of naval aircraft. New types of flexible synthetic aircraft lacquers were developed and were under severe service tests. Large quantities of aircraft finishes were supplied to governments abroad.

Breeze Corporations, Inc., Newark, N. J., an integrated group of engineering and manufacturing divisions, specialized in developing accessories for all types of aircraft and engines. Breeze radio ignition shielding was refined and supplied with improved flexible conduits, gaskets and connectors. The improved components were effective in making shielding assemblies water-tight in conformance with current Army-Navy specifications. Disconnect plugs were used on spark plug leads on some engines so that portion of the ignition cable having the shortest life was replaceable without complete removal and rewiring of a shield.

A new line of multiple-circuit electrical connectors was introduced by Breeze, for use at firewall, generator, radio and instruments with improved contacts, and designed to meet specialized requirements. The line conformed with latest Army-Navy specification, and included single units for accommodating as many as 42 circuits. The Breeze fuel-air ratio indicator gave a fast, accurate reading of the fuel-air mixture based on analysis of the exhaust gas. Because the thermal conductivity of exhaust gas varied with the amounts of carbon dioxide and hydrogen present, and because the proportion of these elements in the exhaust gas was dependent upon the fuel air ratio, measurement of the ratio was made by passing a sample of exhaust gas over an electrically heated filament and comparing the electrical conductivity of the filament thus cooled with that of a similar filament cooled by the outside air. The air and the sample were passed over the two filaments at the same temperature, therefore relative cooling was determined by the thermal conductivity of each gas. The electrical conductivity of the wires was determined by their temperatures, and any differential was measured by means of a Wheatstone bridge which registered on an instrument in the cockpit, calibrated either

to read in fuel-air ratio, or in increments corresponding to those on the manifold pressure gauge. By this latter method, mixtures could be set for any existing manifold pressure without the use of a reference chart.

The Cartridge 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 battery, as the shell was fired by the current from a flash-light cell.

Champion Spark Plug Company, Toledo, O., continued to produce a line of mica aircraft spark plugs and added several new types to take care of new engine requirements. A program was carried out for the improvement of aviation spark plug designs and materials, with the object of providing plugs capable of withstanding the more severe conditions which were expected to be imposed by the high output engines of the future.

Chandler-Evans Corporation, in 1939, moved from Detroit, Mich., to new and larger quarters at South Meriden, Conn., built especially for its requirements in manufacturing CECO non-icing carburetors and aircraft fuel pumps. Production was increased on the two standard types of non-icing carburetors, Models CE 1375-DA-1 used on the Wright Cyclone engine and CE 1375-DB-1 used on the Pratt & Whitney Twin Wasp engine. Minor improvements in the design were accomplished, without fundamental change or modification affecting interchangeability. The models were developments of the Chandler-Groves carburetor originally designed by M. E. Chandler, and used in military and commercial operations. Further improvements were made and tested for 1940 production.

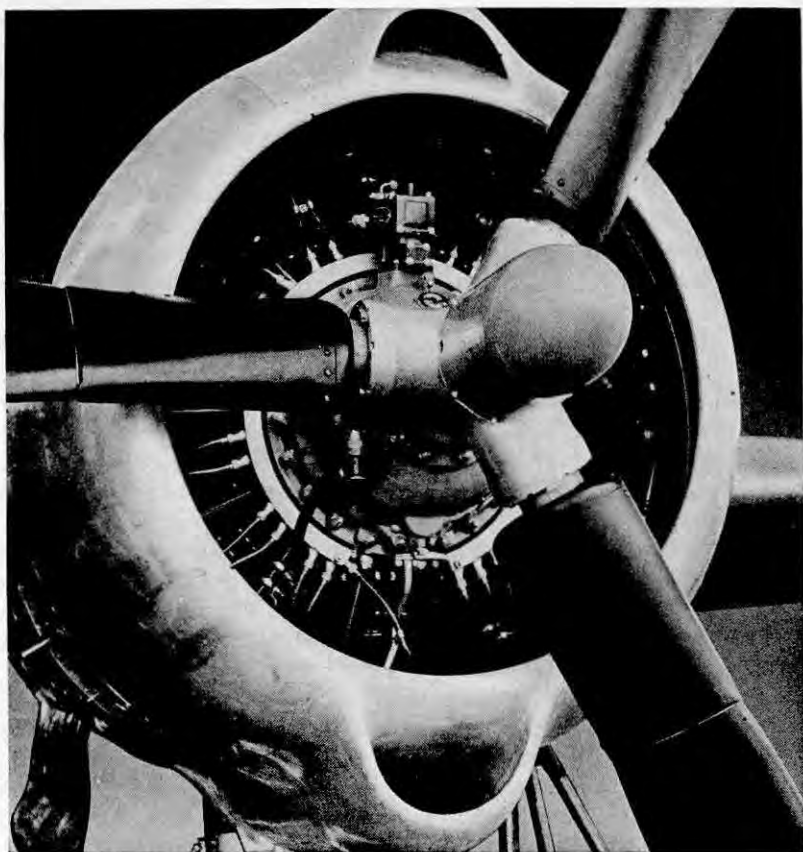
Three basic models of engine-driven fuel pumps were developed, tested by the Army and Navy and put into production. They were of the vane type with balanced relief valve, connection for supercharging, and with wobble by-pass. The distinctive feature was the continuous molded diaphragm of synthetic rubber, which also constituted the relief valve seal. Special attention was given to materials, with no appreciable wear experienced after a 1,200 hour continuous official test at maximum performance. The three sizes were 225, 425 and 800 gallons per hr. at 2,500 r.p.m. Each had standard mounting flanges, drive shafts, port sizes and pressure ranges to meet varying requirements. In addition to the engine-driven fuel pumps, transfer pumps of the Model D-7 and D-10 were developed. The D-7 had a capacity of 35 gallons per min. at 120 r.p.m. and was operated by electric starter energizers, or by a hand crank. The D-10 had a

maximum capacity of 2,100 gallons per hr. at 3,000 r.p.m., and was electrically driven.

Development was completed for 1940 production on a variable capacity engine-driven fuel pump and a re-design of the standard line of pumps to British standards for installation on British engines and for manufacture by a licensee in England.

Cleveland Pneumatic Tool Company, Cleveland, O., manufacturers of Aerol Shock Absorbing Struts, doubled their plant and strut manufacturing equipment. The shock absorbing struts were so designed that the immediate shock of impact was taken on oil, then in taxiing the minor impacts were cushioned by air. The plane's weight, the length of stroke of the strut, the size of tire used, and the air pressure in the tire entered into the design of the metering pin, regulating the size of the orifice controlling the flow of oil in the struts at the instant of landing impact. Aerol strut designs, brought to production, were for the Martin 167F and B26, the Bell Airacuda and Airacobra, the Douglas SBD-1 and A20, and the Boeing 307 Stratoliner. The company also introduced an extensive line of light riveters for use in aircraft. Nos. 14-3, 14-5 and 41 squeeze riveters also were developed. Another item of increased production was the Cleco sheet holder, many being employed temporarily to secure the sheets to each other and to structural members in fabrication operations involving duralumin and other metal sheets.

Curtiss Propeller Division of the Curtiss-Wright Corporation, Clifton, N. J., expanded facilities to accommodate an increasing demand for Curtiss Electric propellers in both the military and commercial fields. The propellers were adopted by the U. S. Navy for large multi-engine patrol bombers such as the Consolidated PB2Y-2, the Sikorsky XPBS-1, and the Martin PBM-1, and were supplied for the Brewster F2A-2 and Grumman F4F-3 Navy fighters. The Coast Guard chose Curtiss propellers for the fleet of PH-3 patrol boats which supplemented the original Curtiss-equipped PH-2 planes. An addition to Curtiss propeller manufacturing facilities was the acquisition of the manufacturing rights, equipment and personnel of the Hollow-Steel Blade Division of the Pittsburgh Screw and Bolt Corporation. It was made in conjunction with U. S. Army Air Corps engineers, hollow-steel blades being used for virtually all the latest Army airplanes of both single and multi-engine types. The hollow-steel blade presented weight economies which became more marked as propeller diameters increased, and offered greater durability and increased resistance to abrasion or corrosion than aluminum alloy. Curtiss, however, continued to manufacture aluminum-alloy blades, particularly for smaller propellers, where that type had given



PROPELLER CUFFS

The Curtiss blade-shank "cuff" to reduce drag at high speeds and improve engine cooling at low speeds.

satisfactory service. Further enlargement of the Clifton plant, plus the Pittsburgh facilities, increased the manufacturing area of the Curtiss Propeller Division to approximately 200,000 sq. ft.

Developments introduced by Curtiss included the controllable four-blade propeller, reverse-pitch, and the electric multi-engine synchronizer, a device which operated independently of any one engine for master control and could be used during take-off as well as cruising. The rapid advances in high-speed airplane design, requiring close engine cowling and reduced frontal area, also brought into use

the Curtiss bladeshank "cuff," to improve engine cooling at low speeds and reduce bladeshank drag at high speeds. The Curtiss four-blade propeller was introduced for much the same reasons that caused the change from 2 to 3 blade propellers. The four-bladed type provided additional blade area to absorb the higher horsepower of modern engines in substantially smaller diameters than would be required with a 3 blade propeller capable of absorbing efficiently an equal amount of power. Reverse pitch was incorporated in propellers built for the large multi-engine patrol bombers of the Navy for use during taxiing operations on water. By setting the outboard propellers of a 4-engine plane in positive pitch and the inboard propellers in reverse pitch, complete water-maneuverability was possible by simple manipulation of the throttles.

Curtiss also built the largest propellers used in this country for a transport airplane when they supplied the 15-foot electric propellers for the 1,700 h.p. Double Row Cyclone 14 engines on the Curtiss-Wright Transport. The company sold propellers to France, Norway, Belgium, Iraq, China, and the Netherlands East Indies. It was a Curtiss Electric-equipped Curtiss Hawk for France which attained a speed of more than 575 m.p.h. in a test dive in 1939.

The Dow Chemical Company, Midland, Mich., reported a greatly increased use of Dowmetal by the aircraft manufacturing industry. A full third lighter than aluminum, these magnesium base alloys, sold under the trade name of Dowmetal, have become increasingly popular with aircraft manufacturers because of their extreme lightness combined with strength, toughness and durability. During the last year many new applications of Dowmetal were made. In addition to the use of sand and mold castings, Dowmetal die castings have found increasingly wide use. To meet the increased demand The Dow Chemical Company licensed one of the largest job producers of die castings to die cast Dowmetal. Another feature of the expansion program was the opening at Bay City, Mich., of a new, large foundry to care for the increased demand for Dowmetal sand castings.

On Menasco's Super Buccaneer engines there are more than 21 Dowmetal engine parts including valve tappet guides, manifolds and supercharger impellers operating at speeds up to 40,000 r.p.m. The Ranger SGV-770 engine uses approximately 60 pounds of Dowmetal, saving 20 pounds of weight, while the use of Dowmetal in certain of the Wright Cyclone models permits the remarkably low weight per horse power ratio of 1.07 pounds. The case of the Sperry Gyropilot is entirely of Dowmetal, in addition to the case of the Sperry Gyro-Horizon.

Eclipse Aviation, Bendix, N. J., a division of Bendix Aviation Corporation, through improved facilities for the design, development and manufacture of aircraft accessory equipment provided by its modern plant introduced many new items of accessory equipment. New starting equipment included a complete series of combination direct cranking electric and inertia starters. Incorporating the features of hand or combination hand and electric inertia starter, they provided the additional advantage of continuous cranking of the engine after dissipation of the flywheel kinetic energy. Thus, the energy stored in the starter flywheel at the initial engagement of the starter and engine jaw was used to overcome the heavier "break-away" torque, after which the lighter load of continued cranking was assumed by the electrical system. A new design was the combination direct cranking electric starter with integrally mounted hydraulic feathering pump for use with Hamilton Standard hydromatic propellers, to replace the conventional direct cranking electric starter and separately mounted electric motor driven hydraulic pump. The starter-pump was similar in construction, and incorporated features of the direct cranking electric starters of high output, except that the hand crank mechanism fitted to starters of that type was removed, and a hydraulic pump mounted in its place. With this type of starter a reversible motor drove the hydraulic feathering pump when the starter was not in operation. The starter pump unit, in addition to saving weight by eliminating additional electric motor and excess line tubing, provided a compact and lightweight installation integral with the power plant.

Another Eclipse development was a new series of inertia starters of improved design and increased output. Much experimental work was carried on with the design and development of hydraulic starters, direct cranking electric starters of low cost and small output, combustion starters of increased output and a multiple breech for use with combustion starters. Progress in design and development of generating equipment was reflected in the 1,500 watt engine driven single voltage battery charging generators for either 12 or 24 volt battery systems. Although rated at twice the output of the standard 750 watt units, no increase in weight or size resulted because of new design and an integral cooling fan. The balancing of armatures with simplified brush rigging resulted in more efficient operation. Voltage booster dynamotors for use with Curtiss Electric propellers was another development. Autosyn dynamotors and alternators, as well as radio dynamotors designed for either 12 or 24 volt battery systems, were developed; and engine driven alternators in capacities ranging up to 10 kw. for use with auxiliary power supply systems

requiring either 400 or 800 cycle AC power were another development. Anti-icer flowmeters for use with the three gear propeller anti-icer pumps of new design which permitted the operator to read directly the consumption of anti-icer fluid were also developed as well as the Snap-Action de-icer valve which permitted positive displacement of de-icer wing and tail elements without the lag experienced with the conventional type of de-icer valve. Experimental work was carried on with the design and development of a new series of air pumps for use with navigating instruments and de-icer equipment. A study of complete cabin supercharger systems for transport aircraft also was made.

Eclipse Aviation also developed new hydraulic equipment, including a new type of electric motor driven, gear type hydraulic pump for use in the operation of flaps, retractable landing gear and tail wheels. Considerable progress also was made in the development of hydraulic pumps for propeller feathering. The electric motor driven propeller feathering pump, as well as the combination direct cranking electric starter with integral propeller feathering pump, were additions to the Eclipse line. Changes in design in standard production, engine driven hydraulic pumps resulted in improved performance and longer service life. Considerable work was in progress in the design and development of a new series of engine driven and motor driven hydraulic pumps. Other new projects under development were a variable volume hydraulic pump, hand hydraulic pump and a group of miscellaneous hydraulic valves. Auxiliary power supply systems for large long range aircraft in capacities up to 10 kw. were developed, as well as engine driven alternators in capacities up to 10 kw. for use in conjunction with both 2 and 4 cylinder engines of Eclipse design. Tow target windlass assemblies were developed for the Air Corps; accessory gear boxes in various capacities; a new type of supercharger regulator for use with exhaust turbine superchargers; ammunition rounds counter containing four individual units furnished as one complete assembly; explosion proof accessory driving motors for use with 400 cycle auxiliary power supply systems and a direct reading fuel flowmeter of 1,200 lbs. capacity for use with airplane installations incorporating engines of high output also were developed. Among miscellaneous equipment in process of design were engine synchronizers and various types and capacities of fuel injection pumps.

Edo Aircraft Corporation, College Point, N. Y., maintained its activities in developing and manufacturing all-metal seaplane floats for the domestic and foreign markets. The company carried a line of 27 standard and semi-standard float models suitable for ships

ranging in gross weights from approximately 1,000 to 18,000 lbs. as land planes. Floats in that class were sold to the U. S. Navy and many foreign governments. Edo continued its experimental and development work and also completed several models in a new series of "Flush Faired" floats, developed especially for the military field, where maximum performance superseded other considerations.

The Fairchild Aviation Corporation, Jamaica, N. Y., enjoyed an increase in business that compared very favorably to the general improvement in American aviation as a whole. As of December 31, 1939, unfilled orders showed an increase of 80 per cent for the year. Production in terms of man hours was steadily increased until it reached a point nearly 100 per cent higher. Production during January, 1940, was 50 per cent higher than in the preceding month.

On January 1, 1940, the Fairchild Aerial Camera Corporation and Fairchild Aviation, Incorporated (the Fairchild export sales organization) were merged with the parent company, Fairchild Aviation Corporation, which assumed all the functions of its former subsidiaries. To take care of increased business, the Corporation's production facilities were expanded by the addition of new precision machinery and equipment, including turret lathes, automatic screw machines, milling machines, gear hobbers, electric and gas-fired heat treating furnaces and plating and anodizing equipment. Additional skilled personnel were employed and the engineering and research departments augmented. A new four-story addition to the present plant at Jamaica was ready for occupancy late in April, 1940.

New equipment included several types of special aerial cameras but details were not released pending exhaustive service tests. The Type W-7 Camera Machine Gun for fixed installation manufactured for many years for the Bureau of Aeronautics of the United States Navy was released for export sale to other governments. The Fairchild F-51 High Precision Photogrammetric Camera was released for production as were a small aerial camera for oblique photography and several items of aerial photographic laboratory apparatus including the Fairchild F-58 Aerial Roll Film Contact Printer, the F-71 Magnifying Stereoscope and the Unit 241 Portable Flight Laboratory.

The F-48 was a small light weight aerial camera designed especially for military scouting work. It took up little space, and room could be found for it in the smallest scouting and observation planes. Its aerial roll film came in lengths sufficient for 50 exposures 4 by 5 inches in size.

The Fairchild Type W-7 Camera Machine Gun was designed especially for aerial machine gunnery training in any type of military airplane where fixed machine guns are used. Suitable for fixed in-

stallation only, on or in the airplane wing, it used a 16 mm. motion picture film in lengths sufficient for approximately 700 shots or exposures, and was operated electrically by means of a trigger switch on the airplane control stick.

The Fairchild F-58 Aerial Roll Film Contact Printer was a sturdy, compact contact printer suitable for fixed base or mobile photographic laboratories. It employed a multiplicity of low-wattage argon-filled lamps for illumination affording advantages of extremely even light distribution, low electric power consumption, faster printing and longer service life. Provision was made for continuous printing from uncut rolls of aerial film up to 200 feet in length.

The Fairchild Unit 241 Portable Flight Laboratory was designed for installation in any type of military airplane. It was a compact unit with all the necessary equipment for developing and printing 5 by 7 inch aerial cut film or plates while in flight.

Federal Metal Hose Corporation, Buffalo, N. Y., manufactured a complete line of flexible metallic hose and tubing known as "Interlock" type.

The Fuel Development Corporation, New York, N. Y., manufactured an anti-knock and carburetor de-icing fluid known as Anilol, and automatic metering equipment. The fluid was in two formulae; No. 4 for direct mixing with gasoline, used principally for racing purposes, and No. 3 used with the metering valve for automatically raising the octane value of the gasoline for take-off and for de-icing carburetors. Both formulae could be directly mixed with gasoline. No. 3 formula increased the octane value of gasoline from 90 to 95 by adding 6 per cent, or from 87 to 95, by the addition of 8 per cent. This was automatically metered into the air scoop of an engine through a patented metering valve controlled by the manifold pressure, or manually for emergency operations. The valve so controlled the flow of Anilol that the quantity was increased with the output of the engine, without attention from the pilot. The system was valuable in single motor operation of bi-motored aircraft through its ability to stabilize engine temperatures and permit operation through icing conditions without the use of carburetor heat, thus increasing the single-engine and two-engine ceiling of the ship. Anilol was an instantaneous carburetor decicer and was widely used because of that and its anti-knock properties.

The General Electric Company, Inc., Schenectady, N. Y., continued its development work on superchargers, at the same time continuing with manufacture, with particular attention to turbo superchargers for high altitude performance. A supercharger control was developed and put on a production basis. Cabin superchargers were supplied for production airplanes, and new development work pointed toward manu-

facture of cabin superchargers capable of maintaining 8,000 to 10,000 ft. cabin altitudes at flight altitudes up to 40,000 ft. A complete cabin pressure control and air flow control was also developed. General Electric was also active in various developmental programs involving the use of electrically controlled equipment.

The B. F. Goodrich Company, Akron, O., continued development of De-Icers, and aircraft wheels, brakes, tires and accessories. Goodrich De-Icers and Expander Tube brakes were used on aircraft as original equipment, with De-Icers considered as an integral part of aircraft design. Close coordination between Goodrich De-Icer engineers and aircraft designers resulted in joint efforts toward first eliminating or minimizing ice hazards on aircraft in the design stage, and then protecting the remaining exposed surfaces with the most efficient installations possible. A new rubber-like surfacing material for De-Icers was developed which, laboratory tests indicated, would have considerably longer service life and improved surface characteristics.

The greater use of slow turning, large diameter propellers increased the difficulty of removing propeller ice. The standard anti-freeze fluid dispensing systems did not adequately spread the fluid along the leading edges of the longer blades and the decreased propeller speed reduced the centrifugal force available to dislodge the ice. The problem became so acute that Goodrich developed an auxiliary device consisting of a special grooved rubber "shoe" bonded to the leading edges of each blade to direct the flow of fluid so as to remove all dangerous propeller ice formations. An extensive research program was launched in 1939 with the Daniel F. Guggenheim Airship Institute to compile quantitative data on the problem of ice in aviation. Its goal was the exact determination of where ice began to form on various types of airfoils in various flight attitudes and meteorological conditions, and the types and forms of De-Icers best suited to provide adequate protection. That program augmented the firm's continuing research in its own refrigerated wind tunnel. This tunnel continued to be available for the entire aircraft accessory industry for special test purposes.

Mechanically, De-Icer installations were improved in 1939 with the development of a snap-action distributor valve in the inflating system which, while retaining the 40-second operating cycle, cut the duration of inflation in each De-Icer cell from eight to four seconds. The improvement, lengthening the dormant period for each cell, not only removed ice more effectively but also resulted in less disturbance to the air flow over the wing, tests showed.

The Goodrich Expander Tube brake was further adapted for large wheel assemblies with the development of a dual-duplex arrangement

in an adaptation of the brake's design advantages which permitted expanded braking capacity by merely increasing the number of brake units. Increased brake loadings created a need for improved brake drum material, with the result that a high carbon, relatively non-shrinking and non-warping cast iron brake drum alloy was created and tested extensively in the Goodrich aircraft brake research laboratory.

The inertia brake testing machine designed by Goodrich was adopted generally. Larger models of the machine accommodated the largest anticipated wheel, brake and tire assemblies and as such promised to contribute to the safe performance of future aircraft. The trend toward higher landing and take-off speeds was reflected in the use by Goodrich of high density cord in the construction of its aircraft tires, as well as further refinements in the Goodrich heat-resisting tubes. The high-density cord provided greater bruise resistance in carcass construction. To eliminate undue servicing requirements of very small pneumatic tail-wheel tires, Goodrich developed a new tire which was constructed of highly resilient rubber cushioning stock which replaced air and eliminated the need for inflation.

Years of research in developing tires to withstand gruelling conditions in aircraft service changed the technique of tire testing. A huge testing device, 90 feet high in the Akron research laboratories, and created to simulate the bruises and impacts aircraft tires take under all service conditions, was used to strengthen the tires for all uses. The device, called the "tire guillotine," was designed by Goodrich engineers to supplement the usual program of tire testing and provided accurate means of determining the bruise-resistance of casings. A blunt-nosed metal hammer, sliding on dual rails in the towering shaft, was dropped at high speeds directly on the tread of an inflated and mounted tire affixed to an axle held in position below. Tires were pounded to destruction and a measure was obtained of the actual strength and breaking point of the carcass as well as strength resistance to bruises and sudden, severe impacts such as might be encountered on airport runways.

The "guillotine" was dropped from various heights, starting from a minimum height which did not cause failure from bruising. After each impact the tire was rotated slightly and the drop distance increased until failure occurred with the bruise resistance of the casing gauged by the momentum of the carriage weight at the moment of the impact which caused the carcass to fail. The ability of aircraft tires to withstand the fatigue of constant flexing and shock landings was determined on a machine which simulated landings and take-offs on a 15-ton flywheel revolving at 62 m.p.h. Another important test of aircraft tire strength was a hydrostatic inflation test, in which the tires



AL WILLIAMS AND HIS STINSON

The manager of Gulf Oil Company's aviation department in his Lycoming-powered Stinson 105, one of the machines he uses in sales work.

were inflated with water to a pressure many times their rated capacity, to determine their bursting point.

The Gulf Oil Corporation's Aviation Department, under the direction of Major Al Williams, continued to expand its activities during the year.

A new plane was added to Gulf's fleet of six. It is a Stinson 105. It is being used by Major Williams as an executive plane, in connection with his travels about Gulf territory. Each of Gulf's five pilots in the field flies a Stinson Reliant. Gulf again renewed its gasoline and oil contracts with air lines and official agencies.

The Hamilton Standard Propellers Division of United Aircraft Corporation, East Hartford, Conn., required additional production capacity. After the consolidation of Chance Vought Aircraft and Sikorsky Aircraft into a single division at Stratford, Conn., Chance Vought's former plant and office building in East Hartford was enlarged and remodeled for Hamilton Standard Propellers.

The demand for Hamilton Standard Hydromatic Quick-Feathering Propellers on multi-engine American-built planes was so great that early in 1940 still further floor space was provided. The greater part of Hamilton Standard's increased production capacity was not, however, gained through additional floor space. Increased production made it practical to replace a number of general purpose machines with semi-automatic special machines that were capable of a much higher rate of production. One new machine often replaced several of the older type, thus releasing the floor space for other purposes. Hamilton Standard Hydromatic Quick-Feathering propellers were in general use on air liners and in military service. Service experience showed that this type of propeller was superior to the older Hamilton Standard controllable and constant speed propellers from the standpoint of maintenance and overhaul costs.

Until the latter part of 1939, the Hydromatic Quick-Feathering Propeller (described in the 21st Annual Edition of this Year Book) was available only in a three-bladed, 50 spline, hub size. 1940 found this propeller available in sizes ranging from the No. 30 spline, two-blade size to the No. 50 and No. 60 spline, three-blade and four-blade size. Diameters ranged from a minimum of about 8 ft. to a maximum of approximately 18 ft. Thus, in addition to the constant speed propellers which cover an approximate range of 180 h.p. to 1,200 h.p., Hamilton Standard Hydromatic Quick-Feathering Propellers were available for engines ranging from approximately 400 h.p. to 2,500 h.p. Because engines with No. 50 spline propeller shafts covered a broad range of horsepowers, it was decided to supplement the present 23E50 three-blade propeller (which was designed for the largest of those engines) with a new three-blade hub design, the 33D50. This propeller had a general application on the lower horsepower half of this group of engines and offered a great savings in weight over previous installations of that type.

The adaptation of the Hydromatic propeller design to single-engine, high-speed aircraft came about naturally. Minor changes in the internal mechanism of the propeller and the constant speed control permitted the rate of pitch change of the blades, during constant speed operation, to be increased to any desired speed of operation. This feature, combined with the large angle range of the Hydromatic type of propeller, permitted the pilots of highly maneuverable planes to operate the propeller at all times as an automatic constant speed propeller without the danger of overspeeding the engine in high-speed dives. This permitted the pilot to devote most of his attention to other duties.

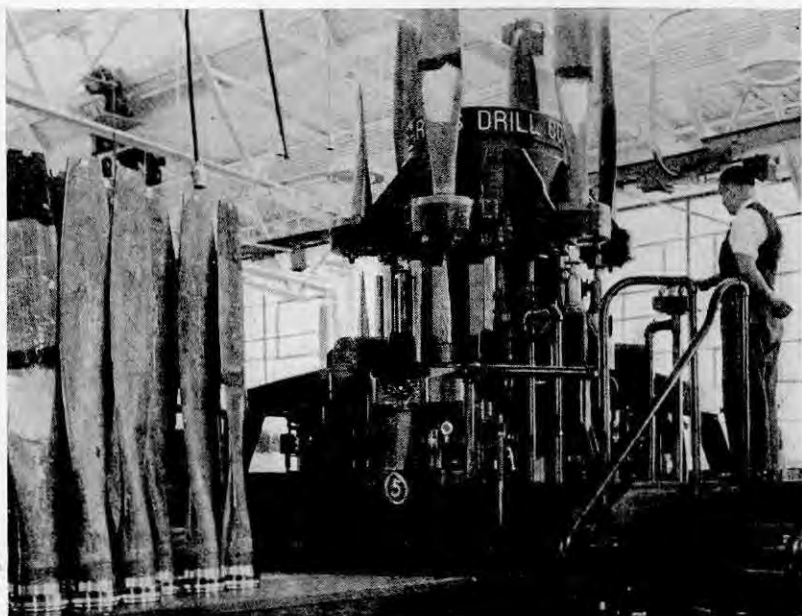
During 1939, Hamilton Standard Propellers began testing a new

type of molded shank fairing. Because this fairing (blade cuff) could be molded to any desired shape, it was possible to carry the true airfoil section and pitch distribution of the blade in much closer to the center of the propeller than was possible with the conventional type of metal cuff. The blade fairing was molded firmly in place and became an integral part of the blade, protecting the inner portion of the metal blades from nicks or surface damage. It was anticipated that little or no maintenance would be required for the fairings.

Four soundproof test houses were constructed, two of which were capable of swinging 24 ft. propellers. The horizontal intake and exhaust stacks assured a straight line airflow of exceptional smoothness. That was particularly important in conducting stress measurements as the conditions approached those of the actual airplane much more closely than those of any similar test house heretofore constructed. Due to the high altitudes at which modern planes fly, several operating mechanisms are subjected to extremely low temperatures. Although the winter operations of various air lines in the United States and Canada had already offered service proof of the ability of the Hydro-matic propeller to operate under extreme weather conditions, a cold room was constructed in which propeller hubs and accessories were run and tested under controlled conditions at temperatures as low as 50 degrees below zero.

Extensive research work on blade materials resulted in a new aluminum alloy. While possessing all the advantages of the former aluminum alloy blade its increased hardness and greater strength gave it a greater resistance to erosion and increased useful life, as well as allowing a considerable reduction in propeller weights without reducing safety.

The new method of vibration stress measurement perfected by Hamilton Standard Propellers, by which the stresses at any point in the propeller were accurately determined either on the ground or during actual flight, led to creation of a special section in the engineering department to conduct that work. As a result of continual testing made on production and experimental types of propellers, changes in design leading to increased efficiency and reduced weight were made with the knowledge that the stresses involved did not exceed safe operating limits. Through close cooperation with the engine manufacturers it was possible in many cases to eliminate, and in others to compensate for, the source of the exciting forces that caused the propeller vibration. The trend toward higher power engines, high flight altitudes, and increased maximum speeds necessitated a well-rounded program of propeller research engineering to maintain high



FOR HAMILTON STANDARD PROPELLERS

One of the new semi-automatic high production machines, a blade borer and reamer, at the Hamilton Standard Propellers plant.

propeller efficiencies under new conditions. As a result of these studies a number of projected designs were developed and tested.

Hayes Industries, Inc., Jackson, Mich., developed a brake known as the reversible hydraulic brake and further developed the expander tube brake. The reversible hydraulic brake was primarily developed for naval aircraft operating from the deck of aircraft carriers, and was so designed that it would hold equally going in either forward or reverse direction. The brakes were made symmetrical, and the only thing that determined whether the brake was for the right or left hand side was the position of the red and black springs. These springs had a different tension. The brake was also so designed that the amount of Servo could readily be changed to accommodate the brake for various weights and types of aircraft. The reversible hydraulic brake was supplied for high pressure, low pressure, streamline and smooth contour wheels.

The expander tube brake was made under Goodrich-Palmer patents and was constructed of special alloy steel stampings. The brake

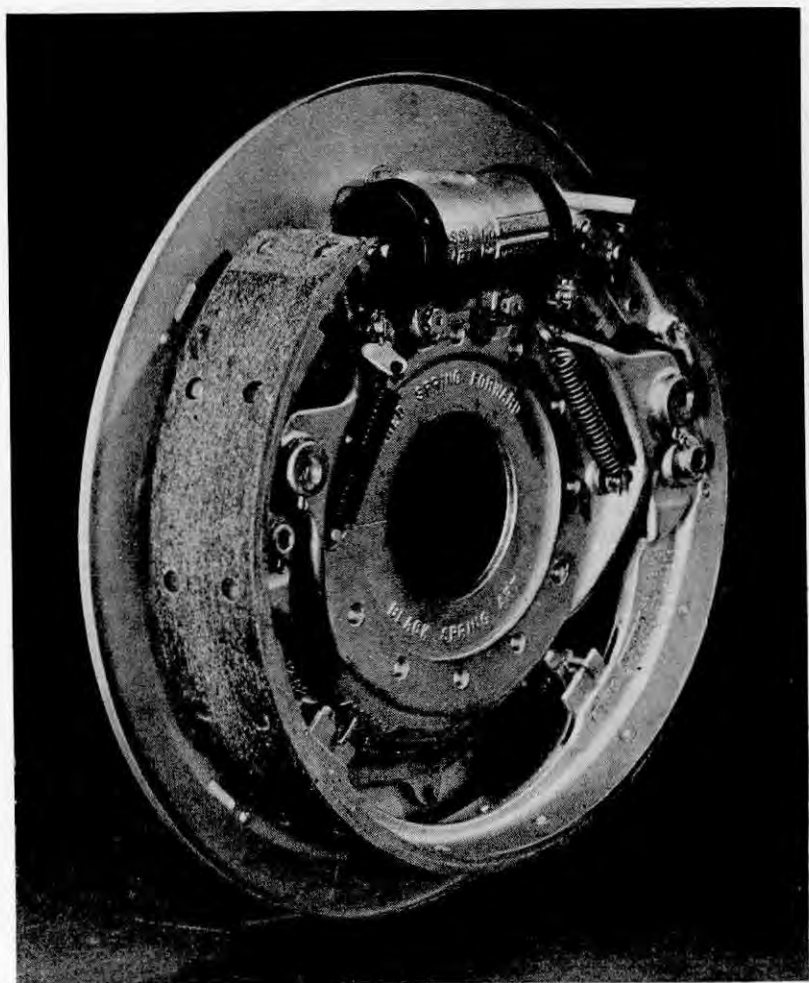
was operated either by brake fluid, Servo oil, or air. There was no tendency to grab. The torque developed by the brake was directly proportioned to the pressure applied. The construction of the brake was described as:

"A continuous rubber expander tube approximately $\frac{1}{4}$ in. thick is located on the outer face of the steel stampings. The brake blocks rest on the expander tube and are held in place by springs through slots across the end of the block. The springs project through holes in the frame. Their function is to hold the blocks in against the expander tube, and to release the brake when the pressure is released. The blocks are held from rotating by the lugs formed in the steel stamping. Inflation of the expander tube by air or fluid forces the blocks out against the drum. Because individual blocks are used, eccentricity of the brake drum does not cause a variation in the brake torque." The brake sizes were from 5 in. in diameter and 1 in. in width to 20 in. in diameter and $5\frac{1}{2}$ in. in width.

The International Flare-Signal Division of the Kilgore Manufacturing Company, Tipp City, O., continued supplying its parachute flares and signals to commercial aviation, the U. S. Government and foreign governments. This equipment, which includes both electrically and pistol operated types, affords outstanding advantages in flexibility of installation and operation, safety and dependability.

Flares for emergency illumination from aircraft have been a major development of International during the past decade. The earlier flares were merely large "candles", wired for electrical ignition and affixed to brackets mounted under the lower wings toward the tips, from which their name "wing tip flares" was derived. Such installations obviously involved abnormal fire hazards, and the illuminative properties were unavoidably so limited that a plane had to descend to a low altitude for effective observation of the ground, thereby greatly reducing the area of illumination and seriously impairing the scope of maneuverability, and consequently the chances for a successful forced landing.

With increasing night flying operations it quickly became apparent that the "wing tip flares" were not only dangerous but extremely inadequate, and also that a suspended source of light effective from relatively high altitudes and independent of the plane, beneath which the pilot, if flight conditions permitted, could maneuver at will over a relatively large illuminated area, was an essential requirement. Parachute flares were of course known, but they had been designed primarily for military purposes, and the requirements of commercial aviation presented entirely different problems of installation, maintenance and operation.



THE HAYES WHEEL BRAKE

The reversible hydraulic brake, manufactured by Hayes Industries Corp., Jackson, Mich., for various sizes of high pressure, low pressure, streamline and smooth contour wheels.

The smallest approved parachute flare is required to burn not less than one minute and develop more than 70,000 candlepower. Next comes a 1½-minute parachute flare with a minimum requirement of 110,000 candlepower. The largest approved parachute flare commercially available is the 3-minute, which must develop more than 200,000

candlepower. All these parachute flares are required to have an average rate of descent of not more than 550 feet per minute.

Walter Kidde and Company, New York, N. Y., supplied carbon dioxide systems for extinguishing airplane motor fires, other pressure gas devices for aircraft, and developed carbon dioxide fire trucks for airports. The most notable of these trucks was built for LaGuardia Field, New York's municipal airport. It had a 1,000 lb. gas capacity and was equipped with large hose-reels and discharge horns for blanketing airplane fires. These units also carried portable carbon dioxide extinguishers and water extinguishers, and were equipped with winches and grappling hooks for removing planes from danger areas, and for salvage work. Carbon dioxide equipment was used extensively as a system of fire extinguishing for private planes. Improvements provided greater simplicity of installation on liquid-cooled as well as aircooled engines. The equipment weighed slightly over 15 lbs. completely charged, and could be installed in a few hours. It entitled the owner to a substantial discount on fire insurance rates. Other equipment manufactured by the Kidde firm included life vests, flotation gear on naval planes operating from aircraft carriers, and emergency life rafts. The latter, which demonstrated their value and practicability in the European war, were inflated in 4 to 8 seconds with a charge of carbon dioxide contained in a small steel cylinder attached to the rubberized raft. A quick-opening, non-freezing valve made this rapid inflation possible.

The Kollsman Instrument Company, Inc., Elmhurst, N. Y., in 1939 became the Kollsman Instrument division of the Square D Company. Employees increased to 450. The Telegon equipment was produced in large quantities to meet the need for a light weight explosion proof remote indicating system.

Kollsman's Direction Indicator, an adaptation of the vertical dial Direction Indicator (magnetic compass), employed a horizontal dial graduated in 1 degree divisions with a pointer and an adjustable reference index. The reference index, consisting of cooperating parallel lines, could be set to any desired heading by turning the knob. A new Electric Tachometer Generator, type 548G, running at one-half engine speed, was bolted to a square pad on the engine crank case as accessory drive unit. A square drive shaft provided a sturdy means for driving the generator, and a positive oil seal prevented oil from leaking out of the engine. The generator was available (as type 588G) for engine Tachometer drives at engine speed.

A specially designed Fuel Quantity Gage was adapted to the Kollsman Telegon Remote Indicating System. The gage was strictly a weighing mechanism, not hydrostatic and, therefore, required no aux-

iliary hand pump. The actuating mechanism was isolated from direct contact with gasoline and the fuel chamber was so constructed as to make leakage impossible. The mechanism was highly damped to eliminate pointer oscillation when rough air sloshed the gasoline and changed the head that was being weighed. The complete transmitter, including the Telegon unit, weighed $1\frac{1}{2}$ lbs. Kollsman's Cartridge Type Manifold Pressure Gage, which employed a mechanism sealed in a vacuum chamber, protecting the precision parts against fumes, gasoline and oil, was modified to provide a zero setting adjustment. A screw, visible when the fitting was removed, returned the pointer to



COSTLY PRECISION WORK

This half-pint of Kollsman altimeter pinions with only 80 cents worth of steel represents 800 hours of precision work accurate to .0001 inch. Each pinion required 24 operations using 11 different machines.

its proper zero position if secular changes in the diaphragm caused an error in indication. Kollsman's new Pitot Tube, type 569, while developed for pressure cabin planes, was also applicable to other airplanes.

The Leece-Neville Company, Cleveland, O., supplied the industry with 12 volt voltage regulated engine driven generators made in three capacities, 15 amperes, 25 amperes and 50 amperes. The Leece-Neville voltage regulators protect the storage batteries from overcharge as they permit the generators to charge only at the correct rate for the state of charge that the battery is in. This greatly prolongs the life of the storage battery, as when the battery is in a state

of full charge the current delivered by the generator will be very low.

Librascope, Inc., Burbank, Calif., introduced the Librascope Flight Computer, an instrument giving mechanical computation of a flight plan, prior to take-off or at any point during the flight. It combines in one mathematical computation all flight variables, eliminating calculations by operations departments or pilots. Time for computing a flight plan is reduced to less than one minute, the makers claimed. The instrument consists of pointer knobs and recording dials, mounted on a panel, in a convenient carrying case. As the pointer knobs are set to correspond with weather conditions and other factors, the dials move a mathematically predetermined distance, to show total distance in miles, true course ground speed, drift angle in degrees, indicated air speed, total fuel consumption, manifold pressure required, engine B. M. E. P. Factors integrated in the computation include wind velocity, wind direction, true course of flight, gross weight, time elapsed, pressure altitude, free air temperature, horsepower and engine R.P.M.

Lights, Incorporated, Alhambra, Calif., working with Pan American Airways and the C.A.A. developed a system of lights which made possible safe night landings on water. Success of this equipment brought it to the attention of the U. S. Navy and it was adopted in modified form by the Coast Guard. The Aeroland system of lighting, used by the Air Corps, was released for private, commercial and air line use. The company also manufactured permanent aviation lighting equipment, including beacons, boundary lights, floodlights, illuminated wind tee and air traffic control projectors.

The Liquidometer Corporation, Long Island City, N. Y., supplied fuel and oil quantity gauges for use on Air Corps, Navy and commercial aircraft. The Liquidometer Dial Change and Selector Switch Combination Unit which provided in one unit separate dials for a number of tanks any of which could be read at will by turning the knob of a built-in selector switch, was used on many new type airplanes. There was also an increase in the use of tank units incorporating built-in switches for use in connection with warning of low fuel level. Improvements were made in its line of Electric Gauges for indicating manifold, fuel or oil pressures. The company also made units for indicating the position of flaps, wheels and tabs. Besides electrical instruments, the company manufactured the Liquidometer Hydraulic Transmission Type Fuel and Oil Quantity Gauge.

Link Aviation Devices, Inc., Newark, N. J., more than doubled factory facilities, and trebled production to fill orders for Link Trainers for instrument flight training.

Macwhyte Company, Kenosha, Wis., developed special hoisting

slings, to be built into aircraft by the manufacturers and used for lifting by a crane. Some of the special slings were made with swaged cable terminals and special fittings. Grommet construction and braided wire rope slings also were made, all slings and fittings of corrosion resisting alloys. Swaged cable terminals were made in stainless steel eye end, fork end, stud end, and turnbuckle end types. "Spike" antennas of tapered corrosion resisting steels were developed for mounting on underside of the fuselage to reduce static and improve radio communications.

Macwhyte tie rods for internal and external bracing were produced from corrosion resisting alloys. Macwhyte "Hi-Fatigue" aircraft cables were made from galvanized, tinned and stainless steel, fabricated to reduce constructional stretch and increase fatigue resisting properties.

Moore-Eastwood & Company, Dayton, O., manufactured tools, dies, jigs and airplane parts for the military services and aircraft manufacturers in the United States and abroad. Among the manufactured articles are bomb racks, bomb shackles, gun mount adapters, gun sights and sighting members.

Norma-Hoffmann Bearings Corporation, Stamford, Conn., extended its lines of precision ball, roller and thrust bearings, adapted for practically every load, speed and duty. In the aviation division, new types and sizes of sealed aircraft control ball bearings, designed to meet special requirements for control applications, were added to the line of aircraft bearings. They included single- and double-row, shielded and unshielded, as well as enclosed felt seal bearings with removable seals. For conditions involving possible misalignment, a new series of self-aligning felt seal bearings with removable seals was developed.

Northwest Air Service, Inc., Seattle, Wash., developed a propeller pitch setter, a machine to align blades by mechanical methods rather than by manual labor, requiring only 20 minutes to do the same work that formerly took three men an hour.

Parker Appliance Company, Cleveland, O., produced seamless tubular plumbing for aircraft with Parker tube couplings. To overcome the tendency of threaded aluminum alloy parts to seize when assembled, Parker developed a number of thread compounds, thread seals and valve lubricants. The company also produced a line of fabricating tools.

Pioneer Instrument Division of Bendix Aviation Corporation, Bendix, N. J., completed its 20th year of service and housed its facilities in a new plant, especially designed for the production of aircraft equipment. A well-lighted production floor with manufacturing tools

scientifically placed; an air conditioned assembly and inspection room with walls of glass, modern drafting rooms, a departmental laboratory, modern offices, and a non-magnetic structure housing a natural field laboratory, were new features. Pioneer developed a new vapor-sealed manifold pressure gauge. The new Pioneer micrometer dial feature was used with a single pointer making a complete rotation for 10 in. of mercury change in pressure. An under-dial indicated the tens of inches with large figures visible through a cutout in the lower sector of the dial. Pioneer also developed a new Mercurial Barometer to give the extremely accurate pressure readings required in the calibration of sensitive altimeters. Precision bored glass tubing, a size of tube selected for the most readable meniscus, a powerful and extremely accurate optical reading system and a heat controlled cabinet were among the Pioneer refinements that combined to make the instrument complete. Another Pioneer presentation was a new sensitive remote tachometer and synchronizer indicator, accurate to 10 r.p.m. made readable by the Pioneer micrometer dial which utilized an underdial instead of the usual second pointer, thus obviating the possibility of confusion with other sensitive instruments. The Pioneer generator had a novel shaft construction that included a free-floating center and a flexible coupling designed to withstand any acceleration or deceleration possible with an aircraft engine drive.

Pioneer developed a revised Autosyn System. The new "Miniature" Autosyns system was about 40 per cent lighter and smaller than the earlier units. Pioneer also announced a direct current autosyn wheel and flap position indicating system. A multiple indicator combined the indication of these important functions on one dial and a radically new dial layout provided easy reading. Pioneer introduced a new airspeed mechanism of small size so constructed that standard etched dials might be used for all instruments. Developments in the technique of diaphragm construction and the introduction of a radically different airspeed mechanism permitted the use of a standard dial for all airspeed indicators. With this new construction, Pioneer was able to cut the depth of the instrument behind the panel by one half.

RCA Manufacturing Company, Inc., Camden, N. J., manufacturing subsidiary of Radio Corporation of America, through its aviation radio section, continued to develop light-weight aircraft equipment. A new addition to the RCA line was the AVR-20 Aircraft Communication Receiver, with frequency range of 2,300 to 6,700 kcs. and provision for crystal control of two frequencies. It was equipped with a beat oscillator for reception of the CW signals, and was a companion receiver to AVR-15 Radiobeacon and Weather Broadcast Receiver.

The RCA AVT-15 light-weight aircraft transmitter was a single

unit transmitter incorporating a built-in vibrator power supply with hermetically sealed vibrator, conservatively rated at 7.5 watts output. The power unit was designed to provide power for one or two AVR-15 or AVR-20 aircraft receivers or a combination of one of each. The AVT-15 Transmitter included the Model AVA-41 Antenna System. This was the most efficient and convenient known method of ejecting and retracting a resonant trailing wire antenna, and was available as a separate item for use with any aircraft transmitter.

RCA also introduced AVA-51B and 51C vibrator power units designed to supply high voltage to either two AVR-15's or AVR-20's or a combination of one of each. In addition to supplying receivers manufactured by the RCA, these power units could replace existing batteries used on other equipment, thus affording complete operation from a single 6 or 12 volt storage battery. A new general purpose receiver, the AVR-7H, also was introduced. It was a 3 band receiver covering the radio range and weather broadcast band of 190 to 420 kcs., the entertainment band of 495 to 1400 kcs. and the communication band of 2,300 to 6,700 kcs. Crystal control of two pre-selected frequencies in the communication range was provided. A CW beat oscillator was also included with automatic volume control on the broadcast and communications bands. It was fully remote controlled, permitting flexible installation. Provision was made for the addition of an aural-null direction finder, RCA Model AVA-56, which was to be available in 1940. The Model AVR-15 radio range and weather broadcast receiver continued to be the standard for this type of light-weight equipment.

RCA aviation transmitting equipment comprised the AVT-15 and 15A light-weight, single unit, 7.5 watt transmitters; the AVT-7B 15 watt, one-channel, two-frequency transmitter; and the AVT-12B 50 watt, two-channel, four-frequency transmitter. This line of receivers and transmitters was available as stock merchandise. The AVR-8D and 8E Aircraft Radio compasses continued in the RCA line.

John A. Roebling's Sons Company, Trenton, N. J., developed the Jacoel Cable Splicer for practical and rapid execution of splices on cables of any kind used on modern aircraft construction. The principal feature was the removability of the jaws. There was a pair of jaws corresponding to every size of cable. They matched the form of the thimble, thus assuring a better grade of workmanship. An extra pair of adjustable jaws was provided for splicing cables of various sizes around bushings, spacers or fittings. They also held undersize or oversize thimbles. The Jacoel Cable Splicer held cables from $\frac{1}{16}$ to $\frac{5}{16}$ in. diameter of cable.

Scintilla Magneto Division of Bendix Aviation Corporation, Sid-

ney, N. Y., supplied Bendix-Scintilla magnetos for all classes of aircraft engines. Of special note was a radio shielded magneto for light plane engines which was widely used on sport planes. Bendix-Scintilla radio shielded ignition harness, a new product, was placed on the market, but it was initially supplied only to engine manufacturers as original equipment. Bendix-Aviation Spark Plugs, shielded and unshielded, were manufactured in large quantities for numerous engine requirements.

Shell Petroleum Corporation, St. Louis, Mo., under Major James H. Doolittle, handled a considerably increased amount of aviation business. Noteworthy trends were greater use of higher octane gasolines, 80, 87, 90, and 100. As in previous years, a great deal of time was devoted to research work, both in the laboratories and in service tests. Active assistance was rendered to the work of the Aviation Fuels Division of the CFR Committee; notably in the study and development of new laboratory detonation test methods and in the correlation of test results with other engine and fuel manufacturers; in the study of fuel tank corrosion; of the piston ring-sticking tendencies of aircraft oils; of vapor lock problems in aviation engines; and of the extension of octane ratings beyond 100. One result of previous research work was the development of a new range of straight mineral aircraft oils, Aero Shell 62, 80, 100, 120, and 140, which were introduced. Present indications are that the stability of the new oils is an outstanding characteristic. A further branch of research work that has lately proved of great interest concerns the development of "Safety Fuels."

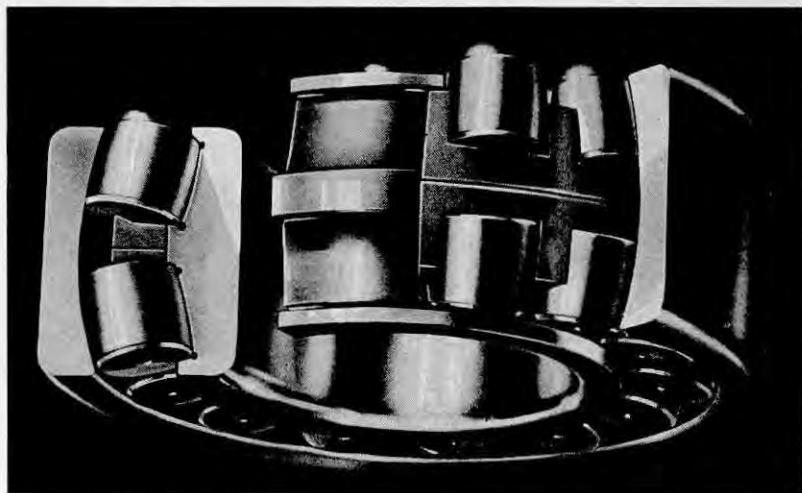
Laboratory research work was materially assisted by actual performance tests carried out in the Shell Modified P-35 Pursuit Plane, powered by a 1,000 h.p. Wright Cyclone. This plane was equipped with special instruments for testing fuel and oil performance at high altitudes.

Simmonds Aerocessories, Inc., New York, N. Y., produced a line of accessories including controls, cowling clips and fasteners, navigation instruments, aircraft flooring and pipe couplings.

Sinclair Refining Company, New York, N. Y., marketed a full line of aircraft engine oils and lubricants, the most outstanding being Sinclair Pennsylvania Aircraft Oils, which had Wright Aeronautical and other engine builders' approval on the highest output engines in service. Sinclair Pennsylvania 120 GX Oil, especially developed for Wright Cyclones, was used on several air lines. Sinclair supplied lubricants to the Army Air Corps and all branches of the industry. Other Sinclair lubricants included Sinclair High Temperature Grease No. 955 for wheel bearings, rocker arms and accessory units where high

heat conditions prevailed, Sinclair Counter Weight Lubricant for counterbalance units, and Sinclair A F-3 and Sinclair O U G-3 for blade bushings and thrust bearings of propellers.

S K F Industries, Inc., Philadelphia, Pa., reported that mass production of aircraft and aircraft engines, various types of aircraft and airport auxiliary equipment, and accompanying retooling and standardization of methods led to a greater use of ball and roller bearings than in any previous year in aircraft history. Both regular and special types of antifriction bearings were used to meet the required high standards of reliability and maintenance. Modern, high-power engines, for instance, were equipped with high capacity cylindrical roller



S.K.F. CYLINDRICAL ROLLER BEARING

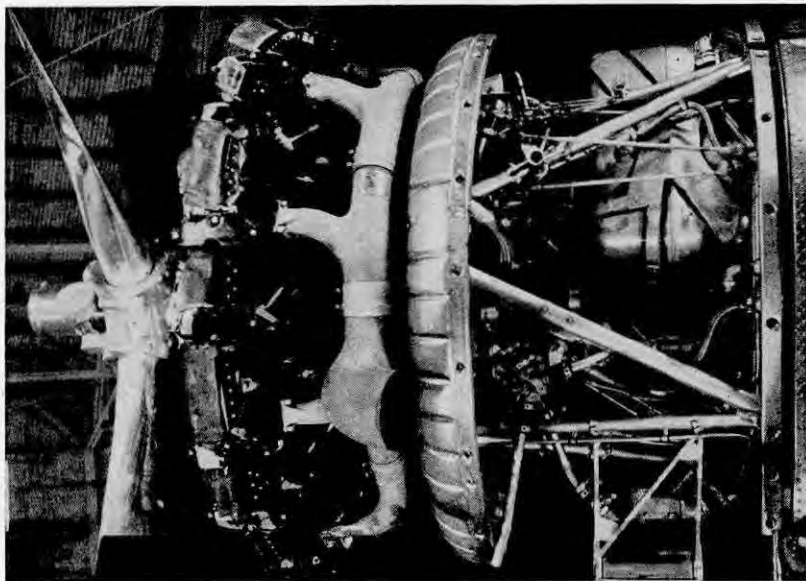
A recent development for high-powered aircraft engines.

bearings. The S K F Red Seal bearing was introduced to provide a lighter and narrower standard felt seal bearing for the aircraft industry.

Investigations were started by S K F to further develop the AN standard bearing to meet new temperature variations concurrent with stratosphere flying. The S K F Double-Row Cylindrical Roller Bearing was widely accepted by machine tool manufacturers for aircraft production machinery, and self-aligning Spherical Roller bearings were generally used for heavy load applications. With these bearings for specific application, in addition to a complete line of standard ball

and roller bearings, a complete bearing service was available for countless aeronautical accessories and parts.

Socony-Vacuum Oil Company, Inc., New York, N. Y., sold its aviation products to air lines, Government aviation services, aircraft engine builders and private plane operators. Products included Aero Mobilgas (in grades ranging from 73 to 100 octane) and meeting all requirements, Aero Mobiloil in the various grades required for all aircraft engines, and aviation specialty products, such as Mobiloil SS, Aircraft Compass Fluid, Aircraft Instrument Oil and Mobilgrease.



SOLAR INSTALLATION

Installation of the Solar corrosion-resistant exhaust manifold, manufactured by Solar Aircraft Co., San Diego, Calif.

Gargoyle Aircraft Hydraulic Fluid was developed to meet the specialized needs of the aircraft industry for operation of hydraulically controlled mechanisms which were used in the latest planes. This product satisfied the requirements of many different mechanisms at wide variations of temperature. Gargoyle Speed Reducer Oil No. 2 was developed.

Solar Aircraft Company, San Diego, Calif., designers and producers of exhaust manifold installations, increased plant and facilities approximately 100 per cent in 1939, and produced over 3,000 mani-

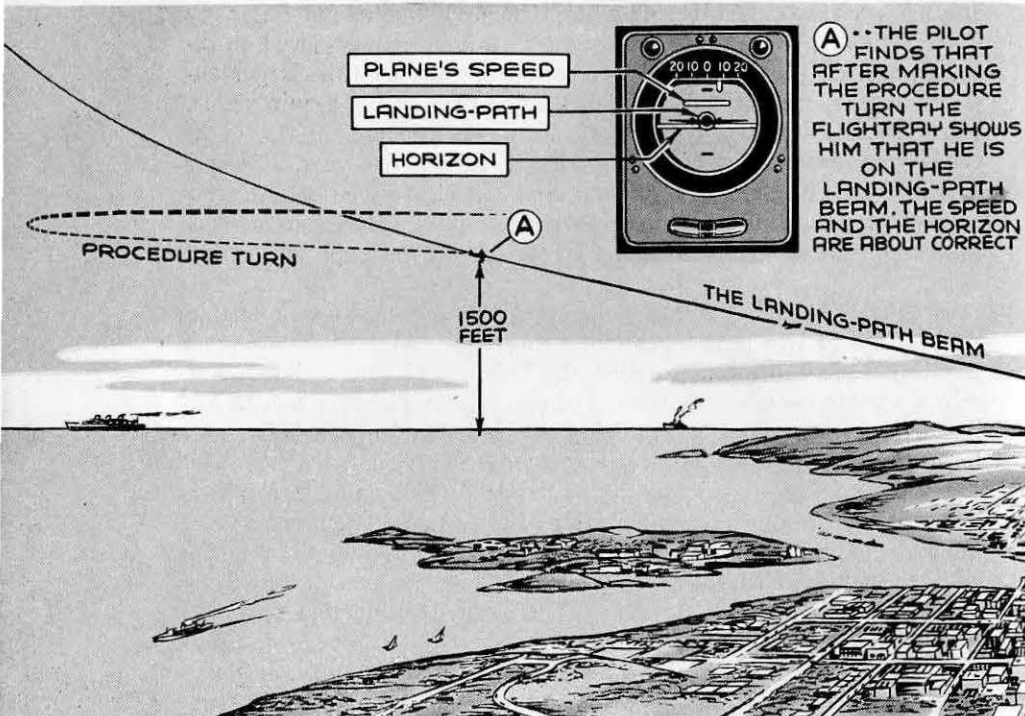
folds of varying design for every type of large engine and for every large airplane plant in the United States. Emphasis was placed on research and design to meet the problems introduced by the larger engines, new types of mountings, new heating and cooling requirements. Research facilities were expanded, and much information was gathered from experimental units produced during the year. Greater emphasis was placed on production methods, closer tolerances, better control of processing, and improved methods of inspection to meet the responsibility involved in the larger production expected during 1940.

Considerable study and thought was given to aircraft cabin heating problems, and two new types of heating equipment were developed and test flight information gathered. This equipment, designated as Airmax equipment, was composed of two types. The first was an exhaust heat recovery system utilizing a new type of finned boiler and high steam pressures. Several heaters of that type were installed. Design flexibility, making the same standard parts suitable for both small and large ships, was a feature of the system. The second type, known as the Central Heating System, was a gasoline-fired boiler equipped with safety devices to prevent accidental fires. It was demonstrated to the Army and Navy, and was in production for both branches of the service. The system permitted cabin temperatures to be maintained independently of the operation of the engine, and was suited for very large ships in which it was necessary to provide comfortable living quarters for the personnel, both in flight and on the ground or water.

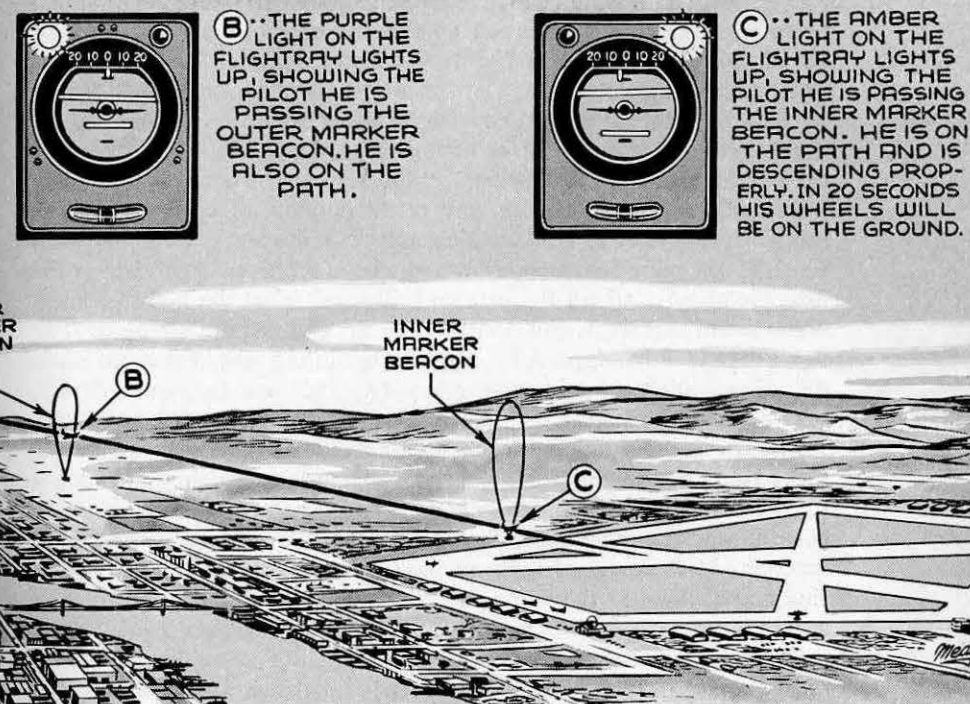
Sperry Gyroscope Company, Inc., Brooklyn, N. Y., early in 1940 announced its Flightray, an important new instrument in the development of "blind flying." The Flightray combined on a single dial face the indications of all the necessary flight instruments. In other words, the Flightray was a multiple indicator combining the readings of the Gyro-horizon, directional gyro, air speed indicator, rate of climb indicator and the radio landing path.

The Sperry Flightray was developed after four years of research and experiment by Chief Engineer Preston R. Bassett and Joseph Lyman, a senior project engineer. It was described as follows:

The Flightray is a cathode ray multiple flight indicator. It simultaneously indicates to the pilot his position relative to the radio glide path, his heading by directional gyro, his altitude by artificial horizon and his airspeed. Conveniently grouped close to the main indicator and in the same mounting are signal lights for the inner and outer marker, and a ball bank indicator. The instrument on which the various indications are combined is the fluorescent screen of a 3-inch cathode



A...THE PILOT FINDS THAT AFTER MAKING THE PROCEDURE TURN THE FLIGHTRAY SHOWS HIM THAT HE IS ON THE LANDING-PATH BEAM. THE SPEED AND THE HORIZON ARE ABOUT CORRECT



B...THE PURPLE LIGHT ON THE FLIGHTRAY LIGHTS UP, SHOWING THE PILOT HE IS PASSING THE OUTER MARKER BEACON. HE IS ALSO ON THE PATH.

C...THE AMBER LIGHT ON THE FLIGHTRAY LIGHTS UP, SHOWING THE PILOT HE IS PASSING THE INNER MARKER BEACON. HE IS ON THE PATH AND IS DESCENDING PROPERLY. IN 20 SECONDS HIS WHEELS WILL BE ON THE GROUND.

OPERATION OF THE PERRY FLIGHTRAY.

ray tube. Patterns are drawn on this face by electrical deflection of an electron beam within the tube. Deflection voltages are obtained from electromagnetic pickups associated with each of the instruments. By means of a switching system these indications are placed on the screen in rapid sequence, at a speed well above the persistence of vision. Thus the complete pattern appears in a steady and flickerless manner, permitting the simultaneous observation of the major instruments used during course flying and landing.

Indications from the various instruments are shown on the face of the indicator in as natural a manner as possible. The horizon line extends across the instrument face moving in synchronism with the standard horizon. Directional gyro heading is shown by a vertical line moving left or right to indicate up to plus or minus 20-degree deviations from a selected course. Airspeed is indicated by a short horizontal bar moving up with increasing speed. This can be set to the desired

speed so that the line will be in the center of the screen at any selected cruising or landing speed.

Position of the real airplane on the radio glide path and localizer is shown by the relative position of a circle normally surrounding the fuselage of the miniature airplane. A position above and to the left of the glide path, for instance, is indicated by a position of the circle down and to the right. The reason for choosing this sensing is to have the miniature airplane flown by the pilot in reference to the glide path just as it is flown in reference to the artificial horizon. This arrangement has been found to be a natural one.

In order to derive the maximum usefulness from the Flightray it is planned to use it in route flying as well as landing. When used for route flying, with no need for the glide path and localizer indications, the indication of the circle moving in the vertical is retained, and transferred to the altimeter as a zero reader. The altimeter may then be set

to any desired cruising level, and as long as this altitude is maintained the circle will remain centered on the fuselage. Deviation from selected altitude will be shown by movement of the circle with respect to the miniature airplane.

The physical equipment consists of three separate parts. The first is the indicator itself which is mounted as nearly directly in front of the pilot as possible. In this connection it should be noted that another indicator can be mounted in front of the co-pilot. The second part is the flight and control panel, which may be mounted anywhere within reach of the pilot or the co-pilot, and which serves to cage and set the directional gyro, adjust the pattern brilliance, select the flight or landing position and set in any desired cruising altitude and airspeed. The third part is a standard ATR chassis containing amplifiers and commutation equipment with power supply. This can be mounted anywhere in the airplane.

In using the Flightray on a regular route through to an instrument landing, the entire flight picture, including cruising altitude, is presented to the pilot in a simple and readily interpreted pattern. As the landing is approached, the glide path intersection altitude, say 1,500 ft., is set into the Flightray altimeter, the ship brought to this altitude and flown to the outer marker, at which point the control box switch is set to "land." The glide path and localizer are then followed, using the same circle and using the same sensing as obtained in flight, until ground contact is established. It is thus seen to be unnecessary to transfer attention to a new set of instruments in order to effect a landing.

Sperry continued advance experimental and development work in the field of automatic flying. 1939 marked a quarter of a century of research and development in this field. While late models of the aircraft Gyropilot greatly resembled earlier ones in exterior appearance, a number of engineering changes were incorporated, to improve flying characteristics of the automatic pilot. The changes were primarily certain refinements in working parts.

As in former years, the Sperry Gyropilot was used extensively by leading commercial and military services throughout the world. The automatic direction finder, introduced in 1938 by Sperry, was placed in quantity production during 1939, and installations were made in airplanes of American Airlines, Braniff Airways, and Transcontinental and Western Air. When tuned to a station it continuously and automatically points to the station tuned. Thus the pilot is only required to glance at the pointer on the face of the instrument in order to get his bearings.

Sperry acquired a new twin-engine Lockheed airplane designed as

a flying laboratory, and it was used for flight research by the Sperry Engineering Department in connection with the company's broad program of research and development. Flight research was in no sense new to the Sperry Company. Various airplanes had been used in the past for experimental work and for development, including ships chartered from the air lines and other companies. In fact, since Lawrence Sperry's earliest airplane experiments, flight research has occupied an important role in the company's broad program of development. However, during 1940 the scope of the company's research program made it imperative that a twin-engine plane be made available for full time use.

The Sperry Lockheed "Air Lab" enabled Sperry engineers to work comfortably in back of the panel, thus allowing relatively quick installation of experimental apparatus and the completion of the all-important flight tests without delay. A separate compartment was provided with a desk and chair for one of the flight research engineers acting as flight recorder, so that performance of experimental equipment could be observed quickly and recorded easily, photographically if necessary, by a member of the crew whose only responsibility is this work. Special laboratory work benches were also built into the plane, similar to the standard research equipment available to engineers in the Sperry Laboratories. They made possible the quick transfer of new instruments from laboratory test to flight test. A complete inter-phone system connected the various crew positions, compartments and research stations, thus allowing easy communication by all on board. Special observation domes or cupolas were provided to test new gyroscopic navigation equipment.

Standard Oil Company of California, San Francisco, Calif., cooperated with Government services and the industry in research and development of high quality fuels and lubricants to meet exacting requirements. A complete line of fuels and lubricants under the brand "Stanavo" was available in the company's marketing area of six western States and Alaska and Hawaii. The products could be secured through any of the company's dealers at landing fields.

The Standard Oil Company of New Jersey, New York, N. Y., through its Esso Laboratories, was given the 1939 National Award for Chemical Engineering Achievement. This was the first time it was given in the oil industry. The award was made in recognition of Esso's advances in the development of super fuels for aircraft and other high powered engines. Esso Marketers supplied large quantities of 100 octane aviation gasoline to both the U. S. Army and Navy and continued to supply Pratt & Whitney Aircraft and Wright Aeronautical Corporation with their fuel requirements. United Air Lines,

which had used the products of Esso Marketers since its inception, signed a new long term contract early in 1940. Distribution of the new products was increased at leading airports.

Steel Products Engineering Co., Inc., Springfield, O., manufactured a line of segregators and other accessories for the industry.

Summerill Tubing Company, Bridgeport, Pa., continued to supply the industry with its line of accessories.

Superior Tube Company, Norristown, Pa., manufacturers of small tubing, produced many special tubes in various metals. Much of their product was under test. They were associated closely with the International Nickel Company in the production of Inconel, Nickel and Monel. Tubes of their own development were Welldrawn, a type available in stainless steels, as well as regular carbons; and Brawn Tubing, available in either Inconel or Monel.

The Texas Company, New York, continued to supply the Government, industry and other users of aircraft with its full line of Texaco aviation fuels, including gasoline, marfak grease and airplane oils in grades suitable for every engine and type of service. The company operated a fleet of planes, and was developing new products to meet the higher standard required by aircraft manufacturers. The technical and research laboratory at Beacon, N. Y., devotes considerable exclusive time to this end. As a result The Texas Company can meet demands for a high octane aviation gasoline.

The Texas Company in the meantime is not overlooking requirements of motors powering lighter aircraft, and in that respect recently had approved by manufacturers of small engines new motor oils in several grades. This meets the demand for a lower priced high quality product for the smaller airplane owner and operator.

Thompson Products, Inc., Cleveland, O., developed an aircraft engine fuel pump, adopted by the U. S. Army Air Corps. The new pump provided a non-pulsating, extremely even flow of fuel and minimized the possibility of vapor lock. Its mechanism included three blades which rotated in an odd-shaped bore. The blades acted in changed positions by centrifugal force. The special materials used in the manufacture of the pump were light in weight but long-wearing. The pump had a low horsepower drag. The company produced more than 400 different parts for planes and engines.

Titeflex Metal Hose Company, Newark, N. J. manufactured a complete line of shielding equipment and accessories for the aircraft industry. In addition to its principal product in this field, radio shielded ignition harnesses, Titeflex produced radio shielded spark plug elbows, shielding conduit and fittings, filter units, wiring manifolds, and terminal and junction boxes. Titeflex also supplied its well

known flexible pressure tubing for fuel and oil lines, instrument lines, and hydraulically controlled devices.

Titeflex also developed a detachable type spark plug lead which is adaptable to conventional radio shielded ignition harnesses. The use of a spark plug lead of this type permits the removal of any individual unserviceable assembly without disturbing the ignition cable contained in the wiring manifold. A detachable spark plug lead is especially desirable where the ignition cable must be conducted adjacent to exhaust manifolds, the excessive heat of which normally causes rapid breakdown of the wire insulation. It is also feasible with this new development to use 7 m/m wire in the shielded manifold and 5 m/m wire in the spark plug leads, thereby creating a weight saving.

United Aircraft Products, Inc., Dayton, O., supplied fuel and oil line systems, wobble pumps, fuel units, oil temperature regulators, strainers, and other accessories. The company continued to produce a viscosity valve attached to the oil temperature regulator. A further development of this valve provided a means of automatically controlling oil temperature regulator shutters. The viscosity valve controlled the flow of oil through the radiator; the automatic shutters controlled the flow of air, thereby maintaining a closer degree of control of the oil viscosity.

The Airplane Division of the Weatherhead Company, Cleveland, O., produced a line of tube and pipe fittings, assemblies requiring flexible hose.

Western Electric Company, New York, N. Y., introduced a multi-channel radio telephone, designed primarily to meet the requirements of long range operation of commercial air lines and private planes. It developed more than twice the power of conventional apparatus. A switch gave the pilot any one of 10 pretuned frequencies. Thus a plane could fly through 5 radio zones and maintain contact with ground stations in each on both the day and night frequencies without replacing equipment upon entering a new zone. In addition to telephonic operation, the new apparatus also provided for telegraph, facsimile and modulated telegraph communication. Other features included remote control accomplished electrically without mechanical shafting or flexible cable, special condenser combinations for matching practically any type of antenna or transmission line, forced draft ventilation, and a special mechanical design to facilitate maintenance.

"Finger tip" control, reduced maintenance and economy of instrument-panel space were featured in a new aircraft radio receiver by Western Electric. Radio frequency elements, with switches, dial and control knobs, were included in one small housing mounted on the instrument panel within reach of the pilot. This unit connected elec-

trically with a second cabinet, which could be installed in the after part of the ship, containing all audio frequency apparatus and power conversion equipment. It enabled the pilot to shift between various incoming frequencies as though the entire receiver were mounted on the instrument as a single unit. All mechanical remote control gear was eliminated.

New York City's municipal airport received 15 Western Electric receivers, interference-free to a degree unprecedented in aviation radio. The receivers and antennas were placed on Rikers Island in the East River, remote from the control tower, and operated automatically without an attendant. The receivers included a device known as a "codan." In the absence of a signal the receivers appeared "dead." As soon, however, as the carrier wave from a plane's transmitter came in, the receiver "came to life" automatically.

The Wilcox-Rich Division of Eaton Manufacturing Company, Detroit, Mich., made two important contributions to aircraft progress; development of the Rich valve in sodium-cooled form, and development of the Zero-Lash Hydraulic Valve Lifter. Working with S. D. Heron, who brought forth the first internally cooled valve at McCook Field in 1924, Wilcox-Rich engineers perfected the Rich Sodium Cooled Valve. The valve is made of Silchrome X Steels. It has a hollow chamber in the head and stem which contains a liquid coolant. When splashed up and down with the valve movement, it transfers the heat from the intensely hot head to the cooled stem. Use of Sodium Cooled Valves in aircraft engines is now almost universal.

There are three large Wilcox-Rich plants, in Battle Creek, Marshall, and Saginaw, Michigan—in addition to the headquarters plant and laboratory at Detroit. These plants make other parts of the valve gear mechanism: tappets, valve springs, push rods, and valve seat inserts. In connection with the latter, company engineers have made important experiments in determining the best valve seat insert design and material to use when matched with a specific valve and to fit a certain type of engine requirement.

Probably the most interesting recent development of the Wilcox-Rich Division is the Zero-Lash Hydraulic Valve Lifter. This device employs mechanical tappets to give zero clearance, bringing many distinct benefits which include accurate valve timing, increased engine output with little or no increase in weight, prolonged life of valve and seat, simplified engine design, improved engine performance, and elimination of need for adjusting tappets.

AIRCRAFT SPECIFICATIONS

From all official company reports received at time of going to press.

Name of Manufacturer	Model	No. of Places	ATC No. or Mil.	Make of Engine	No. of Engines	Total Rated H.P.	Wing Area Sq. Ft.	Gross Weight Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.	Range Miles
Aeronautical Corp. of America	50-C	2	675	Continental	1	50	169	1130	100	90	.....
Aeronautical Corp. of America	50-F	2	688	Franklin	1	50	169	1130	92	87	.....
Aeronautical Corp. of America	50-L	2	702	Lycoming	1	50	169	1130	92	87	.....
Aeronautical Corp. of America	S-50-C	2	675	Continental	1	50	169	1253	90	80	.....
Aeronautical Corp. of America	S-50-F	2	688	Franklin	1	50	169	1253	88	80	.....
Aeronautical Corp. of America	KC	2	655	Continental	1	40	146	1060	88	80	.....
Aeronautical Corp. of America	CF	2	Pend.	Franklin	1	40	146	1080	93	85	.....
Barkley-Grow Aircraft	T8P-1	10	662	Pratt & Whitney Wasp SB Jr.	2	800	354	8750	205	192	750
Beech Aircraft Corp.	E17B	5	641	Jacobs L-5	1	285	296.5	3350	.....	177	700
Beech Aircraft Corp.	F17D	5	689	Jacobs L-6	1	330	296.5	3550	.....	182	755
Beech Aircraft Corp.	D17A	5	713	Wright R-760-E2	1	350	296.5	4200	.....	170	820
Beech Aircraft Corp.	D17R	5	638	Wright R-975-E3	1	450	296.5	4200	.....	202	840
Beech Aircraft Corp.	D17S	5	649	Pratt & Whitney Wasp Jr.	1	450	296.5	4200	.....	202	840
Beech Aircraft Corp.	18A	8-10	630	Wright R-760-E2	2	700	347.5	7200	.....	200	1200
Beech Aircraft Corp.	18D	8-10	684	Jacobs L-6	2	660	347.5	7200	.....	200	1200
Beech Aircraft Corp.	18R	6-8	Pend.	Wright R-975-E3	2	900	347.5	7500	.....	220	1100
Beech Aircraft Corp.	18S	6-8	710	Pratt & Whitney Wasp Jr.	2	900	347.5	7500	.....	220	1100
Beech Aircraft Corp.	AT18S	3-8	Mil.	Pratt & Whitney Wasp Jr.	2	900	347.5	7500	.....	220	1100
Bell Aircraft Corp.	P-39	1	P-39	Allison V1710-37	1	1000+	213	6000	.....	325	.....
Bell Aircraft Corp.	FM-1	5	FM-1	Allison V1710-23	2	1000+	.....	.....	300	250	2000
Bellanca Aircraft Corp.	31-42	6-8	578	Wright R-975-E3	1	420	311	5600	165	145	.....
Bellanca Aircraft Corp.	31-55	6	565	Pratt & Whitney Wasp H	1	550	311	5600	190	172	.....
Bellanca Aircraft Corp.	66-76	2-16	563	Wright Cyclone or Pratt & Whitney Hornet	1	760	665	11,400	172	155	.....
Bellanca Aircraft Corp.	28-110	2	Mil.	Pratt & Whitney Twin Wasp	1	1100	280	8450	284	255	.....
Bellanca Aircraft Corp.	77-320	5	Mil.	Wright Cyclones	2	3200	775	19,700	225	200	.....
Bellanca Aircraft Corp.	14-9	3	Pend.	LeBlond	1	90	140	1700	135	120	.....
Boeing Aircraft Company	307	38	Pend.	Wright Cyclone	4	4400	1486	45,000	240	215	1675

Name of Manufacturer	Model	No. of Places	ATC No. or Mil.	Make of Engine	No. of Engines	Total Rated H.P.	Wing Area Sq. Ft.	Gross Weight Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.	Range Miles
Boeing Aircraft Company	314	89	704	Wright Cyclone	4	6000	2867	82,500	190	175	3100
Boeing Aircraft Company	B-299Y	7-9	Mil.	Wright Cyclone	4	4800	259.0	37,000	268	232	4200
Brewster Aeronautical	138	2	Mil.	Wright Cyclone	1	950	208.9	5008.6	.....	.....	.....
Brewster Aeronautical	XF2A-1	1	Mil.	Wright Cyclone	1	950	208.9	5008.6	.....	.....	.....
Brewster Aeronautical	F2A-1	1	Mil.	Wright Cyclone	1	950	208.9	5016	.....	.....	.....
Brewster Aeronautical	239	1	Mil.	Wright Cyclone	1	1100	208.9	5483.9	.....	.....	.....
Brewster Aeronautical	339	1	Mil.	Wright Cyclone	1	1200	208.9	.....	.....	.....	.....
Brewster Aeronautical	XF2A-2	1	Mil.	Wright Cyclone	1	1200	208.9	.....	.....	.....	.....
Brewster Aeronautical	F2A-2	1	Mil.	Wright Cyclone	1	1200	208.9	.....	.....	.....	.....
Cessna Aircraft Company	T-50	5	Pend.	Jacobs L-4MB	2	450	295	5000	195	191	1000
Cessna Aircraft Company	T-50T	2	Mil.	Jacobs L-4MB	2	450	295	5000	195	191	1000
Cessna Aircraft Company	C-165	4	701	Warner Super Scarab 165	1	165	181	2350	169	157	725
Cessna Aircraft Company	C-145	4	701	Warner Super Scarab 145	1	145	181	2350	162	151	785
Consolidated Aircraft	28-5A (amphib.)	.....	Mil.	Pratt & Whitney Twin Wasp	2	2400	1400	30,500	199	179	4000
Consolidated Aircraft	28 (boat)	20	.....	Pratt & Whitney Twin Wasp	2	2400	1400	30,500	199	179	4000
Consolidated Aircraft	28-5A	20	.....	Pratt & Whitney Twin Wasp	2	2400	1400	30,500	199	179	4000
Consolidated Aircraft	29 (boat)	36-62	.....	Pratt & Whitney Twin Wasp	4	4800	1780	65,000	226	210	5200
Culver Aircraft Corp.	GK	2	674	Ken-Royce	1	90	165	1550	130	110	500
Culver Aircraft Corp.	GW	2	674	Warner	1	90	165	1550	130	110	500
Culver Aircraft Corp.	GS	2	Pend.	Warner	1	125	165	1650	150	130	460
Culver Aircraft Corp.	LCA	2	Pend.	Continental A-75	1	75	120	1305	145	130	600
Curtiss-Wright Corp.	P-36	1	Mil.	Pratt & Whitney Twin Wasp	1	.....	.....	.....	Restr.	.....	.....
Curtiss Aeroplane Div.	P-37	1	Mil.	Allison	1	.....	.....	.....	Restr.	.....	.....
Curtiss Aeroplane Div.	P-40	1	Mil.	Allison	1	.....	.....	.....	Restr.	.....	.....
Curtiss Aeroplane Div.	P-42	1	Mil.	Pratt & Whitney Twin Wasp	1	.....	.....	.....	Restr.	.....	.....
Curtiss Aeroplane Div.	Seagull	2	Mil.	Pratt & Whitney Wasp	1	450	342	5437	165	133	675
Curtiss Aeroplane Div.	Helldiver	2	Mil.	Wright Cyclone	1	850	317	6000	240	204	731
Curtiss Aeroplane Div.	Des 76D	2	Mil.	Wright Cyclone	2	1700	530	12,793	252	212	782
Curtiss Aeroplane Div.	75A	1	Mil.	Wright Cyclone	1	1200	236	5692	323	262	1003
St. Louis Airplane Div.	Transport	40	.....	Wright Double-Row Cyclone R-2600-B	2	3000	1353	38,000	243	210	1500
St. Louis Airplane Div.	21	1	Mil.	Wright Cyclone R-1820-G5	1	.....	174.3	4350	315	274	530
St. Louis Airplane Div.	21-B	1	Mil.	Wright Cyclone R-1820-G5	1	.....	174.3	5000	333	282	630
St. Louis Airplane Div.	Falcon 22	2	2-549	Wright Whirlwind R-975E-3	1	420	174.3	3500	215	195	518
St. Louis Airplane Div.	23	2	Mil.	Pratt & Whitney Wasp	1	550	174.3	4500	254	223	692
Douglas Aircraft Co.	DC-3	14-21	618	Wright Cyclone	2	2400	987	25,200	219	196	1620
Douglas Aircraft Co.	DC-3	14-21	669	Pratt & Whitney Twin Wasp	2	2400	987	25,200	231	195	1700
Douglas Aircraft Co.	DST	21-28	607	Wright Cyclone	2	2200	987	24,800	215	191	1580

Name of Manufacturer	Model	No. of Places	ATC No. or Mil.	Make of Engine	No. of Engines	Total Rated H.P.	Wing Area Sq. Ft.	Gross Weight Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.	Range Miles
Douglas Aircraft Co....	DC-4	40-42	.....	Wright Cyclone	4	5200	1461	50,000	260	243	1650
Douglas Aircraft Co....	DC-4	40-42	.....	Pratt & Whitney Twin Wasp	4	5200	1461	50,000	260	243	1770
Douglas Aircraft Co....	DC-5	16	Pend.	Wright Cyclone	2	2200	827	21,000	225	197	1500
Douglas Aircraft Co....	8A-3N	2	Mil.	Pratt & Whitney Twin Wasp	1	1050	363	7848	260	205	910
Douglas Aircraft Co....	8A-3P	2	Mil.	Wright Cyclone	1	1000	363	7587	249	200	.....
Douglas Aircraft Co....	8A-4	2	Mil.	Wright Cyclone	1	1000	363	7500	255	200	.....
Fairchild Aircraft.....	24 W-40	4	707	Warner	1	145	174	2550	130	122	720
Fairchild Aircraft.....	24 R-40	4	706	Ranger	1	175	174	2550	138	130	470
Fairchild Aircraft.....	M-62	2	Mil.	Ranger	1	175	200	2450	135	120	480
Fleetwings.....	F-5	4-5	680	Jacobs	1	300	235	3850	150	139	550
Grumman Aircraft.....	G-36	1	Mil.	Pratt & Whitney S4C4-G or Wright GR-1820-205A	1	900	260	6100	330	297	1150
Grumman Aircraft.....	G-21A	8	654	Pratt & Whitney Wasp Jr.	2	800	375	8000	201	190	1050
Grumman Aircraft.....	J2F-4	2-4	Mil.	Wright Cyclone	1	725	409	6170	180	162	780
Grumman Aircraft.....	G-21B	3-4	Mil.	Pratt & Whitney Wasp Jr.	2	800	375	7830	201	190	1075
Hall Aluminum Aircraft.	PH-3	4	C. G.	Wright Cyclone	2	1500	1170.1	16,153	159	136	1937
Hall Aluminum Aircraft.	PH-3	7	C. G.	Wright Cyclone	2	1500	1170.1	17,679	159	136	2300
Hall Aluminum Aircraft.	PH-3	5	C. G.	Wright Cyclone	2	1500	1170.1	16,152	159	136	1937
Harlow Aircraft Co....	PJC-1	2	659	Warner-Super Scarab	1	145	185	2231	170	160	.....
Harlow Aircraft Co....	PJC-2	4	Pend.	Same as above.	1	145	185	2600	170	153	.....
Harlow Aircraft Co....	PC-5	2	Pend.	Same as above.	1	145	185	2279	170	153	.....
Howard Aircraft Corp..	DGA-15J	5	717	Jacobs	1	330	210	4350	178	169	1420
Howard Aircraft Corp..	DGA-15P	5	717	Pratt & Whitney Wasp Jr.	1	450	210	4350	201	192	1150
Kellett Autogiro Corp..	KD-1	2	712	Jacobs	1	225	55.2*	2245	125	102	.....
Kellett Autogiro Corp..	KD-1B	1	712	Jacobs	1	225	55.2*	2250	127	102	.....
Kellett Autogiro Corp..	KD-1A	1	Mil.	Jacobs	1	225	55.2*	2245	125	100	.....
Lockheed Aircraft Corp..	12	8	616	Pratt & Whitney Wasp Jr.	2	900	352	8650	225	212	1060
Lockheed Aircraft Corp..	Lodestar	17	723	Wright GR-1820-G205	2	2400	551	17,500	269	253	1651
Lockheed Aircraft Corp..	Excalibur	36	.....	.....	4	.....	.....	.....	300	282	1500
Lockheed Aircraft Corp..	B-14	4	Mil.	Wright Cyclone	2	.....	551	18,500	284	.....	.....
Luscombe Airplane Corp.	8	2	694	Continental	1	50	140	1200	109	96	400
Luscombe Airplane Corp.	8A	2	694	Continental	1	65	140	1200	115	104	350
Luscombe Airplane Corp.	Seaplane	2	694	Continental	1	65	140	1260	102	95	350
The Glenn L. Martin Co.	156C	46	.....	Wright GR-1820-G2	4	3400	2300	63,000	182	140	2410
The Glenn L. Martin Co.	157F	45	Exp.	Pratt & Whitney Twin Wasp	4	4200	2300	70,000	203	145	2410
The Glenn L. Martin Co.	166	4 or 5	Mil.	Wright GR-1820-G 105 A	2	1700	682	15,624	260	160	2080
The Glenn L. Martin Co.	167W	3	Mil.	Pratt & Whitney Twin Wasp	2	1800	538.5	15,297	305	248	2470
North American Av....	NA-16-1	2	Mil.	Wright Whirlwind	1	420	246.22	4375	170	146	730

* Rotor Blade Area.

Name of Manufacturer	Model	No. of Places	ATC No. or Mil.	Make of Engine	No. of Engines	Total Rated H.P.	Wing Area Sq. Ft.	Gross Weight Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.	Range Miles
North American Av....	NA-16-3	2	Mil.	Pratt & Whitney Wasp	1	550	253.7	5340	206	185	805
North American Av....	NA-25	3	Mil.	Wright Cyclone	1	750	348.6	7770	244	212	705
North American Av....	NA-35	2	Exp.	Menasco Pirate	1	150	148	1760	140	124	305
North American Av....	NA-35	2	Exp.	Ranger	1	175	148	1880	145	130	315
North American Av....	NA-40-A	5	Mil.	Wright Double Row Cyclone	2	2800	610.1	24,250	310	256	1728
North American Av....	NA-44	2	Mil.	Wright Cyclone	1	745	258.1	6155	250	223	734
North American Av....	NA-50	1	Mil.	Wright Cyclone	1	840	227.51	5350	270	235	670
Piper Aircraft Corp....	Cub J4	2	703	Continental A65	1	65	183	1301	.....	.....	525
Piper Aircraft Corp....	Cub J5	3	Pend.	Continental A75;	1	75	179.3	1450	.....	.....	675
				Lycoming geared "75"	1	75	179.3	1450	.....	.....	675
Piper Aircraft Corp....	Cub J3	2	691	Continental A65	1	65	178	1100	.....	.....	275
Piper Aircraft Corp....	Cub J3	2	691	Continental A50	1	50	178	1100	.....	.....	250
Piper Aircraft Corp....	Cub J3	2	691	Continental A40	1	40	178	1000	.....	.....	200
Piper Aircraft Corp....	Cub J3	2	691	Lycoming 50	1	50	178	1100	.....	.....	250
Piper Aircraft Corp....	Cub J3	2	691	Lycoming 55	1	55	178	1100	.....	.....	250
Piper Aircraft Corp....	Cub J3	2	691	Franklin 60	1	60	178	1100	.....	.....	260
Porterfield Aircraft Corp.	CP 50	2	690	Continental	1	50	168.8	1108	102	92	275
Porterfield Aircraft Corp.	CP 55	2	Pend.	Continental	1	50	168.8	1160	102	92	340
Porterfield Aircraft Corp.	CP 65	2	720	Continental	1	65	168.8	1160	108	97	320
Porterfield Aircraft Corp.	LP 50	2	Pend.	Lycoming	1	50	168.8	1160	100	90	350
Porterfield Aircraft Corp.	LP 55	2	Pend.	Lycoming	1	55	168.8	1160	102	92	340
Porterfield Aircraft Corp.	LP 65	2	Pend.	Lycoming	1	65	168.8	1160	107	96	320
Porterfield Aircraft Corp.	75 L	2	Pend.	Lycoming	1	75	147	1326	117	105	345
Porterfield Aircraft Corp.	35 W	2	611	Warner	1	90	147	1326	135	120	336
Porterfield Aircraft Corp.	145	2	Pend.	Warner	1	145	278	1950	120	108	355
Rearwin Aircraft & Eng..	Speedster	2	661	Menasco C4	1	125	143.2	1700	150	130	550
Rearwin Aircraft & Eng..	Sportster										
	7000	2	574	Ken-Royce Model 5E	1	70	166	1460	115	103	500
	9000KR	2	591	Ken-Royce Model 5F	1	90	166	1460	125	115	500
	9000	2	624	Warner Scarab Jr.	1	90	166	1460	123	110	500
Rearwin Aircraft & Eng..	Cloudster										
	8090	2	711	Ken-Royce Model 5F	1	90	161.8	1635	125	110	675
	8125	2	711	Ken-Royce Model 7F	1	120	161.8	1735	145	110	625
	8135	3	711	Ken-Royce Model 7F	1	120	161.8	1900	140	120	625
Rearwin Aircraft & Eng..	165	2	Pend.	Continental A65	1	65	164.6	1350	110	100	450
Rearwin Aircraft & Eng..	175	2	Pend.	Continental A75	1	75	164.6	1350	115	105	400
Republic Aviation Corp.	BP-1	1	Mil.	Pratt & Whitney Twin Wasp	1	950	225	5730	315	285	
Republic Aviation Corp.	2-PA	2	Mil.	Pratt & Whitney Twin Wasp	1	950	225	6022	310	280	
Republic Aviation Corp.	XP-41	1	Mil.	Pratt & Whitney Twin Wasp	1	.....	.....	.....	.....	.....	.....
Ryan Aeronautical Co..	STA	2	571	Menasco C-4	1	125	124	1600	126	122	366

Name of Manufacturer	Model	No. of Places	ATC No. or Mil.	Make of Engine	No. of Engines	Total Rated H.P.	Wing Area Sq. Ft.	Gross Weight Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.	Range Miles
Ryan Aeronautical Co...	STA	2	681	Menasco C4-S	1	150	124	1600	142	136	326
Ryan Aeronautical Co...	STM-125	2	Mil.	Menasco C-4	1	125	124	1600	126	122	366
Ryan Aeronautical Co...	STM-150	2	Mil.	Menasco C4-S	1	150	124	1600	142	136	326
Ryan Aeronautical Co...	SC-W	3	658	Warner Super Scarab	1	145	202	2150	150	135	500
Southern Aircraft Corp.	BM-10	2	Mil.	Lycoming R-680-B4C	1	225	305	2700	123	105	365
Southern Aircraft Corp.	BM-10	2	Mil.	Jacobs L4	1	225	305	2700	123	105	365
Southern Aircraft Corp.	BM-10	2	Mil.	Continental W670K	1	225	305	2700	123	105	365
Southern Aircraft Corp.	BM-10	2	Mil.	Wright R760 ET	1	235	305	2700	123	105	365
Spartan Aircraft Co...	NS-1	2	Mil.	Lycoming R-680-7	1	220	301.32	2800	115	100	350
Spartan Aircraft Co...	7W	5	628	Pratt & Whitney Wasp Jr. SB	1	450	250	4400	212	190	900
Spencer-Larsen Aircraft	S-L 15	4	Exp.	Ranger 6 cyl.	1	200	197.5	1860	143	125	500
Stearman Aircraft	100	4	Mil.	Pratt & Whitney Wasp	2	2800	609.44	18,230	275	250	1200
Stearman Aircraft	A75L3	2	Mil.	Lycoming	1	225	297.6	2686	125	103	386
Stearman Aircraft	A75N1	2	Mil.	Continental	1	220	297.6	2649	125	96	394
Stearman Aircraft	A75J1	2	Mil.	Jacobs	1	225	297.6	2705	125	105	420
Stearman Aircraft	76D1	2	Mil.	Pratt & Whitney Wasp	1	320	297.6	3336	151	131	560
Stearman Aircraft	76D3	2	Mil.	Pratt & Whitney Wasp	1	400	297.6	3250	157	135	635
Stearman Aircraft	76C3	2	Mil.	Wright Whirlwind	1	420	297.6	3530	156	136	550
Stinson Aircraft	SR-10C	5	678	Lycoming	1	260	258.5	3900	149	147	618
Stinson Aircraft	SR-10E	5	679	Wright Whirlwind	1	350	258.5	4150	161	152	780
Stinson Aircraft	SR-10F SB	5	685	Pratt & Whitney Wasp, Jr.	1	450	258.5	4650	178.5	169	675
Stinson Aircraft	SR-10F TB	5	685	Pratt & Whitney Wasp, Jr.	1	440	258.5	4650	173	165.5	677
Stinson Aircraft	SR-10G	5	678	Lycoming	1	290	258.5	4000	152	147.3	775
Stinson Aircraft	SR-10J	5	678	Lycoming	1	300	258.5	4000	153	149	770
Stinson Aircraft	SR-10K	5	679	Wright Whirlwind	1	450	258.5	4650	175.5	167.5	600
Stinson Aircraft	105	3	709	Continental	1	75	155	1580	109	107	.....
Stinson Aircraft	105	3	709	Continental	1	80	155	1580	111	109	.....
Stinson Aircraft	105	3	Pend.	Lycoming (geared)	1	75	155	.....	.....	.....	.....
Taylorcraft Aviation	BL	2	700	Lycoming O-145-A1	1	50	167	1150	97	88	250
Taylorcraft Aviation	BC	2	696	Continental A-50-1	1	50	167	1150	97	88	250
Taylorcraft Aviation	BF	2	699	Franklin 4AC-150	1	50	167	1150	97	88	250
Taylorcraft Aviation	BL	2	700	Lycoming O-145-A1	1	50	167	1150	97	88	250
Taylorcraft Aviation	BL-65	2	700	Lycoming O-145-B1	1	65	167	1150	105	95	250
Taylorcraft Aviation	BC-65	2	696	Continental A-65	1	65	167	1150	135	95	250
Taylorcraft Aviation	BF-60	2	699	Franklin 4AC-171	1	60	167	1150	102	92	250
Vought-Sikorsky Div.	V-156	2	Mil.	Pratt & Whitney Wasp	1	750	305	6500	259	225	1055
Vought-Sikorsky Div.	S-43	19	593	Pratt & Whitney Hornet	2	1500	780	20,000	190	173	1590
Vought-Sikorsky Div.	VS-44A	28-40	Pend.	Pratt & Whitney 1830	4	4200	.....	57,500	225	175	3800
Vultee Aircraft	Vang'd 48	1	Mil.	Pratt & Whitney Twin Wasp	1	1200	197	6029	358	360	1800
Vultee Aircraft	Vahant 54	2	Mil.	Pratt & Whitney Wasp	1	450	238	4069	170	143	600

<i>Name of Manufacturer</i>	<i>Model</i>	<i>No. of Places</i>	<i>ATC No. or Mtl.</i>	<i>Make of Engine</i>	<i>No. of Engines</i>	<i>Total Rated H.P.</i>	<i>Wing Area Sq. Ft.</i>	<i>Gross Weight Lbs.</i>	<i>High Speed M.P.H.</i>	<i>Cruising Speed M.P.H.</i>	<i>Range Miles</i>
Vultee Aircraft.....	Valiant 51	2	Mil.	Pratt & Whitney Wasp	1	600	238	5628	217	213	900
Vultee Aircraft.....	V-11A	3	Mil.	Wright Double Row Cyclone	1	1600	384	11,678	280	250	1700
Vultee Aircraft.....	V-12A	3	Mil.	Wright Double Row Cyclone	1	1600	384	11,796	287	248	1710
Waco Aircraft Co.....	YKS	4-5	626	Jacobs L-4	1	225	244	3250	144	135	518
Waco Aircraft Co.....	ZKS	4-5	626	Jacobs L-5	1	285	244	3250	152	144	504
Waco Aircraft Co.....	VKS	4-5	648	Cont. W-670-M	1	240	244	3250	145	136	492
Waco Aircraft Co.....	VKS	4-5	648	Cont. W-670-M-1	1	250	244	3250	148	140	500
Waco Aircraft Co.....	AVN	4	677	Jacobs L-6	1	300	246	3800	161	151	460
Waco Aircraft Co.....	ARE	4-5	714	Jacobs L-6	1	300	246	4000	185	177	1100
Waco Aircraft Co.....	ERE	4-5	Pend.	Wright R760-E2	1	320	246	4000	185	172	1200
Waco Aircraft Co.....	HRE	4-5	Pend.	Lycoming R680-E3	1	300	246	4000	180	168	1250
Waco Aircraft Co.....	SRE	4-5	Pend.	Pratt & Whitney SB	1	400	246	4200	195	195	880
Waco Aircraft Co.....	WRE	4-5	Pend.	Wright R-975-E3	1	420	246	4200	190	190	830
Waco Aircraft Co.....	UPF-7	2	642	Cont. R 670-3	1	220	244	2650	138.6	123	420
Waco Aircraft Co.....	YPF-7	2	586	Jacobs R-755	1	225	244	2650	141	125	432
Waco Aircraft Co.....	LPF-7	2	.....	Lycoming R-680-7	1	220	244	2650	136	120	420
Waco Aircraft Co.....	LPF-7	2	.....	Lycoming R-680B4C	1	225	244	2650	138	122	430
Waco Aircraft Co.....	JHD	2	670	Wright R975-E1	1	365	256	3800	184	180	485
Waco Aircraft Co.....	WHD	2	2-512	Wright R975-E3	1	420	256	3800	193	185	387
Waco Aircraft Co.....	S2HD	2	581	Pratt & Whitney SB	1	400	256	3800	194	185	400

AIRCRAFT ENGINE SPECIFICATIONS

From all official company reports received at time of going to press.

Name of Engine	<i>Aircooled Franklin</i>	<i>Aircooled Franklin</i>	<i>Aircooled Franklin</i>	<i>Aircooled Franklin</i>	<i>Continental</i>
Type	Opposed	Opposed	Opposed	Opposed	Radial
Model Number	4AC-150	4AC-150A	4AC-176	4AC-176	W670 Series K
No. of Cylinders	4	4	4	4	7
Blower	None	None	None	None	None
Norm. H.P. Take-Off R.P.M.					225
					2175
Norm. H.P. Rtg. R.P.M. Alt.	50 2300 Sea Level	60 2400 Sea Level	80 2650	80 2500	
Fuel Octane No.	70	73	73	80	73
Cubic Inch Displ'mt	150	150	176	176	668
Bore & Stroke	3 5/8 3 5/8	3 5/8 3 3/8	4 3 1/2	4 3 1/2	5 1/8 4 5/8
Size in Inches Diam. Length Width Height	28 34 3/8 18 3/8	28 34 3/8 18 3/8	29 7/64 30 1/2 19 13/32	29 7/64 30 1/4 19 13/32	42 1/4
Propeller Shaft Ratio	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive
Dry Weight Lbs.	166	166	170	170	465
A.T.C. No.	194	194			162

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Continental	Continental	Continental	Continental	Continental
Type	Radial	Radial	Opposed	Opposed	Opposed
Model Number	W670 Series M	W670 Series M1	A40	A50	A65
No. of Cylinders	7	7	4	4	4
Blower	None	None	None	None	None
Norm. H.P. Take-Off	240	250	40	50	65
R.P.M.	2200	2200	2575	1900	2300
Norm. H.P. Rtg. Alt.					
Fuel Octane No.	80	80	72	65	72
Cubic Inch Displ'mt	668	668	115	171	171
Bore & Stroke	5 1/8 4 5/8	5 1/8 4 5/8	3 1/8 3 3/4	3 7/8 3 5/8	3 7/8 3 5/8
Size in Inches					
Diam.	42 1/4	42 1/4			
Length			27 1/3	30 2/5	30 2/5
Width			26 11/25	31 7/10	31 7/10
Height			19 11/25	23	22 1/5
Propeller Shaft Ratio	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive
Dry Weight Pounds	465	465	(1)	(1)	(1)
A.T.C. No.	162	162	Ser. 4- 72 Ser. 5-174	190	205

¹ Dry Weight in Pounds:A40, Series 4 — 144
Series 5 — 154A50, Series 7 — 161
Series 8 — 170
Series 9 — 176A65, Series 7 — 161
Series 8 — 170
Series 9 — 176

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Continental	Continental	Jacobs	Jacobs	Jacobs
Type	Opposed	Opposed	Radial	Radial	Radial
Model Number	A75	A80	L-6MB	L-6M	L-5MB
No. of Cylinders	4	4	7	7	7
Blower	None	None	None	None	None
Norm. H.P.	75	80	330	330	285
Take-Off R.P.M.	2600	2700	2200	2200	2000
Norm. H.P. Rtg. R.P.M. Alt.			300 2100 3700	300 2100 3700	285 2000
Fuel Octane No.	72	80	80	80	73
Cubic Inch Displ'mt	171	171	914	914	831
Bore & Stroke	3 7/8 3 5/8	3 7/8 3 5/8	5.5 5.5	5.5 5.5	5.5 5
Size in Inches					
Diam.			45.375	45.375	43 1/2
Length	30 1/5	30 1/5			
Width	31 7/10	31 7/10			
Height	22 1/5	22 1/5			
Propeller Shaft Ratio	Direct Drive	Direct Drive	1:1	1:1	1:1
Dry Weight Pounds	(1)	(1)	550	550	525
A.T.C. No.	213	217	195	195	156

¹ Dry Weight in Pounds:A75, Series 8 — 170
Series 9 — 176A80, Series 8 — 170
Series 9 — 176

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Jacobs</i>	<i>Jacobs</i>	<i>Jacobs</i>	<i>Kinner</i>	<i>Kinner</i>
Type	Radial	Radial	Radial	Radial	Radial
Model Number	L-5M	L-4MB	L-4M	K-5 Series 2	B-5 Series 2
No. of Cylinders	7	7	7	5	5
Blower	None	None	None	None	None
Norm. H.P. Take-Off	285	225	225		
R.P.M.	2000	2000	2000		
Norm. H.P. Rtg.	285	225	225	100	125
R.P.M. Alt.	2000	2000	2000	1810	1925
Fuel Octane No.	73	73	73	73	73
Cubic Inch Displ'mt	831	757	757	372	441
Bore & Stroke	5.5	5.25	5.25	4 1/4	4 5/8
	5	5	5	5 1/4	5 1/4
Size in Inches					
Diam.	43 1/2	43 1/2	43 1/2	45 3/8	45 3/8
Length					
Width					
Height					
Propeller Shaft Ratio	1:1	1:1	1:1	Direct Drive	Direct Drive
Dry Weight Pounds	525	494	494	275	295
A.T.C. No.	156	121	121	3	51

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Kinner</i>	<i>Kinner</i>	<i>Kinner</i>	<i>Lenape "Papoose"</i>	<i>Lenape "Papoose"</i>
Type	Radial	Radial	Radial	Radial	Radial
Model Number	R-5 Series 2	C-7	SC-7	LM-3	LM-365
No. of Cylinders	5	7	7	3	3
Blower	None	None	None	None	None
Norm. H.P. Take-Off R.P.M.			400	50 2325	65 2350
Norm. H.P. Rtg. R.P.M. Alt.	160 1850	300 1800	350 1900 5000	50 Sea Level	65 Sea Level
Fuel Octane No.	73	73	73	73	73
Cubic Inch Displ'mt	540	1044	1044	160.4	167
Bore & Stroke	5 5 1/2	5 5/8 6	5 5/8 6	4 1/8 4	4 1/8 4
Size in Inches Diam. Length Width Height	45 3/8	51 5/16	47 3/4	36	36
Propeller Shaft Ratio	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive
Dry Weight Pounds	330	600	650	138	140
A.T.C. No.	153	122	175	203	203

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Lenape "Papoose"</i>	<i>Lenape "Brave"</i>	<i>Lenape "Brave"</i>	<i>Lenape "Chief"</i>	<i>Lycoming</i>
Type	Radial	Radial	Radial	Radial	Radial
Model Number	LM-375	LM-5	LM-125		R-530-D1
No. of Cylinders	3	5	5	7	7
Blower	None	None	None	None	1:1
Norm. H.P.	75	95	125	150	220
Take-Off R.P.M.	2450	2200	2450	2350	2300
Norm. H.P. Rtg. R.P.M. Alt.	75 Sea Level	95 Sea Level	125 Sea Level	150 Sea Level	210 2200 Sea Level
Fuel Octane No.	73	73	73	73	80
Cubic Inch Displ'mt	170.5	267	267	378	529.2
Bore & Stroke	4 1/4 4	4 1/8 4	4 1/4 4	4 1/4 4	4 5/8 4 1/2
Size in Inches Diam. Length Width Height	36	36	36	36	43 1/2
Propeller Shaft Ratio	Direct Drive	Direct Drive	Direct Drive	Direct Drive	1:1
Dry Weight Pounds	142	192	192	275	430
A.T.C. No.	215	212			182

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Lycoming</i>	<i>Lycoming</i>	<i>Lycoming</i>	<i>Lycoming</i>	<i>Lycoming</i>
Type	Radial	Radial	Radial	Radial	Radial
Model Number	R-530-D2	R-680-B4C	R-680-D5	R-680-D6	R-680-E1
No. of Cylinders	7	9	9	9	9
Blower	1:1	1:1	1:1	1:1	1:1
Norm. H.P.	210	225	260	245	290
Take-Off R.P.M.	2300	2100	2300	2300	2300
Norm. H.P. Rtg.	200	225	245	225	275
R.P.M. Alt.	2200	2100	2100	2100	2200
	Sea Level	Sea Level	Sea Level	Sea Level	Sea Level
Fuel Octane No.	73	73	80	73	80
Cubic Inch Displ'tmt	529.2	680.4	680.4	680.4	680.4
Bore & Stroke	4 5/8 4 1/2	4 5/8 4 1/2	4 5/8 4 1/2	4 5/8 4 1/2	4 5/8 4 1/2
Size in Inches					
Diam.	43 1/2	43 1/2	43 1/2	43 1/2	43 1/2
Length					
Width					
Height					
Propeller Shaft Ratio	1:1	1:1	1:1	1:1	1:1
Dry Weight Pounds	430	492	505	505	514
A.T.C. No.	183	108	172	173	202

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Lycoming</i>	<i>Lycoming</i>	<i>Lycoming</i>	<i>Lycoming</i>	<i>Lycoming</i>
Type	Radial	Radial	Opposed	Opposed	Opposed
Model Number	R-680-E2	R-680-E3	O-145-A1	O-145-A2 O-145-A3	O-145-B Series
No. of Cylinders	9	9	4	4	4
Blower	1:1	1:1	None	None	None
Norm. H.P. Take-Off	280	300	50	55	65
R.P.M.	2300	2300	2300	2300	2550
Norm. H.P. Rtg.	265	285	50	55	65
R.P.M. Alt.	2200	2200	2300	2300	2550
	Sea Level	Sea Level	Sea Level	Sea Level	Sea Level
Fuel Octane No.	73	87	65 or 73	73	73
Cubic Inch Displ'mt	680.4	680.4	144.49	144.49	144.49
Bore & Stroke	4 5/8 4 1/2	4 5/8 4 1/2	3 5/8 3 1/2	3 5/8 3 1/2	3 5/8 3 1/2
Size in Inches					
Diam.	43 1/2	43 1/2			
Length			23.75 ¹	24.63 ²	24.63 ³
Width			29.56 ¹	29.56 ²	29.56 ³
Height			20.59 ¹	20.59 ²	22.59 ³
Propeller Shaft Ratio	1:1	1:1	1:1	1:1	1:1
Dry Weight Pounds	514	514	155	A2 165.5 A3 167.5	B1 155 B2 165.5 B3 167.5
A.T.C. No.	202	202	199	199	210

¹ Applies to O-145-B1 and C1 also.² Applies to O-145-A2, B2 and C2.³ Applies to O-145-A3, B3 and C3.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Lycoming</i>	<i>Lycoming</i>	<i>Menasco C4</i>	<i>Menasco D4</i>	<i>Menasco C4S</i>
Type	Opposed	Opposed	I. Inline	I. Inline	I. Inline
Model Number	O-145-C Series	GO-145-C Series	L-365-100	L-365-102	LS-365-100
No. of Cylinders	4	4	4	4	4
Blower	None	None	None	None	9.6:1
Norm. H.P. Take-Off	75	75			
R.P.M.	3100	3200			
Norm. H.P. Rtg. Alt.	75 3100 Sea Level	75 3200 Sea Level	125 2175	125 2175	150 2260 3000
Fuel Octane No.	73	73	73	73	73
Cubic Inch Displ'mt	144.49	144.49	363	363	363
Bore & Stroke	3 5/8 3 1/2	3 5/8 3 1/2	4 3/4 5 1/8	4 3/4 5 1/8	4 3/4 5 1/8
Size in Inches					
Diam.					
Length	4	28.44 ⁵	47.53	47.53	47.53
Width	29.56	29.56	17.78	17.78	14.5
Height	4	20.67 ⁶	28.56	28.56	28.56
Propeller Shaft Ratio	1:1	27:17	1:1	1:1	1:1
Dry Weight Pounds	C1 155 C2 165.5 C3 167.5	C1 182.5 C2 193 C3 195	284 1/2	299 1/2	299 1/2
A.T.C. No.	210	210	67		134

⁴ See footnotes 1, 2, 3 on previous page.⁵ Applies to GO-145-C1 only. C2 and C3 are 29.31.⁶ Applies to GO-145-C1 and C2. C3 is 22.67.

I. Inline = inverted inline.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Menasco</i> D4S	<i>Menasco</i> Super- Buccaneer	<i>Menasco</i> Geared Super- Buccaneer	<i>Menasco</i> Unitwin	<i>Pratt & Whitney</i> Wasp Jr.
Type	I. Inline	I. Inline	I. Inline	Inline	Radial
Model Number	LS-365-102	LS-544-1	LGS-544-5	2-544	T1B2
No. of Cylinders	4	6	6	12	9
Blower	9.6:1	10.9:1	10.9:1	10.9:1	1 speed
Norm. H.P.		290	350	660	450
Take-Off R.P.M.		2400	2780	2480	2300
Norm. H.P. Rtg. R.P.M. Alt.	150 2260 3000	260 2300 7500	320 2700 9000	600 2400 5000	450 2300 Sea Level
Fuel Octane No.	73	80	87	87	87
Cubic Inch Displ'mt	363	544.9	544.9	1089.8	985
Bore & Stroke	4 3/4 5 1/8	4 3/4 5 1/8	4 3/4 5 1/8	4 3/4 5 1/8	5.187 5.187
Size in Inches					
Diam.					45.75
Length	47.53	67.46	75.37	87.13	
Width	14.5	16.56	16.56	34.63	
Height	28.56	30.59	30.59		
Propeller Shaft Ratio	1:1	1:1	1.5:1	1.21:1	Direct Drive
Dry Weight Pounds	314 1/2	550	630	1390	653
A.T.C. No.		197			Mil.

I. Inline = inverted inline.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Pratt & Whitney Wasp Jr.</i>	<i>Pratt & Whitney Wasp Jr.</i>	<i>Pratt & Whitney Wasp</i>	<i>Pratt & Whitney Wasp</i>	<i>Pratt & Whitney Wasp</i>
Type	Radial	Radial	Radial	Radial	Radial
Model Number	8B2	TB2	S1H1	S2H1	S3H1
No. of Cylinders	9	9	9	9	9
Blower	1 speed	1 speed	1 speed	1 speed	1 speed
Norm. H.P. Take-Off R.P.M.	450 2300	440 2300	600 2250	600 2250	600 2250
Norm. H.P. Rtg. R.P.M. Alt.	400 2200 5000	420 2200 Sea Level	550 2200 8000	500 2200 10500	550 2200 5000
Fuel Octane No.	*80/87	80	87	*80/87	*80/87
Cubic Inch Displ'mt	985	985	1344	1344	1344
Bore & Stroke	5.187 5.187	5.187 5.187	5.75 5.75	5.75 5.75	5.75 5.75
Size in Inches Diam. Length Width Height	45.75	45.75	51.44	51.44	51.44
Propeller Shaft Ratio	Direct Drive	Direct Drive	Direct Drive	Direct Drive	Direct Drive
Dry Weight Pounds	653	653	864	864	864
A.T.C. No.	Pend.	Pend.	129	163	143

* These models are rated on 80 octane fuel for operation not in excess of Normal Rated Power and R.P.M.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Pratt & Whitney Wasp	Pratt & Whitney Wasp	Pratt & Whitney Wasp	Pratt & Whitney Hornet	Pratt & Whitney ***Hornet
Type	Radial	Radial	Radial	Radial	Radial
Model Number	S1H1-G	S2H1-G	S3H1-G	S1E3-G	S1E
No. of Cylinders	9	9	9	9	9
Blower	1 speed	1 speed	1 speed	1 speed	1 speed
Norm. H.P. Take-Off	600	600	600	875-850	875
R.P.M.	2250	2250	2250	2300-2500	2300
Norm. H.P. Rtg.	550	500	550	750	750
Alt.	2200	2200	2200	2250	2250
	8000	10500	5000	7000	7000
Fuel Octane No.	87	*80/87	*80/87	87	87
Cubic Inch Displ'tmt	1344	1344	1344	1690	1690
Bore & Stroke	5.75	5.75	5.75	6.125	6.125
Size in Inches					
Diam.	51.44	51.44	51.44	54.44	54.44
Length					
Width					
Height					
Propeller Shaft Ratio	Geared	Geared	Geared	Geared	Direct Drive
Dry Weight Pounds	930	930	930	1087	975
A.T.C. No.	129	141	142	193	Mil.

* These models are rated on 80 octane fuel for operation not in excess of Normal Rated Power and R.P.M.

*** Alternate or Replacement Models.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Pratt & Whitney ***Hornet</i>	<i>Pratt & Whitney Twin Wasp Jr.</i>	<i>Pratt & Whitney Twin Wasp</i>	<i>Pratt & Whitney Twin Wasp</i>	<i>Pratt & Whitney ***Twin Wasp</i>
Type	Radial	Radial	Radial	Radial	Radial
Model Number	S5E	SB4-G	S1C3-G	SC3-G	S3C3-G
No. of Cylinders	9	14	14	14	14
Blower	1 speed	1 speed	1 speed	1 speed	1 speed
Norm. H.P.	700	825	1200	1050	1100
Take-Off R.P.M.	2050	2625	2700	2700	2700
Norm. H.P. Rtg.	700	750	1050	900	950
R.P.M. Alt.	2050 6000	2550 9500	2550 7500	2550 12000	2700 14300
Fuel Octane No.	87	87	90	87	95
Cubic Inch Displ'mt	1690	1535	1830	1830	1830
Bore & Stroke	6.125 6.125	5.187 5.187	5.50 5.50	5.50 5.50	5.50 5.50
Size in Inches					
Diam.	54.44	44.13	48.00	48.00	48.00
Length					
Width					
Height					
Propeller Shaft Ratio	Direct Drive	**Geared	**Geared	**Geared	**Geared
Dry Weight Pounds	975	1124	1420	1420	1460
A.T.C. No.	164	179	186	186	Mil.

** Optional gear ratios available.

*** Alternate or Replacement Models.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Pratt & Whitney Twin Wasp	Pratt & Whitney Twin Wasp	Pratt & Whitney Twin Wasp	Pratt & Whitney Double Wasp	Pratt & Whitney Double Wasp
Type	Radial	Radial	Radial	Radial	Radial
Model Number	S3C4-G	S4C4-G	S2C4-G	S1A6-G	S2A6-G
No. of Cylinders	14	14	14	18	18
Blower	2 speed (L & H)	2 speed (L & H)	2 speed (L & H)	1 speed	1 speed
Norm. H.P.	1200	1200	1050	1850	1625
Take-Off R.P.M.	2700	2700	2700	2600	2600
Norm. H.P. Rtg.	1100 (L) 1000 (H)	1050 (L) 900 (H)	900 (L) 800 (H)	1500	1450
R.P.M.	2550 (L) 2700 (H)	2550 (L) 2550 (H)	2550 (L) 2550 (H)	2400	2400
Alt.	6200 (L) 14500 (H)	7500 (L) 15400 (H)	12000 (L) 19000 (H)	7500	8500
Fuel Octane No.	95	90	87	100	90
Cubic Inch Displ'mt	1830	1830	1830	2800	2800
Bore & Stroke	5.50 5.50	5.50 5.50	5.50 5.50	5.75 6.00	5.75 6.00
Size in Inches					
Diam.	48.00	48.00	48.00	52.00	52.00
Length					
Width					
Height					
Propeller Shaft Ratio	**Geared	**Geared	**Geared	**Geared	**Geared
Dry Weight Pounds	1460	1460	1460	2265	2265
A.T.C. No.					

** Optional gear ratios available.

(L) Low.

(H) High.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Pratt & Whitney Double Wasp	Pratt & Whitney Double Wasp	Ranger	Ranger	Ranger
Type	Radial	Radial	I. Inline	I. Inline	I. Inline
Model Number	S1A4-G	S2A4-G	6-410B-3	6-440C-2	6-440C-3
No. of Cylinders	18	18	6	6	6
Blower	2 speed (L & H)	2 speed (L & H)	None	None	None
Norm. H.P. Take-Off R.P.M.	1850 2600	1625 2600			
Norm. H.P. Rtg. R.P.M.	1500 (L) 1450 (H) 2400 (L) 2400 (H) 7500 (L) 13000 (H)	1450 (L) 1200 (H) 2400 (L) 2400 (H) 8500 (L) 16000 (H)	175 2450 None	175 2450 None	180 2450 None
Fuel Octane No.	100	90	80	65	73
Cubic Inch Displ'mt	2800	2800	411	441	441
Bore & Stroke	5.75 6.00	5.75 6.00	4.125 5.125	4.125 5.500	4.125 5.500
Size in Inches Diam. Length Width Height	52.00	52.00	50.062 20.250 31.750	52.906 20.156 31.000	52.906 20.156 31.000
Propeller Shaft Ratio	**Geared	**Geared			
Dry Weight Pounds	2300	2300	355	370	370
A.T.C. No.			187	216	Pending

** Optional gear ratios available.

(L) Low.

(H) High.

I, Inline = inverted inline.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Ranger</i>	<i>Ranger</i>	<i>Ranger</i>	<i>Ranger</i>	<i>Ranger</i>
Type	I. Inline	I. Inline	V	V	V
Model Number	6-440C-4	6-440C-5	V-880C-1	SGV-770B-3	SGV-770B-5
No. of Cylinders	6	6	12	12	12
Blower	None	None		7.71:1	8.84:1
Norm. H.P. Take-Off R.P.M.					
Norm. H.P. Rtg. R.P.M. Alt.	190 2450 None	200 2450 None	405 2400 Sea Level	420 2800 Sea Level	420 2800 3000
Fuel Octane No.	80	87	87	87	87
Cubic Inch Displ'mt	441	441	882	772.8	772.8
Bore & Stroke	4.125 5.5	4.125 5.5	4.125 5.5	4 5.125	4 5.125
Size in Inches Diam. Length Width Height	52.906 20.156 31.	52.906 20.156 31.	61.39 29.5 28.812	61.312 28. 32.25	61.312 28. 32.25
Propeller Shaft Ratio			Direct	3:2	3:2
Dry Weight Pounds	370	370	610	640	640
A.T.C. No.	Pending	Pending	None	84	185

I. Inline = inverted inline.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Ranger</i>	<i>Ranger</i>	<i>Ranger</i>	<i>Rearwin Ken-Royce</i>	<i>Rearwin Ken-Royce</i>
Type	V	V	V	Radial	Radial
Model Number	SGV-770B-6	SGV-770B-7	SGV-770B-4	5E	5F
No. of Cylinders	12	12	12	5	5
Blower	8.84:1	Restricted	7.71:1		
Norm. H.P. Take-Off	500	Restricted		70	90
R.P.M.	2950			1950	2250
Norm. H.P. Rtg. Alt.	420 2850 5700	Restricted	450 2900 Sea Level	70 1950 Sea Level	90 2250 Sea Level
Fuel Octane No.	87	87	87	70	70
Cubic Inch Displ't	772.8	773	773	250.5	266
Bore & Stroke	4 5.125	4 5.125	4 5.125	4.125 3.75	4.25 3.75
Size in Inches					
Diam.				33.25	33.25
Length	61.312	61.312	61.312		
Width	28.	28.	36.625		
Height	32.25	32.25	32.625		
Propeller Shaft Ratio	3:2	3:2	3:2	1:1	1:1
Dry Weight Pounds	640	Restricted	655+	245	226
A.T.C. No.	207	Mil.		48	46

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Rearwin Ken-Royce</i>	<i>Warner Scarab Junior</i>	<i>Warner Scarab</i>	<i>Warner Super Scarab Series 50</i>	<i>Warner Super Scarab Model 165</i>
Type	Radial	Radial	Radial	Radial	Radial
Model Number	7F	Series 50	Series 50	Series 50	Model 165
No. of Cylinders	7	5	7	7	7
Blower					
Norm. H.P. Take-Off	120				175
R.P.M.	2225				2250
Norm. H.P. Rtg.	120	90	125	145	165
R.P.M. Alt.	2225	2025	2050	2050	2100
	Sea Level	Sea Level	Sea Level	Sea Level	Sea Level
Fuel Octane No.	73	73	73	73	73
Cubic Inch Displ'mt	372	301	422	499	499
Bore & Stroke	4.25	4 1/4	4 1/4	4 5/8	4 5/8
	3.75	4 1/4	4 1/4	4 1/4	4 1/4
Size in Inches					
Diam.	33.25	36 9/16	36 9/16	36 9/16	37 1/4
Length					
Width					
Height					
Propeller Shaft Ratio	1:1	Direct	Direct	Direct	Direct
Dry Weight Pounds	285	230	285	305	332
A.T.C. No.	52	54	2	104	214

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Wright Double-Row Cyclone 14	Wright Double-Row Cyclone 14	Wright Double-Row Cyclone 14	Wright Double-Row Cyclone 14	Wright Double-Row Cyclone 14
Type	Radial	Radial	Radial	Radial	Radial
Model Number	GR2600 A2	GR2600 A2A	GR2600 A2B	GR2600 A5A	GR2600 A5B
No. of Cylinders	14	14	14	14	14
Blower	7.40: 1	7.00: 1	7.00: 1	7.14: 1 10: 1	7.14: 1 10: 1
Norm. H.P.	1500	1600	1600	1600	1600
Take-Off R.P.M.	2300	2400	2400	2400	2400
Norm. H.P.	1200	1350	1350	1350	1350
Rtg. R.P.M.	2100	2300	2300	2300	2300
Alt.	5400	5000	5800	5000	5000
Fuel Octane No.	95	95	90	95	90
Cubic Inch Displ'mt	2603	2603	2603	2603	2603
Bore & Stroke	6.125 6.312	6.125 6.312	6.125 6.312	6.125 6.312	6.125 6.312
Size in Inches Diam. Length Width Height	55	55	55	55	55
Propeller Shaft Ratio	.666*	.5625*	.5625*	.5625*	.5625*
Dry Weight Pounds	1875	1935	1935	1950	1950
A.T.C. No.	176		176		

* Also available with .4375 and .500 reduction gear ratio.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Wright Double-Row Cyclone 14	Wright Cyclone G-200	Wright Cyclone G-200	Wright Cyclone G-200	Wright Cyclone G-200
Type	Radial	Radial	Radial	Radial	Radial
Model Number	GR2600 ASD	GR-1820 G-202A	GR-1820 G-203A	GR-1820 G-205A	GR-1820 G-202B
No. of Cylinders	14	9	9	9	9
Blower	7.14:1 10:1	7.00:1	8.3:1	7.14:1 10:1	7.0:1
Norm. H.P.	1500	1200	1100	1200	1100
Take-Off R.P.M.	2400	2500	2500	2500	2500
Norm. H.P. Rtg. R.P.M. Alt.	1200 2300 8000	1000 2300 6900	950 2300 9100	1000 2300 4500	950 2300 5000
Fuel Octane No.	87	90	90	90	87
Cubic Inch Displ'mt	2603	1823	1823	1823	1823
Bore & Stroke	6.125 6.312	6.125 6.875	6.125 6.875	6.125 6.875	6.125 6.875
Size in Inches Diam. Length Width Height	55	55.12	55.12	55.12	55.12
Propeller Shaft Ratio	.666*	.666*	.666*	.666*	.666*
Dry Weight Pounds	1950	1310	1290	1302	1305
A.T.C. No.		219			

* Also available with .5625.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Wright Cyclone G-200	Wright Cyclone G-200	Wright Cyclone G-100	Wright Cyclone G-100	Wright Cyclone G-100
Type	Radial	Radial	Radial	Radial	Radial
Model Number	GR1820 G-203B	GR1820 G-205B	GR1820 G-102A	GR1820 G-103A	GR1820 G-105A
No. of Cylinders	9	9	9	9	9
Blower	8.3:1	7.14:1 10:1	7.0:1	8.31:1	7.4:1 10:1
Norm. H.P. Take-Off	960	1100	1100	1000	1100
R.P.M.	2500	2500	2350	2350	2350
Norm. H.P. Rtg.	875	950	900	860	900
R.P.M. Alt.	2300 10200	2300 5000	2300 6700	2300 11100	2300 6700
Fuel Octane No.	87	87	90	90	90
Cubic Inch Displ'mt	1823	1823	1823	1823	1823
Bore & Stroke	6.125 6.875	6.125 6.875	6.125 6.875	6.125 6.875	6.125 6.875
Size in Inches					
Diam.	55.12	55.12	55.10	55.10	55.10
Length					
Width					
Height					
Propeller Shaft Ratio	.666*	.666*	.6875**	.6875**	.6875**
Dry Weight Pounds	1305	1317	1275	1275	1287
A.T.C. No.			169	180	192

* Also available with .5625 reduction ratio.

** Also available with .666 reduction ratio.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Wright Cyclone G-100	Wright Cyclone G-100	Wright Cyclone G-100	Wright Cyclone G-100	Wright Cyclone G
Type	Radial	Radial	Radial	Radial	Radial
Model Number	GR1820 G105C	GR1820 G102B	GR1820 G103B	GR1820 G105B	R & GR1820 G-2
No. of Cylinders	9	9	9	9	9
Blower	7.14: 1 10:1	7.00: 1	8.31: 1	7.14: 1 10: 1	7.0: 1
Norm. H.P.	1050	1000	900	1000	1000
Take-Off R.P.M.	2350	2350	2350	2350	2200
Norm. H.P.	900	850	800	850	850
Rtg. R.P.M.	2300	2300	2300	2300	2100
Alt.	5000	7500	11900	7500	5800
Fuel Octane No.	90	87	87	87	87
Cubic Inch Displ't	1823	1823	1823	1823	1823
Bore & Stroke	6.125	6.125	6.125	6.125	6.125
	6.875	6.875	6.875	6.875	6.875
Size in Inches					
Diam.	55.10	55.10	55.10	55.10	54.25
Length					
Width					
Height					
Propeller Shaft Ratio	.6875*	.6875*	.6875*	.6875*	.6875**
Dry Weight Pounds	1287	1275	1275	1287	1198
A.T.C. No.					157

* Also available with .666 reduction gear ratio.

** Also direct.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Wright Cyclone G	Wright Cyclone G	Wright Cyclone G	Wright Cyclone F50 & F60	Wright Cyclone F50 & F60
Type	Radial	Radial	Radial	Radial	Radial
Model Number	R & GR1820 G3	R & GR1820 G3B	R & GR1820 G5	R1820 F-52	GR1820 F-52
No. of Cylinders	9	9	9	9	9
Blower	8.31:1	8.31:1	7.14:1 10:1	7.00:1	7.00:1
Norm. H.P. Take-Off	875	900	1000	890	875
R.P.M.	2200	2350	2200	2200	2200
Norm. H.P. Rtg.	840	820	850	775	760
R.P.M. Alt.	2100 8700	2100 8800	2100 6000	2100 5800	2100 5800
Fuel Octane No.	87	87	87	87	87
Cubic Inch Displ'mt	1823	1823	1823	1823	1823
Bore & Stroke	6.125 6.875	6.125 6.875	6.125 6.875	6.125 6.875	6.125 6.875
Size in Inches					
Diam.	54.25	54.25	54.25	54.12	54.12
Length					
Width					
Height					
Propeller Shaft Ratio	.687*	.687*	.687*	Direct	.6875
Dry Weight Pounds	1198	1198	1210	1000	1095
A.T.C. No.	171	171	154	148	148

* Also available with direct drive.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Wright Cyclone F 50 & F 60	Wright Cyclone F 50 & F 60	Wright Cyclone F 50 & F 60	Wright Cyclone F 50 & F 60	Wright Cyclone F 50 & F 60
Type	Radial	Radial	Radial	Radial	Radial
Model Number	R1820 F-53	GR1820 F-53	R1820 F-56	GR1820 F-56	R & GR1820 F-55
No. of Cylinders	9	9	9	9	9
Blower	8.31:1	8.31:1	8.83:1	8.83:1	7.14:1 10:1
Norm. H.P. Take-Off	785	770	785	770	875
R.P.M.	2200	2200	2200	2200	2200
Norm. H.P. Rtg. R.P.M. Alt.	745 2100 9600	730 2100 9600	755 2100 11300	740 2100 11300	760 2100 5800
Fuel Octane No.	87	87	87	87	87
Cubic Inch Displ'mt	1823	1823	1823	1823	1823
Bore & Stroke	6.125 6.875	6.125 6.875	6.125 6.875	6.125 6.875	6.125 6.875
Size in Inches Diam. Length Width Height	54.12	54.12	54.12	54.12	54.12
Propeller Shaft Ratio	Direct	.6875	Direct	.6875	.6875*
Dry Weight Pounds	1000	1095	1000	1095	1012 & 1107
A.T.C. No.	149	149	159	159	198

* Also direct.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	Wright Cyclone F50 & F60	Wright Cyclone F50 & F60	Wright Whirlwind	Wright Whirlwind	Wright Whirlwind
Type	Radial	Radial	Radial	Radial	Radial
Model Number	GR1820 F-62	R & GR1820 F-65	R760 ET	R760 E1	R760 E2
No. of Cylinders	9	9	7	7	7
Blower	7.00:1	7.14:1 10:1	None	7.05	9.17
Norm. H.P. Take-Off	900	900	235	300	350
R.P.M.	2350	2350	2200	2250	2400
Norm. H.P. Rtg. Alt.	760 2100 5800	760 2100 5800	235 2000 Sea Level	285 2100 Sea Level	320 2200 Sea Level
Fuel Octane No.	87	87	73	73	80
Cubic Inch Displ'mt	1823	1823	756	756	756
Bore & Stroke	6.125 6.875	6.125 6.875	5.0 5.5	5.0 5.5	5.0 5.5
Size in Inches Diam. Length Width Height	54.12	54.12	45	45	45
Propeller Shaft Ratio	.6875	.6875*	Direct	Direct	Direct
Dry Weight Pounds	1095	1012 & 1107	540	570	570
A.T.C. No.	148	198	126	94	155

* Also direct.

AIRCRAFT ENGINE SPECIFICATIONS

Name of Engine	<i>Wright Whirlwind</i>	<i>Wright Whirlwind</i>	<i>Wright Duplex-Cyclone</i>		
Type	Radial	Radial	Radial		
Model Number	R975 E1	R975 E3			
No. of Cylinders	9	9	18		
Blower	7.80	10.15			
Norm. H.P.	365	450	2000		
Take-Off R.P.M.	2100	2250	Restricted		
Norm. H.P. Rtg. R.P.M. Alt.	365 2100 Sea Level	412 2200 Sea Level	Restricted Restricted Restricted		
Fuel Octane No.	73	80	Restricted		
Cubic Inch Displ'mt	973	973	Restricted		
Bore & Stroke	5.00 5.5	5.00 5.5	Restricted		
Size in Inches Diam. Length Width Height	45	45	Restricted		
Propeller Shaft Ratio	Direct	Direct	Restricted		
Dry Weight Pounds	660	675	Restricted		
A.T.C. No.	87	125	Restricted		

CHRONOLOGY FOR 1939

- Jan. 7 Max Constant wins New York to Miami Sports record, flying Jacqueline Cochran's Wasp Junior-powered Beechcraft, 1,195 mi. in 5 hrs. 43 min.
- Jan. 9 National Advisory Committee for Aeronautics in annual report warns of European efforts to surpass the United States in aeronautical research.
- Jan. 11 Forty-five of 48 Consolidated Navy patrol bombing planes that left San Diego, Calif., complete their non-stop flight of 3,000 mi. to Fleet air base at Coco Solo, C. Z.
- Jan. 14 Private Frederick H. Wilson, air mechanic in Army Air Corps at Mitchell Field, is awarded Soldier's Medal by War Department for heroism in extinguishing a fire in a burning airplane at field July 5, 1938.
- Jan. 16 Hermilinda Briones, Ecuador woman flier, and her mechanic are picked up at sea between Key West and Havana, when her small open cockpit plane ran out of gas and sank.
- Jan. 17 Fifty-four planes, comprising the Marine Corps force to operate in Winter maneuvers with the Atlantic Fleet, arrive at Isla Grande Air Base, Puerto Rico, from Quantico, commanded by Col. Roy Geiger.
- Jan. 23 Flying the last leg of 1,000 mi. from Coco Solo, Fleet Patrol Wing One completes its flight from its San Diego, Calif., base when Capt. Marc A. Misher brings 4 squadrons, 48 planes, down on San Juan Bay. The planes were Consolidated Patrol boats.
- Jan. 24 Test pilot H. Lloyd Child sets new speed record of 575 m.p.h. in Cyclone-powered Curtiss Hawk 75A, above Buffalo Airport. Dive was from height of 22,000 ft., leveling out at 4,000 ft.
- Feb. 2 Sperry Gyroscope Co., Brooklyn, N. Y., is awarded Gold Medal of the American Institute in recognition of scientific achievements.
- Feb. 4 Commanded by Major Caleb V. Haynes, U. S. Army Air Corps, the Boeing XB-15 powered with four Pratt and Whitney engines of 1,000 h.p., each, takes off from Langley Field, Va., loaded with medical supplies for the relief of sufferers from the earthquake in Chile. With landings at the Canal Zone, and Lima, Peru, the aerial mercy mission reached its destination at Santiago, Chile, on Feb. 6. The plane arrived home Feb. 14, whereupon Major Haynes was presented with the Distinguished Flying Cross.
- Feb. 5-6 International speed record of 152.159 m.p.h. is established by A. Henshaw, Great Britain, for flight from London, England to Capetown, Africa in 39 hrs. 25 min. in Percival "New Gull" airplane with D. H. Gipsy VI-2 205 HP engine. Speed for return trip 151.456 m.p.h. in 39 hrs. 36 min.
- Feb. 8 Ten new Douglas B-18 bombers arrive at Balboa, C. Z., to reinforce the Army Air Corps units at Albrook and France Fields. They flew from Randolph Field, Tex., with one overnight stop at Guatemala.
- Feb. 9 Brig. Gen. Delos C. Emmons is named commander of the General Headquarters Air Force at Langley Field Va., with the rank of Major General. Col. George H. Brett, also of the air force, is promoted to Brigadier General.
- Feb. 11 Lieut. Ben S. Kelsey, Air Corps, lands at East Hempstead, N. Y., in Allison-powered twin engine Lockheed P-38 pursuit plane after non-stop flight from March Field, Calif., in 7 hrs. 45 min. 36 sec.
- Feb. 28 Intended for use in compiling weather data to aid transatlantic commercial aviation, radio meteorograph balloons, sent to height of 35,000 feet, registering 60 degrees below zero, declared success in first open ocean trial.
- Mar. 3 Leslie L. Irvin, of Buffalo and London, England, awarded Wakefield Gold Medal of the Royal Aeronautical Society of England for "outstanding and meritorious accomplishments in parachute design."

- Mar. 4 President Roosevelt requests Congress to make an appropriation of \$7,300,000 to be used by the Civil Aeronautics Authority in training 20,000 civilian pilots.
- Mar. 5 Non-stop air mail system by pickup method demonstrated at Coatesville, Pa., with Stinson Reliant planes, by pilots Norman Rintoul and Victor Yesulantes for All American Aviation, Inc.
- Mar. 6-7 M. Lualdi, G. Mazzotti and E. Valente, Italy, establish international speed record of 242.938 m.p.h. in 11 hrs. 25 min. from Rome, Italy to Addis Abbaba, Ethiopia in Fiat BR. 20 L airplane with 2 Fiat Asso 80 1,000 HP engines.
- Mar. 17 Lieut. Richard L. Burke, commander of Coast Guard air base at Cape May, N. J., flew 90 mi. to sea and rescued 2 men from fishing boats who needed hospital attention.
- Mar. 24 Jacqueline Cochran in Beechcraft plane, Twin Wasp powered, sets woman's national altitude record of 30,052.43 ft. over Palm Springs, Calif.
- Mar. 26 Capt. John Henry Towers, U. S. Navy, becomes Chief of Bureau of Aeronautics with rank of Rear Admiral.
- Mar. 30 Navy Department contracts with Newport News Shipbuilding and Drydock Co. for aircraft carrier Hornet, to cost \$31,800,000, exclusive of armor and armament.
- Apr. 2 Trans-Canada Air Lines, with Lockheed 14 transports, starts passenger service over its route between Montreal and Vancouver.
- Apr. 3 The National Defense Act of 1940, providing for aerial rearmament, is signed by President Roosevelt.
- Apr. 4 The U. S. airplane carrier "Wasp" launched at Quincy, Mass.
- Apr. 12 Robert H. Hinckley appointed Chairman of the U. S. Civil Aeronautics Authority.
- Apr. 16 Pan American Airways Boeing "Yankee Clipper" completes final route survey over North Atlantic.
- Apr. 27-28 Brig. Gen. Vladimir Kokkinaki and Major Mikhail Gordienko, Russian airmen, forced down in New Brunswick swamp in flight from Moscow, having flown their twin-engine Russian bomber type monoplane about 4,000 mi. non-stop in about 24 hrs. Engines about 1,000 h.p. each.
- May 10 U. S. Post Office Department starts airplane mail pick-up service over routes covering 1,040 miles in Pennsylvania, West Virginia, Ohio and Delaware, contract for one year going to All-American Aviation, Inc. of Wilmington, Del., using Stinson Reliant planes.
- May 17 Carl Backman, Swedish aviator, is missing in his attempt to fly the Atlantic from Newfoundland to Leksand, Sweden.
- May 18 The French flying boat, Lieut. de Vaisseau Paris, arrives at Port Washington, N. Y., completing the first half of second round-trip survey flight of 4,400 mi. from Biscarosse, France, via Lisbon, the Azores and Bermuda; Capt. Henri Guillaumet in command.
- May 19 The Civil Aeronautics Authority authorizes Pan American Airways to operate a transatlantic commercial air service.
- May 20 First North Atlantic air mail service started by Pan American Airways on southern route to Azores, Portugal and Marseilles, France, from Port Washington, N. Y., by Boeing "Yankee Clipper" powered by 4 Wright Cyclone engines, Capt. Arthur E. LaPorte, commanding. Three Pan American technical observers aboard, with crew of 14. Arrived Marseilles, May 22, with 1,804 lbs. mail. Return flight from Marseilles, May 25; arrival Port Washington, May 27, with 2,024 lbs., mail. Total mileage 9,300.

- May 24 Non-stop record flight, Mexico City to Floyd Bennett Field, Brooklyn N. Y., 2,350 mi., set by Francisco Sarabia, Mexican aviator; Time 10 hrs. 45 min., beating record of 14 hrs. 19 min., set by Amelia Earhart, May 8, 1935. Sarabia flew a Gee Bee racer. Was killed in crash while taking off for return trip from Washington, D. C. on June 7.
- June 17 Pan American Airways' Boeing "Dixie Clipper" departs Port Washington, N. Y., by southern route for Marseilles, France, via Azores and Portugal, carrying 16 press and broadcasting representatives as special observers. Arrives Marseilles, June 19. Mail 609 lbs. Return trip leaves Marseilles, June 22, arrives Port Washington, June 25. Mail 257 lbs.
- June 23 War Dept. awards Soldier's Medal to Capt. Franklin C. Wolfe, of the Air Corps for "extraordinary achievement" in flying medical supplies to earthquake refugees in Chile Jan. 28-Feb. 13, 1939.
- June 24 First North Atlantic air mail service on northern route via New Brunswick, Newfoundland, Eire and England, started by Pan American Airways' Boeing "Yankee Clipper" from Port Washington, N. Y., with arrival at Southampton, Eng., June 28. Government officials and others aboard as special observers and guests total 20. Capt. Harold E. Gray commanding. Mail 2,543 lbs. Return flight from Southampton June 30; arrival Port Washington, July 1. Mail 925 lbs. Total mileage 6,836.
- June 25 Major Gen. Pedro Aurelio de Goes Monteiro, Chief of Staff of the Brazilian Army, and his staff, inspect Randolph Field, the "West Point of the Air," in Texas. Other Air Corps fields were subsequently visited and inspected.
- June 27 Fifteen Consolidated Navy patrol bombers take off from San Diego Bay under command of Lt. Comdr. S. L. La Hache on non-stop flight to Hawaii, completing the flight of 2,250 nautical mi. in 16 hrs. 39 min.
- June 28 First North Atlantic airplane passenger service started by Pan American Airways on southern route to Azores, Portugal and Marseilles, France, from Port Washington, N. Y., by Boeing "Dixie Clipper," with 21 passengers and crew of 9, Capt. R. O. D. Sullivan commanding. Arrived Marseilles, June 30. Mail 416 lbs. Return flight from Marseilles, July 2; arrival Port Washington, July 4, with 13 passengers and 174 lbs., mail. Total mileage 9,300.
- July 1 Consolidated flying boat Guba, bearing the Richard Archbold New Guinea expedition of the American Museum of Natural History, alights on Jamaica Bay, Brooklyn, N. Y., ending an 18,000-mi. journey from Sydney, Australia, begun June 2.
- July 2 Chet Decker, Glen Rock, N. J., in German sailplane, sets new unofficial American distance record of 233 mi., Elmira, N. Y., to Atlantic City, N. J.
- July 4 Lieut. Robt. M. Stanley, U. S. Navy, sets American altitude record at Elmira, N. Y., for single place gliders when he soars to 17,263.743 ft.
- July 6 Eastern Air Lines autogiro takes off from roof of Philadelphia Post Office with mail for Camden, N. J., airport and makes the round trip in 15 min., transporting 49,012 pieces of mail, weighing 600 lbs.
- July 8 First North Atlantic airplane service on northern route started by Pan American Airways' Boeing "Yankee Clipper" from Port Washington, N. Y., via New Brunswick, Newfoundland, Eire to Southampton, Eng., with 17 passengers and crew of 12, Capt. Arthur E. LaPorte commanding. Arrived Southampton, July 9. Mail 614 lbs. Return flight from Southampton, July 12; arrival Port Washington, July 13, with 19 passengers and 410 lbs., mail. Total mileage 6,836.
- July 14 A 15-ton Consolidated patrol bomber built in the U. S., piloted by Russell Rogers, lands at Felixtowe Airport, England, 3 days, 23 hrs. 10 min. out of San Diego, Calif., a distance of 5,750 mi.

- July 25 War Dept. awards Soldier's Medal for "extraordinary achievement" to four officers for developing Army's stratosphere plane and automatic landing system. They are Major Carl F. Greene and Capt. Alfred H. Johnson for stratosphere plane; Capt. Carl J. Crane and Capt. George V. Holloman for automatic landing system.
- July 26 An Army Boeing B-17 Flying Fortress carrying a load of 1,123 lbs. sets a new speed record over a closed triangular course of 1,000 kms. It averaged 204 m.p.h.
- July 27 Major Carl F. Greene, Capt. Alfred H. Johnson, Capt. Carl J. Crane and Capt. George V. Holloman receive Distinguished Flying Cross for "extraordinary achievements" while participating in aerial flights.
- July 30 U. S. Army regains world record for payload carrying when Major Caleb V. Haynes & Capt. W. D. Old fly Army Boeing super-Flying Fortress to 8,200 ft. with payload to 15½ tons at Wright Field, Dayton, O. Record breaks Russian mark of payload by more than ton.
- July 30 International speed record of 311.173 m.p.h. is established by Ernst Seibert, Germany, in Junkers Ju 88 D-ATYU airplane with 2 Jumo 211 engines for flight from Dessau to Zugspitze.
- Aug. 2 U. S. Army observes 30th anniversary of introduction of military aviation in the U. S. Army Air Corps stations throughout nation observe day with appropriate ceremonies.
- Aug. 2 Two international records fall to the Army Air Corps, making a total of 6 world records and 15 national records captured by standard combat planes of the Air Corps in connection with its nation-wide observance of the purchase of the first Army airplane from the Wright brothers on Aug. 2, 1909.
- Aug. 11 Imperial Airways flying boat "Caribou" reaches Southampton, England, from Port Washington, N. Y., completing first round trip in British transatlantic air mail service.
- Aug. 26 Japanese goodwill flight, sponsored by Osaka Mainichi and the Tokyo Nichi Nichi, newspapers, in the Mitsubishi twin-engine transport monoplane "Nippon," is launched at Tokyo by initial flight to Sapporo, 1,000 kms., distant. Succeeding days took crew of six, with Takeo Ohara as goodwill envoy, to Alaska, United States, South America, Africa, Spain, Italy, India and Siam; thence back to Tokyo, a total distance of 32,846 mi., in 55 days of 194 hrs., flying time. The flight ended Oct. 20.
- Aug. 30 The Pan American Airways "California Clipper" lands at Auckland, New Zealand, at 2:20 p.m., completing first flight of fortnightly service from San Francisco, Calif.
- Sept. 2 Frank Fuller, Jr., wins Bendix Trophy race with elapsed time from Burbank, Calif., to Bendix, N. J., 9 hrs. 2 min. 5 sec. By setting records between Burbank and Cleveland, O., and between Burbank and Bendix, N. J., he wins \$12,500. Average speed 217 m.p.h. He flew Wasp powered Seversky racer.
- Sept. 5 Col. Roscoe Turner wins the 300-mi. Thompson Trophy race at National Air Races at Cleveland, O., at 282.536 m.p.h., in a Turner-Laird racer with Twin Wasp engine. Third triumph for Turner who announces retirement from racing.
- Sept. 10 Devon Francis, aviation editor of the Associated Press, is elected president of the Aviation Writers Association. Other officers are James Bassett and Maurice Rossi, vice-presidents, and Michael Froelich, secretary-treasurer.
- Sept. 13 Dr. A. W. Winston, chief metallurgist of the Dow Chemical Co., informs the Electrochemical Society that as a result of development of new high-strength magnesium alloys, military airplane speeds of over 400 m.p.h. are practicable.

- Sept. 15 Jacqueline Cochran, in Seversky monoplane, Pratt & Whitney Wasp 700 h.p. engine, sets new international speed record of 305.926 m.p.h. for 1,000 kms. on Burbank, San Francisco, Burbank course.
- Sept. 25 Col. Nicola de Mauro, at Vigna di Valle, Italy, establishes new world altitude record for seaplanes of 44,429.044 ft., in Caproni 161 seaplane, Piaggio XI RC 100 engine. Former record made by Lt. Apollo Soucek, U. S. Navy, in 1929.
- Sept. 25 Fourteen U. S. Navy Consolidated patrol bombers alight at Cavite, P. I., completing the first Hawaii-to-Manila mass flight ever attempted.
- Oct. 2 The Moffett Memorial Trophy for best safety record in 1939 is won by the aviation unit of the battleship Tennessee.
- Oct. 12 Harry B. Chapman, in Aeronca seaplane, powered with Continental 65 h.p. engine, establishes world's distance record for light seaplanes in 1,163.8 mi. flight from Jamaica Bay, N. Y. non-stop to New Orleans. Former record was 898 mi. held by Dewey Eldred, set in January, 1939, in Taylorcraft, powered by 50 h.p. Lycoming engine in flight from Port Washington, N. Y., to Daytona, Fla.
- Oct. 15 New York Municipal Airport (LaGuardia Field), at North Beach, Queens, N. Y., is officially dedicated.
- Oct. 31 Mackay Army Trophy for 1938 presented to the 2nd Bombardment Group, Langley Field, Va. by the Secretary of War, Harry H. Woodring. The trophy was won as a result of the efficient and successful completion of the flight of 6 B-17 Boeing Flying Fortresses from Langley Field, Va., to Buenos Aires, Argentina, and return during February, 1938.
- Oct. 31 Comdr. Humberto Gallino and Capt. Victor Gallino, Peruvian brothers, land on Puna Island in the Gulf of Guayaquil off Ecuador, after flying approximately 3,300 mi., from New York, which they left Oct. 29 in a Barkley-Grow monoplane, powered by 2 Pratt & Whitney Wasp Junior engines. Lack of fuel forces plane to land short of Lima, Peru, its goal.
- Nov. 10 Seven U. S. Army Air Corps Boeing Flying Fortresses powered with Wright 1,000 h.p. Cyclones, carrying 57 officers and men, leave Langley Field, Va., on a 6,000 mi. good will flight to Rio de Janeiro to participate in the 50th anniversary of the founding of the Republic of Brazil. The 7 B-17B bombers arrived home at Washington, D. C., Nov. 26, completing a 12,500 mi. flight in 70 hrs. flying time.
- Nov. 14 President Roosevelt presents the Schiff Trophy, awarded annually to the naval aviation unit with the best safety record, to Lt. Comdr. Frank T. Ward, Jr., of Patrol Squadron II. His squadron flew 4,903 hrs. without a mishap in 1938.
- Nov. 15 First night non-stop airmail pick-ups in history are made at three of the 28 stations on All American Aviation's Pittsburgh-Philadelphia pick-up route. Pilot Holger Hairis of Wilmington, Del., hauled up mail at Butler, Natrona and Grove City on a 65-mi. flight.
- Nov. 17 Howard Hughes and the 4 men who accompanied him on his record breaking flight around the world in July, 1938, are designated as the recipients of the Collier Trophy for 1938.
- Nov. 26 The Daniel Guggenheim Medal for 1939 is awarded to Donald Wills Douglas, President of the Douglas Aircraft Company, of Santa Monica, Calif., "for outstanding contributions to the design and construction of transport airplanes."
- Dec. 18 Pan American Airways' "American Clipper" marks the 100th regularly scheduled crossing of the Atlantic Ocean since service began May 20. The flying boat, under command of Capt. Harold E. Gray, carried 18 passengers and 2,000 lbs. of Christmas mail.

Flying Facts and Figures

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SUMMARY OF AIR CARRIER OPERATIONS

Air Lines in the United States

Corrected by U. S. Civil Aeronautics Authority

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	325	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	187,858,620	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	205	82,571,523	1,876,051	749,787,096	9,514,299	17,170,021,595

¹ Mail pound miles flown are for domestic services and Inter-Island Airways which company holds a domestic air mail contract; but does not include American Aviation, Inc. pickup service.

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.

U. S. DOMESTIC AIR LINE OPERATIONS

And Accident Statistics for the Yearly Periods

March 27, 1937-March 26, 1938; March 27, 1938-March 26, 1939, and

March 27, 1939-March 26, 1940.

	For 12 Mo. Ending Mar. 26, 1938	For 12 Mo. Ending Mar. 26, 1939	For 12 Mo. Ending Mar. 26, 1940
Miles Flown.....	67,002,154	71,080,308	87,325,145
Total Passengers Carried.....	1,157,738	1,389,818	2,028,817
Total Passenger Miles.....	503,484,761	565,220,938	814,906,250
Fatal Accidents.....	4	5	0
Fatal Passenger Accidents.....	4	5	0
Passenger Fatalities.....	32	20	0
Crew Fatalities.....	10	8	0
Miles Flown per Fatal Accident.....	16,750,539	14,216,062	.....
Miles Flown per Fatal Passenger Accident..	16,750,539	14,216,062	.....
Passenger Miles Flown per Passenger Fatality	15,733,899	28,261,047	.....
Miles Flown per Crew Fatality.....	6,700,215	8,885,039	.....

UNITED STATES AIR CARRIER OPERATIONS

Compiled by U. S. Civil Aeronautics Authority

April 1, 1940

Miles of American-operated air transport routes:	
Domestic.....	35,213
Foreign and Territorial.....	43,528
	78,741
Miles in operation with United States mail:	
Domestic.....	34,519
Foreign and Territorial.....	38,751
	73,270
Miles in operation with passengers:	
Domestic.....	35,213
Foreign and Territorial.....	43,528
	78,741
Miles in operation with express:	
Domestic.....	35,213
Foreign and Territorial.....	43,528
	78,741
Airplane-Miles scheduled daily (Average):	
Domestic.....	265,130
Foreign and Territorial.....	30,453
	295,583
With United States Mail:	
Domestic.....	250,153
Foreign and Territorial.....	25,839
	275,992
With passengers:	
Domestic.....	265,130
Foreign and Territorial.....	30,453
	295,583
With express:	
Domestic.....	265,130
Foreign and Territorial.....	30,453
	295,583
Number of Air Transport Services in operation.....	
Mail.....	170
Passenger.....	140
Express.....	170
Domestic routes.....	170
Mail.....	129
Passenger.....	109
Express.....	129
Foreign routes.....	120
Mail.....	41
Passenger.....	31
Express.....	41
Number of scheduled air transport operators ¹	41
Domestic.....	21
Foreign and Territorial.....	17
	7

¹ Three companies operated both domestic and foreign services.

UNITED STATES AIR TRANSPORT ROUTES

Official Reports of U. S. Civil Aeronautics Authority

April 1, 1940

Routes	Airway miles ¹	Schedule (round trips)	Plane-miles scheduled daily average ²	Operator
DOMESTIC				
New York to Los Angeles via Washington, Nashville and Dallas....	2,754	3 times daily...	16,524	American Airlines, Inc.
New York-Newark to Los Angeles via Washington, Nashville and Dallas....	2,754	daily.....	5,508	"
New York-Newark to Dallas via Washington and Nashville.....	1,458	daily.....	2,916	"
New York to Washington.....	214	3 times daily...	1,284	"
New York to Washington.....	214	4 times daily...	1,712	"
New York-Newark to Chicago via Buffalo.....	773	2 times daily...	3,092	"
New York-Newark to Chicago (direct).....	728	3 times daily...	4,368	"
New York to Chicago via Buffalo.....	773	4 times daily...	6,184	"
New York to Chicago (direct).....	728	daily.....	1,456	"
New York to Cleveland via Syracuse.....	558	2 times daily...	2,232	"
New York-Newark to Detroit via Buffalo.....	530	daily.....	1,060	"
Boston to Chicago via Buffalo.....	849	daily.....	1,698	"
Boston to Syracuse.....	280	daily.....	560	"
Detroit to Chicago (direct).....	243	daily.....	486	"
Detroit to Chicago via Battle Creek	259	daily.....	518	"
New York-Newark to Boston (direct).....	202	4 times daily...	1,616	"
New York-Newark to Boston via Hartford and Providence.....	220	3 times daily...	1,320	"
New York-Newark to Boston via Providence.....	211	daily.....	422	"
New York-Newark to Boston via Hartford and Springfield.....	224	daily.....	448	"
New York-Newark to Boston via Hartford.....	202	daily.....	404	"
New York to Boston (direct).....	186	8 times daily...	2,976	"
New York to Boston via Providence.....	195	daily.....	390	"
Cleveland to Nashville.....	464	2 times daily...	1,856	"
Cincinnati to Louisville.....	91	daily.....	182	"
Washington to Chicago.....	683	3 times daily...	4,098	"
Washington to Cincinnati.....	414	daily.....	828	"
Chicago to Fort Worth via St. Louis and Tulsa.....	924	2 times daily...	3,696	"
Chicago to St. Louis.....	251	daily.....	502	"
Boston to Bangor.....	217	2 times daily...	868	Boston-Maine Airways, Inc.
Bangor to Caribou.....	167	daily.....	334	"
Boston to Burlington.....	184	2 times daily...	736	"
Chicago to Dallas via Kansas City and Wichita.....	925	2 times daily...	3,700	Braniff Airways, Inc.
Chicago to Dallas via Kansas City and Wichita.....	925	daily.....	1,850	"
Dallas to Brownsville via San Antonio.....	546	2 times daily...	2,184	"

United States Air Transport Routes (April 1, 1940)—Continued

Routes	Airway miles ¹	Schedule (round trips)	Plane-miles scheduled daily average ²	Operator
DOMESTIC—continued				
Dallas to San Antonio.....	202	daily.....	584	Braniff Airways, Inc.
Dallas to Houston.....	241	daily.....	482	"
Dallas to Houston.....	241	daily.....	482	"
Houston to Corpus Christi.....	185	daily.....	370	"
Houston to San Antonio.....	193	daily.....	386	"
Amarillo to Galveston via Dallas...	614	2 times daily...	2,456	"
Chicago to New Orleans via St. Louis.....	854	3 times daily...	5,124	Chicago & Southern Air Lines
Denver to El Paso.....	579	2 times daily...	2,316	Continental Air Lines, Inc.
Pueblo to Wichita via Garden City.	410	daily.....	838	"
Charleston to Fort Worth via Atlanta.....	960	2 times daily...	3,840	Delta Air Corporation
Atlanta to Birmingham.....	134	3 times daily...	804	"
New York to New Orleans via Atlanta.....	1,057	3 times daily...	6,342	Eastern Air Lines, Inc.
New York to Atlanta.....	796	daily.....	1,592	"
New York-Newark to Richmond...	310	2 times daily...	1,240	"
New York to Miami.....	1,201	3 times daily...	7,206	"
New York-Newark to Miami.....	1,201	daily.....	2,402	"
New York to Washington.....	214	3 times daily...	1,284	"
Newark to Washington.....	198	6 times daily...	2,376	"
New York to Washington.....	214	3 times daily...	1,284	"
Newark to Washington.....	198	daily.....	396	"
Chicago to Miami via Jacksonville.	1,255	3 times daily...	7,530	"
New Orleans to San Antonio.....	515	2 times daily...	2,060	"
New Orleans to Brownsville.....	636	daily.....	1,272	"
Atlanta to Tampa via Tallahassee.	437	daily.....	874	"
Memphis to Tampa via Birmingham and Tallahassee.....	705	daily.....	1,410	"
Cheyenne to Great Falls.....	573	2 times daily...	2,292	Inland Air Lines, Inc.
Cheyenne to Huron via Spearfish...	542	daily.....	1,084	"
St. Louis to Detroit via Cincinnati.	503	4 times weekly.	643	Marquette Airlines, Inc.
Minneapolis to Tulsa via Sioux City and Kansas City.....	703	daily.....	1,406	Mid-Continent Airlines, Inc.
Minneapolis to Kansas City via Huron.....	670	daily.....	1,340	"
Minneapolis to Huron.....	257	daily.....	514	"
Huron to Bismarck.....	220	daily.....	440	"
Kansas City to Tulsa.....	214	daily.....	428	"
Jacksonville to Miami via Daytona Beach and St. Petersburg.....	443	2 times daily...	1,772	National Airlines, Inc.
Jacksonville to New Orleans via Mobile.....	516	daily.....	1,032	"
Chicago to Seattle via Milwaukee, Fargo, Helena and Wenatchee ..	1,659	daily.....	3,318	Northwest Airlines, Inc.
Chicago to Seattle via Rochester, Minneapolis, Fargo and Butte...	1,846	2 times daily...	7,384	"
Chicago to Minneapolis (direct)...	305	2 times daily...	730	"
Chicago to Minneapolis via Milwaukee, Madison and Rochester.	396	2 times daily...	792	"
Spokane to Portland via Yakima...	296	2 times daily...	1,184	"
Norfolk to Detroit via Washington	547	2 times daily...	2,188	Pennsylvania-Central Airlines

United States Air Transport Routes (April 1, 1940)—Continued

Routes	Airway miles ¹	Schedule (round trips)	Plane-miles scheduled daily average ²	Operator
DOMESTIC—continued				
Washington to Detroit.....	402	5 times daily...	4,020	Pennsylvania-Central Airlines
Detroit to Milwaukee.....	260	2 times daily...	1,040	
Grand Rapids to Chicago.....	132	2 times daily...	528	
Washington to Buffalo via Baltimore and Harrisburg.....	320	daily.....	658	"
Detroit to Grand Rapids via Flint and Lansing.....	155	daily.....	310	"
Detroit to Sault Ste. Marie.....	352	daily.....	704	"
New York-Newark to Los Angeles via Philadelphia, Pittsburgh, St. Louis and Kansas City.....	2,572	daily.....	5,144	Transcontinental & Western Air
New York-Newark to Los Angeles via Pittsburgh, St. Louis, Kansas City and Boulder City.....	2,580	daily.....	5,178	
New York to Los Angeles via Pittsburgh and St. Louis.....	2,552	daily.....	5,104	
New York to Los Angeles via Pittsburgh, Chicago and Kansas City.....	2,580	daily.....	5,160	
New York-Newark to Kansas City via Pittsburgh and St. Louis.....	1,126	daily.....	2,252	
New York to Kansas City via Pittsburgh and St. Louis.....	1,126	daily.....	2,252	
New York to Chicago via Philadelphia and Pittsburgh.....	767	daily.....	1,534	
New York to Chicago via Pittsburgh, Dayton & Ft. Wayne.....	798	daily.....	1,596	
New York to Chicago via Philadelphia, Pittsburgh & Ft. Wayne.....	818	daily.....	1,636	
New York-Newark to Chicago via Philadelphia and Pittsburgh.....	767	daily.....	1,534	
New York to Kansas City via Chicago.....	1,135	daily.....	2,270	
New York to Kansas City via Pittsburgh and Chicago.....	1,154	2 times daily...	4,616	
New York-Newark to Pittsburgh via Philadelphia.....	347	2 times daily...	1,388	
Chicago to Kansas City.....	407	daily.....	814	
Phoenix to San Francisco via Las Vegas and Fresno.....	683	daily.....	1,366	
New York to San Francisco via Chicago and Cheyenne.....	2,631	daily.....	5,262	United Air Lines Transport
New York-Newark to San Francisco via Cleveland, Chicago and Denver.....	2,634	2 times daily...	10,536	
New York-Newark to Salt Lake City via Cleveland, Chicago and Cheyenne.....	2,021	daily.....	4,042	
New York to Salt Lake City via Cleveland, Chicago and Cheyenne.....	2,021	daily.....	4,042	
New York to Chicago (direct).....	728	2 times daily...	2,912	
New York to Chicago via Allentown and Cleveland.....	728	daily.....	1,456	
New York-Newark to Chicago via Akron and Cleveland.....	730	daily.....	1,478	
New York to Cleveland via Akron.....	432	daily.....	864	

United States Air Transport Routes (April 1, 1940)—Continued

Routes	Airway miles ¹	Schedule (round trips)	Plane-miles scheduled daily average ²	Operator
DOMESTIC—continued				
Chicago to North Platte.....	688	daily.....	1,376	United Air Lines Transport
Des Moines to Omaha.....	118	daily.....	236	
Cheyenne to Denver.....	96	3 times daily...	384	
New York to Chicago (direct)...	728	daily.....	1,456	
New York-Newark to Cleveland via Philadelphia, Allentown and Akron.....	491	daily.....	982	"
Philadelphia to Allentown.....	54	daily.....	108	
San Diego to Seattle via Bakersfield	1,141	daily.....	2,282	
Los Angeles to Seattle via San Francisco.....	1,028	daily.....	2,056	
Los Angeles to Seattle via San Francisco and Sacramento.....	1,060	daily.....	2,120	"
Sacramento to Oakland.....	67	daily.....	134	
San Diego to San Francisco.....	471	daily.....	942	
Los Angeles to San Francisco via Santa Barbara and Monterey.....	350	daily.....	700	
Los Angeles to San Francisco via Bakersfield and Fresno.....	348	daily.....	696	"
Los Angeles to San Francisco (direct).....	348	daily.....	696	
Los Angeles to San Francisco (direct).....	348	daily.....	696	
Los Angeles to San Francisco via Bakersfield and Fresno.....	348	daily.....	696	
Salt Lake City to Seattle via Pendleton and Portland.....	813	daily.....	1,626	"
Salt Lake City to Portland via Pendleton.....	676	daily.....	1,352	
Portland to Spokane via Pendleton	347	daily.....	694	
Portland to Seattle.....	137	daily.....	274	
Salt Lake City to Great Falls.....	489	2 times daily...	1,956	Western Air Express
San Diego to Salt Lake City.....	713	2 times daily...	2,852	
Los Angeles to Salt Lake City.....	590	daily.....	1,180	
San Diego to Los Angeles.....	123	daily.....	246	
Wilmington to Avalon.....	31	3 times daily...	186	Wilmington-Catalina Airlines
Total Domestic Routes ³	35,213		265,130	
FOREIGN AND TERRITORIAL				
Burlington to Montreal.....	74	2 times daily...	296	Boston-Maine Airways, Inc.
New York to Montreal.....	340	2 times daily...	1,360	
New York to Montreal via Burlington.....	340	daily.....	680	Can. Col. Airways
Honolulu to Hilo.....	229	daily.....	458	
Honolulu to Port Allen.....	120	daily.....	240	Inter-Island Airways.
Fargo to Winnipeg.....	208	2 times daily...	832	
Miami to Havana.....	226	daily.....	452	Northwest Airlines.
Miami to Cristobal via Cienfuegos and Kingston.....	2,019	2 times weekly.	1,153	
Miami to Barranquilla via Cienfuegos and Kingston.....	1,887	2 times weekly.	1,078	Pan American Airways, Inc.
Cristobal to Barranquilla.....	376	2 times weekly.	215	
Barranquilla to Port of Spain.....	980	4 times weekly.	1,120	"
Maracaibo to Port of Spain.....	730	2 times weekly.	417	

United States Air Transport Routes (April 1, 1940)—Continued

Routes	Airway miles ¹	Schedule (round trips)	Plane-miles scheduled daily average ²	Operator
FOREIGN AND TERRITORIAL —continued				
Port of Spain to Paramaribo (direct).....	564	weekly.....	161	Pan American Airways, Inc.
Port of Spain to Paramaribo via Georgetown.....	583	weekly.....	167	"
San Salvador to Cristobal.....	953	4 times weekly.....	1,089	"
Miami to San Juan via Antilla.....	1,137	4 times weekly.....	1,299	"
San Juan to Port of Spain (direct).....	631	2 times weekly.....	361	"
San Juan to Port of Spain via St. Thomas.....	750	weekly.....	214	"
Port au Prince to San Juan.....	415	weekly.....	119	"
Maracaibo to La Guaira.....	343	weekly.....	98	"
Miami to Nassau.....	188	daily.....	376	"
Brownsville to Mexico City via Tampico.....	466	daily.....	932	"
Mexico City to San Salvador.....	812	4 times weekly.....	928	"
Paramaribo to Buenos Aires via Sao Paulo and Asuncion.....	5,548	weekly.....	1,585	"
Paramaribo to Buenos Aires via Porto Alegre.....	4,590	weekly.....	1,311	"
Miami to Merida via Havana.....	717	weekly.....	205	"
Kingston to Port au Prince via Santiago, Cuba.....	455	weekly.....	130	"
San Francisco to Hong Kong via Honolulu and Manila.....	8,748	weekly.....	2,499	"
New York to Bermuda.....	773	2 times weekly.....	442	"
New York to Lisbon, Portugal via Azores.....	4,708	weekly.....	2,690	"
Juneau to Fairbanks via Whitehorse.....	660	weekly.....	189	Pan American Airways, Inc. (Pacific Alaska Airways.
Fairbanks to Nome.....	540	2 times weekly.....	309	"
Fairbanks to Bethel.....	571	weekly.....	163	"
Los Angeles to Mexico City.....	1,619	3 times weekly.....	1,388	Pan American Airways, Inc. (Cia Mexicana de Avia-
Merida to Mexico City.....	734	daily.....	1,468	cion, S. A.)
Tampico to Mexico City via Tuxpan.....	244	daily.....	488	"
Cristobal to Buenos Aires via Santiago, Chile.....	4,410	2 times weekly.....	2,520	Pan American-Grace Airways
Santiago to Buenos Aires.....	871	weekly.....	249	"
Arica to Buenos Aires via La Paz and Cordoba.....	1,649	weekly.....	471	"
Arica to La Paz.....	191	weekly.....	55	"
Seattle to Vancouver.....	123	daily.....	246	United Air Lines Transport
Total Foreign and Territorial Routes ³	43,528		30,453	
GRAND TOTAL ³	78,741		295,583	

¹ Airway miles here given are airport to airport.² Plane miles scheduled to be flown, averaged on a daily basis.³ Airway miles total corrected for duplications when airways are used for two or more services.

MONTHLY AIR CARRIER OPERATIONS

Domestic Air Lines in the U. S.

Compiled by Civil Aeronautics Authority

1936	Miles Flown	Passengers	Passenger Miles	Mail ¹ Pound-Miles	Express Pounds
January	4,245,190	44,061	18,082,807	761,833,427	354,301
February	3,957,795	41,330	18,121,502	745,844,005	353,293
March	4,859,887	70,026	31,720,880	902,748,876	535,736
April	4,884,556	71,449	30,326,036	885,274,141	483,505
May	5,511,070	96,300	40,090,763	920,628,071	483,798
June	5,619,896	97,453	40,252,357	949,827,992	701,142
July	6,043,403	111,072	44,363,070	1,055,014,828	613,837
August	6,046,421	106,143	43,100,200	1,051,115,146	565,358
September	5,756,363	101,230	43,500,531	998,893,813	652,030
October	5,912,660	102,017	44,411,130	1,060,488,440	799,266
November	5,639,008	96,019	42,890,890	984,287,593	751,890
December	5,300,959	82,022	37,952,460	1,166,914,401	663,721
Total	63,777,226	1,020,931	435,740,253	11,482,872,623	6,958,777
1937					
January	4,108,584	46,012	21,378,754	907,002,712	554,030
February	4,590,714	58,008	26,107,787	1,003,256,476	500,004
March	5,485,569	74,972	34,583,708	1,174,070,037	580,602
April	5,350,903	76,190	33,130,248	1,097,607,786	540,310
May	5,821,544	98,035	42,010,428	1,104,136,025	591,011
June	5,811,404	110,842	47,290,270	1,120,742,717	650,700
July	6,230,068	120,571	50,798,434	1,124,011,770	611,562
August	6,312,271	123,550	51,941,845	1,151,850,037	618,113
September	6,213,632	130,296	54,229,561	1,146,860,144	720,470
October	6,084,747	113,539	49,186,173	1,202,650,061	684,241
November	5,311,978	81,654	34,714,921	1,121,521,232	528,603
December	4,762,035	69,029	31,210,027	1,233,749,611	547,705
Total	66,190,639	1,102,707	476,603,165	13,306,460,117	7,127,369
1938					
January	4,995,333	69,435	32,461,176	1,107,694,279	456,303
February	4,560,887	73,563	34,387,696	1,057,451,924	421,326
March	5,540,460	94,112	43,548,986	1,278,562,116	558,113
April	5,621,818	104,661	44,412,815	1,155,775,372	497,225
May	6,278,025	119,293	48,812,927	1,302,524,805	499,080
June	6,136,757	115,255	47,514,079	1,254,096,591	558,710
July	6,270,990	127,590	50,850,047	1,199,405,168	541,346
August	6,360,401	143,488	56,404,509	1,272,873,777	623,770
September	6,151,147	139,297	54,805,506	1,235,017,708	677,564
October	6,302,438	143,993	56,828,286	1,299,263,414	855,151
November	5,776,490	113,621	49,080,543	1,251,886,341	685,389
December	5,665,063	99,119	41,593,798	1,430,568,176	701,090
Total	69,668,827	1,343,427	557,719,268	14,845,719,671	7,335,967
1939					
January	5,453,093	89,002	38,402,960	1,243,868,110	577,082
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	133,460	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	179,955	70,190,181	1,426,340,778	824,030
July	7,541,305	185,643	72,917,924	1,384,715,567	725,922
August	7,638,796	194,418	75,145,452	1,485,144,960	933,905
September	7,447,600	192,544	75,800,149	1,420,683,215	981,461
October	7,625,890	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	71,530,938	1,770,535,125	1,038,278
Total	82,571,523	1,876,051	749,787,096	17,170,021,595	9,514,290

¹ Includes Inter-Island Airways.

U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1939

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 1939, inclusive

<i>Fiscal year</i>	<i>Miles flown</i>	<i>Cost of service</i>	<i>Average cost per mile</i>	<i>Appropriation</i>
Government operation:				
1918.....	16,009	\$ 13,604.00	\$0.850	\$ 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.....	1,524,763	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	12,129,959.64	.417	15,000,000
1935.....	31,147,875	8,814,295.61	.283	12,003,291
1936.....	38,700,643	12,104,797.31	.313	12,172,500
1937.....	39,958,771	13,088,357.90	.328	13,158,000
1938.....	46,166,192	14,666,153.82	.318	14,747,493
1939.....	52,193,772	16,625,473.90	.319	17,240,000

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 air-mail routes, the miles of service scheduled and actually flown, and cost of air-mail service during the fiscal years 1926-39

<i>Fiscal year</i>	<i>Miles of route</i>	<i>Miles of service</i>		<i>Cost of service</i>
		<i>Scheduled</i>	<i>Actually flown</i>	
1926.....	3,597	411,070	396,345	\$ 89,753.71
1927.....	5,551	3,092,016	2,805,781	1,363,227.82
1928.....	10,932	5,999,948	5,585,224	4,042,777.16
1929.....	14,406	11,032,508	10,212,511	11,169,015.13
1930.....	14,907	16,228,453	14,939,468	14,618,231.50
1931.....	23,488	22,907,169	21,381,852	16,943,605.56
1932.....	26,745	34,509,483	32,202,170	19,938,122.61
1933.....	27,679	38,114,425	35,909,811	19,400,264.81
1934.....	28,820	31,223,641	29,111,474	12,129,959.64
1935.....	28,884	33,770,091	31,147,875	8,814,295.61
1936.....	29,198	40,802,141	38,700,643	12,104,797.31
1937.....	29,622	42,051,957	39,958,771	13,088,357.90
1938.....	33,655	48,735,120	46,166,192	14,666,153.82
1939.....	37,080	54,295,182	52,193,772	16,625,473.90
Total.....		383,173,204	360,711,889	\$164,994,036.48

¹ Subject to final adjustment.

U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1939

Statistical report showing by routes the miles of service scheduled and actually flown, pound-miles performed, and the amount paid air mail contractors for service by airplanes for the fiscal year ended June 30, 1939

Route	Present carrier	Termini	Miles of service			Pound-miles performed		Payments to carriers ¹	
			Scheduled	Actually flown	Percent flown	Total	Percent of whole	Total	Percent of whole
1	United Air Lines Transport Corp.	Newark-Oakland.....	6,620,171	6,433,716	97.18	4,244,021,440	26.83	\$2,570,363.44	15.46
11	"	Seattle-San Diego.....	1,955,683	1,911,631	97.75	535,103,565	3.38	527,910.63	3.18
12	"	Salt Lake City-Seattle.....	1,227,860	1,203,017	97.98	201,517,221	1.28	400,977.05	2.41
17	"	Cheyenne-Denver.....	202,760	197,958	97.63	11,578,172	.07	57,407.82	.34
	Total.....		10,006,474	9,746,322	97.40	4,992,220,398	31.56	3,556,659.54	21.39
2	Transcontinental & Western Air, Inc.	Newark-Los Angeles.....	6,264,716	6,048,586	96.55	2,687,790,375	16.99	2,262,849.66	13.61
36	"	Dayton-Chicago.....	155,848	147,036	94.35	17,979,206	.11	134.04	.008
37	"	Winslow-San Francisco.....	314,100	295,870	94.17	13,661,685	.09	282.88	.002
38	"	Phoenix-Las Vegas.....	125,840	114,078	90.65	2,346,764	.01	35,361.18	.21
	Total.....		6,860,594	6,605,570	96.28	2,721,778,030	17.20	2,298,627.76	13.83
3	Northwest Airlines, Inc.	Fargo-Seattle.....	2,951,151	2,784,817	94.36	677,428,244	4.28	979,579.69	5.89
16	"	Chicago-Winnipeg.....	1,486,789	1,406,310	94.59	472,449,180	2.99	526,927.52	3.17
	Total.....		4,437,940	4,191,127	94.44	1,149,877,424	7.27	1,506,507.21	9.06
4	American Airlines, Inc.	Fort Worth-Los Angeles.....	2,889,009	2,874,978	99.51	1,030,142,448	6.51	802,332.54	4.83
7	"	Newark-Chicago.....	1,751,661	1,672,399	95.48	945,431,993	5.98	660,910.27	3.98
18	"	Boston-Newark.....	467,691	417,480	89.26	112,101,842	.71	138,054.59	.83
21	"	Boston-Cleveland.....	576,436	525,440	91.15	14,730,858	.09	175,134.66	1.05
22	"	Cleveland-Nashville.....	606,051	673,894	96.82	44,288,410	.28	216,755.52	1.30
23	"	Albany-Fort Worth.....	3,419,495	3,332,893	97.47	1,020,048,328	6.45	827,768.87	4.98
25	"	Washington-Chicago.....	1,098,589	1,026,972	93.48	92,264,047	.58	311,754.10	1.88
30	"	Chicago-Fort Worth.....	1,222,737	1,194,077	97.66	214,549,764	1.36	324,775.03	1.95
	Total.....		12,121,669	11,718,133	96.67	3,473,566,699	21.96	3,457,485.58	20.80

U. S. AIR MAIL SERVICE (Cont.)

5	Eastern Air Lines, Inc.	Newark-New Orleans	1,779,021	1,693,076	95.17	520,670,788	3.29	454,232.58	2.73
6	"	Newark-Miami	2,431,409	2,385,124	98.10	966,470,077	6.11	619,328.68	3.72
10	"	Chicago-Jacksonville	1,372,046	1,335,553	97.34	315,871,588	2.00	363,741.04	2.19
20	"	New Orleans-Houston	447,560	424,848	94.93	40,232,148	.25	127,646.22	.77
40	"	Atlanta-Tampa-Memphis	331,322	314,202	94.83	17,748,489	.11	53,398.34	.32
42	"	Houston-San Antonio-Brownsville	151,880	135,668	89.33	7,366,163	.05	.00	.00
	Total		6,513,238	6,288,471	96.55	1,868,368,253	11.81	1,618,346.86	9.73
9	Braniff Airways, Inc.	Chicago-Dallas	1,289,057	1,243,142	96.44	312,801,625	1.98	363,243.33	2.19
15	"	Amarillo-Brownsville	1,518,702	1,480,787	97.50	149,132,855	.04	382,276.51	2.30
	Total		2,807,759	2,723,929	97.01	461,934,480	2.02	745,519.84	4.49
13	Western Air Express Corporation	Salt Lake City-San Diego	1,587,199	1,532,978	96.58	424,964,739	2.69	514,948.57	3.10
19	"	Great Falls-Salt Lake City	789,574	764,019	96.76	46,171,212	.29	245,361.41	1.47
	Total		2,376,773	2,296,997	96.64	471,135,951	2.98	760,309.98	4.57
14	Pennsylvania-Central Airlines	Detroit-Norfolk	998,247	948,009	94.97	192,150,302	1.22	315,919.31	1.90
32	"	Detroit-Milwaukee	475,256	453,387	95.40	17,156,667	.11	129,664.69	.78
34	"	Washington-Buffalo	200,871	180,378	89.80	3,426,376	.02	.12	.00
41	"	Detroit-Sault Ste. Marie	239,420	210,354	87.86	3,536,071	.02	70,111.38	.42
	Total		1,913,794	1,792,128	93.64	216,269,416	1.37	515,695.50	3.10
28	Inland Air Lines, Inc.	Great Falls-Cheyenne	700,280	642,840	91.80	13,750,275	.09	214,273.59	1.29
35	"	Huron-Cheyenne	393,430	359,714	91.43	18,209,765	.11	104,461.84	.63
	Total		1,093,710	1,002,554	91.67	31,960,040	.20	318,735.43	1.92
29	Continental Air Lines, Inc.	Denver-El Paso	736,359	693,479	94.18	25,060,813	.157	231,186.83	1.39
43	"	Wichita-Pueblo	6,480	6,480	100.00	514,935	.093	2,160.00	.01
	Total		742,839	699,959	94.23	25,574,848	.16	233,346.83	1.40
31	National Airlines, Inc.	Daytona Beach-Miami	336,363	328,172	97.56	18,990,200	.12	90,513.70	.55
39	"	Jacksonville-New Orleans	246,840	238,888	96.78	10,543,125	.07	65,077.24	.39
	Total		583,203	567,060	97.23	29,533,325	.19	155,590.94	.94

U. S. AIR MAIL SERVICE (Cont.)

Route	Person carrier	Termini	Miles of service			Pound-miles performed		Payments to carriers ¹	
			Scheduled	Actually flown	Percent flown	Total	Percent of whole	Total	Percent of whole
8	Chicago & Southern Air Lines, Inc.	Chicago-New Orleans	1,303,853	1,275,713	97.84	160,586,108	1.02	409,150.76	2.46
24	Delta Air Corporation	Charleston-Fort Worth	1,370,455	1,337,802	97.62	132,094,711	.83	381,615.20	2.30
26	Mid-Continent Air Lines, Inc. . .	Minneapolis-Tulsa	1,140,403	1,055,248	92.53	63,891,174	.40	384,760.48	2.31
27	Boston-Maine Airways, Inc.	Boston-Caribou-Montreal . .	776,390	647,880	83.45	13,654,830	.09	215,198.85	1.29
33	Inter-Island Airways, Ltd.	Honolulu-Hilo-Port Allen . .	185,518	185,449	99.96	5,081,285	.03	40,362.25	.28
	Total		4,776,619	4,502,092	94.25	375,308,108	2.37	1,437,096.54	8.64
1001	All American Aviation, Inc.	Philadelphia-Pittsburgh . . .	36,391	36,391	100.00	436,754	.004	11,645.12	.07
1002		Pittsburgh-Clarksburg-Huntington	24,179	23,039	95.29	653,646	.006	9,906.77	.06
	Total		60,570	59,430	98.12	1,090,400	.01	21,551.89	.13
	Grand total		54,295,182	52,193,772	96.13	15,818,617,372	100.00	16,625,473.90	100.00

¹ Subject to final adjustment.

FLYING FACTS AND FIGURES

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U. S. FOREIGN AIR MAIL

From annual report of the Postmaster General

For Fiscal Year 1939

Air-mail service to foreign countries during fiscal year, 1939

Route	Miles scheduled	Miles flown	Amount paid carrier	Percentage of performance
1. New York to Montreal (1 way) . . .	224,994	200,288	\$ 120,172.80	89.02
5. Miami to Cristobal (via Kingston direct)	133,393.2	133,393.2	220,578.85	100.00
Miami to Barranquilla	250,344.2	259,344.2	519,323.62	100.00
Miami to Havana	117,711	117,711	235,422.00	100.00
Barranquilla to Cristobal	40,237.6	40,237.6	72,427.68	100.00
San Salvador to Cristobal	183,809.6	183,670	330,599.00	99.92
Port of Spain to Paramaribo	119,818.6	119,818.6	210,133.48	100.00
Barranquilla to Port of Spain	196,854.7	196,820.5	354,283.76	99.98
6. Miami to San Juan	470,357.4	470,357.4	823,764.72	100.00
San Juan to Port of Spain	209,785.2	209,785.2	292,867.83	100.00
7. Miami to Nassau (1 way)	25,944	25,944	32,430.00	100.00
8. Brownsville to Mexico	338,282	337,355.2	607,239.36	99.73
Mexico to San Salvador	166,217.7	166,173.2	299,261.02	99.97
9. Cristobal to Buenos Aires	1,019,793.8	1,019,513.9	1,529,254.31	99.97
10. Paramaribo to Buenos Aires	956,896.4	955,704	1,028,689.44	99.88
14. San Francisco to Hong Kong	732,076.6	680,488.6	1,055,909.19	92.95
15. Juneau to Whitehorse	17,482.4	17,185.2	26,637.04	98.30
16. Fairbanks to Whitehorse	51,136.8	51,136.8	40,909.44	100.00
17. New York/Baltimore to Hamil- ton ¹	161,390	143,519.5	.05	88.93
18. New York to Marseilles (south- ern route—1 way) ²	25,482	25,482	187,212.00	100.00
New York to London (northern route—1 way) ³	3,417	3,417	28,700.00	100.00
Total	4 5,454,424.2	4 5,357,405.1	4 9,224,816.49	4 98.22

¹ Rate of pay is \$0.00001 per pound.

² Service commenced May 20, 1939.

³ Service commenced June 24, 1939.

⁴ 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 1939, 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	6,504,858.17	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	9,224,816.49	1.72	10,352,275

PROGRESS OF CIVIL AERONAUTICS IN THE UNITED STATES

Compiled by U. S. Civil Aeronautics Authority

All statistics as of Jan. 1 each year

Revised to include Territorial Operations

	1937	1938	1939
Firms engaged in the industry ²	1,700	1,700	.....
Scheduled air-line operations			
Airplanes:			
In service and reserve:			
Domestic ¹	282	253	265
Foreign ¹ and territorial.....	104	92	98
Total.....	386	345	363
Book Value of ²	\$19,500,000	\$21,500,000	\$26,500,000
Airways (domestic and foreign ¹ and territorial)			
Services in operation.....	108	139	.....
Express mileage.....	63,656	70,652	.....
Mail mileage.....	57,480	63,292	.....
Passenger mileage.....	63,656	71,199	.....
Total mileage:			
Domestic ¹	31,084	35,492	36,581
Foreign extensions ¹	32,572	35,707	.....
Total.....	63,656	71,199	.....
Accidents (domestic and foreign ¹ and territorial)			
Number of accidents.....	50	44	38
Miles flown per accident.....	1,548,067	1,842,230	2,473,836
Number of fatal accidents.....	6	8	3
Miles flown per fatal accident.....	12,900,561	10,132,266	31,335,258
Number of pilot fatalities.....	5	6	2
Miles flown per pilot fatality.....	15,480,673	13,509,688	47,002,887
Number of co-pilot fatalities.....	6	7	2
Number of crew fatalities (other than pilot and co-pilot).....	4	16	3
Number of passenger fatalities.....	51	32	19
Passenger miles flown per passenger fatality.....	10,836,246	19,861,131	45,028,532
Total fatalities ³	66	61	26
Express and freight carried (pounds):			
Domestic ¹	7,127,369	7,335,967	9,514,299
Foreign ¹ and Territorial.....	1,856,680	2,116,633	2,378,965
Total.....	8,984,049	9,452,600	.....
Express, ton-miles (domestic ¹).....	2,156,070	2,173,706	2,705,614
Fuel (consumed) (domestic and foreign ¹ and territorial)			
Gasoline..... gallons..	41,424,384	45,310,192	55,528,961
Oil..... do.....	844,570	829,870	927,162
Ton-miles of mail (domestic ¹ and territorial).	6,698,230	7,422,860	.....
Income to contractors:			
Domestic ¹ and territorial.....	\$13,100,147	\$15,601,359	\$17,645,406
Foreign ¹	8,194,068	8,600,769	.....
Total.....	\$21,294,215	\$23,641,967	.....

See end of table for footnotes.

	1937	1938	1939
Scheduled air-line operations—			
Continued			
Miles of mail airways (domestic and foreign ¹ and territorial).....	57,480	63,292	.....
Miles flown:			
Daily average (domestic and foreign ¹ and territorial).....	210,948	222,077	.....
Mail (domestic and foreign ¹ and territorial)...	46,896,584	54,659,684	.....
Domestic routes.....	66,071,507	69,668,827	82,571,523
Foreign routes and territorial.....	11,331,858	11,389,300	11,434,252
Total.....	77,403,365	81,058,127	94,005,775
Operators, number of:			
Domestic ¹	17	18	17
Foreign ¹ and territorial.....	7	8	8
Total.....	4 21	4 23	4 22
Passenger-miles flown (1 passenger carried 1 mile):			
Domestic ¹	476,603,165	557,719,268	749,787,096
Foreign and territorial.....	76,045,424	77,836,916	105,755,014
Total.....	552,648,589	635,556,184	855,542,110
Passengers carried:			
Domestic ¹	1,102,707	1,343,427	1,876,051
Foreign ¹ and Territorial.....	187,028	192,684	220,788
Total.....	1,289,735	1,536,111	2,096,839
Passenger-seat-miles flown (domestic ¹).....	828,188,184	949,421,755	1,207,869,577
Passenger-seat-miles, percentage used (domestic ¹).....	57.55	58.74	62.08
Passenger fare, average per mile (domestic ¹)...	\$0.056	\$0.057	\$0.052
Personnel employed (domestic and foreign ¹ territorial)			
Mechanics and ground crew.....	3,280	3,415	4,003
Pilots.....	755	820	838
Copilots.....	602	605	873
Hostesses and stewards.....	420	451	639
Other hangar and field personnel.....	2,356	2,635	3,011
Operation and office personnel.....	4,179	5,383	6,138
Total.....	11,592	13,309	15,502
Trips, percentage completed of those started (domestic ¹).....	95.41	95.36	96.29
Trips, percentage started of those scheduled (domestic ¹).....	91.13	91.37	90.29
Trips, percentage completed of those scheduled (domestic ¹).....	89.51	90.48	93.63
Trips, passenger, average length (domestic ¹)...	432	415	400
Private flying operations			
(all domestic) ¹			
Airplanes in operation (certificated and uncertificated).....	10,446	10,718	12,401
Accidents:			
Number of accidents.....	1,917	1,882	.....
Miles flown per accident.....	53,728	68,735	.....
Number of fatal accidents.....	185	172	.....

See end of table for footnotes.

	1937	1938	1939
Private flying operations (all domestic)¹ Continued			
Miles flown per fatal accident.....	556,737	752,088	.....
Pilot fatalities.....	152	141	.....
Copilot or student fatalities.....	16	15	.....
Passenger fatalities.....	112	115	.....
Aircraft crew fatalities (other than pilot, co-pilot or student).....	2	1	.....
Total fatalities ²	283	275	.....
Miles flown per pilot fatality.....	667,608	917,440	.....
Miles flown per passenger fatality.....	1,009,768	1,124,862	.....
Fuel (consumed):			
Gasoline..... gallons..	10,618,240	10,201,053	.....
Oil..... do.....	310,851	287,875	.....
Miles flown.....	102,996,355	129,359,095	.....
Passengers:			
Carried for hire.....	1,205,904	1,238,133	.....
Carried for pleasure.....	284,508	337,018	.....
Total.....	1,580,412	1,575,151	.....
Airports and C. A. A. Intermediate landing fields			
Airports:			
Commercial and private.....	492	528	456
Municipal.....	764	791	643
Intermediate—C. A. A.—lighted.....	278	265	266
Intermediate—C. A. A.—unlighted.....	5	2	.....
Auxiliary—marked.....	602	628	665
Army, Navy, Marine Corps, National Guard, reserve and miscellaneous airports.....	158	160	250
Total airports in operation.....	2,299	2,374	2,280
Lighted, total.....	720	719	735
Of entry, regular.....	21	37	37
Of entry, temporary.....	34	23	22
Federal Airways System and Aids to Air Navigation			
Communication:			
Radio broadcast stations.....	72	91	92
Radio range beacon stations.....	167	225	244
Radio marker beacons.....	55	48	44
Weather reporting airway and airport stations—Weather Bureau and Department of Commerce operated, long line teletypewriter equipped.....	271	346	412
Miles of teletypewriter service.....	20,588	23,771	30,742
Weather Bureau—first order stations (does not include airport stations).....	198	182	.....
Airway lighting:			
Beacons:			
Revolving.....	1,717	1,753	1,875
Flashing.....	252	214	214
Beacons—privately owned and certified.....	466	530	530
Intermediate landing fields, lighted by Department of Commerce.....	278	271	274
Mileage lighted by Department of Commerce.....	22,319	23,723	27,074
Miles under construction by Department of Commerce.....	945	1,849	2,192

See end of table for footnotes.

	1937	1938	1939
Licenses and approvals			
Approved type certificates (issued by the Department of Commerce):			
Airplanes.....	658	681	.....
Engines.....	186	196	.....
Gliders.....	4	4	.....
Parachutes.....	59	59	.....
Propellers.....	658	666	.....
Wheels.....	40		
Pontoons.....	19	83	.....
Skis.....	14		
Flares and signals.....	5		
Approvals (without approved type certificates):			
Airplanes.....	541	547	.....
Engines.....	11	11	.....
Engines—foreign (temporarily approved)...	15	15	.....
Gliders.....	7	7	.....
Pontoons.....	32	32	.....
Propellers.....	120	120	.....
Repair stations.....	193	212	.....
Schools.....	20	24	.....
Skis.....	31	31	.....
Flares.....	0	0	.....
Wheels.....	0	0	.....
Uncertificated aircraft (active):			
Airplanes.....	1,684	1,150	943
Gliders.....	320	176	176
Certificated (active):			
Airplanes.....	9,152	10,000	12,829
Gliders.....	41	45	44
Instructors, flying.....	91	.....	.....
Instructors, ground.....	55	92	446
Mechanics.....	9,314	9,884	10,296
Pilots, airplane.....	17,681	22,983	31,264
Pilots having scheduled air transport ratings.....	1,064	1,150	1,197
Pilots, glider.....	161	172	170
Riggers, parachute.....	362	397	425
Student pilot certificates issued:			
Airplane.....	21,770	.....	.....
Glider.....	125	.....	.....
Production and exports of aircraft			
Exports:			
Airplanes.....	621	875	1,219
Airplanes, value.....	\$21,027,361	\$37,977,324	\$66,386,736
Engines.....	1,047	1,307	1,880
Engines, value.....	\$5,944,004	\$7,899,144	\$14,120,035
Parts and accessories aircraft, value.....	\$12,157,337	\$21,930,343	\$35,798,922
Parachutes and parts, value.....	\$267,771	\$400,939	\$775,389
Production:			
Airplanes.....	⁶ 3,773	⁷ 2,698	⁷ 3,715
Airplanes and parts, value.....	⁶ \$75,877,256	.....	.....
Engines.....	⁶ 6,084	.....	.....
Engines and parts, value.....	⁶ \$39,115,607	.....	.....

¹ Domestic scheduled air lines operate within the continental limits of the United States.

² Estimate.

³ Does not include ground crew or third parties.

⁴ In several cases the same company operates both domestic and foreign services.

⁵ Value of engine parts for these years not available.

⁶ Aeronautical Chamber of Commerce of America production figures.

⁷ Does not include aircraft produced for the U. S. Military Services.

U. S. AERONAUTICAL EXPORTS

Compiled by Automotive-Aeronautics Trade Division
U. S. Bureau of Foreign and Domestic Commerce

Total Value for Calendar Years

Country of Destination	1938 Value	1939 Value
Algeria.....	\$.....	\$ 99,479
Argentina.....	6,187,342	2,186,630
Australia.....	1,240,510	2,265,152
Azores & Madeira.....	.....	18,208
Barbados.....	.....	1,779
Belgium.....	102,526	279,883
Belgian Congo.....	52	1,653
Bermuda.....	1,264	5,340
Bolivia.....	461,958	68,337
Brazil.....	1,946,947	1,924,649
British East Africa.....	526	2,300
British Guiana.....	3,834	5,389
British Honduras.....	.....	57
British India.....	83,656	77,861
British Malaya.....	8,180	56
British Oceania.....	529	3,454
Bulgaria.....	173,295	9,652
Burma.....	52,994	83,461
Canada.....	3,511,093	3,275,132
Ceylon.....	282	75
Chile.....	64,331	26,396
China.....	6,391,713	1,071,782
Colombia.....	685,185	592,971
Costa Rica.....	122,915	83,579
Cuba.....	33,941	28,001
Czechoslovakia.....	172,549	135,839
Denmark.....	63,269	29,403
Dominican Republic.....	3,728	22,662
Ecuador.....	10,827	41,038
Egypt.....	8,317	1,904
Estonia.....	456,574	44,396
Finland.....	82,357	462,551
France.....	878,775	42,484,742
French Guiana.....	561	48
French Indochina.....	480	5,413
French Oceania.....	.....	14,359
French West Indies.....	154	404
Germany.....	591,127	90,780
Greece.....	36,353	180,212
Guatemala.....	53,866	20,855
Haiti, Republic of.....	2,338	449
Honduras.....	175,789	204,821
Hong Kong.....	1,213,442	404,003
Hungary.....	.....	8,100
Iceland.....	46	4,348
Iran.....	9,271	6,699
Iraq.....	1,222	43,324
Ireland.....	510	245,008
Italy.....	187,005	81,286
Jamaica.....	10,820	1,265
Japan.....	11,062,477	2,580,565
Latvia.....	148	9,431
Lithuania.....	16,602	1,669
Mexico.....	1,246,789	3,239,953
Mozambique.....	14,482	35,252
Netherlands.....	3,278,755	4,353,366
Netherlands Indies.....	8,495,288	6,248,675
Netherlands West Indies.....	479,891	37,275
Newfoundland & Labrador.....	2,434	23,264
New Zealand.....	160,566	78,627
Nicaragua.....	3,968	21,669
Norway.....	28,661	56,344
Other Asia.....	65	144
Other British South Africa.....	65	2,603
Other British West Indies.....	34,435	713
Other French Africa.....	191,330	13,516
Other Portuguese Africa.....	4,475	8,277
Palestine.....	2,260	4,463

<i>Country of Destination</i>	<i>1938 Value</i>	<i>1939 Value</i>
Panama.....	13,011	11,578
Panama, Canal Zone.....	150,141	70,035
Paraguay.....	6,162	135
Peru.....	223,490	1,311,243
Philippine Islands.....	464,973	542,430
Poland & Danzig.....	753,296	427,760
Portugal.....	49,100	75,677
Rumania.....	810,775	86,542
Salvador.....	9,303	5,020
Saudi Arabia.....	61	..
Spain.....	..	59,160
Surinam.....	176	145
Sweden.....	1,004,291	477,285
Switzerland.....	256,465	244,943
Syria.....	9,986	..
Thailand (Siam).....	842,892	624,742
Trinidad & Tobago.....	49,738	20,869
Tunisia.....	445	30
Turkey.....	3,160,336	1,176,732
Union of South Africa.....	465,690	171,330
United Kingdom.....	3,934,756	34,794,800
Uruguay.....	115,207	2,140
U. S. S. R. (Russia).....	5,171,303	2,904,866
Venezuela.....	517,138	445,947
Yugoslavia.....	163,264	266,812
Totals.....	\$ 68,227,689	\$117,081,212

Airplanes, Seaplanes, Amphibions and Lighter-than-air Craft

<i>Country of Destination</i>	<i>No.</i>	<i>1938 Value</i>	<i>No.</i>	<i>1939 Value</i>
Algeria.....	..	\$..	1	\$ 93,168
Argentina.....	93	4,648,105	16	600,431
Australia.....	11	341,376	22	1,600,700
Barbados.....	..	..	1	1,640
Belgian Congo.....	..	..	1	1,249
Bolivia.....	9	352,445	2	9,948
Brazil.....	45	1,579,731	92	1,270,147
British East Africa.....	..	..	1	2,300
British India.....	9	52,020	5	27,083
Canada.....	52	1,303,546	68	2,149,259
Canary Islands.....	..	..	..	..
Ceylon.....	1	..	..	..
Chile.....	1	1,836	2	5,209
China.....	142	4,683,079	6	152,502
Colombia.....	10	301,000	8	258,436
Costa Rica.....	12	94,988	4	37,880
Cuba.....	1	5,070	..	..
Czechoslovakia.....	1	112,500	1	115,500
Denmark.....	6	6,924	..	..
Dominican Republic.....	..	..	..	..
Ecuador.....	1	5,937	1	16,000
Egypt.....	..	..	1	1,600
Finland.....	2	10,647	3	14,550
France.....	12	479,681	444	29,370,567
Germany.....	2	30,787	..	..
Greece.....	1	10,622	..	..
Guatemala.....	7	46,250	..	..
Haiti, Republic of.....	..	..	..	..
Honduras.....	6	93,234	4	175,000
Hong Kong.....	5	214,186	1	120,000
Iraq.....	..	..	1	40,000
Ireland.....	..	..	2	210,434
Japan.....	66	5,515,439	1	32,000
Lithuania.....	1	1,300	..	..
Malta, Gozo & Cyprus.....	..	..	..	..
Mexico.....	58	1,029,778	66	2,253,050
Netherlands.....	8	843,612	26	1,919,332
Netherlands Indies.....	70	6,333,915	66	4,753,010
Netherlands West Indies.....	7	414,868	..	..
New Zealand.....	5	126,818	3	4,500
Nicaragua.....	..	..	2	21,086
Norway.....	3	9,736	..	..
Other British South Africa.....	..	..	1	1,900
Other British West Indies.....	2	33,918	..	..
Other French Africa.....	1	145,000	..	..

Country of Destination	1938		1939	
	No.	Value	No.	Value
Other Portuguese Africa	3	3,892	4	5,391
Palestine	1	2,100	2	3,052
Panama	1	8,500	1	4,100
Panama, Canal Zone	1	5,000	...	...
Peru	1	1,992	22	989,065
Philippine Islands	14	281,910	23	406,954
Poland & Danzig	7	468,889	4	365,705
Portugal	10	15,426	6	8,810
Rumania	7	551,794	...	...
Salvador	1	2,500	...	...
Sweden	7	216,823	2	5,992
Switzerland	5	124,270	2	120,500
Syria	1	9,200	...	...
Thailand (Siam)	20	569,886	...	5,500
Turkey	48	2,646,494	7	168,495
Union of South Africa	12	44,955	30	58,713
United Kingdom	57	1,647,748	241	16,572,570
Uruguay	6	109,920	...	...
U. S. S. R. (Russia)	13	1,969,766	13	1,959,449
Venezuela	10	351,378	7	272,053
Yugoslavia	2	117,133	3	182,036
Totals	876	\$37,977,924	1,220	\$66,386,866

Aircraft Engines

Country of Destination	1938		1939	
	No.	Value	No.	Value
Argentina	25	170,716	31	332,352
Australia	9	63,669	18	155,406
Belgium	5	43,625	8	86,400
Bermuda	...	...	1	3,000
Bolivia	...	...	4	27,200
Brazil	43	62,520	76	191,873
British Guiana	1	2,393	2	5,000
British India	3	8,274	2	3,516
British Malaya	1	750	...	...
Bulgaria	28	165,398	...	...
Canada	204	600,690	83	194,616
Chile	14	37,225	2	12,000
China	84	776,871	55	567,175
Colombia	24	138,056	28	89,165
Costa Rica	19	18,442	34	26,440
Cuba	7	13,000	1	1,000
Czechoslovakia	3	31,000	2	12,840
Denmark	31	19,027	9	5,500
Dominican Republic	1	1,500	2	11,100
Ecuador	1	1,000	1	1,950
Estonia	37	434,484	...	...
Finland	2	13,249	34	216,089
France	12	167,087	563	5,734,572
French Oceania	...	...	5	14,000
Germany	41	381,445	5	17,567
Greece	...	...	4	2,200
Guatemala	...	...	2	7,564
Haiti, Republic of	1	1,000	...	...
Honduras	13	9,350	1	2,500
Hong Kong	59	255,180	...	...
Iceland	...	...	1	3,670
Ireland	...	...	2	29,298
Italy	4	57,000	1	13,900
Jamaica	1	5,000	...	...
Japan	56	466,398	...	...
Mexico	30	65,648	73	557,386
Mozambique	...	...	2	13,670
Netherlands	170	1,301,631	161	1,213,657
Netherlands Indies	43	351,700	28	262,307
Netherlands West Indies	4	35,455	3	19,726
Newfoundland & Labrador	...	...	1	14,500
New Zealand	1	5,900	2	19,300
Nicaragua	2	1,200	...	...
Norway	...	...	9	18,400
Other French Africa	2	32,027	...	...
Other Portuguese Africa	...	...	1	1,471
Palestine	...	...	1	404
Panama	...	...	3	3,400
Panama, Canal Zone	4	5,000	5	12,000

Country of Destination	No.	1938 Value	No.	1939 Value
Paraguay.....	1	5,018	...	...
Peru.....	14	36,502	9	66,459
Philippine Islands.....	6	50,293	3	18,684
Poland & Danzig.....	5	43,853	...	...
Portugal.....	4	5,544	2	14,475
Rumania.....	9	78,010	2	13,050
Salvador.....	...	...	1	850
Sweden.....	70	308,223	14	32,220
Switzerland.....	8	67,200	2	20,200
Thailand (Siam).....	23	143,800	47	346,260
Trinidad & Tobago.....	7	35,000	8	11,500
Turkey.....	7	67,000	...	...
Union of South Africa.....	25	224,262	1	3,600
United Kingdom.....	106	833,818	491	3,432,345
U. S. S. R. (Russia).....	19	171,969	19	176,536
Venezuela.....	20	86,442	19	79,802
Totals.....	1,309	\$7,899,844	1,880	\$14,120,035

Parachutes and Parts

Country of Destination	1938 Value	1939 Value
Argentina.....	\$ 80,249	\$ 75,260
Azores & Madeira Islands.....	...	50
Belgium.....	...	62,650
Bolivia.....	...	180
Brazil.....	540	36,725
Canada.....	4,227	6,993
Colombia.....	190	...
Denmark.....	...	3,853
Dominican Republic.....	825	...
Greece.....	25,731	161,237
Guatemala.....	...	3,050
Honduras.....	2,745	...
Hong Kong.....	1,267	...
Japan.....	26,075	...
Lithuania.....	1,680	...
Mexico.....	3,480	41,860
Netherlands.....	...	5,095
Netherlands Indies.....	120,117	55,061
Norway.....	514	13,233
Palestine.....	...	120
Peru.....	195	225
Philippine Islands.....	4,863	1,393
Rumania.....	35,276	21,702
Spain.....	...	59,160
Sweden.....	450	27,087
Thailand (Siam).....	24,620	191
Trinidad & Tobago.....	...	215
Turkey.....	67,200	191,535
United Kingdom.....	250	4,739
Venezuela.....	...	3,775
Totals.....	\$400,939	\$775,389

Aircraft Parts, Instruments and Accessories (Except Tires)

Country of Destination	Total 1938 Value	Total 1939 Value	Engine Parts and Accessories	Instruments and Parts	Parts and Accessories N. E. S.
Algeria.....	\$	\$ 6,311	\$ 4,902	\$	\$ 1,409
Argentina.....	1,288,272	1,178,587	111,667	100,759	966,161
Australia.....	835,465	509,046	170,526	38,150	300,370
Azores and Madeira Islands.....	...	18,158	6,645	1,618	9,895
Barbados.....	...	139	53	...	86
Belgium.....	58,901	130,833	43,433	9,419	77,981
Belgian Congo.....	52	404	...	...	404
Bermuda.....	1,264	2,340	...	...	2,340
Bolivia.....	109,513	31,009	15,448	...	15,561
Brazil.....	304,156	425,904	123,609	20,483	281,812
British Guiana.....	1,441	389	...	99	290
British Honduras.....	...	57	57	...	...
British India.....	23,362	47,262	34,674	1,869	10,719
British Malaya.....	7,430	56	...	56	...
British Oceania.....	529	3,454	801	...	2,653
Bulgaria.....	7,897	9,652	9,482	...	170

Country of Destination	Total 1938 Value	Total 1939 Value	Engine Parts and Accessories	Instruments and Parts	Parts and Accessories N. E. S.
Burma.....	52,994	83,461	55,500	6,904	21,057
Canada.....	1,602,630	924,264	353,074	238,576	332,614
Ceylon.....	282	75	.....	.....	75
Chile.....	25,270	9,187	2,837	.....	675
China.....	931,763	352,105	26,231	24,904	300,970
Colombia.....	245,939	245,370	98,828	9,329	137,213
Costa Rica.....	9,485	19,259	8,305	1,581	9,373
Cuba.....	15,871	27,001	8,068	3,948	14,985
Czechoslovakia.....	29,049	7,499	2,343	.....	5,156
Denmark.....	37,318	20,050	1,334	.....	18,716
Dominican Republic.....	1,403	11,562	19	.....	11,543
Ecuador.....	3,890	23,088	179	6,312	16,597
Egypt.....	8,317	304	227	.....	77
Estonia.....	22,090	44,396	.....	216	44,180
Finland.....	58,461	231,912	77,725	23,197	130,990
France.....	232,007	7,379,603	1,469,847	346,104	5,563,652
French Guiana.....	561	48	9	25	14
French Indochina.....	480	5,413	.....	424	4,989
French Oceania.....	.....	359	.....	.....	359
French West Indies.....	154	404	.....	158	246
Germany.....	178,895	73,213	8,897	6,414	57,902
Greece.....	.....	16,775	3,556	.....	13,219
Guatemala.....	7,616	10,241	6,219	157	3,865
Haiti, Republic of.....	1,338	449	.....	5	444
Honduras.....	70,460	27,321	13,782	680	12,859
Hong Kong.....	742,809	284,003	67,413	2,503	214,087
Hungary.....	.....	8,100	.....	8,100	.....
Iceland.....	46	678	485	.....	193
Iran.....	9,271	6,699	1,606	.....	5,093
Iraq.....	1,222	3,324	.....	3,224	100
Ireland.....	510	5,276	274	.....	5,002
Italy.....	130,005	67,386	18,069	2,497	46,820
Jamaica.....	5,820	1,265	836	120	309
Japan.....	5,054,565	2,548,565	679,043	92,717	1,776,805
Latvia.....	148	9,431	672	8,759	.....
Lithuania.....	13,622	1,669	769	.....	900
Mexico.....	147,883	387,657	20,663	6,760	360,234
Mozambique.....	14,482	21,582	16,865	.....	4,717
Netherlands.....	1,133,512	1,215,282	409,001	92,491	713,790
Netherlands Indies.....	1,689,556	1,178,297	216,007	49,953	912,337
Netherlands West Indies.....	29,568	17,549	7,299	876	9,374
Newfoundland and Labrador.....	2,434	8,764	2,768	608	5,388
New Zealand.....	27,848	54,827	25,893	108	28,826
Nicaragua.....	2,768	583	30	90	463
Norway.....	18,411	24,711	10,791	4,360	9,560
Other Asia.....	65	144	119	.....	25
Other British South Africa.....	65	703	592	.....	111
Other British West Indies.....	517	713	245	.....	468
Other French Africa.....	14,303	13,516	87	111	13,318
Other Portuguese Africa.....	583	1,415	25	.....	1,390
Palestine.....	160	887	120	.....	767
Panama.....	4,511	4,078	328	459	3,291
Panama, Canal Zone.....	140,141	58,035	16,157	5,842	36,036
Paraguay.....	1,144	135	.....	135	.....
Peru.....	184,801	255,494	42,409	9,437	203,648
Philippine Islands.....	127,907	115,399	47,728	1,122	66,549
Poland and Danzig.....	240,554	62,055	25,151	13,965	22,939
Portugal.....	28,130	52,392	7,134	35,362	9,896
Rumania.....	145,695	51,790	16,432	1,613	33,745
Salvador.....	6,803	4,170	84	124	3,962
Surinam.....	176	145	.....	.....	145
Sweden.....	478,795	411,986	73,395	69,412	269,179
Switzerland.....	64,995	104,243	12,937	22,955	68,351
Syria.....	786	.....	.....	.....	.....
Thailand (Siam).....	104,586	272,851	33,276	22,630	216,945
Trinidad and Tobago.....	14,738	9,154	1,316	519	7,319
Tunisia.....	.....	30	.....	.....	30
Turkey.....	379,642	816,702	139,084	12,100	665,518
Union of South Africa.....	196,473	109,017	73,306	1,379	32,332
United Kingdom.....	1,452,940	14,785,146	1,809,558	840,270	12,135,318
Uruguay.....	5,287	2,140	.....	.....	2,140
U. S. S. R. (Russia).....	3,029,568	768,881	342,811	175,744	250,326
Venezuela.....	79,318	90,317	36,065	6,481	47,771
Yugoslavia.....	46,131	84,776	36,713	3,014	45,049
Totals.....	\$21,948,982	\$35,798,922	\$6,853,833	\$2,337,902	\$26,607,187

NON-MILITARY AIRCRAFT IN THE UNITED STATES

January 1, 1940

Compiled by Civil Aeronautics Authority

State	Aircraft			Gliders
	Certificated	Uncertificated	Total	
Alabama.....	88	4	92	2
Arizona.....	79	8	87	0
Arkansas.....	75	10	85	1
California.....	1,281	63	1,344	28
Colorado.....	136	7	143	6
Connecticut.....	158	4	162	1
Delaware.....	62	1	63	1
District of Columbia.....	149	4	153	2
Florida.....	293	9	302	0
Georgia.....	155	17	172	2
Idaho.....	63	1	64	0
Illinois.....	774	22	796	11
Indiana.....	410	70	480	11
Iowa.....	245	18	263	1
Kansas.....	205	39	244	5
Kentucky.....	89	15	104	0
Louisiana.....	134	2	136	0
Maine.....	113	9	122	0
Maryland.....	157	10	167	3
Massachusetts.....	322	6	328	11
Michigan.....	529	40	569	27
Minnesota.....	775	58	833	4
Mississippi.....	111	6	117	0
Missouri.....	331	31	362	1
Montana.....	76	16	92	1
Nebraska.....	152	23	175	1
Nevada.....	28	7	35	0
New Hampshire.....	48	3	51	1
New Jersey.....	388	16	404	21
New Mexico.....	37	1	38	0
New York.....	991	27	1,018	26
North Carolina.....	231	32	263	1
North Dakota.....	68	19	87	0
Ohio.....	698	54	752	19
Oklahoma.....	243	19	262	0
Oregon.....	149	42	191	2
Pennsylvania.....	888	18	906	13
Rhode Island.....	97	5	102	0
South Carolina.....	102	8	110	0
South Dakota.....	71	2	73	1
Tennessee.....	157	7	164	0
Texas.....	612	87	699	4
Utah.....	44	4	48	2
Vermont.....	39	3	42	0
Virginia.....	181	10	191	0
Washington.....	221	14	235	7
West Virginia.....	130	13	143	0
Wisconsin.....	256	42	298	5
Wyoming.....	46	12	58	0
Alaska.....	94	3	97	0
Canada ¹	1	0	1	0
Canal Zone.....	1	0	1	0
Hawaiian Islands.....	24	1	25	0
Mexico ¹	0	0	0	0
Philippine Islands ²	0	0	0	0
Puerto Rico.....	17	1	18	0
Foreign Miscellaneous ³	5	0	5	0
Totals.....	12,829	943	13,772	221 ³

¹ Figures for these countries are for aircraft and pilots registered by the United States.² Civil aircraft in the Philippine Islands are now registered with the local Government³ Includes 44 certificated and 177 uncertificated gliders.

LICENSED PILOTS IN THE UNITED STATES

January 1, 1940

Compiled by Civil Aeronautics Authority

State	Airline Transport	Com- mercial	Limited Com- mercial	Private	Solo	Total	Glider Pilots
Alabama.....	0	56	7	118	29	210	3
Arizona.....	1	35	3	89	55	183	0
Arkansas.....	0	47	5	50	22	124	0
California.....	162	1,153	112	2,424	1,342	5,193	8
Colorado.....	29	62	7	111	146	355	1
Connecticut.....	1	79	16	190	131	417	3
Delaware.....	0	18	5	48	11	82	2
District of Columbia.....	4	109	5	166	78	362	2
Florida.....	72	208	7	326	135	748	0
Georgia.....	57	93	5	166	114	435	0
Idaho.....	0	31	4	58	92	185	0
Illinois.....	160	402	54	774	427	1,817	7
Indiana.....	2	182	35	377	313	909	8
Iowa.....	3	112	21	226	236	598	0
Kansas.....	4	103	8	168	147	430	1
Kentucky.....	1	48	7	79	46	181	0
Louisiana.....	14	96	10	93	108	321	0
Maine.....	1	47	13	66	57	184	0
Maryland.....	14	101	12	195	86	408	1
Massachusetts.....	20	186	35	411	410	1,062	5
Michigan.....	24	268	50	525	336	1,203	27
Minnesota.....	51	134	36	202	121	544	3
Mississippi.....	0	35	2	71	33	141	0
Missouri.....	90	178	9	196	265	738	5
Montana.....	0	33	7	70	49	159	1
Nebraska.....	1	62	12	102	117	294	1
Nevada.....	1	12	2	22	20	57	0
New Hampshire.....	0	24	7	58	40	129	1
New Jersey.....	146	241	20	467	102	976	18
New Mexico.....	1	14	2	30	22	69	0
New York.....	23	644	77	1,216	676	2,636	30
North Carolina.....	0	85	23	225	185	518	1
North Dakota.....	0	31	4	32	36	103	0
Ohio.....	17	348	74	693	339	1,471	18
Oklahoma.....	1	121	17	177	113	429	0
Oregon.....	18	71	10	134	176	409	0
Pennsylvania.....	6	346	74	934	522	1,882	12
Rhode Island.....	1	20	3	47	38	109	1
South Carolina.....	2	39	10	83	74	208	0
South Dakota.....	1	30	9	51	45	136	0
Tennessee.....	25	74	13	271	34	417	0
Texas.....	118	411	24	540	291	1,384	3
Utah.....	33	29	7	55	28	152	0
Vermont.....	0	22	4	33	33	92	0
Virginia.....	13	156	12	257	114	552	5
Washington.....	38	248	27	304	258	875	2
West Virginia.....	1	45	19	118	88	271	0
Wisconsin.....	1	122	28	201	115	467	1
Wyoming.....	18	22	24	21	28	113	0
Alaska.....	1	86	1	27	10	125	0
Canada ¹	2	6	2	17	8	35	0
Canal Zone.....	4	26	0	7	0	37	0
Hawaiian Islands.....	0	50	6	79	22	157	0
Mexico ¹	0	1	0	4	1	6	0
Philippine Islands.....	0	15	0	4	2	21	0
Puerto Rico.....	1	8	1	5	1	16	0
Foreign Miscellaneous ¹	14	67	1	39	8	129	0
Totals.....	1,197	7,292	988	13,452	8,335	31,264	170
Percent.....	3.8	23.3	3.2	43.0	26.7	100.0	...

¹ Includes 902 women pilots divided as follows: 86 commercial, 30 limited commercial, 476 private, and 311 solo. The glider pilots include 3 women.

U. S. CIVIL PILOT TRAINING PROGRAM

Progress Report February 8, 1940, on 9,267 Students in 437 Colleges in U. S. Civil Aeronautics
Authority Pilot Training Program

February 8, 1940

State	Quota	Dual	Preliminary Solo	Advanced Solo	Dis-qualified	Dis-continued
Connecticut.....	20	..	..	..	..	..
Delaware.....	28	12	3	..	1	..
District of Columbia.....	50	..	..	..	..	..
Maine.....	70	28	..	..	..	..
Maryland.....	100	53	27	1	..	..
Massachusetts.....	320	51	11	..	..	..
New Hampshire.....	20	10	2	..	..	..
New Jersey.....	220	84	50	3	3	1
New York.....	430	166	65	..	..	..
Pennsylvania.....	360	104	31	..	..	..
Rhode Island.....	60	22	4	..	..	..
Vermont.....	70	53	28	1	..	..
Virginia.....	160	46	3	..	..	..
West Virginia.....	130	13	2	..	..	..
Alabama.....	210	50	17	..	..	..
Florida.....	160	61	22	..	1	..
Georgia.....	199	42	12	..	..	2
Mississippi.....	90	2	..	..	..	..
North Carolina.....	190	18	6	..	..	..
South Carolina.....	170	21	3	..	..	..
Tennessee.....	190	82	21	..	1	1
Illinois.....	350	34	6	..	..	..
Indiana.....	250	35	19	2	..	..
Kentucky.....	40	..	..	..	1	..
Michigan.....	480	78	27	..	..	..
Minnesota.....	160	22	1	..	..	..
North Dakota.....	100	19	3	..	..	..
Ohio.....	470	83	32	1	..	..
Wisconsin.....	120	17	4	..	..	..
Arkansas.....	150	61	23	..	..	..
Louisiana.....	220	31	11	..	..	..
New Mexico.....	50	23	8	..	..	..
Oklahoma.....	300	125	44	..	..	..
Texas.....	520	230	58	1	2	..
Colorado.....	160	103	59	4	1	..
Iowa.....	210	82	40	..	..	1
Kansas.....	300	43	4	..	..	..
Missouri.....	270	50	8	..	..	1
Nebraska.....	110	26	13	..	..	..
South Dakota.....	100	4	..	..	..	..
Wyoming.....	30	3	..	..	..	..
Arizona.....	70	4	2	..	..	..
California.....	950	266	82	..	2	6
Nevada.....	10	..	..	..	..	..
Utah.....	80	44	9	..	..	..
Idaho.....	80	19	13	..	..	..
Montana.....	70	32	15	..	..	..
Oregon.....	110	26	2	..	..	..
Washington.....	180	87	8	..	2	..
Territories						
Alaska.....	20	..	..	..	..	..
Hawaii.....	30	..	..	..	..	..
Puerto Rico.....	30	..	..	..	..	..
Totals.....	9,267	2,465	798	12	14	12

U. S. CIVIL PILOT TRAINING PROGRAM

Data Returned by Vocational Pilot Trainees in the Experimental Phase of the Program Conducted by the U. S. Civil Aeronautics Authority During
Fiscal Year 1939
February 8, 1940

Name of Institution	Pilots Certified	Question- naires returned	Continuation of Flying Since Certification		Future Plans			Military Applicants						Plan to buy Planes
			Hours and Minutes Flown	No. Who Have Flown	Pleasure Flying	Com- mercial Avia- tion	Mili- tary	Air Corps			Naval Aviation			
								Ap- plied	Ac- cepted	Pend- ing	Ap- plied	Ac- cepted	Pend- ing	
U. of Alabama.....	30	29	384:00	23	7	10	10	4	3	1	4	1	3	17
Ga. School of Tech.....	28	23	354:35	22	8	7	7	3	....	3	3	2	1	11
U. of Kansas.....	20	19	270:30	17	8	6	1	1	....	1	1	1	....	11
Mass. Inst. of Tech.....	18	17	101:10	14	8	6	2	1	1	....	....	....	....	5
U. of Michigan.....	19	15	176:30	13	1	11	3	2	1	1	3	1	2	11
U. of Minnesota.....	20	18	197:10	16	6	4	7	6	4	2	2	1	1	4
New York U.....	26	23	139:10	20	6	8	8	3	2	1	....	....	....	10
N. C. State College.....	20	12	282:30	11	....	3	8	1	....	1	1	1	....	5
N. Tex. Agr. College.....	29	21	235:18	18	....	4	15	7	3	4	1	....	1	7
Pomona Jr. College.....	14	12	138:40	10	....	4	7	4	1	3	2	....	2	2
Purdue U.....	50	40	602:40	35	9	12	14	7	2	5	7	4	3	13
San Jose St. College.....	15	13	132:49	11	1	4	8	1	1	....	....	....	....	1
U. of Washington.....	24	14	74:19	14	1	2	10	....	....	....	5	1	4	5
Totals.....	313	256	3089:21*	224	55	81	100	40	18	22	29	12	17	102

* Average flight time per student since the completion of the experimental phase of the Civilian Pilot Training Program: 24.238 hours.

AIRPORTS AND LANDING FIELDS

January 1, 1940

Compiled by Civil Aeronautics Authority

State	Municipal	Commercial	C.A.A.	Auxiliary	Navy	Army	Miscellaneous Government, Private and State	Totals	Partially or fully leased
Alabama.....	9	2	6	14	0	2	2	35	12
Alaska.....	1	7	0	118	0	0	0	126	2
Arizona.....	9	7	8	18	0	1	0	43	15
Arkansas.....	10	2	4	6	0	0	2	24	8
California.....	48	45	15	34	5	5	16	168	59
Colorado.....	8	2	2	19	0	0	0	31	6
Connecticut.....	7	6	1	3	0	0	1	18	7
Delaware.....	1	3	0	0	0	1	1	6	3
District of Columbia.....	0	1	0	0	1	1	0	3	3
Florida.....	33	10	3	62	3	2	7	120	27
Georgia.....	19	3	10	18	0	1	0	51	19
Idaho.....	15	0	8	16	0	0	10	49	12
Illinois.....	13	29	6	2	0	2	3	55	28
Indiana.....	13	18	6	8	0	2	3	50	18
Iowa.....	16	8	3	4	0	0	2	33	11
Kansas.....	15	7	4	11	0	2	1	40	14
Kentucky.....	5	1	3	7	0	1	3	20	4
Louisiana.....	9	1	3	6	0	1	5	25	11
Maine.....	9	3	0	7	0	0	1	20	5
Maryland.....	2	8	1	1	0	3	3	18	9
Massachusetts.....	7	24	1	4	1	1	1	39	11
Michigan.....	39	12	0	33	1	3	32	120	24
Minnesota.....	13	5	4	8	0	1	1	32	11
Mississippi.....	13	1	6	11	0	0	0	31	14
Missouri.....	9	6	13	6	0	0	3	37	19
Montana.....	20	1	15	26	0	0	11	73	22
Nebraska.....	14	5	4	4	0	3	0	30	15
Nevada.....	2	3	8	8	1	0	0	22	12
New Hampshire.....	7	3	0	2	0	0	0	12	4
New Jersey.....	4	13	0	1	2	1	1	22	8
New Mexico.....	5	5	10	9	0	0	3	32	14
New York.....	22	32	4	14	0	5	11	88	27
North Carolina.....	16	7	2	4	0	1	0	30	10
North Dakota.....	9	5	7	18	0	0	0	39	11
Ohio.....	27	40	10	15	0	3	11	106	27
Oklahoma.....	18	4	8	9	0	1	2	42	23
Oregon.....	13	2	7	6	0	0	3	31	15
Pennsylvania.....	20	54	7	9	1	1	9	101	35
Rhode Island.....	0	3	0	2	0	0	1	6	1
South Carolina.....	11	4	3	6	2	0	2	28	7
South Dakota.....	16	1	0	7	0	0	1	25	0
Tennessee.....	7	1	8	5	0	0	0	21	14
Texas.....	42	13	26	42	0	9	9	141	51
Utah.....	2	1	11	8	0	0	0	22	14
Vermont.....	6	3	0	1	0	1	0	11	1
Virginia.....	12	13	7	8	3	1	1	45	17
Washington.....	15	4	6	15	1	4	4	49	17
West Virginia.....	10	7	1	7	0	0	1	26	5
Wisconsin.....	17	19	4	8	0	0	3	51	18
Wyoming.....	5	2	11	15	0	0	0	33	15
Totals.....	643	456	266	665	21	59	170	2,280	735

AVIATION GASOLINE TAX SUMMARY

March 21, 1940

Compiled by American Petroleum Institute

States	Taxes		Refunds		Exemption on Aircraft Fuel	Disposition of Funds
	Tax Per Gal. on Motor Fuel	Tax Per Gal. on Fuel Used for Aviation	State Laws Providing for Refund in Certain Cases	Refunds Applying to Aircraft Fuel		
Alabama.....	6	6				Highway purposes
Arizona.....	5		x			*
Arkansas.....	6				x	
California.....	3		x			
Colorado.....	4		x	x		
Connecticut.....	3		x			
Delaware.....	4		x	x		
District of Columbia	2		x	x		
Florida.....	7				x	*
Georgia.....	6	6				2/3 State Highway 1/6 County Rds. 1/6 Education For Aeronautics Fund*
Idaho.....	5	2½				
Illinois.....	3		x	x		
Indiana.....	4		x	x		
Iowa.....	3		x	x		
Kansas.....	3				x	*
Kentucky.....	5	5				Highway purposes
Louisiana.....	7	7				Highway purposes
Maine.....	4	1		3		*
Maryland.....	4		x	x	x	
Massachusetts.....	3		x			
Michigan.....	3	1½		1½		For Aeronautics Fund*
Minnesota.....	4		x			
Mississippi.....	6	1	5	x	5	The 1 cent is used for highways*
Missouri.....	2		x			
Montana.....	5		x	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		x	x		*
New York.....	4		x			
North Carolina.....	6		x	x	x	*
North Dakota.....	4		x	x		
Ohio.....	4	1	x	3		*
Oklahoma.....	4				x	
Oregon.....	5	1	x	4		For State Board of Aeronautics*
Pennsylvania.....	4	4				*
Rhode Island.....	3		x			
South Carolina.....	6	6				For State Aviation Funds*
South Dakota.....	4					*
Tennessee.....	7	7				*
Texas.....	4		x	x		*
Utah.....	4	4				For State Aeronautics Fund*
Vermont.....	4	4				*
Virginia.....	5	3	x	2		*
Washington.....	5		x			
West Virginia.....	5		x	x		*
Wisconsin.....	4		x	x		
Wyoming.....	4	2	x	2		*

* See following notes accompanying name of State.

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 $6\frac{1}{2}$ cents per gallon and the funds are used for highway purposes.
- FLORIDA—Aviation fuel testing 78 octane or higher is not taxed.
- IDAHO—Airplane or air transport carriers importing gasoline into State for use in its airplane were not within statute taxing use of such fuels. For purposes of State Aeronautics Funds.
- KANSAS—Exemption on aircraft fuel applies on purchase of forty gallons or more.
- MAINE— $\frac{1}{4}$ used for highway purposes. If consumer fails to apply for the $\frac{3}{4}$ allowable refund within 9 months, then the $\frac{3}{4}$ of the tax shall be added to the aeronautical fund. $\frac{1}{8}$ of the 1¢ tax for aeronautical purposes shall be allocated to aeronautical fund.
- MICHIGAN—A refund of $1\frac{1}{2}$ ¢ per gallon is made to air line operators operating interstate on schedule operations. All money received from aviation gasoline taxes paid into State Treasury and credited to Aeronautics Fund.
- MISSISSIPPI— $\frac{1}{4}$ used for highway purposes. Licensed airports selling gasoline to crafts engaged in interstate flights entitled to exemption of 5¢ per gallon of the tax paid by licensed airport operator.
- NEBRASKA—For aviation purposes. Available information indicates that all the motor fuel sold for aircraft is used for aviation purpose.
- NEW MEXICO—Refund where amount purchased at one time is at least 50 gallons.
- NORTH CAROLINA—Aviation gasoline is sold tax free. If ordinary gasoline is used in aircraft a refund of 5¢ per gallon will be made if purchase is in quantities of 10 gallons or more at one time. The 1¢ is used for highway purposes.
- OHIO—Refund of 3¢; 1¢ not refundable but used to defray expenses of administering the provisions of Sec. 5542-1 to 5542-18c both incl. of the General Code.
- OREGON—Refund $\frac{4}{5}$; remaining $\frac{1}{5}$ for use of State Board of Aeronautics.
- PENNSYLVANIA—No special appropriation of gasoline tax for aircraft. No money appropriated for aeronautics since 1931. Board of Property in the Dept. of Internal Affairs takes care of airports.
- SOUTH CAROLINA—All taxes on aviation fuel credited to State Aviation Fund for development, advancement, upkeep and promotion of aviation as Aeronautics Commission directs. Apportionment allocated to each airport is in an amount as nearly the same as possible as tax collections at each airport.
- SOUTH DAKOTA—No refund on gasoline used for aircraft but such tax is allocated each month to State Aeronautics Fund. From time to time State Aeronautics Commission allocates to each airport its proportionate share for maintenance.
- TENNESSEE—The 7¢ used exclusively for aviation purposes; $\frac{1}{2}$ to Bureau of Aeronautics and $\frac{1}{2}$ to development of airports. Law of 1939, Ch. 195 provides that any money allocated to the Bureau of Aeronautics out of the proceeds of gasoline tax in excess of any appropriations made to Dept. of Highways and Public Works shall be covered into the general fund.
- TEXAS—Law 1939 Texas Statute 7065 provides for entire refund but still charges \$1.00 filing fee for refund claims as expense for furnishing forms.
- UTAH—Ch. 66 Laws 1939 provides that $\frac{3}{4}$ shall be expended on the airport where gasoline is sold; $\frac{1}{4}$ to be spent for maintenance, etc. as commission may determine.
- VERMONT—Law 1939 Appropriation No. 125 p. 156 provides that \$2,000 is appropriated annually for aeronautical purposes.
- VIRGINIA—Ch. 71 Laws 1940 provide for 3¢ tax on aircraft gasoline to be used for aviation purposes.
- WEST VIRGINIA—Ch. 125 Laws 1939—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. Funds paid to city, town or county where air field is located (and from which tax was collected) for maintenance of such air field.

AIRCRAFT APPROPRIATIONS, UNITED STATES

<i>Fiscal Year</i>	<i>Department Appropriations</i>	<i>Total</i>	<i>Increase or Decrease</i>	<i>Net</i>
1924-25	Army..... \$13,476,619(1) Navy..... 15,150,000 N.A.C.A..... 470,000	\$ 29,096,619	+ \$1,050,619 +502,826 +187,000	+ \$1,740,445
1925-26	Army..... 18,061,191(2) Navy..... 15,130,000 Air Mail..... 500,000 N.A.C.A..... 534,000	34,225,191	+4,584,572 -20,000 +500,000 +64,000	+5,128,572
1926-27	Army..... 18,256,694(3) Navy..... 19,065,288 Air Mail..... 2,000,000 N.A.C.A..... 513,000 Commerce.... 550,000(4)	40,384,982	+195,503 +3,935,288 +1,500,000 -21,000 +550,000	+6,159,791
1927-28	Army..... 25,612,494(5) Navy..... 20,100,000 Air Mail..... 4,650,000(6) N.A.C.A..... 550,000 Commerce.... 3,791,500(7)	54,703,994	+7,355,800 +1,034,712 +2,650,000 +37,000 +3,241,500	+14,319,012
1928-29	Army..... 33,911,431(8) Navy..... 32,189,000 Air Mail..... 14,480,000(9) N.A.C.A..... 628,770 Commerce.... 5,519,350(10)	86,728,551	+8,298,937 +12,089,000 +9,830,000 +78,770 +1,727,850	+32,024,557
1929-30	Army..... 34,910,059 Navy..... 31,430,000 Air Mail..... 19,300,000(11) N.A.C.A..... 1,508,000 Commerce.... 6,416,620(12)	93,564,679	+998,628 -759,000 +4,820,000 +879,230 +897,270	+6,836,128
1930-31	Army..... 38,892,968(13) Navy..... 32,033,211 Air Mail..... 24,600,000(14) N.A.C.A..... 1,321,000 Commerce.... 9,204,830(15)	106,052,009	+3,982,909 +603,211 +5,300,000 -187,000 +2,788,210	+12,487,330

(1) Includes \$678,043 under title of "reclassification of salaries."

(2) Includes \$2,150,000 contract authorization and \$1,000,000 for the construction of Wright Field.

(3) Includes \$3,000,000 contract authorization.

(4) Consists of \$250,000 for "aircraft in commerce" and \$300,000 for "air navigation facilities."

(5) Includes \$4,495,000 contract authorization and \$514,000 deficiency appropriation.

(6) Made up as follows: Domestic, \$4,500,000; Foreign, \$150,000.

(7) Consists of \$700,000 for "aircraft in commerce" and \$3,091,500 for "air navigation facilities."

(8) Includes \$5,000,000 contract authorization and \$3,482,869 deficiency appropriation.

(9) Made up as follows: Domestic, \$12,430,000; Foreign, \$2,050,000.

(10) Consists of \$859,500 "aircraft in commerce" and \$4,659,850 for "air navigation facilities."

(11) Made up as follows: Domestic, \$15,000,000; Foreign, \$4,300,000.

(12) Consists of \$958,000 for "aircraft in commerce" and \$5,458,620 for "air navigation facilities."

(13) Includes deficiency appropriations of \$871,100 and \$1,298,810.

(14) Made up as follows: Domestic, \$18,000,000; Foreign, \$6,600,000.

(15) Consists of \$1,260,830 for "aircraft in commerce" and \$7,944,000 for "air navigation facilities."

AIRCRAFT APPROPRIATIONS, UNITED STATES (Cont.)

<i>Fiscal Year</i>	<i>Department Appropriations</i>	<i>Total</i>	<i>Increase or Decrease</i>	<i>Net</i>
1931-32	Army..... \$31,850,892(16) Navy..... 31,145,000 Air Mail..... 27,000,000(17) N.A.C.A..... 1,051,070 Commerce..... 10,362,300(18)	\$101,409,262	-\$7,042,076 -888,211 +2,400,000 -269,930 +1,157,470	-\$4,642,747
1932-33	Army..... 25,673,236 Navy..... 32,745,420(19) Air Mail..... 26,460,000(20) N.A.C.A..... 920,000 Commerce..... 8,553,500(21)	94,352,156	-6,177,656 +1,680,420 -540,000 -131,070 -1,808,800	-7,057,106
1933-34	Army..... 34,037,769(22) Navy..... 21,957,459 Air Mail..... 22,000,000(23) N.A.C.A..... 695,000 Commerce..... 7,660,780(24)	86,351,008	+8,364,533 -10,787,961 -4,400,000 -225,000 -892,720	-8,001,148
1934-35	Army..... 30,917,702(25) Navy..... 34,842,253(26) Air Mail..... 19,003,291(27) N.A.C.A..... 726,492 Commerce..... 5,681,029(28)	91,170,767	-3,120,067 +12,884,794 -2,996,709 +31,492 -1,979,751	+4,819,759
1935-36	Army..... 50,287,197(29) Navy..... 40,732,310 Air Mail..... 18,700,000(30) N.A.C.A..... 1,177,550 Commerce..... 5,909,800(31)	116,806,857	+19,369,495 +5,890,057 -303,291 +451,058 +228,771	+25,636,090
1936-37	Army..... 62,607,727(32) Navy..... 38,588,270(33) Air Mail..... 20,230,000(34) N.A.C.A..... 2,544,550 Commerce..... 6,850,000(35)	130,820,547	+12,320,530 -2,144,040 +1,530,000 +1,307,000 +940,200	+14,013,690
1937-38	Army..... 67,308,374(36) Navy..... 49,500,000(37) Air Mail..... 24,405,860(38) N.A.C.A..... 1,733,850 Commerce..... 13,238,500(39)	156,186,584	+4,700,647 +10,911,730 +4,175,860 -810,700 +6,388,500	+25,366,037
1938-39	Army..... 73,799,532(40) Navy..... 48,075,000(41) Air Mail..... 27,592,275(42) N.A.C.A..... 2,508,000(43) C.A.A..... 16,231,130(44)	168,205,937	+6,491,158 -1,425,000 +3,186,415 +774,150 +2,992,630	+12,019,353
1939-40	Army..... 320,447,520(45) Navy..... 111,459,000(46) Air Mail..... 31,162,720(47) N.A.C.A..... 6,543,980(48) C.A.A..... 25,768,000(49)	495,381,229	+170,442,000 +63,384,000 +3,060,445 +4,843,980 +9,536,870	+251,867,304

(16) Includes \$135,152 deficiency appropriation.

(17) Made up as follows: Domestic, \$20,000,000; Foreign, \$7,000,000.

(18) Consists of \$1,369,660 for "aircraft in commerce" and \$8,992,640 for "air navigation facilities".

(19) Includes \$7,500,000 appropriated under the National Industrial Recovery Act.

(20) Made up as follows: Domestic, \$19,460,000; Foreign, \$7,000,000.

(21) Consists of \$1,000,000 for "aircraft in commerce" and \$7,553,500 for "air navigation facilities".

(22) Includes \$3,000,000 contract authorization and \$7,500,000 appropriated under the Public Works Administration. Only \$12,692,553 of the \$23,537,769 appropriation was available for the fiscal year 1934, the balance of \$10,845,216 having been impounded.

(23) Made up as follows: Domestic, \$15,000,000; Foreign, \$7,000,000.

(24) Consists of \$1,070,570 for "aircraft in commerce" and \$6,590,210 for "air navigation facilities".

(25) Includes \$3,000,000 contract authorization and \$325,909 for restoration of salary reduction.

(26) Includes \$15,611,572 appropriated under the title of "Emergency Construction—Increase in the Navy".

(27) Made up as follows: Domestic, \$12,003,291 (including salary restoration of \$3,291); Foreign, \$7,000,000.

(28) Consists of \$676,249 for "aircraft in commerce" and \$5,004,780 for "air navigation facilities".

(29) Includes \$7,686,753 contract authorization; provides that \$13,666,000 of the appropriation shall be used exclusively for the purchase of combat planes, their equipment and accessories.

(30) Made up as follows: Domestic, \$10,700,000; Foreign, \$8,000,000.

(31) Consists of \$734,800 for "aircraft in commerce" and \$5,175,000 for "air navigation facilities".

(32) Includes \$10,669,786 contract authorization; provides that \$29,322,602 shall be used exclusively for the purchase of combat planes.

(33) Includes \$6,590,000 contract authorization.

(34) Made up as follows: Domestic, \$12,000,000; Foreign, \$8,230,000.

(35) Consists of \$733,000 for "aircraft in commerce" and \$882,920 for new "air navigation facilities".

(36) Includes \$26,262,760 for combat planes and \$19,126,894 contract authorization.

(37) Includes \$27,180,000 for new aircraft of which \$15,000,000 is contract authorization.

(38) Includes \$14,500,000 for domestic air mail and \$9,905,860 for foreign air mail.

(39) Includes \$2,000,000 authority to contract, prior to July 1, 1938, for purchase, construction and installation of additional air navigation facilities.

(40) Includes \$33,150,646 for combat planes and \$19,126,894 contract authorization.

(41) Includes \$24,633,000 for new aircraft of which \$15,000,000 is for contract authorization.

(42) Includes \$17,240,000 for domestic air mail and \$10,352,275 for foreign air mail.

(43) Includes \$975,000 for beginning of construction of a new wind tunnel.

(44) Includes \$4,575,000 for establishment of air navigation facilities and \$249,750 for aircraft.

(45) Includes \$76,205,988 contract authorization.

(46) Includes \$69,419,000 for new aircraft.

(47) Includes \$18,643,200 for domestic and \$12,519,520 for foreign air mail.

(48) Includes \$4,470,980 for construction and equipment of additional research facilities at Langley Field, Va., and Moffett Field, Calif.

(49) Includes \$7,000,000 for air navigational facilities and \$4,000,000 for Civilian Pilot Training Program.

+ Shows amount of increase over preceding year.

— Shows amount of decrease from preceding year.

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AERONAUTICAL CHAMBER OF COMMERCE OF AMERICA, INC.

729 Fifteenth Street, N.W.,
Washington, D. C.

30 Rockefeller Plaza
New York

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	For Routine Projects

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30 Rockefeller Plaza, New York

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1940

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AIR TRANSPORT ASSOCIATION OF AMERICA

135 South LaSalle St., Chicago, Ill.

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30 Rockefeller Plaza, New York

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Membership Office.....	Transportation Building, Chicago, Ill.
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Executive Secretary.....	J. B. Hartranft, Jr.

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29 West 39th Street, New York

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Vice-President.....	N. N. Tilley
(Representing Aircraft-Engine Engineering)	
Vice-President.....	C. G. A. Rosen
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John Oswald, Vice-President	A. M. Wolf, Councilor
E. R. Smith, Vice-President	David Beecroft, Treasurer
J. M. Davies, Vice-President	H. T. Woolson, Past President (1937)
G. W. Laurie, Vice-President	W. J. Davidson, Past President (1939)

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Aircraft Committee.....	S. J. Zand, Chairman
Aircraft Engine Committee.....	N. N. Tilley, Chairman
Standards Committee	
Aircraft Division.....	J. T. Thompson, Chairman
Aircraft Engine Division.....	Arthur Nutt, Chairman
Aircraft Materials Division.....	B. Clements, Chairman
Research Committee	
Aircraft Engine Lubricants Committee.....	G. K. Brower, Chairman

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29 W. 39th Street, New York

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Vice Chairman.....	B. M. Woods
Secretary.....	Jerome Lederer
Alexander Klemin	R. F. Gagg
James M. Clark	Major Paul H. Kemmer

AERONAUTICAL DIRECTORY

U. S. AIR CORPS, WAR DEPARTMENT

Washington, D. C.

Harry H. Woodring, Secretary of War

Louis K. Johnson, Asst. Secretary of War

Officers on Duty in Washington

- Chief of the Air Corps.....Major General Henry H. Arnold
 Asst. Chief of the Air Corps.....Brig. General Barton K. Yount
 *Commanding General, GHQ Air Force.....Major General Delos C. Emmons
 Brigadier Generals—George H. Brett, Jacob E. Fickel.
 Colonels—Carl Spaatz, George E. Stratemeyer, Robert C. Candee, Wm. F. Volandt.
 Lieut. Colonels—Asa N. Duncan, Harry H. Young, Donald Wilson, Robert Olds, Wm. E. Farthing, Arthur B. McDaniel, Ira C. Eaker, Otto G. Trunk, Walter J. Reed, Oliver S. Person, James F. Powell, Omer O. Niergarth.
 Majors—Orin J. Bushey, James G. Taylor, Leland W. Miller, Alfred J. Lyon, Harold L. Clark, Frank M. Paul, John E. Upston, Edward Hildreth, Barney M. Giles, Claude E. Duncan, Charles W. Sullivan, John A. Laird, Jr., Arthur I. Ennis, Paul E. Burrows, Edward M. Powers, Austin W. Martenstein, Warren R. Carter, Wallace G. Smith, Charles A. Horn, Angier H. Foster, Evers Abbey, Robert M. Webster, Donald R. Goodrich, Thomas D. White, Lawrence J. Carr, John F. McBlain, James T. Cumberpatch, Edmund C. Langmead, James M. Bevans, Cecil E. Archer, Lyman P. Whitten, Donald F. Fritch, Alfred A. Kessler, Jr., Mervin E. Cross, Benjamin W. Chidlaw, Townsend Griffiss, Patrick W. Timberlake, Hoyt S. Vandenberg, Glen C. Jamison, Cecil E. Henry, Richard E. Nugent, John G. Moore, Luther Stevens Smith, Edward H. White, Ralph E. Fisher.
 Captains—Linus D. Frederick, James G. Pratt, Samuel R. Harris, Jr., Charles A. Ross, Walter S. Lee, Thurston H. Baxter, Gordon P. Saville, Wm. T. Hefley, James F. Olive, Aubrey L. Moore, Haywood S. Hansell, Harold W. Bowman, James P. Newberry, Arthur F. Merewether*.

* Stationed at Langley Field, Va.

U. S. FOREST SERVICE
DEPARTMENT OF AGRICULTURE

Washington, D. C.

Henry A. Wallace, 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: Washington, D. C.
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 |

BUREAU OF AERONAUTICS, U. S. NAVY

Washington, D. C.

Charles Edison, Secretary of the Navy

Lewis Compton, Assistant Secretary of the Navy

Officers on Duty in Washington, D. C.:

Chief of Bureau..... Rear Admiral J. H. Towers
 Assistant Chief of Bureau..... Captain M. A. Mitscher
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 E. M. Pace, A. E. Montgomery, D. C. Ramsey, H. C. Richardson (CC).
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 W. S. Diehl, R. E. Farnsworth, L. M. Grant, T. P. Jeter, W. M. Lockhart, E. L. Marshall
 (CEC), C. A. Nicholson, H. R. Oster, F. W. Pennoyer, A. M. Pride, L. B. Richardson,
 V. H. Schaeffer, L. C. Stevens, F. B. Stump, J. R. Poppen (MC).
 Lieutenant Commanders..... W. M. Beakley, W. F. Boone, J. W. C. Brand, W. E. Cleaves,
 C. F. Cotton, W. A. Evans, J. W. Harris, R. S. Hatcher, C. L. Helber, F. M. Hughes,
 L. W. Johnson, D. N. Logan, J. B. Moss, I. M. McQuiston (USNR), W. S. Parr, J. E.
 Pixton, J. L. Pratt, W. T. Rassieur, S. C. Ring, C. W. Smith, A. Soucek, S. B. Spangler,
 W. D. Thomas, A. B. Vosseller, C. G. Halpine, E. W. Clepton.
 Lieutenants..... E. C. Beck, W. I. Darnell, H. R. Dozier, M. K. Fleming, H. B.
 Jones (CEC), W. F. Kline, J. M. Lane, S. G. Mitchell, J. A. Moreno, J. S. Russell, H. D.
 Scrymgeour, P. D. Stroop, P. A. Wyckoff, R. S. Quackenbush.
 Marine Corps Aviation..... Colonel R. J. Mitchell; Lt. Col. L. G. Merritt; Major B. F.
 Johnson; Captains M. L. Dawson, A. D. Cooley, S. S. Jack, R. H. Rhoads, F. H. Schwable,
 P. K. Smith.

Naval Air Stations

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 Lakehurst, N. J..... Commander G. H. Mills
 Norfolk, Va..... Captain P. N. L. Bellinger
 Pensacola, Fla..... Captain A. W. Fitch
 San Diego, Calif..... Captain J. S. McCain
 Seattle, Wash..... Commander A. W. Radford
 Coco Solo, C. Z..... Commander C. W. Wieber
 Pearl Harbor, T. H..... Captain E. Buckmaster
 San Pedro, Calif..... Commander J. C. Monfort
 Sitka, Alaska..... Lt. Comdr. J. C. Cronin

Marine Flying Fields

Quantico, Va..... Lt. Colonel Field Harris
 San Diego, Calif..... Lt. Colonel L. E. Woods
 St. Thomas, Virgin Islands..... Lt. Colonel E. P. Mulcahy

Carrier Divisions

Commander Aircraft, Battle Force..... Vice Admiral C. A. Blakely
 Chief of Staff..... Captain J. H. Hoover
 Commander Carrier Division One..... Rear Admiral W. F. Halsey
 U. S. S. SARATOGA..... Captain A. C. Read
 U. S. S. LEXINGTON..... Captain A. D. Bernhard
 U. S. S. RANGER..... Captain R. F. Wood
 U. S. S. YORKTOWN..... Captain E. L. Gunther
 U. S. S. ENTERPRISE..... Captain C. A. Pownall
 U. S. S. WASP..... Captain J. W. Reeves
 Commander Aircraft, Scouting Force..... Rear Admiral A. B. Cook

Naval Aircraft Factory

Philadelphia, Pa..... Captain W. W. Webster

Special Aviation Duty

Aide to Commander-in-Chief, U. S. Fleet..... Commander O. B. Hardison
 Aide to Commander, Battle Force..... Lieut. Comdr. J. F. Bolger
 Aide to Commander, Scouting Force..... Lieut. Comdr. H. M. Martin
 Office of Naval Operations..... Commander F. P. Sherman, Commander M. B.
 Gardner, Lieutenant J. H. Griffin
 Naval Examining Board..... Lieut. Comdr. J. R. Dudley
 Board of Inspection and Survey..... Commander G. R. Henderson

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Bureau of Ordnance.....	Lieut. Comdr. D. V. Gallery, Jr., Lieutenant J. S. McClure
Bureau of Engineering.....	Lieut. Comdr. R. C. Sutliff
Bureau of Medicine and Surgery.....	Commander J. C. Adams (MC)
Hydrographic Office.....	Lieut. Comdr. J. S. Michael, Lieut. Comdr. J. I. Taylor
Aeronautical Board.....	Commander A. M. Pride

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

Headquarters, Navy Building, Washington, D. C.

Laboratories, Langley Field, Va.

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.

Vannevar Bush, Sc.D., Chairman, Carnegie Institution, Washington, D. C.

George J. Mead, Sc.D., Vice Chairman, West Hartford, Connecticut.

Charles G. Abbot, Sc.D., Secretary, Smithsonian Institution.

Henry H. Arnold, Major General, United States Army, Chief of Air Corps, War Department.

George H. Brett, Brigadier General, United States Army, Chief Materiel Division, Air Corps, Wright Field, Dayton, Ohio.

Lyman J. Briggs, Ph.D., Director, National Bureau of Standards.

Clinton M. Hester, A.B., LL.B., Administrator, Civil Aeronautics Authority.

Robert H. Hinckley, A.B., Chairman, Civil Aeronautics Authority.

Jerome C. Hunsaker, Sc.D., Massachusetts Institute of Technology, Cambridge, Mass.

Walter G. Kilner, Brigadier General, United States Army (Retired), Washington, D. C.

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., Washington, D. C.
Orville Wright, Sc.D., Dayton, Ohio.

George W. Lewis, Sc.D., Director of Aeronautical Research.

S. Paul Johnston, B.S., Coordinator of Research.

John F. Victory, LL.M., Secretary

Edward H. Chamberlin, Asst. Secy.

Henry J. E. Reid, Engineer-in-Charge, Langley Memorial Aeronautical Laboratory, Langley Field, Va.

John J. Ide, Technical Assistant in Europe, Paris, France.

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Paul Walker

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Henry Morgenthau, Jr., Secretary of the Treasury

Herbert E. Gaston, Assistant Secretary in charge of Coast Guard and Narcotics

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Commandant, U. S. Coast Guard..... Rear Admiral R. R. Waesche
 Assistant Commandant (Chief Operations Officer)..... Rear Admiral L. C. Covell
 Engineer-in-Chief (Chief of Material Division)..... Rear Admiral H. F. Johnson

Coast Guard Air Stations

Salem, Massachusetts (Winter Island)..... Seaplanes only
 New York, N. Y. (Floyd Bennett Field)..... Seaplanes-Landplanes
 Elizabeth City, N. C. (Davis Bay, Pasquotank River)..... Seaplanes-Landplanes
 Charleston, S. C. (Navy Yard)..... Seaplanes-Landplanes
 Miami, Florida (Dinner Key)..... Seaplanes only
 St. Petersburg, Fla. (Albert Whitted Airport)..... Seaplanes-Landplanes
 Biloxi, Mississippi (Cadet Point)..... Seaplanes only
 San Diego, California (Lindbergh Field)..... Seaplanes-Landplanes
 San Francisco, Calif. (San Francisco Municipal Field)..... Seaplanes-Landplanes
 Port Angeles, Wash. (Ediz Hook)..... Seaplanes-Landplanes

BUREAU OF FOREIGN AND DOMESTIC COMMERCE

U. S. DEPARTMENT OF COMMERCE

Washington, D. C.

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Edward J. Noble, Under Secretary of Commerce

James W. Young, Director, Bureau of Foreign & Domestic Commerce

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Chief..... Paul R. Mattix
 Chief, Aeronautics Trade Section..... Brower V. York

Note:—The Automotive-Aeronautics Trade Division is a source of information on civil aviation developments abroad, aeronautical export markets and related data.

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Washington, D. C.

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 First Assistant Postmaster General..... W. W. Howes
 Deputy First Assistant Postmaster General..... J. M. Donaldson
 Superintendent, Air Mail Service..... Charles P. Graddick
 Assistant Superintendent, Air Mail Service..... C. M. Knoble
 J. C. Young, Assistant Superintendent..... New York, N. Y.
 J. A. Cruickshank, Assistant Superintendent..... Chicago, Ill.
 B. H. Lockett, Assistant Superintendent..... Atlanta, Ga.
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Flight Information Section.....	R. J. Aubry
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Publications & Statistics Division.....	F. B. Brinkley
Statistical Section.....	Stafford Kernan
Publications Section.....	John Parker

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Utilities Section.....	A. J. LaBaie
Construction Section.....	G. E. Stratton
Radio Section.....	W. F. McBride
Maintenance Section.....	Harry Howard
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Airway Traffic Control Section.....	G. A. Gilbert
Airport Traffic Control Section.....	F. L. Smith
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Airport Section.....	A. B. McMullen
Air Transport Section.....	R. W. Knight
Radio Development Section.....	W. E. Jackson

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Richard D. Schall.....	Assistant to Director
State Coordinator.....	Elwood B. Cole
Private Flying Development Division.....	Grove Webster
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Development Section.....	Jack R. Cram
Vocational Section.....	Leslie A. Walker
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Consulting Aeronautical Assistant.....	Harold E. Hartney
Technical Assistant.....	John F. Warlick
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Aircraft Unit.....	H. D. Hoekstra
Appliance Unit.....	John Vitol
Power Plant Unit.....	G. W. Newton
Specification Unit.....	J. M. Chamberlain

Air Carrier Inspection Section.....	H. W. Anderson
Operations Inspection Unit.....	W. T. Miller
Maintenance Unit.....	H. B. Taylor
Radio Unit.....	R. G. Nichols
General Inspection Section.....	F. M. Lanter
Airmen Unit.....	Freeman Albert
Aeronautical Inspection Unit.....	G. W. Neal
Engineering Flight Test & Inspection Unit.....	C. F. Dycer
Medical Section.....	Dr. E. S. Adams
Certificate Section.....	Clarke Conway
Regulation & Enforcement Division.....	Stuart C. Tipton
Regulation Section.....	Elmer McD. Kintz
Enforcement Section.....	Glen Woodmansee

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F. A. Toombs.....	Assistant to Director
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Inquiry & Compliance Section.....	John C. Freeland
Informal Complaints Section.....	Antoinette D. Hechmer
Tariffs Section.....	Edward A. J. Fay
International Division.....	Samuel E. Gates
Foreign Arrangements Section.....	Edward M. Weld
Foreign Research Section.....	Melvin A. Hall

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Harry Agertor.....	Assistant to Director
Directors Regional Offices	
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Second, Atlanta, Ga.....	R. C. Copeland
Third, Chicago, Ill.....	Harold R. Neely
Fourth, Fort Worth, Tex.....	L. C. Elliott
Fifth, Kansas City, Mo.....	Leonard W. Jurden
Sixth, Santa Monica, Calif.....	J. S. Marriott
Seventh, Seattle, Wash.....	R. D. Bedinger

Interdepartmental Commission, Washington National Airport

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Resident Engineer.....	H. H. Houk
Administrative Assistant.....	Thos. G. Early

Air Safety Board

Tom Hardin.....	Chairman
C. B. Allen.....	Vice Chairman
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Asst. to Executive Officer.....	John Foscue
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Investigation Division.....	Frank E. Caldwell
Examiners Section.....	Fred Glass
Investigation Section.....	Paul E. Gillespie
Analysis Section.....	Wm. F. Centner
Technical Section.....	G. C. Miller

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION

Standing Committees of the 76th Congress, third session, 1940

Senate

Appropriations

Carter Glass	(D)	Harry S. Truman	(D)
Kenneth McKellar	(D)	Edward R. Burke	(D)
Carl Hayden	(D)	Theodore Francis Green	(D)
Elmer Thomas	(D)	Francis T. Maloney	(D)
James F. Byrnes	(D)	Dennis Chavez	(D)
Millard E. Tydings	(D)	Frederick Hale	(R)
Richard B. Russell	(D)	Gerald P. Nye	(R)
Alva B. Adams	(D)	John G. Townsend, Jr.	(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)	Robert A. Taft	(R)

Interstate Commerce

Burton K. Wheeler	(D)	H. H. Schwartz	(D)
Ellison D. Smith	(D)	Lister Hill	(D)
Robert F. Wagner	(D)	Tom Stewart	(D)
Alben W. Barkley	(D)	Ernest Lundeen	(FL)
Matthew M. Neely	(D)	Wallace H. White, Jr.	(R)
Homer T. Bone	(D)	Warren R. Austin	(R)
Vic Donahey	(D)	Henrik Shipstead	(FL)
Sherman Minton	(D)	Charles W. Tobey	(R)
Harry S. Truman	(D)	Clyde M. Reed	(R)
Charles O. Andrews	(D)	Chan Gurney	(R)
Edwin C. Johnson	(D)		

Military Affairs

Morris Sheppard	(D)	James M. Slattery	(D)
Robert R. Reynolds	(D)	A. B. Chandler	(D)
Elbert D. Thomas	(D)	Warren R. Austin	(R)
Sherman Minton	(D)	Gerald P. Nye	(R)
Edwin C. Johnson	(D)	Styles Bridges	(R)
Josh Lee	(D)	Chan Gurney	(R)
H. H. Schwartz	(D)	Rufus C. Holman	(R)
Lister Hill	(D)	Ernest Lundeen	(FL)
Sheridan Downey	(D)		

Naval Affairs

David I. Walsh	(D)	Guy M. Gillette	(D)
Millard E. Tydings	(D)	Allen J. Ellender	(D)
Ellison D. Smith	(D)	Scott W. Lucas	(D)
Richard B. Russell	(D)	Frederick Hale	(R)
Homer T. Bone	(D)	James J. Davis	(R)
Harry Flood Byrd	(D)	Hiram W. Johnson	(R)
Peter G. Gerry	(D)	Ernest W. Gibson	(R)
Rush D. Holt	(D)	W. Warren Barbour	(R)
Charles O. Andrews	(D)		

Post Offices and Post Roads

Kenneth McKellar	(D)	Allen J. Ellender	(D)
Carl Hayden	(D)	William H. Smathers	(D)
Josiah W. Bailey	(D)	James M. Mead	(D)
William J. Bulow	(D)	D. Worth Clark	(D)
James F. Byrnes	(D)	Lynn J. Frazier	(R)
Joseph C. O'Mahoney	(D)	Robert M. La Follette, Jr.	(Ind.)
James E. Murray	(D)	Styles Bridges	(R)
Dennis Chavez	(D)	James J. Davis	(R)
Rush D. Holt	(D)	Clyde M. Reed	(R)

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION

(Continued)

House of Representatives

Appropriations

Edward T. Taylor	(D)	Joseph E. Casey	(D)
Clarence Cannon	(D)	John H. Kerr	(D)
Clifton A. Woodrum	(D)	George H. Mahon	(D)
Louis Ludlow	(D)	Harry R. Sheppard	(D)
Malcolm C. Tarver	(D)	Butler B. Hare	(D)
Jed Johnson	(D)	John Taber	(R)
J. Buell Snyder	(D)	Richard B. Wigglesworth	(R)
James McAndrews	(D)	William P. Lambertson	(R)
Emmet O'Neal	(D)	D. Lane Powers	(R)
George W. Johnson	(D)	J. William Ditter	(R)
James G. Scrugham	(D)	Albert E. Carter	(R)
James M. Fitzpatrick	(D)	Robert F. Rich	(R)
Louis C. Rabaut	(D)	Charles A. Plumley	(R)
Joachim O. Fernandez	(D)	Everett M. Dirksen	(R)
Millard F. Caldwell	(D)	Albert J. Engel	(R)
David D. Terry	(D)	Karl Stefan	(R)
John M. Houston	(D)	Francis Case	(R)
Joe Starnes	(D)	Dudley A. White	(R)
Ross A. Collins	(D)	Clarence J. McLeod	(R)
Charles H. Leavy	(D)	Frank B. Keefe	(R)

Interstate and Foreign Commerce

Clarence F. Lea	(D)	James P. McGranery	(D)
Robert Crosser	(D)	Donald L. O'Toole	(D)
Alfred L. Bulwinkle	(D)	Luther Patrick	(D)
Virgil Chapman	(D)	Charles A. Wolverson	(R)
William P. Cole, Jr.	(D)	James Wolfenden	(R)
Edward A. Kelly	(D)	Pehr G. Holmes	(R)
John A. Martin	(D)	B. Carroll Reece	(R)
Herron Pearson	(D)	James W. Wadsworth	(R)
Lyle H. Boren	(D)	Charles A. Halleck	(R)
Martin J. Kennedy	(D)	Oscar Youngdahl	(R)
Elmer J. Ryan	(D)	Carl Hinshaw	(R)
Charles L. South	(D)	Clarence J. Brown	(R)

Military Affairs

Andrew J. May	(D)	William D. Byron	(D)
R. Ewing Thomason	(D)	Anthony J. Dimond	(D)
Dow W. Harter	(D)	Walter G. Andrews	(R)
Charles I. Faddis	(D)	Dewey Short	(R)
Andrew Edmiston	(D)	Leslie C. Arends	(R)
Edwin M. Schaefer	(D)	Charles R. Clason	(R)
J. Joseph Smith	(D)	Albert G. Rutherford	(R)
Matthew J. Merritt	(D)	J. Parnell Thomas	(R)
John M. Costello	(D)	Paul W. Shafer	(R)
C. Arthur Anderson	(D)	Thomas E. Martin	(R)
Overton Brooks	(D)	Charles H. Elston	(R)
John J. Sparkman	(D)	Forest A. Harness	(R)
Paul J. Kilday	(D)	Samuel W. King	(R)
Joseph W. Byrns, Jr.	(D)		

Naval Affairs

Carl Vinson	(D)	William S. Jacobsen	(D)
Patrick H. Drewry	(D)	Franck R. Havenner	(D)
Leonard W. Schuetz	(D)	Michael J. Bradley	(D)
William H. Sutphin	(D)	John K. Griffith	(D)
Joseph B. Shannon	(D)	Beverly M. Vincent	(D)
Warren G. Magnuson	(D)	Colgate W. Darden	(D)
Lyndon B. Johnson	(D)	Pat Cannon	(D)

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION

(Continued)

Naval Affairs (Continued)

James H. Fay	(D)	George J. Bates	(R)
Anthony J. Dimond	(D)	William E. Hess	(R)
Melvin J. Maas	(R)	George P. Darrow	(R)
Ralph E. Church	(R)	Arthur B. Jenks	(R)
James W. Mott	(R)	Walter S. Jeffries	(R)
W. Sterling Cole	(R)	Samuel W. King	(R)

Post Office and Post Roads

Milton A. Romjue	(D)	Michael J. Kennedy	(D)
Thomas G. Burch	(D)	Lee E. Geyer	(D)
Martin L. Sweeney	(D)	Clyde T. Ellis	(D)
William A. Ashbrook	(D)	Fred A. Hartley, Jr.	(R)
Arthur W. Mitchell	(D)	E. Harold Cluett	(R)
B. Frank Wheelchel	(D)	Noah M. Mason	(R)
Joe Hendricks	(D)	Charles F. Risk	(R)
Noble J. Gregory	(D)	William W. Blackney	(R)
Thomas A. Flaherty	(D)	Ben F. Jensen	(R)
Clyde L. Garrett	(D)	Albert E. Austin	(R)
J. Harold Flannery	(D)	James Secombe	(R)
Carl T. Durham	(D)	George W. Gillie	(R)
		John McDowell	(R)

THE NATIONAL ASSOCIATION OF STATE
AVIATION OFFICIALS

Officers for 1940.

President D. O. LANGSTAFF Director of Aviation State of Louisiana	First Vice-President RAYMOND R. STAUB Treasurer, Board of Aeronautics State of Oregon
Second Vice-President DEXTER C. MARTIN Director of Aeronautics State of South Carolina	Third Vice-President ASA ROUNTREE, JR. Director of Airfields and Developments State of Alabama
Secretary-Treasurer GEORGE C. ROBERTS Secretary, Illinois Aeronautics Commission	Legal Counsel GEORGE B. LOGAN St. Louis, Missouri
Regional Vice Presidents	
East Central Region SHELDON B. STEERS Ass't Director, Department of Aeronautics Capital City Airport Lansing, Michigan	Southwest Region W. D. HAMMOND Chairman, Utah State Aeronautics Commission 439 Capitol Building Salt Lake City, Utah
Southeast Region HERB WHITNEY Director, Aviation Division Room 10, Martin Bldg. Tallahassee, Florida	Northeast Region C. L. MORRIS Commissioner of Aeronautics P. O. Box No. 537 Hartford, Connecticut
North Central Region I. V. PACKARD Secretary, Nebraska Aeronautics Commission Lincoln, Nebraska	

STATE AVIATION OFFICIALS

ALABAMA:	Alabama State Aviation Commission Hayden Brooks, Chairman, c/o 230 S. 31st Street, Birmingham
ARIZONA:	No Aeronautical regulatory body. (Arizona Corporation Commission, W. M. Cox, Chairman, Phoenix, has jurisdiction over aircraft common carriers.)
ARKANSAS:	No aeronautical regulatory body.
CALIFORNIA:	No aeronautical regulatory body.
COLORADO:	Colorado Aeronautics Commission Jerry Vasconcels, Chairman, Denver
CONNECTICUT:	Department of Aeronautics Charles L. Morris, Commissioner of Aeronautics, P. O. Box 537, Hartford.
DELAWARE:	No aeronautical regulatory body.
FLORIDA:	No aeronautical regulatory body. (Promotion work is under the direction of the State Road Department.)
GEORGIA:	Georgia Aviation Commission Marvin Griffin, Chairman, State Capitol, Atlanta
IDAHO:	Department of Public Works W. H. Hill, Director of Aeronautics, State House, Boise
ILLINOIS:	Illinois Aeronautics Commission L. P. Bonfoey, Chairman, Quincy (Illinois Commerce Commission, 205 S. Sixth St., Springfield, has jurisdiction over common carriage.)
INDIANA:	No aeronautical regulatory body.
IOWA:	Iowa Aeronautics Commission Lt. Col. Charles W. Gatschet, Chairman, Des Moines
KANSAS:	No aeronautical regulatory body.
KENTUCKY:	No aeronautical bureau.
LOUISIANA:	Louisiana Aeronautics Commission D. O. Langstaff, Chairman, New Orleans Airport, New Orleans
MAINE:	Office of Secretary of State Burtis F. Fowler, Chief Inspector in Charge of Aviation, State House, Augusta
MARYLAND:	Maryland Aviation Commission Dr. Hugh H. Young, Chairman, Johns-Hopkins Hospital, Monument and Broadway, Baltimore
MASSACHUSETTS:	Massachusetts Aviation Commission Chandler Hovey, Chairman, Newton
MICHIGAN:	Michigan Board of Aeronautics Wm. B. Mayo, Chairman, 2272 First Natl. Bank Bldg., Detroit
MINNESOTA:	Minnesota Aeronautics Commission Major Ray S. Miller, Chairman, Athletic Club, St. Paul

MISSISSIPPI:	No aeronautical regulatory body.
MISSOURI:	No aeronautical regulatory body.
MONTANA:	Montana Aeronautics Commission Fred B. Sheriff, Commissioner, Helena.
NEBRASKA:	Nebraska Aeronautics Commission Max Kier, Chairman, 539 Stuart Bldg., Lincoln
NEVADA:	No aeronautical regulatory body. (Nevada Public Service Commission, C. B. Sexton, Chairman, Carson City, has jurisdiction over aircraft common carriers.)
NEW HAMPSHIRE:	New Hampshire Public Service Commission James F. O'Neil, Director of Aeronautics, Manchester
NEW JERSEY:	New Jersey Department of Aviation Gill Robb Wilson, State Director of Aviation, Trenton
NEW MEXICO:	State Corporation Commission H. Townsend, Executive Director, New Mexico Aeronautics Commission, Santa Fe.
NEW YORK:	No aeronautical regulatory body.
NORTH CAROLINA:	State Aviation Commission Dr. F. M. Boldridge, Chairman, Charlotte, N. C. c/o Duke Power Co.
NORTH DAKOTA:	No aeronautical regulatory body. (Board of Railroad Commissioners, Elmer W. Cart, President, Bismarck, has limited regulatory powers.)
OHIO:	State Bureau of Aeronautics Earle L. Johnson, Director of Aeronautics, 913 Wyandotte Bldg., Columbus
OKLAHOMA:	Oklahoma Department of Public Safety Owen A. Smith, Director, Traffic Control, Oklahoma City
OREGON:	State Board of Aeronautics Arthur W. Whitaker, Chairman, 619 Lumbermens Bldg., Portland
PENNSYLVANIA:	Department of Revenue, Division of Aeronautics Wm. M. Schwarz, Acting Director, Harrisburg Airport, New Cumberland
RHODE ISLAND:	Department of Public Works, Division of State Airports Willard M. Fletcher, Chief, Division of Airports, State Airport, Hills-grove
SOUTH CAROLINA:	State Aeronautics Commission J. P. Williamson, Chairman, Greenville
SOUTH DAKOTA:	South Dakota Aeronautics Commission T. B. Roberts, Jr., Chairman, Pierre
TENNESSEE:	Bureau of Aeronautics G. J. Paulie, Director, 1018 Cotton States Bldg., Nashville
TEXAS:	State Civil Aeronautics Committee E. E. McAdams, Chairman, Austin
UTAH:	State Aeronautics Commission W. D. Hammond, Chairman, 439 Capitol Bldg., Salt Lake City

VERMONT:	Motor Vehicle Department, Aviation Section Raymond C. Thompson, Inspector of Aeronautics, Montpelier
VIRGINIA:	State Corporation Commission, Division of Aeronautics Thomas W. Ozlin, Chairman, Richmond
WASHINGTON:	No aeronautical regulatory body.
WEST VIRGINIA:	West Virginia Board of Aeronautics Burr H. Simpson, Chairman, Charleston
WISCONSIN:	State of Wisconsin Aeronautics Board Howard A. Morey, Chairman, Madison
WYOMING:	State Aviation Commission John Phifer, Chairman, Wheatland

AERONAUTICAL PERIODICALS OF THE UNITED STATES

AERO DIGEST	515 Madison Avenue, New York, N. Y.
AIR LAW REVIEW	Washington Square East, New York, N. Y.
AIR LINE PILOT	3145 W. 63rd Street, Chicago, Ill.
AIR TRAILS	79 Seventh Avenue, New York, N. Y.
AMERICAN AVIATION	Earle Building, Washington, D. C.
AVIATION	330 W. 42nd St., New York, N. Y.
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 AERONAUTIC MAGAZINE	Willard Hotel, Washington, D. C.
OFFICIAL AVIATION GUIDE	608 S. Dearborn Street, Chicago, Ill.
PILOT	Grand Central Air Terminal, Glendale, Calif.
POPULAR AVIATION	608 S. Dearborn Street, Chicago, Ill.
SOARING	1500 Locust Street, Philadelphia, Pa.
SOUTHERN FLIGHT	P. O. Box 570, 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.

DIPLOMATIC SERVICE TO THE UNITED STATES

The following foreign aeronautical representatives may be addressed at their respective embassies in Washington, D. C.

Argentina.....	Col. Pedro Zanni, Military and Air Attaché.
Belgium.....	Count Robert van der Straten-Ponthoz, Ambassador E. and P.
Bolivia.....	Senor Don Fernando Pou Munt, Counselor.
Brazil.....	Lt. Comdr. Olavo de Araujo, Naval Attaché.
Bulgaria.....	Mr. C. S. Baer, Consul.
Canada.....	Mr. Merchant M. Mahoney, First Secretary.
Chile.....	Squadron Commander Ismael Sarasua, Air Attaché.
China.....	Dr. Chang-Lok Chen, Counselor of Embassy.
Colombia.....	Lt. Col. Eduardo Leongomez, Military Attaché.
Costa Rica.....	Senor Don Ricardo Castro-Beeche, Minister Resident.
Cuba.....	Major Felipe Munilla, Military Attaché.
Ecuador.....	Senor Dr. Don Eduardo Salazar, Counselor.
Egypt.....	Mahmoud Hassan Bey, E. E. and M. P.
El Salvador.....	Senor Dr. Don Hector David Castro, E. E. and M. P.
Finland.....	Col. Per Zilliacus, Military Attaché.
France.....	Col. René P. G. Weiser, Air Attaché.
Germany.....	Lieutenant General Friedrich von Boetticher, Air and Military Attaché.
Great Britain.....	Group Captain G. C. Pirie, M. C., D. F. C., Air Attaché.
Greece.....	Mr. George S. Depasta, Counselor of Legation.
Guatemala.....	Senor Dr. Don Enrique Lopez-Herrarte, First Secretary.
Honduras.....	Senor Dr. Don Julian R. Caceres, First Secretary of Legation.
Hungary.....	Major Loránd de Utassy, Military Attaché.
Irish Free State.....	Mr. Garth Healy, Secretary of Legation.
Italy.....	Colonel Vincenzo Coppola, Air and Military Attaché.
Japan.....	Commander Taro Taguiti, Assistant Naval Attaché.
Lithuania.....	Secretary of Legation.
Mexico.....	Senor Dr. Don Francisco Castillo Nájera, Ambassador E. and P.
Netherlands.....	Count W. van Rechteren Limpurg, Counselor of Legation.
Norway.....	Mr. Aage Bryn, First Secretary of Legation.
Panama.....	Senor Don Julio E. Briceño, Secretary of Legation.
Peru.....	Capt. Enrique Labarthe, Naval Attaché.
Poland.....	Count Jerzy Potocki, Ambassador E. and P.
Portugal.....	Mr. João Rodrigues Affra, Secretary of Legation.
Rumania.....	Mr. George Boncesco, Financial Counselor of Legation.
Siam.....	Phya Abbihal Rajamaitri, E. E. and M. P.
South Africa.....	Mr. Robert Webster, Secretary of Legation.
Spain.....	Senor Don Luis de Silva, Marquis de Zahara, Counselor of Embassy.
Sweden.....	Mr. Harry Eriksson, Commercial Counselor of Legation.
Switzerland.....	Mr. Eduard Feer, Counselor of Legation.
Turkey.....	Mr. Mehmet Münir Ertegün, Ambassador E. and P.
U.S.S.R.....	Major Constantine Ovchinnikov, Asst. Military Attaché for Air.
Uruguay.....	Mr. J. Richling, E. E. and M. P.
Venezuela.....	Senor Don Arturo Lares, Secretary of Embassy.
Yugoslavia.....	Col. Mirko Burya, Military and Air Attaché.

**FLYING AND GROUND SCHOOLS OPERATING ON CERTIFICATES OF
COMPETENCY OR LETTERS OF AUTHORITY ISSUED BY
THE CIVIL AERONAUTICS AUTHORITY**

(The Authority does not issue comparative approvals. The order of listing is alphabetical.)

- Alabama Institute of Aeronautics, Inc., Municipal Airport, Tuscaloosa, Ala. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Ashburn Flying Service, Beacon Field, Alexandria, Va. Flying and Ground, Solo, Private.
- Athens Air Service, Inc., Municipal Airport, Athens, Ga. Flying and Ground, Solo, Private.
- Baltimore School of Aeronautics, Inc., Curtiss-Wright Airport, Smith and Greenspring Avenues, Baltimore, Md. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Barnes Air Service Company, Barnes Municipal Airport, Westfield, Mass. Flying and Ground, Solo, Private.
- Boeing School of Aeronautics, Oakland Municipal Airport, Oakland, Calif. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Brayton Flying Service, Inc., Lambert-St. Louis Municipal Airport, Robertson, Mo. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Brinkerhoff Flying Service, Inc., College Park Airport, College Park, Md. Flying and Ground, Solo, Private.
- Buffalo Aeronautical Corporation, Buffalo Airport, Buffalo, N. Y. Flying and Ground, Solo, Private.
- Cal-Aero Training Corporation, 1224 Airway, Glendale, Calif. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- California Flyers, Inc., Los Angeles Municipal Airport, Inglewood, Calif. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Cape Aircraft, Inc., Falmouth Airport, Hatchville, Mass. Flying and Ground, Solo, Private.
- Cape Cod School of Aeronautics, Inc., Hyannis Airport, Hyannis, Mass. Flying and Ground, Solo, Private.
- Chicago School of Aeronautics, Curtiss Airport, Glenview, Ill. In conjunction with: Additional ground school: Aeronautical University, Inc., 1338 S. Michigan Ave., Chicago, Ill. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Commercial Aircraft Company, Swan Island Airport, Portland, Oreg. Flying and Ground, Solo, Private.
- Daitz, Denny, Flying Corporation, (Flying) Hangar 33, Roosevelt Field, Mineola, L. I., N. Y. In conjunction with: New York University, School of Education, New York, N. Y. Flying and Ground, Solo, Private.
- Dallas Aviation School and Air College, Love Field, Dallas, Texas. Flying and Ground, Solo, Private, Commercial, Limited Commercial.
- Deane Flying School, Hangar No. 5, Floyd Bennett Field, Brooklyn, N. Y. In conjunction with: Additional ground school: New York University, School of Education, New York, N. Y. Flying and Ground, Solo, Private.
- Dervend Flying School (Flying), Hangar No. 10, Roosevelt Field, Mineola, L. I., N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- East Coast Flying School (Flying), Hangar No. 6, Floyd Bennett Field, Brooklyn, N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Private.
- Edwards Flying Service (Flying), 47 Emmet Street, New Hyde Park, L. I., N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Private.
- Evers, Carl, Flying School (Flying), Hangar No. 3, Floyd Bennett Field, Brooklyn, N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Private.
- Floyd Bennett Flying School (Flying), Hangar No. 6, Floyd Bennett Field, Brooklyn, N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Private.
- Floyd Bennett Flying Service (Flying), Hangar No. 7, Floyd Bennett Field, Brooklyn, N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Private.

- Flying Service, Inc. (Flying), Hangar No. 6, Floyd Bennett Field, Brooklyn, N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Private.
- Graham Aviation Company, Pittsburgh-Butler Airport, Butler, Pa. Flying and Ground, Solo, Private.
- Grand Central Flying School (Flying), 1435 Flower Street, Glendale, Calif. In conjunction with: Curtiss-Wright Technical Institute of Aeronautics (Ground), 1224 Airway, Glendale, Calif. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Hancock, Allan, College of Aeronautics, Santa Maria Airport, Santa Maria, Calif. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Inter City Airlines, Inc. (Flying), Boston Municipal Airport, East Boston, Mass. In conjunction with: New England Aircraft School (Ground), Boston Municipal Airport, E. Boston, Mass. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Lewis Holy Name School of Aeronautics, Route 66, Lockport, Ill. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Lincoln Airplane & Flying School, 2415 "O" Street, Municipal Airport, Lincoln, Nebr. In conjunction with: Additional ground school at: Union Airport, Lincoln, Nebr. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Lynchburg Air Transport & Sales Corporation, Preston Glenn Airport, Lynchburg, Va. Flying and Ground, Solo, Private.
- Matthews & Rappaport (Flying), Roosevelt Field, Mineola, L. I., N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Mayes Field (Flying), Box 91, Huntington, W. Va. In conjunction with: Marshall College (Ground), Huntington, W. Va. Flight and Ground, Solo, Private.
- Mountain States Aviation, Inc., 38 and Dahlia Streets, Denver, Colo. Flying and Ground, Solo, Private.
- Municipal Flying Service (Flying), Floyd Bennett Field, Brooklyn, N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Private.
- Oklahoma Military Academy, Will Rogers Airport, Claremore, Okla. Flying and Ground, Solo, Private.
- Orlando Air School, Municipal Airport, Orlando, Fla. Flying and Ground, Solo, Private.
- Pacific Aeronautical College, 200 Administration Building, Los Angeles Municipal Airport, Inglewood, Calif. Flying and Ground, Solo, Private.
- Parks Air College, Inc., Parks Airport, East St. Louis, Ill. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Pittsburgh Institute of Aeronautics, Bettis Airport, Dravosburg, Pa. Flying and Ground, Solo, Private.
- Portland Flying Service, Inc., Municipal Airport, Portland, Maine. Flying and Ground, Solo, Private.
- Reich Air Service, Inc. (Flying), Roosevelt Field, Garden City, L. I., N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Private.
- Roosevelt Field, Inc., Aviation School Division, Roosevelt Field, No. 1, Mineola, L. I., N. Y. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Ryan School of Aeronautics, Ltd., Lindbergh Field, San Diego, Calif. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Safair, Inc. (Flying), Hangar B, Roosevelt Field, Mineola, L. I., N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Limited Commercial, Commercial, Private.
- Scott Flying Service, Municipal Airport, Long Beach, Calif. Flying and Ground, Solo, Private.
- Southern Air Service, Inc., Municipal Airport, Memphis, Tenn. Flying and Ground, Solo, Private.
- Spartan School of Aeronautics, Box 2649, Tulsa, Okla. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
- Standard Flying School (Flying), Hangar No. 3, Floyd Bennett Field, Brooklyn, N. Y. In conjunction with: New York University (Ground), School of Education, New York, N. Y. Flying and Ground, Solo, Private.

Stengel, Carl, Flying Service, P. O. Box 352, Gainesville, Fla. Flying and Ground, Solo, Private.
 Western Air College, 620 East Valley Blvd., Alhambra, Calif. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
 Whipp Flying Service, Logan Field, Dundalk, Md. Flying and Ground, Solo, Private.
 Wiggins, E. W., Airways, Inc., Box 121, Norwood, Mass. Flying and Ground, Solo, Private.
 Wiggins, E. W., Airways, Inc. (Flying), Boston Municipal Airport, East Boston, Mass. In conjunction with: New England Aircraft School (Ground), Boston Municipal Airport, E. Boston, Mass. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
 Wiggins, E. W., Airways, Inc., Rhode Island State Airport, Providence, R. I. Flying and Ground, Solo, Private, Limited Commercial, Commercial.
 Wilson, Ray Flying School, Park Hill Airport, Denver, Colo. Flying and Ground, Solo, Private, Limited Commercial, Commercial.

AIRPLANE AND ENGINE MECHANICS' SCHOOLS GRANTED LETTERS OF RECOGNITION BY THE U. S. CIVIL AERONAUTICS AUTHORITY

Aero Industries Technical Institute, 5245 W. San Fernando Road, Los Angeles, Calif.
 Aeronautical University, The, Inc., 1330 South Michigan Ave., Chicago, Ill.
 Aviation Institute of New York, 24-13 Bridge Plaza North, Long Island City, N. Y.
 Boeing School of Aeronautics, Oakland Municipal Airport, Oakland, Calif.
 California Flyers, Inc., School of Aviation, Los Angeles Municipal Airport, Inglewood, Calif.
 California State Polytechnic School, Post Office Box 321, San Luis Obispo, Calif.
 Casey Jones School of Aeronautics, Inc., 1100 Raymond Blvd., Newark, N. J.
 Curtiss-Wright Tech. Institute of Aeronautics, Grand Central Air Terminal, Glendale, Calif.
 Dallas Aviation School and Air College, Love Field, Dallas, Texas.
 General Airmotive Corporation, Municipal Airport, Cleveland, Ohio.
 Lewis Holy Name School of Aeronautics, U. S. Route 66, Lockport, Ill.
 Lincoln Airplane & Flying School, 2415 "O" Street, Municipal Airport, Lincoln, Nebr.
 Luscombe School of Aeronautics, Bear Tavern Road, West Trenton, N. J.
 Missouri Aviation Institute, 334 Richards Road, Kansas City, Mo.
 New England Aircraft School, 126 Newbury Street, Boston, Mass.
 New York State Aviation School, 823 Union Street, Utica, N. Y.
 Parks Air College, Inc., Parks Airport, East St. Louis, Ill.
 Pittsburgh Institute of Aeronautics, Bettis Airport, Dravosburg, Pa.
 Rising Sun Aircraft School, Inc., 191 W. Roosevelt Blvd., Philadelphia, Pa.
 Roosevelt Field, Inc., Aviation School Division, Roosevelt Field No. 1, Mineola, L. I., N. Y.
 Ryan School of Aeronautics, Ltd., Lindbergh Field, San Diego, Calif.
 Sansom's Aviation School, Capt., 157 Charter Oak Ave., Hartford, Conn.
 Spartan School of Aeronautics, Apache Blvd. and Chamberlain Drive, Tulsa, Okla.
 State Trade School, 28 Providence Street, Putnam, Conn.
 Stewart Technical Trade School, The, 253-5-7 West 64th Street, New York, N. Y.
 Stinson School of Aviation, 27-01 Bridge Plaza North, Long Island City, N. Y.

NEUTRALITY ACT OF 1939

[PUBLIC RESOLUTION—No. 54—76TH CONGRESS]

[CHAPTER 2—2D SESSION] [H. J. Res. 306] Approved Nov. 4, 1939

The following is Section 12 of the Act:

NATIONAL MUNITIONS CONTROL BOARD

SEC. 12. (a) There is hereby established a National Munitions Control Board (hereinafter referred to as the "Board"). The Board shall consist of the Secretary of State, who shall be chairman and executive officer of the Board, the Secretary of the Treasury, the Secretary of War, the Secretary of the Navy, and the Secretary of Commerce. Except as otherwise provided in this section, or by other law, the administration of this section is vested in the Secretary of State. The Secretary of State shall promulgate such rules and regulations with regard to the enforcement of this section as he may deem necessary to carry out its provisions. The Board shall be convened by the chairman and shall hold at least one meeting a year.

(b) Every person who engages in the business of manufacturing, exporting, or importing any arms, ammunition, or implements of war listed in a proclamation referred to in or issued under the authority of subsection (i) of this section, whether as an exporter, importer, manufacturer, or dealer, shall register with the Secretary of State his name, or business name, principal place of business, and places of business in the United States, and a list of the arms, ammunition, and implements of war which he manufactures, imports, or exports.

(c) Every person required to register under this section shall notify the Secretary of State of any change in the arms, ammunition, or implements of war which he exports, imports, or manufactures; and upon such notification the Secretary of State shall issue to such person an amended certificate of registration, free of charge, which shall remain valid until the date of expiration of the original certificate. Every person required to register under the provisions of this section shall pay a registration fee of \$100. Upon receipt of the required registration fee, the Secretary of State shall issue a registration certificate valid for five years, which shall be renewable for further periods of five years upon the payment for each renewal of a fee of \$100; but valid certificates of registration (including amended certificates) issued under the authority of section 2 of the joint resolution of August 31, 1935, or section 5 of the joint resolution of August 31, 1935, as amended, shall, without payment of any additional registration fee, be considered to be valid certificates of registration issued under this subsection, and shall remain valid for the same period as if this joint resolution had not been enacted.

(d) It shall be unlawful for any person to export, or attempt to export, from the United States to any other state, any arms, ammunition, or implements of war listed in a proclamation referred to in or issued under the authority of subsection (i) of this section, or to import, or attempt to import, to the United States from any other state, any of the arms, ammunition, or implements of war listed in any such proclamation, without first having submitted to the Secretary of State the name of the purchaser and the terms of sale and having obtained a license therefor.

(e) All persons required to register under this section shall maintain, subject to the inspection of the Secretary of State, or any person or persons designated by him, such permanent records of manufacture for export, importation, and exportation of arms, ammunition, and implements of war as the Secretary of State shall prescribe.

(f) Licenses shall be issued by the Secretary of State to persons who have registered as herein provided for, except in cases of export or import licenses where the export of arms, ammunition, or implements of war would be in violation of this joint resolution or any other law of the United States, or of a treaty to which the United States is a party, in which cases such licenses shall not be issued; but a valid license issued under the authority of section 2 of the joint resolution of August 31, 1935, or section 5 of the joint resolution of August 31, 1935, as amended, shall be considered to be a valid license issued under this subsection, and shall remain valid for the same period as if this joint resolution had not been enacted.

(g) No purchase of arms, ammunition, or implements of war shall be made on behalf of the United States by any officer, executive department, or independent establishment of the Government from any person who shall have failed to register under the provisions of this joint resolution.

(h) The Board shall make a report to Congress on January 3 and July 3 of each year, copies of which shall be distributed as are other reports transmitted to Congress. Such reports shall contain such information and data collected by the Board as may be considered of value in the determination of questions connected with the control of trade in arms, ammunition, and implements of war, including the name of the purchaser and the terms of sale made under any such license. The Board shall include in such reports a list of all persons required to register under the provisions of this joint resolution, and full information concerning the licenses issued hereunder, including the name of the purchaser and the terms of sale made under any such license.

(i) The President is hereby authorized to proclaim upon recom-

mentation of the Board from time to time a list of articles which shall be considered arms, ammunition, and implements of war for the purposes of this section: but the proclamation Numbered 2237, of May 1, 1937 (50 Stat. 1834), defining the term "arms, ammunition, and implements of war" shall, until it is revoked, have full force and effect as if issued under the authority of this subsection.

THE FOREIGN LOAN ACT OF 1940

Authorizing the Export-Import Bank to Finance Foreign Sales of
Commercial Aircraft Built in the
United States.

[PUBLIC—No. 420—76TH CONGRESS] [CHAPTER 34—3D SESSION] [S. 3069]

To provide for increasing the lending authority of the Export-Import Bank of Washington, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 9 of the Act approved January 31, 1935 (49 Stat. 4), as amended, is amended (1) by striking out "\$100,000,000" and inserting in lieu thereof "\$200,000,000", and (2) by inserting before the period at the end thereof a colon and the following: "*Provided further*, That the aggregate amount of loans to any one foreign country and the agencies and nationals thereof which are hereafter authorized to be made and are outstanding at any one time shall not exceed \$20,000,000. and such amount shall be in addition to the amount of loans heretofore authorized or made to such foreign country and the agencies and nationals thereof: *Provided further*, That the Export-Import Bank of Washington shall not make any loans to any government which was in default in the payment of its obligations or any part thereof to the Government of the United States on April 13, 1934, or in violation of international law as interpreted by the Department of State or for the purchase of any articles, except aircraft exclusively for commercial purposes, listed as arms, ammunition, or implements of war by the President of the United States in accordance with the Neutrality Act of 1939".

Approved, March 2, 1940.

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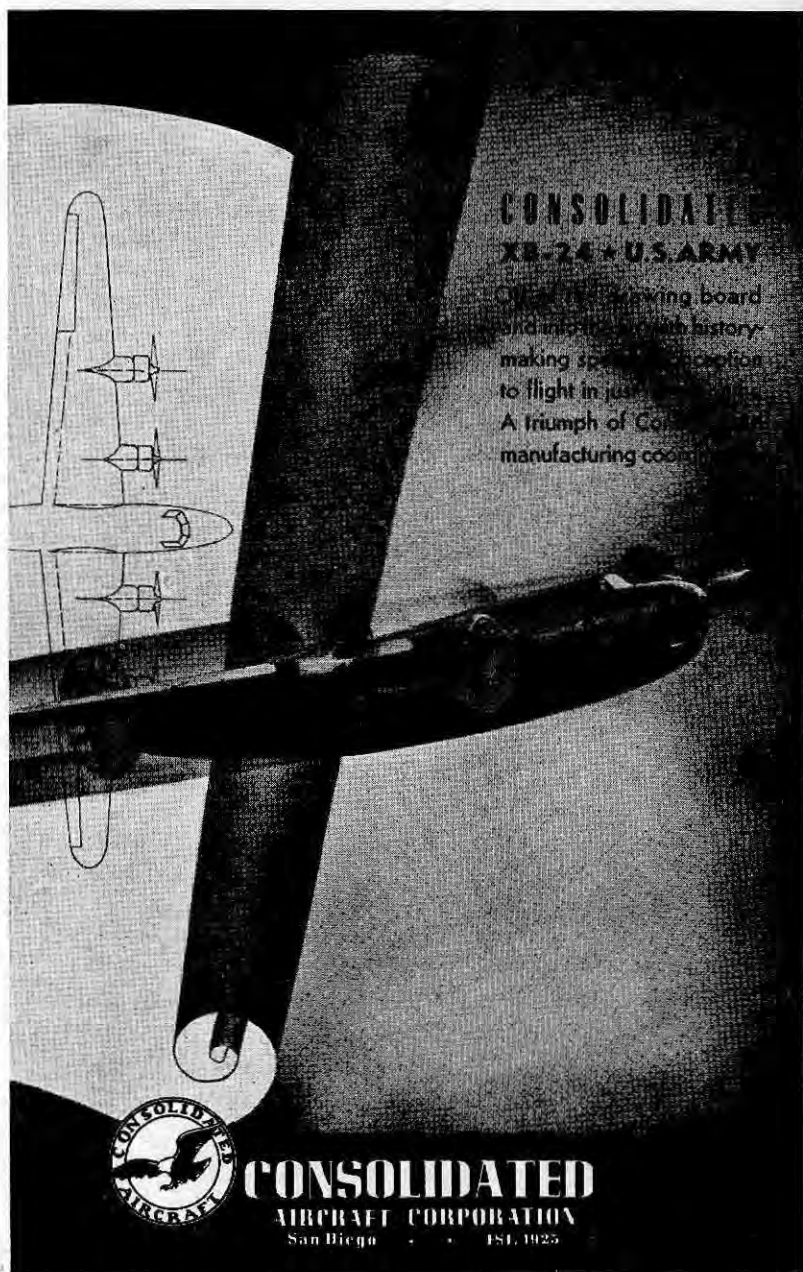
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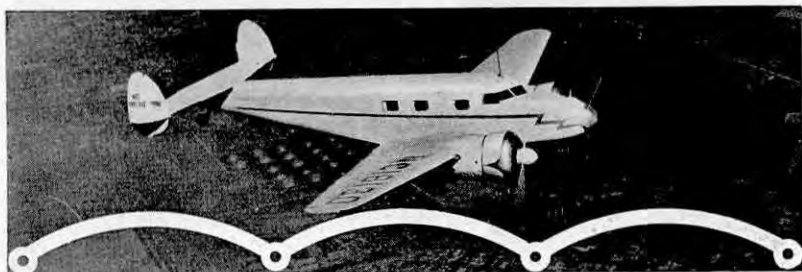
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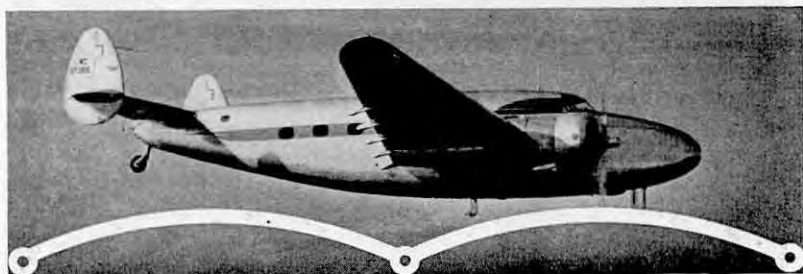
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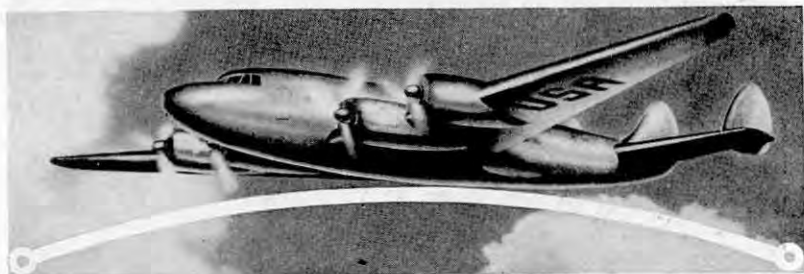
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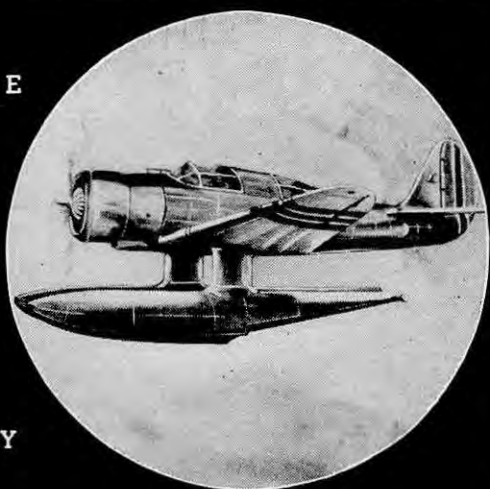
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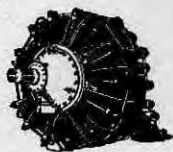
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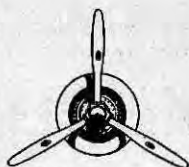
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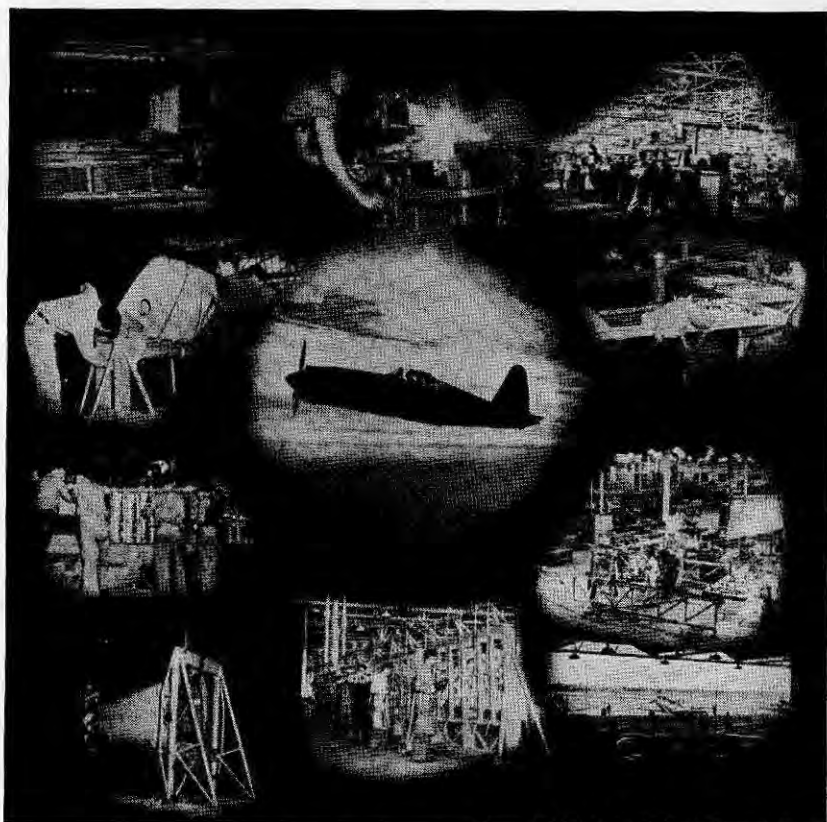


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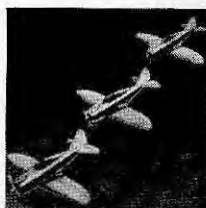
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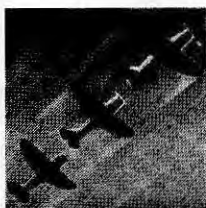
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