The AIRCRAFT YEAR BOOK

For 1937

ACCA

LEADING THE NATION INTO FLIGHT

AIRCRAFT YEAR BOOK FOR 1937

Official U. S. Army Photo

THE AIR CORPS AT MARCH FIELD

Bombers and fighters over scores of other squadrons on the ground at the annual review of the West Coast contingent.

The
AIRCRAFT YEAR BOOK

(Registered U. S. Patent Office)

For 1937

NINETEENTH ANNUAL EDITION

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Editor

Published by the
AERONAUTICAL CHAMBER OF COMMERCE
OF AMERICA, INC.
30 Rockefeller Plaza New York

MANUFACTURED COMPLETE BY
THE COLONIAL PRESS INC., CLINTON, MASS.
ENGRAVINGS BY HARDING PHOTO-ENGRAVING COMPANY, INC., NEW YORK

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OVER THE GRAND CANYON

Passengers on some TWA planes flying its transcontinental route view one of the most remarkable scenic wonders in the world. For nearly 200 miles they get a birdseye view of this great, radiantly-colorful, mile-deep jagged gash in the surface of the earth. The plane is a Wright Cyclone-powered Douglas transport.

CHAPTER I

GROWTH OF AIR POWER

Significance of Scientific Development in Europe—Mass Production of Military Aircraft Abroad—Importance of Civil Aviation as Reserve Air Power.

A YEAR ago men familiar with aeronautics asserted that the real significance of the flying machine lies in what it promises to be in the near future. The accuracy of that opinion is in evidence today. It exists in the United States which is making steady progress in private flying and air transportation, at the same time maintaining the nucleus of an air force for national defense. But most significant of all, and a situation that defies any sort of restraint in describing it, is the breakneck race of all the other large nations for military supremacy in the air.

The American people have taken real pride in the success with which they have developed the airplane as a vehicle of peaceful transportation. They always have preferred that kind of development as compared to making the flying machine an instrument of war; and there is no indication that the national thought has changed. On the other hand, the present activity abroad is predominantly military; and it is growing so rapidly that it no longer can be ignored.

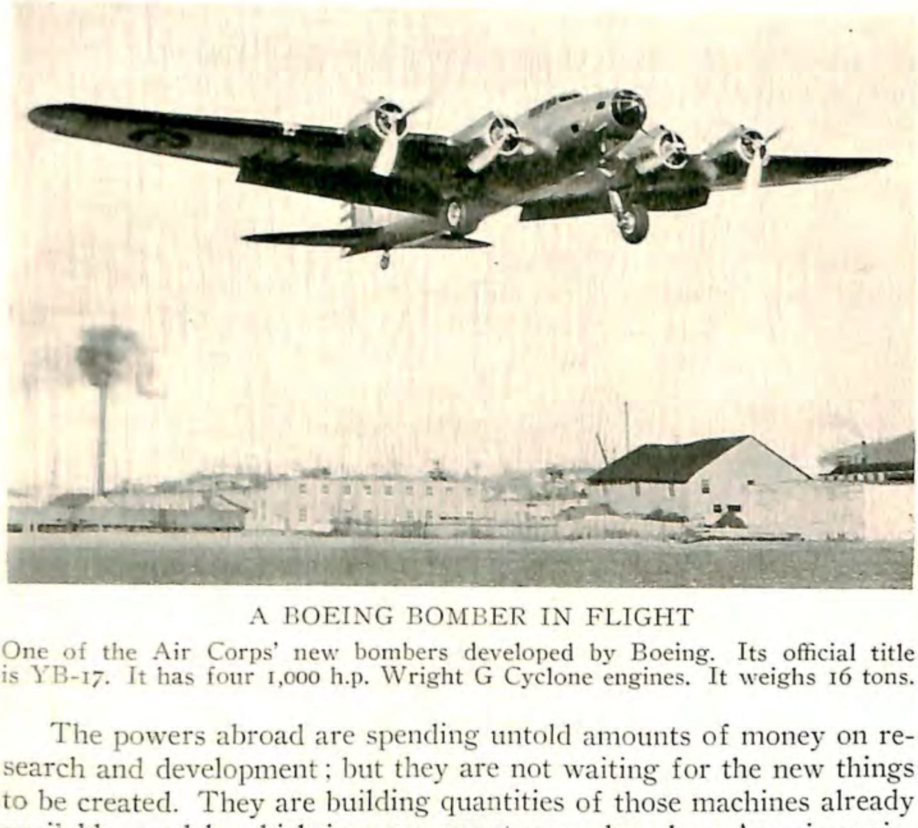
Great Britain, France, Germany, Italy, Russia and Japan are going into mass production of military aircraft and other air force equipment as rapidly as facilities permit. Their factories are operating day and night. In the laboratories and drafting rooms their scientists and technicians are working secretly but none-the-less feverishly on new things designed for aerial warfare.

Official U. S. Army photo

THE BOMBING OF MAUNA LOA

When Army Air Corps machines attacked the Hawaiian volcano and stopped the lava flow menacing the city of Hilo. The explosion of one of the 20 bombs dropped by the planes can be seen through the clouds of smoke and sulphur fumes.

Many reports of these developments abroad sound fantastic, such as for example, hundred of soldiers with machine guns dropping by parachute, to take positions as a regiment of infantry ready for attack behind an imaginary enemy's lines. When photographs of that event were published, it still seemed fantastic, more of a stunt, perhaps, than a maneuver of tactical value. But in aviation the stunt flight of today seems bound to be a commonplace tomorrow. France, too, is playing with air infantry, having exchanged ideas with the Russians, giving them in return, it is reported, an airplane cannon firing hundreds of explosive shells a minute.



A BOEING BOMBER IN FLIGHT

One of the Air Corps' new bombers developed by Boeing. Its official title is YB-17. It has four 1,000 h.p. Wright G Cyclone engines. It weighs 16 tons.

The powers abroad are spending untold amounts of money on research and development; but they are not waiting for the new things to be created. They are building quantities of those machines already available, models which in every country are based on American aircraft operated in the United States during the last two or three years.

The laboratory work in progress, however, surely will result in much originality of design and construction. There lies the only possible menace to American leadership. The only reason that Europe lacks aircraft as efficient and enduring as American machines is that other nations in the past have not carried on as much steady engineering development and technical research as has the United States since the World War. Europe and Japan let research lapse until they saw war clouds tumbling overhead. They now are making up for lost time, and whether they eventually produce the best aircraft depends on the future research and development effort in the United States. That is a most important form of air power, in war or peace.

The following chapters give in detail an estimate of comparative combat strength and conditions under which air forces are being established, the present status of American aviation, and further on a description of the more important branches of aeronautics here. There is more civil flying in the United States than in all other countries combined. Americans use more planes in private flying and air transportation than they have in their air forces. Under present conditions, this is encouraging in view of the fact that progress in private flying, air transportation, a progressive manufacturing industry, and sufficient raw materials, combined with constant research and invention, form the reserve air power that a nation needs as a vital part of its insurance for lasting peace.

The discussion of foreign air force programs in Chapter III, particularly the estimates of the numbers of combat airplanes now possessed by the other powers, necessarily is based on unofficial reports. The figures may be surprising, even to those familiar with aviation. To the layman they may appear exaggerated. But to many expert observers who visited these countries in 1936, the estimates will appear too conservative.

A NEW NAVY VOUGHT SCOUT BOMBER

The SB2U-1, powered by a Pratt & Whitney Twin Wasp Junior, was built by the Chance Vought division of United Aircraft at East Hartford, Conn.

CHAPTER II

AVIATION IN THE UNITED STATES

American Superiority in Aircraft Performance Threatened by Research Programs Abroad—Efficiency of Army and Navy Air Forces—Record Export Sales—The Industry Supports Administration's Neutrality Policy—Increased Sales of Commercial Planes—Growth of Air Line Traffic—Increase in Pilots and Planes—Activities of Leading Aviation Organizations.

AS this chapter is written early in 1937 the United States is making substantial progress in many branches of aviation; but in some respects it is not as rapid as that being made by other powers striving for both commercial and military supremacy in the air.

Although during the last 12 months, as shown in Chapter III, the United States has dropped from fifth to sixth place among the seven air powers of the world in numbers of combat planes available for an emergency; that alone would not be so important except for the intense research and development work which the others are undertaking as part of their air force programs.

Its geographical position and a sincere desire to stay out of all international quarrels in Europe and Asia combine to keep the United States free from the urge to build up the world's largest fighting machine. Nevertheless, the foreign activity now threatens to reduce by progressive stages the present American superiority in the performance of aircraft. Many authorities are convinced that the United States is not spending enough money on fundamental research.

All the European powers are devoting increasingly large amounts of money to aeronautical research and experiment. In certain phases of their programs—such as the development of faster military and commercial planes, huge land transports, giant bombers and ocean flying boats, more powerful engines and machinery for mass production of aircraft—the funds made available for advanced technical knowledge are practically unlimited. Thus while the superiority of American equipment is unquestioned at present, it is being challenged by the scientific efforts of the other powers.

A year ago qualified observers reported that technically the United States was 18 months ahead of Europe, but that this lead was only half of what it had been in former years. At the beginning of 1937 the United States still holds that technical lead, despite many reports to the contrary. The scientific programs abroad have been proceeding more slowly than was thought possible. The lag has been caused, not by lack

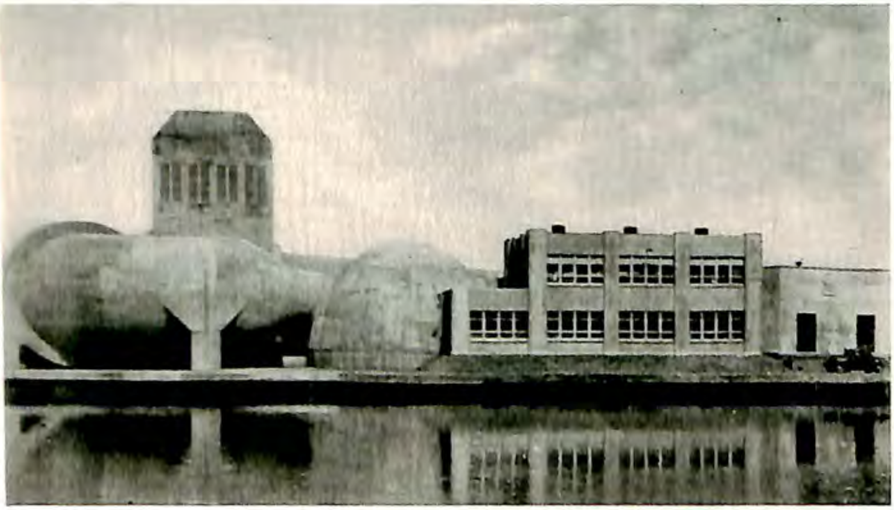
WHILE THE PASSENGERS SLEEP

American Airlines pilots on a sleeper plane using their Western Electric radio telephone to maintain contact with the surface.

of resources, but by lack of a sufficient number of technicians trained in advanced aeronautical research. On the other hand, they are being trained with surprising rapidity and thoroughness; and there is little doubt in the minds of informed persons that Europe in the near future will show the world some surprising results of this effort along scientific lines.

As a matter of fact, many foreign missions visited the United States during 1936, as they had in the past, to learn all that they could about technical progress; but for the first time in many years the visitors invariably were able to leave something new in the form of technical knowledge acquired abroad.

Outside the United States technical progress is generally financed solely by the respective governments, whether it relates to military or civil aviation. The American system is different. The privately owned aircraft industry carries on commercial development out of the proceeds from sales of equipment. It also spends on new engineering, design and construction methods a liberal portion of the revenues from the sales of equipment to the Government services. That is augmented



NEW HIGH SPEED WIND TUNNEL

The National Advisory Committee for Aeronautics' eight-foot high speed tunnel at Langley Field is the largest in the world. It simulates conditions for testing planes up to 500 m.p.h.

by the invaluable work of the National Advisory Committee for Aeronautics. The Committee has carried on to the extent of funds appropriated by Congress; and a large part of its labors has been devoted to improvement of military equipment.

Constant research and development are absolutely essential in aviation, because the science of aerodynamics is relatively new. To make progress the aeronautical engineer first must know how to design a better machine, and secondly, he must know in advance how the completed machine will perform. Experimentation and engineering research have brought about the steady improvements in aircraft. Actually, the aircraft manufacturers for years have spent on development work more money than the Government. In that sense the aircraft industry has been subsidizing the Government, despite the important contributions of the National Advisory Committee for Aeronautics.

The funds appropriated for the Committee's activities have never been extensive. For the fiscal year 1937 they total only $2,544,550, of which $1,367,000 is earmarked for construction of a new wind tunnel and the lengthening of the seaplane tank at the Committee's laboratories at Langley Field, Va. It is a very small appropriation indeed, when compared to the large sums and other facilities placed at the disposal of foreign research organizations. The need for a broadening of the National Advisory Committee's duties to include all forms of

NORTH AMERICAN'S BOMBER

Built by North American Aviation for the 1937 Air Corps competition, it is powered by two twin-row Wasp engines, and is known as the "Dragon."

research, taking in the specific needs of civil aviation, is more apparent because of the increasing speed and size of flying machines. The huge planes which have been projected both in the United States and abroad have cast up entirely new problems which await solution before the performance of such craft can be assured.

That raises the question of whether other air powers will be the first to produce long range aircraft, both transports and bombers, larger than anything in the air at present. With that in mind the Engineers Committee of the Aeronautical Chamber of Commerce of America late in 1936 recommended that Congress provide approximately a half million dollars in additional appropriations which would permit the National Advisory Committee for Aeronautics to carry on this important research work.

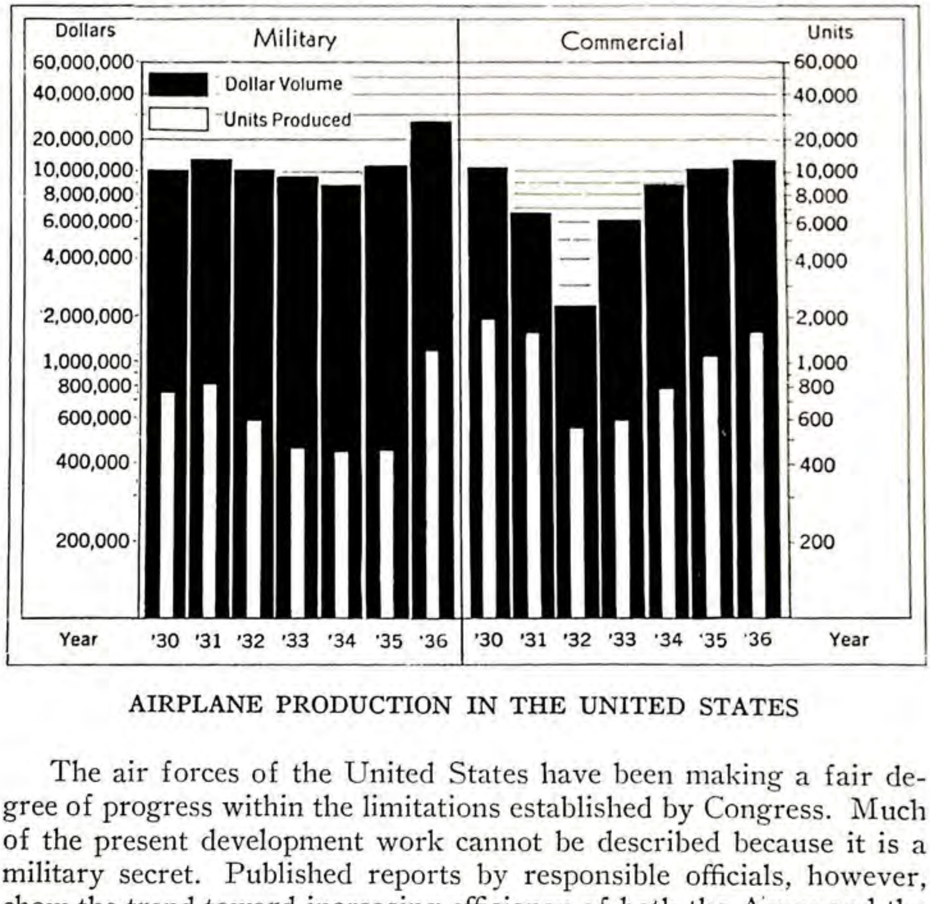
Among the many reasons why the United States should keep abreast, at least, of other nations in technical development is the ever-present need for preparedness in national defense. American scientists and aeronautical engineers returning from Europe toward the end of

CURTISS TWIN-ENGINE ATTACK PLANE

Model Y1A-18, an all metal, mid-wing monoplane for long range flying and low altitude raiding of enemy lines. It is powered by Wright G Cyclone engines.

1936 reported that while it might be true, as stated, that no foreign air force then was capable of carrying on a successful raid against the United States, there can be no such assurance for the future. The prospect of transocean flying craft carrying large numbers of persons, bombing planes bearing tons of explosives and capable of flying the oceans non-stop and whole fleets of small, fast fighting machines which also can cross oceans are no longer the dreams of enthusiasts and visionaries, the experts assert. They know that the technical knowledge already present in a variety of different forms soon will make the United States as vulnerable as any other country in the world.

Americans returning from abroad are convinced that the national thought as to safety from invasion must change; and that whether the people of the United States like it or not, they must take care that foreign nations do not surpass them in the development of air power.

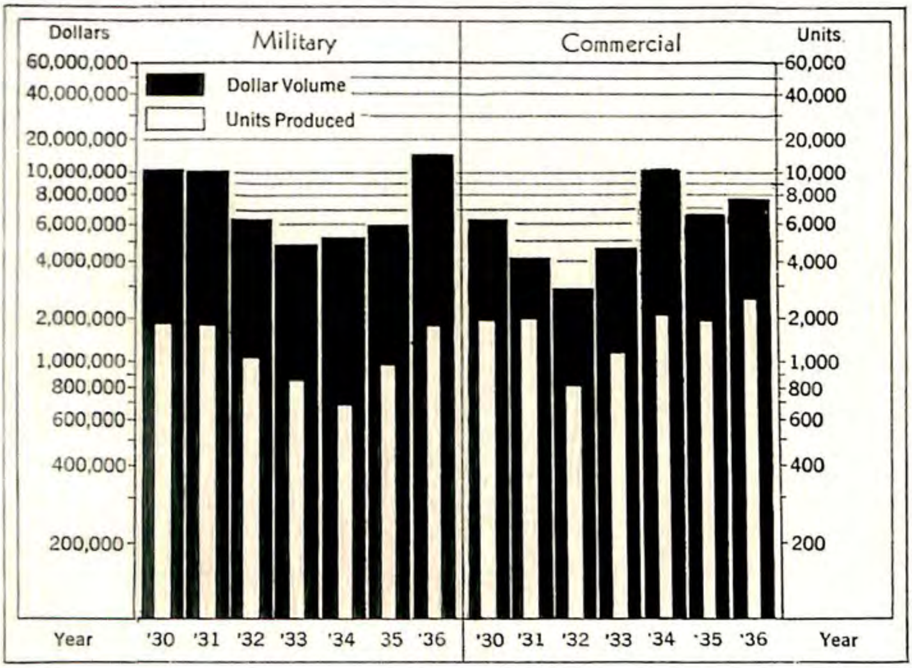


AIRPLANE PRODUCTION IN THE UNITED STATES

The air forces of the United States have been making a fair degree of progress within the limitations established by Congress. Much of the present development work cannot be described because it is a military secret. Published reports by responsible officials, however, show the trend toward increasing efficiency of both the Army and the Navy air arms.

A year ago the Army Air Corps had in active service about 1,100 socalled combat planes, but only 300 of that number were actually fit for war duty. The rest were obsolete. The present procurement program provides for approximately 500 new combat planes a year; and these have been entering service at an increasingly rapid rate. At present, it is believed, the Air Corps has about 1,200 combat planes in service, at least half of that number useful in action against a first class power.

The Secretary of War's annual report discloses that 600 machines will have been ordered during the fiscal year 1937, which ends June 30, this year. Fighter planes are now approaching service speeds of 300 miles an hour. New observation planes are 40 miles an hour faster than the older models. Bombers carrying a ton of explosives and capable of flying 1,500 miles non-stop at an average speed of 200 miles



AIRPLANE ENGINE PRODUCTION IN THE UNITED STATES

an hour are entering service. But the Air Corps actually has only 60 per cent of the planes which the General Staff of the Army considers necessary for adequate peacetime strength. It has only half the number of officers and men believed requisite to an efficient corps maintained at full peacetime strength. The Air Corps agrees with the General Staff in its belief that 800 new planes a year are required to maintain the service in a state that will permit efficient expansion in an emergency. That number, the officials assert, will give the Air Corps at all times a total strength of 2,500 machines.

A year ago the Navy Bureau of Aeronautics had in active service about 800 combat airplanes, with 450 machines on order. Allowing for replacements the Navy now has about 1,000 combat planes. The program requires a total of 1,910 machines of all types by 1942. Of that number, which also includes training and transport planes, the Navy will have on hand about 1,700 by the end of this year. When its present program is completed the Navy will have a total of 70 combat squadrons attached to the Fleet, 39 squadrons being on ships, 22 based

A TEST FOR SAFETY'S SAKE

The Stinson company at Wayne, Mich. puts one of the wings of its Model A transport under tons of dead weight as a strength test of design and construction.

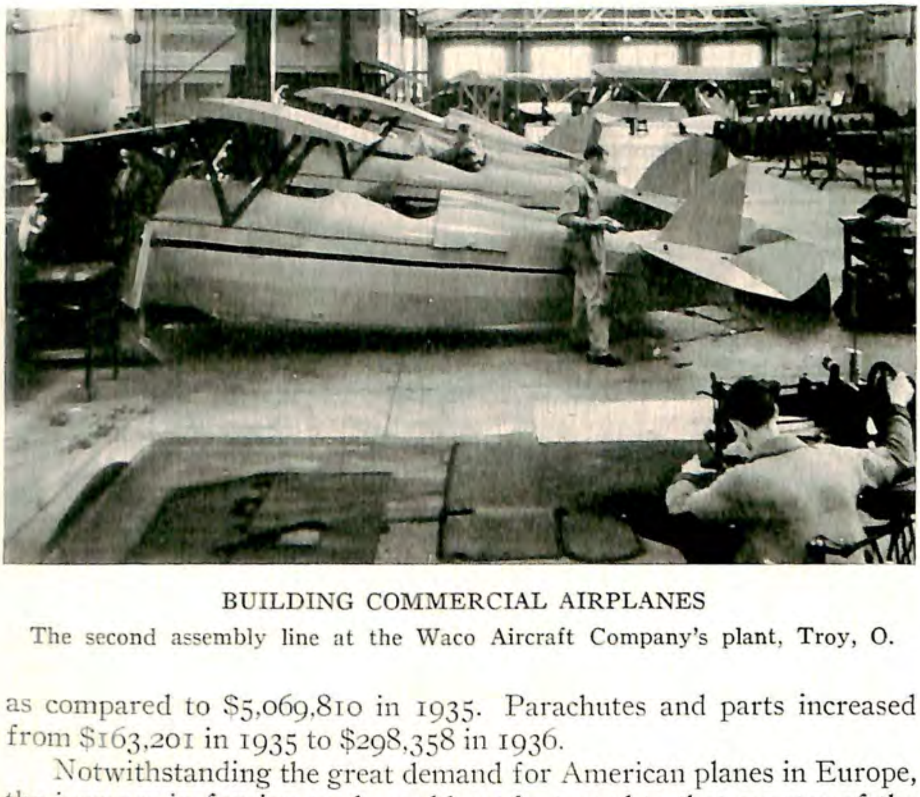
with tenders and nine attached to the Fleet Marine Force.

Both branches of the service have been devoting considerable attention to training of pilots and other personnel for aviation duty. Much progress has been made in blind flying. Hundreds of cadets have qualified as pilots during the last 12 months. As the chapters on the Army Air Corps and the Navy air forces will show, these services are not lagging behind either in efficiency or the scope of their training programs.

There is another branch of American aviation which eventually must be influenced by the research and development programs abroad.

That is the foreign trade in aeronautical equipment. The fine performance of American planes, engines, propellers and other equipment for several years has built up valuable markets among the non-industrial peoples of the earth.

During the calendar year 1936 exports of American aviation equipment broke all records, amounting to \$23,055,761 as compared to \$14,-290,843 in 1935. A total of 500 planes valued at \$11,299,451 went abroad in 1936 as compared to 333 planes valued at \$6,598,515 in 1935. A total of 945 aircraft engines valued at \$5,397,469 represented the 1936 shipments as compared to 568 engines valued at \$2,459,317 in 1935. Parts and accessories, except tires, totalled \$6,060,483 in 1936



BUILDING COMMERCIAL AIRPLANES

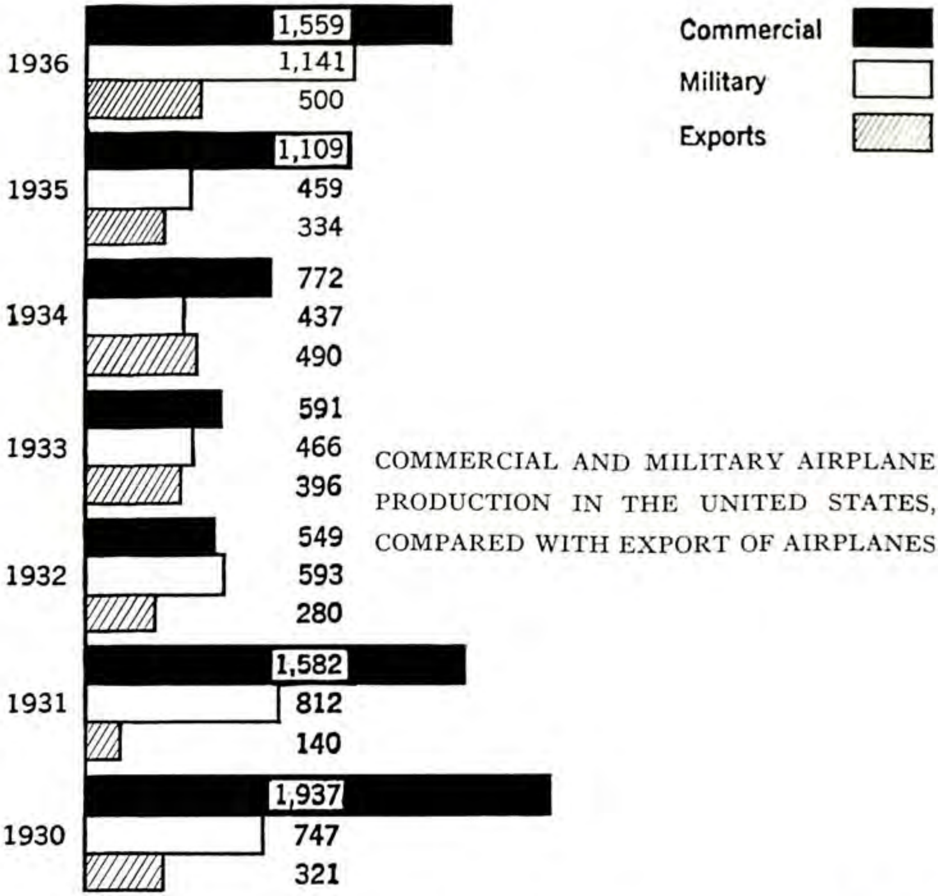
The second assembly line at the Waco Aircraft Company's plant, Troy, O.

as compared to \$5,069,810 in 1935. Parachutes and parts increased from \$163,201 in 1935 to \$298,358 in 1936.

Notwithstanding the great demand for American planes in Europe, the increase in foreign trade could not be traced to that quarter of the globe; quite the contrary. There was no appreciable change in the trade with European nations, excepting Russia and the Netherlands; and there in both cases exports dropped off to about a fourth of those during 1935. The increased exports in general went to South America and the mainland of Asia.

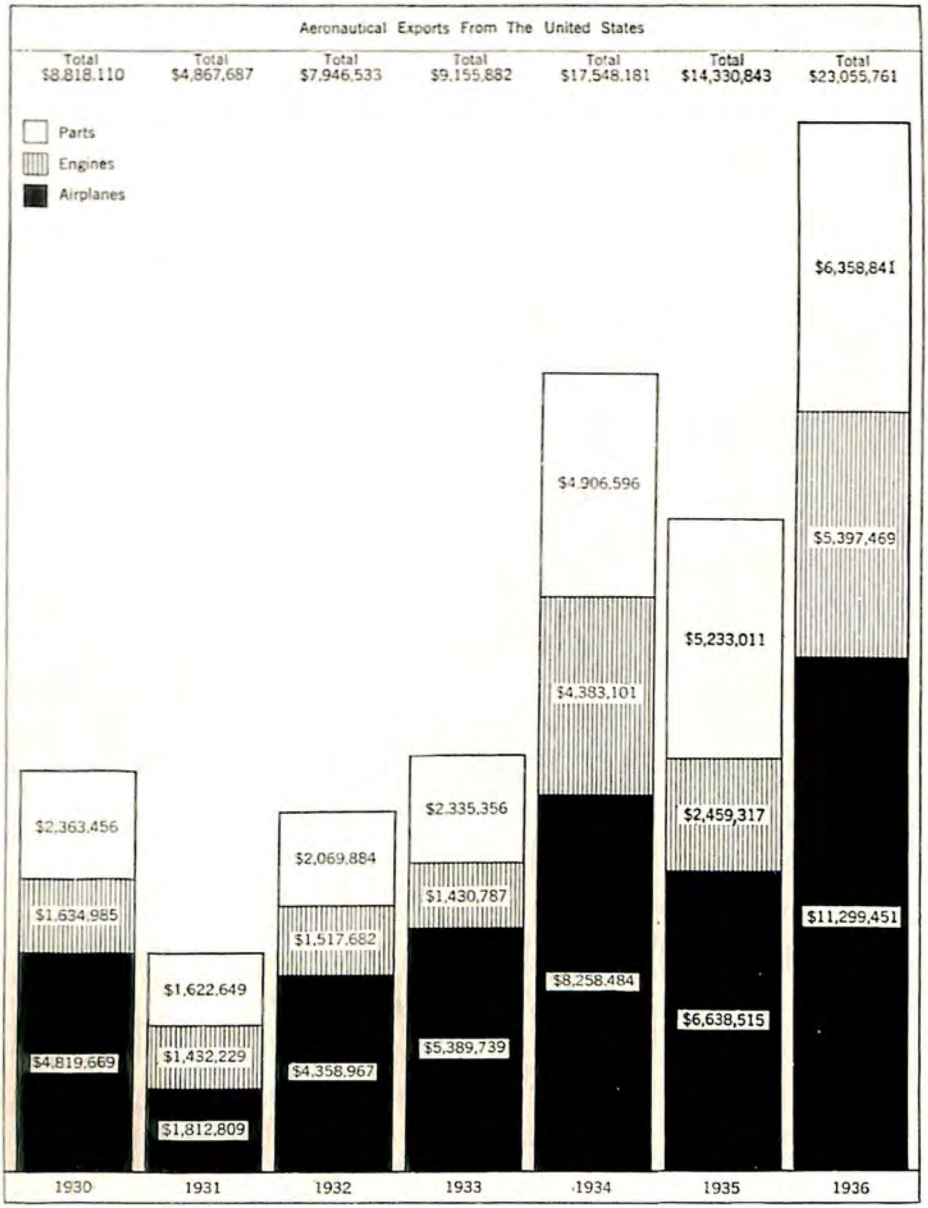
During the last year American manufacturers repeatedly rejected business with the warring factions in Spain, pursuing a policy similar to that which had prevailed during the Italian conquest of Ethiopia. That policy was expressed by Leighton W. Rogers, president of the Aeronautical Chamber of Commerce of America, representing the industry, when in January, 1937 he stated:

"American aircraft manufacturers are cooperating with the Government one hundred percent in seeing that their products are not ex-



COMMERCIAL AND MILITARY AIRPLANE PRODUCTION IN THE UNITED STATES, COMPARED WITH EXPORT OF AIRPLANES

ported abroad contrary to the spirit of neutrality expressed by the present law and the policy of the administration. Our manufacturers have had repeated opportunities to make huge profits selling their products to foreign interests dealing with the Spanish factions, and in every case they have declined to engage in this kind of business. It should be borne in mind, of course, that the American manufacturers



AERONAUTICAL EXPORTS FROM THE UNITED STATES

have no way of controlling resale of their products on the part of private owners. They will continue, however, to cooperate with the Government to the limit of their ability in maintaining the spirit of American neutrality policy."

If, through their present research programs, the European governments succeed in increasing the technical qualities of their aircraft to a point above that of American products, the United States is bound to lose its foreign trade, because other factors favor the Europeans. Their respective governments arrange credits, finance production and shipments and often supervise the actual selling of aviation equipment in foreign countries. They also sell it below cost on occasion, the reasonable excuse being that they are pleased to get it out of the way in order to make room for newer equipment at home. It is another reason why the United States should never relax its efforts to improve the flying machine.

The year 1936 was the American aircraft industry's best period in its history. Deliveries of aircraft, engines and spare parts totalled

AIRCRAFT DESIGNERS AT WORK

This is the engineering department of the Boeing Aircraft Company, Seattle, Wash., which employs an average of a hundred aeronautical engineers.

$76,805,000. It represented an increase of 85 per cent over the 1935 total of $41,545,000.

The 1936 sales volume of $76,805,000 was 96.9 per cent of the production value of planes, engines and parts amounting to $79,224,000 manufactured during the peak year of 1929. As more than 10 per cent of the 1929 production was carried over as inventory, 1936 was the industry's banner year in point of actual sales deliveries.

Deliveries of commercial aircraft for the full calendar year 1936 totalled 1,528 units valued at $12,535,526, as compared to 1,046 units, valued at $9,669,814, in 1935—an increase of 29 per cent over the 1935 value.

Private flying showed a very substantial growth in 1936. Of the total of 1,528 commercial aircraft delivered last year, 1,356 machines were for two, three or four persons, as compared to 914 of the same type in 1935.

Deliveries of multi-engine land planes and amphibions in the air transport class totalled 126 as compared to 115 in 1935. Of the 1936 deliveries, however, 41 were delivered during the last quarter, indicating that the large orders placed for air line equipment were just beginning to leave assembly lines late in the year, and should continue, therefore, in 1937.

Deliveries of military aircraft for 1936 totalled 1,024 machines

INSIDE AN AIRPLANE PLANT

Assembly of Navy single-seat fighters at the factory of the Grumman Aircraft Engineering Corporation, Farmingdale, Long Island, N. Y.

valued at \$26,898,916, compared to 344 planes, valued at \$8,876,303 in 1935.

Deliveries of commercial aircraft engines in 1936 totalled 2,527 units valued at \$7,946,015 as compared to 1,886 engines, valued at \$6,397,751, in 1935—an increase of 24 per cent over 1935 values.

Deliveries of military aircraft engines in 1936 totalled 1,794 valued at \$14,619,453 as compared to 894, valued at \$5,906,358, in 1935.

All aircraft and aircraft engine deliveries from American manufacturers totalled \$61,999,910, with spare parts adding \$14,804,908 to make the total of $76,804,818 in 1936, as compared to $30,850,226, with spare parts of $10,694,774 totalling $41,545,000 in 1935. Exclusive of spare parts the total sales value of planes and engines in 1936 represented an increase of 101 per cent over the previous year.

In air transportation the United States continues to lead the world, as it always has led, maintaining better schedules, flying both day and night in all kinds of weather over all kinds of terrain and, on Pan American Airways routes, over the longest stretches of open water. An average of 3,400 passengers, 10 tons of express and 23 tons of mail are carried on air lines of the United States every 24 hours.

SUNSET ABOVE THE CLOUDS

Below the clouds it was as black as night, but passengers on this United Air Lines plane saw their silver lining on the way into Cleveland.

Growth of traffic on the lines is shown by the following table:

	1934	1935	1936
Passengers	537,637	908,185	1,146,138
Express, pounds, ...	2,946,460	6,162,056	8,340,408
Mail, pounds, ...	7,155,281	13,538,952	17,737,097

The amazing increase in air mail poundage reflects the growing popularity of the service among business houses.

The chapter on air lines of the United States describes in detail the improvements made during the year. The Pacific was definitely conquered, Pan American Airways starting regular passenger, mail and express service between the Pacific Coast and Manila. The service was to go through to China early in 1937. The domestic lines made better schedules, shortening flying time from coast to coast and between the northern and southern cities. They installed improved equipment, including sleeper planes and lounge, or club, planes providing the very latest conveniences in comforts for the aerial traveler. They were projecting even larger planes, machines carrying 40 passen-

AIR TRANSPORTS GROW LARGER

There are 21 passengers on this Cyclone-powered Douglas DC-3 transport, one of the American Airlines fleet.

gers by day or 20 persons in berths at night. They were conducting extensive tests seeking a practical means of traversing the continent in the sub-stratosphere, above all bad weather.

The United States now has 2,342 airports and landing fields, 705 of them either partially or fully lighted. Many of these airports are either new or improved through the efforts of the Works Progress Administration which has carried on an effective airport development with the assistance of the Bureau of Air Commerce. Over-water flying is gaining in popularity because of the movement to establish marine air terminals in all waterfront cities.

Forty-five different models of private flying machines are now on the market, and one can buy a plane precisely as he would buy a motor car. The prices range from about $1,300 up to $100,000 and even more. One can pay cash or buy on the installment plan.

The number of licensed pilots has increased during the last 12 months, the present 15,952 pilots with licenses comparing with 14,805 a year ago. There also has been a slight increase in the number of licensed planes, 7,424 as compared to 7,371 a year ago. That low in-

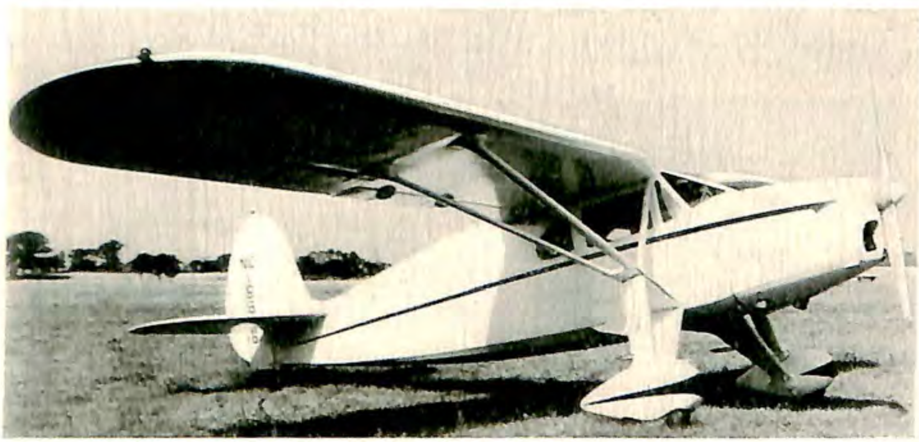
A PRIVATE OWNER BEECHCRAFT
It is powered by a Wright Whirlwind engine.

crease indicates that nearly all the machines sold in 1936 were to replace obsolete equipment.

Training for commercial aviation, whether as a pilot or a mechanic, is largely in the hands of private organizations of which there are nearly 500 in the United States, in contrast to the very small number of private schools abroad where students are taken in hand by official agencies and given the training for which the officials believe each student is adapted.

Among the Federal departments actively concerned with aviation is the Coast Guard. Its valuable work is described in a chapter devoted to that purpose. The aviation activities of the Coast Guard were increased 50 per cent during the fiscal year 1936. It needs 76 airplanes to carry on the duties from 10 air stations. Sometime this year it will have 51 machines. No reason has been assigned as to why one of the most important flying branches of the Government service, one which after a declaration of war, becomes part of the armed forces, is not given sufficient equipment for its needs.

Among the organizations representing the interests of American aviation in all its various branches are the Aeronautical Chamber of Commerce of America, Air Transport Association of America, American Society of Mechanical Engineers, Institute of the Aeronautical Sciences, Manufacturers Aircraft Association, National Aeronautic Association, National Association of State Aviation Officials and the Society of Automotive Engineers.



NEW FAIRCHILD 24
It is powered by a Ranger engine.

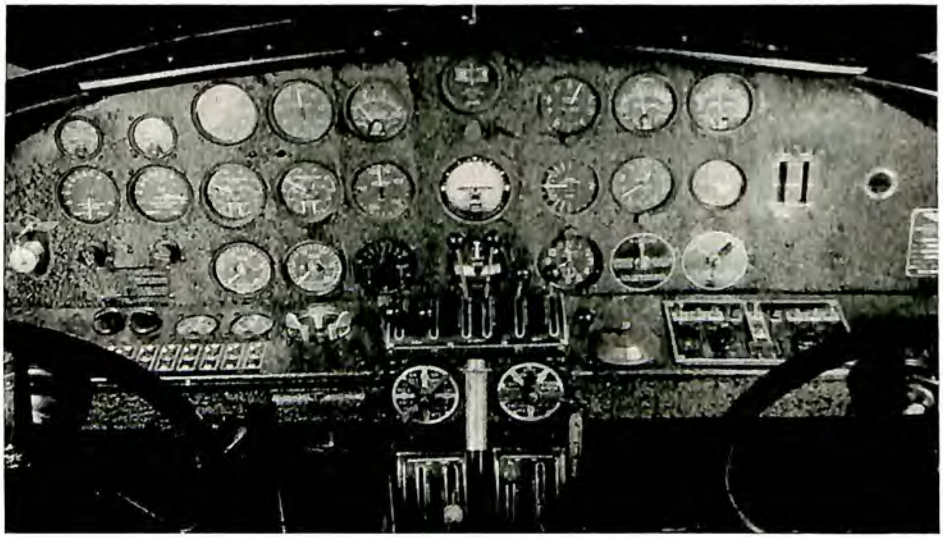
Another national organization keenly interested in aviation is The American Legion, which, through its Aeronautics Commission, has consistently advocated the development of aviation as a third arm of the national defense. In 1936 the Legion's Aeronautics Commission advocated these policies:

1. An increase in National Guard aviation facilities from the present 19 States to include all States and territories. An increase in the flying activities of the Army Air Reserve, Navy Air Reserve and the U. S. Coast Guard.
2. Elimination or revision downward of State aviation gasoline taxes in those States where a refund, all or in part, is not now allowed.
3. Elimination of all pole lines adjacent to airports.

The American Society of Mechanical Engineers, through its aeronautic sections, held several aviation engineering meetings during the year. Activities of the National Association of State Aviation Officials are described in the chapter on State aviation. The work of the other organizations during 1936 is summarized here.

Aeronautical Chamber of Commerce of America

As the trade association for the aircraft manufacturing industry the Chamber represented the group opinion and effort of the various companies in matters related to their markets at home and abroad. Through its engineers committee the Chamber secured an agreement upon desired changes in Federal airworthiness requirements to be worked out in conference with the Bureau of Air Commerce, an agreement on the industry's views regarding increased facilities required by the Bureau, and further, a program of fundamental research to be

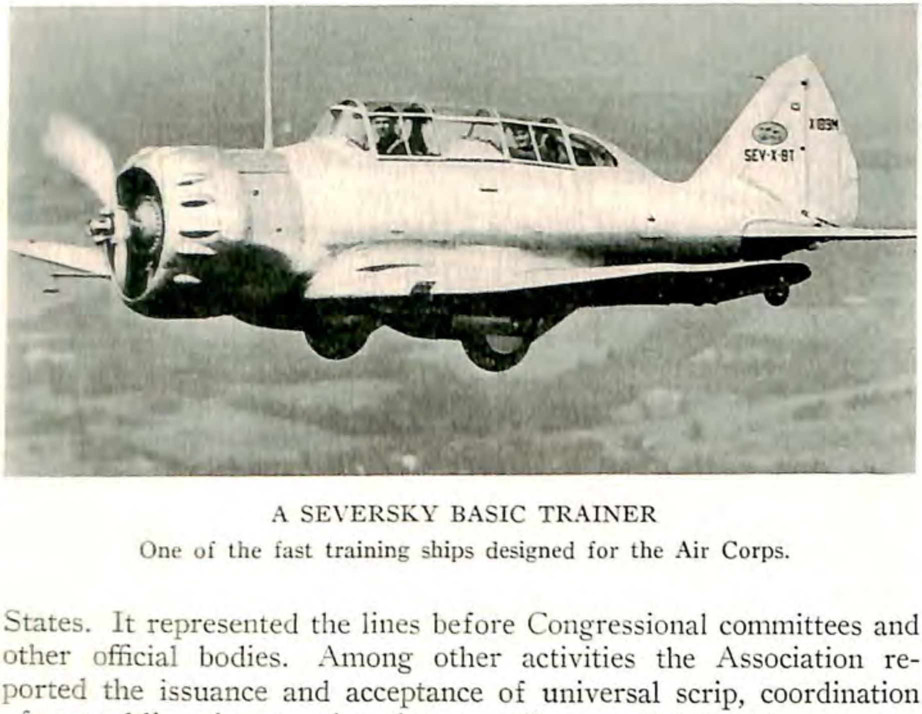


WHAT A PILOT LOOKS AT
The instrument panel of a Lockheed Electra.

recommended to the National Advisory Committee for Aeronautics in order to assure continued progress in development during the next few years. The Chamber made available to educational institutions and other organizations a fund of factual material on private flying. It cooperated with the Bureau of Air Commerce and the Works Progress Administration in the airports development program. Through its marine air terminals committee, it interested many waterfront communities in a project to establish over-water flying facilities in those localities. It cooperated with the Munitions Control Board, in the State Department, keeping the industry informed on all policies and regulations concerning exports. It represented the industry before the various Congressional committees, and supplied statistics concerning the manufacturing branch of aviation. At the beginning of 1937 the manufacturing membership of the Chamber represented about 80 per cent of the total value of production in 1936.

Air Transport Association of America

The Air Transport Association of America was established in 1936 to coordinate the group activities of the air lines of the United



A SEVERSKY BASIC TRAINER

One of the fast training ships designed for the Air Corps.

States. It represented the lines before Congressional committees and other official bodies. Among other activities the Association reported the issuance and acceptance of universal scrip, coordination of several lines in operating airway traffic control, later taken over by the Bureau of Air Commerce, exchange of data on maintenance and cooperation of the lines with Government approved schools for training mechanics.

Institute of the Aeronautical Sciences

The Institute of the Aeronautical Sciences conferred many honors in 1936. Those elected Honorary Fellows of the Institute for contributions to the science were Donald W. Douglas, of Santa Monica, Calif., General G. A. Crocco, of Italy; Dr. Hugo Eckener, of Germany; Professor Albert Caquot, of France; and Professor B. Melvill Jones, of England. Harry F. Guggenheim was elected an Honorary Member for his aid to aeronautical education. The Sylvanus Albert Reed Award was presented to Professor E. S. Taylor, of the Massachusetts Institute of Technology, for development and practical application of the dynamic vibration absorber for aircraft engines. The Lawrence Sperry Award, established by the brothers and sister of Lawrence B. Sperry, was given to W. C. Rockefeller, of the Califor-

TAILS UP BUT HE WINS

An Air Corps pilot noses over as he taxis his Wasp-powered Boeing pursuit to the line during maneuvers at Miami, Fla., but no damage results.

nia Institute of Technology, for the application of aerodynamics and meteorology in determining the optimum flight path in air transport operation. At a dinner which the Institute gave in his honor Dr. George W. Lewis, director of research of the National Advisory Committee for Aeronautics, was presented with the Daniel Guggenheim Medal. The Institute reported that the Works Progress Administration had prepared for it an aeronautical index which contains

400,000 classified cards. The Institute also announced a "Wright Brothers Lecture" annually on December 17, commemorating the invention of the airplane by Orville and Wilbur Wright.

Manufacturers Aircraft Association

In July, 1936, the Manufacturers Aircraft Association entered its 20th year in administration of the Patent Cross-Licensing Agreement, an agreement making the inventions of members available to all members, and avoiding patent litigation. Fifty new patents were reported during the year and licensed to members of the Association, making a total of 870 patents which have been brought under the

Official U. S. Army Photo

A GREAT FLEET OF BOMBERS

Thirty-five Cyclone-powered Martin bombers and a Douglas amphibion in the Air Corps line-up at Hamilton Field.

operation of the agreement to date. Because fewer than one-sixth of such patents have expired, members of the Association at present have full manufacturing rights under 730 patents, including many basic inventions which still are in effect. On January 1, 1937, the Association reported that a total of 34,766 airplanes manufactured since July, 1917, have been licensed to use the inventions covered by all the above patents.

The Association also maintains a Patent Research Division and library for the use of its members, and publishes a digest of all current American and British airplane patents, including abstracts of the patent specifications and official drawings. The research library of the Association, which includes copies of American and foreign airplane patents, as well as books and other publications, is considered one of the most comprehensive on the engineering and scientific aspects of aviation.

National Aeronautic Association

The National Aeronautic Association increased its membership, published the National Aeronautic Magazine and served as the American member of the Fédération Aéronautique Internationale in homologating all American and international record flights. It reported chapters in 100 American cities and educational committees in 500 communities. The N.A.A. held its annual convention in Chicago in November, 1936, and adopted a seven-point program to promote the development of aviation. The Association sanctioned all the official flying meets and record attempts in the United States in 1936.

Society of Automotive Engineers

In October, 1936, the Society of Automotive Engineers sponsored at Los Angeles its first national aircraft production meeting. Because of the intense interest created, a similar three-day meeting, will be held in Los Angeles, October 7-9, 1937. During 1936, 63 papers upon aeronautical subjects were presented before 38 sessions of national and local meetings of the Society. A number of aircraft and aircraft engine research and standardization projects were continued. Standards on aircraft engine shaft ends and propeller hubs were revised as were others applicable to use in the aviation industry.

Official Photo U. S. Navy

AIRCRAFT CARRIER "RANGER"

CHAPTER III

AIR POWERS OF THE WORLD

Estimated Combat Airplane Strength of the Seven Powers—The British Empire Program—Developments in France—Germany's Strength and Weakness—Italy's Air Power—Russia's Huge Air Machine—Japan's Growing Air Force.

THE following table presents the estimated combat airplane strength of the seven air powers as this is written early in 1937. It is only an estimate. It could not be otherwise, because of the official secrecy which now cloaks this important air force development throughout the world. The figures are based on all that has come to light during the last year, both official and unofficial. Here the term combat airplane includes all armed planes—pursuit-fighters, attack, light and heavy bombers, armed scout and observation, armed patrol and transport planes, machines in active service, reserves and secondary reserves.

Estimates for January 1935 and 1936 are shown for purposes of comparison.

Estimated Combat Airplane Strength

	January 1935	January 1936	January 1937
British Empire	2,800	3,600	4,000
France	3,600	3,400	3,600
Russia	3,000	3,300	3,400
Italy	2,300	2,800	3,200
Germany	600	1,600	3,000
United States	2,060	1,900	2,200
Japan	1,850	1,800	2,000

While these figures show very light increases during the last 12 months, they do not represent all the machines built in that period.

In every country hundreds of new planes took the place of machines too old for any kind of service. During 1936 every air force discarded increasingly large numbers of obsolete planes and engines. In France, Italy, Germany, Russia and Japan, the number of combat planes de-

Official U. S. Army photo

ARMY AIR CORPS CADETS

Future officer-pilots stand retreat formation at the end of the day as the flag is taken down at the Air Corps training center, Randolph Field, Texas.

stroyed through crashes increased progressively as novice pilots were supplied with the higher-powered machines for training. With that in mind the present status of the air force programs, country by country, is of interest.

The British Empire Program

Under the stimulus of war threats the British Government is planning an air force second to none. In these preparations official thought is in terms of the whole empire; meaning that India, the dominions and every possession is being called upon to contribute to the air strength believed vital under present international conditions.

The Air Ministry announced early in 1937 that its expense estimates for the new fiscal year would reach $412,500,000, more than double the amount asked for the air forces in 1936. The new budget also allowed $10,575,000 for civil aviation, double the 1936 estimates.

The British program, which has been changed and expanded sev-

Official Photo U. S. Navy

NEW PILOTS FOR THE NAVY

They are lined up at the Captain's inspection, a feature of training at the Pensacola Naval Air Station.

eral times in recent months, now contemplates six different kinds of activity, as follows:

1. Bomber squadrons, equipped for long range operations.
2. Increase in combat squadrons to serve with the Fleet.
3. Expansion of the Home Defense, including fast pursuit squadrons, a balloon barrage over each important center and surface protection against air attack.
4. Storage in the United Kingdom of reserve supplies including gasoline.

5. Development of aircraft manufacturing facilities on a mass production basis in the United Kingdom, Canada and Australia.
6. Increase of trained air force personnel throughout the empire.

British air forces possessed 3,600 combat planes in January, 1936. During the last 12 months the number has increased to a total of 4,000. The Home Defense forces now have 1,400 combat planes on active service with approximately 1,000 in reserve. The Navy still has about 500 machines, including reserves. The Royal Air Force units stationed outside the United Kingdom have 600 combat planes, including reserves. The air forces in India and the dominions have a total of 500 planes, including reserves.

The Royal Air Force now has about 90 squadrons, and is short

Official U. S. Army Photo
A HIGH ALTITUDE PURSUIT PLANE
The two-place Consolidated P-30, Air Corps fighter powered by a Curtiss Conqueror supercharged engine.

42 squadrons of the number which the Air Ministry planned to have available by March 1, 1937. Efforts are being made to organize and equip 23 more squadrons by July 1, 1937.

The total air force personnel in the British Empire is approximately 52,000, with 4,500 pilots either in active service or qualified for such duties. About 2,500 student pilots have been accepted for air force training within the last 15 months, and others will be taken into service as quickly as facilities are provided, meaning schools, instructors and training equipment. Eleven air force flight training schools are now filled to capacity.

Great Britain's aircraft industry has been badly disorganized by the expansion program. The private manufacturers were preparing to take quantity orders on a few models and have some freedom in developing new and more modern designs, when the Government stepped in and placed quantity production orders with all the 12 plane and four engine companies on the approved list.

Sixteen other aircraft concerns not on the approved list were trying to get business when in 1936 the Government announced its Shadow plan, for aircraft and engine production, a scheme whereby several plants would be established for the sole purpose of producing in huge quantities equipment developed elsewhere. The plan was bitterly attacked, and soon became a political football. The Government

Official Photo U. S. Navy

FROM SCOUTING SQUADRON ONE

A Wasp-powered Vought SBU-1 flown by members of one of the squadrons on the carrier "Ranger."

now expects two Shadow factories to be in production by the end of 1937, one for the mass production of planes and the other for engines.

The output from established plants has lagged several months behind expectations, for several reasons. Not since the World War has there been any move toward quantity production. The management underestimated the difficulties and problems to be solved before mass production was possible. There has been great difficulty in securing skilled labor and adequate tools. The manufacturers lack a sufficient number of technicians and engineers to speed up new design. Production of new military models in quantity cannot be accomplished in a few months, when months are required for development work alone.

On the other hand those factories in production are working day and night in three shifts, and the output of military aircraft will increase steadily in 1937. Great Britain intends to have an air force at least the equal of Germany's.

The British air officials believe that there will be no cessation of air force development on the continent, and they plan to keep pace with that expansion, even if they must triple the present strength in first line planes for home defense.

The British encouragement of Atlantic airplane service and construction of the large Empire flying boats to be operated by Imperial Airways is only partly for commercial purposes. Flying boat opera-

Official Photo U. S. Navy

NEW NAVY TORPEDO-BOMBER

The TBD-1 built by the Douglas company.

tions on a transoceanic scale offer another form of transport for necessary supplies in case of war.

Appropriations for research and experimental work at the Air Ministry's laboratories at Farnborough have been increased on several occasions; and the present flexible air expansion budget affords ample funds for necessary development of equipment.

Developments In France

The French air forces, which at home and abroad had about 3,400 combat planes in January, 1936, now have approximately 3,600 such machines, divided as follows: In Metropolitan France there has been no increase in pursuit ships; the squadrons having 240 pursuits in active service and 240 in reserve. The planes are new, however, replacing the obsolete equipment of a year ago. The bombing squadrons in France have increased numerically, and they are now equipped with 340 heavy bombers with 240 additional in reserve. Armed scout and observation squadrons now have 720 machines, with 620 in reserve. In warehouses, France also maintains a secondary reserve of about 600 combat planes, which through obsolescence no longer are useful for active service except in an emergency. The French also have with

NEW CURTISS ALL METAL PURSUIT PLANE

The Y1P-36, a fast low-wing monoplane developed for military service. It has a Wright G Cyclone engine.

the Navy 180 combat planes, some of them new, and a similar number in reserve. In the possessions and mandated areas French squadrons have 240 combat machines, nearly all obsolete types, and useful only in operations where there is no air defense.

A year ago the French air ministry planned to have a total of 4,000 planes in 12 months, but there was much confusion caused by the Socialist Government's plan to either control the plants through official inspectors or by outright purchase and nationalization. As in England there also developed considerable panic over the extent of

Germany's construction program. French officials dared not wait. They ordered all plants to speed up production on planes, engines and accessories.

The results are that France is beginning to achieve production which will materially augment the present numerical strength; but with few exceptions the performance of the machines is not what it might be. They have neither the speed nor the range which France would require in many of the contingencies against which the Government is preparing. Like a majority of the present combat machines throughout the world, including England, the French bombers and armed scouts resemble the bi-motored and single-engine commercial planes produced in the United States three years ago; and many lack the speed of these American models which are now approaching obsolescence in the United States.

THE FREE-SPINNING WIND TUNNEL

Airplane models, launched in the vertical shaft of air in this National Advisory Committee for Aeronautics apparatus, spin freely. A clock-work mechanism automatically sets the controls for recovering from the spin, and the result is recorded in motion pictures. Thus the scientists can determine whether a design will be controllable before a full-size plane is built.

The 25 French aircraft and engine plants were being decentralized slowly early in 1936, when the Government changed its policy to await a more opportune time, and if possible, speed up production. For purposes of Government control the industry is being divided into four sectional departments, each under the direct management of Government appointees.

The French air establishment now contains approximately 4,000 pilots and 50,000 personnel. The present plan is to complete the training of 1,000 additional pilots and 9,000 personnel by the end of 1937. Plans also exist for a 50 per cent increase in the number of pursuit planes, among the 1,500 new machines which the Government hopes to produce in 1937.

Great stress has been placed on the new plan for the air defense

Official U. S. Army Photo

FEEDING AN ARMY BOMBER

Loading 600-pound concrete bombs on a Hornet-powered Martin B-12 for release two miles over Muroc Dry Lake in California.

of Paris. It provides four zones. One nearest the city will be a ring of sound devices reported to be capable of detecting planes 12 miles distant. Next, squadrons of scout planes will patrol the air. Thirty miles from Paris a ring of anti-aircraft guns will greet invaders. Fourth, at intervals there will be established balloon barrages, balloons with cables between them to ensnare enemy planes. All told, the plan provides for 30 such cables a few yards apart at various levels and designed to make flying dangerous at all except the highest possible altitudes.

For offensive warfare in the air the French are developing heavy bombers, equipped with 23 mm. cannon firing hundreds of shells a minute, and carrying from one to two tons of high explosives.

The Russian plan of dropping infantry behind enemy lines by means of parachutes also has attracted the French, and they are forming two regiments to test the merits of the system.

Most secret of all the air force institutions in France are the great research laboratories Chalais-Meudon. Here an elaborate program of research and development has been getting under way for several months. Many observers believe that the results of the work at Chalais-

A NORTH AMERICAN ADVANCED TRAINER
A two-place machine built by North American Aviation.

Meudon will be apparent in the greater speed and general efficiency of French military machines produced in 1938.

Germany's Strength and Weakness

Germany's amazing air force development during the last 12 months has increased the power and influence of the Hitler Government in the chancellories of Europe and Asia; but it has brought into prominence two weak points, the influence of which only time will show. First, Germany's air force program has aroused Europe to the dangers of unpreparedness in aviation. The result has been that England, France and Russia have expanded their programs in an effort to maintain parity. Russia's present effort is leading Japan into the competition; and the French expansion has caused Italy to broaden the scope of her air force plans. Secondly, all the secrecy of which the German military leaders are capable cannot conceal the fact that the Reich lacks many of the raw materials necessary to continued and prolonged production and operation of aircraft after a declaration of war.

While it is true that German chemists and metallurgists have been rather successful in producing synthetic materials as substitutes for many important materials, there is no evidence at present that the substitutes are practical in the construction of military flying machines.

Official Photo U. S. Navy

A GRUMMAN AMPHIBION

One of the JF utility planes in the Navy.

Many competent observers believe that the various official announcements as to Germany's independence in war materials are more political propaganda than reality.

A year ago the German air forces were equipped with a few hundred pursuits and bombers and several hundred armed machines assigned for training. The personnel of the air force was just being assigned to squadrons for which new facilities had been created. But Germany actually had available a total of 1,600 combat planes, including many machines which officials classified as transport ships.

Intense training activities at scores of new air stations depleted through crashes the rapidly increasing supply of combat planes that left the factories in 1936. Unlike other European governments, Germany offered to sell planes abroad in any quantity desired, and at very low prices. Japan and South America acquired large numbers of German planes. Others went to Spain.

The German air forces now have available for immediate use approximately 3,000 combat planes, as follows: 600 heavy bombers, with about 1,000 in reserve; 300 light bombers and scouts, with 400 in reserve; and 300 pursuit planes, with 400 in reserve.

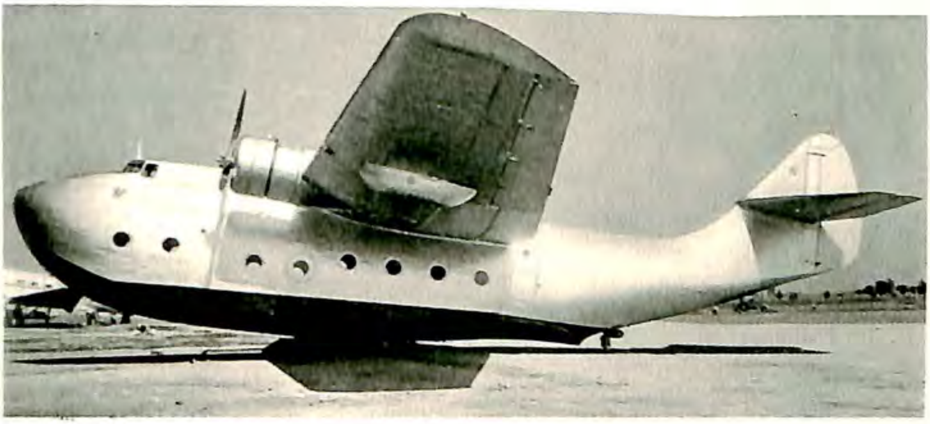
THE STYLE FOR SUBSTRATOSPHERE

D. W. Tomlinson, famous TWA expert, in the headgear he wears on substratosphere flights. The cockpit is glass-enclosed, of course, but the knotted handkerchief is to protect his head from the sun. The microphone keeps him in radio contact with the earth, and running over his left shoulder and into his mouth is a constant supply of oxygen.

According to usually reliable sources the air forces on active duty now number about 25,000, including 2,200 thoroughly trained pilots. The official plan is eventually to have 20,000 qualified pilots either on active duty or ready for immediate service.

The 17 aircraft factories, through mergers, official or otherwise, have been reduced to 12; but production capacity is being stepped up to a point where it is adequate for any program that the Government may adopt. Many persons believe that German plants will turn out thousands of airplanes in 1937; many of them, of course, relatively slow and unarmed, but excellent for training.

The technical and scientific research laboratories at Adlershof have been equipped to an unprecedented degree. They possibly are the best equipped aeronautical laboratories in Europe, second only to those of the National Advisory Committee for Aeronautics in the United States, an organization which for practical results in fundamental research still is a model for the rest of the world. As elsewhere in Europe the German laboratories have the plant equipment, but they have had neither sufficient time nor enough experienced research



THE NEW DOUGLAS FLYING BOAT

Designed to carry 32 passengers and a ton of freight or mail, it is powered by two 1,000 h.p. Wright G Cyclones. The wing floats are retractible.

workers in aviation to produce maximum results. The next year or two should tell a different story.

Meanwhile, efforts are being made to apply to aircraft construction the various compositions which have resulted from experiments with plastics in an effort to find substitutes for wood and metals. Because of a shortage of high grade gasoline efforts are being made to create substitute fuels which will be available at home in case of war. Development of the Diesel engine and its widespread use in military types is based largely on necessity, because that type uses fuel which the Germans can procure.

A notable development of the year in Germany was the perfection of heavy machinery capable of speeding up fabrication of metals in airplane construction to a stage permitting mass production, for the first time anywhere. It makes possible quantity production of the most modern types of high performance military planes.

Italy's Air Power

The Italian air forces have available for immediate service approximately 3,200 combat airplanes, as compared to 2,800 in January, 1936. Four-ton bombers and long range naval flying boats are included in the program to place Italy on a parity with other air powers, if possible. As a result of lessons learned during the Ethiopian campaign, Italy has made many technical improvements in the large planes, providing higher speed, better climbing power and longer range.

WILL IT BE AERIAL TRAINS?

United Air Lines sending three of its Wasp-powered Boeing transports on the same schedule from Newark to Chicago.

As in other countries on the continent the training program in Italy provides for a rapid increase in the number of pilots, both active and reserve, until at least, 6,000 are available. The 2,000 pilots and 20,000 other personnel in the air forces in January, 1936, have been increased to 3,600 pilots and 43,000 personnel, with more pilots undergoing advanced training than at any time in the history of Italian aviation.

The 15 aircraft factories have been kept on a war basis, operating 24 hours a day, and new models of heavy and light bombers are beginning to leave the production lines in steadily increasing numbers. The program provides for 2,000 new military aircraft in 1937, some of them capable of carrying four tons of bombs.

New military airdromes have been established in the Valley of the Po, and along the coasts of the Adriatic and Tyrrhenian Seas.

The new aeronautical research and experimental city of Guidonia is a source of considerable pride on the part of the Mussolini Government, and no expense is spared in providing the latest scientific apparatus. Here the Italians are carrying on fundamental research and development work which, they believe, will keep them technically ahead of other powers in the struggle for supremacy in the air.

Russia's Huge Air Machine

Most mysterious of all air force programs is that of Soviet Russia, simply because in a country of Russia's size, with ample resources in raw materials and plenty of labor available, even the most grandiose

THE VULTEE ATTACK BOMBER
It is powered by a Wright Cyclone engine.

scheme for expansion does not appear too impractical. Official Russia plans in terms of tens of thousands of military aircraft and hundreds of thousands of men and women trained for air force duty. Actually, Russia is striving to equal the combined air strength of Germany and Japan.

The Red Air Fleet now has approximately 3,400 combat planes, as compared to the 3,300 available in January, 1936. Some 1,200 of that total are modern enough to be of real value against an efficient enemy air force. The others are slow, and they lack the long range and useful load capacity of similar types in Germany, for example, and also Japan.

Approximately 1,300 combat planes are maintained in Eastern Siberia where the Red Air Fleet contingents are undergoing rigorous training for possible operations against Japan. About 900 combat planes are maintained with the squadrons in the Moscow area, while 900 others are assigned to the chain of 35 military airdromes established near the Western border from Leningrad to the Black Sea. The Navy aviation forces have about 300 combat planes.

Some of Russia's 11 aircraft plants are producing two planes a day. Others succeed in turning out four machines a day for certain periods. Many of the aircraft plants build no new planes, confining operations to servicing and repairs, for which there is a steadily increasing need because of the vast training programs with resultant accidents. Total production in 1936 is estimated at 1,700 combat machines, of which 1,600 went for replacements due to losses or obsolescence and shipments to neighboring States and to Spain.

PASSENGERS ON BRANIFF AIRWAYS
This is the interior of a Lockheed Electra.

It is believed that Russia has approximately 15,000 pilots trained in varying degrees of efficiency in air force flying. It is known that thousands of pilots are receiving some kind of training annually.

Characteristic of the huge scale with which aviation developments are carried out, is the size of several new models of combat aircraft. Giant bombers, much larger than machines as yet flown anywhere, are being built. They are equipped with several machine gun nests and three cannon of the same model as that adopted by the French, from whom Russia is said to have procured it. These super-bombers are similar to the Douglas transport in appearance; although much larger and they are credited with having a speed of 180 miles an hour, with a cruising range of 1,200 miles fully loaded.

Somewhat similar in design are the new troop planes built to carry 60 soldiers with full field equipment. They are improvements on the present four-engine machines, hundreds of which have made thrilling public demonstrations in recent months. In one air force review over Moscow 900 planes were counted, nearly all being combat machines and about half of them bombers.

The air infantry program, whereby whole regiments are trained to use parachutes and jump out of planes at one time, to alight behind an enemy line, has gained great headway. On one occasion in 1936, a regiment of soldiers and their equipment were landed within a time limit believed quick enough for the whole detail to function as a unit

THE FAIRCHILD 91 AMPHIBION

It was designed for transport use over combined land and water routes.

in any tactical maneuver on the ground. Soviet strategy is to strike deeply in enemy territory, both by air raids, and heavy bombing, to be followed immediately by surface troops from the air.

The Central Aero Hydrodynamics Institute at Moscow is the seat of Russian research and development in military aviation. It is a mammoth affair, with scientific laboratories and practical shops combined. Skilled engineers are in charge, but they are handicapped at present by numbers of inexperienced enthusiasts who lack the background required for productive research. There is too much haste for technical progress which results only by slow degrees during the most painstaking efforts. Once this obstacle is removed, when the technicians are sufficiently trained, observers believe that Russia will make impressive progress in aeronautics.

Japan's Growing Air Force

The Japanese air forces are like those of the United States in that the army and the navy each has its own aviation. Japan's army air force has about 940 combat planes, representing no increase during the last 12 months. The navy, however, has 480 combat planes with the fleet and 580 at shore stations—an increase of 200. Japan's total of 2,000 combat planes compares with the 1,800 on hand in January, 1936, according to recent estimates.

The 2,300 pilots and 22,000 personnel are about evenly divided between the army and navy.

The headquarters air force of the army aviation service is closely patterned after the American Army Air Corps G. H. Q. force. It is the striking force of army aviation, and is charged with the defense of Japan's coasts and her outposts in Manchuria. It is divided into three brigades, one at Gifu, the second based at Kwainei, Korea; and the third in Formosa.

In July the navy laid the keel for its new aircraft carrier "Hiryu," of 10,050 tons displacement.

During recent months production of planes and motors from Japan's own aircraft factories has been augmented by shipments from Germany, as a result of the new treaty between the two powers.

The 32 army squadrons are to be increased to 38 and the navy's 40 squadrons will be increased to 52 during the next 18 months. Japan's objective, of course, is to create an air force powerful enough to ward off possible air attacks from Russia's Red Air Fleet.

FOUR SEVERSKY MODELS

They are the amphibion, the land plane, Air Corps pursuit and basic trainer.

CHAPTER IV

THE U. S. ARMY AIR CORPS

Progress in Air Force Development—Secretary of War Woodring's Report—Night Bombing Practice—Cold Weather Maneuvers—Major General Westover's Description of Air Corps' Activities—Flying Cadets—Awards for Heroism and Efficiency—Conquering a Volcano

IN his annual report for the fiscal year 1936 Secretary of War Harry H. Woodring gave a most comprehensive account of how the U. S. Army Air Corps is being built up to a strength commensurate with its vital importance as an arm of the national defense. He stated:

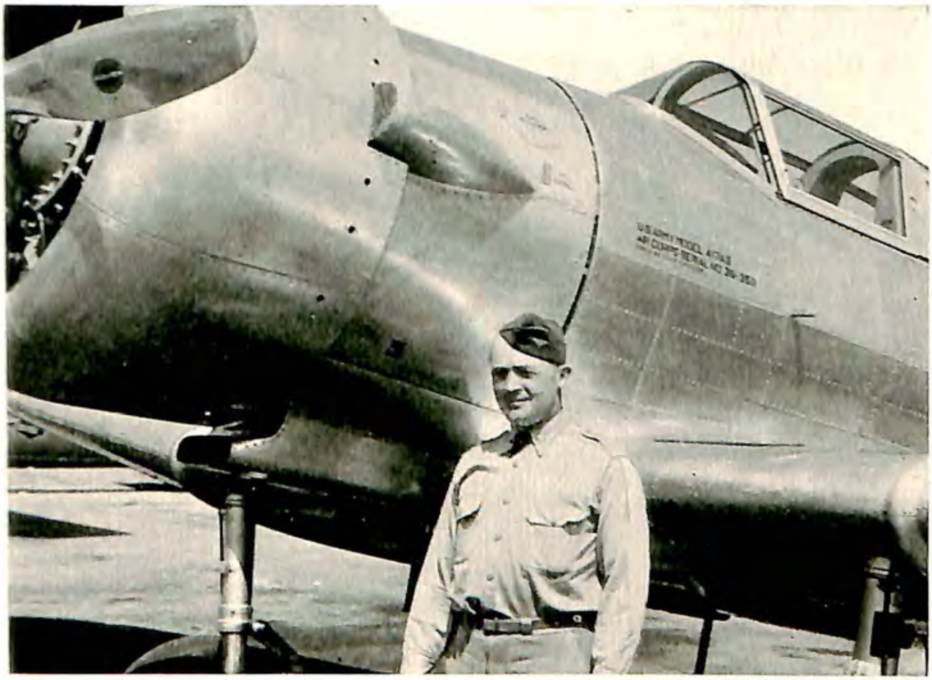
"During the last year it has been a source of gratification to those deeply interested in a sound national defense policy to note the progress that has been made in the procurement of aircraft for the Army Air Corps, both from a standpoint of quantity of aircraft and increased efficiency of type. During this period the speed and performance of aircraft have shown a marked advancement until at the present time the later types have a speed approaching 300 miles per hour. The new system of development has produced planes carrying greater loads for longer distances and at greater speeds than were dreamed of a few years ago. These results, together with the greater ease of operation and comfort for the personnel manning the planes, places them at the head of similar known aircraft of the world powers.

"When the results of the lean years which preceded the installation of the present procurement system were felt, it was readily realized that the delivery of aircraft to the Army Air Corps had to be speeded up. Careful study and analysis resulted in the installation of the present system of procurement. Since that policy has been put into effect the War Department has contracted for 849 airplanes, and of this number, 181 have been delivered up to the end of the fiscal year. Inasmuch as this delivery may at first glance seem small, it must be realized that the greater part of the period was necessarily taken up in development and in exhaustive tests of performance and design which are essential before delivery of airplanes can be accomplished at an accelerated rate. Every effort has been put forward to reduce the length of time elapsing between the inception of the airplane design and the delivery of this finished product to the tactical units of the General Headquarters Air Force. It is expected that the contracts for the purchase of new airplanes with the funds appropriated by Congress for the fiscal year 1937 will be made, with one exception,

CHIEF OF THE ARMY AIR CORPS
Major General Oscar Westover and his new Northrop.

prior to January 1, 1937. Furthermore, plans for the procurement of aircraft for 1938 have already been made and the contracts for these airplanes will be made shortly after the funds become available in July of next year. During the fiscal year 1937 it is contemplated that orders will be placed for upwards of 600 airplanes of various types.

"The tangible results of the procurement plan now in operation may be seen on the several air fields in watching the maneuvers of the various tactical units with their trim, fast, modern aircraft. It has been possible to furnish the General Headquarters Air Force, the highly mobile fighting section of the Air Corps, with a substantial number of the new tactical types of aircraft. These consist of medium range bombardment planes with proportionate numbers of single and two-place pursuit and swift, heavily armed attack planes. New observation planes, which travel 40 miles an hour faster than any previous types, are being supplied to the corps and army observation units. Cargo airplanes capable of carrying heavy loads are now being delivered. They will be able to transport practically all the supplies for the



ARMY'S ASSISTANT AIR CHIEF

Brigadier General Henry H. Arnold, Assistant Chief of the Air Corps, and his new Northrop.

air force, giving it a high speed aerial express, which in an emergency can be used for the transportation of personnel.

"The great increase in speed and range has not been overlooked by those in charge of the training schools, and the Air Corps training center is now being rapidly supplied with new, fast, and better performing training planes than those heretofore provided. All the new-type planes are of an all metal structure, which insures longer life, greater efficiency, and greater safety. It is a pleasure to note that aircraft procurement has been gradually slipped into high gear with the maximum advantage, both to the Army Air Corps and to the aircraft industry of the nation.

"In the event of a national emergency it may readily be seen that in any calculation of Government needs for aircraft the burden of pro-

Official U. S. Army photo

COMMANDER OF ARMY'S GHQ FORCE

Major General Frank M. Andrews, Commanding Officer, General Headquarters Air Force, (left) and his staff during winter maneuvers in New England.

duction, particularly in the first stages of the emergency, must be borne by existing commercial plants and organizations. An adequate aircraft industry, therefore, becomes the backbone of immediate national defense. The results of the past two years readily substantiate the contention that sources of supply will increase rather than decrease as a result of opportunities offered to a bona-fide manufacturer to compete for the airplane business of the War Department. Creative interest in engineering and development has been stimulated to the extent that industry is now in a better position to meet the needs of the Army Air Corps in an emergency than ever before.

"One of the greatest factors for stimulating interest in a growing industry is the assurance to inventors, patentees, and designers that their rights will be fully recognized and that they will be suitably rewarded for their efforts. The Aircraft Act of 1926 provides for such rewards in certain cases and extensive use of its provisions is advocated. Patented inventions and patents are protected by law but

WORLD'S FASTEST BOMBER

The Boeing "flying fortress" is America's largest land plane. It has averaged 230 miles an hour on a cross-country flight, powered by four Wright Cyclone engines.

proprietary design rights often cannot be covered by patents and can be protected only by their recognition by the Government and the adoption of a protective policy based on such recognition. The War Department agrees that the design rights of designers and manufacturers should be recognized, and such recognition is covered in the present policy of procurement.

"With our present War Department procurement system reaching its full stride, our patriotic citizens interested in national defense can now feel that our Army Air Corps is on its way toward taking its proper place among those of the other nations of the world with respect to both efficiency of fighting aircraft and numbers of planes. The nation may rest assured that our aircraft industry is gradually being built up to the point where it will be adequately prepared for any emergency that may arise.

"I am glad to be able to report that considerable progress is being made in the coordination between the War Department and the Navy Department in regard to the allocation of industrial plants to the respective services for use in a major emergency. As an example, this year an agreement was consummated between the two, settling the question of the allocation of machine-tool plants for wartime procurement. This will permit contact and direct planning in detail for specific types of machine tools. A similar agreement between the two services

Official U. S. Army Photo

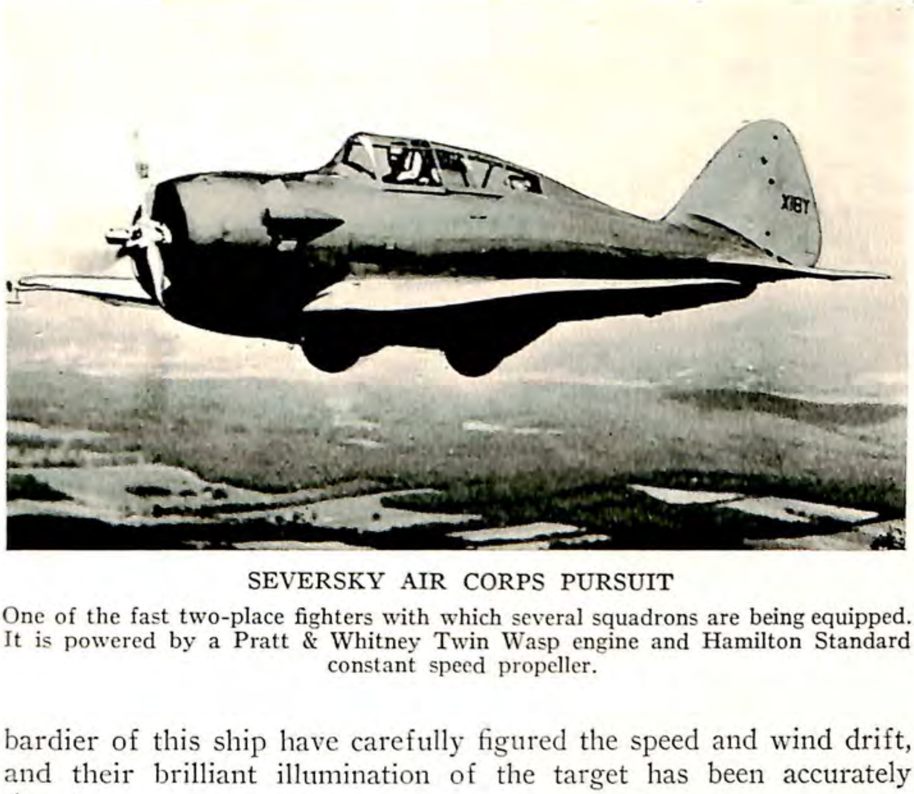
NEW DOUGLAS AIR CORPS BOMBER

It is powered by two Wright G Cyclone engines.

has been made on a substantial number of other important manufacturing establishments, including those engaged in the production of aircraft—one of the industries most vital to national defense. Until recently neither service had sufficient information concerning the requirements of the other to permit satisfactory progress, and it was only during the past year that the real cooperation necessary for efficiently utilizing the nation's industrial facilities reached the point where gratifying results could be reported."

Eight thousand feet above southern California, over an area from which all landmarks have been obliterated, a huge multi-engine bomber roars through the night. Inside is the crew, and from the insignia on their uniforms one might learn that they belong to the 19th Bombardment Group. All hands, from pilots to gunners and radio operators are watching intently, as if they should be able to see the surface below them simply by peering down through the inky blackness. But wait!

Below the bomber and slightly ahead of it there comes a sudden flash of light, and instantly as if someone had turned on an electric switch, the whole countryside is bathed in light actually more brilliant than day. It is a parachute flare which has been released from another ship flying within a half mile of the surface; and it has passed over the target a few seconds ahead of the bomber. Pilot and bom-



SEVERSKY AIR CORPS PURSUIT

One of the fast two-place fighters with which several squadrons are being equipped. It is powered by a Pratt & Whitney Twin Wasp engine and Hamilton Standard constant speed propeller.

bardier of this ship have carefully figured the speed and wind drift, and their brilliant illumination of the target has been accurately timed.

As the bomber speeds toward the target its bombardier is tensely checking the time until at the proper instant he trips his releases and hundreds of pounds of high explosive lunge straight for the spot at which it was aimed. Such is the practice flight of an Air Corps bomber.

But bombing with live bombs is expensive, and for that reason a substitute method has been adopted for general target practice. For example, nearly two miles over March Field, Calif., a bomber sets a course, and when the target appears in the bomb sight the bombardier releases, not a bomb, but a radio signal, and down below on the field, the fact as to whether the target has been hit or missed is accurately recorded by camera obscura. This is how it works. Radio truck and camera obscura are placed in position on the edge of the tarmac at March Field. Beyond the range of vision toward the Southwest the bomber climbs for altitude. The radio operator in the truck calls to the camera operator, announcing the ship's course. The camera swings about until the lens in the roof of the box is inclined slightly toward the oncoming bomber.

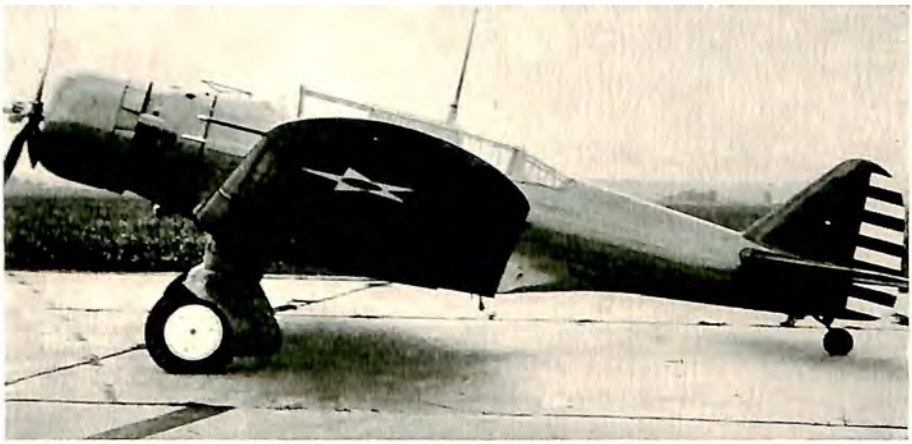
FOR ARMY SCOUTS

North American Aviation's O-47, a Cyclone-powered observation plane for the Air Corps. The observer's post is in the "belly" of the plane.

If you were in the bomber, you might hear the bombardier's voice droning into the interphone system: "Steady on course. Turn right, steady, stop, right again, stop, turn left, stop—" until finally the cross-hairs on the bomb sight show the target centered. Then the bomber "dumps his eggs" but in this instance it is a radio signal, a single impulse. At that instant the occupants of the camera obscura box, which is not more than four feet square and light-proof, catch the signal; and they see at the same time the exact position of the bomber, because the lens facing the plane infallibly projects its shadow image on a chart; and there the scorer makes a mark, quickly, for it is the spot where the bomb should have been released had one been aimed at the target. Precisely 23 seconds later the scorer marks on the chart where the bomb should have landed, in relation to the target. It saves money, and it develops bombers.

Another money-saving device is the concrete bomb. The Air Corps makes them up in three sizes, 600, 1,100 and 2,000 pounds. Several squadrons received valuable training in 1936, dropping the bombs on Muroc Dry Lake in southern California.

Advancing human knowledge concerning the age-old mysteries of the stratosphere and to avoid some of the hazardous high altitude flying which would be required otherwise, the Air Corps is installing at Wright Field, Dayton, an "icebox laboratory" which can be transformed into a vacuum or partial vacuum to simulate actual con-



AN ARMY ATTACK PLANE

A Twin Wasp Junior-powered plane developed by the Northrop Corporation.

ditions at any height up to 80,000 feet. It is sheathed in boiler plate and when completed will contain scores of delicate scientific instruments, and on occasion animals and even men who have volunteered to undergo the rigors of an altitude flight by remaining in the chamber for certain periods of time that their reaction to temperatures and pressures may be learned as well as the efficiency of new equipment for high altitude work.

In weather which often sent the thermometer below zero when it was least expected, Air Corps bomber, attack and pursuit squadrons, with service and cargo detachments, went into New England and practised under conditions which could not be more rigorous in wartime. It was the cold weather maneuvers of Major General Frank

M. Andrews and his GHQ Air Force, and it marked another milestone in the development of the military flying service.

Summarizing the progress made during the last 12 months Major General Oscar Westover, Chief of the Air Corps, said: "As 1936 draws to a close, the Army, of which the Air Corps forms so vital a part, can look with considerable satisfaction on the progress made during the last year in the development of its aerial arm. The last Congress was responsible for three pieces of legislation, which when put fully into effect, will have a decidedly beneficial reaction in the Air

Official U. S. Army Photo

A TEST OF MEN AND PLANES

One of the Cyclone-powered Martin bombers with which the Air Corps conducted winter tests after a night out at Concord, N. H.

Corps; the Act authorizing an increase in airplanes, equipment and accessories in such numbers as will permit the Secretary of War to complete the equipment and organization and to maintain in the Army Air Corps the General Headquarters Air Force and our overseas defenses, together with a 25 per cent reserve for such forces, and to procure such other airplanes and equipment as are necessary for carrying out the mission of the Air Corps; the Act authorizing the President to call to active duty, with their consent, 1,350 Air Corps Reserve officers for periods of not more than five years, and in addition authorizing the appointment to temporary rank in the grades of colonel, lieutenant colonel and major such numbers of officers of the Regular Army Air Corps as the Secretary of War may determine necessary; lastly the Wilcox Bill authorizing additional strategic and intermediate air bases for the General Headquarters Air Force.

Official U. S. Army photo

MAKING AN ENGINE COMFORTABLE

Captain Early and Lieut. Irvine, of the Army Air Corps, demonstrate a tent and gasoline heater used in warming up an airplane engine before setting out on a flight in sub-zero weather.

"There are in the Air Corps and National Guard squadrons approximately 60 per cent of the number of planes deemed absolutely essential by Congress, the War Department and the several Boards which have from time to time been appointed to investigate the condition of the Air Corps. A large number of the planes now in service are of obsolete or obsolescent types." After quoting from the 1935 report of the Secretary of War recommending an effective and balanced force of 2,500 planes with a small complement of operating reserve, and an annual procurement of 800 completely equipped planes, Major General Westover stated that during the last three fiscal years contracts had been let for only one-third of the number recommended annually. The reasons were ever-recurring lack of funds, increased cost of materials for modern all metal aircraft and the increased cost of labor.

Recent developments believed to promise relief of that situation

AN AERIAL MACHINE GUNNER

Dressed for zero weather flying, he is ready for business in an Army attack plane during cold weather maneuvers.

were listed, among them being the progress made in development of larger bombardment planes, machines of all metal construction capable of carrying 2,000 pounds of bombs approximately 1,500 miles at speeds in excess of 200 miles an hour, and machines capable of flying non-stop to reinforce the aerial defense of Panama, Hawaii or Alaska. The Chief of the Air Corps added that at the time the service reaches its authorized airplane strength it should have about 30,000 officers and men, as compared to the "little over half that number in the Air Corps today."

Training for the Air Corps was described in numerous statements issued by the Army during the year. Candidates for appointment as flying cadets must be unmarried male citizens who, at the time of application, have reached the age of twenty, but not their twenty-seventh birthday. An applicant must present a certified document from the office of the registrar of a certified college or university showing that he has satisfactorily completed one-half or more of the necessary credits for a degree which normally requires four years' work, or he must pass an examination which is the equivalent of this educational requirement.

Flying cadets receive $75 a month, a ration allowance of $1 a day

Official U. S. Army photo

WHERE AIR CORPS CADETS ARE TRAINED

The primary flying school of the Army's air forces, Randolph Field, Texas.

and a clothing allowance which keeps them in uniform and equipment. The course embodies a year's ground and flying instruction at the primary and advanced flying schools at Randolph and Kelly Fields in Texas, respectively, and those who are graduated then serve a year with a tactical unit at some Air Corps field in return for their free education.

They are then eligible for commissions as second lieutenants in the Air Corps reserve, and get a year's active duty in this status or retire to civil life if no openings exist.

A total of 61 members of the class of 276 Cadets who graduated from the United States Military Academy on June 12, 1936, were, under recent orders of the War Department, directed to proceed upon the expiration of their graduation leave to Randolph Field, Texas, for duty and flying training.

These 61 students, or 22.1 per cent of the entire graduating class of 276 students, received commissions in the various branches of the Army, except the Air Corps, as follows: Corps of Engineers, 4; Cavalry, 9; Signal Corps, 1; Coast Artillery, 4; Field Artillery, 13; Infantry, 30. A year of intensive flying training is ahead of these West Point graduates to whom aviation presents a special appeal, an eight months primary and basic course at the primary flying school at Randolph Field, and a four months course at the advanced flying school at Kelly Field. Those who succeed in completing the year's course will be given the rating of "Airplane Pilot" and transferred to the Air Corps, while those failing to make the grade will return to the branch of the Army in which they were commissioned upon their graduation from the Military Academy.

For 15 years the army has assigned West Point graduates to the Air Corps flying schools for training. During the period from 1922 to 1935, inclusive, 848 West Pointers were accepted for flying training, of which number 401 were graduated from the Advanced Flying School, or 47 per cent of the total. It appears from this that slightly less than one-half of the young men mentally and physically qualified to undergo flying training at the Air Corps Training Center are able to pass through the course successfully.

The Cheney Award, bestowed annually by the Chief of the Air Corps for an act of valor, or of extreme fortitude, or self-sacrifice, was awarded on January 20, 1936, for the year 1935, to First Lieutenant Robert K. Giovannoli, Air Corps, for extreme bravery in the rescue of two men from a burning bomber that crashed at Wright Field on October 3, 1935. He was killed March 8, 1936.

The Mackay Trophy for 1935 was awarded early in 1936 to Major Albert W. Stevens and Captain Orvil Anderson, Air Corps, for their feat in ascending 72,394 feet into the stratosphere in the "Explorer II," during the National Geographic-Army Air Corps Stratosphere Flight on November 11, 1935.

The Frank Luke, Jr., Memorial Trophy, a trophy presented by the American Legion of Arizona in honor of Second Lieutenant Frank Luke, Jr., one of the outstanding aerial heroes of the World War, has been awarded annually since 1931 to the pursuit pilot of the Air Corps stationed on the West Coast who made the highest gunnery score; but for 1936 the recipient of the award was changed to the pursuit organization having the highest aggregate score in aerial gunnery for the year. Accordingly, the award for the year 1936 was made to the

79th Pursuit Squadron, 20th Pursuit Group, General Headquarters Air Force, stationed at Barksdale Field, Shreveport, La.

The Distinguished Flying Cross, which is awarded for acts of heroism or extraordinary achievement while participating in an aerial flight, was awarded posthumously to the widow of Major Hez McClellan, in recognition of his outstanding and meritorious flights to and from and while in Alaska during the summer of 1935. Major McClellan was killed in an airplane accident near Wright Field, before the award was approved.

The Soldier's Medal, which is awarded to members of the military forces of the United States who distinguish themselves by heroism not

Official U. S. Army photo

NEW ARMY OBSERVATION PLANE

The Wasp-powered Douglas O-46 developed by the Douglas Aircraft Company, Santa Monica, Calif. The plane is powered by a Pratt & Whitney Wasp engine.

involving actual conflict with an enemy, was awarded to Lieut. Giovannoli and also to Lieut. Leonard F. Harmon for their courageous rescue work in freeing the occupants of the burning bomber. Both were badly burned.

Nobody ever faced a more gigantic and doubtful task than that confronting the aviators of the 5th Composite Group, U. S. Army Air Corps. They had to go up and fight a volcano. On the island of Hawaii vicious old Mauna Loa was indulging in another rampage. Heralding her outburst with nothing less than an earthquake, Mauna Loa started vomiting boiling rock which sprayed up in huge fountains as high as 800 feet, to form a plume-shaped cloud of sulphur gas and vapor a half mile in the air. From the great vent at one side of her maw a river formed, a river of wine-red lava a quarter of a mile wide. Soon it was cascading over the breast of Mauna Loa, an awful churning flood of fire rushing down on the lowlands at express train speed. Just how awful it was may be imagined by the rocks floating on its surface. They were as big as houses and they bobbed up and down like so many corks.

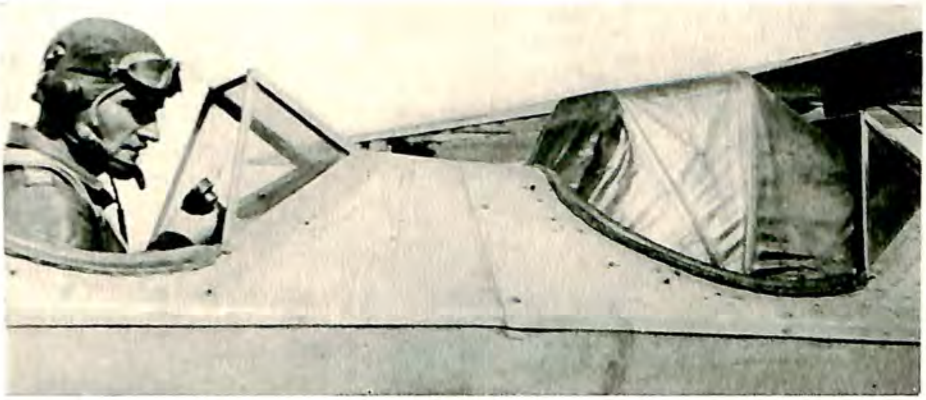
A half mile down the slope perhaps a fourth of the river of fire slipped away from the main stream and poured itself back into a huge crack, a veritable Niagara tumbling into a bottomless pit. The rest of the molten lava splashed on down the northeast slope of Mauna Loa, fed unceasingly from the main source above. For a mile it kept to the surface, then it ran underground through tunnels for some 200 yards, to emerge again and persistently flow on, like some kind of a monstrous flame-spouting dragon creeping upon its victim. And there were victims here; for in the path of the lava stream lay ranches, the headwaters of the Wailuku River and the city of Hilo where the people were clamoring for something to be done—anything, to prevent the catastrophe that threatened. What could be done to stop flowing lava pushed on by the steady pressure from the volcano's mouth?

As the old lava cooled it formed a glassy crust under which fresh lava streamed, like so much liquid fire, which reached the vicinity of Humuula Station, fanned out into a lake, burned grass and forest and then headed straight for Hilo at a speed of a mile a day. Six days later it was within 13 miles of Hilo. Then the Air Corps flew in, first the 18th Pursuit Squadron headed by the wing commander, Col. Delos Emmons, and followed shortly by the composite group under Lieut. Col. Asa Duncan.

After a scouting flight by the pursuit ships, which took the pilots through freezing air off the snow-capped peaks and straight on into the hot, choking sulphur fumes over Mauna Loa, the officers went into conference with Dr. T. A. Jagger, volcano expert for the National Park Service. Now Dr. Jagger had a theory. He was convinced that even such puny things as men might wage successful battle against volcanos when aided by flying machines. He believed that the Army Air Corps could blast that lava stream into such shape that it would halt in its course, freeze up in fact and form a huge breastwork against any fresh onslaught from Mauna Loa. It sounded fantastic, but the men of the Air Corps are accustomed to fantastic assignments. They took Dr. Jagger with them and soared over the molten tide, while he explained just where he thought the enemy should be attacked.

Early next morning five bombing planes went out from Hilo, each carrying two 600-pound demolition bombs and two 300-pound practice bombs for sighting shots. Swinging a half-mile above the source of the lava stream, where it emerged from the vent in Mauna Loa's maw, each of the five bombers dropped first a small bomb, then a heavier shot. As the pilots watched they saw the molten mass tossed hundreds of feet, great gaping holes which, as Dr. Jagger had said, should release the lava and liquid gases which had been spouting out under terrific pressure. The first shots blasted enough holes and vents to form a sluiceway which diverted the flow. Then the bombers went after their next target, the tunnel which fed the lava stream menacing Hilo. Here the exploding bombs crashed through the hardened surface and ripped the tunnel apart, enough to break up the steady, persistent flow.

Returning to Hilo the bombers reloaded and returned to the as-



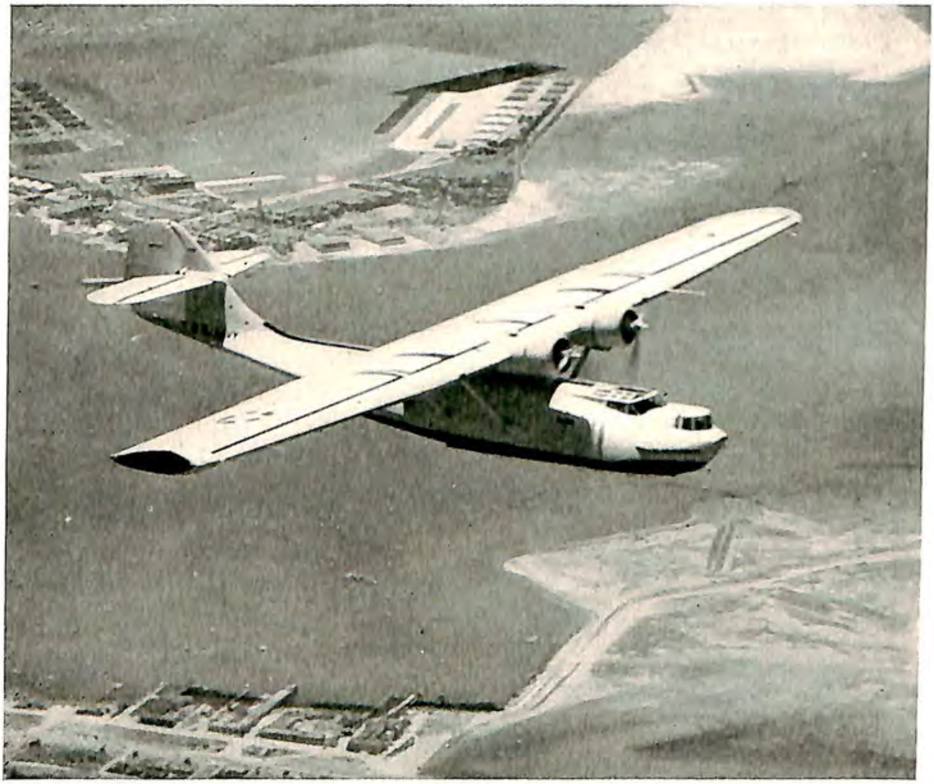
Official U. S. Army photo

THE AIR CORPS TEACHES BLIND FLYING

The instructor in the rear phones directions to the cadet who is in the hooded cockpit learning to fly by instruments and radio.

sault, first on the source and again on the tunnel. And that was enough. They saved Hilo and the surrounding countryside. Just before the bombing the lava had been gliding toward Hilo at the rate of 800 feet an hour. Just after the bombing it slowed down to 150 feet an hour. Next day it had dropped to 40 feet, and a day later it ceased entirely, leaving only clinker lava to spill out over the hardened rim, a few feet a day until that also stopped.

Explaining the bombing results from the viewpoint of a scientist Dr. Jagger reported to the Air Corps: "A lava slag tunnel-and-vent system is in stabilized equilibrium. The physical chemistry of glassy basaltic molt containing gases in solution, particularly hydrogen, involves nice adjustments of pressure. Any flow from a high source, after streaming so long as to threaten a place as distant as Hilo, would be in balanced adjustment. Bombing should destroy that adjustment and stop the flow. This is what you have proved by your magnificent experiment. The Army in one day's work has stopped a lava flow which might have continued indefinitely, and have caused incalculable damage to forest, water resources and city."



CONSOLIDATED PATROL SHIP WITH FLOATS UP

Flight-testing one of the new Twin Wasp-powered PBY-1 long range Navy patrol boats near the plant of its builder, Consolidated Aircraft Corporation at San Diego, Calif. The floats fold up to become wing tips during flight.

CHAPTER V

THE U. S. NAVY AIR FORCES

Rear Admiral Cook's Description of Naval Aviation—The Navy's Air Force Program—Achievements in 1936—Expenditures—Need for More Development Funds—Lighter-Than-Air—Recommendations—Secretary of the Navy Swanson's Report—Awards for Achievement—Status of Aircraft Carriers.

FOLLOWING in the footsteps of Admirals William A. Moffett and Ernest J. King as Chief of the Bureau of Aeronautics, Rear Admiral Arthur Byron Cook took over command of the Bureau in June, 1936, to the general satisfaction of everybody, because Admiral Cook himself is a pilot with a long and brilliant record of achievement. In his aviation duties he served first as commander of the carrier Langley, then chief of staff with the aircraft battle squadrons, then assistant chief of the Bureau of Aeronautics, followed by command of the great carrier Lexington from which he entered the Bureau as Chief.

In a vivid description of the various functions of aviation in the Navy, Admiral Cook placed its aircraft in three classes; first, the patrol plane and flying boat; second, the seaplanes which are carried on battleships and cruisers and are launched by means of the catapult; and third, the land planes on the carriers. One of the Navy's major tasks in war being to protect ocean commerce and give timely warning of an enemy's approach toward the coasts, the patrol ship and patrol plane perform vital duties. The Navy during 1936 was building up strategically located bases and increasing the number of patrol planes. By 1937 it was planned to have in readiness for any emergency an adequate force of patrol planes able to operate over great distances at sea, to be self-sustaining, powerful as a defense weapon and equally powerful if called upon to assume an offensive, and primarily capable of joining the Fleet at any time or place, ready to take part in any kind of action.

The observation and scouting planes of the Navy are used on the battleships and cruisers of the Fleet, and their job is to assist the individual vessels to which they are attached. "It is of paramount importance in this type that they be able to land and be picked up at sea in as rough water as possible," said Admiral Cook. "It would be

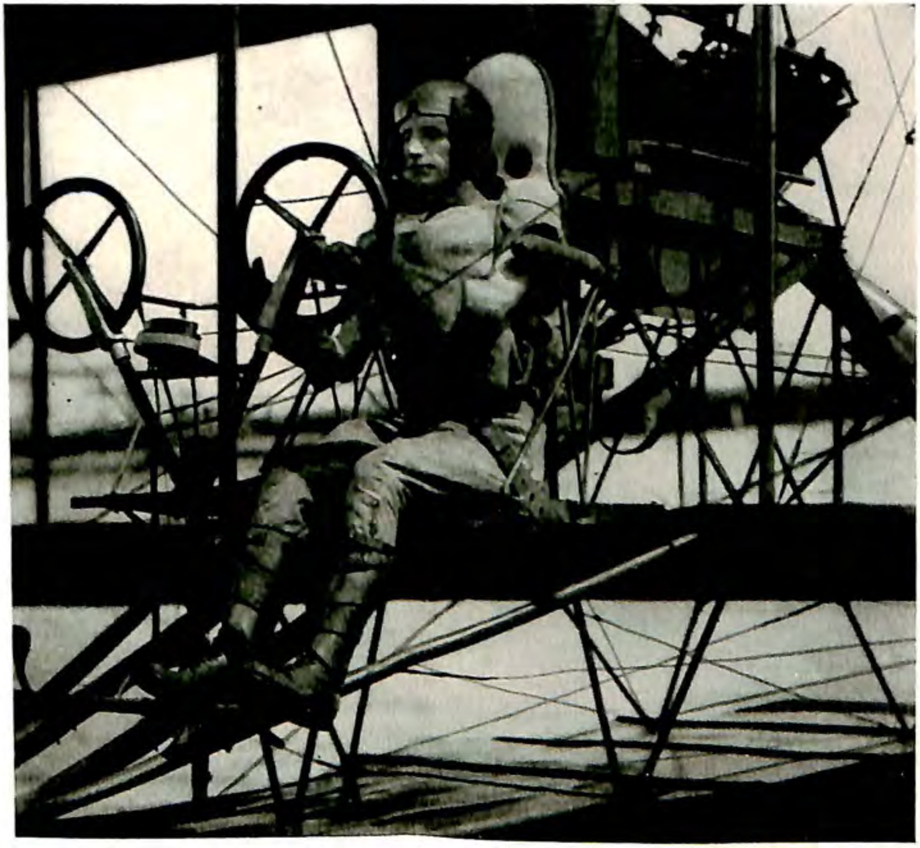
CHIEF OF NAVY AIR FORCES

Rear Admiral Arthur B. Cook, Chief of the Bureau of Aeronautics of the Navy, on a visit to an air station.

impossible to take full advantage of the great range of the guns of modern battleships and heavy cruisers unless aircraft were available to direct and correct the fire of these guns. Again, in the case of cruisers, the effective area which they can cover is vastly increased by the use of planes, and at the same time they are protected to a greater degree from the possibility of encountering at destructive ranges superior forces of the enemy."

The third class of Navy plane was described as that belonging to the aircraft carriers. The planes based on the carriers can take an independent offensive, precisely like that of the guns and torpedoes; and they have a single major function, to strike the enemy both on the surface and in the air.

The aircraft carriers have by far the greatest number of planes in the sea-going forces. The carriers are armed, floating, mobile flying



NAVY'S ASSISTANT AIR CHIEF

Captain Albert C. Read, now Assistant Chief, Bureau of Aeronautics of the Navy, in the 1916 seaplane in which he learned to fly.

fields from which the planes fly off and to which they return for re-servicing. They are completely equipped with machine and overhaul shops, elevators, repair facilities, hangar space, gas tankage, radio beacon and control station, and in addition, barracks and living quarters for 2,000 persons. In war the carriers, remaining out of range of the enemy guns, could launch hundreds of fighting planes and bombers against the enemy's ships.

In his annual report for the fiscal year 1936 Rear Admiral Cook made these comments: "The increase of naval aircraft as authorized by the Vinson-Trammell Act has progressed satisfactorily in accordance with a program drawn up by the Bureau of Aeronautics in conjunction with the Office of the Chief of Naval Operations which

COMMANDER OF NAVY'S BASE FORCE

Rear Admiral Ernest J. King, commander of the Aircraft Base Force, and his Curtiss SOC-1 flagship.

provides an orderly expansion over a period of from five to seven years to make the eventual strength of the Naval Air Component commensurate with the Treaty Navy. However, the provision of the supporting shore facilities for these aircraft has not kept pace with the aircraft expansion program. This is creating congestion at aircraft operating and repair bases that is becoming increasingly serious and requires prompt provision for additional shore facilities, including overhaul shops, housing for personnel, hangars, and operating improvements which have been recommended by this Bureau, if interference with Fleet operations is to be avoided.

"The Bureau has made every effort to maintain the aviation forces afloat in a condition of readiness for war in accordance with the Operating Force Plan, and in order to attain a satisfactory state of readiness has endeavored to provide aircraft and equipment of the highest reliability and most modern design, and to use improved materials and maintenance methods. The measure of success attending these efforts

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CRUISER AIRCRAFT WING

A formation of Navy scout observation planes, Model SOC-1, built by the Curtiss Aeroplane Division of the Curtiss-Wright Corporation. They are Wasp-powered.

may be judged by the highly satisfactory manner in which fleet aircraft have continued to carry out their duties in the Fleet.

"Funds provided for experimental purposes have been used to obtain a very marked improvement in airplanes and engines and the best possible improvement in instruments, radio, armament, materials, aerodynamics, carrier launching and arresting gear and seaplane launching and recovery gear. Competition has been fostered in the industry in bringing out advanced experimental models of aircraft and at this time the Bureau has available for procurement in quantity one or more models in each class with improved performance.

"In the matter of new and replacement aircraft the Bureau has used funds to procure aircraft of approved types, and in accordance with approved complements which embody the latest and most important developments in aeronautics. Increased engine powers available and improved aerodynamic design have contributed to the marked increase in speed range of new service types. This has been most evident in new scout-bomber airplanes and patrol planes now under procurement."

Official Photo U. S. Navy

PLANES FROM THE NAVY CARRIERS

Wasp-powered Voughts and Grummans winging their way along the coast line.

Rear Admiral Cook listed these important accomplishments during the fiscal year:

"(a) Provision of experimental aircraft and engines of decidedly improved performance in connection with the conduct of the experimental development program of aircraft, engines and accessories, and of the research activities connected therewith.

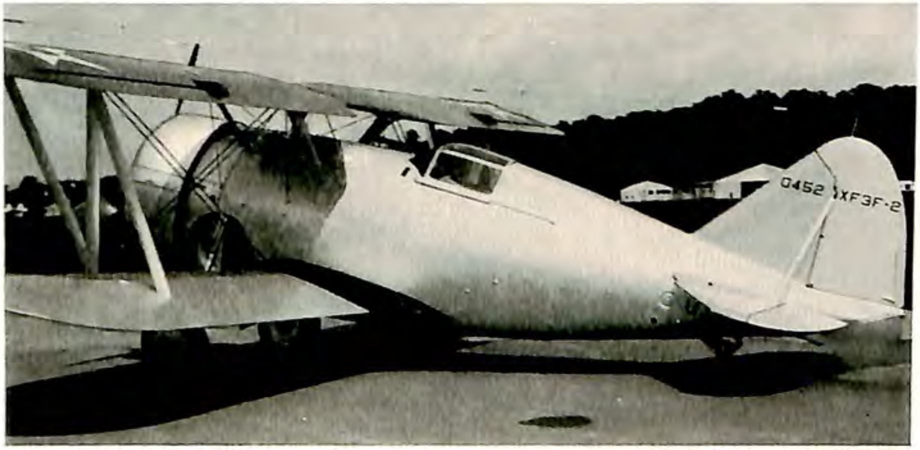
"(b) Procurement of new service aircraft of outstanding performance in accordance with the requirements of the Naval Aeronautic Organization.

"(c) Flight of the XP3Y-1 airplane from the Naval Air Station, Norfolk to Coco Solo and non-stop from Coco Solo to San Francisco, the latter flight establishing two new international distance records for seaplanes.

"(d) Initiation of training of Aviation Cadets under program to meet the shortage of naval aviators.

"(e) Expansion of Naval Aircraft Factory for the manufacture of aircraft and aircraft engines in accordance with the Vinson-Trammell Act requiring 10 per cent of the naval aircraft and engines be built by the Government.

"(f) Transfer by Executive Order of Rockwell Field, San Diego;



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A NEW NAVY FIGHTER

The F3F-2 built by the Grumman Aircraft organization for some of the carrier squadrons. It is powered by the 1,000 h.p. Wright G Cyclone engine.

Luke Field, Pearl Harbor and Old Bolling Field, Anacostia, D. C., from the custody of the War Department to the Navy Department and of the Naval Air Station, Sunnyvale, Calif., from the custody of the Navy Department to the War Department.

"(g) Establishment of aviation field at St. Thomas, V. I., by Marine Corps Aviation by direction of the President.

"(h) Authorization for acquisition of site and for construction of a Naval Air Station at Alameda, California.

"(i) Expansion and modernization of the Naval Air Station, Pensacola, by replacement of old facilities and provision of new facilities to provide for the increased training program.

"(j) Launching of carrier 'Yorktown.'

"(k) Delivery of 370 airplanes and 468 engines incorporating advanced performance.

"(l) Overhaul of 544 airplanes and 1,135 engines at naval aviation overhaul bases, an increase of 12 per cent in overhauled aircraft and 45 per cent in overhauled engines as compared with the fiscal year 1935.

"(m) Increase in number of flying hours between routine over-

Official Photo U. S. Navy

STEARMAN NAVY TRAINERS

Some of the 61 NS-1 primary trainers delivered to the Navy air forces by the Stearman Aircraft Company, Wichita, Kan.

hauls for both airplanes and engines as a result of improved operating maintenance, better design features and improved quality of overhaul work.

"(n) Selection of 44 officers for Aeronautical Engineering Duty Only.

"The Bureau recommended that favorable action be taken by the Navy Department on the following matters:

"(a) Improvement of unsatisfactory housing conditions for families of naval personnel at the Fleet Air Base, Coco Solo.

"(b) Provision of adequate tender facilities for patrol boats.

"(c) Construction of Margarita Breakwater at Coco Solo.

"(d) Expansion and improvement of shore facilities at the Naval Air Stations and Fleet Air Bases to care for the increase in number of naval aircraft."

Rear Admiral Cook made the following report on expenditures and number of aircraft during the last three fiscal years:

"The following amounts were made available for obligation during the fiscal year 1936 under 'Aviation, Navy.' For the purpose of comparison the amounts made available for obligation during the fiscal years 1934 and 1935, including allotments from emergency appropriations, are stated together with the number of aircraft being operated in the Naval aeronautic organization:

	1936	1935	1934
Navigational, photographic, aerological and radio equipment	\$ 498,200	\$ 672,152	\$ 971,006
Maintenance and operation, aircraft and air stations....	11,020,450	10,634,277	9,790,198
Experiments and development	2,498,000	1,803,252	2,188,000
Aircraft construction	24,805,660	12,221,000	3,300,000
Total for Aviation, Navy	\$38,822,310	\$25,330,681	\$16,249,204
Emergency Appropriations:			
Aircraft construction.....		12,902,772	7,500,000
Expansion of aircraft factory		2,708,800	
Grand Total.............	\$38,822,310	\$40,942,253	\$23,749,204
Number of operating aircraft	958	774	754

"Funds for maintenance and operation of aircraft and air stations were not proportionate to the increase in number of operating airplanes and added burdens to air station facilities. The situation at air stations was partially relieved through work done by employees of the Works Progress Administration, but it is anticipated that funds must soon be appropriated directly under the appropriation out of which these stations are normally sustained.

"The appropriation for the fiscal year 1936 authorized the procurement of the second increment of airplanes in the program to provide a naval aeronautic force in number commensurate with a Treaty Navy. This authorization will supply the carriers 'Yorktown' and 'Enterprise' and six new cruisers, 'Quincy,' 'Vincennes,' 'Brooklyn,' 'Philadelphia,' 'Savannah' and 'Nashville' with aircraft.

"A marked increase in the cost of experimental airplanes has been noted. This factor together with constant improvement and new developments in all branches of the aeronautical field merits a substantial increase in funds for this purpose.

Official Photo U. S. Navy

CADETS LEARNING RADIO

The Navy's cadet fliers at Pensacola at work in the radio laboratory. It will help them in blind flying.

"The following construction work was assigned to the Naval Aircraft Factory in accordance with the Treaty Navy Act which specifies that not less than ten per cent of the airplanes and engines procured by the Navy be manufactured in a Government plant: One experimental training plane, 85 service type training planes, one twelve cylinder engine, 100 engines for training planes, design high speed engine, design two cycle engine, V type and design compression ignition engine.

"During the fiscal year 1936 the several aviation shore stations serving the fleet overhauled 544 airplanes and 1135 engines. This represents an increase of 12 per cent in overhauled aircraft and 45 per cent in overhauled engines as compared with the fiscal year 1935."

Commenting on lighter-than-air, Rear Admiral Cook reported:

"Airship development, especially as regards large sized airships, has been largely in a suspended status awaiting formulation of attitude towards procurement of additional large airships for Naval purposes.

"The special committee on airships of the Science Advisory Board,

A NEW NAVY DIVE BOMBER

One of the Wasp Junior-powered fighting planes built by Northrop Corporation.

appointed at request of the Secretary, made a report in January, 1936, containing its recommendations as to policy, which recommendations were favorable to a continuing program of airship construction.

"In May, 1936, the Chief of Bureau made recommendations to the Secretary with reference to the Naval airship situation, and in keeping with the Durand Committee's Report, briefly as follows:

"(a) Non-rigid airships. Build the two airships for which funds were included in 1937 estimates.

"(b) Moderate-sized rigid airships. Obtain funds and begin immediately construction of an airship of about 2,500,000 cubic feet size, as recommended by the General Board in 1934.

"(c) Experimentation and advancement of the art. Obtain funds and begin immediately construction of a metal-hulled airship of about 1,500,000 cubic feet size.

"(d) Large rigid airships. Include large airships in the Department's program for airship development, but that ways and means for acquiring large airships be not fixed at this time, pending a clarification of activities in the commercial airship field, in which commercial airship activities the Department should cooperate wherever practicable."

In his annual report for the fiscal year 1936 Secretary of the Navy Claude A. Swanson stated:

Official Photo U. S. Navy

NEW NAVY OBSERVATION PLANE
Developed by Vought, it is known as the O4U-2.

"The high standard set by our naval aviation in the past has been maintained. Distinct gains have been made during the year in material and in the numbers and efficiency of personnel. Operations of aircraft with the fleet have extended and their coordination with other elements of fleet strength has been constantly advanced. The present outstanding position of our naval aviation could not have been reached without that unity of command and community of effort which characterizes the existing system of naval administration. Formulation of the Navy's policy with regard to lighter-than-air craft awaits further study of all aspects of the present situation and mature consideration of the reports of the special committee of the Science Advisory Board, which has been making an analysis of the subject and has submitted a partial report."

The first airplane to fly the Atlantic ocean was the Navy-Curtiss flying boat NC-4, in May, 1919; and the commander of that ship on its famous flight was Capt. Albert C. Read who became a naval aviator in March, 1916. In August, 1936, Capt. Read reported for duty as Assistant Chief of the Bureau of Aeronautics.

The Herbert Schiff Memorial Trophy, presented annually to the squadron having the best record for safe flying was awarded to

Official Photo U. S. Navy

A SCOUT BOMBER FOR THE NAVY

The new Curtiss SBC-3, Twin Wasp Junior-powered, one of 83 built for the Navy.

Training Squadron Two, commanded by Lieut. Phil Haynes, at Pensacola, Fla., out of 61 competing squadrons. The winning squadron had flown a total of 18,699 hours during the fiscal year 1935. The Edwin Francis Conway Memorial Trophy for 1935, awarded annually to the Naval Reserve Aviation Base with the highest efficiency mark for the year, was won by the base at Miami, Fla., commanded by Lieut. A. K. Morehouse. A new trophy, named in honor of Rear Admiral William A. Moffett, for safest flying among battleship and cruiser units, was to be awarded for the first time in 1937.

Lieut. Comdr. Knefler McGinnis received the Distinguished Flying Cross with the following citation: "For extraordinary achievement in a record breaking flight" from Norfolk, Va., to San Francisco, Calif., by way of Fleet Air Base, Coco Solo, C. Z., in October, 1935, when in a new Consolidated patrol boat he made the longest non-stop flight by seaplane. Alton Franks received a special letter of commendation from the Secretary of the Navy for his heroic rescue of R. B. von Stein, aerographer, from a burning airplane at Anacostia, D. C., in December, 1935. Belated recognition of a remarkable achievement came to Lieut. Col. Francis T. Evans of the Marine Corps. He received the Distinguished Flying Cross for being the first man in history to put a seaplane into a loop-the-loop and pull it

Official Photo U. S. Navy

THREE CARRIERS IN A LINE

The "Lexington" and "Ranger" from the deck of the "Saratoga."

out safely, thereby demonstrating a now common method of recovering from spins caused by whip stalls. The Evans adventure immediately increased the performance of seaplanes, and aided materially in the advancement of the science of naval aviation. Lieut. Frank Akers received the Distinguished Flying Cross for a most hazardous experiment. In May, 1935, he took a new type plane off from the runway at the San Diego air station, and landed it on board the small carrier Langley. For their heroic work and wise judgment while with the second Byrd Antarctic Expedition a number of Navy men won official recognition. Joseph Pelter, photographer, received the Distinguished Flying Cross for his work as aerial surveyor on the 1,110-mile flight south of Little America during which he obtained photographs which "changed the map of the Antarctic." For saving the Byrd ship "Bear of Oakland" from being crushed in the ice several times her skipper, Lieut. Robert English, received the Distinguished Service Medal. Ensign Kennett L. Rawson, Radioman Clay Bailey, and William M. Bowlin, chief machinist's mate, were awarded the Navy Cross for extraordinary achievement with the expedition.

Nine naval aircraft participated in the rescue and relief work dur-

A MARINE CORPS SQUADRON

U. S. Marine Corps Fighting Squadron 9-M preparing to take off in Boeing pursuit planes.

ing the floods that swept through Pennsylvania in March. Naval reserve planes from Minneapolis cooperated with the National Park Service in fighting forest fires in Michigan during August. Nearly 500 reserve cadets were on the program for pilot training, and 250 of that number were to be assigned to duty with the Fleet by the end of 1937. With 1,300 aircraft in service the Navy planned to augment equipment until it reached the authorized strength of 1,910 planes in 1942.

The Navy's fleet of aircraft carriers is growing steadily in number, size and importance as an arm of the national defense. The "Langley" no longer counts. It was small to begin with, a converted collier of 11,500 tons, length 542 feet and speed of only 15 knots. It has been used for experiments, never as an arm of the fleet when it moved out over the open seas on serious maneuvers. The "Saratoga" and the "Lexington," however, are great carriers, 888 feet in length 105½ feet wide and each having a displacement of 33,000 tons. They have a speed of 33 knots and therefore can cruise with the fleet on any mission. Each of these carriers is armed with eight 8-inch and 12 5-inch anti-aircraft guns. A very large share of the equipment on the carriers is held secret; but the following official description is of interest: A long flying deck extends over the entire top of these ships from stem to stern and is free from all obstructions with the exception of

Official Photo U. S. Navy

A BUSY HOUR ON A CARRIER

Spotting planes on the deck so they will be ready for take-off, one after another.

an "island" on the starboard side, where in a massive combined funnel enclosure, the masts, uptakes, turrets and superstructure are located. To make up for the preponderance of weight on the starboard side, quantities of oil, gas and water are carried on the port side of the vessel. When gas and oil are consumed in large quantities, water ballast can be substituted in their place.

The interior of the "Saratoga" and "Lexington" is quite different from the space below decks on other naval vessels. There are storage places for hundreds of planes as well as cranes and elevators with which to hoist them to the flight deck.

The crew's quarters are on the deck beneath the flying deck and the hangar deck is below that, thus receiving the protection of two upper decks. Forward of the hangar deck there are eight decks from the hold to the flying deck. There are fully equipped aircraft machine shops and carpenter shops on board, a laboratory for testing engines and shops for fabric work, doping and painting. There is a sheet metal shop, a plumbing shop and sewing shop with more than 40 sewing machines.

The interior of these ships is divided into more than 600 compartments. Of these 600 compartments, 117 are assigned to the supply department of the vessel. Thirty-one compartments are set aside for the storage of technical aviation material, 70 are assigned to the storage of general ship's supplies, equipage and provisions, and 16 compartments are utilized for the galley, bakery, butcher shop, general

STAFF TRANSPORT FOR THE NAVY

It is an Electra of the line developed by Lockheed Aircraft Corporation, Burbank, Calif.

mess, issue room, clothing issue room and ship's store or "canteen."

These ships are floating airplane fields and electric generating plants combined. The propulsion machinery comprises four 35,200 kilowatt turbine generator sets which supply current to eight powerful motors. The generators are operated by steam from 16 oil-fired boilers. The eight motors are connected in pairs to each of the four propeller shafts. Each motor has a capacity of 22,500 horsepower and measures 15 feet in diameter. A total of 45,000 horsepower is delivered to each shaft which drives the propeller blades at 317 revolutions a minute.

The "Saratoga" and the "Lexington" were commissioned in 1927. They were not laid down as carriers originally, their hulls having been designed for battleships. The "Ranger" was the first ship to be originally designed as a carrier. The "Ranger" was commissioned in 1934, the sixth U. S. Navy craft to bear that name. The first was commanded by Capt. John Paul Jones.

The present "Ranger" has a displacement of 14,500 tons, is 769 feet long, over 80 feet wide, and has a speed of 29.25 knots.

Two new carriers were launched in 1936. They are the sister ships "Yorktown" and "Enterprise." They have a displacement of 19,900 tons, are 761 feet long, more than 83 feet wide, and their speed will be faster than that of other carriers. They will enter active service early in 1937. Another carrier, the "Wasp," is under construction. It will have a displacement of 14,200 tons.

END OF A MERCY FLIGHT

Removing a patient from the Coast Guard plane "Altair" after a long flight out over the open sea to take him off a vessel.

CHAPTER VI

THE U. S. COAST GUARD

Expansion of Activities—Wide Range of Coast Guard Duties—Development of New Equipment—Storm Warnings—Rescues at Sea—Mercy Flights.

THE rapidly increasing value of U. S. Coast Guard aviation activities is evidenced by the following table showing its work during the fiscal year 1936 as compared to that of 1935:

	1935	1936
Square miles of area searched	6,675,782	8,371,212
Miles cruised by Coast Guard planes	500,468	837,696
Hours spent in flight	5,358	8,959
Vessels identified	16,181	51,694
Airplanes identified	2,011	6,836
Responses to requests for search	67	118
Persons assisted	26	1,013
Vessels assisted	103	430
Emergency medical cases transported	43	85
Assistance to other Gov't. departments	185	233
Foreign smuggling vessels located	60	70
American smuggling vessels located	40	34
Suspicious airplanes sighted and reported ..	4	7
Smuggling landing fields located	28	8
Stills located, reported and seized	131	402

The Act of 1916 authorized the Secretary of the Treasury to establish, equip and maintain not to exceed ten air stations along the Atlantic, Pacific and Gulf coasts, and along the Great Lakes, to assist persons and vessels in distress and to aid in the national defense. Eight of these air stations were in commission at the beginning of 1937. The number of airplanes that will ultimately be required for assignment to these ten air stations is 76. Under the Treasury Post Office Appropriation Act for the fiscal year 1937 funds were received which will enable the Coast Guard to increase the number of aircraft in service to 51. Contracts were let for the procurement of six offshore patrol planes and five convertible landplanes.

In June, 1936, an Associated Press dispatch carried the following: "The usually quiet Virginia countryside was in an uproar today while the Coast Guard demonstrated a new airplane device which will be used in southern waters to spread warnings of approaching hurricanes. Residents listened for two hours to a booming voice which came down to them from a half-mile in the air, stating in clarion tones such messages as: 'This is the Coast Guard testing a new invention.' The demonstration culminating a year's investigation was pronounced successful by Coast Guard and Treasury Department officials who acted as observers on the ground at Fort Hunt. In addition to providing a means of warning deep sea and sponge fishermen and the inhabitants of the Florida Keys of approaching hurricanes the device is regarded as important for use in the direction of rescue work from the air. It can receive messages from the commanding officer on the ground or on shipboard and broadcast commands from rescue boats. The device weighs only 110 pounds. It was perfected by engineers of Price Brothers Engineering Company, Frederick, Md., and by Commander F. A. Zeusler, chief of the communications division of the Coast Guard, C. T. Solt, chief radio electrician and W. N. Durham, a Coast Guard pilot."

That is an instance of the progressive policy in the U. S. Coast Guard which has been steadily building up its aviation division whenever funds would permit. With about 50 pilots and 40 airplanes Coast Guard aviation units at the beginning of 1937 were located at Salem, Mass., Cape May, N. J., Miami, Fla., Biloxi, Miss., San Antonio, Tex., San Diego, Calif., Port Angeles, Wash., Brooklyn, New York, and Charleston, S. C. Planes from those stations cruised more than 800,000 miles during 1936, over land and sea, day and night, in all kinds of weather, on hundreds of different missions, the most notable perhaps being the saving of human life.

Four Coast Guard amphibions cruised out over the Atlantic coastal areas in September spreading ample warning of a hurricane blowing up from the southern waters. Then they stood by awaiting emergency calls from hurricane victims. As a result of their warning, however, all small boats had put into port and the residents of isolated hamlets along the coast had taken adequate precautions. There was plenty of property damage but no loss of life reported.

Hundreds of messages were received at Coast Guard headquarters during the year expressing gratitude for work done by the flying

Guardsmen on patrol. There were stories of passengers saved from burning small craft far at sea, children picked up from overturned canoes and rowboats drifting offshore, fishermen drifting out to sea after their motors had died, leaving them derelict and at the mercy of wind and currents. In February a Coast Guard plane flew 200 miles out over the sea off Miami, its pilot made a landing on the tossing waves near the tanker "Catahoula" and took off a seaman with a broken leg, bringing him to the hospital for treatment. It was routine business, but it dramatized the everyday work performed by the twin miracles of speed, radio and aircraft, the one guiding the other through the night without a single landmark, straight to its destination on the broad Atlantic, and returning it straightway to its base on shore. The

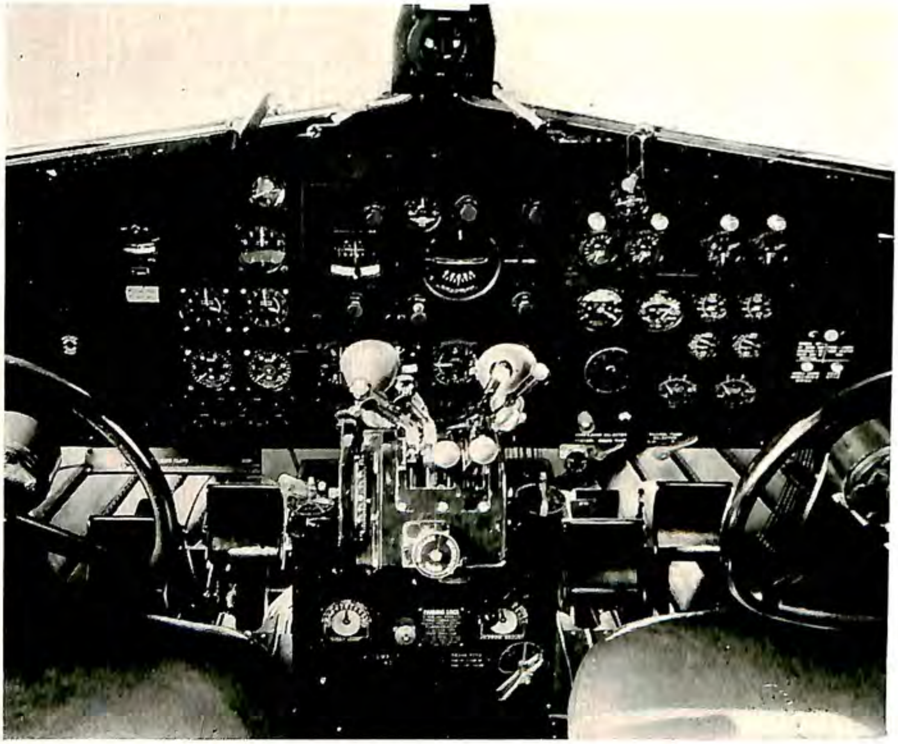
READY FOR ANY MISSION

The Coast Guard amphibion "Canopus" poised on the runway at her home port, Salem Harbor, Mass. It is a Wasp-powered Douglas Dolphin.

human element must not be ignored here, however. Courage and skill on the part of the Coast Guard personnel are responsible for the invariable success of the mercy flights.

In June a Coast Guard amphibion sailed out of Salem, Mass., and the pilot pointed her nose toward Highland Light. Somewhere out on the Atlantic the trawler "Atlantic" was waiting for help. The skipper lay low with acute appendicitis, and the ship had wirelessed the bad news ashore. The bad part of the flight was fog. It was thick and the pilot could see less than a thousand feet ahead. When he felt that he was approaching the trawler he flew low, close to the surface for ten minutes at a time, but the search appeared futile. Finally he went up above the fog on another tack, and after several minutes was able to peer down through a hole in the mist. There below him lay the trawler. Within a few minutes her captain was aboard the plane despite rough seas; and the machine again took the air, although it received a terrific bumping by hitting the swells and crests of the waves. Radio enabled the ship to make the return flight entirely above the blanket of fog.

Similar feats of heroism were performed by the flying guardians of the coast off New Jersey, Rhode Island, St. Petersburg, Fla., San Diego, Calif., and New Orleans.



SPERRY GYROPILOT INSTALLATION

The bridge of one of American Airlines Douglas DC-3 transports showing automatic flying equipment.

CHAPTER VII

GOVERNMENTAL AVIATION ACTIVITIES

Bureau of Air Commerce—Bureau of Fisheries—Federal Communications Commission—Forest Service—Geological Survey—Hydrographic Office—Interdepartmental Committee—Interstate Commerce Commission—National Advisory Committee for Aeronautics—National Bureau of Standards—Office of Arms and Munitions Control—Public Health Service—Soil Conservation Service—Tennessee Valley Authority—U. S. Coast and Geodetic Survey—U. S. Weather Bureau.

SIXTEEN bureaus and other agencies of the Federal Government provided for this chapter carefully prepared summaries of their activities relating to aeronautics in 1936 and plans for the new year. They did not include the various committees of Congress or the judicial branches. The Court of Claims, for example, still had before it a series of aviation claims.

The air force activities of the Army, the Navy and the Coast Guard are treated in individual chapters. The air mail service of the Post Office Department is described in the chapter on air lines. Nine other general agencies embraced aviation among their routine duties.

The Department of Justice had the manifold responsibility of defending the Government against claims, instituting suits and at the same time investigating innumerable aviation matters. The Office of the Comptroller General handled aviation problems as a general accounting office dealing with all federal expenditures. The Procurement Division of the Treasury Department was charged with determination of policies and methods of procurement with regard to everything purchased by the Government. The Patent Office received an average of three aeronautical patent applications daily. The Reconstruction Finance Corporation made loans for aircraft manufacture. The National Labor Relations Board, under the legislation of 1935, was intended to exercise considerable control over labor in the aircraft industry. The Bureau of Foreign and Domestic Commerce, created under the law "to promote and develop the foreign and domestic commerce of the United States," included aeronautical work among its activities. The Bureau of Customs examined passengers and cargoes of aircraft entering the United States.

There also was the Council of National Defense, including six members of the President's Cabinet. According to the Congressional Directory of January, 1937, it "was charged by the Act of August 29, 1916, among other things, with the 'coordination of industries and resources for the national security and welfare' and with the 'creation of relations which will render possible in time of need the immediate concentration and utilization of the resources of the Nation.' No appropriations have been made for nor any meetings held by the Council since the fiscal year 1921. The records of the Council of National Defense, as well as those of the War Industries Board and the Committee of Public Information, are now under the jurisdiction of the Assistant Secretary of War, who is charged by law (Act of June 4, 1920) with the 'assurance of adequate provision for the mobilization of materiel and industrial organizations essential to war-time needs.' "

Bureau of Air Commerce

The Bureau of Air Commerce, Department of Commerce, which is the agency of the Federal Government having responsibility for fostering and regulating air commerce, during 1936 undertook to exercise control over traffic along the airways. Advances in air navigation instruments, engine dependability and flying technique have made it possible for airplanes to undertake blind flying on an extensive scale. Cancellations are necessary nowadays for airplanes with full radio and instrument equipment only when conditions are zero-zero, or nearly so, at airports where takeoffs and landings have to be made. Bringing about a greater adherence to schedules, with benefits to the industry and the flying public, blind flying as a routine operation also has brought new difficulties. The pilot flying in the clouds cannot see other airplanes, and there is the possibility under such conditions that airplanes may get too close to each other for safety.

The obvious solution is a system of traffic control which gives the positions of all aircraft flying an airway, and provides central authority for some one to direct airplane movements so that the various craft can be adequately separated. As such a task has to be carried out by one agency, with authority and responsibility centered in one place, it is logical that the Bureau of Air Commerce undertake it.

Airway Traffic Control began on January 1, 1936, as a cooperative project in which the Bureau of Air Commerce had the assistance of the air lines, with the first control unit at Newark Airport, Newark, N. J. The Army, Navy, Marine Corps, Coast Guard and miscellaneous commercial and private flyers agreed to be governed by instructions issued from the control station. Later additional stations were established at Chicago and Cleveland.

On July 6 the Bureau took over full responsibility for operation of airway traffic control, and issued regulations covering airplane movements in areas where the system was in effect. During the latter part of 1936 additional stations were installed at Detroit and Pittsburgh, and units were being organized for Washington, D. C., Burbank, Calif., and Oakland, Calif.

Working in close cooperation with the air lines operating at the airport upon which it is based, and with the municipally operated airport traffic control tower which supervises actual take-offs and landings, an airway traffic control station receives departure, arrival and position reports on all aircraft in its area. A pilot flying in or above the clouds, and unable to see the ground, reports his passage over "radio fixes" or check points; that is, when he passes over a radio marker beacon, through the "cone of silence" which indicates the location of a radio range beacon transmitter or crosses a radio range course which intersects the one he is flying. Privately owned aircraft and airplanes of the Army, Navy, Marine Corps and Coast Guard, when operating along airways, also give their flight plans, and when so equipped report by radio so that they can be accounted for in connection with traffic control.

For an outbound airplane, an airway traffic control station receives advance information concerning the flight plan, including altitude and approximate time when the airplane will arrive over the first radio check point, cruising altitude to be maintained, estimated flying time to destination, type of airplane and any other necessary information. If this plan will involve any conflict with other traffic already in the air, the pilot is so advised and a new flight plan worked out. This is the plane's clearance. As soon as it has taken off, word is flashed to the control room and an operator there puts an airplane marker on a map to indicate its location. The marker is moved every 15 minutes to indicate the progress that the airplane should be making at its previously calculated cruising speed, allowances for wind, weather and other factors having been made previously. As position reports are received from the pilot the position shown by the marker is checked against these reports and corrected if necessary.

In the case of an incoming airplane, reports of departure and progress along the airway are watched in the same careful manner, and in addition its movements are coordinated with other craft approaching on the same or other airways. When the first report on the incoming airplane is received, the airway traffic control station at the destination computes its probable arrival time, and compares this with expected arrival times of other airplanes. As the minutes pass, the station may discover that some other airplane, which took off later, is overtaking the first one. If this occurs when visibility is limited, Airways Traffic Control will assign a lower flight altitude to the first airplane.

If a possible conflict arises because two or more different airplanes are due to arrive at approximately the same time on different airways, Airways Traffic Control assigns precedence for approaching the airport. The ship which is first given clearance comes in for a landing, and others are required to hold back by reducing speed or circling over specified check points. When the first plane has established contact with the control tower and landed, the second is brought in, and so on until all are down on the ground.

Another phase of the Bureau's work which is closely related to airway traffic control is the Federal Airways System, operated by the Bureau since its establishment in 1926. The Federal Airways System now comprises more than 22,000 miles of routes equipped with beacon lights, intermediate landing fields, radio range beacons for directional guidance, radio broadcast stations for conveying weather and other information to airmen in flight, and a weather reporting service on the ground.

Construction work carried out last year included completion of certain facilities on the new Nashville-Washington airway and modernization of aids to air navigation on various routes. Plans have been made for continuing the modernization program on an even more extensive scale during the next two or three years.

A system of radio broadcasting which provides for the simultaneous transmission of radio range beacon signals and voice on the same frequency, the pilot selecting one or the other or both with his receiving equipment, was further developed and adopted for the Nashville-Washington airway. Transmission of teletypewriter communications by radio, instead of over telephone circuits, was demonstrated at the Bureau's experimental radio station at Silver Hills, Md., and plans were made for installing the system on the Nashville-Washington airway. With this system, teletypewriter messages not only may be exchanged between ground stations, but also may be received in airplanes if the necessary receiving equipment is provided in the aircraft.

Although no material changes were effected in regulatory procedure, aside from the establishment of the airway traffic control already described, the regulatory burden became heavier as a result of increased activity in the industry. The Bureau has been engaged in redrafting all its regulations, clarifying the texts and making them uniform in presentation. In cooperation with the Army and Navy the Bureau has been engaged on a set of standardized design requirements and test methods for aircraft. The latter work has been carried out by the Army-Navy-Commerce Committee on aircraft manufacturing.

Since 1934 the Bureau has pursued a development program seeking improvements in airplanes, engines and equipment. Emphasis has

AIR TRAFFIC CONTROL

In the Bureau of Air Commerce Airways Traffic Control Station at Chicago. The man at the right is computing probable arrival times with the aid of a circular slide rule.

been placed on private owner types, but there also have been projects the results of which are applicable primarily to scheduled air transportation.

The Bureau's development program includes work on engines, propellers, blind landing devices, de-icing equipment and high altitude flying.

In November, the Bureau took delivery on a Lockheed 12A, a new all metal two-motor transport type airplane, built to the Bureau's specifications. The Lockheed is for use by air line inspectors in connection with their checks of air line operations and personnel, and for development work on air navigation aids. Also it is a type which is considered to have possibilities for "feeder" air line services.

The airport development program, in which the Bureau of Air Commerce cooperates with the Works Progress Administration, had progressed to a point where expenditure authorizations had been made by the State Administrators for more than $56,000,000, which is about 75 per cent of the project limitation of the program authorized for expenditure. The program included 616 projects at 446 airports. The Bureau's role is that of technical adviser. Bureau engineers pass upon each project under consideration for W. P. A. assistance, and the Bureau's approval is required by W. P. A. before it will list a project as eligible for operation.

In passing upon airworthiness of a new airplane the Bureau of Air Commerce examines it first for type approval. If the craft passes the thorough tests involved in this procedure, each airplane built in accordance with the approved design is eligible for license. After the approval of a type for an airplane which is to be produced in quantities, in a factory where the facilities meet the inspection requirements of the Bureau of Air Commerce, an approved type certificate is awarded. In some other cases the Bureau gives its approval and issues approved specifications, but not an approved type certificate. An application for type approval is addressed to the Secretary of Commerce and may be submitted either to the Manufacturing Inspection Service of the Bureau of Air Commerce, Department of Commerce, Washington, D. C., or to the branch office of the Manufacturing Inspection Service at Los Angeles Municipal Airport, Inglewood, California.

Accompanying the application there should be a complete set of drawings, stress analysis and other technical data showing compliance with the airworthiness requirements. If the application and data are submitted to the branch office, they should be in duplicate; otherwise single copies are sufficient except that one additional copy of a drawing list is required in each case.

The drawings submitted for approval should be complete, well dimensioned, and show the structure in sufficient detail. Assembly drawings of the major structural units, such as wings, stabilizer and elevator, will suffice if they are completely dimensioned and if they show the cross sections of all wooden members or metal members of special design and the sizes and material of connection bolts, standard wires and tubes used in the assembly. The location and design of hinges, control masts, joints, and points of attachment of all brace struts or wires should be clearly shown. Drawings should be made to a scale, the scale being indicated, and all important dimensions given. A stress analysis covering an investigation of the strength of the primary members of the wings, fuselage, landing gear, control surfaces, engine mounts or nacelles, and control systems, and of fittings connecting parts of the primary structure, is to accompany the application. The stress analysis also should include an analysis of secondary members carrying heavy loads and an investigation of main members subjected to eccentric loads. Further, it should state, by specification number, the material used for each member or group of members; whether or not it is heat treated, and what physical properties are guaranteed by the manufacturer. If metal members of special design are used, test data showing their strength properties under loads similar to those to which they will be subjected in the structure should be submitted to substantiate the values assumed in design. Buoyancy computations should be submitted for hulls and floats. The stress analysis should bear the signature of the responsible engineer. If the application is for a seaplane, drawings of the floats showing their lines, detail construction and general dimensions and a layout of sizes of struts and wires and means of attachment to the fuselage should be included.

The material used in each of the members of the primary structure of any aircraft, including fittings, should be clearly indicated by specification number on the drawings. If heat-treated materials are used, the ultimate tensile strength and other means of positive identification should be shown for each member. Upon receipt of the foregoing application and supporting material the Manufacturing Inspection Service requests the Bureau Supervising Aeronautical Inspector of the district in which the factory is located to arrange for inspection of the factory and preliminary inspection of the aircraft.

The factory inspection includes an investigation of all the phases of manufacturing which have a bearing on the reliability and airworthiness of the aircraft to be produced. It involves purchasing arrangements of the plant, stock room, materials, factory equipment processes, inspection organization, flight-testing arrangements and personnel. The primary object of this inspection is to determine whether the factory can produce aircraft in quantities in the same standard and quality as that embodied in the aircraft submitted for inspection. The aircraft can be approved as airworthy without having an approved type certificate, and when this is the case, factory facilities need not be approved by the Bureau.

Static tests are required for some parts, and these are designed to ascertain the strength of stationary surfaces and parts and the strength and ease of operation of moving parts of the aircraft in order to determine its ability to operate under the loading conditions for which it was designed. Major tests are conducted by the manufacturer in the presence of a Bureau of Air Commerce inspector. Generally these tests include wing-rib static tests, control-surface tests, control-system tests, and landing gear drop tests. However, the Department may require additional tests on different parts of the aircraft where the design or data indicates the necessity. As an illustration of the procedure followed in static tests, the wing ribs are loaded with sandbags or lead shot, the amount varying with the aircraft, in order to test their strength. The strength of the landing gear may be tested, when it is thought necessary, by actually dropping the aircraft to which it is attached, from a prescribed height. The control surfaces, such as ailerons, rudder, elevators and stabilizers, are tested both for strength and ease of operation by placing weights on them and then working the controls. The control system, which includes the cables and levers which move the surfaces, is also tested for strength and ease of operation, special attention being given to ascertain freedom from jamming, excessive friction or deflection.

Reports of these tests are made by the manufacturer to the Bureau and are signed by the inspector who witnessed them. The results of the tests, as submitted to the Bureau, describe fully the method of loading, give load distribution curves, deflection readings or curves, and include a log of the test describing all failures or repairs made during the tests. Photographs of all failures in the structure and photographs of suitable size showing the test set-up and the points from which deflections were measured are enclosed.

For the purpose of expediting engineering inspections and flight tests, the Bureau has established and equipped four engineering test stations. However, it is not compulsory that the manufacturer take his airplane to a Bureau of Air Commerce test station if he prefers to have it tested at his factory, and can furnish suitable facilities for conducting the test. In such cases it is only necessary for the factory to advise the test base that the inspection is desired at the factory, and the engineering inspector will proceed to that point. If the plane is to be tested at the factory, suitable scales are provided to obtain its empty weight. The test bases are located at: Roosevelt Field, Long Island, N. Y.; Wayne County Airport, Detroit, Mich.; Municipal Airport, Kansas City, Mo.; and Municipal Airport, Los Angeles, Calif.

In conducting the engineering inspection the inspector first determines the empty weight of the airplane. If this weight added to the computed useful load does not exceed the gross weight authorized (determined by the technical data submitted), the inspection and flight test may continue, in which event the manufacturer will complete for the inspector a manufacturer's affidavit, stating that the airplane is identical with that for which technical data were submitted and approved.

The airplane then undergoes flight tests of such nature as to demonstrate its balance, stability, maneuverability, and general flying and taxiing characteristics. Prior to, or at the time of presentation of an airplane to the Bureau for flight tests, the manufacturer submits to the inspector making the tests a detailed report of the manufacturer's flight tests on the airplane involved. The report submitted is signed by the manufacturer's test pilot, and it indicates that the aircraft has been fully test flown, including all the required maneuvers, such as tests for longitudinal, lateral and directional balance and tests for stability, and found to comply with requirements. If the flight tests given by the Department of Commerce inspector are successfully accomplished, the airplane is approved for license. If, in addition, suitable manufacturing facilities are in evidence, and the manufacturer so desires, an approved type certificate is issued.

When an approved type certificate is granted, one set of drawing lists is impressed with the seal of the Bureau and returned to the manufacturer. The other data are placed in the Bureau's files. The Department inspectors may call for, and should have access to, these approved drawing lists. As finished airplanes are ready at the factory they are licensed upon inspection.

An aircraft is required to hold a Department of Commerce license, if it is to carry the United States mail, or persons or property for hire between two or more States or to or from foreign countries. The licensing requirements also apply to aircraft carrying persons or property for hire between two points in one State, if a part of the flight is over another State. Further, a license is necessary if the aircraft is to carry persons or property for hire between two points in one State, if the flight is a part of a through carriage between points in different States or countries; within the air space over the District of Columbia or any Territory or possession of the United States, and where an airplane is flown from one state to another for commercial operation in the latter State. These requirements apply also to interstate flights in the conduct of a business such as flying with advertising matter painted or displayed on the plane and the carrying of executives or employees of a company on interstate flights in behalf of the company's business.

An aircraft used solely for pleasure or noncommercial purposes is not required by the Federal Government to be licensed, although engaged in flying between States. However, such a license may be obtained if the owner so desires, and most of the States require aircraft operating within their borders to be Federally licensed. In the event that the owner does obtain a Federal license, all the requirements governing licensed aircraft must be observed. Whether licensed or not, all aircraft must display identification marks assigned by the Department of Commerce. The licensing requirements do not apply to military airplanes.

Aircraft licenses are issued for a period of not exceeding one year and are granted subject to compliance with the Air Commerce Regulations. Upon the expiration of an existing license the aircraft may be relicensed for additional periods of not exceeding one year, upon the application of the recorded owner for relicensing and the finding of the Secretary of Commerce that the aircraft is airworthy and is owned by an eligible owner. It is the responsibility of the recorded owner to make contact with an inspector of the Department of Commerce prior to the expiration of the aircraft license for reinspection of his aircraft.

A licensed aircraft's identification mark consists of the license number of the aircraft preceded by one of the following letters; the Roman capital C for all commercially licensed aircraft except gliders; the Roman capital S (meaning State) for aircraft used solely for governmental purposes and belonging to Federal agencies, States, Territories, possessions or political subdivisions; the R for aircraft which are licensed only for restricted purposes, the X for aircraft engaged in experimental work, and the G for gliders.

In addition to the above, the Roman capital letter N may be displayed, preceding the license letter and number, by all commercially licensed aircraft of the United States, except those licensed for experimental or restricted purposes. The letter N, which denotes that it is an aircraft of the United States, is required on licensed aircraft navigated beyond the continental limits of the United States.

The identification mark for unlicensed aircraft is assigned upon the application of the aircraft owner and is required to be permanently affixed to the aircraft. The nationality mark may not be made a part of it, nor may any other letter, design, symbol or description be prefixed.

Bureau of Air Commerce airworthiness requirements stipulate that the engine or engines used in a licensed airplane shall be of a type approved and assigned a power rating and speed rating by the Secretary of Commerce. (Exception: Engines for light airplanes, as defined by the regulations, need not be approved, but must have ratings assigned by the Secretary. However, most airplane engines are manufactured under type approvals.) The manufacturer with a new engine for which he wishes to seek approval first mounts it on his own test stand and conducts a 100-hour test, including 50 hours at full throttle. Then, he submits his application for an approved type certificate, a log of his 100-hour test and data describing the status of the engine. The next step is the official 50-hour endurance test.

This is conducted at the manufacturer's plant, but he is required to have the testing equipment which is listed in "Airworthiness Requirements for Engines and Propellers" (Aeronautics Bulletin No. 7-G), and before permitting the test to proceed, the Bureau's inspector has the responsibility of determining that all this test equipment is available and that each item is suitable and adequate. The inspector also has to inspect the engine thoroughly before the beginning of the test and pass on the conditions under which the test will be made.

When the engine is started, the manufacturer is required to keep it operating in periods of at least five hours each on consecutive working days. It is permissible for him to make such adjustments as would be given the engine under normal service conditions; for example, greasing, oil changing, tappet adjustment, cleaning and adjusting spark plugs, setting magneto points and tightening, but not major adjustments. If there are more than three forced stops during the 50 hours, the engine must be disapproved, and if there is a failure which would cause an immediate forced landing in flight, this terminates the test. "Forced stop" and "failure" are carefully defined in the requirements and in the instructions which have been issued to inspectors, but if there is doubt about any stop the matter is referred to the Manufacturing Inspection Service in Washington.

When the 50-hour test has been completed, there is another 10-hour run for calibration, to determine horsepower rating. Only routine adjustments, such as those permitted during the 50-hour test itself, are permitted before the calibration run is started. The power rating determined by this test is corrected to standard conditions of pressure, temperature and humidity.

Finally, when the 50-hour and 10-hour runs have been completed, the engine is completely torn down and inspected with the inspector as a witness. As a result of this inspection the Bureau may require revisions in design, or it may even be necessary to reject the engine, depending upon the degree of wear or signs of failure in important parts.

Assuming that the engine has met all of these tests satisfactorily, the manufacturer's next step is to submit his report of the test to the Bureau, together with drawings, a parts list in duplicate and a detailed report of a 10-hour flight test of the engine. It is not necessary for this flight test to be witnessed by a Bureau inspector, but the report on it must be supported by an affidavit. All this material is checked in Washington, and if it is satisfactory, the manufacturer receives approval, and his engine is eligible for use in any licensed airplane which has been approved for engines of this type and horsepower.

For an engine which has previously been approved by the Army or Navy, this detailed testing procedure is not required. The manufacturer has only to apply for approval, supplying a copy or reference number of the Army or Navy endurance test report properly signed by the military representative and specifying the approved rating.

Propellers, like engines, may be approved upon the basis of previous approval by the Army or Navy. For a propeller which has not been so approved, it is necessary for the manufacturer to submit drawings, a report on an endurance test and in some cases a stress analysis. Important tests, or tests where unconventional features of design are involved are witnessed by Bureau inspectors, otherwise the manufacturer's test report, accompanied by an affidavit, is acceptable. For propellers other than fixed pitch wood propellers the requirements call for a 50-hour test which may be run without stop, or may be broken up into runs of five hours or more each. It is accomplished with an engine of the same general characteristics as the engines upon which the propellers are to be used in service, and at the proposed rated speed and power of the propeller. For a fixed pitch wood propeller, the test is a 10-hour endurance run on an engine block, or a 50-hour flight test.

Following the test run the propeller is minutely inspected and if there has been a failure it cannot be approved. Failure of a metal propeller is defined as actual breakage, cracking or permanent set of any part of the blades, hub, bolts, lock nuts, splines, keyways, slipping of the blade in its clamping socket, seizing or pitting of the bearings or jamming of the automatic or controllable pitch mechanism. Wood propellers are considered to have failed if tipping pulls or cracks, glue joints open or if there is any local failure or crushing around hub or bolts.

If the test is passed, the propeller is approved and eligible for use on licensed airplanes powered by engines with ratings equal to or less than the rating assigned the propeller.

There are type approvals also for certain important components and accessories. In each case airworthiness requirements have been drawn up, and the component or accessory, after satisfactorily meeting these requirements, is approved for use in licensed airplanes. Components and accessories approved under this procedure include landing gear wheels, seaplane floats, skis, position lights, landing flares, safety belts and certain structural and control units.

Parachutes also are eligible for type approval after meeting the applicable airworthiness requirements, which include functional drop tests with normal packs and also with twisted lines, strength drop tests with a 600-pound weight, and finally, live drop tests with a 170-pound man.

It is an often-repeated truth that airplanes cannot fly without the aid of many workers who seldom, if ever, leave the ground. Some of these ground workers are selling tickets, doing office work or carrying out other duties not closely linked with flying operations, but others are directly concerned with safety of flight, and therefore are required to hold Bureau of Air Commerce licenses before they are permitted to work on licensed airplanes.

Ground workers licensed by the Bureau include mechanics who work on either aircraft, aircraft engines, or both, and parachute riggers who repack and repair parachutes. To be eligible for a license as airplane or airplane engine mechanic, the candidate must be at least 18 years old, able to read, write, speak and understand the English language, and demonstrate that he is qualified by training, experience and aptitude. For a license as an engine mechanic, he must show that he has had two years experience on internal-combustion engines, one year of which shall have been on maintenance of aircraft engines. Experience may be gained by working as an apprentice under the supervision of a licensed mechanic. Unlicensed mechanics may assist on repairs, maintenance or alterations of licensed airplanes under the direction of a licensed mechanic who is in charge of the job and responsible for seeing that it is done correctly.

Having gained this experience the candidate applies to the Supervising Aeronautical Inspector for the district in which he resides for an application blank (or contact any inspector for information). Then, when a Bureau inspector next visits his airport, he reports for his examination, presenting the application blank, with all questions answered, to the inspector. The inspector checks his knowledge of engines in theoretical and practical tests to determine whether he is sufficiently conversant with engines and their accessories, including ignition systems, to inspect, maintain, repair and overhaul them. In addition, the inspector examines the candidate on those regulations with which he must be familiar. If he qualifies under these tests, he receives an airplane engine mechanic license which is valid for two years, and which may be renewed if he renders services under his license during at least one-half of its term.

For the airplane mechanic license the age and knowledge of English requirements are the same as those for engine mechanics. The experience requirement is one year engaged in building, maintaining or repairing aircraft. Here again the candidate for license applies to the Supervising Aeronautical Inspector for his application blank, and reports to an inspector for examination. The practical and theoretical tests cover aircraft structure and rigging, including control systems, inspection, maintenance and overhaul, and the same regulations that are included in the engine mechanic test.

The mechanic need not confine himself to airplanes or to engines. He may be licensed for both types of work if he is qualified, and many mechanics are so licensed. It is possible also for one to hold a license as a pilot, or as a parachute rigger.

Official U. S. Army photo

HOW PARACHUTES ARE PACKED

The skill with which a parachute is packed determines the success or failure of a jump when one has to use the aerial life preserver. On the principle that a "chute" packed right will open right, only experts are permitted to handle it. Here is the Army Air Corps parachute division at Chanute Field, Ill.

Like the licensed mechanic, the candidate for a parachute rigger's license must be at least 18 and read, write, speak and understand the English language. To be considered for a license he is required to furnish proof that he has packed 20 or more parachutes that were either satisfactorily jumped or drop-tested. If he has had this experience, he may apply for examination in the same way as for a mechanic's examination.

Before proceeding with the parachute rigger examination the inspector makes certain that the would-be licensed rigger has the facilities necessary for repacking and repairing parachutes, including housing space, an airing and drying rack, a packing table at least three by 40 feet, tools and minor repair equipment. It is not required that he own it, but it is necessary that it be available for his use whenever he works on parachutes, as the regulations do not permit repacking parachutes without it. Assured on this point the inspector proceeds with the examination. He gives the candidate a written examination on the regulations of the Bureau of Air Commerce pertaining to parachutes and another dealing with the repacking and care of parachutes. The latter covers procedure in repacking and repairing parachutes after various kinds of service.

In some circumstances it is the responsibility of a parachute rigger to refuse to repack a parachute. If major repairs are required, he is obligated to recommend that the owner send the chute back to the factory; and if the owner does not care to do so, the rigger must return it to him without repacking it, keeping in his own files a record of the parachute and his reasons for refusing to repack it.

Along with the written examination, there is a practical examination which consists of the repacking of a parachute. The successful applicant receives a license that is valid for two years, and which may be renewed if he renders service under it for at least one-half of the term, and packs at least 25 parachutes that have either been successfully jumped or drop-tested.

Only licensed parachute riggers may pack, repair, inspect and maintain a parachute used in connection with licensed aircraft, except that parachute packers designated as such, and actively engaged for the Army or Navy may carry out this work for parachutes of civilian airmen, and it is not necessary for Army or Navy riggers to hold civilian licenses as riggers.

Ground school instructors teaching in ground schools approved by the Bureau of Air Commerce are required to hold ground instructors' licenses. The license is issued to a candidate after he passes an examination in the subject or subjects he is to teach, as, for example, engine and plane mechanics and rigging, meteorology or air navigation. The license is valid for one year, and may be renewed if the holder has served as a ground instructor in an approved school during at least half of the period covered by his license.

Bureau of Fisheries

As in the past the Bureau of Fisheries of the Department of Commerce maintained an aerial patrol of the fisheries in Alaska during the season of 1936. Planes were chartered from four companies on 46 days. During 143 flying hours 14,413 miles were flown. A similar patrol was to be maintained during 1937.

Federal Communications Commission

The Communications Commission in 1936 continued to allocate additional frequencies to the aviation service to accommodate growth. Provision was made for the use of radio communication by all domestic transport lines having mail contracts, three air transport lines in Alaska holding mail contracts, the transpacific air line, two competitive organizations holding contracts for delivery of mail to Central and South American countries, and a proposed air mail line across the Atlantic. In addition to transport aircraft, increased facilities were provided for itinerant aircraft, an additional frequency having been assigned for use under conditions when the frequencies previously allocated are unsuitable. At the end of the year the private flier could be authorized to use the frequencies 3105 and 3120 kilocycles on an unlimited basis and 6210 kilocycles for daytime use only. All stations of the Department of Commerce and many stations licensed by the Commission maintain a continuous watch on 3105 kilocycles. These same stations will arrange for a watch on 6210 kilocycles, if so requested.

During 1937, it is expected that frequencies about 30,000 kilocycles will be allocated to the aviation service. It is contemplated to use these frequencies for the control of air traffic in the vicinity of airports, for the marking of obstructions and particular points, for the prevention of collisions between aircraft in the air and for blind landing facilities.

Forest Service

The Forest Service, U. S. Department of Agriculture, during 1936 continued and increased its use of aircraft in the control of forest fires and in aerial mapping. The year brought material progress in the development of new techniques of emergency transportation of supplies and equipment and in the retarding of forest fires from the air. The Forest Service reported use of aircraft in fire control work in the national forests to the extent of 1,382 flying hours during the fire season of 1936. This figure totals activities in three fields; air patrol and scouting, experimental and test flights, and the transportation of men and supplies. A total of 139,007 pounds of supplies and equipment were carried and 319 men were transported. Aircraft also were used in surveys of forest areas for map making, survey of timber and grazing lands and for administrative purposes. The use of aircraft is contracted for with private companies, as the Service owns no planes. Use of aircraft on forest fire control during the fire season of 1936 may be divided in the following classifications:

Detection of forest fires: As the ground lookout system in national forests is extended, the need for aerial detection of forest fires has lessened. The ground detection system is definitely more accurate than detection by airplane. Airplanes are used for detection, however, on newly acquired national forest units where the lookout system has not been fully developed, during periods of extremely low visibility over large areas, usually caused by heavy smoke and haze, and following electric storms which, in hazardous fire weather, may cause simultaneously a number of fires.

Transportation of men: This phase of aircraft use is extremely important in the Northwest, where forest fires may occur deep in back-country, difficult to traverse overland. To facilitate increased transportation of men by air, the total number of emergency landing fields in National Forests during 1936 was increased to 59. Supervisors in Montana and north Idaho were ordered to survey their forests for additional suitable locations for fields.

Transportation of Supplies: Throughout the season of 1936, greater use was made of aircraft for carrying needed tools, equipment and provisions to fire fighters. Where no landing fields were used, supplies were dropped from planes. Development of suitable packaging and techniques of dropping has been one of the more important phases of experimental activities. Transportation of supplies by air compares favorably in cost with overland transportation in rough, back-country terrain, and is by far the fastest method.

Scouting: Use of aircraft by forest officers in reconnaissance of large going fires has proved of increased value. The development by the Forest Service of a special short-wave radio set which operates efficiently in any type airplane has added to the value of scouting from the air, because the observer can talk direct with officials in charge of fire-fighting on the ground. Scouting by plane enables foresters to determine the pattern and scope of large fires, rate and direction of spread, location of certain topographical features, and other information often unobtainable from the ground, thus facilitating the employment of efficient control tactics.

Experimentation: The Forest Service has pioneered in many phases of its use of aircraft, for no comparable problems exist with other organizations. Investigation into the techniques of dropping supplies crystallized during 1936 into a definite project with funds set aside for that purpose. Certain standard practices have thus been determined in methods of packaging, use of parachutes or retarders and in free-dropping. These experiments are being continued in 1937.

Inquiries into the feasibility and technique of direct aerial attack on fires have also been consolidated into a distinct project. Work in this field consist of exhaustive tests of various chemical mixtures suitable for dropping on fires, development of chemical bombs, use of explosive bombs, and related problems. No standardized practices have been announced, because this work still is in an experimental stage. Foresters emphasize the point that the object of direct control from the air is not necessarily to extinguish forest fires, for that is in most cases demonstrably impossible, but rather to retard the spread and check the speed of a fire before the arrival of ground crews.

Geological Survey

The use of aerial photographs in connection with standard topographic mapping by the U. S. Geological Survey, Department of the Interior, during the fiscal year 1936 consisted of the compilation of planimetric base maps of 43 quadrangles (7½-minute) and parts of quadrangles in Louisiana, a total area of 2,749 square miles, and the compilation of planimetric base maps of 20 quadrangles (15-minute and 7½-minute) and parts of quadrangles in other States covering 1,957 square miles. The total area covered by these maps compiled from aerial photographs totalled 4,706 square miles. During the year commercial firms under contract photographed 6,754 square miles for the Survey. The total area in the United States covered by maps compiled by the Geological Survey from aerial photographs, to June 30, 1936, was 90,250 square miles.

The Survey's Aerocartograph, an apparatus for stereoscopic mapping from aerial photographs, has been completely overhauled with considerable remodeling and the addition of new parts, which will enable the use of oblique negatives in the instrument, as well as vertical negatives. Another stereoscopic instrument, the Multiplex Aero Projector, is in use by Survey personnel in mapping in the Tennessee River Basin for the Tennessee Valley Authority.

Although the five-lens type of camera has continued to be used extensively, the wide-angle single-lens camera is gaining favor with the Survey for the compilation of planimetric maps. One advantage in the use of the wide-angle lens is that fewer photographs are required to cover a quadrangle than with the old type long focal length camera. In the case of the latter, 300 or 400 photographs had to be taken to cover an area of approximately 230 square miles while, on the other hand, with the short focal length camera the number required was approximately 50 negatives. In addition, ratioed enlargements from the negatives are adaptable to the radial line intersection method like those taken with the five-lens camera, while those of the long focal length are not, with the same amount of ground control.

Standard specifications for taking aerial photographs have been adopted by the Survey for its use. These specifications cover single-lens and five-lens aerial photography for radial-line intersection work, and also aerial photography for stereoscopic mapping. Owing to more rigid requirements in the accuracy of aerial photographic negatives for radial-line intersection work and stereoscopic mapping, more particularly the latter because of the increasing use of stereoscopic instruments, the development of precision mapping cameras is of paramount importance. Camera manufacturers, realizing the demand by Federal mapping agencies for greater accuracy in negatives, are working to produce cameras of precision character.

Some idea of what will later be required of a lens in a precision camera is indicated by the following tentative numerical values: No lens shall be used which, at the proposed maximum stop opening, fails to resolve lines in any orientation spaced seven to the millimeter and at the center of the shorter side of the negative; or which fails to resolve lines in at least one orientation spaced five to the millimeter at the angular distance from the center of the field which is the multiple of five degrees falling nearest the corner of the negative.

At the present time specifications for aerial photographs in the stereoscopic plotting of contour maps require that the camera shall be so constructed as to make it impossible to assemble the focal plane, cone, and lens, with a difference in relative position between the focal plane and the lens greater than plus or minus 0.002 inch; that no lens, or combination of lens and glass focal plane plate, shall be used without special permission of the contracting agency unless the distortion for any part of the negative falls within the range plus or minus 0.1 millimeter; that between-the-lens shutters or louvre shutters, such that light is transmitted to all parts of the photograph when the shutter is open, shall be used; that the efficiency of the shutters shall be at least 85 per cent at the fastest speed, with a tolerance in shutter speed of not to exceed plus or minus 25 per cent at any speed; and that the exposure interval shall be as short as light conditions will permit and in no case shall it exceed 1/50 second.

Hydrographic Office

The Hydrographic Office, U. S. Navy, distributes Notice to Aviators, Memoranda for Aviators, Pilots Charts of the Upper Air, Naval Air Pilots, Strip and Sectional Charts of coastal areas of North America, Central America, Mexico and the West Indies. The file of foreign data on the principal airports and seaplane bases of the world, and the collection of foreign aviation charts was greatly augmented in 1936, and such information was supplied to pilots contemplating foreign flights.

Interdepartmental Committee

The President of the United States on July 2, 1935, appointed as members of the Interdepartmental Committee on Civil International Aviation, R. Walton Moore, Assistant Secretary of State; Stephen B. Gibbons, Assistant Secretary of the Treasury; Harllee Branch, Second Assistant Postmaster General; and John Monroe Johnson, Assistant Secretary of Commerce. The White House announced their appointment was "for the purpose of making observations and gathering information pertaining to civil international aviation in all its phases and submitting such recommendations as may seem called for."

At the meetings of the Interdepartmental Committee during 1936 a variety of problems affecting American civil aviation interests in the international field were discussed. On various occasions the Committee met with official air missions from France and from Germany and with a representative of commercial aviation interests in Norway. These meetings were held for the purpose of discussing questions pertaining to transatlantic air transport, and all interested American companies were invited to be present. The meeting with the German mission facilitated the making of experimental flights successfully completed by German aircraft during the year. The German authorities offered to accord reciprocal facilities to American aircraft. The growing interest in international air transport presages an active year for the Committee in 1937. No definite program has been arranged, however. The Committee meets only at irregular intervals as occasion may require.

Interstate Commerce Commission

At the beginning of 1937 many members of Congress were preparing proposed legislation designed to give in one way or another the I.C.C. more extensive jurisdiction of the domestic air transport operations in the United States. Following is the aviation section of the Commission's annual report for the fiscal year 1936:

"Our work under the air mail laws proceeded during the year responsive to the provisions of the amendatory act of August 14, 1935 (49 Stat. 614), which materially expanded and increased our duties as shown in our Forty-ninth Annual Report.

"Among those provisions was that of section 6 (e) requiring that, not later than January 15, 1936, and after having made a full and complete examination in the premises, we should report to the Congress whether, in our judgment, the fair and reasonable rate for eight specified air mail routes is in excess of $33\frac{1}{3}$ cents per airplane-mile, together with a statement of the facts and reasons upon which may be based any recommendations made by us for or against claims for increases. For reasons stated in our communication of January 11, 1936, to the Congress, we were unable to submit this report by the date specified; but it was adopted by us July 7 and forthwith transmitted.

"On February 21, 1936, we issued a report and order prescribing the rates of compensation for the transportation of air mail over route no. 31 in Florida, which connects St. Petersburg with Daytona Beach, but which was temporarily extended to Jacksonville, *Air Mail Rates for Route No. 31* (214 I. C. C. 387). A like determination was made on June 22, 1936, in respect of such transportation between points in the Hawaiian Islands, *Air Mail Rates for Route No. 33* (216 I. C. C. 381).

"Pursuant to the petition of Northwest Airlines, Inc., we reconsidered our determination as to rates for routes nos. 3 and 16, published in *Air-Mail Compensation* (206 I. C. C. 675). Route no. 3 extends from Fargo, N. Dak., to Seattle, Wash., and route no. 16 from Chicago, Ill., to Pembina, N. Dak., via Fargo. In our report on further hearing, dated June 6, 1936 (216 I. C. C. 166), to meet changed conditions we ordered increases in the rates theretofore found by us to be reasonable for transportation of air mail over these routes.

"Our jurisdiction to entertain an application by Transcontinental & Western Air, Inc., for permission to institute and maintain exclusive passenger and express schedules between Albuquerque, N. Mex., and San Francisco, Calif., in connection with present operations over its transcontinental air mail route no. 2 between Newark, N. J., and Los Angeles, Calif., was questioned by the Postmaster General and the applicant joined him in seeking initial decision on the jurisdictional question. In its report of January 10, 1936, division 3 found that section 15 of the Air Mail Act of 1934, as amended, conferred upon us jurisdiction to entertain the application, *Transcontinental & W. Air, Inc., San Francisco Operation* (213 I. C. C. 551), and on reargument before us the decision of the division was affirmed (214 I. C. C. 552). Hearing on merits of the application has been held and a proposed report was served on the parties September 25, 1936.

"On October 1, 1936, Transcontinental & Western Air also filed an application for review of air-mail rates on route no. 2.

"Braniff Airways, Inc., operating routes nos. 9 and 15, and Delta Air Corporation, the operator of route no. 24, filed applications requesting a review of the rates fixed for those routes in *Air-Mail Compensation, supra*. Route no. 9 extends from Chicago to Dallas, Tex., via Kansas City, Mo.; route no. 15 from Amarillo to Brownsville, Tex., via Fort Worth, with a branch from Waco to Galveston, Tex.; and route no. 24 from Charleston, S. C., to Fort Worth, via Atlanta, Ga., and Birmingham, Ala.

"On April 4, 1936, American Airlines, Inc., inaugurated a nonmail schedule between Washington, D. C., and New York, N. Y. This carrier transports air mail between Chicago and Washington over route no. 25, and between New York and Fort Worth, via Washington, over route no. 23. On May 9, 1936, North American Aviation, Inc., the contractor for the transportation of air mail over route no. 6 between New York and Miami, Fla., via Washington, filed a complaint under section 15 of the Air Mail Act against the inauguration by American of the nonmail schedule between Washington and New York. The hearing in this case has been postponed at the request of the parties.

"A complaint filed by Central Airlines, Inc., under section 15 against Pennsylvania Airlines & Transport Co., relating to the latter company's off-line service between Detroit, Mich., and Washington was dismissed on April 20, 1936, upon request of the complainant.

"On March 9, 1936, American Airlines, Inc., filed an application for the review of air mail rates on the eight air mail routes for which it holds contracts with the Postmaster General. Hearings have been held, and our examiners are preparing a proposed report.

"On October 5, 1936, National Parks Airways, Inc., filed an application for adjustment of the base rate mileage fixed by us in *Air-Mail Compensation, supra,* to conform to subsequent changes in service requirements for the transportation of air mail over its route no. 19 extending from Salt Lake City, Utah, to Great Falls, Mont.

"By order dated October 23, 1936, we instituted, on our own motion, a proceeding of investigation to determine the method or methods to be used for ascertaining the anticipated postal revenue from domestic air mail, in order to enable us to comply with the provisions of section 6 (e) of the Air Mail Act, approved June 12, 1934. A hearing in this matter was assigned for December 3, 1936.

"In our previous report we explained the delay occasioned by the passage of the amendatory act of August 14, 1935, in completing the annual review of rates on all 33 domestic air mail routes for the calendar year 1935. Since that time, the progress of this work has been unsatisfactory due to the inadequacy of the appropriation for air mail work. Since this review is required to be made at least once in each calendar year, we have consolidated the 1935 program with that for the calendar year 1936. The review of rates for the current calendar year will cover the period from the beginning of operations under each air mail contract to the end of the respective audit period for each route.

"Section 6 (f) requires air mail carriers to report to us semiannually certain data with respect to free transportation furnished by them. Reports covering the last 6 months of 1935 show that during that period 43,184 passengers were accorded free transportation to the extent of 22,380,963 passenger-miles, having a tariff value of $1,314,680, and that 467 passengers were transported at reduced fares. The tariff value of such reductions was $9,393 and represented 173,386 passenger-miles. Exclusive of Government officials and employees and persons traveling on company business, 20,514 passengers were accorded free transportation having a tariff equivalent of $689,084. It is probable that many of these free passengers would not have traveled by air had they not been carried without charge. It is just as probable, however, that many of them would have traveled by air in any event. The carriers are required by their contracts to provide passenger service on the theory that as passenger revenues increase the rates of air mail compensation may be reduced. We understand that the carriers are endeavoring to curtail the amount of free transportation."

National Advisory Committee for Aeronautics

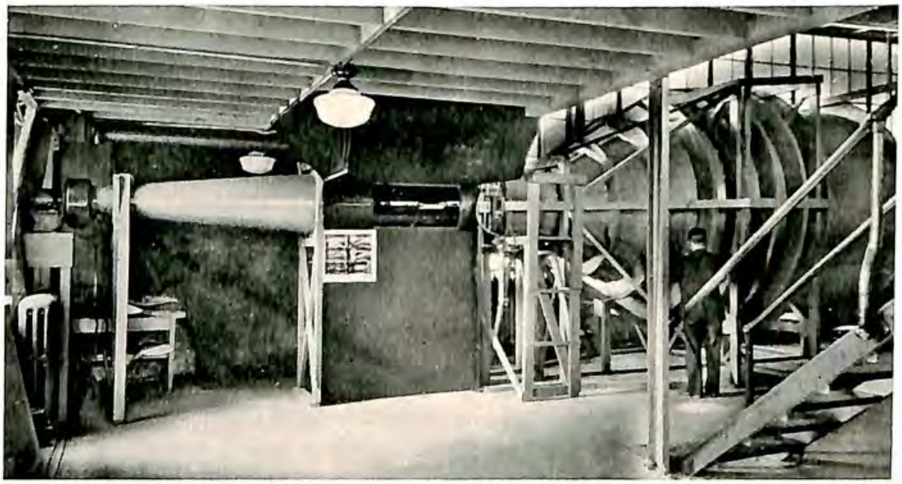
The law provides that the National Advisory Committee for Aeronautics (NACA) shall "supervise and direct the scientific study of the problems of flight, with a view to their practical solution, and to determine the problems which should be experimentally attacked, and to discuss their solution and their application to practical questions." The NACA is also authorized by law to "direct and conduct research and experiment in aeronautics."

During the year 1936 the Committee continued its scientific studies of the problems of flight and the development of research facilities at Langley Field, Virginia.

There was completed and placed in operation the largest high-speed wind tunnel in the world. It has a throat eight feet in diameter, and has developed air speeds over 500 miles an hour. This new type of wind tunnel has more than met its designed performance. Early experience with its operation indicates that it will be a valuable addition to the Committee's research facilities.

The Committee secured an appropriation from Congress for the construction of a large pressure-type wind tunnel in which relatively large models can, by increasing the pressure in the tunnel to three or more atmospheres and thus increasing the Reynolds Number, be tested under conditions that will give results more nearly corresponding to the actual performance of large airplanes flying at high speeds than it is possible to obtain in any wind tunnel in the United States at this time. Work has been started on this tunnel and it is expected that it will be completed during 1937.

The large seaplane is becoming an important factor in the development of transoceanic air transportation and of long-range Naval aircraft. To meet the problems presented by this development, the NACA also has secured during the last year a supplemental appropriation to lengthen by approximately 900 feet the present seaplane towing basin. This extension, on which work has been started, will make the tank 2,900 feet long and will make it possible to study the hydro-



THE N. A. C. A. SMOKE TUNNEL

National Advisory Committee for Aeronautics experts can actually see the nature of air flow around airplane models. Streamers of smoke are passed into the air stream, and flow around the model under observation.

dynamic characteristics of seaplane floats and flying-boat hulls at take-off speeds up to at least 80 miles an hour.

The Committee's research staff was substantially increased during the last year and it is planned to operate some of its activities on a two-shift basis in order to meet the growing demands of the Army, Navy, and the aircraft industry for the solution of new fundamental problems constantly arising in connection with the ever-increasing speed of aircraft.

The continued improvement in the safety, efficiency, range, speed, comfort, and capacity of American aircraft is largely the result of the work of the NACA. The success of that organization as a coordinating agency, and as an agency to conduct in one central aeronautical laboratory the fundamental scientific research necessary to meet the needs of both military and civil aviation, has been made possible largely by the status of the Committee as an independent Government establishment, and also by the fact that all Governmental agencies concerned with the development of aeronautics are represented on the Committee and its subcommittees.

National Bureau of Standards

The National Bureau of Standards, of the Department of Commerce, investigates the behavior of materials used in aircraft construction, the strength of aircraft structures, the performance of engines, instruments, fuels, lubricants, and ignition systems. Specific investigations are usually undertaken at the request of other Government units, such as the National Advisory Committee for Aeronautics and the Bureau of Aeronautics of the Navy Department. When commercial testing laboratories are not equipped to do so, tests of materials and apparatus may be made for individuals and organizations outside the Government upon payment for the work. Fee schedules, available upon application, indicate the specific tests which the Bureau ordinarily makes. A number of the special investigations and developments in progress during 1936 are briefly outlined here.

Aerodynamics: Fundamental studies in aerodynamics are in progress on wind tunnel turbulence and boundary layers in cooperation with the National Advisory Committee for Aeronautics. Investigations of the nature of turbulence and its effects have been extended to cover the scale of the turbulence, or "average eddy size", as well as the intensity of the turbulence, hitherto designated percentage turbulence. In the boundary layer investigation the distribution of the air speed and the intensity of turbulence near a plate in the laminar, transition, and eddying regions was determined. The pressure distribution around the central section of an elliptic cylinder with the major axis parallel to the wind has been determined at higher air speeds than previously reported.

Thermal expansion of copper-beryllium alloys: The thermal expansion of copper-beryllium alloys (important in aircraft construction) has been determined over the composition range 1.3 to 3.0 percent beryllium and between 20° and 300°C.

Weathering of light alloys: The study of weathering of light alloys used in aircraft has been continued. The marked superiority in corrosion resistance of aluminum alloys containing magnesium as the major alloying constituent over similar alloys containing copper has been definitely shown. However, no light structural material has been found which, for severe service, surpasses the aluminum-coated or "Alclad" materials. In the search for better protective treatments for magnesium alloys, an anodic treatment has been developed, and used on a semi-commercial scale, which is comparable to the widely used anodizing treatment for the aluminum alloys.

Airplane propeller materials: Studies of propeller materials have been continued, particularly to determine whether, in long continued service, involving repeated stressing, the properties of the material are deleteriously affected before "fatigue" cracks occur.

Properties of metals and alloys at low temperatures: The important mechanical properties of most of the commonly used aircraft structural materials have been determined at sub-zero temperatures, simulating those which are encountered in service at high altitudes.

Examination of failed airplane parts: Metallurgical examinations have been made of miscellaneous airplane parts which had failed in service, in order to determine any defects which may have been instrumental in causing failure. The information thus secured has, in many cases, been used to good advantage in the redesign of the parts.

Behavior of aircraft structures under load: Some of the investigations relating to aircraft structures in progress are those on the elastic behavior of thin sheets of duralumin and alloy steels in tension and compression, and on duralumin and chromium-molybdenum tubing under both torsional loads and loads other than torsion. A report on an experimental study of the strength of welded joints in tubular members for aircraft has been prepared. The strength of riveted joints in aluminum alloy, as a function of type of rivet heads, driving stress and other factors, is being determined. A machine for determining the endurance of wing beams under longitudinally reversed stress has been constructed.

In cooperation with other interested Government organizations, studies on propeller vibration and airplane vibrations are in progress. It has been found that submultiple resonance probably has been an unrecognized cause of a number of baffling cases of undue vibration in engineering structures.

Combustion phenomena in aircraft engines: In the investigation of combustion phenomena, which has been carried on for a number of years in cooperation with the National Advisory Committee for Aeronautics, a study has been made of the influence of humidity on ignition lag in gaseous explosions, and a 9-inch spherical bomb with central ignition, provided with means for recording accurately both flame travel and pressure development in the early stages of an explosion, has been constructed.

Temperatures developed in aircraft power plants: Power plant temperature surveys have been made for the Bureau of Aeronautics on some 15 types of airplanes, both on the ground and in flight. These surveys serve to detect overheating of the engine or its accessories and to determine whether modifications in the installation have overcome such difficulties.

Ignition systems: The major variables affecting the electrical characteristics of aircraft magnetos and causes of failure in aviation spark plugs are being studied. A report on the design of mica spark plugs, based on the analysis of heat flow, is in preparation.

Engine indicator: A promising engine pressure indicator based on the photo-elastic effect, which gives oscillograph records of the cyclic changes in pressure or in rate of change of pressure, has been developed for the Bureau of Aeronautics of the Navy. Convenient means for the reliable detection of incipient detonation in full-scale aircraft engines is being sought.

Fuels for aviation engines: The Bureau has cooperated with the Cooperative Fuel Research's Sub-Committee on Aviation Fuels in the selection and specification of standard reference fuels with which various types of high octane aviation fuels are to be compared in aircraft engines of high output. The Bureau recently has been designated as the agency to analyze the data obtained in a proposed survey of vapor lock in airplane fuel systems.

Endurance tests of engines and propellers: Endurance tests have been made for the Bureau of Air Commerce on several engines of less than 100 horsepower. The type test of a solid steel propeller was followed by an analysis of the stresses in the blades and a critical study of the hub design.

Lubrication of aircraft engines: Further investigation has been made of the stability of aircraft engine lubricating oil in cooperation with the Bureau of Aeronautics and the National Advisory Committee for Aeronautics. A satisfactory correlation has been found between the data obtained by a selected laboratory method and the changes which take place in the same oils when operated in an aircraft engine of moderate power output. The investigation is being extended to cover the effect of engine design on oil stability both in service and in dynamometer tests. A new laboratory method is being developed for oil stability in which the oil is being subjected to heat under conditions closely resembling those existent in the engine. Emphasis has been placed thus far on sludge formation in the engine, but a program has been started involving the study of the effect of acid formation on corrosion of aircraft engine bearings.

In a study of the influence of lubrication on wear, precision weighings were made of aircraft engine parts before and after running for definite periods under various conditions of lubrication.

Cotton parachutes: Parachutes are generally made of silk. Some years ago an investigation was started at the Bureau to find out how to make parachutes of cotton, in order to use a domestic rather than an imported raw material. The first step was a study of the silk fabric, to ascertain exactly the properties required: strength, weight, air-permeability and tearing resistance. Then, through experiments in the Bureau's mill, a method was developed for making a cotton fabric as nearly like the silk one as possible. Cotton manufacturers were persuaded to make this fabric on an experimental scale and from this some parachutes were constructed, and then tested by the Navy. The manufacturers, however, insisted on using imported cotton, claiming that they could not get a sufficiently fine staple in this country. During 1936, a satisfactory cotton parachute fabric was produced on a commercial scale, wholly from domestic cotton.

Weather resistance of dopes: A cotton wing fabric will absorb water under damp conditions and lose it under dry conditions. The natural area of the fabric, and consequently its tautness, will vary with the moisture content, and these changes in tautness will affect the flying characteristics of the plane. The fabric is doped to prevent, or at least delay, these changes of water content. The dope used is generally a solution of cellulose nitrate. To avoid the use of such an inflammable material, the Bureau has recommended that the fabric be first fire-proofed and then doped with cellulose acetate. Panels with and without fire-proofing, and doped with cellulose nitrate and acetate, have been exposed to the weather for about two years.

During 1936, these panels were tested for tautness and fire resistance, and returned for further exposure. A new tautness meter has been designed, because the present one can be used on horizontal surfaces only and is therefore not adapted to service tests at airports.

Permeability of aircraft finishes to moisture: Protective coatings are used on the fabric, metal, and wooden parts of airplanes, as well as on the gas-cells of dirigibles. One function of such coatings is to prevent the penetration of water, which might cause corrosion, loss of tautness, or increase of weight. These coatings are generally solutions of organic plastics. An additional coat of wax may be applied to the surface.

During 1936, films of some 25 coatings which are in commercial use were prepared, and their permeabilities to water vapor, under a wide range of conditions, were measured. The results are now being prepared for publication.

Plastics for windshields: Glass has certain disadvantages when used for airplane windshields. For proper stream-lining, the windshield should be curved rather than plane, and a curved glass windshield would be difficult to fit into place and still more difficult to replace if broken. When the windshield is broken by impact from a bird or hail-stone, the flying pieces of glass may cause a serious accident. To overcome these difficulties, many attempts have been made to use organic plastics instead of glass. Several kinds of plastics are sufficiently transparent and flexible and will not shatter when broken. But little is known about their ability to retain their transparency when exposed to the weather, to resist scratching from blown sand, to resist impact, and several other important properties. The Bureau's first problem, therefore, has been the development of the necessary test-methods to measure these properties.

A paper entitled "Methods of Testing Plastics," by G. M. Kline, was published in the October, 1936, number of the Journal of Industrial and Engineering Chemistry. At present, an intensive study is being made of the ability of plastics to resist impact.

Aircraft instruments: Studies of aircraft instrument performance have been continued for the Bureau of Aeronautics and the National Advisory Committee for Aeronautics. Two reports were published by the National Advisory Committee for Aeronautics, one on "Aircraft Compass Characteristics" and the other on "Carbon Monoxide Indicators for Aircraft." Investigations are in progress on the pressure drop in tubing used to operate aircraft gyroscopic instruments and to connect altimeters and air speed indicators to the proper parts of pitot-static tubes, and also on the effect of vibration on aircraft instruments. Complete laboratory tests have been made of the new Sperry gyromag compass.

At the request of the Bureau of Aeronautics, development work has been in progress on an apparatus for calibrating in the field the pressure, temperature, and humidity recording elements of aerographs. Precision weighings of aircraft instruments have been made in connection with test flights.

Airport lighting: Utilizing engineering data accumulated in the past, the Bureau has furnished the airport section of the Bureau of Air Commerce with a technical basis for their "Standard Specifications for the Installation of Airport Lighting Equipment and Materials" and their "Performance Specifications for Airport Lighting Equipment and Materials." Among the innovations represented in these specifications is the reduction of boundary light lamps to two lamps for series circuits and two lamps for multiple circuits, lamps of higher candlepower being used in each case for red and green units than are required for the clear units. The threads for boundary light fittings and glassware have been standardized and specifications for the color and candlepower distribution of the units adopted.

Analysis of the cost of installing series and multiple circuits indicated that series circuits do not become economical except in very large fields and a type of 550-volt or 460-volt multiple circuit with individual transformers at each individual boundary light unit has been worked out. The cost of the material for such a circuit is from 10 to 50 per cent less than the material for either of the conventional circuits, except in the case of very small airports. The system is also well adapted to the existing 230-volt circuits. Two types of neon transmission line construction lights have been tested and found usable although expensive to install. A new type of landing area illumination has been developed in the form of a one-way illuminator which illuminates the surface of the runway from an elevation only slightly above it. Flight tests indicate that the illumination is very satisfactory for landing, and observations in fog indicate that this type of lighting may be used at times when the ordinary flood lighting is entirely impracticable because of the excessive glare which results from the scattering of the light by the fog.

Airway lighting: An approach light to be installed adjacent to airports along the course followed in making instrument landings has been developed. These units utilize neon lamps of the type ordinarily used for sign lighting, but their efficiency has been improved through selecting tubes and transformers on the basis of engineering tests and by addition of a properly designed reflector. In this way an axial candlepower of approximately 1000 candles has been obtained.

Range test on the alternate frequency of beacon flashes have indicated that a flash frequency between one and two flashes per second gives the most conspicuous signal. This confirms the laboratory results found by Langmuir and Westendorp. A study is now being made to develop a high speed low-cost beacon for airway use.

Aircraft lighting: In cooperation with the Bureau of Aeronautics of the Navy, a study has been made of the cut-off angles for aircraft position lights. The results to date indicate that there will be a material improvement in the safety afforded by such lights if the angle of cut-off for the wing tip lights is increased from 110° to 170°, measured from dead-ahead, and the cut-off of the rear lights is increased from 70° to 90°, measured from dead-astern. Service tests are now being made by the Navy on wing tip lights constructed in accordance with these cut-offs. A type of landing light suitable for use in landing aircraft on water has been developed sufficiently to permit of service tests.

Airship fabrics: The work on fabrics during 1936 was a continuation of the study of the behavior of organic film-forming materials when applied to closely-woven cotton cloth. The purposes of this investigation are to evaluate such coating materials in terms not only of their permeability to inflating gases, but also their suitability from the standpoint of flexibility, resistance to weathering, ability to withstand high and low temperatures, and adaptability to technical practice in coating fabric and the assembly of airships and gas cells. A number of materials of synthetic nature, having rubber-like properties, have been found to possess a much greater impedance to the diffusion of gases than natural rubber, and in addition have properties which present definite advantages over materials of hydrophilic nature (gelatin, cellulose). Among such rubber-like compounds may be mentioned those whose basic ingredients consist of polychloroprene, polysulphide rubbers, highly plasticized polyvinyl chloride, and

GREETING THE "HINDENBURG"

A Coast Guard amphibion escorts the Zeppelin into her berth at the Lakehurst Naval Air Station.

a rubber-like plastic consisting of substantially saturated hydrocarbons.

Aside from the fact that these materials represent advantages over natural rubber they also have strategic value in that they may be produced from raw materials wholly available in adequate quantities in this country.

Performance of stratosphere balloon: In connection with the flight of the stratosphere balloon "Explorer II," on November 11, 1935, sponsored by the National Geographic Society and Army Air Corps, a report has been prepared on the studies which were made in cooperation with the Goodyear Zeppelin Corporation on the performance of the balloon. This included the relation of superheat and ballast in connection with its effect on the maximum altitude which could be attained with complete safety. Excessive stresses were found to be set up in the fabric when a rip panel of conventional design was used. The discovery of the stress concentration at the end of the panel led to a modified design which functioned safely.

Determination of altitude: During the flight of the "Explorer II" data were obtained for determining the altitude of the balloon by three methods; (a) by the barometric formula, upon which the calibration of altimeters is based, (b) by photographs at intervals of 90 seconds taken vertically downward through a window in the gondola, and (c) by observations from the ground (made by the Coast and Geodetic Survey) of the position of the balloon. The percentage difference in the altitudes so determined was small, a result which gives confidence in the barometric method of measuring aircraft altitudes in the range up to 72,000 feet.

Office of Arms and Munitions Control

Joint Resolution No. 67, Public, First Session, 74th Congress, approved August 31, 1935, commonly known as the Neutrality Act, was amended and extended by Joint Resolution No. 74, Public, Second Session, 74th Congress, approved February 29, 1936. The Joint Resolution as extended and amended contained some temporary provisions. The provision which requires the President whenever he shall find that there exists a state of war between or among two or more foreign states to proclaim that fact, and that thereafter the exportation of arms, ammunition, or implements of war to the belligerents shall be prohibited, was valid only until May 1, 1937. In January, 1936, however, new legislation was passed, prohibiting shipments to either of the factions in the Spanish Civil War.

Most of the other provisions of the Joint Resolution are of a permanent character. Among the most important of these permanent provisions are those establishing a system of supervision and control of the international traffic in arms. Under these provisions the National Munitions Control Board was organized in September, 1935. It includes the Secretary of State, who is 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. In order to carry out his functions as Executive Officer of the Board and the other duties devolving upon him in connection with the international traffic in arms, the Secretary of State created in September, 1935, an office within the Department known as the Office of Arms and Munitions Control.

The Office of Arms and Munitions Control is thus officially described in the Congressional Directory: "Is charged with the registration of manufacturers, exporters and importers of articles proclaimed by the President to be arms, ammunition and implements of war, the export or import of which without a license would be a violation of any law of the United States; the issuance of licenses for the exportation or importation of arms, ammunition and implements of war under such regulations as may be promulgated by the Secretary of State; such supervision of international traffic in arms, ammunition and implements of war as falls within the jurisdiction of the Secretary of State under treaties and statutes."

The Department of State has issued a pamphlet "Laws and Regulations Administered by the Secretary of State Governing the International Traffic in Arms, Ammunition, and Implements of War and Other Munitions of War" in which can be found in convenient form the texts of the laws and regulations relating to the registration of manufacturers, exporters and importers, and the issuance of export and import licenses.

Among the laws and regulations which relate to aviation, the following are of particular interest.

The enumeration of arms, ammunition and implements of war proclaimed by the President on April 10, 1936, with the advice of the National Munitions Control Board, includes:

"Category III.

(1) Aircraft, assembled or dismantled, both heavier and lighter than air, which are designed, adapted, and intended for aerial combat by the use of machine guns or of artillery or for the carrying and dropping of bombs, or which are equipped with, or which by reason of design or construction are prepared for, any of the appliances referred to in paragraph (2) below:

(2) Aerial gun mounts and frames, bomb racks, torpedo carriers, and bomb or torpedo release mechanisms.

"Category V.

(1) Aircraft, assembled or dismantled, both heavier and lighter than air, other than those included in Category III;

(2) Propellers or air screws, fuselages, hulls, wings, tail units, and under-carriage units;

(3) Aircraft engines, assembled or unassembled."

Aircraft parts not mentioned in the proclamation and aircraft engine parts, unless they are exported in such a manner as to constitute in fact one of the units listed in these categories, in unassembled form, do not require export or import licenses.

"The production for experimental or scientific purposes, when such production is not followed by sale, of the appliances and substances included in Category VI, or of single units of other arms, ammunition, and implements of war, is not considered as manufacture for the purposes of section 2 of the joint resolution."

"The country designated on the application for license to export as the country of destination should in each case be the country to which the shipment is consigned, unless the shipment is merely passing in transit through the country to which it is consigned. In this case, the country designated on the bill of lading as the country of ultimate destination should be given on the export license as the country of destination."

"Export licenses and export declarations covering arms, ammunition, and implements of war must be filed with the appropriate collector of customs at least 24 hours before the proposed departure of the shipment from the United States, and, in the case of a shipment by a sea-going vessel, 24 hours before the lading of the vessel."

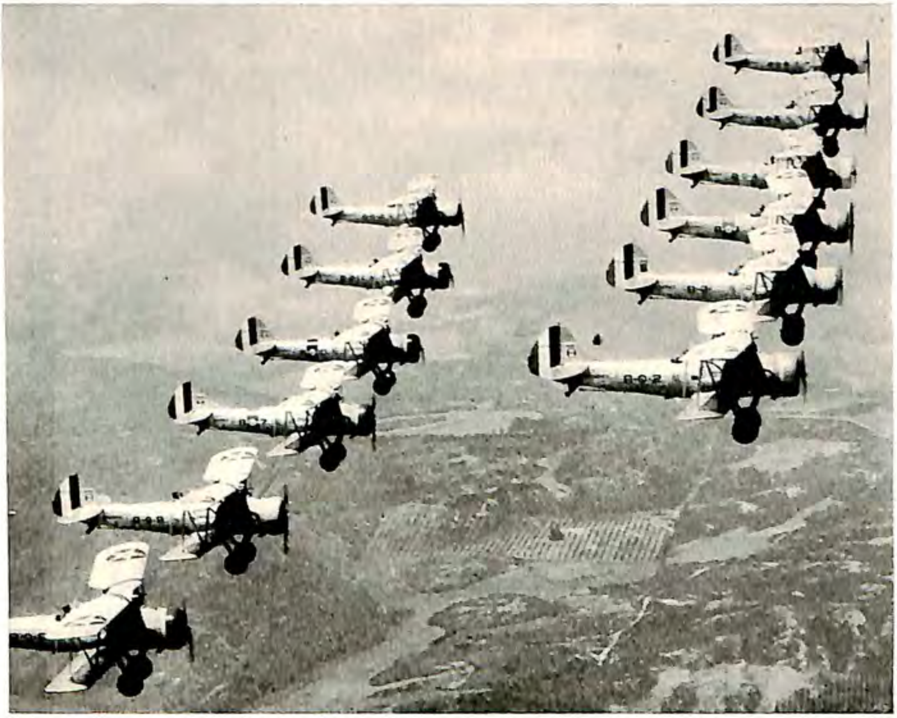
"Airplanes flown or shipped from the United States will not be considered as exported within the meaning of section 2 of the joint resolution when it is the intention of their owners that they shall remain under United States registry and shall be operated by a United States licensed pilot during the entire period of their sojourn abroad, and, further, when there is no intention on the part of their owners to dispose of them or of any of their essential parts listed in the President's proclamation of April 10, 1936, in any foreign country. Should the owners, after the departure of a plane flown or shipped from the United States without an export license, propose to place the plane under foreign registry or to have it operated by a pilot not holding a United States license, or to dispose of the plane or any of the essential parts referred to in any foreign country, the plane, or the part in question, must be returned to the United States and a license obtained for its export to the country concerned. Airplanes of American registry returning to the United States from foreign countries and airplanes of foreign registry entering the United States for a temporary sojourn will not be considered as imported within the meaning of section 2 of the joint resolution."

Export licenses are valid for a period of one year. They are, however, subject to revocation without notice.

A provision of the regulations of particular importance reads as follows:

"Title I of an act approved June 15, 1917, reads in part as follows:

" 'Whoever, with intent or reason to believe that it is to be used to the injury of the United States or to the advantage of a foreign nation, communicates, delivers, or transmits, or attempts to, or aids or induces another to, communicate, deliver, or transmit, to any foreign government, or to any faction or party or military or naval force within a foreign country, whether recognized or unrecognized by the United States, or to any representative, officer, agent, employee, subject, or citizen therof, either directly or indirectly, any document, writing, code book, signal book, sketch, photograph, photographic negative, blue print, plan, map, model, note, instrument appliance, or information relating to the national defense, shall be punished by imprisonment for not more than twenty years.........'



Official Photo U. S. Navy

U. S. MARINES IN THE AIR

Observation Squadron 8-M, oldest organized air unit of the Marine Corps, Captain Thomas J. Cushman commanding. They are flying Wasp-powered Vought Corsairs.

"The Secretary of State will not issue an export license to cover the shipment of any arms, ammunition, or implements of war considered by the Secretary of War or by the Secretary of the Navy as instruments or appliances included among the articles covered by those terms as used in this act."

A provision of the Neutrality Act of particular importance reads as follows:

"No purchase of arms, ammunition, and 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 Act."

Public Health Service

In its quarantine work the U. S. Public Health Service continued the inspection of airplanes and their passengers and crews arriving from foreign countries. During the fiscal year 1936, 3,823 airplanes, carrying 37,352 persons, arrived at United States airports from other countries, as compared with 4,081 planes carrying 34,135 persons in 1935—a much larger number of persons per plane in 1936. Of those arriving in 1936, 2,281 planes carrying 31,898 persons, were accorded quarantine inspection by medical officers as required by law. The other planes arrived at airports at which no medical officers were available for duty, and therefore did not undergo inspection.

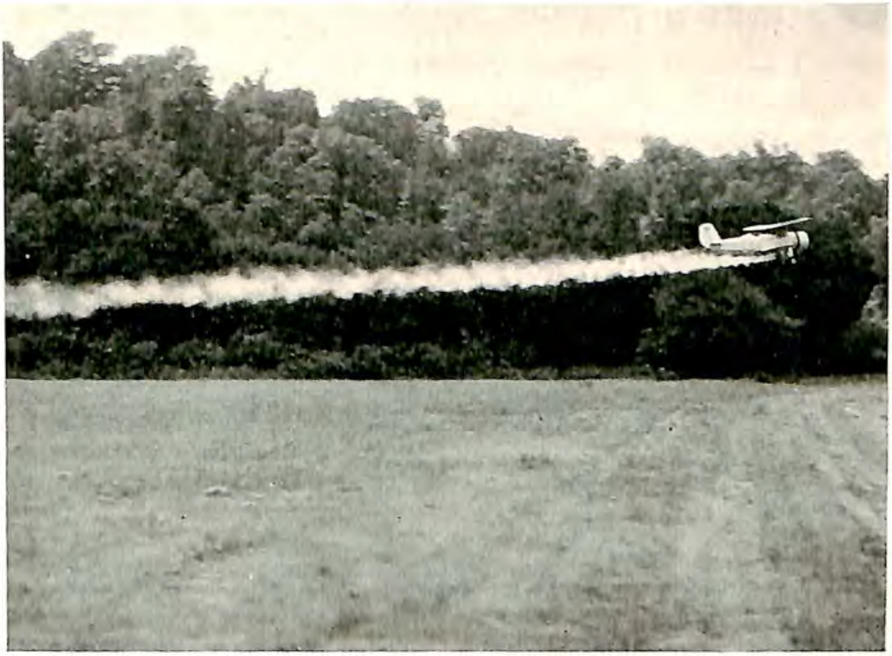
With the inauguration of aerial transport service across the Pacific, exposing the Pacific Coast, the Territory of Hawaii, and the Philippine Islands to epidemic and endemic diseases in the Orient, it became necessary for the Public Health Service to issue special instructions regarding aerial quarantine activities at Pacific continental and insular stations to prevent the introduction of disease and to prevent the bringing of mosquito vectors of malaria into the Territory of Hawaii, where malaria does not now exist, owing to the absence of such insect carriers. All aircraft are inspected and fumigated both upon departure for and arrival at Honolulu. Various species of insects have been recovered following fumigation at San Francisco and Honolulu on both inbound and outbound planes.

Attention has been called to the fact that the international sanitary conventions do not provide for the sanitary supervision of postal packages mailed in international commerce which contain material infectious to man involving actual or potential menace to the public health. This matter is to be given consideration by the International Office of Public Health at future meetings of its Permanent Committee.

During the year Public Health Service quarantine officers at New Orleans developed a mosquitocide for use on airplanes in flight. This mosquitocide consists of carbon tetrachloride and pyrethrum extract mixture; and laboratory tests have resulted in 100 per cent kill of mosquitoes following 5 minutes exposure to as little as 5 cc. of this mixture finely sprayed in 1,000 cubic feet of space. As this mixture is nonflammable and is apparently harmless to human beings in the concentrations used, it approaches more nearly the ideal mosquitocide than any other yet developed for use on aircraft in flight to prevent the transportation of mosquito carriers of human disease.

Soil Conservation Service

During the calendar year of 1936 the Soil Conservation Service, of the Department of Agriculture, awarded contracts for approximately 240,000 square miles of aerial surveys. The largest unified area is approximately 68,000 square miles, and is the largest aerial



TVA MOSQUITO CONTROL

A Stearman plane used in dusting poison over malaria mosquito infested areas near the reservoirs in the Tennessee Valley.

survey ever attempted in the United States. The contracts for that area were awarded to the following companies: Fairchild Aerial Surveys, Aero Service Corporation, Aerial Explorations, Inc., Kargl Aerial Surveys, Brubaker Aerial Surveys, Robinson Aerial Surveys, Holmberg Air Mapping Company, Aero Exploration Company, Pacific Aerial Surveys, Bowman-Park Aero Company, Standard Air Service, Southwestern Aerial Surveys, and Wallace Aerial Surveys.

The following scales were used on the above-mentioned contracts:

1:12,000; 1:15,840; 1:20,000; 1:31,680. The scale used on individual areas depended entirely upon the terrain and the purpose for which the surveys were being made. The majority of the photographs were at a scale of 1:20,000.

Of the approximately 240,000 square miles on which contracts were awarded for aerial surveys, radial controlled aerial photographic mosaics were required on approximately 41,000 square miles. Single lens photographs were required on the remaining area and will be used for compiling planimetric maps on the scale of 1:15,840. These planimetric maps will be used as a basis on which to compile erosion, slope, land use, and related soils data.

Tennessee Valley Authority

During 1936 the Tennessee Valley Authority operated three airplanes, a Monocoach, a Bellanca, and a Stearman. These airplanes were used in making maps, surveys, road relocation studies, and the control of malarial mosquitos. Charged with the long range development of the Tennessee River watershed, embracing an area of more than 40,000 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 in less time than that required by surface methods.

U. S. Coast and Geodetic Survey

During 1936 the U. S. Coast and Geodetic Survey completed adjustment and testing of the largest aerial camera in the world, the construction of which was described in the 1936 Aircraft Year Book. One of the photographs simultaneously exposed from the nine lenses of this camera takes the place of from eight to 20 of the usual type of single-lens photographs. The Army Air Corps furnished an airplane for the flight tests and for a mapping project at the head of Chesapeake Bay. This project, which was just getting underway at the beginning of 1937, was expected to demonstrate a marked increase in efficiency in mapping from aerial photographs.

The coast of New Jersey was mapped on a scale of 1:10,000 from aerial photographs taken by a commercial company. Mapping is in progress in Florida along the St. Johns River and the Florida Keys with five-lens photographs taken by the Army Air Corps. The Port of New York is being mapped on a scale of 1:5,000.

Before 1935 the Coast and Geodetic Survey had compiled and printed for the Bureau of Air Commerce 31 strip airway maps and 27 sectional aeronautical charts. Owing to the need for sectional aeronautical charts covering the entire United States, a comprehensive program was initiated in the fall of 1934 with the aid of a Public Works allotment to publish the entire series of 87 sectional charts. Under the enlarged program, 34 additional charts were printed by January 1, 1936, and the remaining 26 charts have since been published. Under this project the entire United States has for the first time been provided with a series of charts at a uniform scale, especially designed to meet the needs of air navigation. With the availability of this series, the strip maps formerly published have been canceled.

The publication of this series does not mark the end of work on the sectional charts. Some 25,000 miles of lighted airways and more than 2,000 airports are included on the charts. The many changes in these aids, in addition to the completion of new surveys, necessitate frequent revision, as it is the intention of the Department to maintain

TVA FLYING EQUIPMENT

A Bellanca and a Lambert plane operated by the Tennessee Valley Authority.

these charts to show existing conditions accurately. During the year 136 new editions including new charts were produced. Nearly two hundred thousand were issued during the year ending June 30, 1936 and the number to be issued during the next year will be appreciably greater.

The sectional aeronautical charts were formerly known as airway maps; however, since they are equally useful for navigation off the airways, and are in every way comparable to the nautical charts so essential for safety at sea, the new designation was adopted. The series of sectional charts is printed at a scale of 1:500,000, or about 8 miles to the inch. To meet the need of high speed long distance flying, there was started an additional series, known as regional aeronautical charts. This second series is at a scale of 1:1,000,000, or about 16 miles to the inch. Two regional charts (known as 9M and 10M) had been published by January 1936. These have been revised.

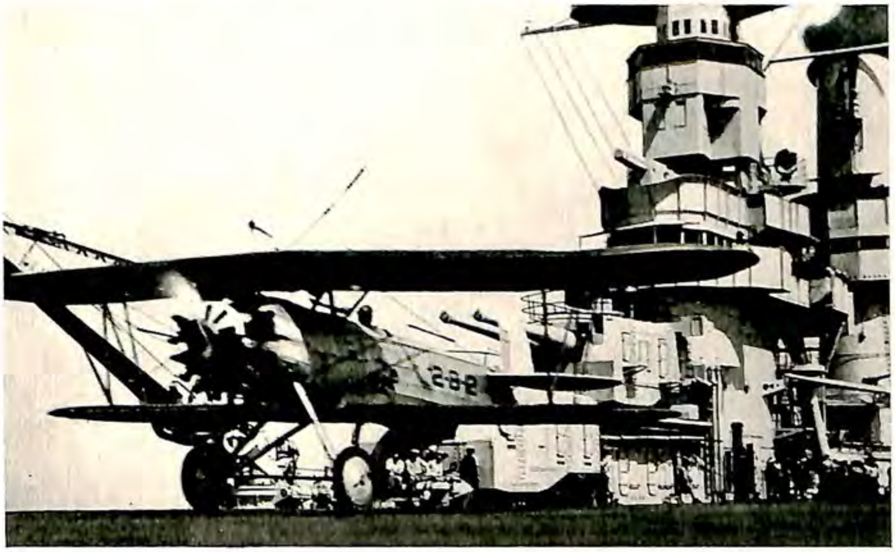
Chart No. 3060a "Aeronautical Planning Chart" of the United States, showing principal airports and broadcasting stations at a scale of 1:5,000,000 (about 80 miles to the inch), has been well received. In addition to its usefulness in planning long flights, this chart is peculiarly suitable for radio compass work, and will have a wider distribution as this method of navigation becomes more general.

The pamphlet of some 60 pages, entitled, "Practical Air Navigation and the use of the aeronautical charts of the Department of Commerce", issued in 1936 has proved popular with pilots of all classes. It has been adopted as a text at a number of schools, and is issued to pilots by some of the leading transport companies. The largest single order of 1,650 copies went to the Army Air Corps. The first edition of 7,000 copies has been exhausted, and a second edition is now in preparation. In addition to an extensive revision of the previous material on navigation by piloting, dead reckoning, and radio, the new edition will include a complete treatment of celestial navigation and a section on meteorology.

U. S. Weather Bureau

The airway meteorological service is operated by the Weather Bureau in cooperation with the Bureau of Air Commerce, the latter bureau furnishing teletype, radio, and other necessary communication facilities. Ten airport stations of the Weather Bureau, located at Atlanta, Ga., Burbank, Calif., Chicago, Ill., Cleveland, Ohio, Dallas, Tex., Kansas City, Mo., Newark, N. J., Oakland, Calif., Portland, Oreg., and Salt Lake City, Utah, supervise the service in their respective districts and issue regular and special airway weather forecasts every six hours for the periods 4:30 a. m. to 12:30 p. m., 10:30 a. m. to 6:30 p. m., 4:30 p. m. to 12:30 a. m., and 10:30 p. m. to 6:30 a. m., E. S. T. Weather maps, hourly airway weather reports, pilot balloon observations and meteorological advice are available at 52 first-order Weather Bureau airport stations located at important airway terminals. In addition, there are 186 stations rendering hourly weather observations, 324 airway stations giving weather observations on call, and 66 off-airway stations making weather reports every six hours in the network, or a total of 628 weather reporting stations.

During 1936 arrangements were made to furnish two reports, an hour apart, from "on call" stations so that airline operators might determine weather trends for clearing planes on routes over which hourly reports are not available by teletype or radio. Arrangements were also made to establish approximately 100 new 6-hourly weather reporting stations in regions where observations of this type were not heretofore available. Complete sets of meteorological instruments were installed at all new stations, including mercurial barometers and barographs. The barographs were of the latest open-scale type to permit accurate readings of 3-hourly barometric pressure change and characteristic data which are essential to air mass and frontal analysis. The new stations began reporting on January 15, 1937, and with this increase in density of observations, there was a marked improvement in the analyses of weather conditions, as well as more accurate determinations of velocities, troughs and wind-shift lines.



Official Photo U. S. Navy

PLANES TAKING OFF FROM THE CARRIER "SARATOGA"

Meteorological and communication activities were consolidated at 35 airports during 1935 through the cooperation of the Bureau of Air Commerce and the Weather Bureau. Additional stations were consolidated during 1936. The plan, which provides for utilizing both Bureau of Air Commerce and Weather Bureau personnel in carrying out the work of each Bureau, permits a reduction in personnel at each station without loss of service, and has proved to be a most efficient and economical arrangement. It has, in large part, eliminated dual responsibility of the employees, permitted certain economies to be effected, and has provided more time for maintenance of radio and teletype aids by the Bureau of Air Commerce. The advantage of the maintenance program at consolidated stations is reflected by a marked drop in the number of reports to that Bureau of inoperative facilities at such stations.

During the first half of the year, there were in operation in the United States and the Hawaiian Islands, 23 airplane weather observation stations, where an instrument called an aerometeorograph is taken aloft by an airplane to make an autographic record of the barometric pressure, temperature, and relative humidity of the free air, and the pilot makes visual observations of such phenomena as clouds, precipitation, icing conditions and turbulences encountered during the flight. These include the following: Weather Bureau stations; flights made by a private flying concern under contract: 1. Billings, Mont., 2.

Official Photo U. S. Navy

AIRCRAFT CARRIER "LEXINGTON"

Cheyenne, Wyo., 3. El Paso, Tex., 4. Fargo, N. Dak., 5. Murfreesboro, Tenn., 6. Oklahoma City, Okla., 7. Omaha, Nebr. and 8. Spokane, Wash.

Army stations; flights made by the Army Air Corps, carrying an aerometeorograph, the records of which are evaluated by personnel of the Weather Bureau, which owns the instruments:

1. Barksdale Field, Shreveport, La., 2. Boston, Mass., 3. Kelly Field, San Antonio, Tex., 4. Maxwell Field, Montgomery, Ala., 5. Mitchel Field, Hempstead, L. I., N. Y., 6. Selfridge Field, Mount Clemens, Mich., 7. Scott Field, Belleville, Ill. and 8. Wright Field, Dayton, Ohio.

Navy stations; flights made by the Navy Department, using Navy equipment and personnel, while the data are furnished to the Weather Bureau:

1. Lakehurst, N. J., 2. Norfolk, Va., 3. Pearl Harbor, Hawaii, 4. Pensacola, Fla., 5. San Diego, Calif., 6. Seattle, Wash. and 7. Washington, D. C.

During the last half of 1936 the Weather Bureau established four additional stations, at Oakland, Calif., Miami, Fla., Salt Lake City, Utah, and Sault Ste. Marie, Mich., where private flying concerns make daily flights under contract.

An investigation made to determine certain physical aspects of polar continental air which gives rise to cold waves, indicated the urgent need for one or more airplane weather observation stations in the regions over which these air masses acquire their intense coldness.

THE F2F-1 GRUMMAN FIGHTER

One of the new combat planes developed for the Navy air forces. It is powered by a Pratt & Whitney Twin Wasp Junior engine.

Under the stimulus of this work, an allotment of funds under the Bankhead-Jones Act was secured to establish such a station at Fairbanks, Alaska, during the winter season 1936-1937. Also, the Canadian Meteorological Service established an airplane weather observation station at Fort Smith, Canada, in order that sufficient data should be available in conjunction with stations in the United States for a complete investigation of cold waves.

In cooperation with the National Bureau of Standards, the Weather Bureau has worked toward the perfection of a practical system for radiometeorography, whereby knowledge of meteorological conditions aloft can be made instantly available for forecasting and other purposes. Two types of instruments are being developed, one at the Bureau of Standards, and the other at the Weather Bureau. The most satisfactory one will be adopted, and it is expected that it will be suitable for attaching to a hydrogen-filled sounding balloon and be able to transmit by high-frequency radio a record of the temperature, pressure, and humidity every fifteen seconds as the balloon ascends. If the development proves successful, it will supplant the airplane observations, and it is expected that work will be done in 1937 on the problem of plotting the course of such balloons by radio direction-finding. If this problem is solved, the Weather Bureau will have a method of obtaining free air data, including wind aloft information, regardless of weather conditions and, what is considered very important, it will be possible to obtain measurements of wind directions and velocities within and above cloud layers.

Investigations to develop a more intense beam of light for illuminating a spot on a cloud layer at night as a means of determining heights of cloud layers, are also being carried on in cooperation with the National Bureau of Standards. New ceiling light projectors, designed to measure cloud heights up to 10,000 feet, are being installed at important terminal airports. If these projectors prove satisfactory, it is expected that additional projectors will be purchased later for use at intermediate airway weather reporting stations.

AN AMERICAN AIRLINES VIEW

The capitol at Washington, with Senate and House office buildings, the new Supreme Court building and the Library of Congress—all at a glance from one of the American Airlines flagships coming in from the West.

CHAPTER VIII

NOTABLE FLIGHTS OF 1936

Swain's Record Altitude Flight—Bjorkvall's Attempt to Reach Sweden—Mrs. Markham's Adventure—The Richman-Merrill Round Trip—Mollison's Atlantic Hop—Howard Hughes Makes Transcontinental Record—Major Eaker's Blind Flight—Russians Fly to Moscow.

ADVENTURE in one form or another awaited thousands of pilots when they went up on their various missions during 1936. Sometimes it was happy adventure, again it approached the tragic; but always it was thrilling.

Describing one of the most thrilling high flights in the history of aviation the New York Times carried the following graphic description from its London correspondent, dated September 29, 1936: "Squadron Leader F. R. D. Swain, Royal Air Force test pilot, established a new world altitude record for airplanes yesterday, the Air Ministry announced tonight.

"Narrowly escaping disaster, the 33-year-old airman reached an altitude of 49,967 feet in an experimental high flying Bristol machine powered by a special Pegasus engine, breaking by 1,269 feet the unofficial record of 48,698 feet set by the Frenchman, Georges Detra, last month. Swain described his thrilling flight, which lasted three hours 20 minutes. At one time when suffocated and weakened almost to the point of unconsciousness he had managed to save his life by slashing his helmet with an emergency knife to let in air. He attributed the sensation of suffocation to exhaustion that usually follows long periods at high altitudes with the oxygen supply at a lower pressure than that of the ground level.

"His physical power progressively grew weaker and his predicament was made worse by his inability to open the sliding roof of the cockpit. Swain tried to get hold of the slide fastener of his airtight suit, but, encumbered by his safety harness and parachute, was unable to find it. He then applied his failing strength to reaching for his knife at the side of the cockpit and slitting a panel of his helmet. Apart from the trouble the suit caused in this emergency, the outfit, consisting of two pieces wholly enclosing the head, trunk and limbs and joined with an airtight seam at the waist, apparently worked well. Oxygen was fed under pressure into one side of the helmet and the used gases were carried through a purifier and put back into circulation.

"The big airplane, a low-wing monoplane constructed entirely of wood, took off from the R. A. F. experimental station at Farnborough at 7:30 in the morning and climbed in wide circles above the airdrome. At 40,000 feet Swain turned southeast and climbed in a straight line. When at 45,000 feet, he was about ten miles north of Brighton, flying in a heavy northwesterly wind. At 46,000 feet he looked down and, although he found the light very dazzling, he could see the whole coastline of England from Margate to Lands End and northward almost as far as The Wash. For the rest of the climb he kept his eyes glued to the instruments so that he might not make the mistake of assuming he was climbing when in fact he might be losing height. The pressure in his suit then began to trouble him, because in the suit's expanded condition he found movement difficult and began to have slight symptoms of cramp in his right arm. He had no trouble in breathing.

"The airplane reached its climbing limit when the altimeter showed 51,000 feet, which Swain believed represented a true altitude of 50,000 feet. He decided to descend and throttling the engine, began to glide. After he had lost 5,000 feet in altitude the window of his helmet began to collect mist and the cockpit cover was frosted over completely, so that he was unable to see either the ground or his instruments. Noting the glare of the sun through the mist he flew into the sun, guessing he was going eastward and therefore homeward. Though still losing height, Swain began to feel he was being suffocated and concluded he was running short of oxygen.

" 'I pressed the release lever which should have opened the sliding roof but it wouldn't work,' he said. 'Then I tried to get hold of the zip cord fitted to my suit in the hope of opening it and so getting my head clear of the helmet. I found I couldn't get at it because of my pilot's harness. Gradually getting weaker, I thought the only thing to do was to get hold of my knife and try to cut open the window of the helmet. I had great difficulty doing this as by that time I was really very weak. With a final effort I put the knife through and then tore it out to enable me to get in some fresh air. I began to get better and when I looked at the altimeter I was down to 14,000 feet.' "

Early in the morning of October 6, 1936, Kurt Bjorkvall, a Swedish pilot, took off from Floyd Bennett Field, New York, in his Wasp-powered Bellanca Pacemaker, on an attempt to fly non-stop over a great circle route of 3,400 miles to Stockholm. The next afternoon he ran short of fuel about 100 miles east of Valencia, Ireland, and came down in the Atlantic near the trawler Imbrin which picked up pilot and plane. He had made a "lone eagle" flight of 2,400 miles non-stop, but headwinds held him back and emptied the gas tanks with a little more than two-thirds of his flight completed.

IT FLEW THE ATLANTIC AND BACK

This is the Cyclone-powered Vultee monoplane which Harry Richman and Henry T. (Dick) Merrill called the "Lady Peace" before they alighted in a Newfoundland bog after their not so peaceful round trip flight to England.

Two of the most adventurous flights of the year were the Atlantic trips, one by Mrs. Beryl Markham, English aviatrix, and the other the round trip flight by Harry Richman and "Dick" Merrill. The Atlantic still is a wide ocean whether you take it by boat or plane. At one stage or another the crossing is bound to cast up for the aviator high winds or fog, and very often rain or sleet or snow. Invariably the success or failure of a stunt flight over the ocean depends on winds and whether they are strong enough to hold back a plane and deplete its fuel supply before reaching port.

Mrs. Markham with a long string of record flights to her credit climbed aboard her Gypsy-powered Percival Gull low-wing monoplane and flew out of Abingdon, England, shortly after noon on September 4, 1936. She hoped to land in New York within 24 hours, a daring plan in view of the fact that despite its extra fuel load the plane carried enough for only 26 hours in the air under favorable conditions. And they proved to be everything but favorable. Mrs. Markham was warned about bad weather, but she discounted it. A tail wind and a bright moon escorted her out of England. Ireland greeted her with fog and rain. Bumpy air kept her working hard at the controls. She had to fly high and navigate solely by instruments. This sort of thing kept up for 20 hours, and it became tiresome for the lone voyager whose hope of flying non-stop to New York gradually faded before the onslaught of the headwinds which, she knew, were draining the tanks of valuable gasoline.

Then a knock developed in the engine. It was only a little knock, but it bothered her considerably. She strained her eyes peering through the fog for a sight of land. A few hours later she caught a glimpse of Newfoundland, but it was only a glimpse because fog obscured all landmarks, and she realized she would have great difficulty locating a landing field. Yet land she must; her fuel supply was about exhausted. But there was only one thing to do, that was to keep on flying. Fatigue now began to tell on the frail pilot. She had set out with only a jug of coffee, some nuts and fruit, and the coffee had been upset and spilled the first time she tried to take a drink. That contributed to weariness, because a day and a night without any stimulant and a minimum of food will break down the hardiest physique.

However, as expertly as though she were turning a curve on a motor highway Mrs. Markham zipped across a corner of Newfoundland, looked at her map and struck out for Nova Scotia. There she was lucky. She sped over the shoreline and sighted Baleine. A hasty check of the gas convinced her that she should land. Through the mist she saw what appeared to be an open field, and reluctantly glided into it. The field was nearly all swamp. Within 40 feet after touching the surface her wheels bogged down, stuck and tipped the plane over on its nose, ripped out the engine and propeller, smashed a wing and shattered the landing gear. When the natives ran up they found the pilot, bruised and shaken, sitting in the mud alongside the wreck yet grinning cheerfully.

Ten days later Richman and Merrill repeated Mrs. Markham's performance when they set their Wright Cyclone-powered Vultee plane down in a bog at Musgrave Harbor, Newfoundland, ending the first round trip Atlantic flight in history. Richman, actor and private pilot, wanted to be first to fly from New York to London and return.

He took with him Dick Merrill, veteran transport pilot for Eastern Air Lines. They also carried the blessing of Dick's boss, Colonel Eddie V. Rickenbacker, American ace of aces in the World War and head of the Eastern Air Lines system. They left Floyd Bennett Field, New York, late in the afternoon of September 2. They had named their ship "Lady Peace" and theirs was a relatively peaceful flight eastward. One bump threw them out of their seats and let them down 3,000 feet, but for the most part they sped across the ocean at a height of two and a half miles, cheered by the knowledge that their wings contained some 40,000 table tennis balls calculated to keep them on the surface in case of a forced landing at sea. Fog and mist, cross winds and rain greeted them over Ireland, which they never saw. Somewhere over the Irish Sea they lost their bearings. Trying to get back

THE BELLANCA FLASH

A fast plane powered by a twin-row Wasp Junior engine. Capt. James Mollison used this ship on his record Atlantic flight.

on the true course to London they exhausted their fuel supply. They landed in a cow pasture near Llwyncelyn, Wales. Still, they had crossed the Atlantic in record time, 18 hours and 38 minutes at an average speed of 210 miles an hour.

On September 14, they took off from Southport Beach, England, in pitch darkness, facing a headwind of 25 miles an hour, which would reduce their speed that much. They had ordered a steak dinner in New York for the next evening; and they were happy in the thought that they were the first aviators to demonstrate actually that one crossing of the Atlantic was not enough for them, they were making a return trip. And that, we may say here, spells the very acme of high courage. The two aviators needed courage on the return flight.

Half-way across the ocean the weather commenced venting its spleen against these men who had dared its terrors twice. The wind came at the "Lady Peace" with gale force, sending the ship up and down over one bump after another. Rain, torrents of it, obliterated the horizon and made water and sky one vast, impenetrable bank of mist and fog. Richman had never encountered anything like this. Merrill assured him that he had flown through weather just as bad on many occasions. He explained that he had come down from their normal flight path and was flying close to the water to prevent ice forming on the wings. He then checked the fuel supply. To his surprise he found that the dump valve on the big fuel tank had been opened, and some hundreds of gallons of gasoline lay spattered over the ocean. Then Merrill started looking for land in dead earnest. It was midafternoon when the "Lady Peace" nosed down in a swamp near Musgrave Harbor, 100 miles north of St. Johns. On September 21, Richman and Merrill flew the "Lady Peace" back to New York and the end of one of the most adventurous flights of the year.

At 8:44 on the morning of October 27, 1936, at Floyd Bennett Field, New York, a sleek, streamlined Bellanca monoplane roared up out of the morning mist and pointed its nose for Harbor Grace, Newfoundland. At the controls sat Captain James Mollison, clad in a dinner jacket beneath his heavy flying suit. He was setting out to establish a new west-east record for the Atlantic crossing. His 700 horsepower Pratt & Whitney Twin Wasp Junior engine whisked him the 1,100 miles to Harbor Grace in six hours 41 minutes.

Taking off the next morning, in the face of icy gales and a blinding snow storm, he flew at an altitude of 15,000 feet. He soon found that at this altitude his wings were becoming coated with ice, and was forced to descend to a warmer stratum. This was easier to decide upon than to do, as his path to the ocean level was blocked by a thick unbroken layer of clouds. After about an hour of searching and wasting precious time and fuel, he found a small hole through which he shot down near the water. Warmer air melted the ice from the wings.

During the entire trip he sighted no ship and had to depend entirely on his own calculations to determine his exact location. After about ten hours over the lonely and desolate wastes of the gray Atlantic, Mollison passed a light house off the coast of Ireland. He was nearing his goal. He landed at Croydon Airport, London, 13 hours and 17 minutes after leaving Harbor Grace; the first pilot ever to reach London non-stop from America, the first pilot to fly the Atlantic three times and the third man to fly the Atlantic solo and reach his predetermined destination non-stop—the other two being Colonel Charles A. Lindbergh and the late Wiley Post.

Not content with holding the world speed record of 352 miles an hour for land planes, made in his special plane in 1935, Howard Hughes, film producer and one of the leading pilots of the country, decided to make the fastest trip ever made between the Pacific and Atlantic coasts. On the afternoon of January 13, 1936, at the Union Air Terminal, Burbank, Calif., he loaded 700 gallons of gasoline aboard a Northrop Gamma mail plane powered with the new Wright G Cyclone engine and a Hamilton constant speed propeller. Saying that he hoped his next stop would be Newark, N. J., Hughes took off and climbed to a height of 15,000 feet. Thick weather closed in around him over the mountains, so he climbed to 18,000 feet, flying by instru-

HOWARD HUGHES ENDS RECORD FLIGHT

Landing his Wright G Cyclone-powered Northrop Gamma at Newark Airport after making his 1936 record flight from Los Angeles.

ments only. He could not use his radio because the antenna had snapped during the take-off. When breathing became difficult in the rare atmosphere he "smoked" oxygen from the tanks carried for that purpose.

After more than two hours of flying through the impenetrable murk he came out into clear weather over New Mexico. From there on he had fairly clear sailing until north of Wichita, Kans., when a bad bump knocked the compass off its pin, and thereafter it served only as an approximate guide. When night fell, however, Hughes was able to make out the cities by their lights, as he checked off one after another on his map. A tail wind helped to increase his speed.

He spanned the 170 miles from Indianapolis to Columbus in 35 minutes, the 160 miles from Columbus to Pittsburg in 32 minutes. Shortly before one o'clock that night he reached Newark Airport. He had been in the air only nine hours, 26 minutes and 10 seconds. He had broken Col. Roscoe Turner's record of 1934 by 35 minutes, and he had established a world record for speed over a course of that

A TRANSCONTINENTAL BLIND FLIGHT

Major Ira C. Eaker (left) during a fuel stop in his New York-Los Angeles flight in a Wasp-powered Boeing pursuit plane, discusses the route with Major William E. Kepner, who acted as escort. The Army Air Corps and Navy air forces are becoming experts in flying by radio direction.

length. His average speed had been more than 259 miles an hour. One has to look back only a few years to realize that the stunt flight of today is the commonplace of tomorrow. Regular air transport planes are keeping schedules from coast to coast in less time than the record flights of ten years ago. Thus we may be sure that everybody one day will be traveling back and forth across the continent in a matter of nine hours or so.

Flying by instrument only is practised by all pilots of the Air Corps, Navy and the air transport lines. Skill in this kind of "blind" flying will take a pilot through any kind of weather when he cannot see outside his cockpit. Just to prove that the Air Corps is good at that sort of thing Major Ira Eaker flew an Army Wasp-powered Boeing pursuit ship from New York to Los Angeles in June, 1936, without once seeing outside his ship while he was in full flight. He peeked out

A FLEET MODEL 10

One of the Consolidated Aircraft Corporation's training planes.

when landing at airports for gasoline; that was all. The rest of the time he sat under the hood which made his cockpit like night, watching his instruments, listening attentively to the radio, which was guiding him along a straight, if invisible, course, and fighting off that drowsy feeling which comes from listening to the steady purr of engine and propeller. Escorting Eaker in another ship, just to make sure that nothing went wrong, was Major William Kepner. Many times when the weather was thick Kepner fell in behind the blind flying machine and let it guide him along the radio beam. The flight was uneventful, proving that pilots can fly blind for long distances without too much fatigue.

One of the adventurous flights of 1936 was the trip of two Russian pilots, Sigismund Levanevsky and Victor Levchenko, who took delivery on a Vultee monoplane in Santa Monica, Calif., and set out to fly it back to Moscow, Russia. They took off on August 5 and flew by easy stages to Juneau and Nome, Alaska, and then crossed Bering Straits to Siberia, thereafter making a beeline flight across the continent to Moscow, a 10,000 mile journey by air which ended on September 13, and won for them the plaudits of all Russia and a purse of $34,000. Soviet Russia makes heroes of all its good pilots.

BEDS FOR AIR TRAVELERS

An upper and a lower berth on one of the American Airlines Douglas sleepers which carry 14 passengers.

CHAPTER IX

AIR LINES OF THE UNITED STATES

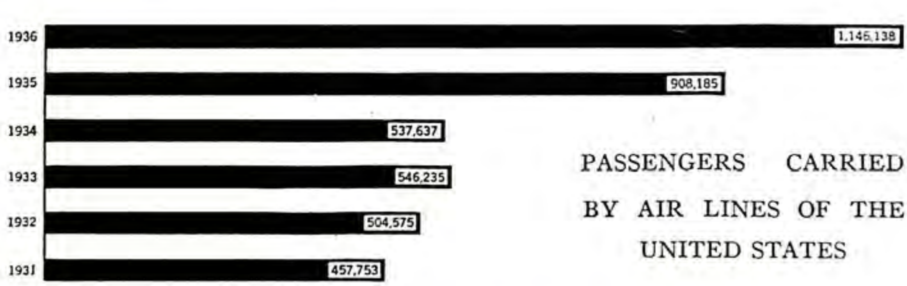
Growth of Traffic—Plans for Larger Transports—Rules for Transport Pilots—Air Express Development—The Postmaster General's Report—Domestic Operations of Leading Companies —The Pan American Airways System—Airship Operations.

A MAN in Honolulu walked down the street one day and realized that the weather had become too sultry for comfort. He stopped short, turned into an office and sent a message to a New York store asking that a hot weather suit be rushed to him immediately by air. That was Friday. On Tuesday evening he wore the suit at dinner. A four-pound package of pest-destroying insects, all nicely cooled by damp moss, was shipped from Honolulu to the sugar cane fields in Kenya Colony, Africa, all the way by air, 15,000 miles in 10 days. A manufacturer in Peoria, Ill., shipped an 80-pound machine shaft to Khartoum, Africa, in a week. The heaviest air shipment of 1936 was 1,820 pounds of machinery to repair a steamer at Cristobal, Panama Canal Zone. It traveled from Newark, N. J., in two days.

At the beginning of 1937 the air lines of the United States were carrying an average of 3,400 passengers, 10 tons of express and 23 tons of mail every 24 hours, in a day and night service without a counterpart anywhere in the world. All privately-operated companies, they were improving their service week by week, and actually setting such a high standard of efficiency that foreign experts who came here to see how it was done admitted that foreign-owned lines were a long way behind the Americans in the most remarkable form of transportation yet devised. Overnight flights from coast to coast or almost anywhere in the country offered a striking example of the speed of the new air liners.

There were more than 60,000 miles of air routes over which airplanes of American registry were in regular, scheduled operation. About 28,000 miles of routes were in the United States, and 40,000 miles made up the total of extensions and other lines in foreign countries and possessions, including the new Pan American Airways 8,000-mile route across the Pacific. The domestic transports flew about 196,000 miles daily and the foreign line ships under the American flag traversed about 16,000 miles daily.

Of course a daily flying schedule equal to more than seven times around the earth or three-fourths the distance to the moon provided experience and training, and paved the way for still greater achievements tending to assure even greater efficiency and safety in air travel. A most comprehensive report prepared by the Air Transport Association of America, representing the air line operators, lists as highlights increased schedules, reduction of travel time between important centers, larger transports, improved sound-proofing, sleeper planes with real berths, better meals aloft, improved weather-reporting facilities



PASSENGERS CARRIED BY AIR LINES OF THE UNITED STATES

and service, more comfortable passenger accommodations at ground stations and passenger and express rates giving one a great deal more for his money. As if that were not enough for the air lines to do for the public in one year, the Air Transport Association described the new system whereby one might buy an air travel card and make it available to all his employees, thereby saving 15 per cent over transient fares, also describing the advantages of round trip tickets which saved 10 per cent; and still further, giving an inkling of what the air transport of the near future will look like, in these words:

"The most interesting and significant technical development of recent years in any form of transport has been the contract let by five companies in 1936 for an experimental model of a four-engine, 40-passenger transport. The lines joining in the financing and development of this experimental plane are American Airlines, Eastern Air Lines, Pan American Airways, Transcontinental & Western Air, Inc. and United Air Lines. Specifications call for a plane weighing 25 tons fully loaded, with a top speed of 230 miles an hour and a cruising speed of 193 miles an hour, using 60 per cent available power. The plane will have a wing span of 140 feet, an overall length of 95 feet and height of 20 feet. There will be four 1,000 horsepower engines. The landing speed is not to exceed 65 miles an hour, and the plane is to incorporate the latest features of design, construction and navigation aids. The passenger cabin will be 40 feet long and 10 feet wide, fitted with 20 upper and lower berths, with separate dressing rooms for men and women. The machine is to be capable of carrying 20 pas-

AN AMERICAN AIRLINES SLEEPER

Passengers going aboard at Grand Central Air Terminal Los Angeles for an overnight ride to New York in regular berths. This is a Cyclone-powered Douglas DST transport.

sengers and two tons of express and mail on long-distance flights and 40 passengers with the same cargo on shorter trips. This type of transport may be in service in 1938."

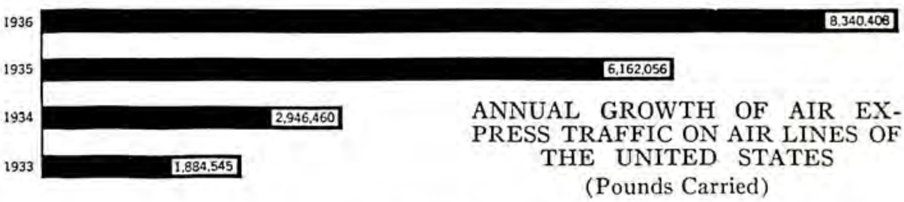
Rules for Transport Pilots

Special Bureau of Air Commerce regulations govern operation of scheduled air lines. These regulations, which are the safety standards for scheduled air transportation, require that airplanes meet the Bureau's standards of airworthiness, that airmen be competent and experienced, that operations methods be appropriate and adequate, that the type of operation engaged in be no more difficult than is warranted by the existing air navigation aids.

To be eligible for duty as first pilot on a scheduled plane carrying passengers, a pilot is required to hold a Scheduled Air Transport Rating. This is not a separate license, but a rating noted on his transport pilot license. To qualify for it, he shall have had 1,200 hours of solo flying time within the eight years preceding the date of application for rating, of which at least 500 hours shall have been cross-country flying. His flying experience also shall have included 75 solo hours of night flying, at least half of this over lighted airways. Then he is required to pass a written test on the air line regulations, on the use of radio and on meteorology. Finally, there is a flight test in which he has to demonstrate his ability to operate an airplane, keep it on course and find his destination entirely by instruments and radio.

Growth of Air Express

Through the Air Express Division of the Railway Express Agency this super-swift shipping facility reached directly a total population of



ANNUAL GROWTH OF AIR EXPRESS TRAFFIC ON AIR LINES OF THE UNITED STATES
(Pounds Carried)

more than 40,000,000 and indirectly every other city and town of consequence in the United States. This constituted by far the largest air transport service in the world and, considered with rail express with which it was intimately linked, the largest transportation system anywhere. An agreement between the Air Express Division of the Agency and the Pan American Airways spread this great aerial network over most of the civilized globe.

But fast transportation of shipments necessarily required that it be complete in every respect; that it should take a package speedily from the sender and carry it directly into the hands of the receiver. Because pick-up and delivery service had long been a characteristic advantage of express service, it had been indispensable with the air express. So the full resources of the express company, with 23,000 offices in the United States, 50,000 experienced employees and the nearly 10,000 motor vehicles used in its local collection and delivery operations, likewise were made available to the air express division.

Particularly significant was the use of air express by shippers and receivers at off-airline points. That was made possible by a happy combination of rail express with the air service. Thus, a shipper who might be located at a point away from the air line map could easily connect with it by fast rail express; similarly, if the consignee were located at a point beyond the nearest airport, fast rail express service quickly completed the journey of the air express shipment addressed to him. The record showed that one in three air express shipments originated at, or was delivered to, off-line destination.

MADE UP FOR DAY FLYING

The American Airlines' Cyclone-powered Douglas sleeper ready for a daylight trip.

Due to the better understanding which the public had gained of the air express service and the increased speed and frequency of flying schedules, the air traffic had shown marked advances in variety as well as volume. While the package business was still substantial, the weight of air shipments rose rapidly, and consignments for air movement were of a size and character which a few years ago were impractical.

The marked advances made in commercial aviation, which had brought forth three-mile-a-minute air transports with large cargo capacity operating on schedules maintained with perfect regularity and often in unfavorable weather, speeded up all this air express shipping. Less than five hours between New York and Chicago and between 16 and 17 hours from New York to San Francisco and Los Angeles were commonplace speeds of air express at the beginning of 1937.

Many shipments were from industries and professions in which time-saving in transit was a vital factor. News photographs, newsreel film, advertising electros, layouts and printed matter, bank checks, women's ready-to-wear goods, samples of manufactured articles, machine and automobile parts, cut flowers, newspapers and periodicals were only a few of the outstanding items of the air traffic which had shown marked increases in 1936.

The rapid tempo of American business operations created innu-

AVERAGE NUMBER OF MILES FLOWN DAILY BY THE AIR LINES OF THE UNITED STATES

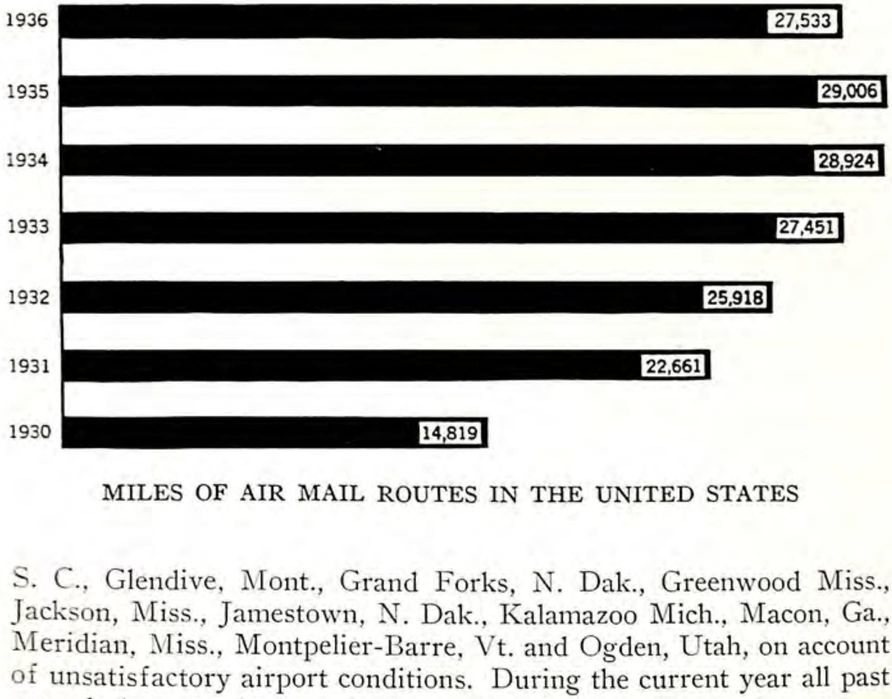
merable instances where the fastest medium of transport was needed, irrespective of cost. Such a demand came from shippers who had substantial shipments to send, as well as from those with packages needed at a distance in a hurry. Heavy machine parts, for example, were commonplace in air express shipments. In July, 1936, 700 of such shipments were flown, and they included steam shovel parts, mining machinery, gears, shaftings, bearings, couplings, gaskets, and marine engine parts.

During the same month, 2,700 shipments of automobile parts and tires and 700 of electrical supplies and equipment moved by express through the skies and were handled with the same speed accorded to packages that might be carried by hand. One day's business by air express out of New York, which produced more traffic of this kind than any other city, was more than that for the entire country during a full year not so long ago.

Postmaster General's Report

In his report for the fiscal year 1936 Postmaster General James A. Farley made these comments:

"This fiscal year is the first year under the new air-mail system in which all routes were in operation throughout the year. No new routes were established and no extensions of routes were made. Three stops were added during the year at Allentown-Bethlehem, Pa., Providence, R. I., and Vero Beach, Fla. It was necessary to suspend stops at Charlotte, N. C., Chattanooga, Tenn., Columbia,

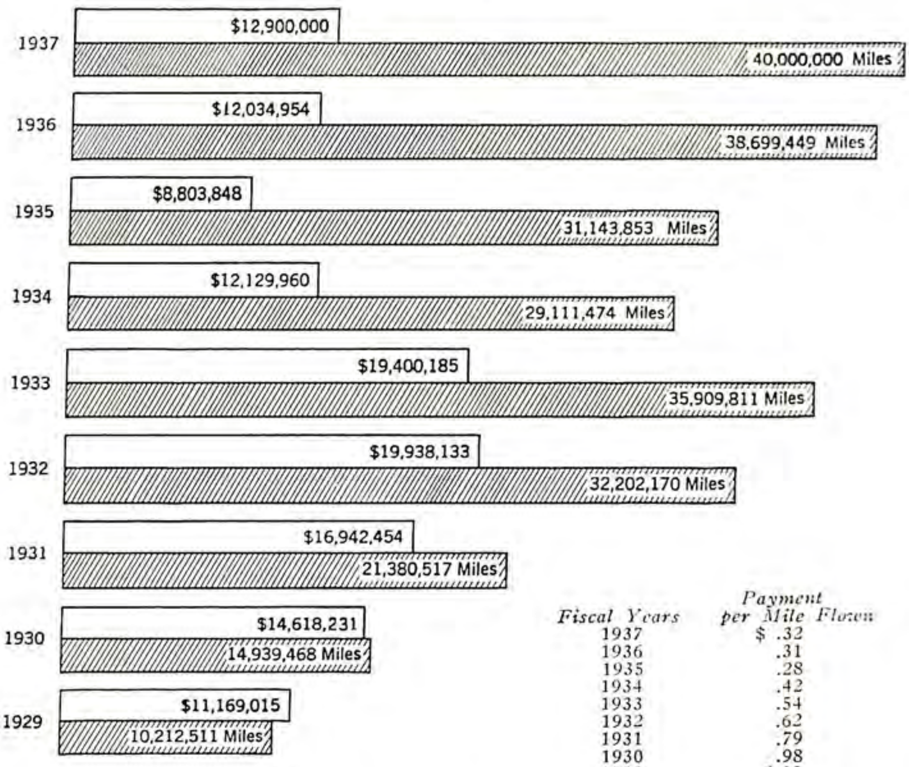


MILES OF AIR MAIL ROUTES IN THE UNITED STATES

S. C., Glendive, Mont., Grand Forks, N. Dak., Greenwood Miss., Jackson, Miss., Jamestown, N. Dak., Kalamazoo Mich., Macon, Ga., Meridian, Miss., Montpelier-Barre, Vt. and Ogden, Utah, on account of unsatisfactory airport conditions. During the current year all past records have again been broken, not only in mail poundage transported but in passenger and express traffic. Poundage transported in every month of the fiscal year was well over 1,000,000 pounds. A record high was set several times during the fiscal year. Final reports show that the month of June set an all-time high with 1,476,469 pounds transported. A total of 15,377,993 pounds was transported during this fiscal year as compared to 10,775,248 pounds in the fiscal year 1935; 6,476,919 pounds in 1934; 6,741,788 pounds in 1933; and 8,845,967 pounds in the fiscal year 1932, which was the high poundage record set when the postage rate was 5 cents per ounce.

"Passenger traffic has shown a phenomenal increase under the new system, as will be seen by tables in the appendix. New all-time records were set several times during the fiscal year. Comparison with previous

ANNUAL COST TO THE GOVERNMENT FOR EACH MILE FLOWN WITH MAIL IN THE UNITED STATES



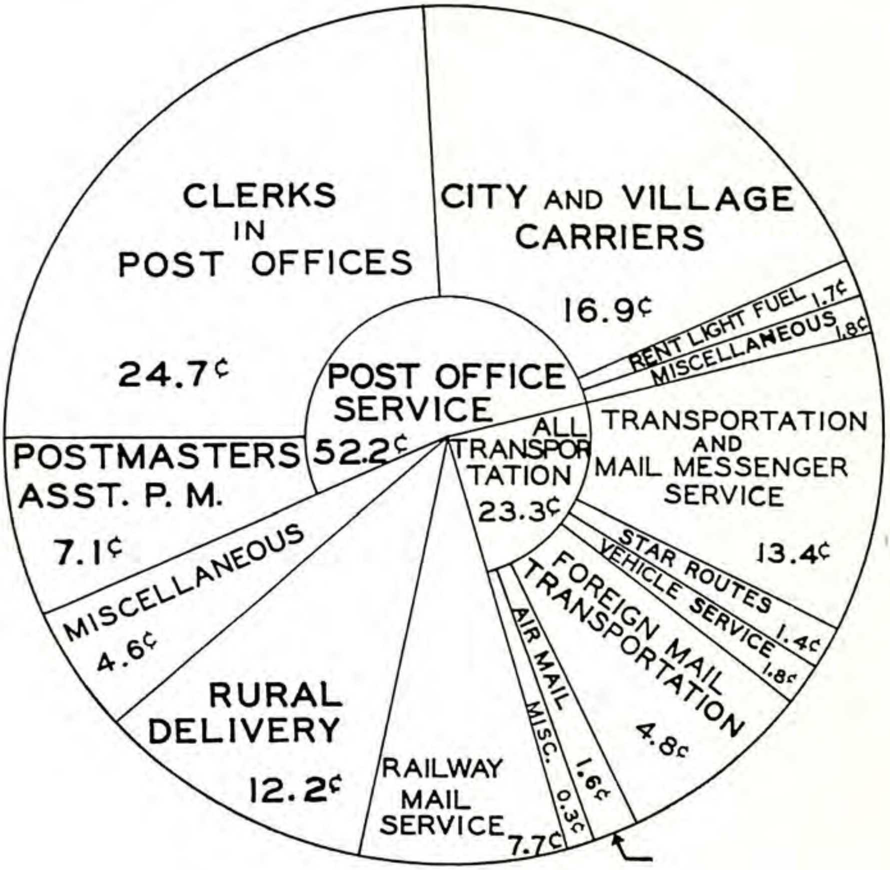
Fiscal Years	*Payment per Mile Flown*
1937	$ .32
1936	.31
1935	.28
1934	.42
1933	.54
1932	.62
1931	.79
1930	.98
1929	1.09

This graph shows, in white bars, Post Office payments and, in shaded bars, the number of miles of air mail flying by domestic lines in the United States by fiscal years. During the fiscal year 1937 the average rate of payment per mile of flying with mail is 32 cents.

years shows that even during the inclement weather months air passenger travel is steadily increasing. Express is also increasing rapidly. Despite the express poundage transported, express revenues to the air-mail contractors are still a minor factor.

"The tables show that 4,639,424 pounds of express were transported by air-mail contractors during the fiscal year, for which they received a revenue of only $796,171.08, whereas 15,377,993 pounds of air mail were transported, from which they received a revenue of $12,034,953.89.

"Increased rates fixed by the Interstate Commerce Commission

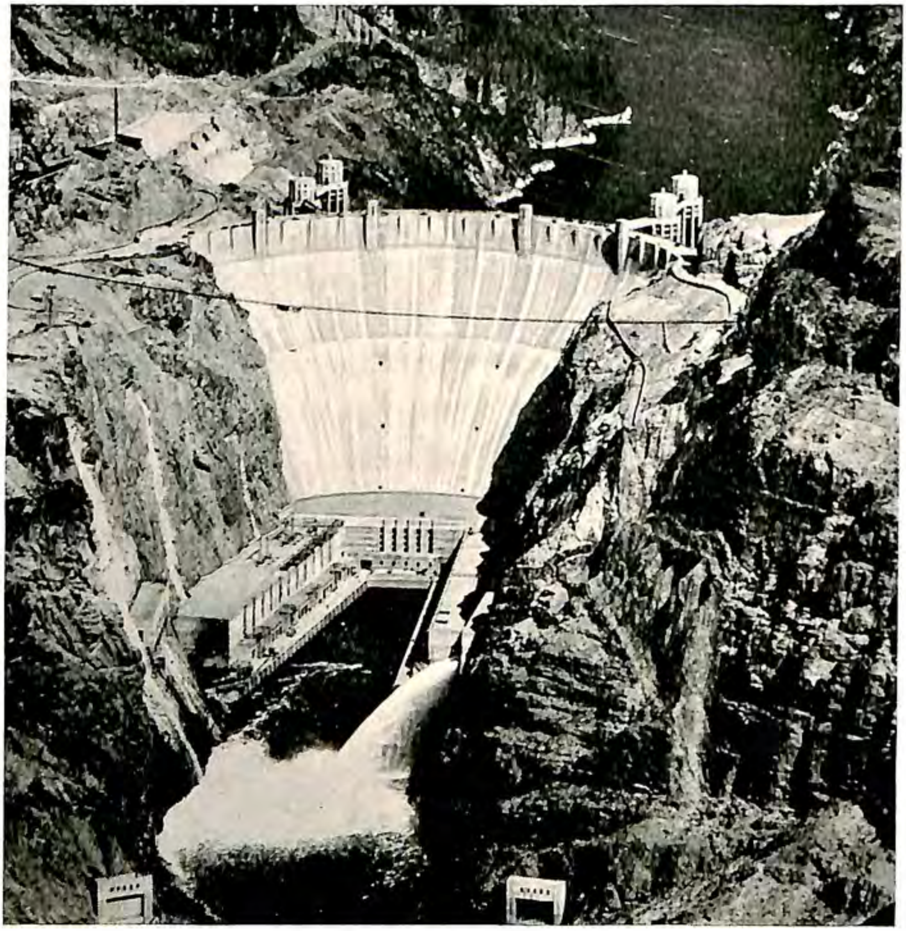


THE POSTAL DOLLAR

During the fiscal year 1936 only 1.6 cents out of every dollar of expenditures by the U. S. Post Office Department were spent for flying the mail in the United States.

became effective on 24 routes. As of the service in effect at the end of the fiscal year, the increases amounted to $1,539,229.45 per annum. These increases account for the greater portion of the increase in expenditures for air-mail service. Tables published in the appendix show the bid rates and the rates prescribed by the Interstate Commerce Commission; also the scheduled miles in effect at the close of the fiscal year.

"In connection with investigations of the mail contracts and as a



A VIEW OF BOULDER DAM

From a passenger plane on the Western Air Express route between Los Angeles and Salt Lake City.

result of extended negotiations with the contractors, agreements were reached during the fiscal year for material reductions in compensation for service on the foreign air-mail routes, effective October 1, 1935; also other adjustments of service were made, effecting savings in expenditures. The total annual savings amount to approximately $1,038,700.

"A materially expedited service has been put into operation on the air-mail routes to Central America, South America, and the West Indies. Flights are now made from Miami, Fla., via Cuba and Jamaica to Colombia in less than 10 hours; to the Canal Zone in 24 hours; to Argentina in 4½ days; and to Rio de Janeiro and other points in Brazil in 5 days. Service to the other countries has been correspondingly expedited.

"There has been a material increase in the amount of air mails carried on the routes to the Latin-American countries. The increase over the amount carried in the previous year of the mails dispatched from this country was 26.6 percent, and the increase in the mails received was 22.5 percent.

"A contract for trans-Pacific air-mail service from San Francisco, Calif., by Honolulu, Hawaii, Guam, and Manila, P. I., to Canton, China (or other adjacent point), and return, once a week, was let October 25, 1935, for a 10-year term to begin at a date optional with the contractor but not later than October 25, 1936. Service was inaugurated November 22, 1935, on that part of the route from San Francisco, by Honolulu and Guam, to Manila and return, service beyond Manila to a point in Asia being deferred under a provision of the contract until satisfactory operating arrangements are completed. Fourteen flights were made to June 30, 1936, and regular weekly flights available to passengers are now being made."

Regarding international air mail poundage the Postmaster General submitted this table for the fiscal year 1936:

	Pounds	Increase over 1935
On United States foreign air-mail routes:		*Percent*
United States origin	145,782	29
Canal Zone origin	11,865	25.5
Foreign origin	126,611	19
Total	284,258	24.35
On United States domestic routes only:		
Foreign origin (does not include mail from Mexico and Canada, figures on which are not available)	22,281	47
On foreign routes other than those of Canada, Cuba, and Mexico:		
United States origin	30,094	53

Following are some of the air line operations as reported by the companies.

American Airlines

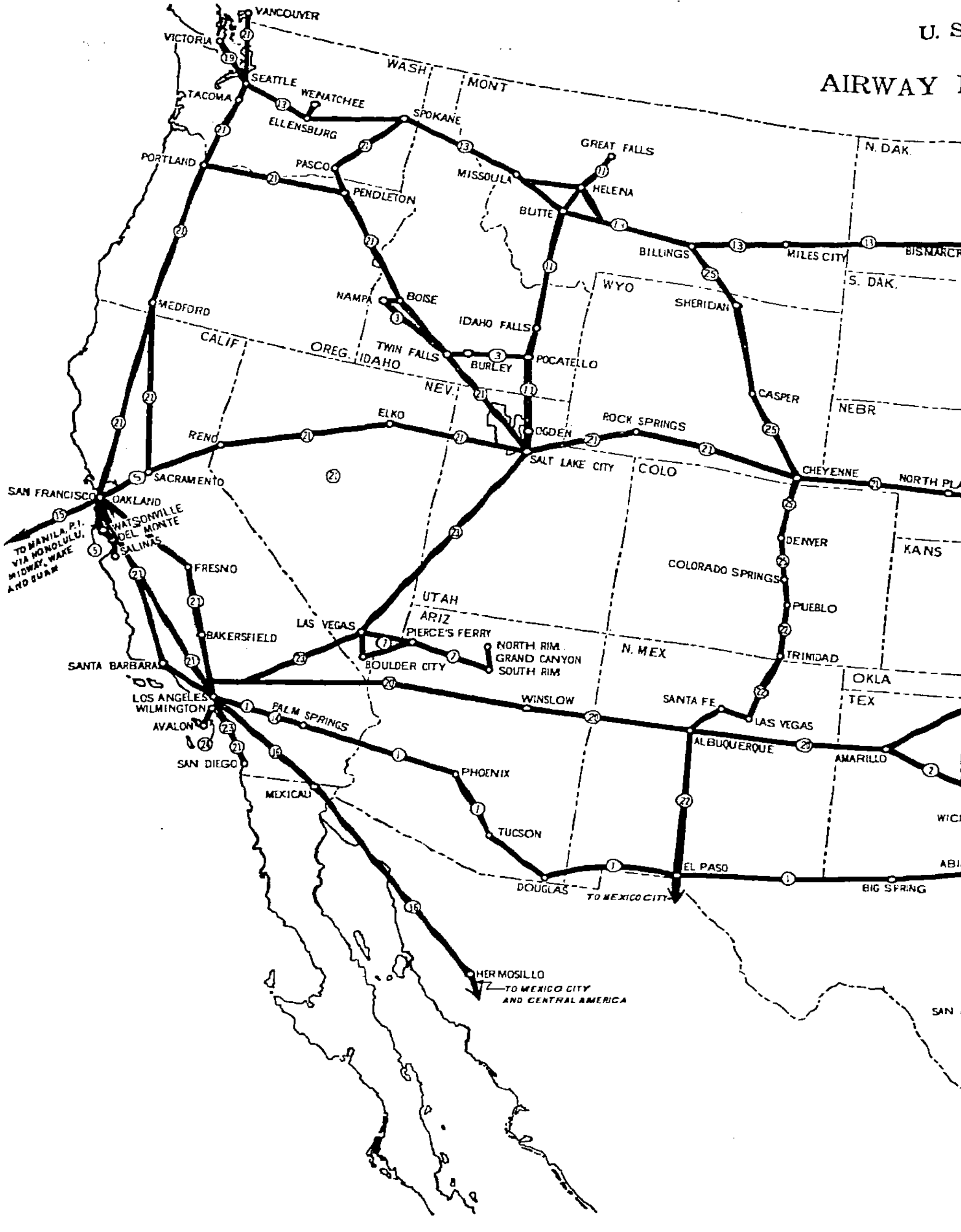
Anticipating an increasing market for faster and more comfortable services on its nation-wide transport system, American Airlines observed its tenth anniversary during 1936 by acquiring a fleet of 20 giant Douglas DC-3 and DST Flagships for approximately $2,100,000, ordering five additional Flagships for $525,000 and thus increasing the cost of its gigantic re-equipment program of the last two years to more than $4,750,000. The wisdom of this program was demonstrated when American Airlines claimed that it had transported more passengers over its routes during a given period than any other air transport system in the world.

American's first Flagship, delivered in May, promptly performed up to all advance notices. The largest and fastest land transport ever built in the United States, this new plane flew the 910-mile stretch from Dallas to Chicago, non-stop, in four hours 22 minutes, an average of 208.2 miles an hour. It further demonstrated its cruising range by flying from Chicago to New York and back to Chicago without stopping or refueling, and later flying from Los Angeles to Chicago without stopping.

These performances paved the way for the new non-stop schedules between New York and Chicago, including double daily non-stop services, as well as non-stop on seven of the 10 round trips daily between New York and Boston.

Having pioneered sleeper services on its southern transcontinental route in 1934, American Airlines replaced its Condor Sleepers with 14-passenger Flagship sleeper planes and on September 18 launched the "American Mercury," a through, over-night, coast-to-coast service in either direction between New York and Los Angeles, stopping only at Memphis, Dallas and Tucson but without any change in planes. That new service enabled a traveler to leave Los Angeles late in the afternoon, enjoy a comfortable night's sleep in Pullman style and arrive in New York the following morning, all within a period of 15 hours and 50 minutes. The westbound flight of the "American Mercury" requires 17 hours and 41 minutes. Another through, overnight, transcontinental schedule, "The Southerner", making but four intermediate stops, was started in both directions on October 1.

A word about the Flagships in their sleeper and club plane versions which made possible these non-stop and through sleeper services. Both marked the Douglas Aircraft Company's latest and greatest achievement in the air transport manufacturing field. Whereas the Flagship club plane on the non-stop Boston-New York and New York-Chicago routes accommodated 21 passengers and a crew of three, the Flagship sleeper planes in transcontinental service were equipped with



U. S
AIRWAY
VANCOUVER
VICTORIA
SEATTLE
TACOMA
WENATCHEE
ELLENSBURG
SPOKANE
PORTLAND
PASCO
PENDLETON
WASH
MONT
GREAT FALLS
MISSOULA
HELENA
BUTTE
BILLINGS
MILES CITY
BISMARCK
N. DAK.
S. DAK.
WYO
SHERIDAN
NAMPA
BOISE
IDAHO FALLS
TWIN FALLS
BURLEY
POCATELLO
MEDFORD
CALIF
OREG.
IDAHO
NEV.
CASPER
NEBR
ELKO
ROCK SPRINGS
RENO
OGDEN
SALT LAKE CITY
COLO
CHEYENNE
NORTH PLA
SAN FRANCISCO
OAKLAND
SACRAMENTO
WATSONVILLE
DEL MONTE
SALINAS
TO MANILA, P.I. VIA HONOLULU, MIDWAY, WAKE AND GUAM
DENVER
KANS
COLORADO SPRINGS
PUEBLO
FRESNO
UTAH
ARIZ
LAS VEGAS
PIERCE'S FERRY
BAKERSFIELD
NORTH RIM
GRAND CANYON
SOUTH RIM
BOULDER CITY
N. MEX
TRINIDAD
SANTA BARBARA
OKLA
LOS ANGELES
WILMINGTON
AVALON
WINSLOW
SANTA FE
TEX
PALM SPRINGS
LAS VEGAS
ALBUQUERQUE
AMARILLO
SAN DIEGO
PHOENIX
MEXICALI
TUCSON
EL PASO
DOUGLAS
TO MEXICO CITY
BIG SPRING
HERMOSILLO
TO MEXICO CITY AND CENTRAL AMERICA

. DEPARTMENT OF COMMERCE

BUREAU OF AIR COMMERCE

MAP OF THE UNITED STATES

SCHEDULED AIRWAY OPERATIONS

January 1, 1937

Route No.	*Operator*	*Routes Operated*	*Route Mileage*	*Class of Service*
1	American Airlines, Inc.	New York to Boston	192	MPE
		Boston to Cleveland via Albany & Buffalo	673	MPE
		New York to Chicago via Buffalo & Detroit	779	MPE
		Detroit to Chicago via Kalamazoo	261	MPE
		Detroit to Chicago (direct)	245	PE
		Chicago to Ft. Worth via St. Louis & Tulsa	940	MPE
		Cleveland to Nashville	469	MPE
		Washington to Chicago via Cincinnati	684	MPE
		New York to Los Angeles via Washington, Nashville & Dallas	2,649	MPE
		New York to Montreal	332	MPE
2	Braniff Airways, Inc.	Chicago to Dallas via Kansas City & Wichita	965	MPE
		Amarillo to Dallas to Galveston	618	MPE
		Dallas to Houston	225	MPE
		Dallas to Brownsville	546	MPE
		Houston to Corpus Christi	186	MPE
3	Capital Airlines, Inc.	Pocatello to Boise	230	PE
4	Chicago & Southern Air Lines, Inc.	Chicago to New Orleans	892	MPE
5	Condor Air Lines	San Francisco to Salanias	100	PE
		Alameda to Sacramento	80	PE
6	Delta Air Corporation	Charleston to Dallas	1,065	MPE
7	Grand Canyon Airlines, Inc.	Boulder City to Grand Canyon	260	PE
8	Hanford Airlines, Inc.	Tulsa to Omaha	383	MPE
		Minneapolis to Omaha via Sioux City	320	MPE
		Sioux City to Bismarck	391	MPE
9	National Air Line System	St. Petersburg to Jacksonville via Daytona Beach	237	MPE
10	National Airways, Inc.	Boston to Bangor	213	MPE
		Boston to Burlington	188	MPE
11	National Parks Airways, Inc.	Salt Lake City to Great Falls	483	MPE
12	North American Aviation, Inc., (Eastern Air Lines Division)	New York to Miami	1,209	MPE
		New York to New Orleans via Atlanta	1,218	MPE
		Chicago to Miami via Atlanta & Jacksonville	1,267	MPE
		New Orleans to Houston	329	MPE
13	Northwest Airlines, Inc.	Chicago to St. Paul via Milwaukee	405	MPE
		Chicago to St. Paul (direct)	364	MPE
		St. Paul to Pembina via Fargo	361	MPE
		Fargo to Seattle	1,264	MPE
		Pembina to Winnipeg	65	MPE
14	Palm Springs Airlines	Los Angeles to Palm Springs	100	PE
15	Pan American Airways, Inc.	Miami to Havana	229	MPE
		Miami to San Juan	1,161	MPE
		San Juan to Rio de Janeiro	4,571	MPE
		Rio de Janeiro to Buenos Aires	1,471	MPE
		Miami to Cristobal via Kingston & Barranquilla	1,713	MPE
		Barranquilla to Port of Spain	1,021	MPE
		Miami to Nassau	188	MPE
		Brownsville to Mexico City via Tampico	466	MPE
		San Francisco to Manila, P. I. via Honolulu, Midway, Wake and Guam	7,990	MPE
		Belem, Brazil to Fortaleza, Brazil	810	PE
		Fortaleza to Rio de Janeiro	1,764	PE
		Rio de Janeiro to Porto Alegre, Brazil	817	PE
		Mexico City to Cristobal via Guatemala	1,764	MPE

See next column

Route No.	Operator	Routes Operated	Route Mileage	Class of Service
		Mexico City to San Jose, C. R.	1,304	PE
		Miami to Merida	748	PE
		Merida to Mexico City	736	PE
		Kingston to Port au Prince	304	PE
		Port au Prince to Santo Domingo	161	PE
16	Pan American Airways, Inc. (Aerovias Centrales)	Los Angeles to Mexico City	1,684	PE
17	Pan American-Grace Airways, Inc.	Cristobal, Canal Zone to Montevideo, Uruguay via Santiago, Chile	4,552	MPE
18	Pennsylvania-Central Airlines Corp.	Washington to Detroit via Pittsburgh & Cleveland	469	MPE
		Detroit to Milwaukee	259	MPE
		Cleveland to Detroit (Direct)	93	MPE
19	Seattle-Victoria Air Mail, Inc.	Seattle to Victoria	74	M
20	Transcontinental & Western Air, Inc.	New York to Los Angeles via St. Louis	2,555	MPE
		New York to Los Angeles via Chicago	2,583	PE
21	United Air Lines Transport Corporation	New York to San Francisco	2,647	MPE
		Salt Lake City to Seattle	816	MPE
		Pendleton to Spokane	169	MPE
		San Diego to Seattle	1,198	MPE
		Seattle to Vancouver	123	PE
22	Varney Air Transport, Inc.	Pueblo to El Paso	519	MPE
23	Western Air Express Corp.	San Diego to Salt Lake City	702	MPE
24	Wilmington-Catalina Airline, Ltd.	Wilmington to Avalon	31	PE
25	Wyoming Air Service, Inc.	Billings to Cheyenne	380	MPE
		Cheyenne to Pueblo	199	MPE

M—Mail P—Passenger E—Express

berths for 12 and a "sky room" or private drawing room. All berths were convertible for day flight, providing seats for as many as 28. These planes were powered with two 1,000 horsepower Wright Cyclone engines, with a cruising speed of 190 miles an hour, and were alike in design except for their interiors.

Not content with providing berths six feet five inches long and wide as a twin bed, and separate dressing rooms and toilets for men and women, American Airlines' sales department introduced throughout the Flagship in both its sleeper and club plane versions many of the air transport world's most unique innovations. Noiseless typewriters, electric razors, cigarette lighters, meals served on tables with silverware, real china, linen, and even monophone communication between the pilots' compartment and the cabin as well as other devices not previously available on the air lines became standard equipment on these giant planes. Air conditioning at terminals and aloft, as well as soundproofing were some of the attractions.

With the subsequent delivery of its entire fleet of 20 Flagships, American Airlines had eight 14-passenger Flagship sleeper planes in through, transcontinental service and 12 21-passenger Flagship club planes in non-stop service from New York to Boston and Chicago. This development made available the re-distribution of fifteen 14-passenger Douglas DC-2 transports as well as a number of multi-motor Stinson A transports for the improvement of service on other of its routes. All Curtiss Condors and Vultees were retired from service late in 1936.

Anticipating also the day when globe-encircling air service would be common, the Company entered into an exclusive air line agreement with the Deutsche Zeppelin-Reederei for flying its passengers between New York and Lakehurst, and on May 9 with the Zeppelin "Hindenburg's" first arrival at Lakehurst flew 31 of its 51 passengers to New York. Flagship club planes were subsequently employed in connecting at Lakehurst with all arrivals and departures of the "Hindenburg."

Supplementing the non-stop and sleeper services, American Airlines made numerous improvements in schedules during 1936. Stinson A's were put into operation between Boston and Cleveland and also introduced in local service between Washington, D. C. and Nashville, serving Lynchburg, Roanoke, Bristol and Knoxville. Direct passenger service between New York and Cincinnati via Washington, D. C. was resumed with Douglas DC-2 planes, and a round-trip service between Chicago and East St. Louis, non-stop, was started. Flight schedules were speeded on other routes. Douglas DC-2 ships were put in service on the Chicago-Ft. Worth division, serving St. Louis, Tulsa, Oklahoma City; and also between Cleveland and Nashville; and Stinson A transports between Boston and New York on local runs serving Providence, R. I., Hartford and New York.

The company continued its school of instruction for hostesses and members of the sales department. Having originated the idea of air line scrip about three years ago, the American Airlines sales department cooperated with the national organization of 20 air lines in selling air transportation by this plan; and late in 1936 reported that more than 1,900 companies were participating in it and that over 27,000 individuals were identified with it.

Continuing its action of 1935 in establishing meteorological stations at its key cities, Chicago, Newark, Cincinnati, Nashville, Ft. Worth and Glendale, from which individual weather forecasts were issued prior to each flight, the company's meteorology department during 1936 began cooperating with the sales department by providing it with complete weather information for prospective passengers, at six hour intervals.

The maintenance department, which earlier in 1936 developed a system of automatic valve lubrication, perfected brake-test equipment suitable for all types and also designed hydraulic jacks permitting a Flagship to be lowered with landing gear retracted, thus making it more accessible for mechanical servicing. This department also had under consideration an improved type of ignition harness with which it expected to obtain greater performance and more economy of operation at higher altitudes.

After experiments with de-icing equipment during the winter of 1935-36, the operations department late in 1936 began installing deicers on all the Flagships. It also completed the construction at Chicago of a new instrument overhaul base featuring the latest facilities, including air conditioning as an additional assurance against dust. Complete facilities for overhauling the Sperry automatic pilots, with which all Flagships were equipped, were installed at the Chicago base.

At the beginning of 1937, American Airlines was operating day and night schedules over 6,714 miles of airways. With never less than five planes in the air day and night, and often represented with a maximum of 32 planes aloft, American Airlines schedules called for flying 48,525 miles every 24 hours. The company employed 1,565 persons, including 118 pilots, 78 co-pilots and 77 stewardesses. American Airlines divisions included Ft. Worth-Dallas-Los Angeles, Newark-Chicago, Boston-Newark, Boston-Cleveland, Cleveland-Nashville, Newark-Ft. Worth, Washington-Chicago, Chicago-Ft. Worth and Newark-Albany.

Further improvements in service with still more and faster schedules were important items of American Airlines' program for 1937. This was indicated in its order, placed late in September, for five additional Flagships at a total cost of $525,000, for delivery early in 1937.

Chicago & Southern Air Lines

Early in 1936 it became apparent that larger and faster ships would be required to accommodate the increasing number of passengers flying the "Valley Level Route" between Chicago and New Orleans. Accordingly, Chicago and Southern Air Lines placed an order for a fleet

THE CHICAGO AND SOUTHERN

A Wright Whirlwind-powered Lockheed Electra transport bound for New Orleans.

of Lockheed Electras, powered with Wright engines, and these ships were delivered during April. Electra service replaced the former equipment between Chicago and St. Louis on April 20. Eleven days later the Electras were continued on down to New Orleans by way of Memphis and Jackson, Miss. Passenger business immediately improved and increased in volume from month to month.

A special speed flight was made between Chicago and New Orleans on April 28, with Major James H. Doolittle as guest pilot at the controls and senior line-pilot, W. J. Fry, acting as co-pilot. The passengers consisted of representatives of the press accompanied by company officials. The sleek Lockheed covered the 903 miles of airways, with a 15 minute stop at Memphis, in five hours 45 minutes, despite adverse weather conditions, establishing a new speed record between the terminals.

Chicago and Southern was granted a Certificate of Convenience and Necessity by the Illinois Commerce Commission permitting the company to transport passengers intrastate in Illinois. This resulted in Peoria and Springfield receiving, for the first time, service provided by all metal, multi-motor airplanes.

SUPPER ON A NIGHT FLIGHT

Passengers on this Eastern Air Lines transport are enjoying a meal while flying through space at three miles a minute speed.

With the purchase of Lockheed Electras a complete Western Electric radio communications system was installed. Newest type company transmitters were placed in the five principal line cities. Ships were equipped with the conventional type of duplicate receivers and transmitters. A meteorological department was instituted, to become an outstanding aid to operations. Shop and maintenance facilities in the company headquarters at Lambert Airport, St. Louis, were improved during the year. Additions included the erection of hydraulic hoists for lifting and lowering the new ships and a new department for complete overhaul of propellers. In New Orleans it was necessary to move into larger quarters at Shushan Airport, at which time the mechanical personnel of the station was increased. During July, Chicago operations at the Municipal Airport moved into additional space. The traffic department was augmented by additional traffic solicitors and the remodeling of the company's district offices. More accounting personnel was also added.

The outstanding improvements in connection with this central valley service so stimulated travel that the company planned additional schedules for 1937. During 1936 it made two flights a day each way, on a six hours and 25 minute schedule, permitting early evening departures with arrivals at the opposite terminal before midnight.

Eastern Air Lines

Continuing the expansion which led Eastern Air Lines into a foremost position in domestic air transportation, the company at the beginning of 1937 was operating 3,143 miles of passenger, mail, and express routes under the personal supervision of Colonel E. V. Rickenbacker, America's ace of aces. A total of 18,918 miles daily flying were scheduled during 1936 as against the 13,106 scheduled daily miles in 1935. A 25 per cent increase in revenue passenger traffic was noted for the year. Part of this increase was attributed to the 15 daily round trip service between Newark Airport and Washington, D. C.

That service, expanded on May 15 from 12 daily round trips, was the most frequent service between any two cities in the world. Colloquially termed the "Merry-Go-Round," this schedule used only Douglas 14-place transports, and most trips were on 80-minute schedules. Interspersed among these 80-minute schedules were slightly longer flights which served Philadelphia, via Camden, Baltimore, and Richmond, as well as Washington. In addition to this celebrated Washington run, Eastern Air Lines operated two round trips daily from Newark to Miami and two round trips from Newark to New Orleans. The Miami schedule called for stops at Washington, Raleigh, Charleston, Savannah and Jacksonville. The New Orleans schedule provided stops at Washington, Richmond, Greensboro, Charlotte, Spartanburg, Atlanta, Montgomery and Mobile.

From Chicago, the northwestern terminus of the Great Silver Fleet system, planes stopped at Indianapolis, Louisville, Nashville, Chattanooga and Atlanta on their daily round trips to Miami and New Orleans. Eight and one half hour schedules prevailed on the New York-Miami and the New York-New Orleans runs, while approximate 10-hour schedules were operated between Chicago-Miami and Chicago-New Orleans. The addition of two Douglas 21-passenger DC-3 ships to Eastern Air Lines' fleet of five Lockheed Electras and 14 Douglas DC-2 transports gave it a deluxe express service to Miami with less-than-eight hour schedules.

Addition of 40 flight-stewards to the personnel of Eastern Air Lines marked a revolutionary change from the usual hostess service. Proceeding on the theory that trained servants were best equipped to

ON EASTERN AIR LINES

One of its Cyclone-powered Douglas transports speeding over the line between Chicago and Atlanta.

attend and anticipate the needs of its passengers. Eastern Air Lines on December 1 put flight-stewards on all New York-Miami schedules. Stewards later were to be placed on all other runs.

Recruited from the ranks of the best-trained servants available the flight-stewards had expanded tremendously the original conception of aviation passenger service. They numbered among their duties the handling of incidental luggage brought into the passenger cabin, care of through passengers in stops along the line, handling over-exuberant passengers with tact and skill, and manifold other functions.

Eastern Air Lines reported a one hundred per cent increase in the number of air express shipments.

Experimental work through the early part of 1936 finally led to the installation on all Eastern Air Lines planes and in all EAL ground stations equipment for transmitting messages from plane to ground and vice-versa on a radio channel of their own to supplement the regular point-to-point radio service. In this way there was no possibility of confusion between the two types of radio messages. Planes could talk to their ground stations on an entirely different wave-length. At the beginning of 1937 the company reported 32 million miles of scheduled flying since its organization in 1927.

On December 29, 1936, Assistant Secretary of Commerce J. Monroe Johnson made public letters between himself and Col. E. V. Rickenbacker, general manager of Eastern Air Lines, relative to increasing safeguards for regular air transport. Col. Rickenbacker wrote:

"My dear Col. Johnson:

"As you know Eastern Air Lines has been extremely fortunate in its recent difficulty through the forced landing of our pilot, Dick Merrill, at Port Jervis, N. Y.

"Fortunate in the fact that not one of the passengers was injured, and the crew only slightly, permitting a detailed description of what actually took place and an opportunity to benefit accordingly.

"The causes of this accident have brought to surface, more vividly, the necessity for the following improvements:

"(a) That the Department of Commerce make every effort to modernize and raise to the highest standard of efficiency, all of its present air aids, as soon as Congress appropriates the necessary money.

"(b) That all modern air transports be equipped with radio compasses qualified to operate both day and night with antennas shielded against rain, sleet and snow static.

"(c) That the Department of Commerce equip all of its ground stations with T-L antennas offering the transport ships in the air a twenty-four hour a day service, with special identification for each city or airport, where the facilities of the Department are located, eliminating the necessity, as at present, of using commercial stations which are not consistent in announcing their designations, or on the air twenty-four hours a day.

"(d) That all Department of Commerce radio stations be equipped with radio direction finders on special frequencies, with personnel qualified to man them twenty-four hours a day, that may be trained on any operator's ship which may be temporarily lost due to unusual circumstances or conditions, giving them their exact location through the triangulation system, and directing them to the nearest airport that is open.

"It is my opinion that all of the operators have been sincere and diligent toward developing aids of this nature, the same as Eastern Air Lines has for the past two years, but progress has not been as rapid in the development of these aids as the progress of the art demands.

"The above recommendations are in no way a reflection on the pilot personnel of the American air transport industry who, in my opinion, are the finest body of self-disciplined men in existence.

"Neither are they a reflection on the operators or the executives of the respective air transport companies, who have been consistent in their watchfulness and effort toward greater safety and reliability and which, in a great measure, is responsible for America leading the world today in every branch of the art.

"Neither are they a reflection on your high office or any members of the Department of Commerce, but it is essential that Congress realize more fully the necessity of these aids and appropriate the necessary money as soon as possible.

"It must be realized by your Department and organization as it is by the air transport operators of this country that several of the accidents of the last three weeks were due to a most unusual combination of weather conditions unknown to any of us.

"These conditions may never occur again, and yet they may occur only one or two days a year, but if life and property are saved on these one or two days a year, the expenditure would be well merited.

"In my opinion, such aids as recommended above, in conjunction with those now in use, will eliminate 75 per cent of the possibility of such accidents as occurred to Dick Merrill of Eastern Air Lines.

"The public acceptance of air transport service recommends the serious consideration and support that your high office holds, and I am certain that you can rely on the hearty cooperation of those of us interested in the industry."

In his reply to Col. Rickenbacker's letter Col. Johnson stated:

"My dear Colonel Rickenbacker:

"I am in receipt of your very interesting letter of December 28th, and appreciate the fine spirit of cooperation evidenced therein.

"The lessons learned from the recent crash of the EAL ship flown by Dick Merrill are of particular interest and I am glad to advise that your recommendations are generally in accord with what we have had under consideration for some time and intend to carry through as soon as sufficient funds are available, and the new facilities, such as the airplane radio compass and radio direction finder for ground stations, are proven to have been developed to a point where they are free from rain and snow static interference, and otherwise sufficiently reliable.

"The Department recognizes the fact that all responsible operators are genuinely interested in the development of air navigation aids which may eliminate some of the types of accidents which have recently occurred and we will bend every effort toward the continued development and improvement of our ground facilities. But, in addition thereto, all air lines who are not already doing so should,

"(a) Make constant effort to improve their own radio equipment, both ground and plane installations. (There has been such rapid progress in the improvement of radio during the past two years that much of the equipment now installed on some air line planes and on the ground is obsolete.);

"(b) Expedite the installation of approved de-icing equipment both for carburetors and for plane structures;

"(c) And, those air lines who are authorized to do instrument, over-the-top, or night flying should take immediate steps to give all their pilots and co-pilots a thorough course under competent instructors on the Link Trainer, in addition to increasing the facilities for instrument training and check in air line type airplanes.

"The Department very confidently expects to secure adequate funds to make all the improvements in its air navigation facilities that you have suggested in your letter, plus several additional improvements.

"We have made definite plans to call into conference, at an early date, representatives of all air line operators, the Army, Navy, Coast Guard, and National Advisory Committee for Aeronautics, for the purpose of studying the records of all of the recent air line accidents and of ways and means which may be adopted to improve existing conditions and prevent another series of similar accidents. I will communicate with you further as soon as the date for this conference has been set.

"The Department of Commerce will not let up for one moment in its efforts to secure the necessary funds and facilities for improving the services which it provides for the air traveler, but it is essential to American aeronautics that all operators, commercial and military, and all Federal agencies interested in aeronautics cooperate to the fullest extent in order to maintain world leadership in air transportation. There has been a tremendous improvement in the safety of travel on scheduled air lines since 1930 but we feel confident that as funds and facilities are made available for the improvements we already have in mind for our navigation facilities, it will be possible to eliminate at least 75 percent of the type of accidents which we have experienced in the past and it is our determination to bring about these improvements as rapidly as possible."

Hanford Airlines

A fleet of Lockheed Electra air liners was purchased to supplant the old Ford equipment formerly used by Hanford Airlines. As a result of this new equipment, flying time was reduced materially between points on the Hanford line. A saving of one and one half hours of

THE YELLOWSTONE'S GRAND CANYON

United Air Lines passengers can transfer to a National Parks Airways Boeing transport and see this scenic wonder in a tour of an hour and a half.

flying time between Kansas City and Minneapolis was effected and also a saving of half-an-hour between Omaha and Kansas City.

On September 1, Hanford Airlines extended its service from Kansas City to Tulsa, Okla. This marked a resumption of service between those two cities which had been offered by another line, and supplied the Oklahoma oil market with a north outlet by air.

Inter-Island Airways

Inter-Island Airways, of Hawaii, completed seven years of operation November 11, 1936, with a record of carrying 80,000 passengers and flying 2,000,000 miles over water without accident to either passengers or employees.

INTER-ISLAND AIRWAYS
Passengers boarding Sikorsky S-43 amphibions at Honolulu, T. H.

During 1936, passenger traffic increased 40 per cent over the previous year. Starting service with two S-38 Sikorsky amphibians, the fleet has been increased to four S-38s and two S-43s, the latter the first of their type built. A third S-43 Sikorsky was delivered in January, 1937.

Daily scheduled round trips are operated among the Islands. Planes operate out of Honolulu on a 235-mile route to the southeast, touching the islands of Lanai, Molokai, Maui and Hawaii. To the northwest, planes travel 135 miles to the island of Kauai. Headquarters are maintained at John Rodgers Airport in Honolulu, ten minutes from the heart of the city. All flying is done from land bases. Emergency calls for chartered planes are frequent. The 380,000 persons living in the Territory are divided among six inhabited islands, some of which have but twice-a-week steamer service. With the Sikorsky planes it is possible to reach Honolulu from any island in an hour and a half. Planes are equipped with two-way radio and homing compasses and are in constant communication with the main base in Honolulu.

During 1937, Territorial and Federal governments plan expenditures of $1,000,000 to enlarge and improve fields on all islands. Plans

ALOFT WITH NORTHWEST AIRLINES

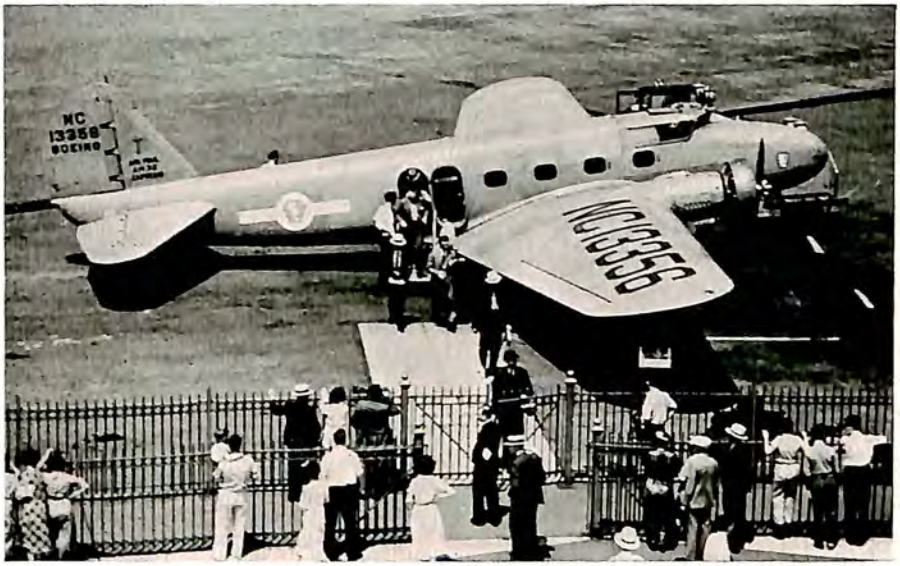
One of its twin-engine Whirlwind-powered Lockheed Electra transports flying west from Chicago.

have been tentatively approved for a $2,000,000 "international base" adjoining the Inter-Island Airways port at Honolulu.

National Airlines System

The following interesting report was received from G. T. Baker, of National Airlines:

"While our route is one of the shortest in the country, being 262 miles long, it is over some interesting terrain. Leaving Jacksonville, we fly down the beach of the Atlantic Ocean to Daytona Beach. From Daytona Beach we fly overland to Orlando, crossing numerous swamps, forests, and lakes. From Lakeland to Orlando the air traveler is impressed with the number and symmetry of the citrus groves below. From Lakeland to Tampa we fly over some of the largest phosphate mines, as well as over Plant City, which is known as the Strawberry City. Tampa is, as you know, the Cigar City of the country, as well as an important seaport. At this city they are building a beautiful new airport which is nearly completed on Davis Island within a mile and a half of the post office. From Tampa we fly over beautiful Tampa Bay, the rendezvous of pirates in earlier days, to St. Petersburg, with its downtown airport. Our passenger and express business in 1936 has increased from three to four hundred per cent over 1935. Our



MEETING THE 5:15

Passengers leaving the Boeing transport of Pennsylvania-Central Airlines at Pittsburgh, Pa.

mail poundage has more than doubled, and we look for additional big increases during the coming winter season, at which time we contemplate operating new all metal multi-engine planes."

National Parks Airways

On August 1, 1936, National Parks Airways commenced its eighth year of successful air line operations between Salt Lake City, Ogden, Pocatello, Butte, Helena and Great Falls. A feature of the service was the tourist travel to Yellowstone Park. All forms of traffic increased and passenger revenues gained 65 per cent.

Pennsylvania-Central Airlines

The Pennsylvania-Central Airlines Corporation resulted from the consolidation of two rival lines in November 1936. Operating through the very heart of the industrial East, Pennsylvania-Central supplies the equivalent of the service previously rendered by the two individual companies, on schedules designed to better serve the public. Eight round trips daily on non-overlapping schedules are flown between Washington, D. C., Pittsburgh, Akron, Cleveland, Detroit, Lansing, Grand Rapids, Muskegon, and Milwaukee. However, the line is by no means purely local in character because it connects with many other trunkline systems, thereby serving the entire country. At present the combined operations of the two concerns show a monthly average of 243,000 scheduled miles being flown and more than 6,000 passengers,

TOMLINSON AND HIS STRATOSPHERE PLANE

D. W. Tomlinson and his TWA flying laboratory equipped for transcontinental flying at a height of 35,000 feet. The plane is a Northrop Gamma powered by a Wright G Cyclone engine with Hamilton Standard constant speed propeller.

30,000 pounds of air express, and 45,000 pounds of air mail being transported over a route 727 miles in length.

Transcontinental & Western Air

TWA cut the flying time and reduced passenger fares on its coast-to-coast system in 1936. Reductions in flying time of from half an hour to more than an hour were made in the schedules. Matching TWA's eastbound Sky Chief schedule of 15 hours and 23 minutes, a new and faster westbound Sky Chief schedule of 16 hours and 59 minutes was set up. The difference in the time allowed to make the flights, which were the fastest coast-to-coast schedules, was attributed to prevailing winds.

The elimination of some stops on the express runs and quicker handling of planes on the ground permitted speeding up of TWA schedules.

At the same time TWA announced the "Sky Century," an afternoon non-stop flight to Chicago. This operated on a four hours 45 minute westbound schedule and a three hours 55 minute eastbound schedule. The special winter passenger rates, which went into effect November 1, cut the cost of air travel on the TWA system below rates on extra fare trains. The New York to Los Angeles fare was cut from \$160 to \$139.95. Using scrip, the cost of the coast-to-coast flight was \$118.96. New York to Chicago fare was reduced from \$47.95 to \$39.95 or \$33.96 figured on the scrip basis. This was \$6.79 less than

KEEPING AIR LINERS IN TRIM

Experts go over every part of the ship after it has been in the air a certain number of hours.

the fare on crack trains between the two points and 71 cents more than the regular train fare of rail plus Pullman. Time in transit to Chicago was four hours 45 minutes as against 18 hours by rail. The reductions were in line with standard transportation practice of other carriers which found that special winter rates stimulate travel at a time when traffic ordinarily falls off.

An innovation in transportation was introduced on October 19 when TWA opened the first air freight service using "flying box cars."

They were the company's old Ford airplanes with a pay load capacity of 3,500 pounds. Operations were started between New York and Chicago, with intermediate stops at Philadelphia, Pittsburgh, Columbus and Indianapolis. Midnight to dawn freight service was offered in each direction, with departures from New York and Chicago at midnight and arrival at the other terminal before the opening of business.

Assignment of the Ford equipment to the transportation of air freight in no way conflicted with the operation of the regular General

THE OLD AND THE NEW

Sixty miles west of Albuquerque, N. Mex., is the Sky City of Acoma, believed to be the oldest continuously inhabited Indian village in America. Here it is viewed from a TWA plane on the New York-Los Angeles route.

Air Express service. The latter service was continued as before and, of course, commanded a higher rate than air freight, as the express consignments were carried from coast-to-coast on the regular TWA Skyliners with frequent departures. Rates for the new air freight service were reduced to 57 per cent of the regular tariffs charged on the General Air Express system.

Other innovations by TWA included changes in its entire fleet of Douglas Skyliners to make the seats convertible for sleeping. Another forward step in passenger comfort was standardization of air-conditioning units at TWA's principal stations. These units pre-cool or pre-heat conditioned air and force it into the cabins of Skyliners before flight, supplementing the naturally cool air aloft in summer months or the steam-heated air in winter. All passenger planes were completely equipped with de-icing facilities, including the recently perfected de-icing equipment for propellers. New instruments for aiding the pilot were installed in TWA ships, with other mechanical improvements as rapidly as these were perfected and proved.

Bourke-White Photo

MAIL AND EXPRESS BY AIR

Stowing a cargo in a TWA Cyclone-powered Douglas for the transcontinental run.

TWA reported for the calendar year 1936 that nearly 23,000 more revenue passengers were transported than in 1935, and that the revenue passenger miles flown increased by nearly 15 million. Mail pound miles jumped by more than 660 million, while air express, carried by General Air Express, increased by more than 135 million pound miles. The actual number of revenue passengers transported by TWA in 1936 was 88,851. The total pounds of air mail flown in 1936 was 2,120,182 as compared with 1,587,884 in 1935. Air express increased to 368,671 pounds in 1936 from the 1935 total of 254,971 pounds. In addition to the cargoes handled by General Air Express, TWA planes also transported 28,882 pounds of air freight. TWA reported that its planes operated a total of more than nine million miles and completed over 95 per cent of scheduled flights. Early in 1937 the company ordered from the Boeing Aircraft Company six four-engine transports for delivery in 1938.

UNITED AIR LINES LOUNGE
Aboard one of the Douglas DC-3 club transports in United Air Lines service.

Flying at an altitude of 35,000 feet, well above the strata of weather, D. W. "Tommy" Tomlinson, assistant to the president of TWA, in 1936 conducted the first of a series of tests in high altitude or "overweather" flying.

Tomlinson used a Cyclone-powered Northrop Gamma on his high altitude flights. He was sent aloft to study conditions encountered in the "overweather" belt and to chart the problems which must be solved before passengers can be carried at those levels. His findings on the first series of flights were applied to designs and plans being made by

TWA officials for the development of an "overweather transport."

High altitude flight offered great potentialities for maintaining schedules, smooth flight and safety in travel through the air, and TWA officials disclosed plans for the development of great aircraft of 50-passenger capacity and with wings 150 feet from tip to tip. They

SAN FRANCISCO'S TRANS-BAY BRIDGE

As viewed by passengers on a United Air Lines Boeing transport over San Francisco.

hoped to have such ships in service on the TWA route in two years. The research work carried on by Tomlinson was directed toward the development of these giant high altitude ships.

Primarily, the work of the laboratory plane was directed toward engine research. Supercharging equipment was tested under all conditions, fuel consumption had to be determined, speed differentials had to be known. Tomlinson was accompanied by James Heistand, development engineer for TWA. A special set of instruments were installed in the observer's compartment of the Gamma. In order that their readings might be recorded permanently a photograph of the entire panel was taken as the machine ascended each 1,000 feet of altitude. A camera, suspended at the rear of the compartment on a fixed mounting took the pictures as special lights were turned on by the observer to illuminate the instruments for these pictures. These instruments, 36 in all, told the story of the engine's functioning. When the plane reached an altitude of 35,000 feet obviously oxygen had to be provided for the pilot and the observer. Special heating equipment also was carried because 30 degrees below zero might be encountered.

On the high altitude flights heat was provided through a special heater operating from the exhaust of the plane's engine. Although both pilot and observer wore light summer clothing each was comfortable. The oxygen used by Tomlinson and Heistand also was heated before it was taken into their lungs. The degree of heating could be regulated separately by pilot and observer that each might suit his individual ideas.

Throughout each flight the plane was in touch by radio with one or more TWA ground stations. So that Tomlinson might have both hands free to manipulate the many controlling devices in his compartment, a special microphone frame was devised which also held the oxygen tube in one corner of his mouth. Thus he was able to inhale oxygen or talk by radio to the ground without the necessity of using his hands to hold the tube or the microphone.

United Air Lines

At the beginning of 1937 United Air Lines reported the last 12 months to have been the most successful in its history. It carried more traffic, maintaining its position of flying more passenger miles than any other line in the world. United Air Lines also completed conversion of its fleet of twin-engine Wasp-powered Boeing transports to model 247-Ds, making them faster, quieter and more comfortable than ever before; completed the flying of 100-million miles, becoming the first air line in the world to attain this tremendous total; observed its tenth anniversary of operations on April 6, 1936; cooperated in the preliminary engineering and joint action of five air lines in ordering the new type four-engine 40-passenger plane; and placed in service a fleet of twenty Douglas DC-3 21-passenger and 14-passenger super-transports.

In 1936 the company substantially bettered its volume of traffic over the previous year, when, in 1935, United carried 177,457 revenue-passengers and flew 15,000,000 airplane miles. Total revenue-passengers for 1936 numbered about 215,000, with the company flying approximately 17,500,000 airplane miles.

MEDITATION AT 3 MILES A MINUTE

And it takes smooth flying to keep these checkers in place. Aboard a United Air Lines Wasp-powered Boeing transport over the Middle West.

Air express continued to establish a new record, the company carrying approximately fifty per cent more express than in 1935, when a total of 1,723,000 pounds was transported. Air mail, too, continued to show substantial gains, and it was indicated that 1936 would total approximately 20 per cent more mail poundage than the 5,000,000 pounds flown on United's routes during 1935.

United, in order to accommodate this intensely increased passenger and mail traffic, flew greater scheduled mileage than ever before, establishing a world record for total miles flown in a single month on one air line, by completing 1,724,102 miles in August, 1936. So heavy was United's traffic that extra sections were frequently flown in addition to the regularly scheduled seven round trip flights daily between New York and the West, 11 between Chicago and New York, 11 between San Francisco and Los Angeles, five between Seattle and Portland and three along the entire length of the Pacific Coast.

United entered 1936 with its entire fleet of twin-engined Boeings in virtually brand new condition. New series S1H1 geared Wasp engines had been installed and the planes equipped with three-bladed constant speed propellers, the first installation of a constant speed propeller on an air line in the United States. Installation of the new power plants resulted in raising the cruising speed of the 247-D Boeings to 189 miles an hour at the most efficient cruising elevation, and enabled United to substantially speed up its schedules coast-to-coast and between principal cities. United had also completely soundproofed the interior of its fleet and installed new ventilating-heating systems and a new decoration scheme, to increase the popularity of the Boeings with the air traveling public.

A survey showed, first, that United needed immediate delivery of additional planes to amplify its fleet of Boeings, and, secondly, that the potential future volume of traffic justified plans for a super air liner considerably larger than any land planes previously used. United engineers took an active part in developing specifications for this super liner and were joined by engineers of four other principal air lines, in a contract for an experimental four-engined 40-passenger transport from the Douglas company for delivery of the experimental plane first to United Air Lines in 1937 for test purposes.

To solve its more immediate equipment problem, United ordered twenty DC-3s from Douglas. Of this fleet, 10 were 21-passenger and the balance of the fleet a deluxe model with accommodations for only 14 passengers in the 21-passenger cabin. Henry Dreyfuss, leading interior decorator and industrial designer, who had just completed the design on the interior of New York Central's crack speed train, the "Mercury," was commissioned by United to design the interiors of its DC-3 ships to provide greater luxury.

The company's plans for service with these ships called for placing them on coast-to-coast and Chicago-New York flights, faster than those formerly in operation. The majority of United's fleet of Boeings were to continue in operation on coast-to-coast schedules with more frequent stops and for more frequent intermediate and local types of service.

On June 17, 1936, United passed one of the most significant mileposts in aviation history—its 100-millionth mile of flying, becoming the first air line in the world to reach that coveted goal in flying experience. On that date, only shortly after the celebration of the company's tenth anniversary of operations, United's record included the carrying during the past ten years of 775,000 passengers, 17,000 tons of air mail and 2,400 tons of air express.

Among the important contributions which United had made to the development of air transportation were the establishment of the first

UNITED AIR LINES BIRTHDAY

Passengers boarding a Wasp-powered Boeing transport to begin the second hundred million miles of flying with United Air Lines.

coast-to-coast service; the first long-distance night flying of passengers on regular schedules; the first multi-motored transport plane capable of a speed of over three miles a minute; the first two-way radio-telephone communication between planes and the ground and the first instrument radio landing system.

On April 6, 1936, the company officially observed its tenth anniversary, which stamped it as the oldest organization now engaged in the transportation of passengers, mail and express by air. On April 6, 1926, Varney Air Lines, predecessor division of United on its Pacific Northwest route, inaugurated mail schedules to fly United's first mile.

Faced with statistics which showed that 75 per cent, or more, of its passengers were business men traveling on business, United turned to an important travel field to which air lines had hitherto paid little attention. This field was that of the vacation air traveler, and to attract him to air transportation, United launched a far-reaching sales program. The keynote of this promotion was that speed of air travel literally added days to vacations and enabled easterners, for instance, to visit western vacation wonderlands which previously had been inaccessible during the orthodox two weeks holiday.

Stellar attractions offered by United included a hook-up at Salt

A SIKORSKY OCEAN TRANSPORT

The S-42 A, one of the four-engine Hornet-powered clipper ships developed for Pan American Airways. It carries from 32 to 40 persons.

Lake City with National Parks Airways for a short side trip flight to and over Yellowstone National Park, and a hook-up with Western Air Express and Grand Canyon Airlines for short air tours over Boulder Dam and the Grand Canyon. United found these major attractions were popular not only with vacationists but also with persons traveling from the East to the Pacific Coast on business, adding a few hours to their trip to include the Yellowstone and the Grand Canyon.

United pointed with pride to its outstanding record of scheduled performance which, for 1936, promised to lift the company's year around average to 98 per cent, an unparalleled figure in previous records. Responsible for this world's record for long-distance operations was the remarkable record of 95.2 per cent completion of all scheduled miles during the five winter months of the 1935-36 season, buttressed with 100 per cent performance during the 1936 summer season. From April to September United's monthly average of scheduled miles completed did not drop below the virtually perfect mark of 99 per cent.

Much of the credit for the high record of completed miles was attributed to United's far-reaching system of weather reporting, weather

AN AIR LINER'S STATEROOM

One of the compartments on a Martin clipper ship operated by Pan American Airways.

analysis and dispatching developed over the last two years. United had systematically trained in meteorology 600 pilots, second pilots, dispatchers and passenger agents, and was giving an advanced course in meteorology to 400 pilots, second pilots and dispatchers.

During the summer of 1936 United reached a new high in the number of stewardesses employed, when 153 stewardesses were on the company's payroll. In May the stewardesses celebrated their sixth anniversary, for it was in 1930 that United created the innovation of stewardesses on the planes.

To increase comfort on its planes in addition to the reappointments of the interiors, United placed at principal airports mobile air conditioners for pre-cooling and pre-heating its transports. During the sweltering summer months these air conditioners poured cold air into the cabin before passengers were allowed into the planes. In winter hot air was being introduced into the cabin in the same fashion.

United placed a contract with the Standard Oil companies of New Jersey, Ohio, Indiana and California for a three-year gasoline supply, calling for a minimum of 27 million gallons of aviation fuel during the next three years, equivalent to 3,375 tank cars of gasoline. This was the largest single order for gasoline ever placed by an air line.

Pan American Airways

Commercial air passenger service over the transpacific route to the

THE SIKORSKY S-43 AMPHIBION

One of the two-engine Hornet-powered transports operated by Pan American Airways and other land and water lines. It was developed by the Sikorsky division of United Aircraft at Bridgeport, Conn.

Orient, beginning October 21, 1936—the world's first transocean airplane service for passengers—climaxed nearly six years of intensive preparation by the Pan American Airways System.

Of that six years, 18 months represented actual transpacific flying, dating from the first transport crossing by the pioneer "Pan American Clipper" from San Francisco to Honolulu, April 16-17, 1935. Pan American clipper ships and their crews made 51 crossings of the 2,410 mile sector between San Francisco and Honolulu, the longest open-sea stretch on the world's trade routes. They completed 23 round trips between California and the Philippines. During this period, under rigidly controlled transport routine, the ocean-flying clippers logged nearly 500,000 miles of transocean flying.

Even behind that achievement lay more than four years of intensive preparation, dating back to 1930, when airplane designers first

ROUTES OF THE PAN AMERICAN AIRWAYS SYSTEM

undertook to construct for Pan American Airways the ocean-flying clipper ships which, although accepted today as the most efficient marine transport aircraft in the world, were then considered almost impossible. After long months of research and design work, keels were laid in the Sikorsky plant at Bridgeport for the 19-ton four-engined flying boats, one of which was destined to pioneer America's first ocean air route. Later, work began in the Martin plant at Baltimore on three 26-ton giants, the first of which was to carry America's first air mail across the Pacific.

An ocean-flying laboratory was set up in Miami, marine operating headquarters for Pan American's inter-American airways. There, pilots, mechanics, radio operators, airport managers, weather men and flight engineers were put through intensive courses in seamanship, engineering, meteorology, astronomy, radio, international law, navigation, blind flying, celestial and radio-compass navigation. After they had passed successfully, class by class, through the theory of this new formula for transport flying they were graduated into the practice class, into the "ocean laboratory," Pan American's 600-mile over-sea airway that spans the Caribbean between North and South America. On that run, under strict transport routine, men, methods and materials were given every conceivable test.

When, in 1934, the first of the ocean-type clipper ships arrived from the Sikorsky plant, it was fitted smoothly into the groove of long range operation for which the flying personnel had prepared themselves. The second of the Sikorskys was fitted out as a laboratory ship, made practice "Pacific crossings" over the Caribbean and Atlantic. Then, early in the spring of 1935, the "Pan American Clipper" swung across the Gulf of Mexico to the Pacific and followed up the coast to Alameda, ready for the Pacific test.

Meanwhile, once ships were assured and men had proved their ability to fly them, work was begun on the air bases on far-flung, little-known islands stretched across the broad Pacific. In three months pioneer colonies were transported and established on Midway Island, 5,000 miles out in the Pacific, and on Wake Island, a tiny atoll 1,200 miles further westward, which had never before been inhabited. Radio stations, piers, docks, channels, quarters for airport staffs, and all the necessities of life were installed at these outposts. Complete operating bases were set up in Honolulu, Guam and the Philippines. The first ocean-weather service for airplanes was established. A spectacular new ocean-spanning radio guide for the clippers was perfected and installed.

While the air base constructors were still at Midway Island, their first mid-ocean base site, the "Pan American Clipper" was blazing an air trail between California and the Hawaiian Islands. Step by step the construction forces moved toward the Philippines. Behind them, in successive flights, the air trail was pushed further westward. Before the expedition, their first task completed, returned to the mainland in July, the clipper had pushed the trail as far as Midway Island. In August, the "Pan American Clipper" made the first through flight from the United States to Wake Island and return. In October, the trail blazer went through again, this time to Guam, 6,600 miles from the California base, and returned, reporting the airway ready to the last stretch. Then, on November 22, 1935, the "China Clipper" took aboard the first United States ocean air mail and made a triumphal flight across the 8,200-mile course to Manila and return.

While the public hailed these flights as the "conquest" of the Pacific Ocean, the Pan American men admitted no such achievement. Rather, they set for themselves a goal of a half million miles of flying experience, exhaustive proof of men and methods and materials, before passengers should be carried over this aerial bridge across the broadest ocean. They were facing the first ocean transport flying ever

CLOSE-UP OF "CHINA CLIPPER."

Warming up the four Pratt & Whitney Twin Wasps on the Pan American Airways Martin flying boat for transpacific service.

attempted through winter weather conditions. The great Martin clippers were new to the service. Other flight crews, 35 men, were to be graduated into this, the most advanced flying task the world had ever seen. On training schedules, and the survey flights of the pioneer "Pan American Clipper," they had logged better than 100,000 miles of actual ocean transport flying. Now a flight program was set up to add another 400,000 miles of additional flying experience over the route itself.

It could not be expected that such a program could be accomplished without setbacks. For the initial stage, two flights each month were to be made through to the Philippines and return, the three clippers alternating approximately every 15 days. But the third clipper, due for delivery late in December, did not reach the Pacific coast until late spring. Then, after her successful inaugural flight, the "China Clipper," preparing to take off for Honolulu, struck a submerged object in the breakwater pass and damaged her hull. Meantime, the "Philippine Clipper" was undergoing an engine change. Late delivery of the "Hawaii Clipper," necessary work on engine installations and repairs to the "China Clipper," held up the carefully planned progress. Twice, too, during the early period, and at the height of winter weather conditions, the Clippers set out for Hawaii only to turn back at the halfway mark when headwinds, reaching as high as 56 miles an hour, indicated that they would not be able to reach Honolulu with the fuel reserve prescribed on their flight plan.

But these troubles all came within six weeks. In February, the Clippers were plying back and forth across the ocean again. In July, schedules were stepped up to three flights for the month. In August four flights were made. In September, the Clippers were arriving and departing from the San Francisco terminal at seven-day intervals.

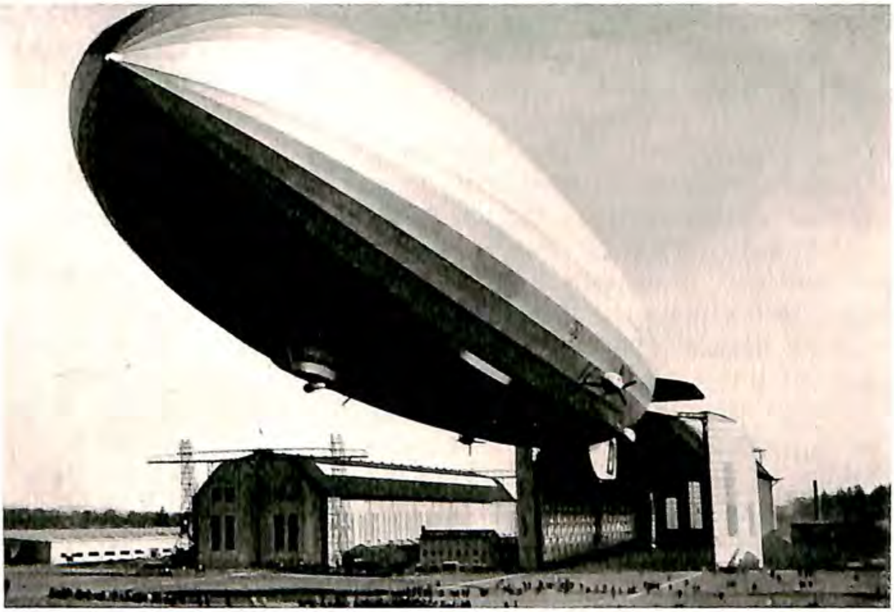
After the clippers carried the first mail over the 8,200-mile route to the Orient in November, 1935, they operated as mail and cargo ships, transporting tons of equipment and supplies to the mid-ocean air stations on Midway, Wake and Guam Islands in addition to mounting commercial loads of air mail and express. On 43 flights as cargo planes during this time, more than 85 tons were carried, with an average load of nearly two tons, in addition to the standard crew and fuel, taken in or out of San Francisco on each flight. West of Honolulu, the clippers carried loads as high as five tons. The management of Pan American Airways announced that it had invested $5,000,000 in the transpacific operations before starting to carry passengers in October, 1936.

The map of Pan American Airways presented a vivid picture of this great system which embraced more than 40,000 miles of land and water airways in North and South America, the Pacific and the Orient.

Atlantic Air Transport

While very much alone in the Pacific, Pan American at the beginning of 1937 was confronted with plenty of competition on the Atlantic where the American system had been projecting transoceanic service for several years. The British, French and Germans want a share of the Atlantic air transport business. Representatives of the three nations have been discussing it with American officials and others for two years. All three European interests are building huge flying boats for Atlantic service. Britain's Imperial Airways plans to share a United States-England route with Pan American Airways, flying the Azores route in winter and the more northern course by way of Newfoundland when summer weather permits.

Meanwhile, the German Zeppelin Company and Lufthansa, the airplane transport company, have pooled operations, and intend to have a transatlantic service of their own, if arrangements can be made in the United States, possibly with Pan American. The Zeppelin "Hindenburg" gave a perfect demonstration in 1936, making many round



THE "HINDENBURG" LEAVES HOME

More than 803 feet long, 146 feet high and carrying a payload of 21 tons, Germany's new Zeppelin leaves her hangar at Friedrichshafen.

trip scheduled flights with passengers, on one flight cruising from Lakehurst, N. J., to Frankfort, Germany, in less than 43 hours. The normal cruising speed of the "Hindenburg" is 78 miles an hour. Lufthansa late in 1936 experimented with a mother ship in the North Atlantic, launching two flying boats by catapult from a surface vessel near the Azores. After they had flown to New York the mother ship came on, and a few days later the planes were catapulted out on their homeward journey, stopping enroute at the Azores.

The Atlantic ocean will be the next scene of triumph for scheduled air transport. The rest of the world is fairly covered. This was dramatically shown in October, 1936, when three New York newspaper reporters set out to make a trip around the world in 21 days. They were Leo Kieran of the Times, H. R. Ekins of the World-Telegram and Miss Dorothy Kilgallen of the Journal. All three left New York on the "Hindenburg" October 1. Ekins chose to ride K-L-M, the Dutch air line through the Orient. Miss Kilgallen and Kieran picked the British Imperial Airways. Actually all three had planned to board the Pan American "China Clipper" leaving Manila on October 16.

On October 10 Ekins landed in Manila before breakfast. The fast American Douglas transports operated by the Dutch line had sped him to within a short boat ride distance of Manila at a cruising speed of three miles a minute, twice as fast as the slower ships of Imperial Airways under the best conditions. But conditions were not the best for Miss Kilgallen and Kieran. Their ships ran behind schedule. They were at Calcutta, India, 5,000 miles behind Ekins, when he reached Manila.

Their trip called public attention to the fact that the only stretch impossible to cover by air was the water between the mainland of Asia and Manila; and Pan American Airways expected to fill in that gap in 1937.

Ekins managed to get aboard the Pan American "Hawaiian Clipper" three days after reaching Manila. He landed in San Francisco on October 18, and next day a TWA plane from Los Angeles set him down in New York before noon, the very day on which his two rivals were leaving Manila on the "China Clipper." Ekins had traveled about 25,000 miles around the earth in 18 days.

READY TO GO PLACES

Harry Crosby and his Menasco-powered Crosby racer.

CHAPTER X

GROWTH OF AERIAL SERVICE

Aircraft for Hire—A Day and Night Service—Emergency Work—Airplane Distributors—How the Government Employs Aerial Service—Flights of the G-Men.

THEY are scattered throughout the country, these aerial service operators, ready to fly anybody or anything anywhere at any hour of the day or night. They sleep near a telephone, with their planes nearby, ready for instant departure. It may be a case of dire emergency, rushing a dying person across miles of barren country or open water to get him into a hospital, or it may be a football player who has to cross half a dozen States during the next few hours in order to be on hand for a game next day. The Bureau of Air Commerce lists nearly 600 firms and individuals operating aerial service in the United States; and there are scores who have not reported for listing. Some 200 operators do aerial photography, 25 have machines especially equipped with hoppers for crop-dusting, 94 are doing exhibition and sightseeing work. All will fly on any kind of a mission that is within the law. It is a rapidly growing business. Many of the leading aerial service organizations are distributors for airplane manufacturers; and they will rent you a plane or sell you one, yes, and even teach you how to fly it; acquiring an airplane is practically the same simple process as buying an automobile.

Scores of aircraft were impressed into service during the floods that swept over Pennsylvania in March. The air lines supplied additional service for the emergency. Planes went into areas which could not be approached on the surface. They carried tons of food, clothing, medicines and a variety of other emergency supplies. When Redowl, Twilight, Stoneville and Fairpoint, all in South Dakota, were snowed under and isolated by Arctic blasts that sent the mercury to 56 below zero, planes sped overhead with food and fuel, saving whole communities from starvation and disease. In April a chartered plane flew out over the lofty Wasatch mountains in Utah and dropped 400 pounds of food to 20 hungry miners who had been snowbound in their camp 9,000 feet above sea level. Three fishermen caught in an open boat on Lake Michigan in January found that slush ice would prevent them from reaching shore for weeks. They had eaten the last of their food and were on the verge of collapse when an airplane, chartered by anxious friends, soared out of a fog bank, dropped down to within a few feet of them and let go a huge bag of supplies, repeating the operation until the three men had enough of everything

WHEN ANTELOPES FLY

That is right. Bill Monday delivered a plane full of baby prong-horn antelopes to various zoos in the United States.

they needed. When cold weather threatened to starve all the birds in isolated sections of northern New Jersey planes loaded with small bags of grain hovered overhead and dropped the bags one by one. They burst open as they struck the hard snow, and a later survey revealed that no flock of game birds had suffered from lack of food.

On Nantucket Island 3,600 persons were cut off from the Massachusetts mainland for days, when winter brought an ice barrier of Arctic proportions. A chain store received an order by telephone for 500 loaves of bread, 200 pounds of meat and 200 pounds of butter. Another store was asked to send 320 loaves, 100 dozen eggs, 700 pounds of meat and 200 pounds of coffee. All orders were delivered by airplane, as were payroll checks for the 174 P. W. A. workers on the island. At the same time Tangier and Smith islands in Chesapeake Bay were cut off from shore, and more than 100 families were fed by plane, a half ton of provisions being carried out to the islands each time.

To observe the concentration and migratory habits of wild ducks the U. S. Biological Survey employed planes in a survey along the Atlantic coast. The Dutch elm disease which threatened to destroy all elms in New York and New Jersey was successfully fought from

A RELIANT ON EDO FLOATS

This Stinson multi-purpose cabin plane is powered by a Lycoming or Wright Whirlwind engine.

the air, pilots charting the affected trees on sectional maps and making them available to workers on the ground. Long Island's 10 million dollar potato crop was threatened by bugs, and planes were sent up to dust vast areas when the plants were wet with dew. The campaign proved wholly successful, and the work was done far less expensively than had it been attempted by hand-dusting on the ground.

Herbert Wright was aroused from sleep one night at his home in Cambridge, Md. A baby had been lost in the woods, and it was thought that he might be able to help find it from the air. He was in the air at dawn, and circling over the woodlands in the neighborhood. Within a few minutes he spotted the baby. Nosing his plane downward, he directed the ground party of searchers directly to the child whom they found unharmed. When a man and two dogs started drifting out to sea off New York in a disabled motorboat an aerial service pilot summoned by the man's family located them within an hour. Seven men trapped by a brush fire in Rhode Island were saved by a plane when a pilot found them and directed a party of rescuers to the exact spot in the woods.

Huge fortunes in cash and securities were flown across country

A WACO BUSINESS PLANE

Operated by the Bridgeport Machine Company on business throughout the country.

on innumerable occasions during the year, all in cases of emergency where time saved meant money saved. Charles J. Belden, who owns the Pitch Fork ranch in Wyoming, hires Bill Monday and his airplane to fly whole cargoes of young prong-horned antelope to zoos which have purchased them. He says it is the only sure way of having the animals reach their destinations in good health.

For years the airplane was a natural vehicle for outlaws, gangsters and other criminals who desired to mask their coming and going by taking to the sky lanes where they would leave no tracks for officers of the law to follow. At one time the customs officials had 15 planes which had been confiscated during smuggling raids. Then came J. Edgar Hoover and his famous corps of G-men waging relentless war on the criminal world. Soon the leaders of gangs the country over realized that something was wrong with their game.

Knowing that G-men who were on their trail might catch up with them at any moment, the gangsters would leave town quietly by twos and threes, flying to new hide-outs in other States, where they relaxed, came out in the streets during daylight hours, secure in the knowledge that the Government agents were hundreds of miles away. But now something has happened to change all their ideas of safety in flight. The G-men have taken to the air; and they are able to get around by plane far more quickly than the outlaws, for the simple reason that it is easier for a Government agent to make quick connections, command emergency service if necessary, than it is for an outlaw to sneak out and negotiate airplane trips without leaving his trail wide open. That is one of the principal reasons why the G-men have been so successful in their campaign against the known criminal elements of the country. They work secretly, and they do not publish the facts about their methods; but they fly up and down and across the United States, on air lines when schedules make it practicable, and in chartered aerial service planes when occasion demands.

The airplane smuggling business received one blow after another in 1936 when G-men, Coast Guardsmen, Army and Navy pilots and aerial service operators cooperated in hundreds of quick cross-country flights to catch an outlaw of the air. Once caught, the smugglers, and other gang leaders like Alvin Karpis, who was flown from New Orleans to St. Paul, Minn., after his capture in the southern metropolis, learned that hundreds of aerial service operators make able auxiliaries for the agents of law and order.

Another form of aerial service activity that will expand in future is that of helping the Government weather forecasters. The pilots and their planes are engaged to make routine flights daily, carrying weather recording instruments. During the hot weather when the earth lay melting under torrid heat these pilots would climb into their planes at four o'clock in the morning and fly to great heights. The flying routine was carried on in 27 different centers throughout the United States, and invariably the pilots encountered drastic drops in temperature. It seems funny to see a pilot climbing into heavy fur-lined clothing with people about him gasping for breath in heat of 100 degrees or more. Over Washington the pilots one day found the air to be five degrees below freezing when it was 80 degrees above zero on the ground. One day when Omaha sizzled in a heat wave the weather pilot went up and found a snow storm swinging merrily across the skies. At Billings, Mont., when the thermometer recorded summer heat the pilot found the air five degrees below zero. All the facts on temperature, pressure, humidity, wind direction and velocity are computed and reduced to a code by the weather experts on the surface; and that is put on a teletype system linking all forecasting centers. From such reports the daily weather map of the country is drawn, with a forecast of what it should be in various localities during the next 24 hours.

More than 300 new airplanes were added to aerial service operations in the United States during 1936, and there was every promise that this branch of flying would expand more rapidly during the future.

LOUISE THADEN AND HER BEECHCRAFT

They won the Bendix Trophy Race from New York to Los Angeles in 1936. The plane was built by the Beech Aircraft Co., Wichita, Kans., and was powered by a 450 h.p. Wright Whirlwind engine.

CHAPTER XI

PRIVATE FLYING

Increase of Licensed Pilots—Traffic Control for All Aviators—New Planes—45 Different Models for the Private Owner—Light Plane Records—The National Air Races—Gliding and Soaring.

AT the beginning of 1937 the U. S. Bureau of Air Commerce reported that in the United States there were 15,952 licensed pilots and 7,424 licensed aircraft as compared to 14,805 licensed pilots and 7,371 licensed aircraft in January, 1936. In January, 1937, there also were 1,805 unlicensed but identified aircraft, the Bureau reported. Among the 15,952 persons holding pilot licenses as of January 1, 1937, were 7,250 transport, 880 limited commercial, 7,154 private and 668 amateur. The licensed pilots included 444 women classified as follows: transport 71; limited commercial 23; private 295 and amateur 55.

More pilots in private planes were using equipment which enabled them to abide by the traffic rules at the leading airports of the country, where traffic regulations for private craft were found to be as necessary as those for regular transport planes operated by the air lines.

This is how the system works: Imagine Smith, a sportsman pilot, flying in from the West toward Newark Airport, where he intends to land. The control tower operator at Newark is listening in on the radio loudspeaker which is tuned to 3,105 kilocycles for communications from all itinerant or private machines.

"Smith in a Stinson Reliant calling WREE, Newark. Hello Newark."

"O K Smith in Reliant. Go ahead."

"Smith calling. I am over Morristown on my way from Chicago. Over Morristown on my way from Chicago. Go ahead Newark."

"O K Smith in Reliant over Morristown. Come on in to Newark. The wind is southeast 8, wind southeast 8, construction work at northeast end of runway. Watch construction work at northeast end of runway. It is clear for you to come in. Give me another call before you land. Go ahead Smith."

"O K Newark, wind southeast 8, construction work at northeast end of runway. I will call you."

A few minutes later Smith calls the control tower again, and is told to circle the airport once while an air liner is completing its landing; then he is instructed to land. Equipped with two-way radio and

A PRIVATE OWNER PLANE
Looking inside a Stinson Reliant.

a full set of flight instruments the private machine is capable of the same kind of flying that the air transport companies do, including blind flying along the airways. Of course, there are thousands of planes which have few instruments and no radio, and that limits their owners to fair weather flying, unless they want to take chances. The majority of accidents are traced to pilots who have taken up their planes on work that they are not equipped to do.

More than 45 different models of private flying craft were on the market in the United States at the beginning of 1937. They ranged from the light two-place machines, on up through the three-place and four-place models, the five-place and six-place machines to luxurious air yachts accommodating as many as 12 and 14 persons. Some of the very light planes sold for as little as $1,300. And one might pay as much as $60,000 for an aerial coach. One could buy a plane for cash or he might pay for it on the installment plan. He could have a machine giving him 25 miles to a gallon of gasoline or he could acquire a big ship with two or more motors. He could buy planes with retractible landing gear, amphibions capable of landing on or taking off from land or water, machines with pontoons for all over-water flying,

THE AERONCA LOW-WING PLANE

It can be procured with engines ranging from 70 to 100 h.p. It carries two persons side-by-side.

or ordinary land planes with a pair of wheels. He could buy a machine to fly at 65 miles an hour and he could pick others with speeds ranging up to 250 miles an hour. Buying an airplane, like the purchase of a motor car or boat, had become a relatively simple proposition in 1937.

An attempt to list, much less describe, the activities of private pilots, would be precisely like narrating all the varied experiences of motorists. Some pilots, however, went off the beaten path in their search for new thrills by way of the air. Robert Buck and his cousin, Lee Bellingrath, of Westfield, N. J., took their light Lambert Monocoupe, with Lambert engine, to Burbank, Calif., fitted it so they could drop the wheels after a take-off, and then on May 5 set out to beat the light plane distance record. They dropped their wheels over the Union Air Terminal at Burbank, and when they came to earth again, they had flown 1,987 miles in ten minutes less than 18 hours non-stop, a world record for machines weighing less than 1,232 pounds. They landed at Columbus, O., gliding into the airport on the belly of their little ship.

On July 4, 1936, Rudolph A. Kling in his Menasco-powered Keith-Reider monoplane went up at Denver, Colo., and made a world record speed for light planes. His average was nearly 228 miles an hour. For extra light planes Robert F. Turner and George L. Craig, in the Aeronca-powered Aeronca C-3 monoplane won a world distance record when on May 20, 1936, they flew from Raleigh, N. C., to

A LAMBERT ON EDO FLOATS

This Lambert Monocoupe is powered by a 90 h.p. Lambert engine.

Boca Raton, Fla., more than 653 miles non-stop. Seven days later their record was broken by Wilson L. Mills and Constance Righter in the same model airplane, flying non-stop 717 miles from Miami, Fla., to Winston-Salem, N. C. On August 23, 1936, Miss Irene Crum in her little Aeronca C-2 monoplane with its 36 horsepower Aeronca engine, went up over Galliopolis, O., and broke the world altitude record for planes in that class, reaching a height of 19,425 feet. In the same model plane Benjamin King made the world speed record for the class when he averaged 74.8 miles an hour over a course at Hampton Roads, Va.

The seventh annual soaring and gliding meet held in Elmira, N. Y., June 20-July 5, 1936, was the greatest meet ever held in the

United States, according to Lieut. Comdr. Ralph S. Barnaby, famous Navy pilot and president of The Soaring Society of America. The contest lasted 15 days and soaring flights were made on 14 of them. Pilots were in the air about 354 hours. A total of 145 flights were made above 500 feet. A total of 185 flights lasted 30 minutes or more, and 52 of the flights carried their pilots five miles or more. Two world and three national records were made by the 82 glider pilots who were using a total of 23 machines. Chester J. Decker made the

A SENSATIONAL TEAM

Harold Neumann and his Menasco-powered Folkerts Special in which he won many prizes at the 1936 National Air Races.

longest flight, 146 miles from Elmira to Ottisville, Pa., on July 5, and he also won the greatest number of points during the meet. Emerson Mehlhose made the national altitude record of 6,516 feet on June 29. Five pilots qualified for the international Silver C award, meaning that they had performed the remarkable achievements of motorless flight at least 31 miles across country, had soared to a height of at least 3,280 feet and had made a duration flight of at least five hours, all in motorless craft. The five winners were Stanley W. Smith, of Rochester, N. Y., Emil Lehecka, New York, Chester J. Decker, of Glen Rock, N. J., Emerson Mehlhose, of Wyandotte, Mich., and Henry Wightman, Upper Montclair, N. J. Three other American pilots had won the award in former years. They were Richard C. duPont, of Wilmington, Del., Lewin B. Barringer, of Philadelphia, and J. K. O'Meara, New York. Martin Schempp won the award in the United States while competing as a German citizen.

The 1936 National Air Races starting late in August at Los Angeles provided more than the usual quota of thrilling episodes. Among the new designs were the Caudron-Renault racer which the Frenchman, Michel Detroyat, brought over to fly in the National

THE FAIRCHILD 24
Powered by a Warner engine.

Air Races. He took first place in the Greve Trophy Race at 247.3 miles an hour against five unsuspecting American competitors, and then won the Thompson Trophy Race at a speed of 264.13 miles an hour against a field of five American pilots. His exploit was enough to spur American racing pilots to acquire faster ships another year. One of the heroes of the meet was Harold Neumann flying a Menasco-powered Folkerts Special. He took first place in two Shell Trophy contests, second prizes in the Greve and the Shell Cup races and fourth place in the Thompson race. Then there were Roger Don Rae, winning the Shell Cup race, and David Elmendorf, both in their

Menasco-powered Keith-Reider racers, and Harry Crosby in his similarly-powered Crosby all metal racer. The little planes made speeds up to 270 miles an hour. The Bendix transcontinental free-for-all was won by two women when Louise Thaden and Blanche Noyes sped from New York to Los Angeles in their Whirlwind-powered Beechcraft, 2,600 miles in 14 hours, 54 minutes and 46 seconds, beating such notables as Laura Ingalls, W. Gulick, George Pomeroy and Amelia Earhart, all of whom finished, and Roscoe Turner, Benny Howard and Joe Jacobson, who did not finish. Turner cracked up on the way East for the start. Benny Howard and his wife crashed in New Mexico while they were ahead of all others

A WACO CABIN PLANE

Henry King, motion picture director, and his private machine.

in the race, and Jacobson bailed out over the Middle West when his racer got out of control. He landed safely. The winners, incidentally, set up a new feminine record for east-to-west speed. Frank Spreckels in his Warner-powered Luscombe won the Ruth Chatterton race and Betty Browning in her Warner-powered Cessna won the Women's A.T.C. race. Al Williams, Milo Burcham, Harold Johnson, Gerd Achgelis of Germany, Alex Papana of Roumania, Dick Granere of Canada and Army, Navy and Marine Corps pilots gave thrilling demonstrations of stunt, acrobatic or formation flying.

The National Intercollegiate Flying Club banded together in April, 1935, as a chapter of the National Aeronautic Association. The club holds an intercollegiate flying conference and an intercollegiate air meet. More than a score of individual clubs are represented in the group. Since its inception, through the efforts of the national organization, many students have taken up flying. Approximately one hundred delegates gathered for the second annual National Intercollegiate Flying Conference at Washington, D. C., March 30 and April 1, 1936. Experience in various methods of club operation were discussed. Standardization of all types of events scheduled on N. I. F. C. meet programs was accepted, thereby enabling comparison of all records made in different meets. The four standardized events were spot landing from 500 feet, from 1,500 feet, bomb dropping and paper strafing. An interesting sidelight on intercollegiate flying was the attendance at the conference of eight girls as delegates.

The Loening Intercollegiate Trophy, established in 1929 to encourage college students to learn to fly, was presented to the University of Minnesota Flying Club for the second consecutive year. Award of the Trophy is based in part on general activity of individual clubs during the curricular year and in part on points won during the annual intercollegiate meet.

Two Stanford University pilots won for their club the second annual National Intercollegiate Flying Meet at Detroit in June, scoring 16 points in four events. Minnesota followed closely with 14 points. Harvard was third with 10. In the glider events on the opening day the glider club of the Lawrence Institute of Technology, Detroit, was victorious with 13 points. A total of 53 club members participated in the meet.

TAYLOR CUB SEAPLANE
It is mounted on Edo floats.

CHAPTER XII

TRAINING AND EDUCATION

Various Kinds of Training in Colleges and Aviation Schools—Aeronautical Engineers, Pilots, Mechanics—Courses in Management—Approved Flying Schools—Cost of Flight Training—Prominent Institutions Giving Aeronautical Education.

WHEN the Wright brothers invented the airplane they taught themselves to fly. In fact they learned to fly before they invented the flying machine. While they were risking their necks gliding off the sand dunes at Kitty Hawk they discovered the principal laws governing aerodynamics, and with high courage, patience and incalculable genius reduced their knowledge to a precise scientific formula, after which they incorporated it in the world's first powered flyer capable of sustained flight with its operator. The Wright brothers taught others to fly, and some of the country's famous pioneers taught themselves to fly by corresponding with the brothers, asking them questions and receiving the answers which they applied in actual practice. Other schools sprang up, some to train pilots and others to teach mechanics. The colleges broadened their courses in mechanical engineering so that one might become an aeronautical engineer. A well equipped airplane factory today employs scores of engineers.

The Bureau of Air Commerce lists 497 organizations and individuals offering flight instruction and ground school training, and 110 universities, colleges and technical schools offering some kind of aeronautical education. There are many of the so-called "one man flying schools" where one veteran pilot operates an aerial taxi service and trains students. Many of these are excellent teachers, and they turn out good pilots. The organized flying school is much like any other college, with formal courses of study, specialists in all subjects of ground instruction, pilot instructors who teach beginners and others who handle the advanced students. Some of these flying schools teach drafting and engineering, and their courses are as thorough as could be taught in any college, the graduates receiving degrees and other honors similar to those conferred by the larger universities. In some colleges of the air the work and discipline are as strict as one would find at West Point or Annapolis.

As an aid to the prospective student pilot, and to assist the flying schools in establishing and maintaining standards by which the public can judge their work, the Bureau of Air Commerce has regulations applying to flying schools and a procedure for approving an institution and rating its instructors. These official school approvals are not mandatory. They are voluntary. A school does not have to be approved in order to operate; but if it does apply for approval, meets

LEARNING A GREAT TRADE

Future engine experts at the Casey Jones School of Aeronautics.

the requirements and is awarded a certificate, that is evidence that it has met the standards set up by the Bureau. As to those schools lacking the certificate of the Bureau the student must judge for himself. Many of those schools not on the approved list are in fact excellent; but many are equipped to give only limited instruction in many courses. There are 22 approved flying schools located in 11 States, California, Colorado, Illinois, Indiana, Maryland, Massachusetts, Nebraska, New York, Oklahoma, Oregon and Texas.

In one's choice of a school the important consideration is the objective of the student. What does he want to be, a professional pilot or an amateur, a mechanic, a draftsman or a scientific engineer?

For the neophyte the first step in becoming an airplane pilot is to report to a Bureau of Air Commerce medical examiner for a physical test. There are 600 medical examiners in the United States, each qualified to determine physical fitness for flying. The examination is thorough, and includes tests of the eyes, ears, heart, lungs, nervous system and digestive system.

The applicant pays $10 for this examination; that and a subsequent fee of $6 when the student has become a pilot and comes up to renew his license are the only costs involved. They are paid to the physicians

CURTISS-WRIGHT TECHNICAL INSTITUTE

Student body of the noted school at Grand Central Air Terminal, Glendale, Calif.

for professional services, and are not paid to the Bureau. Having qualified as a student the prospective pilot is ready for instruction. The time required and the cost vary considerably. It is true that he who devotes all his time to flight instruction will advance more rapidly than he who puts into it only his evenings and week-ends. The average course leading to an amateur license requires 10 weeks and costs about $276. The average for a private license is 17 weeks and $505. For a limited commercial license the average is 20 weeks and the cost $553. To get a transport pilot's license the average course requires a student to put in 46 weeks and spend $1,777.

A student is eligible to apply to the Bureau of Air Commerce for an amateur license after 25 hours of solo flying. At 50 hours he may come up for either a private or limited commercial license. After 200 hours he may apply for the transport grade, although the air lines actually require considerably more time before they will even consider an applicant for a job as transport pilot. Then some of the lines add a great deal of training before letting the pilot take the controls of a scheduled air liner. There are written examinations and flight tests for each grade, and they are conducted by the 80 inspectors employed by the Bureau of Air Commerce. They fly about the

POWER PLANT INSTRUCTION

Students receiving practical training at the Boeing School of Aeronautics, which is operated by United Air Lines.

country visiting airports and carrying on department business, and they are always available within reasonable time. There were nearly 30,000 active student pilot licenses at the beginning of 1937.

Airplane and mechanics schools are sometimes connected with flight training institutions, but many are individual organizations. The Bureau of Air Commerce lists 78 schools training aircraft mechanics. There were more than 8,500 active mechanic licenses in the United States at the beginning of 1937.

Hundreds of high schools and elementary grades were teaching some form of aeronautics. Students were either building their own models or working on full-sized ships, some of which they had procured from various sources and were remodelling or repairing. Hundreds of high school students were learning to fly.

The aviation schools making reports for this book are described in the following paragraphs.

The Aeronautical University, Chicago, offers courses for aeronautical engineers, pilots and mechanics. It reported that all graduates in engineering and licensed mechanic's courses had been successful in obtaining desirable positions in the industry. The Boeing School of Aeronautics, at Oakland, Calif., a division of United Air Lines,

STUDENTS MAKING WINGS

One of the departments at Parks Air College which is organized like any other institution of higher education.

added two new courses to its curriculum in 1936, a dispatching and meteorology course and a sheet metal course. The former is designed to teach a student the routine of air line operations, so that he can become a dispatcher, and with the advanced knowledge in meteorology, including air mass analysis, make each dispatcher a meteorologist. Shortage of sheet metal workers in aircraft factories led to the latter course, requiring three months to make a student competent to become a sheet metal apprentice in a factory. The one year course in air line mechanics gives a basic foundation during the first nine months, with three months specialization in a major phase; or the student may take a 24-months course, which would include four major subjects during his second year. The air line pilot course, training co-pilots, gives 250 hours of flying and one or two years of ground instruction. In 1935 the Boeing School started instrument and radio beam flight instruction at the beginning of the student's flight training; and the results were so good that students are now

A FLIGHT FROM SCHOOL

Students from the Ryan School of Aeronautics practising formation flying in Ryan S-T low-wing monoplanes.

put under a hood and taught instrument flying at the start. After a few hours in the open cockpit they are soloed, then put back under the hood for more advanced instrument flying. Boeing School, with 32 full time instructors, had about 200 students in school eight hours a day.

Parks Air College, East St. Louis, Ill., with a faculty of 33 had a student enrollment of 276, including 41 in the professional flight executive school, 16 in the aviation operations and executive school, 102 in the master mechanics' flight school and 103 in the engineering school. Fourteen were taking the airplane and engine mechanic course, a three-term introductory course preparing them for continuation in one of the four schools. The major courses required a total of 96 weeks, the graduate receiving the college diploma and the appropriate Bachelor of Science degree. Parks Air College prepares for air transport service, 62 per cent of its students entering that field, the others going into manufacturing or miscellaneous operations. The students live in dormitories at the college, and those in a major course are eligible for flight instruction. The college uses a fleet of ten planes for training.

The Curtiss-Wright Technical Institute at Grand Central Air

READY FOR CROSS-COUNTRY

Spartan students line up for a mass flight out of Tulsa.

Terminal, Glendale, Calif., specializes in training expert artisans for the industry; and its hundreds of graduates every year are immediately placed in jobs among important units of the industry. The Grand Central Flying School, at the same airport, specializes in blind flying training, and for this purpose the students are taught in two planes especially equipped for teaching instrument and radio flight, and also seven other ships for regular flight training, including cross-country and night flying.

The Casey Jones School of Aeronautics, Newark, N. J., specializes in training aeronautical engineers and master mechanics, with a capacity enrollment of 400 students. Others are accepted to replace those who have graduated. One of the entrance requirements is a high school diploma. There are 22 instructors. The school reports that every graduate has immediately secured a position in the industry. The courses include aeronautical engineering, two years straight through winter and summer, tuition \$950; master mechanic, 14 months straight through winter and summer, tuition \$525.

The Ryan School of Aeronautics, San Diego, Calif., reports 100 students including those taking transport pilot and master mechanic courses. The advanced courses embrace blind, cross-country and night flying. Students also have the privilege of purchasing a Ryan plane at the beginning of their training and thus, using their own ship, receive a transport pilot course for about \$300 above the cost of the plane. The school reported 15 members on its faculty. Safair Flying School, at Roosevelt Field, Long Island, N. Y., provided courses for all pilot grades, with ground school classes at New York University.

Lincoln Airplane & Flying School, "where Lindbergh learned to

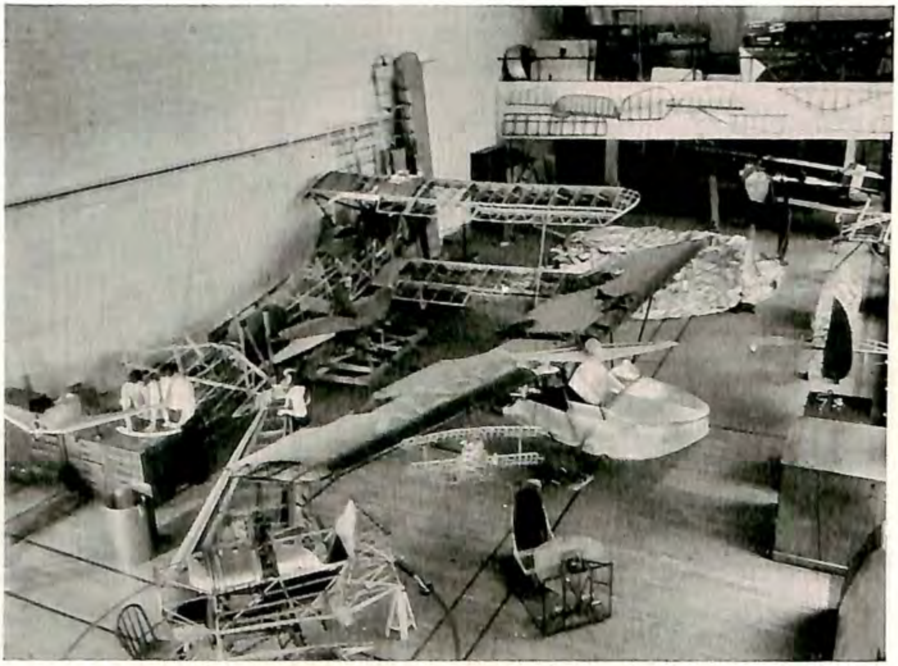
FUTURE PILOTS

Students in the line-up at Lincoln Flying School.

fly," at Lincoln, Nebr., reported an annual enrollment of 300 students in its pilot and mechanic courses. Students were offered flight training on four types included in the school's fleet of 11 machines. Pilots were given complete courses, including instrument, radio and night flying. The student body represented seven countries besides the United States.

The Spartan School of Aeronautics, Tulsa, Okla., with 18 planes in its training fleet and 12 instructors, offered courses for special transport pilot, with 66 weeks of ground school work and 225 hours of flying; courses for regular transport license taking 12 months, a six months limited commercial course with 50 hours flying time, a six months private course with 40 hours flight training, and a six or 12 months mechanic course with 15 hours flight training, if desired. A special radio operator's course is also offered. The students live in the school barracks. The school reports more than 100 graduates annually. The Stewart Technical Trade School, New York City, reported four aviation courses, including aeronautical engineering requiring two years, aviation master mechanics requiring 14 months, Diesel engineering requiring one year and Diesel mechanics four months.

Among those colleges giving aviation courses was Rensselaer Polytechnic Institute, Troy, N. Y., which reported that its newest



AN AIRPLANE LABORATORY
Students in aeronautical engineering at the University of Minnesota.

department, aeronautical engineering, was also its fastest growing at the beginning of 1937. The number of students in that course had increased 20 per cent. They also had a glider club. Graduates of the Institute received engineering degrees. Worcester Polytechnic Institute, Worcester, Mass., reported that it had graduated 50 students in aeronautical engineering, all having first completed the three years mechanical engineering course before specializing in aeronautics.

The University of Washington, Seattle, Wash., reported an increase in the number of students enrolled for the course in aeronautical engineering. The University of Virginia, Charlottesville, Va., provided a basic engineering training with optional courses in aeronautics. It also reported increased enrollment in that branch. The University of Oklahoma, Norman, Okla., gave aeronautics as an optional course in the school of mechanical engineering, with special emphasis on fuel and lubricant laboratory study and experimentation, and also regular degrees in aeronautical engineering. That university founded the aeronautics fraternity, Tau Omega. The University of Florida, Gainesville, Fla., offered an aeronautical engineering degree course in its mechanical engineering department. The University of

FIGURING IT OUT

University of Detroit seniors making calculations during a wind tunnel experiment.

California, Berkeley, Calif., was one of the first to offer regular aeronautical degree courses, and it has a large alumni prominent in the industry, with an average of 70 new students each semester. The University of Detroit, Detroit, Mich., enrolled 100 aeronautical engineering students for the 1936 school year. Tri-State College, Angola, Ind., in June, 1936, graduated 30 men with the degree of Bachelor of Science in Aeronautical Engineering. The Ohio State University, Columbus, O., reported about 20 students enrolled in its elementary aeronautics courses in the mechanical engineering department. Carnegie Institute of Technology, Pittsburgh, Pa., offered aeronautical engineering as an optional course, and reported an increasing number of graduates entering the aircraft industry. Lehigh University, Bethlehem, Pa., reported a number of aeronautical courses in its various engineering departments. New York University, New York City, reported the acquisition of new equipment for its aeronautical engineering course, notably a towing basin for testing seaplane and flying boat hulls and pontoons, this augmenting the equipment in the engineering college which has a wind tunnel and other research facilities.

The Georgia School of Technology, Atlanta, Ga., in its Daniel Guggenheim School of Aeronautics, gave courses leading to degrees in aeronautical engineering with one additional year of study after the regular four years engineering courses. Several research projects were under way at this school. Iowa State College, Ames, Ia., gave several

FUTURE AIRPLANE DESIGNERS

Engineering students at Tri-State College testing a model in the wind tunnel.

aeronautical courses leading to degrees in mechanical engineering, and assigned a new building for aviation work. The Kansas State College, Manhattan, Kans., offered courses in aerodynamics and airplane design, and had a glider club using machines of its own design and manufacture.

An excellent description of aeronautical work at Massachusetts Institute of Technology, Cambridge, Mass., was prepared for this book by Dr. R. H. Smith, the senior professor of aeronautical engineering. He wrote as follows:

"The primary objective of the undergraduate course in aeronautical engineering at M.I.T. which leads to the S.B. degree is to provide a sound general training in subjects fundamental to the practice of engineering, and then to familiarize the student with the general principles of flight of all types of aircraft and with some of the detail of design and construction as applied to the airplane. To this end, the greater part of the first three years of study is devoted to fundamental subjects, most of the strictly professional work being deferred until the fourth year. During the course, lectures and recitations are supplemented by laboratory and drafting room work.

"In general, the professional subjects are directed particularly toward airplane design, but in order that the student may gain some knowledge of other branches of aeronautical activity, he is allowed to elect in the fourth year certain subjects in some related professional field, such as internal combustion engines and meteorology.

BEHOLD THE JEEP!

Art Chester and his special Menasco-powered racer.

"On account of the large number of students who wish to take the course in Aeronautical Engineering, and on account of the limited facilities available, it has been found necessary to limit the number of men who may transfer into it from other institutions or from other courses at the Institute, and to restrict the total enrollment in each year's class to 30.

"The Department facilities consist of a large four-story building, the 'Guggenheim Aeronautical Laboratory', which contains ample drafting rooms, lecture rooms and offices, two large wind tunnel rooms, a departmental library, a well equipped shop and several special laboratories for aeronautical instruments and meteorology. Additional equipment of which much use is made by the Department, is the Sloan Automotive Laboratory, and the Testing Materials and the Metallurgy Laboratories of the Departments of Mechanical Engineering and Mining. Use is also made of the municipal airport and of the equipment there in giving the senior class a certain hourage of flight instruction as a part of the regular curricula of studies in airplane design.

"There is a very active engineering society in the Department whose chief activity is gliding. They maintain several gliders for instruction purposes and compete annually in the Glider meets.

"The Graduate School offers courses leading to the Masters and Doctors degrees in both aeronautical engineering and meteorology. The graduate enrollment this year is approximately 50.

HOW TO STUDY AN AIRPLANE

These students in the laboratory of Rensselaer Polytechnic Institute are taking measurements of a real machine.

"The aeronautical and meteorological staffs number 11 men of faculty rank, nine men of non-faculty rank and several men for special work, including a machinist and two radio operators.

"The Department of Aeronautical Engineering and Meteorology at M. I. T. is administered with the Department of Mechanical Engineering. Both are under the direction of Dr. J. C. Hunsaker."

Prof. John D. Akerman, head of the aeronautical engineering department at the University of Minnesota, Minneapolis, contributed the following account of activities at that institution:

"The total enrollment of aeronautical students at the end of 1936 was 237, exclusive of extension work. Two faculty members and three research assistants were added. The Loening Intercollegiate Flying Club Trophy was won for the second consecutive year by the University of Minnesota Flying Club, for outstanding aeronautical activities. At the Intercollegiate Flying Club Meet in Detroit in June, 1936, the University of Minnesota Flying Club won second place in the total number of points. During the year the student branch of the

LINDBERGH AND HIS NEW PLANE

Col. Charles A. Lindbergh inspects the American Menasco engine in his English-built Miles Mohawk monoplane.

Institute of the Aeronautical Sciences was organized with a total of 35 members.

"An important step in aeronautical education was taken by the University of Minnesota in establishing a chair for special study of questions pertaining to the stratosphere. Dr. Jean Piccard, outstanding scientist and stratosphere explorer, was secured for this work. A grant from the National Advisory Committee for Aeronautics was given to experiment with cellophane stratosphere sounding balloons, and automatic radio reporting apparatus to investigate pressure, temperature, humidity and cosmic rays. Eleven ascensions of sounding balloons were made from Minneapolis, Minnesota and the St. Cloud, Minn., airport. One of the balloons remained in the air for 8½ hours and traveled 613 miles at approximately 12 miles altitude. During the present school year experimentations in the stratosphere will be continued.

"In the airplane laboratories, design and construction of two experimental airplanes were undertaken. An experimental tailless air-

THE WACO D-6 MILITARY PLANE

It is powered by a Pratt & Whitney Wasp Junior or a Wright Whirlwind, and it is fully equipped for radio, blind and night flying.

plane for investigation of slot and flap action on this type of airplane has been completed, and is undergoing research tests. Plans are under way for a new large wind tunnel, which will be completed by the summer of 1937. The throat of this wind tunnel is 10 feet by seven feet with wind velocities of approximately 100 to 120 miles. An internal combustion engine laboratory will be located in the same building, which will be devoted to the testing and research of aircraft engines. During the year 1936, enough consultation work for industry was carried on by the faculty members to employ all available senior and graduate students on actual aeronautical work, thus giving them better preparation for positions in industry. In 1936 a course in Airway Meteorology, which had been carried on a small scale for four years, was developed to such a status that a complete course in Airway Meteorology is now available."

Among other colleges giving aeronautical courses leading to engineering degrees were the University of North Carolina, Raleigh, N. C., the University of Nebraska, Lincoln, Neb., the University of New Hampshire at Durham, N. H., and the Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Western Electric Co. photo

AIR TRANSPORT RADIO

The Eastern Air Lines radio ground station at Candler Airport, Atlanta, Ga.

CHAPTER XIII

AIRWAYS AND AIRPORTS

Development of Airports—Traffic Control—Air Navigation Aids—Growth of Weather Bureau Service—Improvements in Airway Radio Facilities—W.P.A. Airport Work—Service Charges at Airports—"Flight Strips."

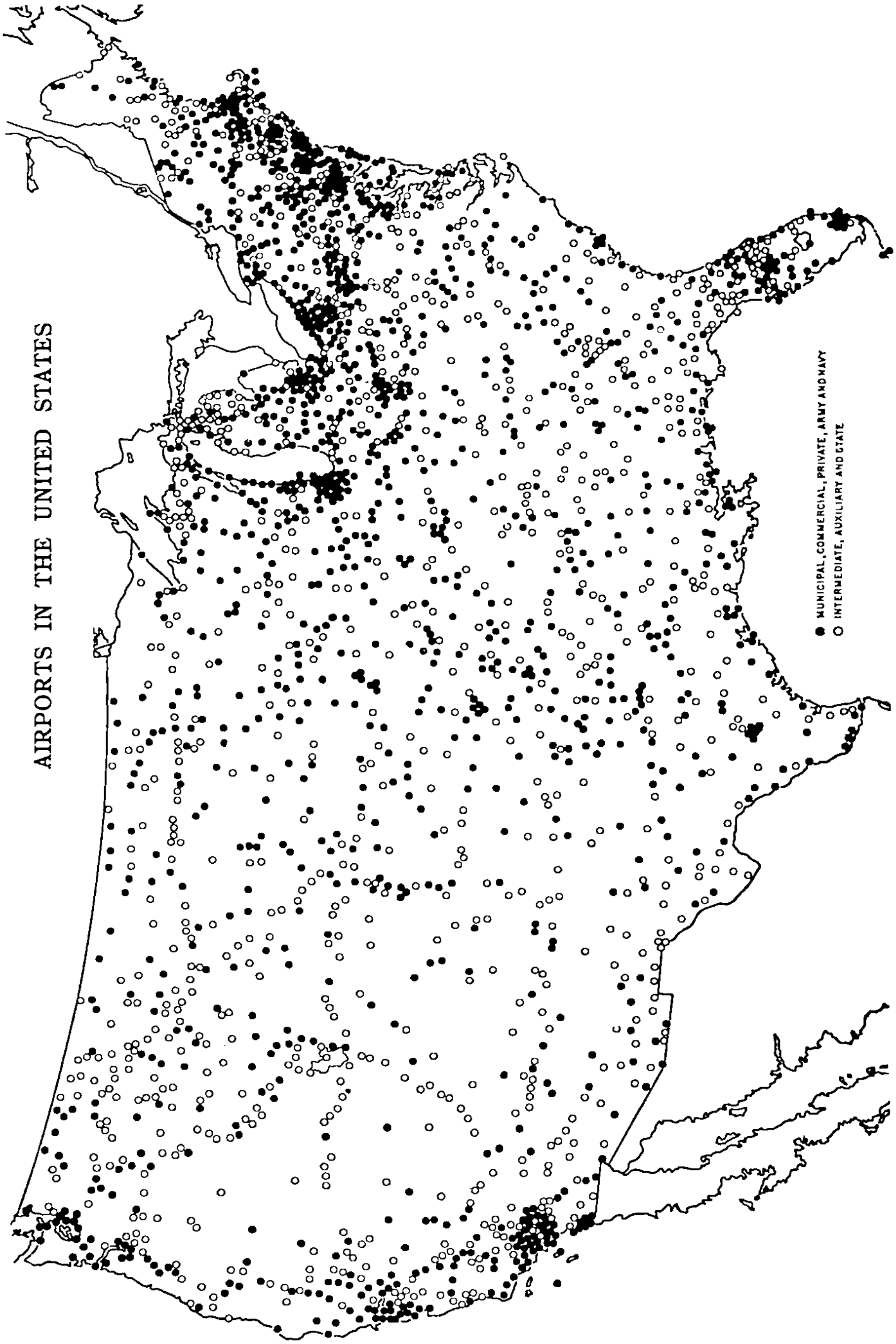
THERE were 2,342 airports and landing fields in the United States on January 1, 1937, according to the Bureau of Air Commerce. Of these 705 were partially or fully lighted for night use.

The total included 738 municipal and 451 commercial airports, 296 Department of Commerce intermediate landing fields, 622 auxiliary fields, 26 Naval air stations, 61 Army airdromes and 148 miscellaneous Government, private and State airports and landing fields. On January 1, 1936, there were 2,369 airports and landing fields.

Six states had 100 or more airports and landing fields each on January 1, 1937, California 181; Texas 134; Michigan 123; Florida 116; Pennsylvania 111 and Ohio 106. The report by States is in the appendix.

The skyways have become so crowded that an airways traffic control system is necessary. It is now being installed throughout the Federal Airways System by the Bureau of Air Commerce which is charged by law with regulating all civil flying and safeguarding travel through the air. The first units of the traffic control system thus far established, with the cooperation of the air lines, are at Newark, N. J., Chicago, Ill., and Cleveland, O.

Working closely with the air line officials at the local airport and with the municipally operated airport traffic control tower which supervises actual take-offs and landings, the Airways Traffic Control Station receives arrival, departure and position reports on all aircraft flying in its area. A pilot flying in or above the clouds and unable to see the ground reports his passage over "radio fixes" or



AIRPORTS IN THE UNITED STATES

check points. When he passes over a radio marker beacon through the "cone of silence" which indicates the exact location of a radio range beacon transmitter or when he crosses a radio range course which intersects the one he is flying, he is passing over one of these check points.

All air line planes, private machines and Government service craft, when equipped with radio, submit their flight plans, and report their position by radio so they can be accounted for in connection with air traffic control. For an outbound plane the control station receives altitude and approximate time when the machine should pass over the first radio check point, cruising altitude to be maintained and other data. If this plan will conflict with that of other traffic already

MILES OF LIGHTED AIRWAYS IN THE UNITED STATES

in the air, the pilot is advised and a new plan is given him, after which the plane is cleared.

As quickly as the plane takes off, word is flashed to the control room and an operator there puts an airplane marker on the map to indicate its position. The marker is moved every 15 minutes to indicate the progress of the plane, with allowances for wind, weather and other factors that have been considered before departure. As reports are received from the machine by radio the marker on the map is corrected accordingly. In the case of an incoming plane its progress is watched in the same careful manner and the pilot is guided into the airport at a certain altitude so that he will not collide with other traffic. The traffic control station undertakes to keep traffic moving at different altitudes from beginning to end of any flight. For example, the control operator computes the speed and location of one airplane with that which took off later on the same route. If the second plane is faster and proves to be overtaking the first machine, and the visibility is limited, the operator will assign a lower altitude which the first plane must take in order to prevent the second machine from possibly colliding with it. On every route of the Federal Airways System the planes are assigned different altitudes and positions to the right of the course for each direction that a plane may fly. For example, eastbound planes may take altitudes of odd numbers of thousands of feet, say three or five, while the westbound plane may take four or six, and so forth. That is why there is slight danger of planes colliding in mid-air.

Air navigation aids along the 22,000 miles of the Federal Airways System provide markings to indicate the routes for pilots flying in daylight and clear weather, lights to keep them on their course at night, and radio directional signals to guide them when they cannot see outside their plane. Aside from the routine duties of the airways personnel it provides any number of miscellaneous services some of them of the utmost value in emergencies.

A pilot started to fly from Akron to Columbus, O., and as his machine left the field, one of the men on the ground saw that the right wheel of the landing gear was dangling from a broken strut. The pilot of the ship, of course, was unaware of the accident, and it spelled disaster for him if he should attempt to land at Columbus without knowing of it, and taking necessary precautions. A good pilot can land a ship on one wheel if he knows what the conditions are. The head of a flying service at the Akron airport lost no time in trying to save the airman from trouble. He dashed for a telephone, called the Air Commerce radio station at Cleveland, explained the situation and hung up. The Cleveland official immediately started sending an emergency message to the machine in the air, which had no transmitter, and therefore could only receive messages and not send them. The Cleveland operator kept calling, however, telling the pilot what was wrong with his ship, and he kept it up at intervals of five minutes, until he received a thankful phone call from Akron saying that the pilot had heard his message and had returned to the airport, making a safe landing on his one good wheel.

Similar services are being rendered almost daily by each of the hundred Bureau stations which are equipped to talk with pilots in flight. The 1,800 employees in the navigation division of the Bureau of Air Commerce take care of the aids to flying. They include about 200 officials and headquarters assistants. The others are engineers, radio operators, airways keepers, caretakers of intermediate fields, radio electricians and airways mechanicians in the field. Civil engineers supervise construction of the emergency fields and sites for radio and teletypewriter stations; while radio engineers handle the construction and improvement of radio aids. The radio operators broadcast the weather reports each hour, watch the operation of the radio range beacons and receive and transmit weather reports by teletypewriter or point-to-point radio connecting stations on the ground. At key points the Bureau of Air Commerce and U. S. Weather Bureau stations occupy adjoining offices, and they cooperate in caring for the service. At some points a Bureau staff handles the work, at others the Weather Bureau staff does it. They exchange information and, working together at places where both are represented, provide an unceasing flow of valuable information.

The U. S. Weather Bureau of the Department of Agriculture is charged with the responsibility of supplying an adequate meteorological service for aviation. As weather is one of the main problems in air travel the data supplied cannot be too voluminous or accurate. More than 500 stations have been established at intervals of 50 to 100 miles on the Federal Airways System in the United States, Alaska and Hawaii. Also there are more than 60 stations off the airways, with about 100 more in process of construction at the beginning of 1937. The Weather Bureau maintains first-order stations at 52 important airway terminals, airports. Here skilled meteorologists are on duty throughout the 24 hours, charting reports on maps, discussing them with pilots and making up complete data. At 72 other stations they take upper air observations by means of small balloons and instruments, and at 27 stations pilots are engaged to fly up into the higher altitudes and record actual conditions on sensitive instruments.

The airway weather service is controlled by ten general supervising stations located at Atlanta, Ga., Burbank, Calif., Chicago, Ill., Cleveland, O., Dallas, Tex., Kansas City, Mo., Newark, N. J., Oakland, Calif., Salt Lake City, Utah, and Portland, Ore. The weather observations include ceiling (height of cloud layer above the ground) in feet, sky conditions, visibility in miles, weather conditions (including precipitation and squalls) obstructions to vision, (dense fog and haze) temperature, dew point, wind direction and velocity, barometric pressure and amount and direction of cloud types. The stations on the airways report in symbols on teletype and radio circuits, while off-airway stations, including stations in Alaska and Canada, report their observations in a word code. All Weather Bureau first-order stations at airway terminals and a number of stations off the airways are equipped to take six-hourly observations of directions and velocities of upper air winds. The observations are made by means of so-called pilot balloons, light-weight balloons inflated with hydrogen gas to a diameter of approximately 26 inches. When released they ascend at a fairly uniform rate of approximately 600 feet a minute. In taking an observation the observer follows the balloons with a theodolite, an instrument similar to a surveyor's transit, and angular readings are made each minute. From these data and the ascensional data, wind direction and velocity at the height of the balloon are readily computed for each minute of ascent.

Special forecasts are issued when conditions change rapidly. In addition, forecasts for advance periods up to 30 hours are prepared

TWA RADIO CONTROL ROOM

Constant communication with planes in flight on its entire system is maintained by the radio staff at the company headquarters in Kansas City.

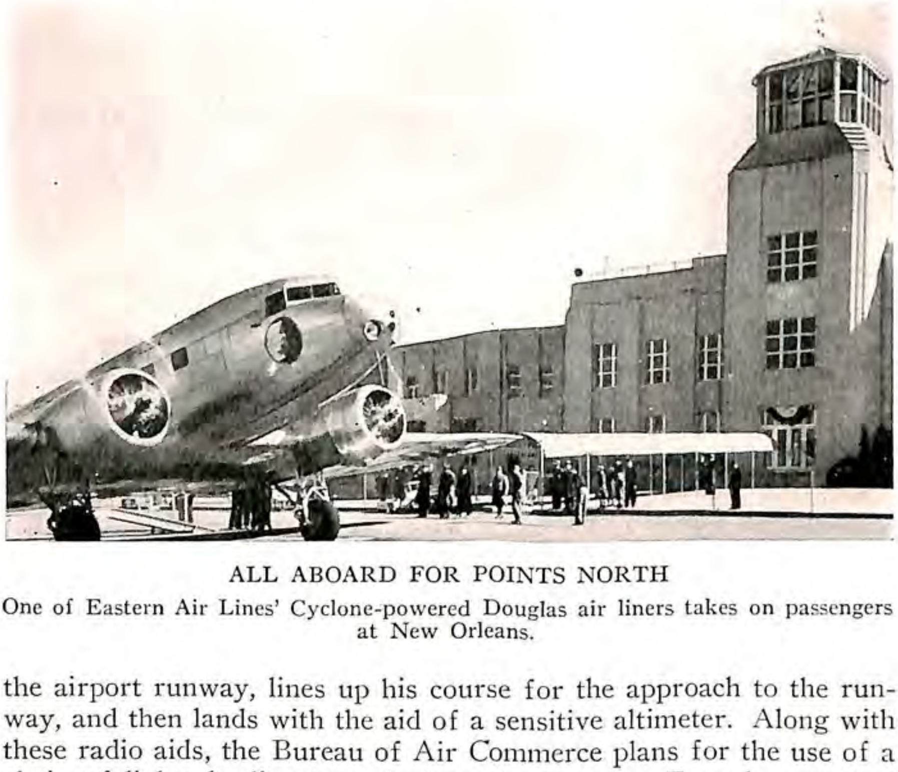
on request for long cross-country flights. The following is given as an example of a regional airway forecast issued by the supervising stations: "Warm front extending Springfield to Tarkio to North Platte to Dickinson with warm moist air to south and west over-running cold surface air to north and east will advance slowly north and eastward causing scattered to broken clouds with ceiling 8,000 feet or more ahead of it and overcast 5,000 feet or more in few mild thundershowers. Visibility six miles or more all stations except in rain areas and smoke at Chicago where visibilities of three miles or more will be experienced. Increasing high scattered to broken clouds and increasing lower clouds becoming overcast during afternoon in mild to moderate thundershowers within warm air mass in Iowa and Southern Minnesota. Ceiling 3,000 feet and visibility very low at times during afternoon in shower areas, otherwise visibility more than six miles."

The Bureau of Air Commerce has done much research on new developments in air navigation aids. One such development is simultaneous transmission of radio range beacon signals and voice, on a single frequency. It was about ready for general use at the beginning of 1937. Because of the limited number of frequency channels available for these broadcasts, and to avoid the necessity of frequent retuning of the radio receiver by the pilot, radio range signals and voice broadcasts are transmitted by a given station on one frequency. The range signals are on the air continuously until it is time for a weather broadcast, and then they are silenced for a period not to exceed three minutes while the announcer gives the weather report.

That procedure has disadvantages. The radio range beacon signals may be silenced just when a pilot needs them most, as for example, when he is approaching an airport while flying blind. This has been partially corrected by keeping the directional signals on the air without interruption when pilots request it, postponing the broadcasts until later or giving them on the alternate frequency of 236 kilocycles, but the best solution is a system which puts all transmissions on one frequency yet still gives the pilot an opportunity to make his own choice as to whether he will receive directional signals or weather information. The simultaneous system, which has been extensively tested at Pittsburgh, provides for transmission of both voice and directional signals on the same carrier frequency, but with different modulations. Filters in the transmitters and in the airplane receiver make it possible for the pilot to plug in his earphones for radio range signals alone, voice alone, or both. Flying along by radio guidance he will have his headset plugged in to receive both sets of signals. Most of the time the range signals only will be heard. Then there will be a scheduled broadcast or special communication, and the pilot will hear it along with the range. If he wants to pay close attention to the voice broadcast, he will plug in his earphones to hear it and shut out the directional signals. On the other hand, if he wants directional guidance, he will plug in his earphones to hear the range signals only. Then after a few minutes, he will return his headset plug to the jack which brings in both voice and range, so that he can follow the range signals and still have notice of any voice broadcast.

Radio guidance for blind landings—to aid pilots in getting to the ground when clouds, fog, haze or smoke obscure the landing area—

is another project which has the attention of the Government. Two types of radio installations for blind landing are under test at Indianapolis. One utilizes a runway localizer which is a radio range beacon on a small scale to guide the airplane to the runway, a landing beam to bring it down in the proper glide path, and marker beacons to show how far the airplane has progressed toward the point at which the wheels are to touch. The other, which is an adaptation of the Army Air Corps blind landing system, uses two radio transmitting stations to which the pilot guides his plane with a radio compass. He flies between the two transmitting stations, which are on a line with



ALL ABOARD FOR POINTS NORTH

One of Eastern Air Lines' Cyclone-powered Douglas air liners takes on passengers at New Orleans.

the airport runway, lines up his course for the approach to the runway, and then lands with the aid of a sensitive altimeter. Along with these radio aids, the Bureau of Air Commerce plans for the use of a chain of lights leading to and along the runway. Even in very bad weather the pilot can almost always see the ground during the final few minutes, and the lights will aid him in completing the landing after he has descended close to the landing space with radio aid.

Continuing to foster development and improvement of airports throughout the country, the Bureau of Air Commerce during the past year has been cooperating with the Works Progress Administration in a nationwide airport development program. Airports owned by cities, counties and states were eligible for assistance in this program. Bureau of Air Commerce technical representatives checked all applications to make sure that the proposals will achieve the desired results and will be valuable from the aeronautical point of view. When the Bureau approved a project the W. P. A. considered it, and if it also approved, funds were made available for employment of relief labor in constructing runways and hangars, installing lighting equipment or radio, or otherwise making the airport a more efficient base for flying operations. Reporting on activities to June 30, 1936, the Works Progress Administration announced that more than $40,000,000 had been authorized for expenditure at 438 locations.

Provision of roof markings for guidance of airmen was a supplementary part of this program. The W. P. A. reported that work was in progress in 30 States with authorizations of $400,000 for air markings.

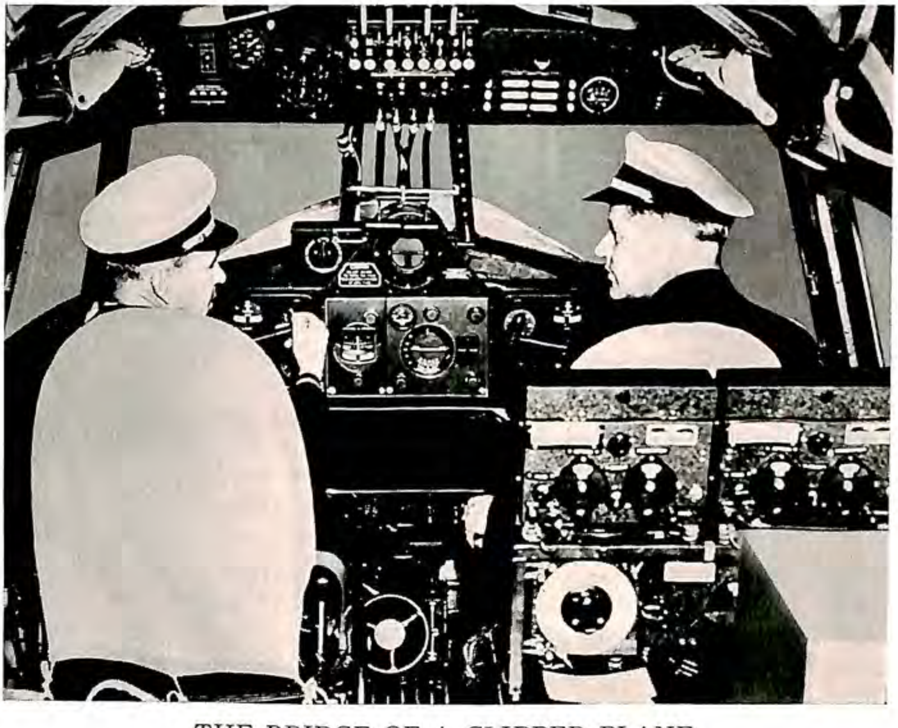
The Bureau of Air Commerce in 1936 started a survey of airports throughout the United States, seeking to find rates charged for storage and repair service, and for services to scheduled operators, fixed base operators, schools and itinerant airmen. Although results were far from complete, some indications of trends were available at the beginning of 1937. For eleven airports reporting on storage fees, representative figures were $15 a month for a small airplane, $30 a month for a craft of medium size, and $50 a month for a large airplane. A few reported that they reduced this rate for dead storage—the average rate for dead storage being 60 per cent of the rate for active storage. One airport charges $5 a month for open field storage, another $15 a month for the same service. One airport reported that its regular storage rate was 75 cents a foot, per month, with one-fourth off for dead storage.

Four airports reported that they charged a fee for turning on landing lights, the rates being from 50 cents to $1 a landing. Some airports have an hourly rate for air lines. Charges for repair service are $1.65 an hour for the services of a mechanic and $1 an hour for a mechanic's helper. Charges to fixed base operators for the privilege of carrying passengers average $8.75 a month for a one-passenger plane, $13.30 a month for a two-passenger plane, $20 a month for a four-passenger plane and $31.67 a month for an airplane carrying six or more passengers. Representative charges to schools are $5 to $15 monthly an airplane.

At the beginning of 1937 Colonel Stedman Shumway Hanks was making considerable progress in attracting to his plan for "flight strips" the interest of Federal, State and County officials. The Hanks plan for "flight strips" was described by its creator as follows:

"Flight strips, originally conceived in my plan for ground facilities, are flat areas at intervals, adjacent to the highways, in highway rights-of-way or freeways, of sufficient width and length for the landing, servicing and taking-off of aircraft. Parts of such areas may be adaptable for rest places, picnic grounds or restricted parking spaces for automobiles, trailers or aircraft, when the facilities at such areas are properly planned and developed.

"The laws in some States permit the state road department to plan as well as construct and maintain 'airports', 'landing strips' and 'emergency landing fields' with highway funds, outside of highway rights-of-way and freeways. In such States the highway or road departments should continue to construct and maintain these ground facilities but in order to avoid confusion, should not call areas 'flight strips' unless they are adjacent to the highway, in highway rights-of-way or freeways."



THE BRIDGE OF A CLIPPER PLANE

A Pan American Airways Martin flying boat, showing the Sperry gyropilot. The control units mounted at the center of the instrument panel provide constant visual knowledge of the attitude of the ship during flight.

CHAPTER XIV

STATE AVIATION ACTIVITIES

The National Association of State Aviation Officials—Discussion of Fuel Tax Problems—Other Legislation—Aims and Recommendations of the National Association—New England's Plan for More Airways—W. P. A. Projects and Other Activities in Various States.

THE relation of State governments to aviation and the activities of officials handling State aeronautics during 1936 are summarized here from reports submitted by the officials themselves.

Gill Robb Wilson, president of the National Association of State Aviation Officials, made the following report for his organization:

"During the year there was noted steady development in State aviation; and it was more apparent than ever before that any State can profit by having in its governmental establishment officials representing the various forms of aeronautical activity that States must handle. The National Association of State Aviation Officials was successful in having an additional number of States develop some form of aviation authority to provide channels for presenting the principles of the national association.

"At the same time the organization made clear its oft-repeated statement that it urges no State to set up official aviation boards or other authority beyond its own particular needs and requirements. The National Association of State Aviation Officials carried on a steady campaign against the abuse of taxation in relation to aviation facilities and fuels. It was found that airports, being in the nature of public utilities and occupying large areas, are particularly susceptible to attacks which often render it impossible for them to stay in business as private commercial enterprises. But the taxation on aviation fuels on the same basis as that governing fuel tax for surface transportation is not only destructive to progress but patently inequitable.

"The consumption of fuels is so large in aviation and the price is so much higher basically that when the usual surface transportation fuel tax is added, it wreaks a grave injustice to the continued development of air transportation and private flying. If fuel tax proves to be the only method by which aviation can bear its share of the responsibility to State governments, then new ratios must be worked out, ratios which are determined by the technical characteristics of aviation fuels. Meanwhile, none can deny the injustice of having aviation fuel taxes diverted to non-aeronautical purposes, as is the case in some States at the present time. Here the State aeronautics board or similar organization can function in the interests of the State and its people, by securing for that State its fair apportionment of industrial and commercial aviation activity.

"Since curtailment of the inspection services of the U. S. Bureau of Air Commerce there has developed a trend toward having the State assume responsibility for such functions. The national association opposes this trend, and stands for a strong central regulations and inspection establishment in the Federal Government.

"The organization of the National Association of State Aviation Officials is divided in seven regional areas, each headed by a regional vice president. During the year regional meetings are held, and the programs of these meetings are based on developments in the national convention. Standing committees carry on project phases of the association. Thus the national body performs a real service by making available to State bodies the results of this constant exchange of experience and uniformity of purpose.

"The principles for which the national association stands may be summarized as follows:

1. Uniformity of regulation.

2. Protection of aviation from exploitation and unjust taxation.

3. The establishment of standing committees on aviation in the United States Congress.

4. Centralizing of the various phases of aeronautics in some one Government agency.

5. Development of a Federally-planned airport system with relation to air transportation and the national defense. No State airport program can be planned logically without taking into consideration a national program.

6. A national budget providing for adequate airway navigational aids.

"Standing committees operating in the national association are established to study such subjects as compulsory insurance for intrastate operators, the development of highway landing strips in sparsely settled country, the development of airport traffic control, the promotion of bases for water-borne craft, relations with other aeronautic organizations and numerous such practical problems.

"A secretary of the organization is in charge of the general offices at 357 East Chicago Avenue, Chicago, Ill."

Col. Porter Adams, chirman of the aviation committee of the New England Regional Planning Commission, late in 1936, issued a report recommending the following extension of airways in the five States:

Boston-Albany (Northern Route)—Improvement of this airway would provide a more direct route to Albany and by way of the Mohawk Valley to Buffalo and the West. While the Mohawk Valley is one of the great rail routes from the West to New York City, from the standpoint of air transportation, its logical Eastern terminus is Boston.

Providence-New Haven—This airway in connection with a seasonal airway from Providence to New Bedford and Hyannis, would furnish a route from New York and the South to the Cape Cod recreation area.

Connecticut Valley Airway (Hartford to White River Junction)—This airway would provide safe flying from Connecticut Valley points and New York. In connection with the suggested seasonal airway up the valley from White River Junction, it would serve the White Mountain and Northern New Hampshire vacation area.

Bangor-Calais, Maritime Provinces, Bangor-Caribou—These are natural extensions of the Boston-Bangor Airway and are closely related to Canadian developments in adjacent areas. Due to the close relationship of airways in this part of New England and those of the adjoining Canadian Provinces, the commission has contacted the Canadian aviation authorities and obtained information relative to existing conditions and plans which might affect New England. A route from Montreal to the Maritime Provinces is contemplated as a link in the projected Trans-Canada Airway. Airways are under construction from Montreal to Megantic, Que., and from Upper Brockway, N. B., to Moncton. The exact route across Maine to be followed by this airway has not as yet been decided.

Airways suggested for seasonal use include: Albany-Rutland-Burlington Airway.

Albany-Portland Airway.

Portland-Bar Harbor-Calais Airway.

Augusta-Rangeley-Jackman Airway, Waterville-Greenville Airway, Bangor-Jackman Airway.

In conjunction with this study, the commission prepared an analysis of existing aeronautical legislation relating to New England.

Colorado improved five airports during 1936, and started a new airport with W. P. A. funds at Glenwood Springs. In two of the six W. P. A. districts the air-marking program progressed satisfactorily. It was planned to establish a State Aviation Commission in 1937.

Connecticut's Department of Aeronautics, as reported by Commissioner Charles L. Morris, had a vigorous program for the advancement of aviation and the reduction of air accidents during 1936. During the year 85 new airmarking signs were painted, and 45 old signs repainted, averaging 12 feet in height. Aviation ground school courses, of a not-too-technical nature, were organized under the W. P. A. educational program. In nine localities over 1,200 persons attended the opening nights, and 878 enrolled for the courses. Accidents in 1936 totalled 29, as compared to 52 in 1930. The State legislature was to be asked to approve a plan for "flight strip" landing fields along the highways.

Florida's ten-year program of aviation development, started in 1935, made progress during 1936, when 14 new airports were completed under the direction of A. B. McMullen. Other airports were enlarged, and improved with paved runways, lights, hangars and other facilities. Seven radio stations were established for disseminating weather information. The air-marking program was completed, 430 communities being adequately marked. During the year 2,141 students in 11 cities received some form of aviation education under the direction of the Aviation Division of the State Road Department.

Idaho's plan of improving 25 airports did not materialize, according to Director of Aeronautics W. R. Graham, because of lack of W. P. A. funds. Only two were improved. It was hoped to complete the project in 1937, as well as build a new airport at Boise, to cost $450,000.

The Illinois Aeronautics Commission, through its secretary, Elwood B. Cole, reported that six municipal airports had been improved.

Maine's aviation projects, according to Capt. Burtis F. Fowler, chief inspector of aeronautics, included completion of night flying facilities at the Portland airport, completion of the airport at Augusta, a radio beam station near that city, and construction work on eight other airports in the State.

Maryland's State Aviation Commission reported 127 towns airmarked with W. P. A. funds during 1936.

The Massachusetts Committee for Aeronautics reported that airports at Hyannis, Westfield, Turners Falls and East Boston had been improved during the year.

Michigan's State Department of Aeronautics reported considerable progress in its aviation development program. Eighty-two airport and landing field projects were approved for W. P. A. development, and

57 were placed under construction. Four of 13 hangars projected had been completed at the end of the year. A movement was started to eliminate all trees, pole lines and other hazards adjacent to airports. Eight new landing fields were to be constructed, using C. C. C. labor. Of the 570 town-marking projects, 476 were completed. The department also maintained 14 beacons on two state airways. Improvement of a number of airports, construction of new fields and four marine air terminals were among the projects for 1937.

Mississippi's plan for an aviation board was to come before the State legislature for the second time in 1937. Meanwhile, under W. P. A. supervision landing fields in 21 cities and towns were being either constructed or improved. Ten new fields were being completed.

Montana's Aeronautic Commission headed by Fred B. Sheriff, re-

A WACO C-6 MODEL

It is powered by a Continental, Jacobs or Wright Whirlwind engine.

ported 75 landing fields improved with W. P. A. funds. Efforts were being made at the end of 1936 to close the gap in regular air service between Lethridge, Canada, and Great Falls, Mont., completing the service between Edmonton and Salt Lake City.

Nebraska's Aeronautics Commission made this report: "Air Commerce Regulations were adopted by the State to broaden the scope of regulatory jurisdiction, and to increase regulatory control. All aircraft and all airmen were licensed and registered by the Commission. A current history of both aircraft and airmen is maintained by the Commission. All law enforcement officers are educated in the nature of air laws, and their cooperation in the enforcement of regulations is constantly solicited. The results are gratifying.

"Airport development work with W. P. A. funds was stressed and a very active part taken in coordinating the efforts of the community, the Works Progress Administration, and the Bureau of Air Commerce. This Commission cooperated with the technical specialists of the Bureau of Air Commerce in ironing out difficulties arising in airport work. Bureau officials and W. P. A. officials were transported in the State plane to points of difficulty, meetings of all interested parties arranged and the trouble corrected by amicable agreement between parties. A State-wide air-marking project was sponsored by the Commission, and is now developing rapidly under Commission supervision. This is being achieved with W. P. A. funds. When completed 300 towns will be air-marked. With the assistance of the State Planning Board, a file of plans for each existing airport is being prepared with a view to the future development of such facilities. These plans include a drawing of existing facilities, a drawing of the airport and all adjacent terrain within six miles, all highways transmission lines and obstructions and all neighboring airports, a cross-section of adjacent land for scrutiny in contemplated expansion and zoning procedure, a general map of Nebraska and adjoining States for use in determining the situation of the future needs in airports facilities, with a view to interstate travel.

"Plans for 1937 include: 1. Continued close regulatory control of aircraft and airmen. 2. Promotion of airport development needed at strategic points on travelled routes, and the installation of navigation aids. 3. Educational program to create public confidence in air transportation; to educate both the public and the law enforcement officers in the nature of air-laws; to educate airmen in the necessity of safe operations to procure and retain public confidence. 4. Continued close cooperation with all sections of the Bureau of Air Commerce."

New Hampshire's Public Service Commission in 1936 cooperated with the W. P. A. in improvement of airports in the State.

New Jersey's Director of Aviation, Gill Robb Wilson, submitted this report: "New Jersey has the most heavily travelled airways in aviation, yet it is more than five years since the life of any commercial passenger was lost in any type of flying, from barnstorming to scheduled air transport in the State. Constituting as they do a laboratory for air traffic, it is on these airways that the problem of traffic control, the requirements for two-way radio, the inauguration of the flight plan for Federal airways and other such measures have first been tried and brought into practice. The airports in the State have been protected from destructive competition of outside miscellaneous barnstorming which takes the cream of the profits without making any capital investment and which leaves the fixed-base operator 'holding the bag.'

Barnstorming is permitted but not where it will injure fixed-base operation. Safety in the State has been preserved by the regulation of airports and operators, the development of navigational aids, prevention of the erection of hazards and obstacles; but most of all by the constant cooperation of the fixed-base operators themselves. The Department of Aviation owns no aircraft or motor vehicles and operates on an extremely limited budget which is paid out of the general State tax fund. There is no taxation on aviation in any form in New Jersey, the fuel tax being refunded; and there is no fee of any kind for any service rendered."

Oregon's State Board of Aeronautics, through its secretary, Webster A. Jones, submitted a comprehensive report of its activities, of which the following is a summary: "Oregon has the largest airport construction program of any of the Pacific Northwest States. By the end of the coming year at least $3,500,000 will have been expended by various federal agencies on the construction of airports in Oregon. From all indications, this airport program will be continued for some time to come. The State Board has followed closely the airport program, has presented its problems to the agencies and has demanded recognition. The Board is happy to state that those in charge of the agencies have cooperated to the fullest extent to support the program. E. J. Griffith, State W. P. A. administrator, has recognized our problems and has been generous in designating money for airport construction. Such fine work will bring forth the praise of all in the flying industry. The State Board was an important factor in obtaining for Portland its new major airport development on the Columbia river. It was necessary for a bond issue to be voted, exceeding $300,000 before the Federal funds could be obtained. During the past 12 months the State Board of Aeronautics cooperated with the State Board of Higher Education in sponsoring a series of ground aviation schools through the use of W. P. A. funds, in which approximately 250 students, adults, have enrolled to receive instruction in aviation subjects. A year ago an air-marking program was outlined by the Board to secure adequate marking for all cities in Oregon. This program has been completed as sponsored by the Board through help from Federal agencies. Approximately 200 signs have been painted, adequately marking every city and town in Oregon so that visiting fliers will know their exact location."

Rhode Island, according to Willard M. Fletcher, in charge of the State airport division, completed its first State-owned airport in 1936—that at Warwick—and started work on a second, at Westerly. A third is to be located on Block Island.

South Dakota's Aeronautics Commission, according to its chairman, T. B. Roberts, Jr., planned to develop revenue-making projects in 1937, to provide funds for the maintenance of airports.

Tennessee's Aeronautics Commission, through its director, R. O. Lindsay, issued a 23-page report giving in detail plans for aviation development in that State.

Utah acquired 20 new landing fields under W. P. A. projects in 1936, and at the end of the year was completing extensive improvements to the airport at Salt Lake City.

Vermont increased its licensed aircraft in 1936 from 37 to 57 and pilots from 70 to 91.

Virginia licensed 10 new airports in 1936, and also granted licenses to an increasing number of pilots and student pilots.

Wyoming, under the direction of its State-treasurer, J. Kirk Baldwin, completed air-marking of 110 localities in 1936. An effort to pass a uniform regulatory law was to be made during the 1937 legislative session.

The gas tax summary and table on State regulatory bodies will be found in the appendix.

A HIGH-FLYING BOAT

The Hornet-powered Sikorsky S-43 amphibion on a record-breaking flight.

CHAPTER XV

NEW THINGS IN THE AIR

Progress in Aircraft Construction—Developments in Design—Awards for Contributing to the Art—Work of the Aircraft Manufacturers—Builders of Aircraft Engines—Manufacturers of Accessories—Design Drawings of Planes and Engines.

GIANT air liners, flying boats and bombing planes, faster racers, fighters and attack planes, more powerful aircraft engines and an amazing array of improved navigational instruments, not forgetting a very rapid growth in the popularity of light planes—those are some of the most recent developments in American aviation. And in the making are still greater things, still larger transports, flying boats twice the size of anything yet built, bombers promising to dwarf the present aerial fortresses, far more powerful engines and more efficient instruments, radio, metals and other gadgets that enter into the construction of new flying craft.

Many of the developments, either in existence or in sight at the beginning of 1937, were calculated to make aircraft faster, more comfortable, safer and more economical for the operator. Thousands of persons in one way or another were contributing to this onward march toward the complete conquest of the air. While many remained in the background others received merited rewards and renown; as, for example, Dr. George W. Lewis, director of research of the National Advisory Committee for Aeronautics, who was awarded the Daniel Guggenheim Medal for 1936 for "outstanding success in the direction of aeronautical research and for the development of original equipment and methods." And also Donald W. Douglas, builder of the famous ships by that name, who received the coveted Collier Trophy for the year's (1935) outstanding achievement in aeronautics, the Douglas transport. There were scores of other honors, but none more fitting than that bestowed on Richard H.

AIRCRAFT SPECIFICATIONS

From all official company reports received at time of going to press.

Name of Manufacturer	*Model*	*Places*	*ATC No.*	*Make of Engine*	*No. of Engines*	*Total Rated H. P.*	*Wing Area Sq. Ft.*	*Gross Weight Lbs.*	*Pay Load Lbs.*	*High Speed M.P.H.*	*Cruising Speed M.P.H.*
Aeronca	LC	2	614	Warner Scarab Jr.	1	90	150	1650	285	123	108
Aeronca	LCS	2	614	Warner Scarab Jr.	1	90	150	1852	272	116	100
Aeronca	K	2	Pend.	Aeronca E-113C	1	36	150	1040	214	93	85
Arrow	F	2	613	Arrow	1	82	180	1675	503	100	95
Beech	C17L	4 or 5	602	Jacobs L-4	1	225	273	3150		175	166
Beech	C17B	4 or 5	602	Jacobs L-5	1	285	273	3150		185	177
Beech	C17R	4 or 5	604	Wright R-975-E3	1	450	267	3900		211	202
Beech	18	8	Pend.	Wright R-760-E	2	640	347	6500		200	190
Bellanca	28-70	2		P & W Geared Twin Wasp Jr.	1	700	279	8350	3800	275	250
Bellanca	31-42	6	578	Wright R-975-E3	1	420	359	5600	1198	165	145
Bellanca	31-42	1		Wright R-975-E2	1	420	311	5600	2000	160	145
Bellanca	66-85	2		Wright GR-1820-G3	1	850		11,400	4021	178	161
Bellanca	31-55	6	565	P & W Wasp S3H1	1	550	359	5600	1096	190	180
Boeing	247-D	13	558	P & W Wasps	2	1100	836	13,650	2582	202	189
Boeing	281	1		P & W Wasp	1	500	150	3380	1026	235	210
Boeing	299 (YB-17)	variable		Wright G Cyclones	4	4000		32,000 (approx)			
Curtiss	A-18			Wright Cyclone	2	2000					
Curtiss	SBC-3	2		P & W Twin Wasp	1						
Curtiss	Y1P-36	1		Wright Cyclone	1	1000					
Curtiss	SOC-1	2		P & W Wasp	1	550					
Curtiss	Hawk III	1		Wright Cyclone	1	750	262	4317		240.2	202.9
Curtiss	Hawk 75	1		Wright Cyclone	1	840	236	5172		273.4	234.3
Curtiss	A-12	2		Wright Cyclone	1	775	285	5925		202	171
Curtiss	Seagull	2		P & W Wasp	1	550	342	5192		168	137.3
Curtiss	Hawk IV	1		Wright Cyclone	1	745	262	4598		248.5	211.3
Curtiss-Wright	Condor			Wright Cyclone	2	1520	1328	18,500		181	164
Fairchild	45	5	603	Wright R-760-E2	1	320	248	4000	733	170	165
Fairchild	C-8-E	3	600	Warner Super Scarab	1	145	173	2400	440	120	116
Fairchild	C-8-F	3	610	Ranger 639-D-3	1	150	173	2400	390	120	116
Fleetwings	F5	4	Pend.	Jacobs L-5	1	285	235	3450	780	150	133
Grumman	FF-1	2		Wright F-52	1	775	310	4650	1550	220	200
Grumman	JF-2	2-4		Wright F-52	1	775	409	5760	1650	180	160
Grumman	F2F-1	1		P & W R-1535	1	650	230	3790	1160	240	210
Grumman	G-21	6-8		P & W R-985	2	800	375	7500	1120	180	170
Kellett	KD-1A	2		Jacobs	1	225	55.2	2200	210	120	100
Lockheed	Electra	12	551	P & W Wasp Jr. SB	2	800	458.3	10,100	v'ble	210	195
Lockheed	12	8	618	P & W Wasp Jr. SB	2	800	352	8400	v'ble	226	213
Lockheed	Super Electra	14		Wright Cyclone GR-1820-G3	2	1680	551	15,000	v'ble	265	240
Luscombe	Phantom	2	552	Warner	1	145	142	1950	630	160	145
Martin	130	52	585	P & W Twin Wasp	4	3400	2170	52,000	27,389	180	140

Name of Manufacturer	Model	Places	ATC No.	Make of Engine	No. of Engines	Total Rated H. P.	Wing Area Sq. Ft.	Gross Weight Lbs.	Pay Load Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.
Martin	139W	5		Wright G Cyclone	2	1700	678	14,780	5280	235	200
Martin	156	52	Pend.	Wright G Cyclone	4	3400	2290	62,000	32,643	190	165
Mercury	T-2	2	235	LeBlond	1	90	192	935	578	115	95
North American	NA-16	2	2-517	P & W	1	550	248	4500	1350	216	202
North American	NA-16-1	2		P & W	1	550	248	4500	1355	218	212
North American	NA-16-2	2		P & W	1	500	248	4500	1355	224	218
North American	NA-16-3	2		P & W	1	500	262	5300	2100	220	213
North American	NA-16-4	2		Wright	1	440	248	3860	1035	188	178
North American	NA-16-5	1		Wright	1	835	225	4550	1110	270	260
Porterfield	35-70	2	567	LeBlond 5-E	1	70	147	1310	200	115	105
Porterfield	35-V	2	606	Velie M-5	1	65	147	1310	200	112	103
Porterfield	35-W	2	611	Warner Scarab Jr.	1	90	147	1326	200	125	110
Porterfield	CP-40	2	Pend.	Continental A-40	1	40	169	1040	220	80	70
Rearwin	7000	2	574	LeBlond	1	70	166	1460	220	115	103
Rearwin	8500	2	591	LeBlond	1	90	166	1460	220	123	110
Rearwin	9000	2	2-523	Warner	1	90	166	1460	220	120	107
Rearwin	6000	2		Cirrus	1	95	145	1700	220	140	120
Rearwin	6000M	2		Menasco	1	125	145	1700	220	160	140
Rearwin	6000MS	2		Menasco	1	150	145	1700	220	200	165
Ryan	S-T	2	541	Menasco B4	1	95	124	1575	210	140	120
Ryan	S-T-A	2	571	Menasco C4	1	125	124	1575	210	150	127
Ryan	S-T-A Special	1	Pend.	Menasco C4S	1	150	124	1575	210	160	135
Sikorsky	S-42-B	37	592	P & W S1EG Hornet	4	3000	1340	42,000	9495	188	163
Sikorsky	S-43	18	593	P & W S1EG Hornet	2	1500	780.6	18,500	3243	190	166
Stearman-Hammond	Y-1	2	Pend.	Menasco C4	1	125	210	2150	290	120	110
Stearman-Hammond	Y-1-S	2	Pend.	Menasco C4S	1	150	210	2175	290	135	120
Taylor	J-2	2	595	Continental A-40-4	1	40	178	970	175	85	72
Chance Vought	SBU-1	2		P & W Twin Wasp Jr	1	700		5318		205	
Chance Vought	SB2U-1	2		P & W Twin Wasp Jr.	1	700					
Chance Vought	V-142	2		P & W Twin Wasp Jr.	1	700	327	5445		205	
Chance Vought	V-143	1		P & W Twin Wasp Jr.	1	700	187	4300		280	
Vultee	V-1A	10	545	Wright Cyclone SR-1820-F52	1	775	384	8500		230	210
Vultee	V-1A	10	545	Wright Cyclone SR-1820-G2	1	850	384	8500		235	215
Vultee	V-1A	10	545	Wright Cyclone SR-1820-G5	1	850	384	8500		240	220
Vultee	V-11GB	2 or 3		Wright Cyclone SGR-1820-G2	1	850	384	8853		236	217
Vultee	V-11GB	2 or 3		Wright Cyclone SGR-1820-G2	1	850	384	11,150		225	203
Waco	VKS-7	5	528	Continental W670M1	1	250	240	3250	739	148	131
Waco	UKS-7	5	528	Continental W670K	1	225	240	3250	783	147	130
Waco	ZKS-7	5	533	Jacobs L-5	1	285	240	3250	718	153	136
Waco	YKS-7	5	533	Jacobs L-4	1	225	240	3250	756	147	130
Waco	YGC-7	5	Pend.	Jacobs L-4	1	225	246	3650	892	158	140
Waco	ZGC-7	5	Pend.	Jacobs L-5	1	285	246	3650	852	164	150
Waco	UGC-7	5	Pend.	Continental W670K	1	225	246	3650	922	158	140
Waco	VGC-7	5	Pend.	Continental W670M1	1	250	246	3650	872	159	141
Waco	DGC-7	5	Pend.	Wright R-760-E1	1	285	246	3650	822	167	151
Waco	EGC-7	5	Pend.	Wright R-760-E2	1	320	246	3650	772	174	156

Depew, Jr., and Beckwith Havens, partners and airplane dealers with headquarters at Roosevelt Field, Long Island, N. Y. One day scores of their friends gathered at the field and congratulated them on their anniversary. Both had been flying steadily for 25 years, a record held by few, if any, others and an accomplishment of which anyone might be proud—flying since 1911.

"It is becoming easier every year" was all the two veterans had to say.

Commemorating the 33d birthday of the airplane on December 17, 1936, Leighton W. Rogers, president of the Aeronautical Chamber of Commerce of America, representing the aviation manufacturers of the United States, sent a telegram to Orville Wright pointing out the amazing development in a radically new vehicle during the comparatively brief period of 33 years. The telegram reads:

"On behalf of the members of the Aeronautical Chamber of Com-

THE AERONCA MODEL K

This side-by-side, two-place monoplane has the 40 h. p. Aeronca engine.

merce of America and the aircraft manufacturing industry which it represents we felicitate you on this the thirty-third anniversary of human flight, a date which Americans will ever commemorate as marking the invention of the airplane by Orville and Wilbur Wright. Those who design and construct airplanes are especially mindful of your epochal achievement because the increasingly rapid progress in aircraft design and construction is based on the same natural laws which you were first to reduce to the aerodynamic science that gave wings to the world. It has permitted the steady increase in speed. Beginning with the 40 miles an hour speed of the first plane, our fighting planes today approach 300 miles an hour, an increase of 650 per cent in speed, and are capable of active service six miles above sea level. Your first airplane engine possessed only 16 horsepower. Our aircraft engines now range as high as 1,000 and 1,200 horsepower.

Throughout the world great industries have grown from the Wright invention. The American aircraft manufacturing industry alone employs approximately 30,000 persons, and represents several hundred million dollars of invested capital.

"Working throughout on the same scientific principles established by you and your brother our aircraft industry has produced upward of 40,000 airplanes. Your first plane carried one person. New transport aircraft carry as many as fifty, and fly at more than three miles a minute. There is every promise that aviation will make even more rapid strides in the future."

Rapid strides in aircraft manufacturing were made during 1936, as the following account of company activities will show.

Manufacturers of Aircraft

Aeronautical Corporation of America, Cincinnati, O., produced three new models, the Aeronca K, replacing the former C-3; the Aeronca LC landplane and the Aeronca LCS seaplane. Model K is a two-place side-by-side high-wing strut-braced cabin monoplane, powered by an Aeronca E-113C 40 h.p. engine. It has a stated cruising speed of 85 m.p.h., range of 250 miles, weight empty 590 pounds, useful load 450 pounds, length 20 feet 7 inches, span 9 feet and wing area 146.35 square feet. Model LC is a low-wing cabin monoplane seating two persons, powered by LeBlond or Warner engines. With the Warner Scarab Jr. 90 h.p. engine the LC has a stated high speed of 123 m.p.h., cruising at 108 m.p.h., range 535 miles, length 22 feet 3½ inches, span 36 feet, wing area 150 square feet, weight empty 1,034 pounds, and useful load 646 pounds. The LCS seaplane with a Warner Scarab Jr. 90 h.p. engine is equipped with Edo floats, and has a stated cruising speed of 100 m.p.h., range 450 miles, weight empty 1,193 pounds, useful load 659 pounds, span 36 feet, length 23 feet 9½ inches and wing area of 150 square feet.

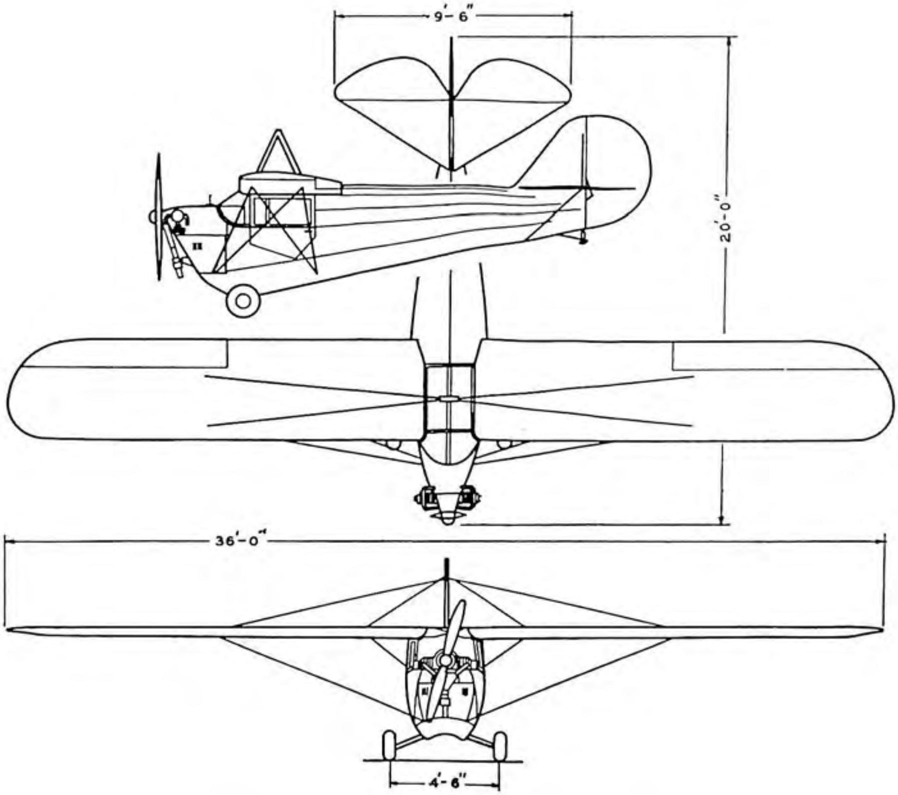
Air Transport Manufacturing Company, Ltd., Glendale, Calif., produced a high-wing six-place cabin plane powered with three Kinner K-5 engines. It had a stated high speed of 140 m.p.h.

The Arrow Aircraft Motor Corporation, Lincoln, Neb., was developing a two-seater, side-by-side light sport plane, Arrow Sport, a low-wing, open cockpit monoplane, 36 feet nine inches wing span, 21 feet four inches in length, stated cruising speed 90 m.p.h., powered with the 82 h.p. Arrow V-8 motor, a conversion of the Ford V-8 automobile engine.

The Autogiro Company of America, Willow Grove, Pa., was continuing its intensive experimental work seeking further developments of rotor blade type aircraft. Three objectives were being

THE AERONCA MASTER C-3

This side-by-side, two-seat high-wing monoplane has the 40 h.p. Aeronca engine.

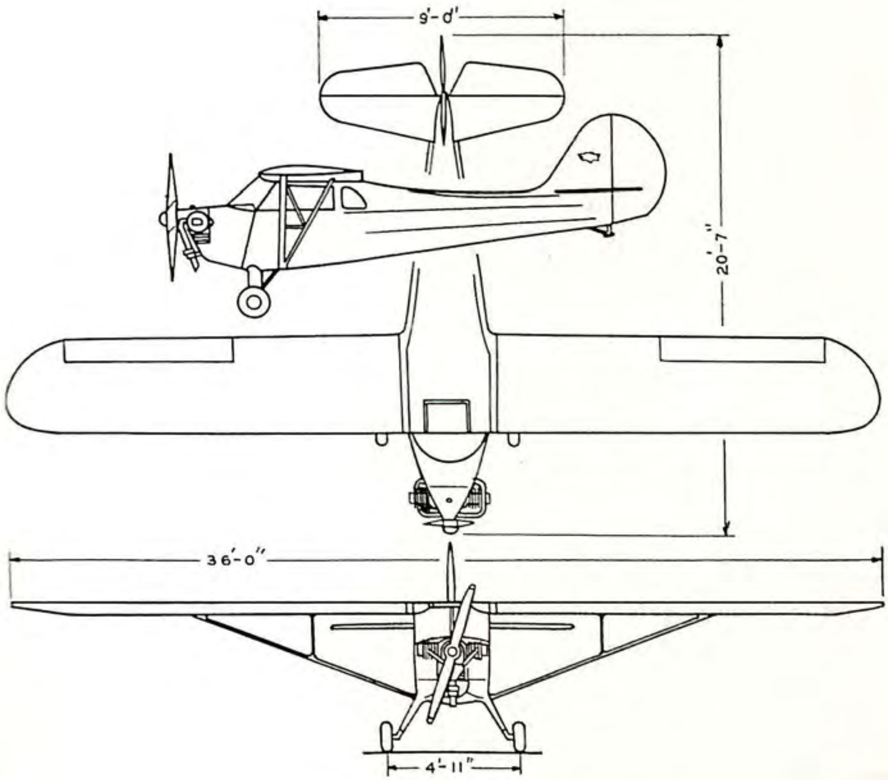


AERONCA C-3

This two-place cabin plane is powered with an Aeronca E-113C engine.

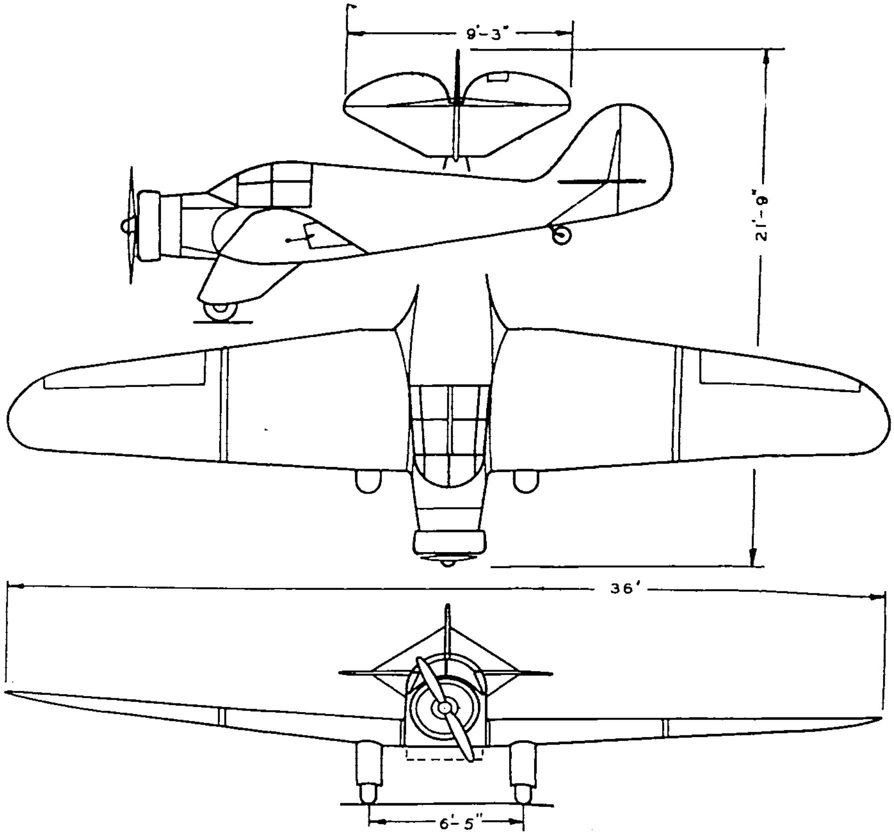
reached, experimentally—a perfected means of direct control wholly independent of motor power and forward speed; direct take-off without any forward run; and third, development of an autogiro with characteristics of a motor car so that it might be operated on highways when not in flight. A model of that design was completed for the Bureau of Air Commerce. Experimental models of military design showed top speeds approaching 150 m.p.h., an increase of 20 per cent over the speed of fixed-wing models using the same engine horsepower.

Direct control was accomplished by mounting the rotor head on bearings so that the movement of the pilot's control stick simultaneously moved the rotor, tilting it, and thus displacing the direction of rotor lift in respect to the center of gravity and thereby giving a definitely related controlling force during any flight speed, even in



AERONCA K

A two-place plane for the private flyer with an Aeronca E-113C engine.

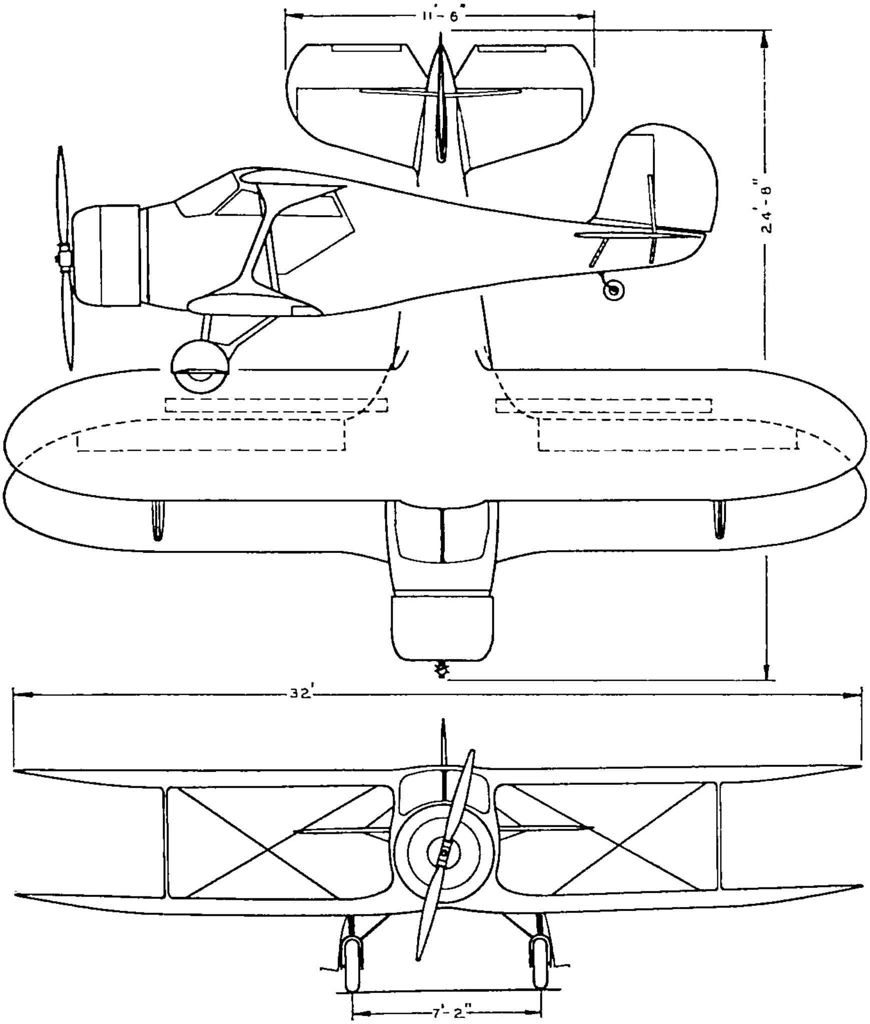


AERONCA LB AND LC

This two-seater cabin monoplane for private flyers is powered with a Le Blond 85 h.p. engine or a 90 h.p. Warner Junior.

vertical descent. Elimination of wings and movable control surfaces enhanced the simplicity of the autogiro. Direct take-off was obtained by a control permitting the pilot to flatten the blades. The pilot started his blades through the conventional rotor clutch and steer mechanism, then brought them, with blades flattened and not exerting lift, to a speed considerably greater than normal rotating speed. He then released the starter clutch, permitting the blades to assume normal flight incidence. The excess kinetic energy represented in the excess speed of the rotor was then converted into a direct lifting force sufficient to lift the machine directly off the ground. Individual designs developed by the Company's licensees, Kellett Autogiro Corporation and Pitcairn Autogiro Company, are described in the sections devoted to those concerns.

Barkley-Grow Aircraft Corporation, Detroit, Mich., reported that it had designed an all metal, low-wing, twin-engine, eight place transport, incorporating in the wing a multi-spar type of construction —a multiplicity of full spanwise members of thin sheet metal having their web sections lightened by blanked and flanged holes and their

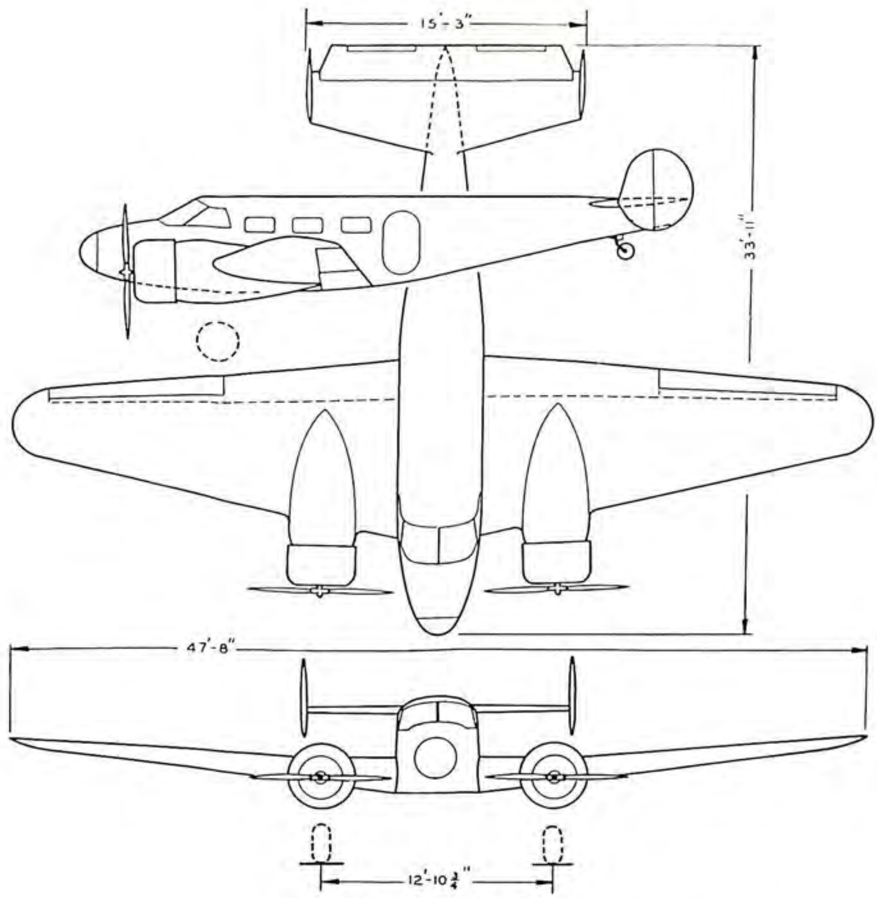


BEECHCRAFT C17R

This five-place cabin model is powered with a Wright Whirlwind 450 h.p. engine.

flanges made of separate pieces of heavier gauged metal. The company was also planning to manufacture hollow, steel-bladed propellers.

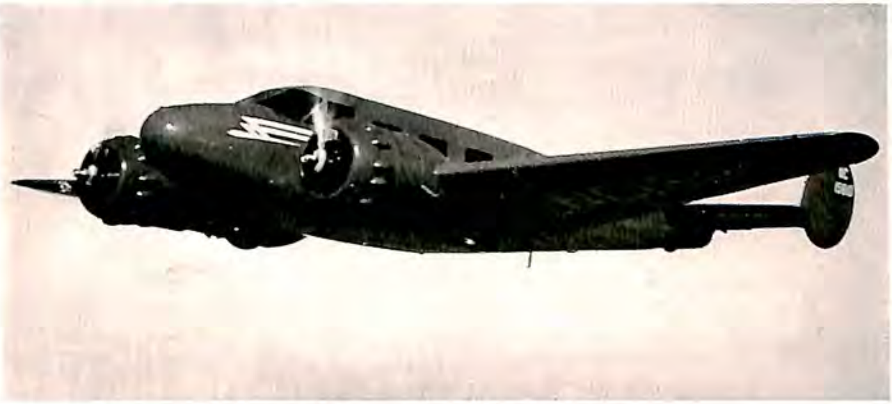
The Beech Aircraft Company, Wichita, Kans., was producing four different Beechcraft models, all high speed five-place cabin biplanes. Two were powered with Jacobs engines. Two carried Wright engines. The Beechcraft C17B, with a 285 h.p. Jacobs L-5 engine, had a stated cruising speed of 177 m.p.h., landing at 45 m.p.h., and range of 700 miles. The C17L with a 225 h.p. Jacobs L-4, had a stated cruising speed of 166 m.p.h. and range of 800 miles. The



BEECHCRAFT MODEL 18

A new model powered either with two Wright seven-cylinder engines or two Jacobs of 285 h.p. each.

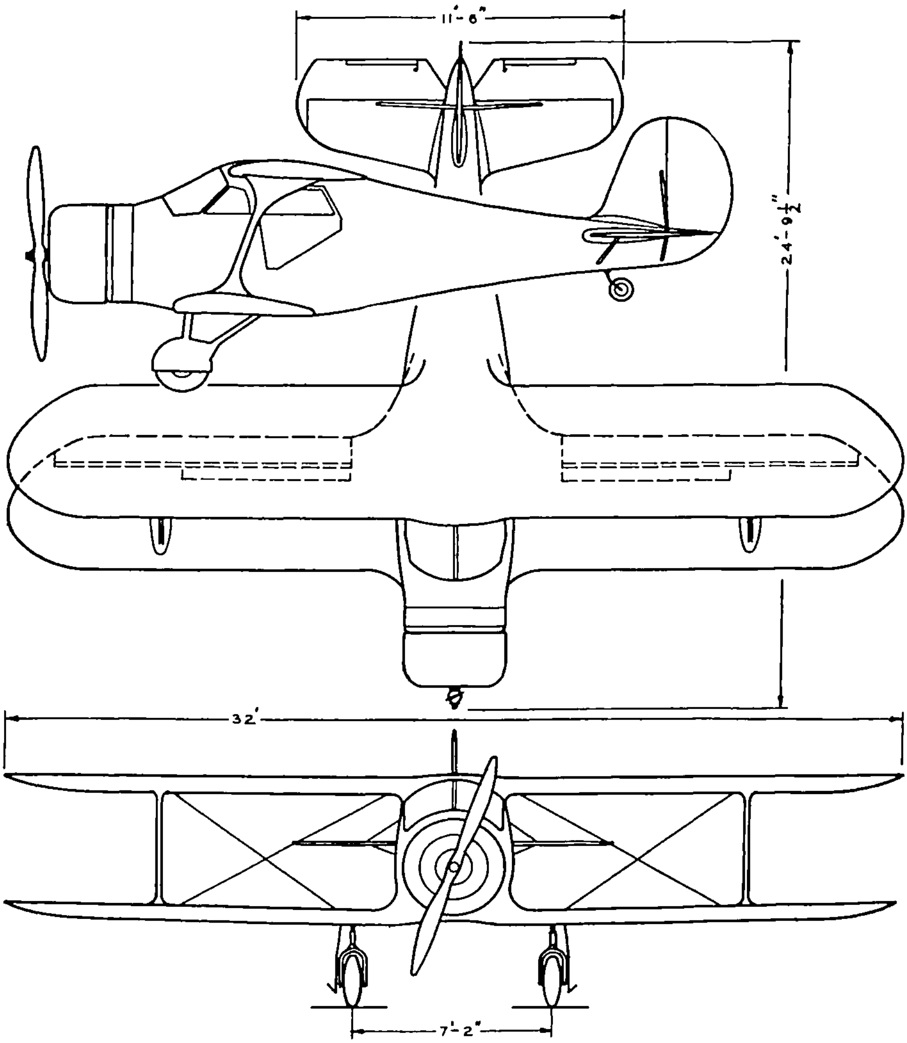
C17R with 450 h.p. Wright Whirlwind had a stated cruising speed of 202 m.p.h., and the same model with 420 h.p. Whirlwind had a cruising speed of 177 m.p.h. Louise Thaden and Blanche Noyes flew a Wright-powered Beechcraft when they won the Bendix Trophy race in 1936, averaging more than eight miles a gallon of gasoline against head winds. The Beechcraft models were used extensively by oil well drilling contractors. A new product of the company for 1937 was Beechcraft Model 18, a twin-engine low wing cabin monoplane for six passengers and two pilots, a stated cruising speed of 192 m.p.h. at 10,000 feet, range 1,070 miles with full load, gross weight 6,500 pounds, empty weight 3,920 pounds, span 47 feet eight inches, length 31 feet 11 inches, height nine feet five inches and wing area



THE TWO ENGINE BEECHCRAFT

This eight-passenger transport, Model 18, is powered by two 285 h.p. Jacobs or two 350 h.p. Wright Whirlwind engines.

347 square feet. It was further described by the company as follows: "Powered with two Wright 350 h.p. motors it shows a climbing rate of 1250 feet for first minute of climb. The take-off run is extremely short; this ship getting off with full load in less than four hundred feet. The slow landing speed permits the ship to be landed in fields much smaller than usually required for ships of similar capacity and speed. The Model 18 Beechcraft is also designed for installation of Jacobs 285 h.p. motors which increase the economy in operation with little loss in performance. For a swift, economical and luxurious plane for use as a 'flying office' or in feeder line operation, the Model 18 Beechcraft has a spacious cabin completely insulated to exclude noise and equipped with unique and effective ventilation and cabin tempera-



BEECHCRAFT C17L

This four-five place cabin plane for the private flyer is powered with a Jacobs 225 h.p. engine.

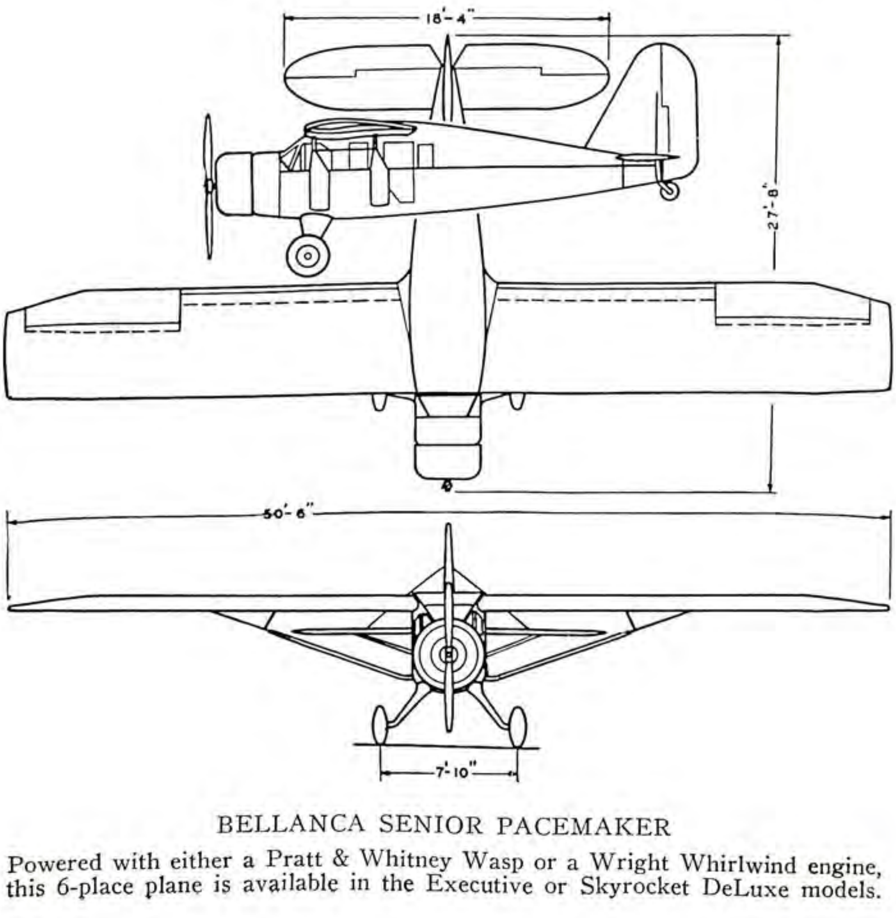
ture control, which provides an ample, draftless, cabin atmosphere under all weather conditions. The seating arrangement is optional and may include a lounge or desk or both. In every case the upholstery is luxurious and designed for comfort. The large baggage compartment and toilet facilities are available from the cabin. Dual controls and two-way radio are features that appeal to executives."

A BUSINESS BEECHCRAFT

This Jacobs powered Beech product has taken its owner to the Texas oil fields.

Bell Aircraft Corporation, Buffalo, N. Y., was incorporated under the laws of the State of New York in July, 1935, with Lawrence D. Bell president and general manager, Ray P. Whitman vice president and treasurer, Robert J. Woods chief engineer and Charles L. Beard secretary and assistant treasurer. All were formerly connected with the Consolidated Aircraft Corporation. Bell Aircraft Corporation described its 1936 activities as follows: "Since the first of the year we have taken over additional floor space, bringing our total square footage now up to approximately 150,000 square feet with additional space under option. We have entered into two sub-contracts with Consolidated Aircraft Corporation covering our construction for it of all of the outboard wing panels for the PBY Flying Boats which Consolidated is building for the Navy. We started deliveries in June and will complete the total orders about the middle of 1938. In addition to this production business, which has brought our total personnel up to more than 600, we have a number of small spare orders which we are filling for the Army and Navy. Included among these are some for parts for the Great Lakes Aircraft Corporation BG-1 Dive Bomber. In this connection we bought at public auction last October all rights to the manufacture and sale of the BG-1 Dive Bomber, including tools and fixtures."

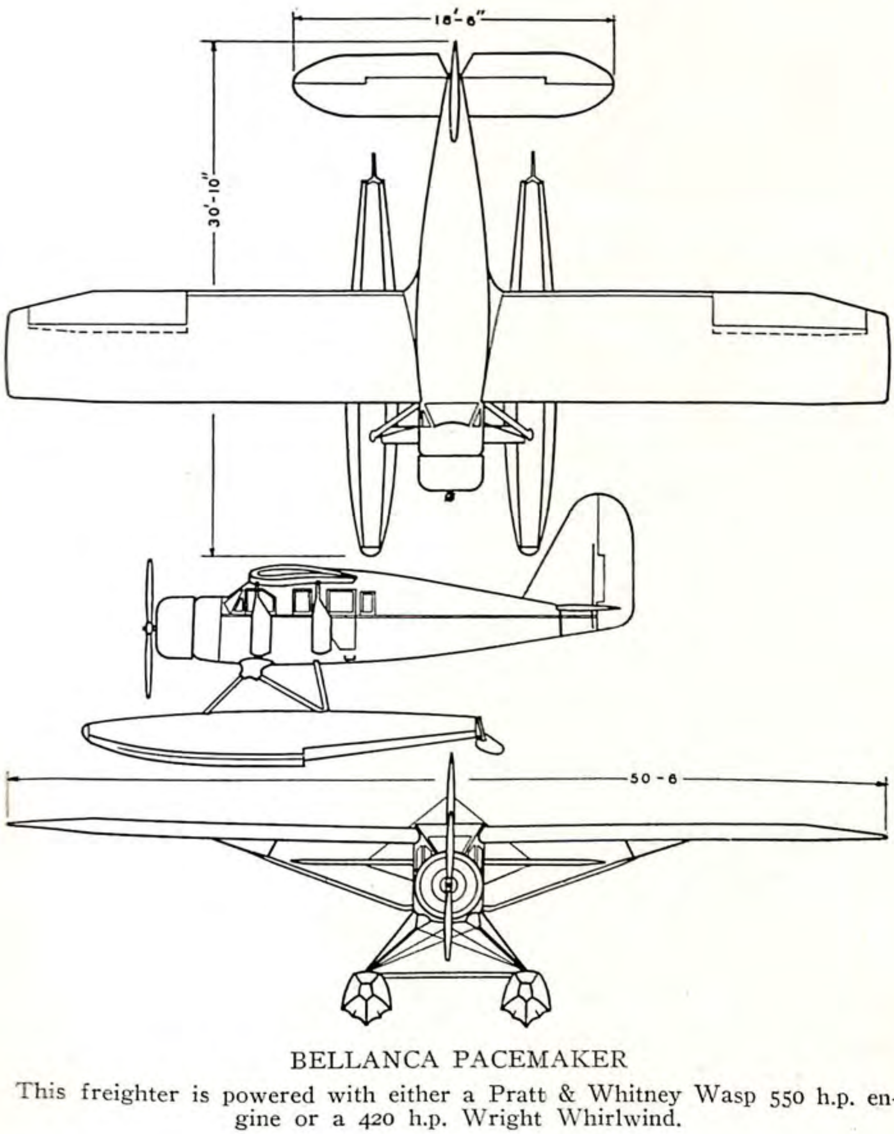
Bellanca Aircraft Corporation, New Castle, Del., produced its Senior Pacemaker, with a 420 h.p. Whirlwind engine, carrying a one ton payload. That model was in use in Canada, Norway and Alaska. Senior Skyrocket models were sold to private owners in the United States, another was used for aerial mapping work in Arabia. Capt. James Mollison, British pilot, bought a Bellanca 28-70. It was named Flash and was designed for record flights over long distances, its 700 h.p. Pratt & Whitney Twin Wasp Junior giving it a stated speed of 260 m.p.h. at 9,000 feet. Late in 1936 Mollison flew the Flash to London, averaging 227 m.p.h. from land to land, 2,100 miles in nine hours 15 minutes. The Flash has a wing span of 46 feet 2 inches, length 26 feet, height 7 feet and wing area of 279 square feet, weighs empty 4,074 pounds useful load 4,276 pounds and gross weight 8,350 pounds.



BELLANCA SENIOR PACEMAKER

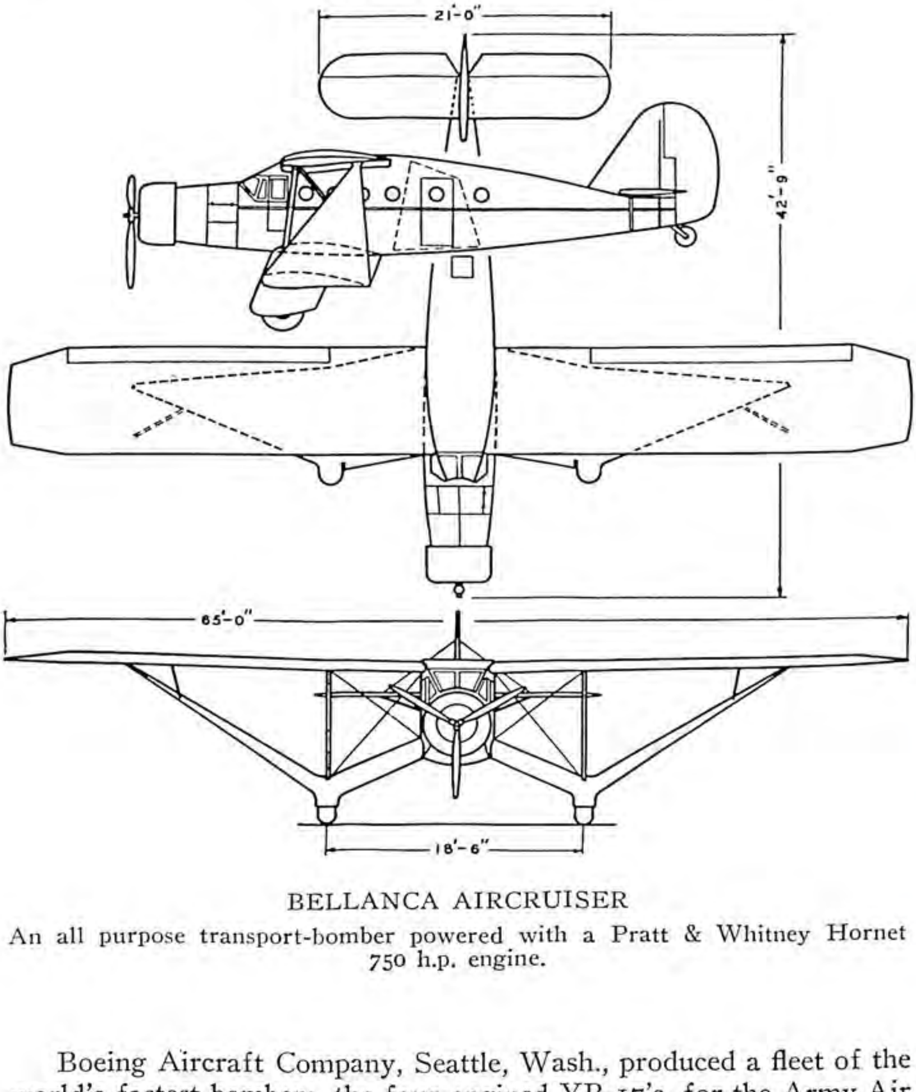
Powered with either a Pratt & Whitney Wasp or a Wright Whirlwind engine, this 6-place plane is available in the Executive or Skyrocket DeLuxe models.

It was a low-wing braced monoplane, with tapered wing of braced, two-spar construction, fabric-covered. Kurt Bjorkvall, Swedish aviator, chose a Bellanca Pacemaker monoplane and equipped it with special fuel tanks for his attempted flight from New York to Sweden. The company planned to market a low-price airplane in 1937.



BELLANCA PACEMAKER

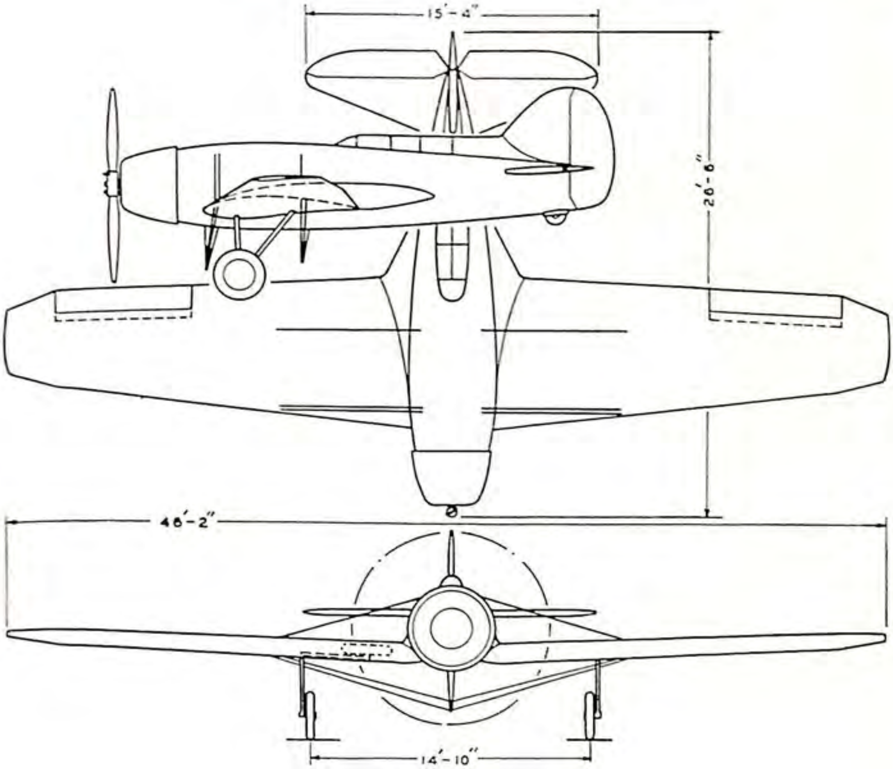
This freighter is powered with either a Pratt & Whitney Wasp 550 h.p. engine or a 420 h.p. Wright Whirlwind.



BELLANCA AIRCRUISER

An all purpose transport-bomber powered with a Pratt & Whitney Hornet 750 h.p. engine.

Boeing Aircraft Company, Seattle, Wash., produced a fleet of the world's fastest bombers, the four-engined YB-17's, for the Army Air Corps. Thirteen of these giant planes were being built, to provide a formidable new addition to the nation's aerial defense equipment. In appearance they were similar to the original experimental model of this type plane, the Boeing 299, an all metal, low-wing monoplane, with retractible landing gear and tail wheel, and with five gun emplacements, four of them in the form of streamlined "blisters". On its initial flight from Seattle to Dayton, O., the 299 covered the 2,100 miles non-stop in nine hours, offering a striking example of the



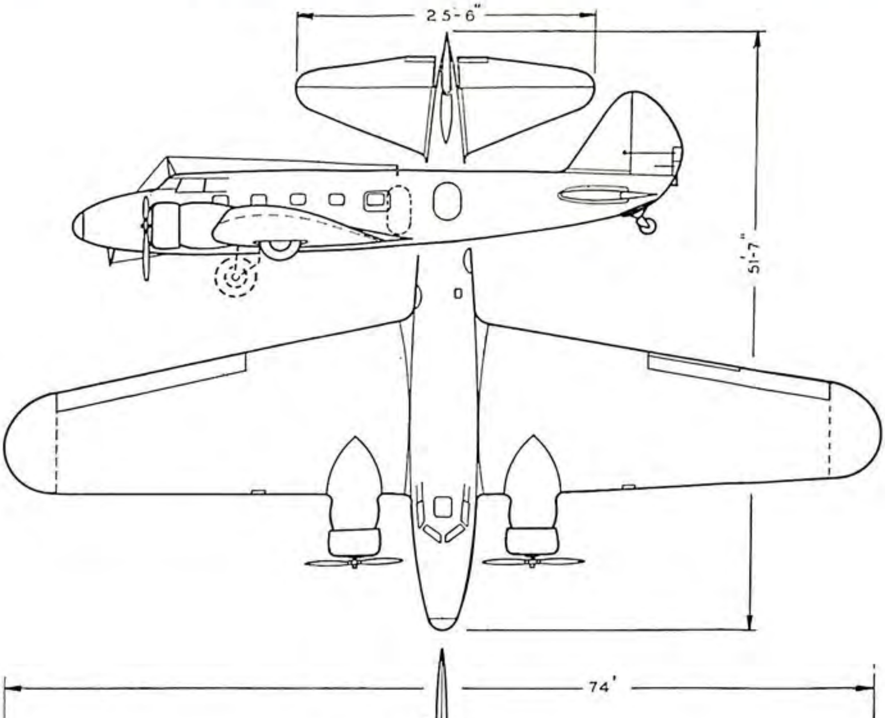
THE BELLANCA FLASH

This two-place plane is powered with a 700 h.p. Pratt & Whitney Wasp Junior engine.

plane's performance. The YB-17's were equipped with the new Wright "G" Cyclone engines and Hamilton Standard three-bladed constant speed propellers. They rank as the largest land planes in America, with a wing span of 105 feet, length 70 feet, height 15 feet, and gross weight 16 tons. Their construction is of the typical Boeing semi-monocoque type, consisting of longerons, skin stiffeners, bulkheads and smooth outer skin covering of alclad aluminum alloy. The planes carry the latest in flight and engine instruments. Included among them are automatic pilot, two-way radio equipment and a radio "homing" device. Air-operated wheel brakes, which were for the first time applied to aircraft in the original Boeing 299, are another feature.

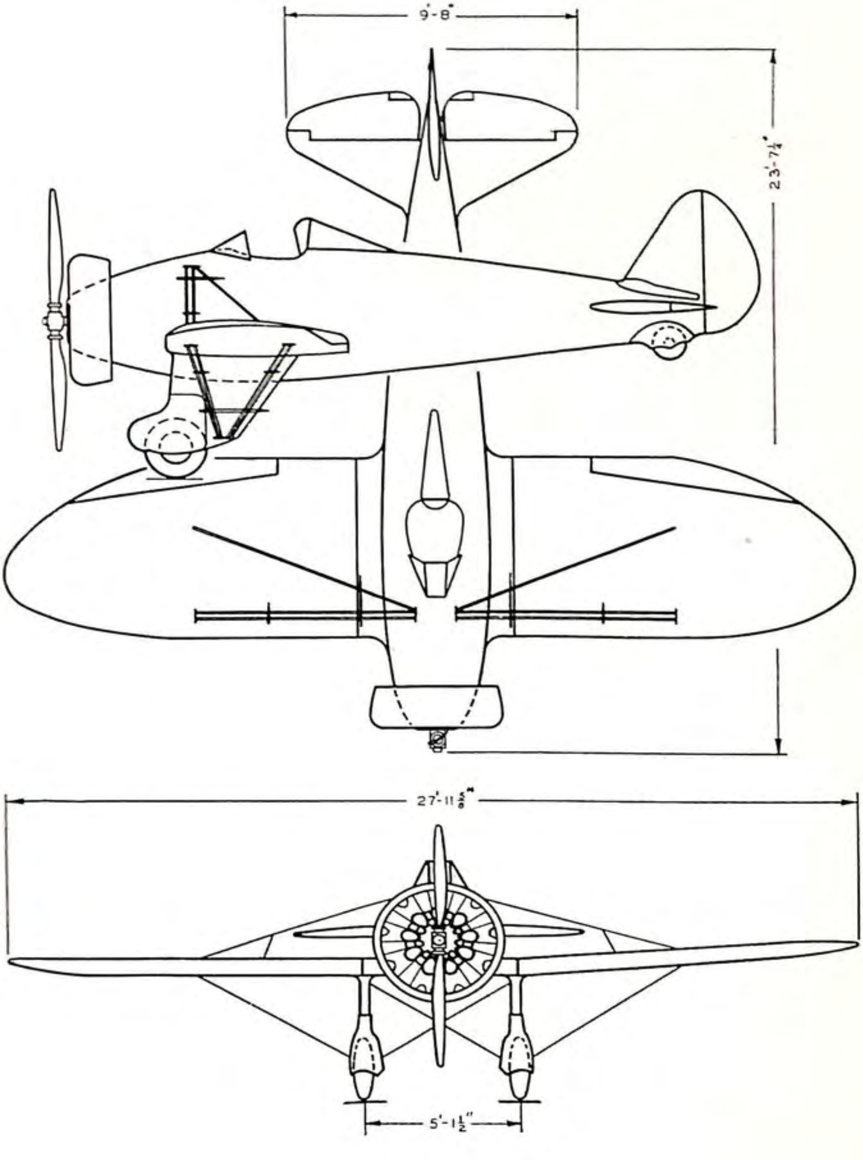
Late in 1936 the Boeing Aircraft Company started production of a

A CLOSE-UP OF THE BOEING BOMBER



BOEING 247-D

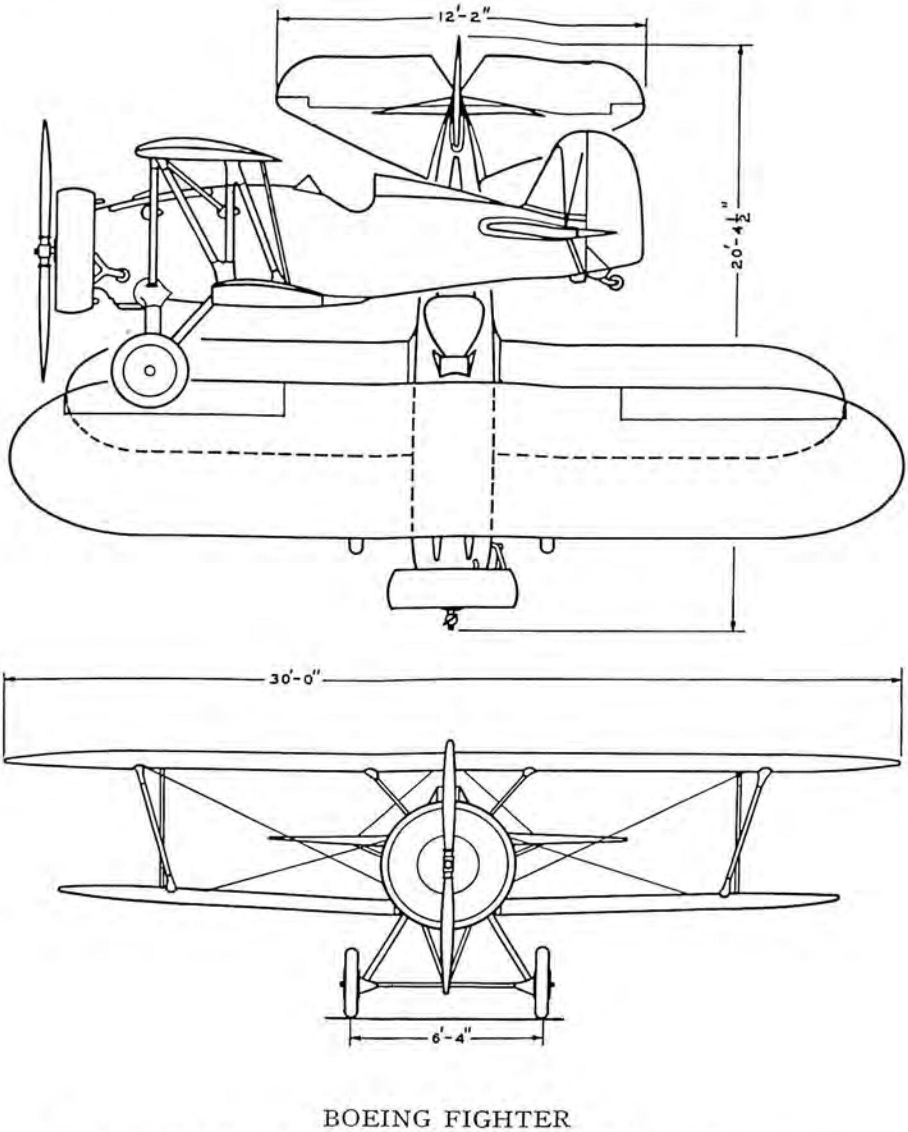
A 12-place transport powered with two Pratt & Whitney Wasps.



BOEING P26-A PURSUIT

This single-seater is powered with a Pratt & Whitney Wasp.

fleet of six mammoth flying boats ordered by Pan American Airways for transoceanic service. Complete details of these giant clipper ships were not made known. It was announced, however, that the planes would be tremendous in size and passenger capacity, carrying more than 60 passengers, providing sleeper accommodations for 40 pas-



BOEING FIGHTER
This model F4B4 is powered with a Pratt & Whitney Wasp engine.

FOR AIR CORPS SERVICE

Putting final touches on one of the Boeing bombers. It is 70 feet long, has a wingspread of 105 feet and is powered by four 1,000 h.p. Wright G Cyclone engines.

sengers and having a gross weight of more than 82,000 pounds. It was reported they would have a wing spread of 152 feet, a length of 109 feet, and an over-all height of 28 feet. Their speed was expected to range up to 200 m.p.h. These marine giants, described as ocean liners of the air, will be internally braced, high-wing monoplane flying boats of all-metal construction, riding the water during take-off and landing on short stub-wing hydro-stabilizers instead of the conventional wing tip floats, Boeing officials announced. They will be the first flying boats to contain two full decks, an upper deck housing an elaborate control cabin, crew's quarters and baggage compartment, and a lower deck containing luxurious day and night passenger accommodations, galley, lavatories, and dressing rooms. Exquisitely upholstered seats, thorough soundproofing, heating and ventilation, reading lamps, and wide vision windows are among the features to be provided for a superlative degree of passenger comfort and enjoyment during long ocean flights. An interesting detail in the construction of these huge planes is the provision of passage ways through the wings to the engine nacelles to permit inspection and servicing of engines during flight. The clipper ship project marked the Boeing Company's re-entrance into the civil flying boat field after a period of strictly military production. The company had not been in that field since 1929 when it made final deliveries of its Model 204 single engine flying boats and turned to other types. One of the most famous Boeing flying boats was the PB-1 of 1925, a large twin-engined Navy patrol boat which held records as a weight carrier. The earliest Boeing flying boat to achieve fame was the Boeing B-1 built in 1919 during the Company's early years and used by the late Edward Hubbard beginning in 1920 when he began this country's first privately contracted airmail service and the first international air mail service, flying between Seattle, Washington and Victoria, B. C. The first of the new Boeing clippers was to be ready for the air in the late fall of 1937.

In 1936, the Boeing Company completed another military project involving a total of 136 P26-type fighters for the Air Corps, delivering 23 P26-C's, differing in minor details from the original P26-A's. These Pratt & Whitney Wasp-powered planes were single-seaters of the all metal, low-wing monoplane type, with wire-braced wings and landing gear. A fleet of 10 single-seater pursuits known as the Boeing 281, an export version of the P26-A, was delivered to the Cantonese air force in China. The 281 had a stated high speed of 235 m.p.h.; cruising speed 210 m.p.h.; landing speed 68 m.p.h.; service ceiling, 28,200 feet; cruising range 745 to 1,115 miles. The plane may be operated as a fighter with two machine guns or as a fighter-bomber carrying either five 30-pound bombs or two 122-pound bombs.

Boeing 247-D twin-engine all metal low-wing transport planes during 1936 were being flown an average of more than 60,000 miles daily, equivalent to twice the distance around the world, in the service of United Air Lines, Pennsylvania Airlines, Western Air Express, National Parks Airways, and Wyoming Air Service. A Boeing transport was in regular use by Marshal Chang Hsueh Liang in China, and another, with special deluxe features, was used by executives of the Phillips Petroleum Company.

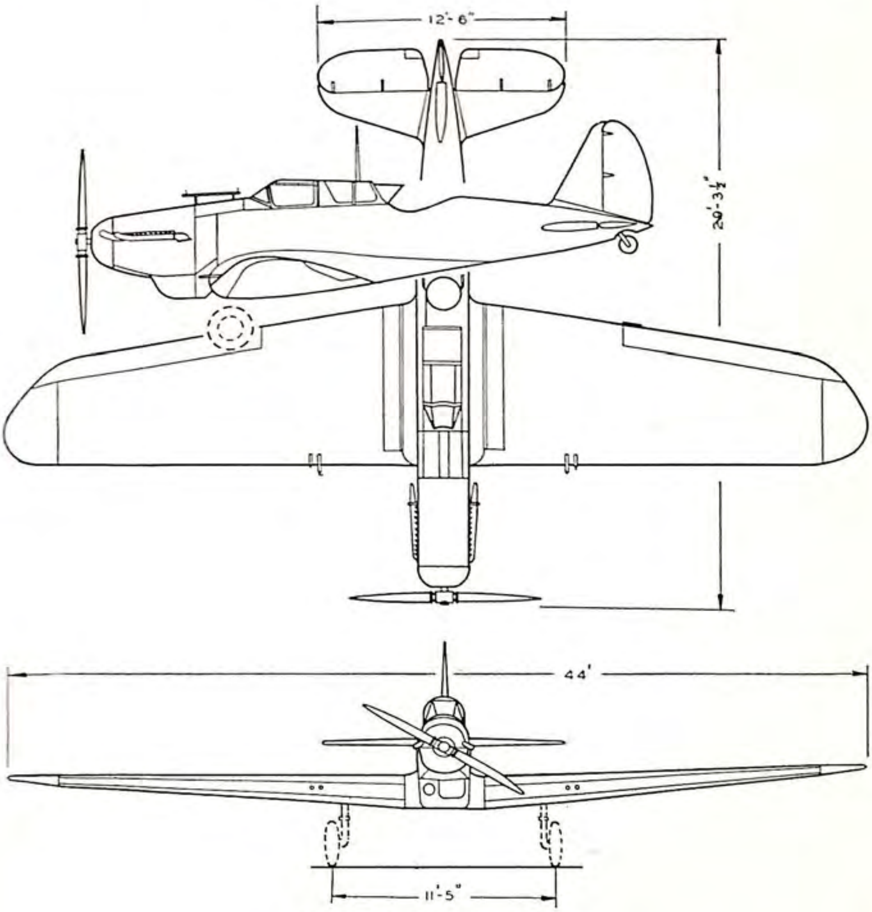
Carrying out a sizable plant expansion program during the year, the Boeing Aircraft Company purchased a 28-acre tract adjacent to Boeing Field, Seattle, on which was constructed a new assembly plant large enough to accommodate nine of the four-engined Boeing bombers, fully assembled, at one time. This new plant unit, along with a new hammer shop building increased the Boeing plant area to a total of 408,550 square feet.

The Boeing Company observed its twentieth anniversary in 1936. Since July, 1916, when it began operations with a handful of employees in a one-room shop on Lake Union, Seattle, it had produced 2,000 airplanes of 62 different types.

Lawrence W. Brown Aircraft Company, Los Angeles, Calif., produced the Brown B-3 and B-3-R, for sport, racing or training. The B-3 had a 250 h.p. Menasco engine and the B-3-R had a Wright

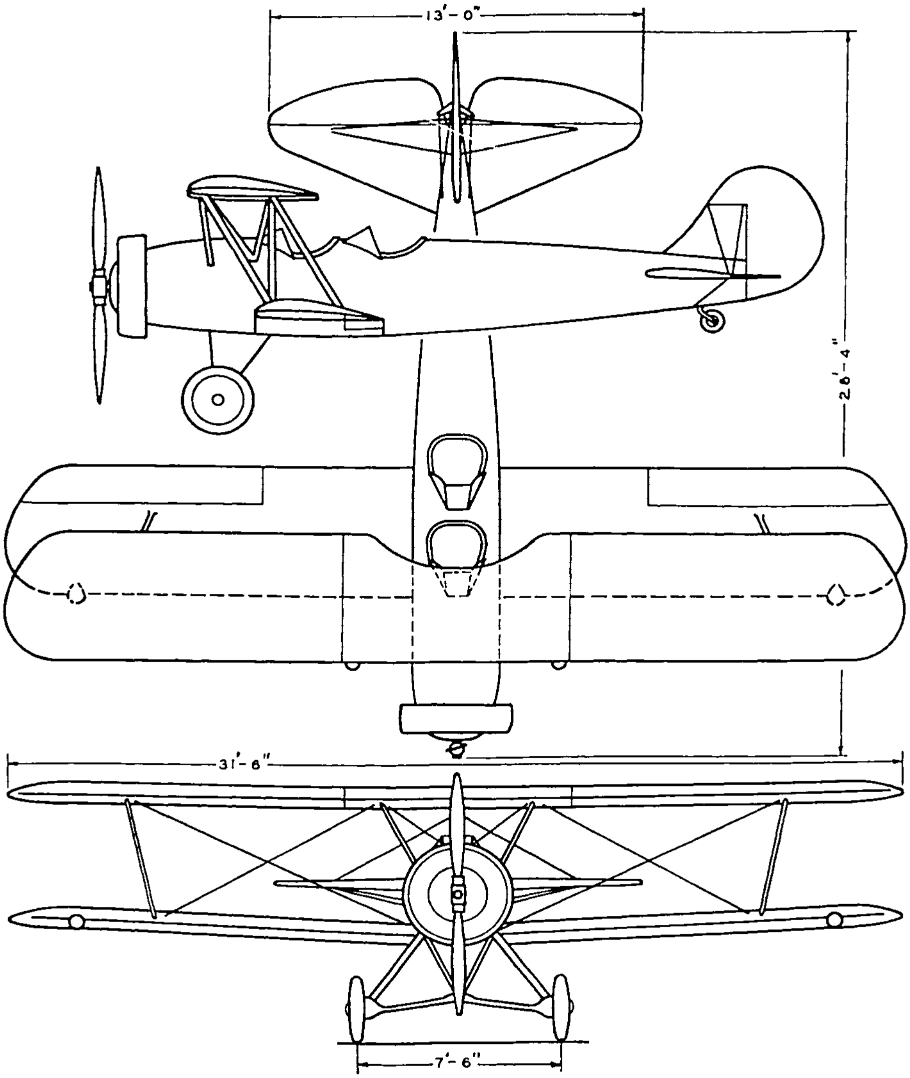
Whirlwind from 285 to 350 h.p. The plane had a wing span of 32 feet, length 26 feet, stated top speed of 205 m.p.h., cruising at 190, and range of 600 miles. The company built a new racer for Col. Roscoe Turner, with which he hoped to break records in 1937.

Consolidated Aircraft Corporation, San Diego, Calif., with 3,000 employees, expanded its plant 80 per cent in 1936, and planned to have 440,000 square feet in service in 1937. The main factory, 1,000 feet long and 300 feet wide, permitted straight line production of the large Navy patrol boats built by Consolidated. The company produced 50 PB-2 two-place pursuit planes for the Air Corps. They



CONSOLIDATED PB2-A

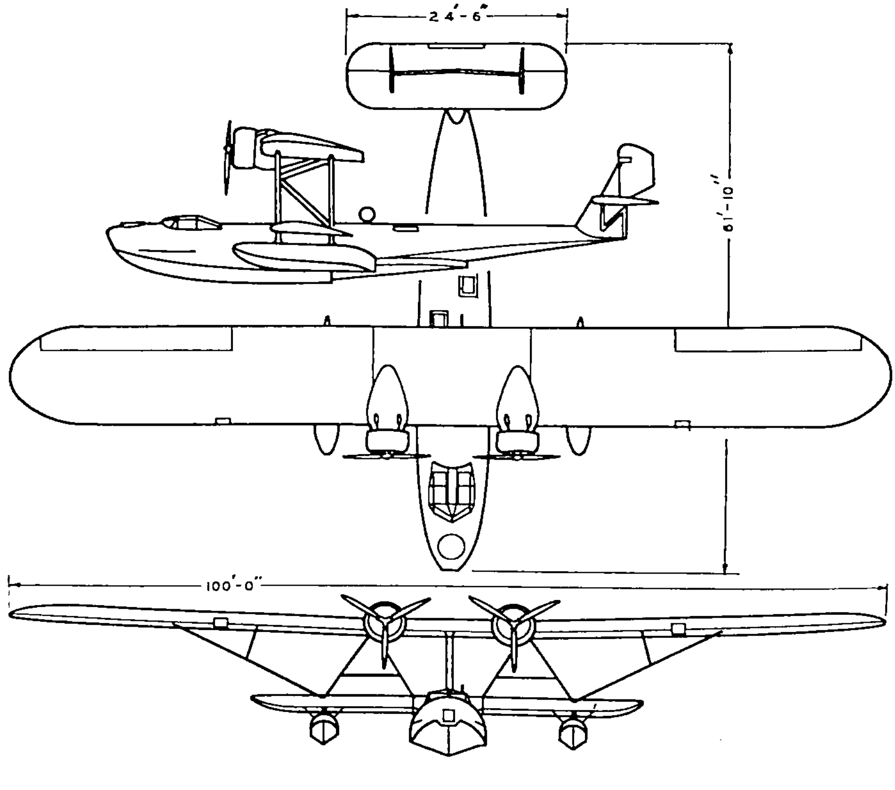
A Curtiss Conqueror-powered two-place pursuit ship.



CONSOLIDATED FLEET 21

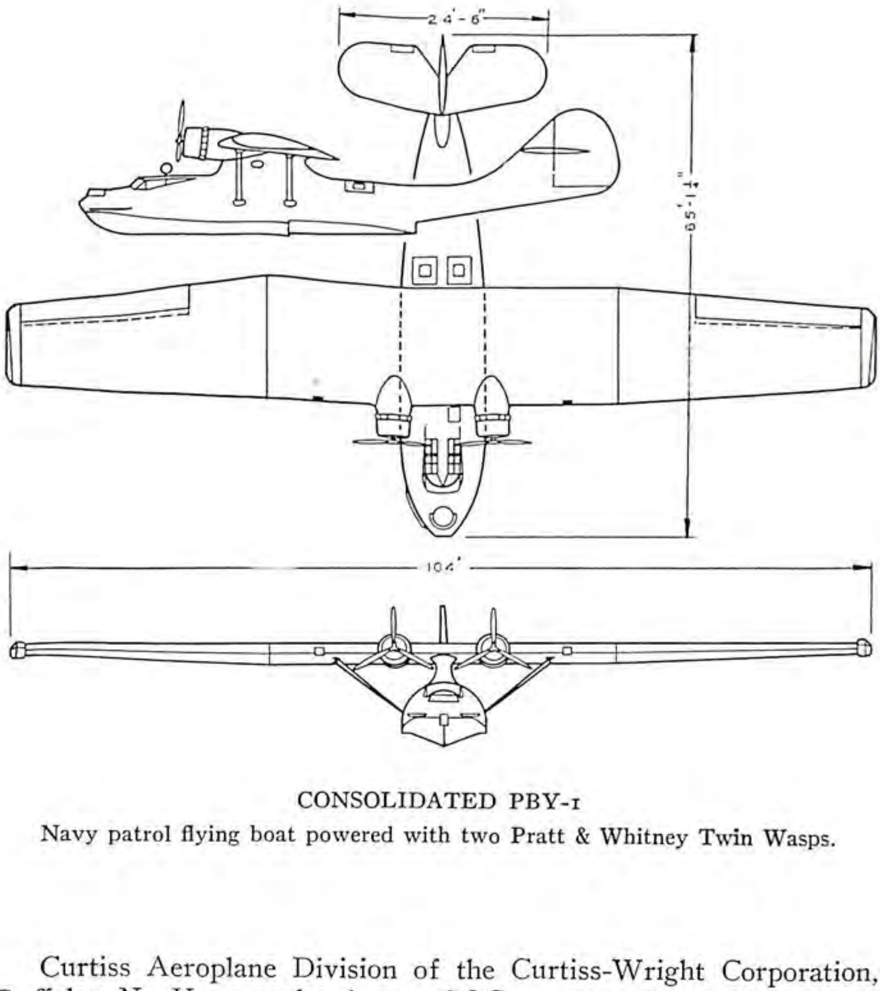
This two-place sport plane is available powered with either a Pratt & Whitney Wasp Junior, or a Lycoming engine.

were powered with Curtiss Conqueror engines. Details of their high performance were military secrets. The company was working on orders from the Navy for a total of 110 twin-engine long range patrol flying boats and spare parts equivalent to 22 additional machines. The orders included 60 planes of the PBY-1 type, contracted for in 1935, and 50 of the PBY-2, latest of a long and distinguished line of flying boats designed by Consolidated. In 1937 the company planned to finish development work on an even more advanced design for the Navy. Consolidated was also completing an order of six P2Y-3 flying boats for the Argentine Navy. The company also produced the Fleet model sport and Model 21 trainer at the plant of its subsidiary, Fleet Aircraft of Canada, Fort Erie, Ontario.



CONSOLIDATED P2Y-3

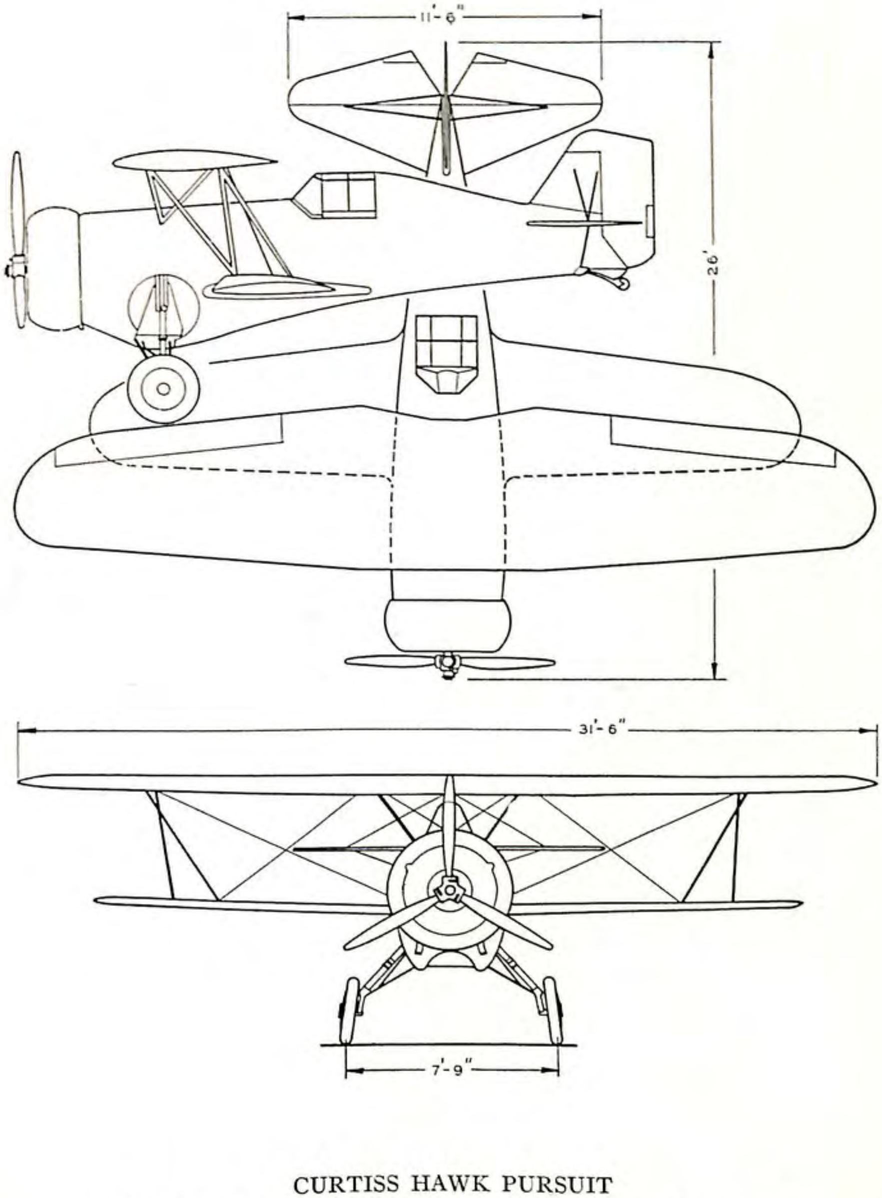
A Navy long-range patrol bomber powered with two geared Wright Cyclone engines.



CONSOLIDATED PBY-1

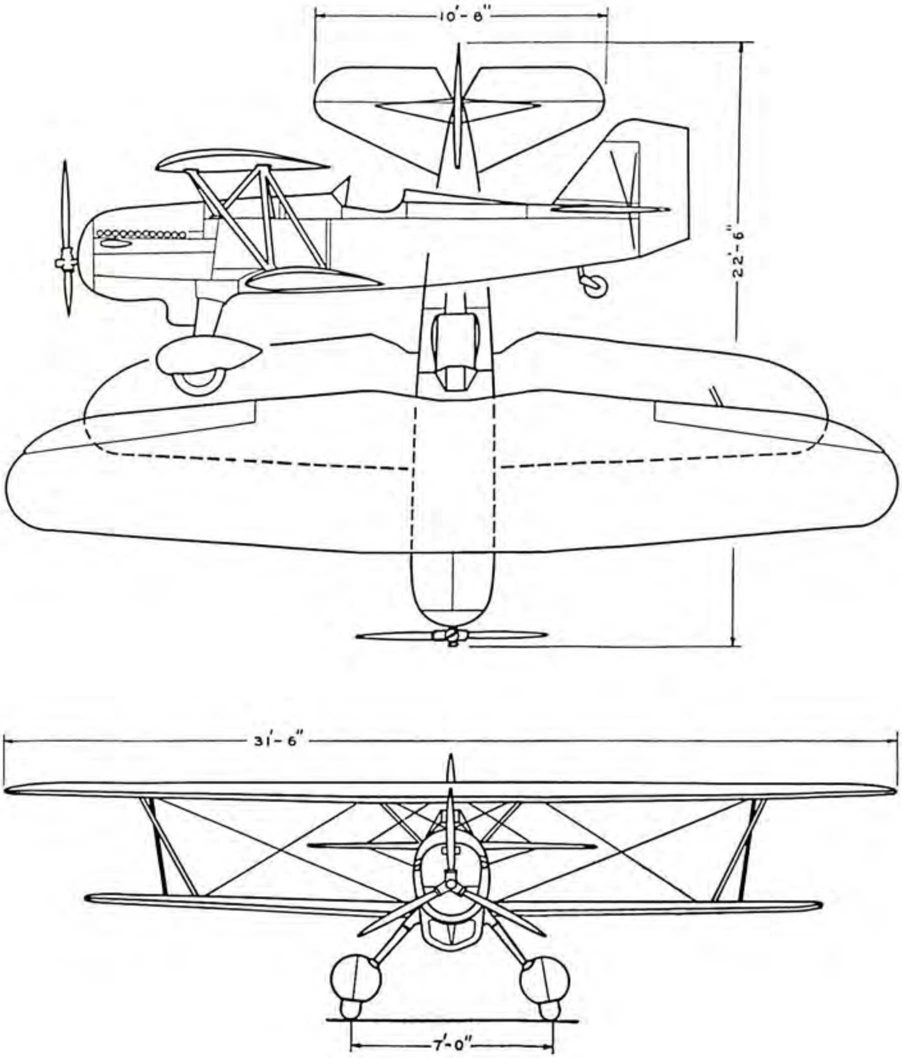
Navy patrol flying boat powered with two Pratt & Whitney Twin Wasps.

Curtiss Aeroplane Division of the Curtiss-Wright Corporation, Buffalo, N. Y., completed 135 SOC-1 scout observation planes for the Navy and started work on 40 more of the same type. Eighty-five Navy scout bombers were to be delivered in 1937 as were a number of Wright Cyclone-powered Y1A-18 twin-engine attack planes for the Army Air Corps. Other developments included production of Y1P-36 single-seat pursuit, the SBC-3 two-seat scout bomber and Curtiss Hawk Type IV single-seat fighter. Several orders were filled for foreign governments. The Y1A-18 was believed to be the only two-engine attack plane in the world. It was

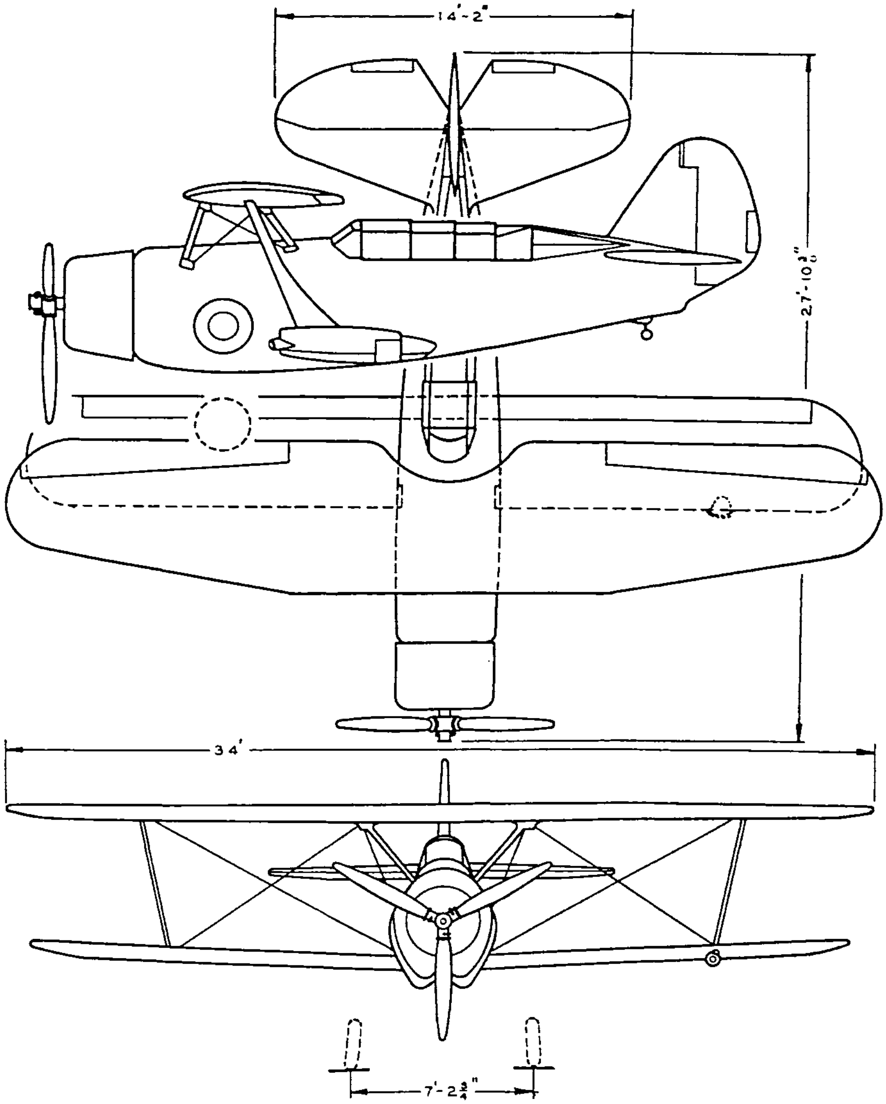


CURTISS HAWK PURSUIT

This Type IV is a single-place plane Wright Cyclone-powered.

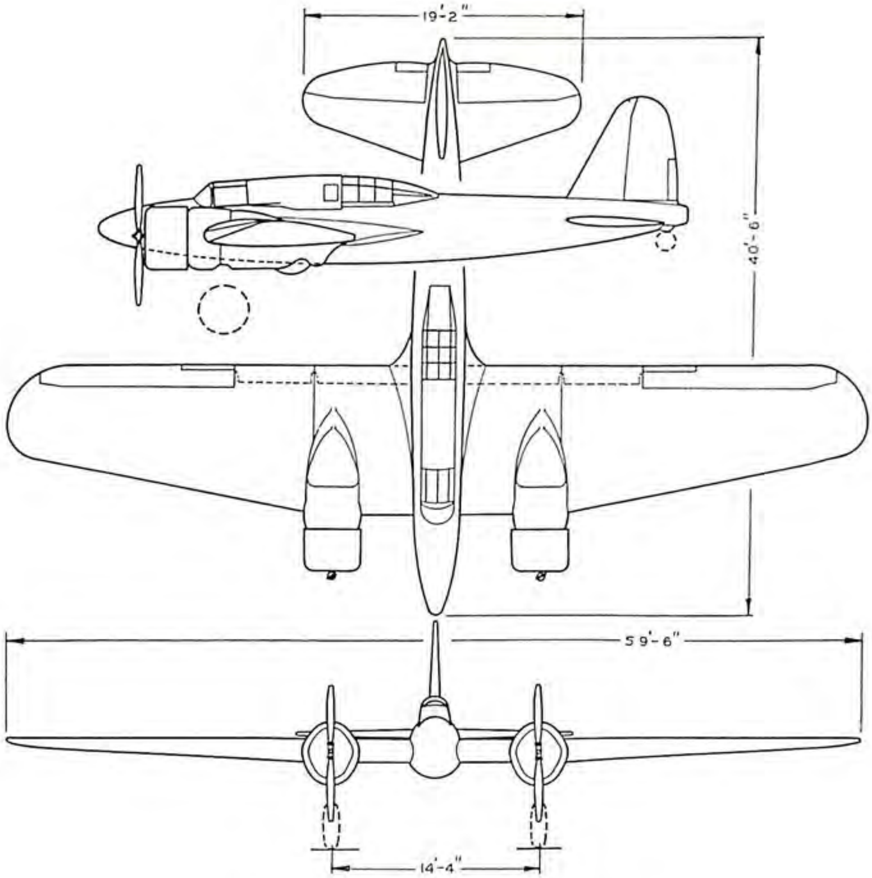


CURTISS HAWK PURSUIT P-6E
It is powered with a Curtiss Conqueror engine.



CURTISS SBC-3 SCOUT BOMBER

A two-place scouting plane, powered with a Pratt & Whitney Twin Wasp Junior.

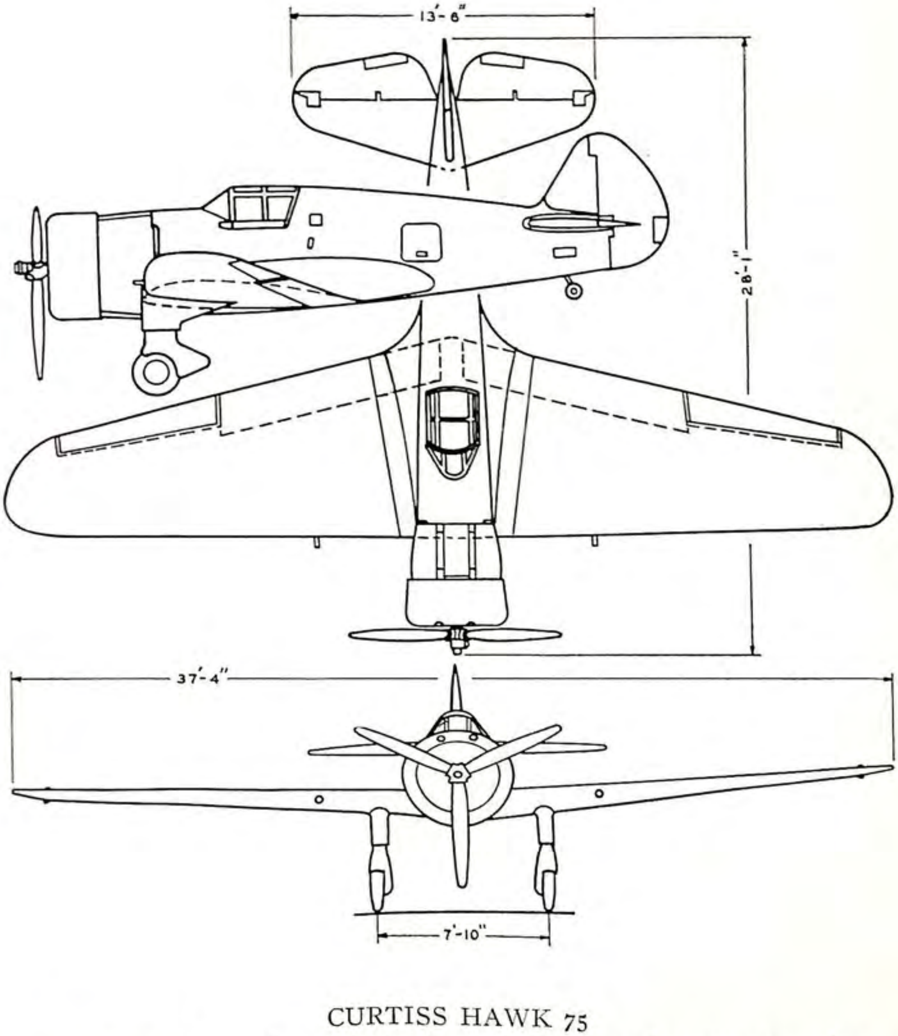


CURTISS ARMY ATTACK-BOMBER

This model A-18 is powered with two Wright Cyclones of 1,000 h.p. each.

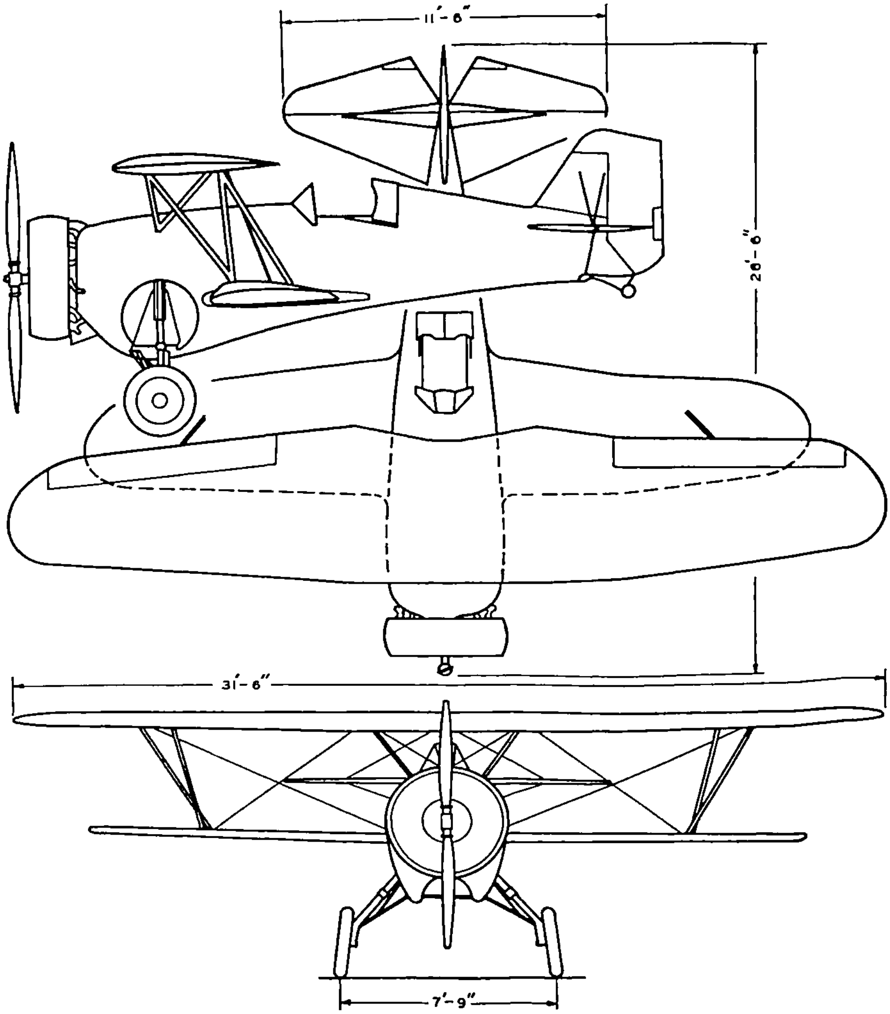
an all metal, mid-wing monoplane with retractible landing gear. The pilot and the gunner were sheltered in cockpits with transparent hoods. Performance was a military secret, but the Y1A-18 was admitted to be one of the fastest two-engine machines ever built, with an exceptionally long range and capable of attack work close to the surface. The Curtiss Aeroplane Division has been carrying on production of its electric controllable pitch propeller, designed to make possible setting the angles of the blades at any pitch, even to the extent of feathering the blades on one engine in case the other engine fails on a twin-engine plane. These propellers were in service in the Air Corps, the Navy and on commercial planes.

Late in the year the Curtiss Aeroplane division produced the Seagull, an export version of the SOC-1. The Seagull is a single pontoon



CURTISS HAWK 75

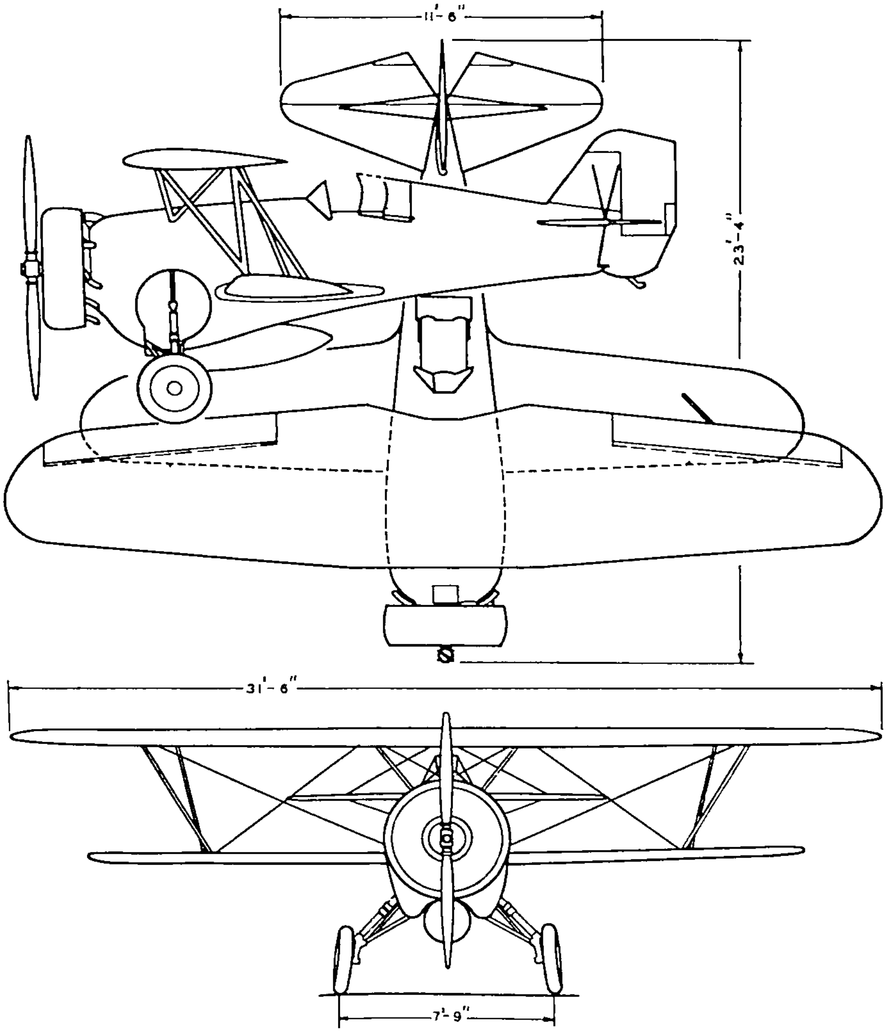
A single-seat pursuit powered with a Wright 1,000-horsepower engine.



CURTISS HAWK BF2C-1
This Navy fighter is Wright Cyclone powered.

seaplane. It is 32 feet long, has a span of 36 feet, and is powered by a Pratt & Whitney 550 h.p. Wasp engine.

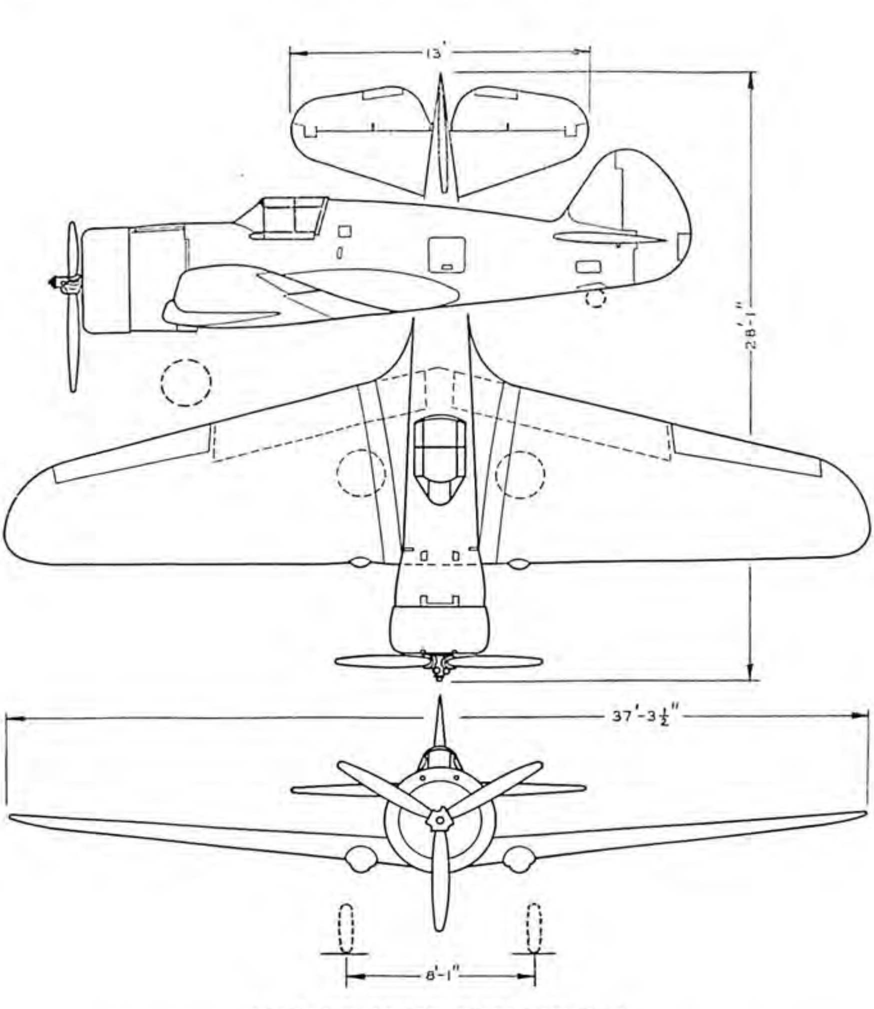
St. Louis Airplane Division of the Curtiss-Wright Corporation, Robertson, Mo., entered the field of all metal cantilever monoplanes with its development of the Coupe, Model 19W, a



CURTISS HAWK PURSUIT TYPE III

A one-place pursuit powered with a Wright Cyclone 780 h.p. engine.

two- and three-place commercial cabin plane, and the Model 19R, a two-place enclosed cockpit, advanced military trainer for use as a trainer, two-place pursuit or observation ship. The company continued development of its Model 14 advanced trainer, a two-place advanced military training plane with full armament equipment, includ-

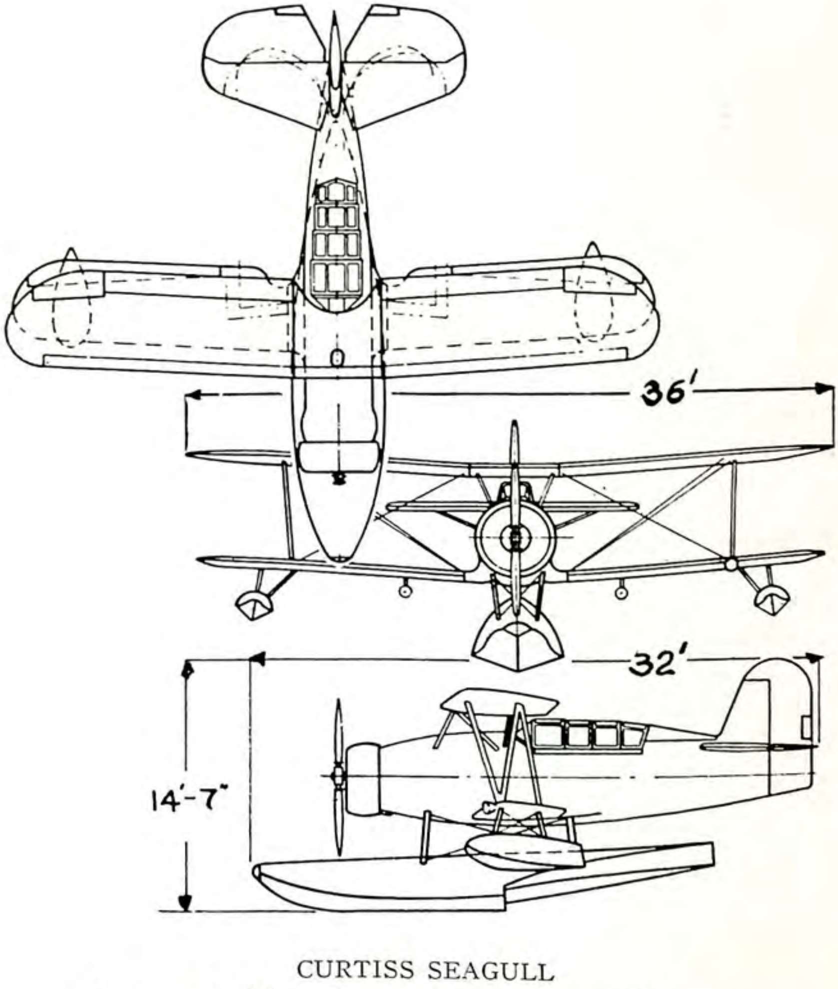


CURTISS ARMY PURSUIT P-36

This one-place military plane is powered with a Wright Cyclone 1,000 h.p. engine.

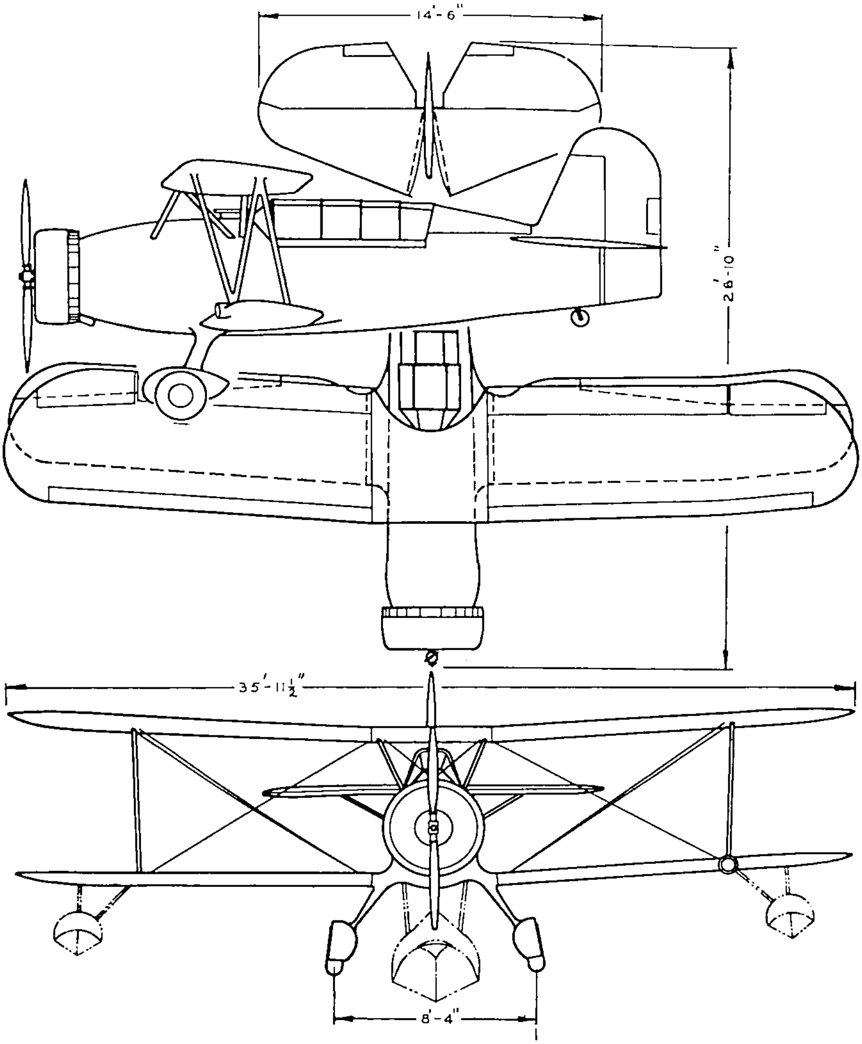
ing synchronized and flexible machine guns, bomb racks, radio and camera. Curtiss-Wright also produced a number of its Model 16 trainers, a primary military training machine. The Coupe 19W had a wing spread of 35 feet, 70 per cent of which carried flaps, which with slots and an ingenious aileron control, rendered it practically stall-proof and spin-proof, according to the builders. It had a cruising range of 580 miles, and a stated speed of 131 m.p.h. powered with a Lambert

90 h.p. engine. The Model 19R trainer was powered by a Wright Whirlwind engine, ranging from 250 to 420 h.p. Flaps on 55 per cent of the 35-foot wing reduced the landing speed 10 miles an hour. It had a service ceiling of from 19,000 to 25,000 feet, stated cruising speed of from 169 to 201 m.p.h., depending on engine power and load, and a range of from 570 to 602 miles.

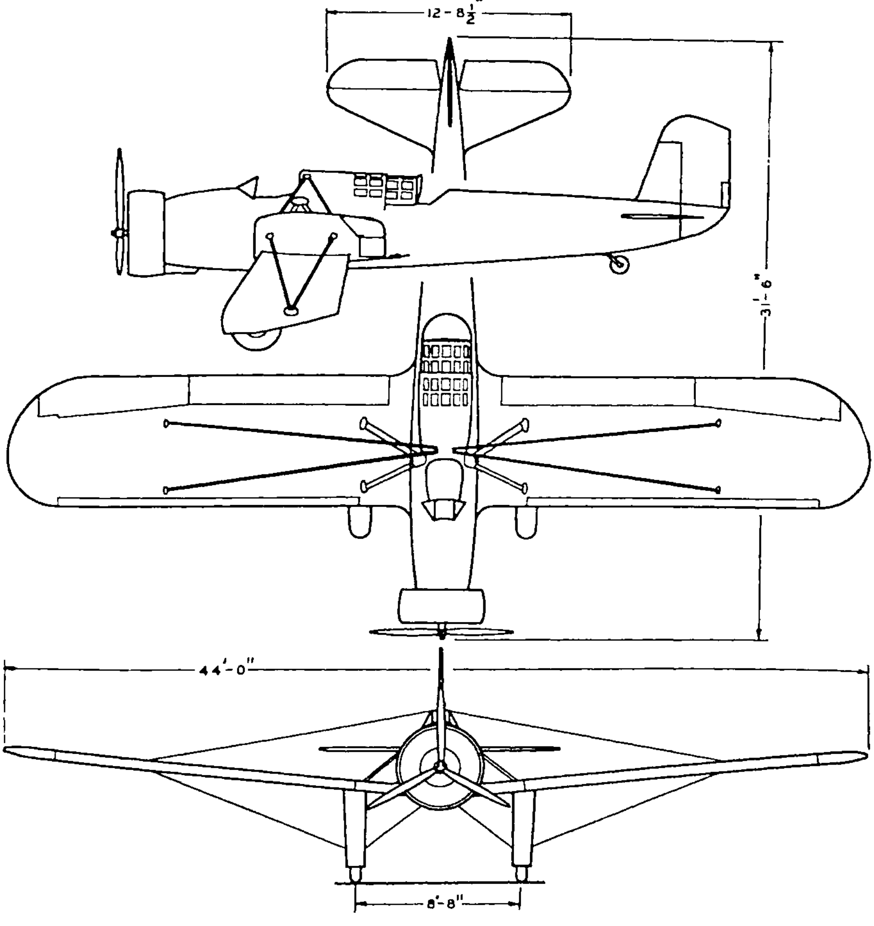


CURTISS SEAGULL

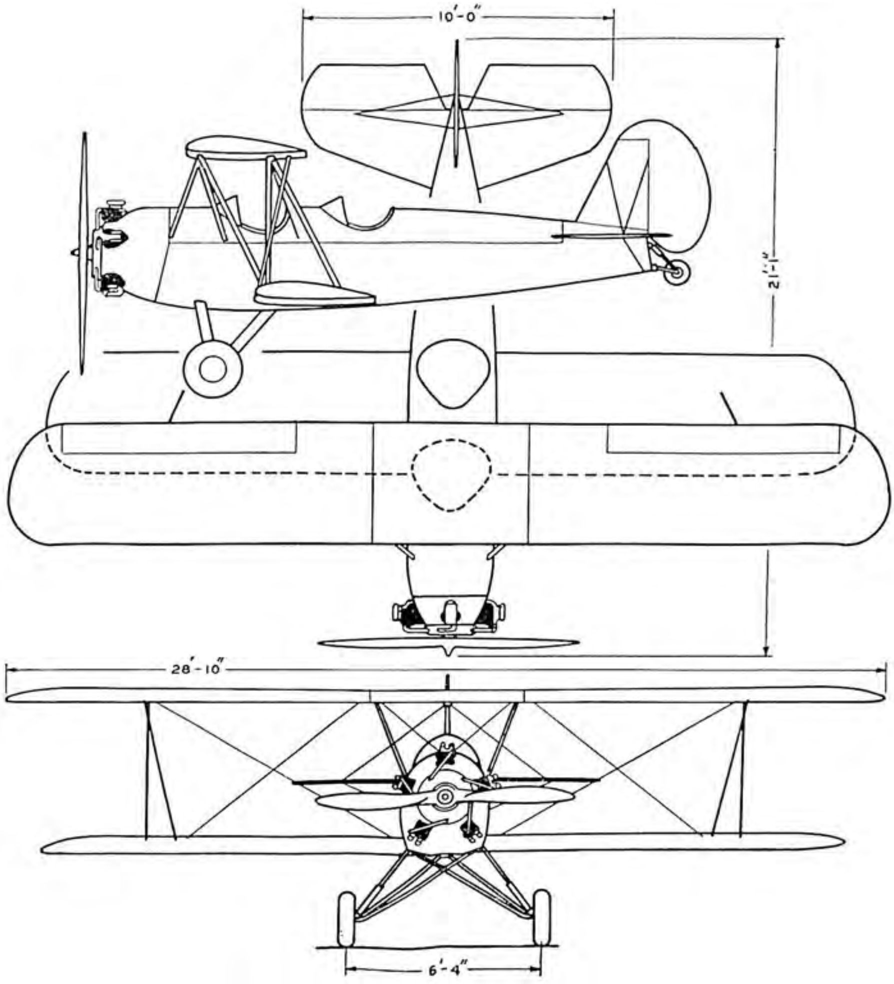
A Pratt & Whitney Wasp-powered seaplane carrying two.



CURTISS OBSERVATION SCOUT
Model SOC-1, powered with a Pratt & Whitney Wasp.

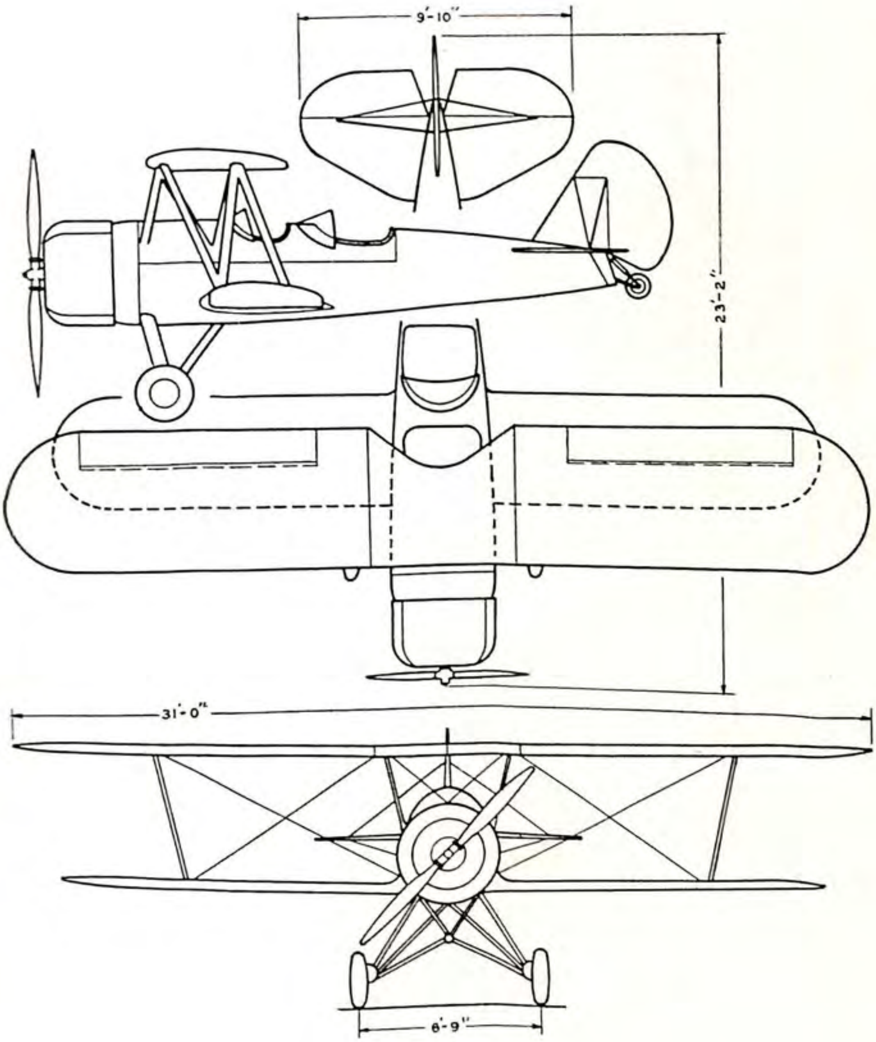


CURTISS SHRIKE
An attack plane powered with a Wright Cyclone 775 h.p. engine.

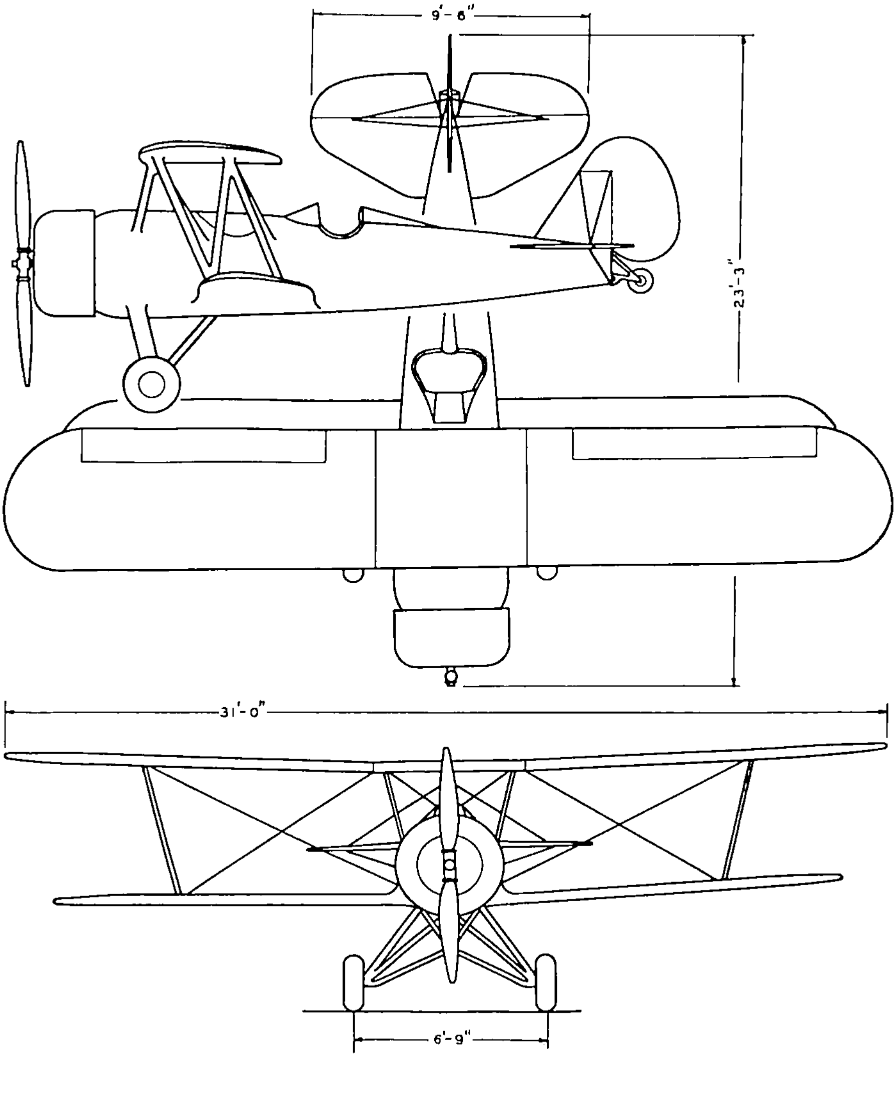


CURTISS-WRIGHT TRAINER

Available as either a land or seaplane, it is powered with a choice of a Warner Scarab or a Wright Whirlwind engine.

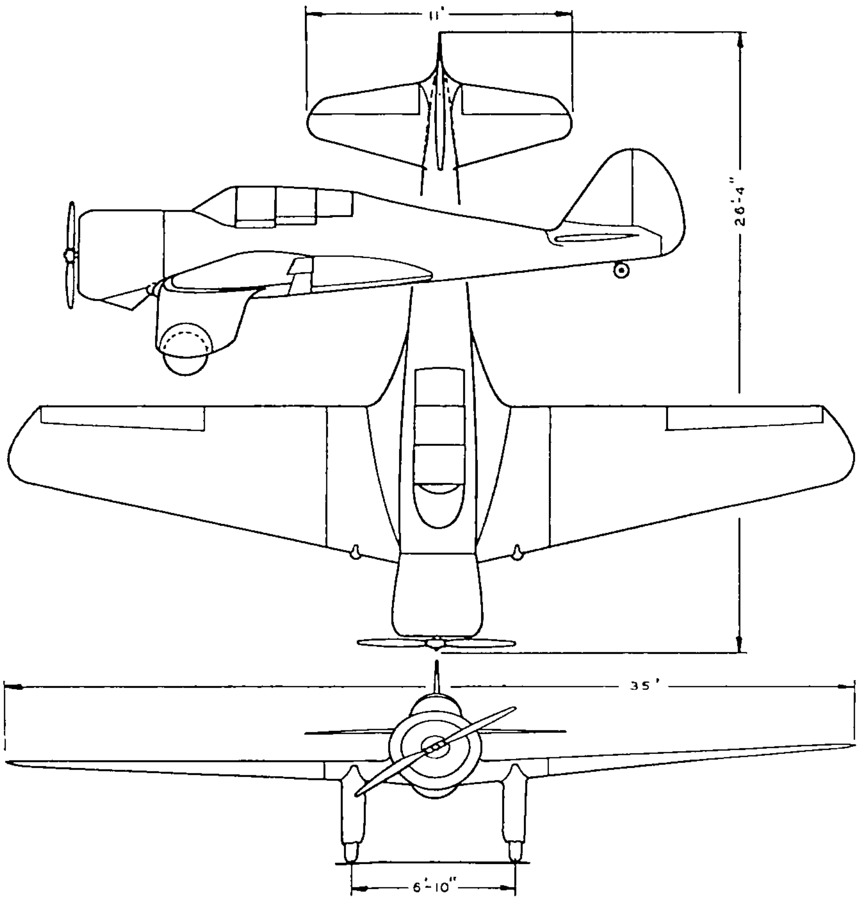


CURTISS-WRIGHT ADVANCED TRAINER
This military trainer is powered with a Wright Whirlwind engine.



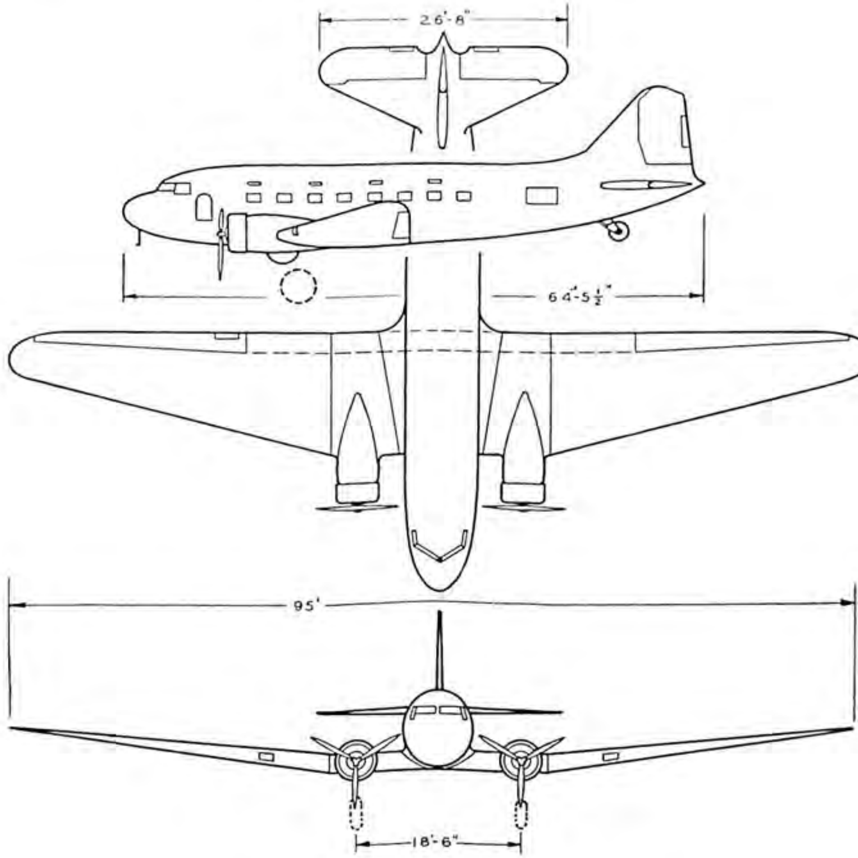
CURTISS-WRIGHT SPEEDWING

A one to three-place plane for the private flyer, powered with a Wright Whirlwind engine, available in ratings of 285, 330, or 420 h.p.



CURTISS-WRIGHT BASIC TRAINER

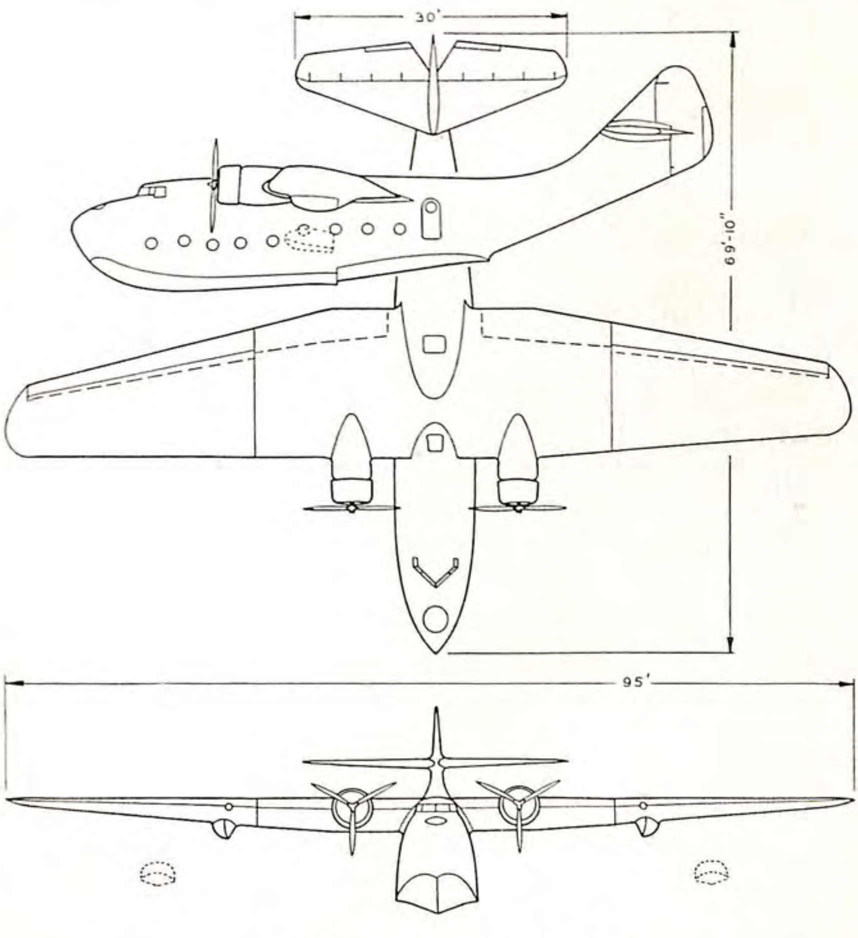
Wright Whirlwind-powered, this model 19-R is a two-place plane.



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 G-2 Cyclone engines.

Douglas Aircraft Company, Inc., Santa Monica, Calif., employing 400 engineers and 4,000 others, at the beginning of 1937 had built and sold 150 DC-2, 14-passenger day transports, including 18 cargo transports for the Army Air Corps. These transports made their appearance in air line service early in 1935, and became popular throughout the world. The company produced a new model in 1936, the DC-3, a daylight transport carrying from 14 to 21 passengers. Equipped for 14 passengers the DC-3 was virtually a club plane, with individual lounge chairs much larger and more comfortable than ordinary seats in regular planes. The cabin of the DC-3 was seven feet eight inches wide, 27 feet eight inches long and 6½ feet high, not including other compartments on the ship. Carrying 21 passengers the cabin had a wide aisle, with two rows of seven chairs on one side and one row of seven on the other. The DST was the sleeper version of the DC-3. It was the first air-liner to be designed and built primarily as a sleeper. Two berths, a lower and an upper in each of six sections accommodated 12 of the 14 passengers in the main cabin. Made up



DOUGLAS DF FLYING BOAT

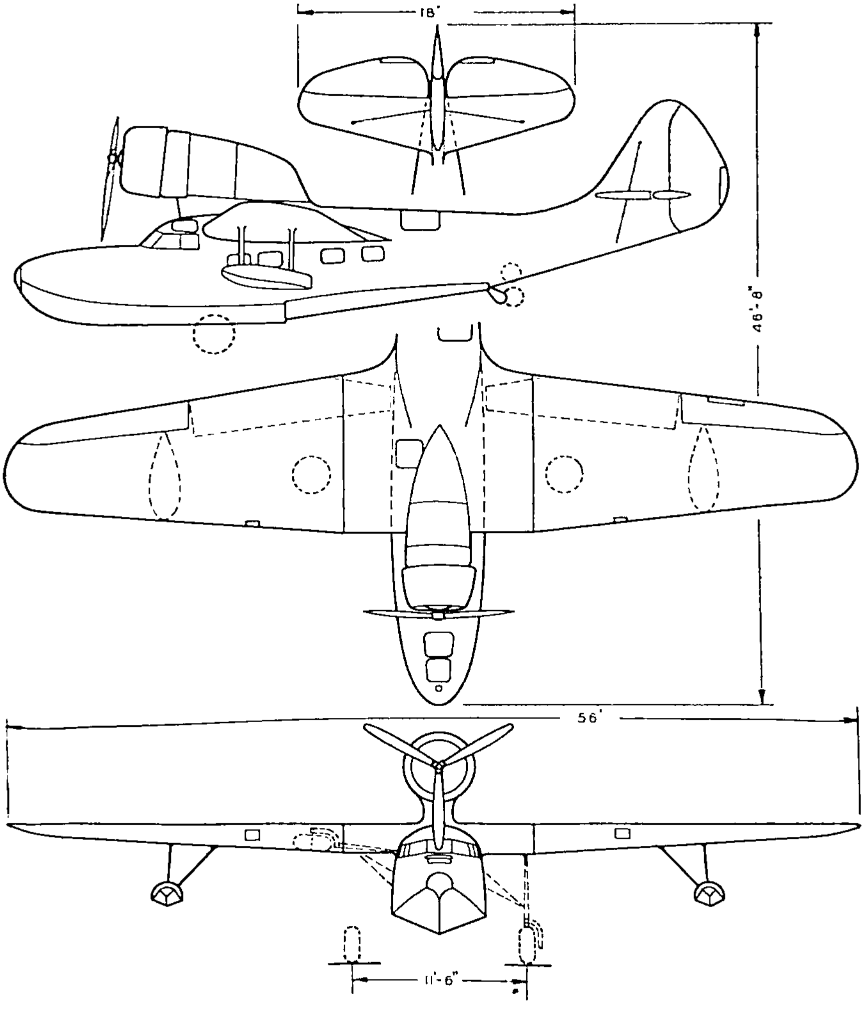
Powered with two Wright G Cyclones, this commercial flying boat carries 32 passengers and crew of four.

for day flying the sections would seat 24 passengers. The Sky Room, a private compartment, offered both day and night accommodations for two passengers. The DST and DC-3 had a wing span of 95 feet, wing area of 987 square feet, overall lengths 64½ feet and height 16 feet 11 inches in three-point position. These ships, powered by either two Pratt & Whitney Twin Wasp or two Wright G-2 Cyclone engines, had a stated high speed of 212 m.p.h., cruising at 180 m.p.h., landing at 64 m.p.h., service ceiling of 22,000 feet, and could operate on one engine. They carried gross loads of about 12 tons. At the be-

A NEW NAVY FIGHTER

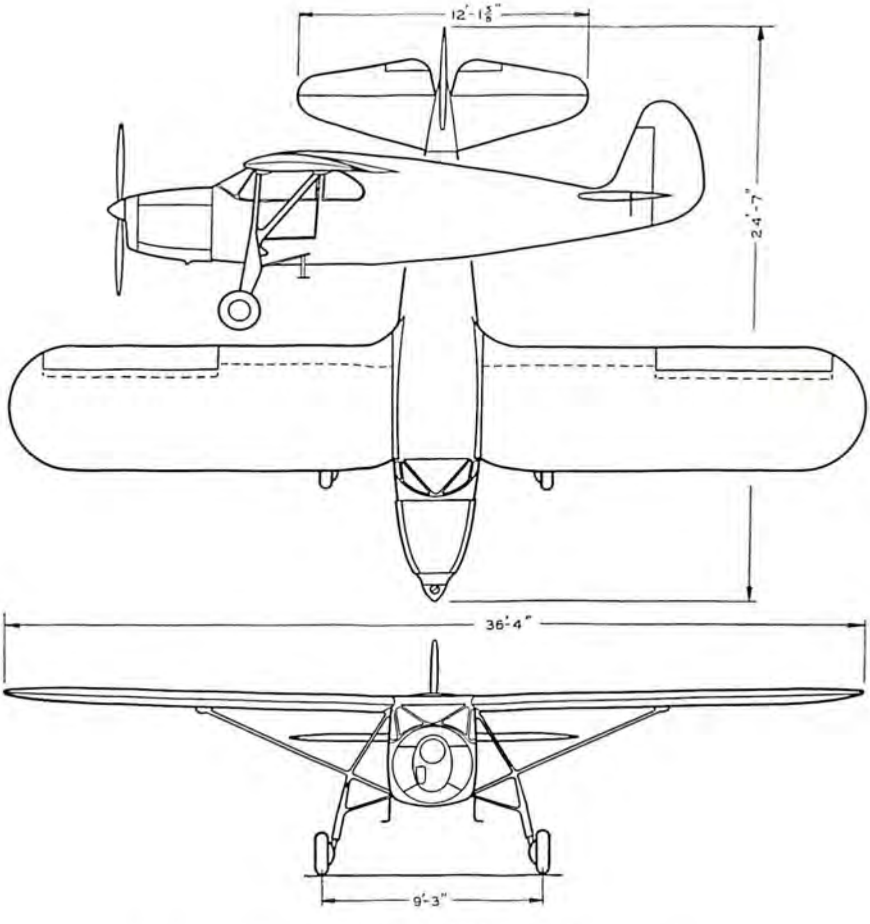
Experimental FD-1 two-place fighter developed for the Navy by Douglas. It is powered by a Pratt & Whitney Twin Wasp engine.

ginning of 1937 Douglas had sold 20 DC-3 planes to United Air Lines, 17 to American Airlines, two to Eastern Air Lines, eight to TWA and eight to Dutch Airlines; and eight DST sleepers had been delivered to American Airlines. The latest development of the Douglas company was the DF flying boat carrying 32 passengers and a crew of four. It was a twin-engine center-wing monoplane, powered with two Wright G Cyclone motors, wing span 95 feet, overall length 69 feet 10$\frac{9}{16}$ inches, height 17 feet 9½ inches. The company was also completing an order of twin-engine bombers for the Air Corps.



FAIRCHILD AMPHIBION MODEL 91

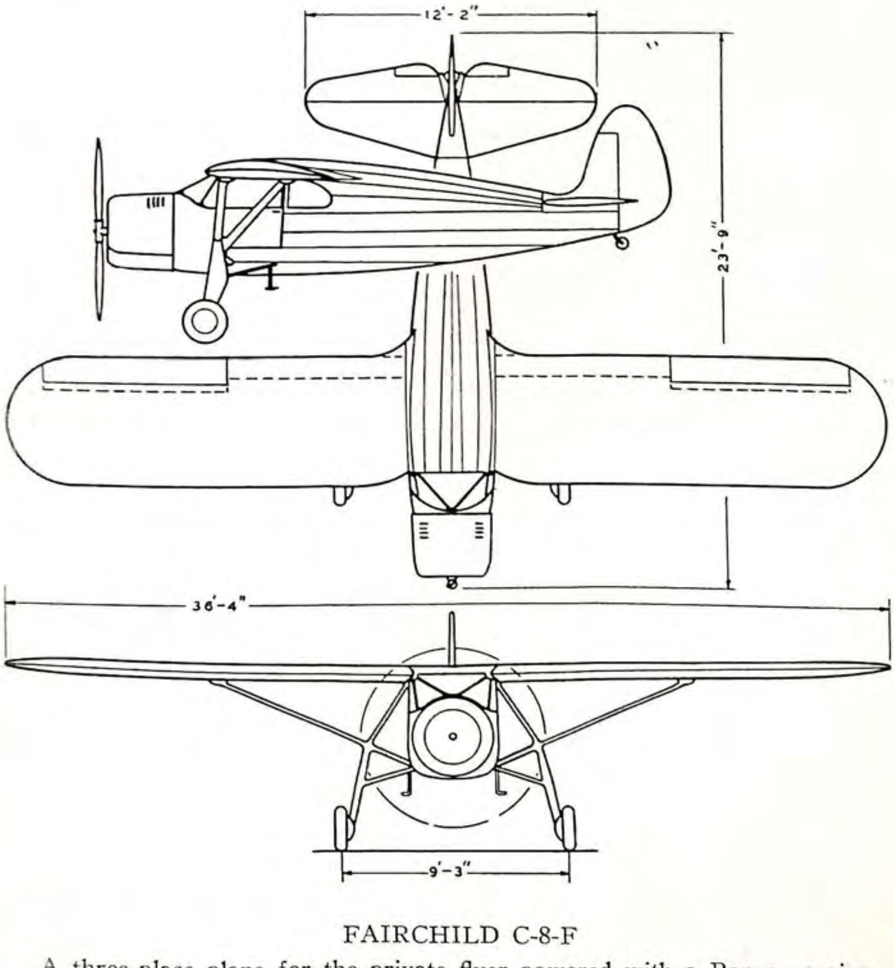
A 10-place transport powered with either a Pratt & Whitney 750 h.p. Wasp or Wright Cyclone 760 h.p. engine.



FAIRCHILD MODEL 24

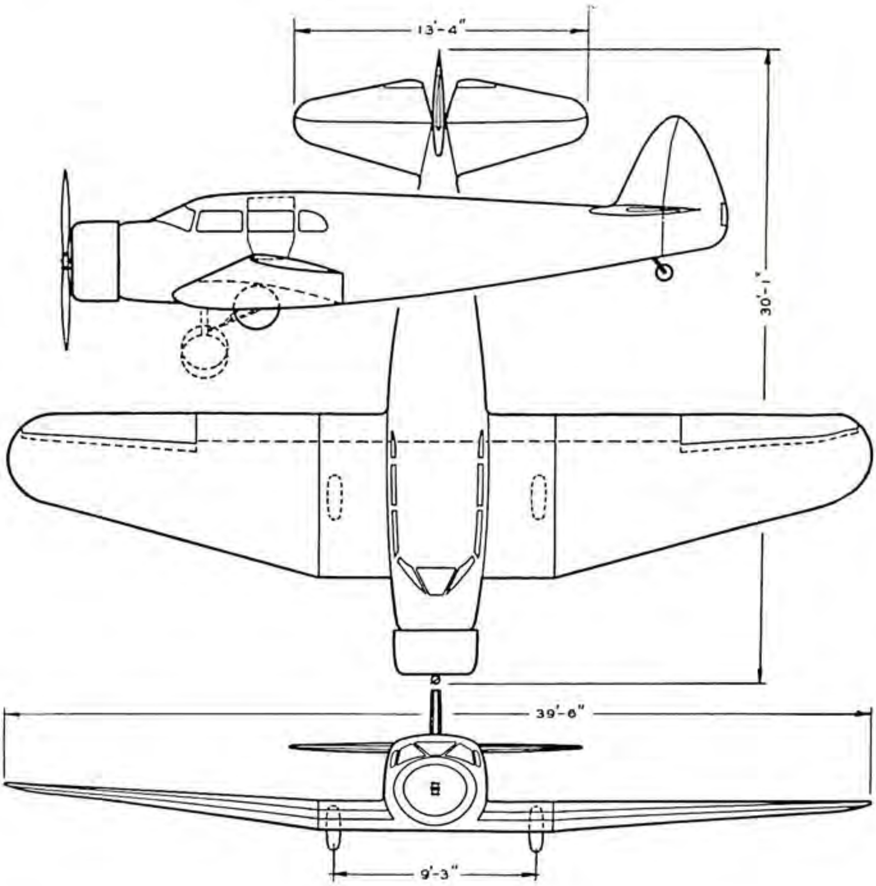
Ranger-powered three-place plane for the private flyer.

Fairchild Aircraft Corporation, Hagerstown, Md., was supplying planes to several different classes of users at the beginning of 1937. The company produced the Fairchild 24 for sportsman pilots, the Fairchild 45 for executive and private transport and the Fairchild 91 amphibion for air line use and for those private owners desiring something in a class with a yacht. The 24 model was powered with either the Ranger 150 h.p. inverted in-line engine, with motor-driven generator and electric starter equipment, or the Warner Super-Scarab 145 h.p. radial engine. Both models carried flaps, safety glass windshield, wheel brakes, balanced ailerons and other modern equipment. The 24 was a three-passenger plane. The Fairchild 45 was a five-place monoplane with 320 h.p. Wright Whirlwind engine and a stated cruising speed of 173 m.p.h. at 5,000 feet. The Fairchild 91 amphibion was a tapered wing, two-spar type, full cantilever metal flying boat with retractible wheels. Powered with either a 750 h.p. Pratt & Whitney Hornet or 760 h.p. Wright Cyclone it was a 10-place ship with additional capacity for 1,000 pounds of cargo. It was 46



FAIRCHILD C-8-F

A three-place plane for the private flyer powered with a Ranger engine.

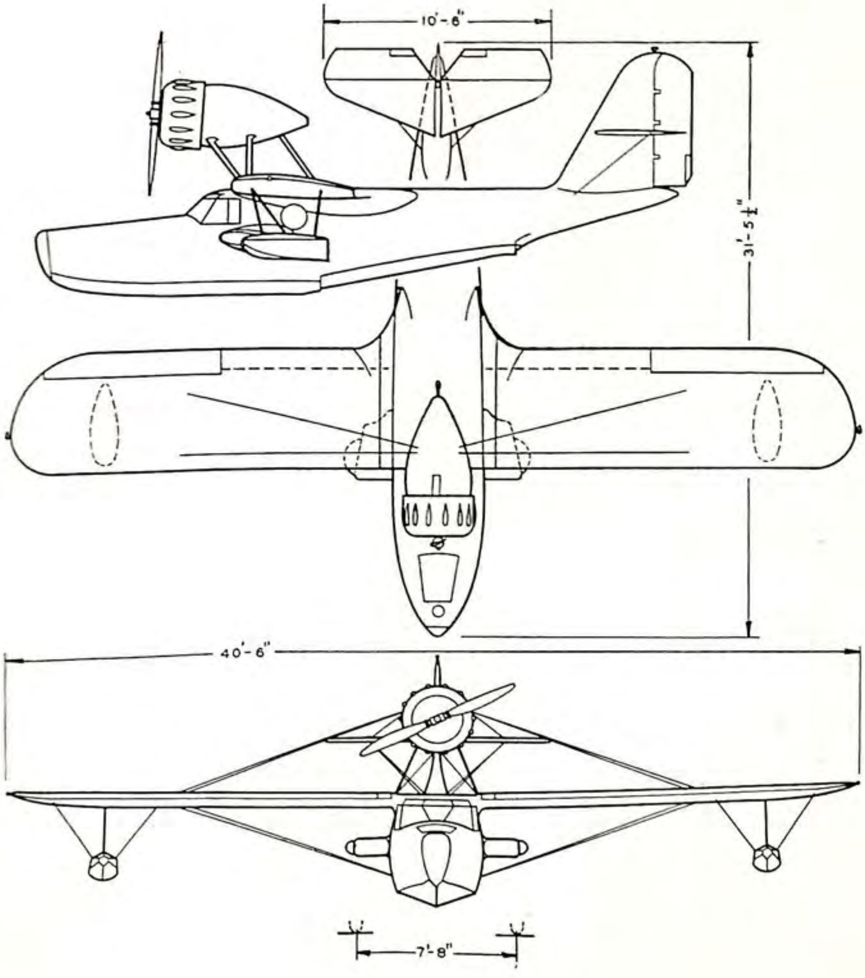


FAIRCHILD MODEL 45

A five-place plane for the private owner, Wright Whirlwind-powered.

feet long, had a wing span of 56 feet and a stated cruising speed of 152 m.p.h. The company reported that it planned to develop the model as a twin-engine ship in 1937.

Fleetwings, Inc., Bristol, Pa., brought out a four-passenger cabin amphibion, the Sea Bird, the first stainless steel airplane built for commercial use. It was fabricated by the "shot-weld" process, fuselage and wing making one unit, with new features in streamlining and light weight. The Sea Bird weighed 2,285 pounds empty, had a fuel capacity of 52 gallons, 100-pound baggage capacity, and a rated high speed of 150 m.p.h., with a 285 h.p. Jacobs engine. It had a service ceiling of 15,000 feet and a range of 450 miles. It was equipped with flaps and drooping ailerons, and had a landing speed of 47 m.p.h. The retractible landing gear was operated hydraulically. All fittings were placed well above the water line. The tail wheel was also retractible. The machine was fully equipped with blind flying facilities. The cabin was soundproofed to 80 decibels. The mono-



FLEETWINGS SEA BIRD

This four-passenger amphibion is powered with a Jacobs 285 h.p. engine.

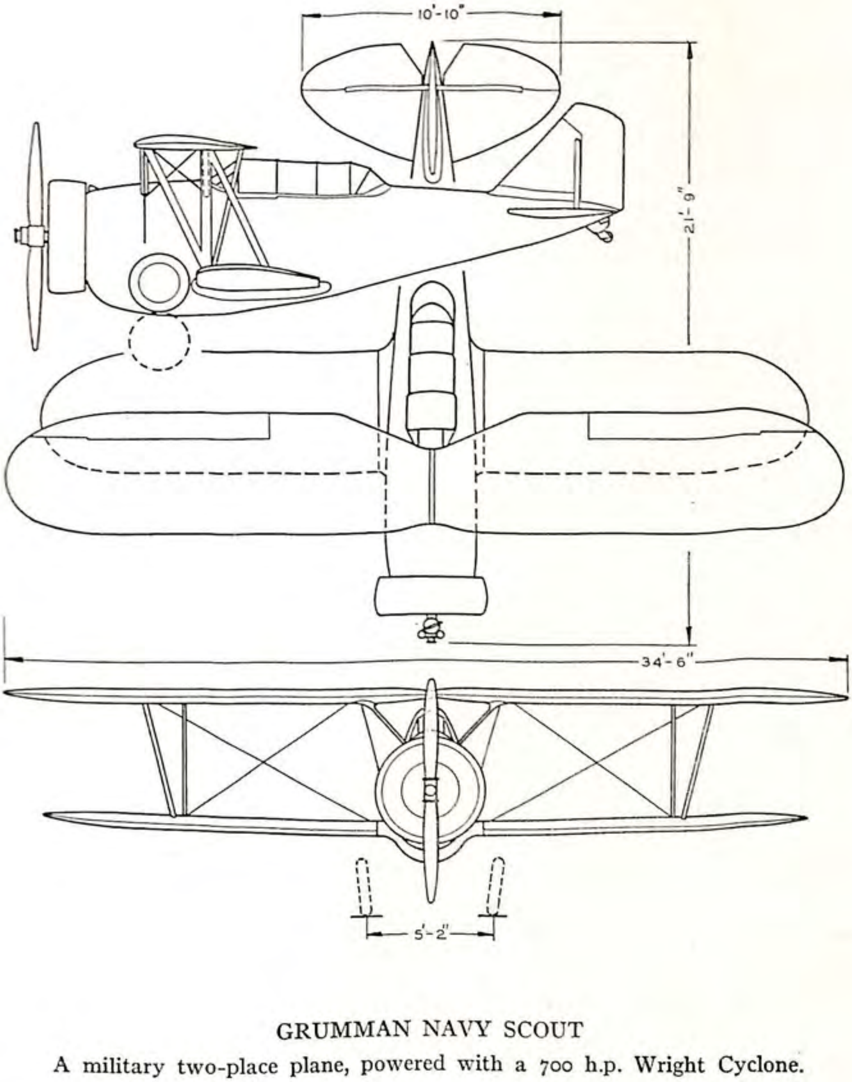
AN AIRPLANE OF STAINLESS STEEL

The new Jacobs-powered Seabird amphibion developed by Fleetwings, Inc., at its Bristol, Pa., plant. The hull is of shot-welded stainless steel, and it has accommodations for four persons.

plane wing was cloth covered. The Sea Bird had a wing spread of 40½ feet, length 31 feet 5½ inches and wing area of 235 square feet. Its height was less than 13 feet.

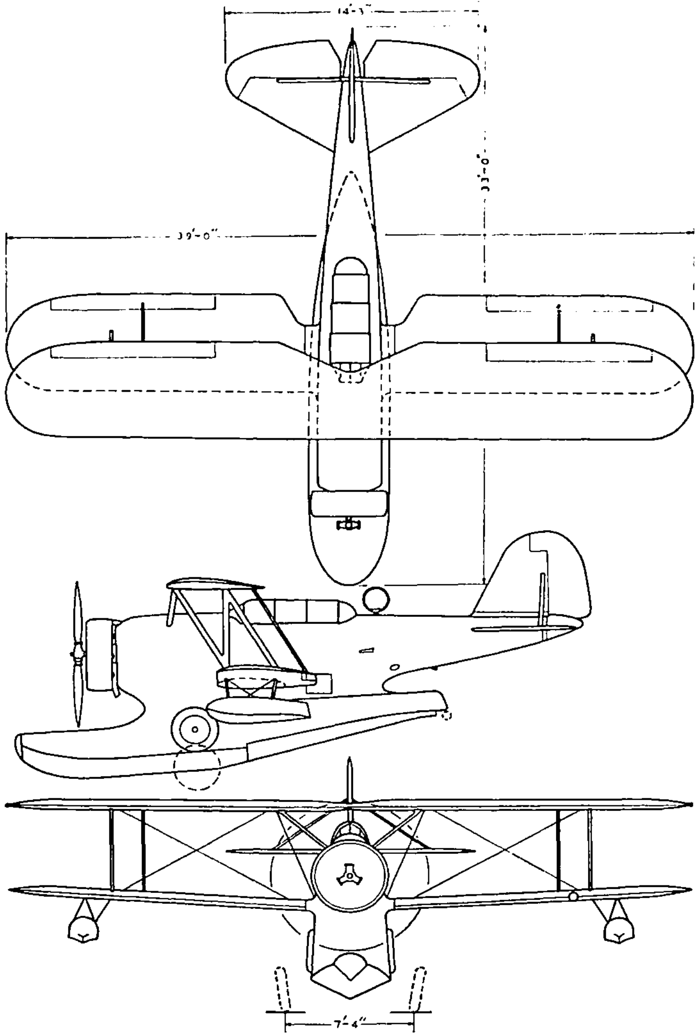
The Goodyear Tire and Rubber Company, Inc., Akron, O., operated its fleet of non-rigid airships, the "Reliance" and the "Puritan" at Cleveland all summer, the "Puritan," "Resolute" and "Reliance" in Miami and St. Petersburg in winter, the "Enterprise" continuously at Washington and the "Volunteer" at Los Angeles. The "Enterprise" performed a great feat in taking food and Red Cross supplies to ice-bound residents of Tangier Island. Frank Trotter, of the Goodyear staff, won the 1936 National Balloon Race out of Denver. He landed at Presho, S. D., having drifted a distance of 385 miles.

Grumman Aircraft Engineering Corporation, Farmingdale, N. Y., continued to build single-seat fighters and utility amphibions for the Navy. The single-seat fighters, model F3F-1, are similar to the F2F-1 but carry a heavier armament load with better performance. Fifty-four F3F-1 airplanes were delivered during 1936. The utility amphibions, model J2F-1, are a development of the JF-1, JF-2, and JF-3 planes previously built for the Navy and the Coast Guard. This type of airplane held the world's speed record for amphibions, and the altitude record carrying a 500 kilogram load in the same classification. Both these records were made by Coast Guard personnel flying one of their standard JF-2 Grumman amphibions. More than seventy-five of that type were built for the Navy and the Coast Guard. During 1936 an experimental scout-bomber and an experimental single-seater were delivered to the Navy. Another experimental single-seat airplane of advanced design was to be delivered early in 1937. Several of the company's military models were released for export during the year. The Scout, formerly known as the SF-1 airplane, is a two-seater equipped with a Wright Cyclone of



GRUMMAN NAVY SCOUT

A military two-place plane, powered with a 700 h.p. Wright Cyclone.



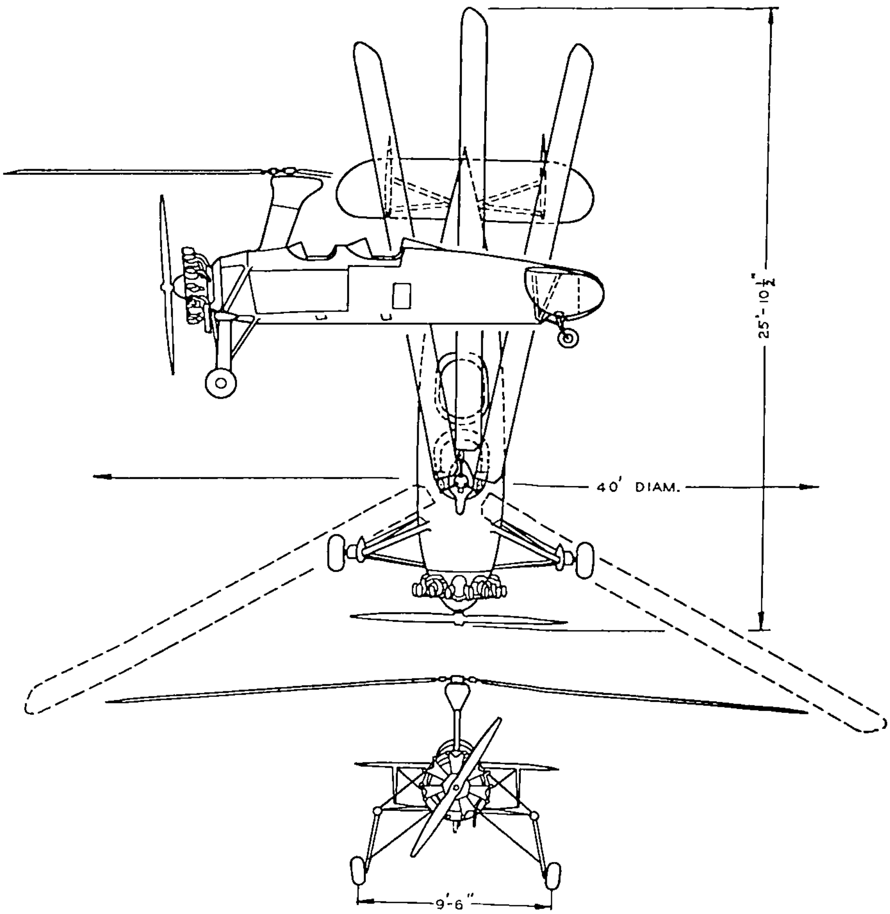
GRUMMAN JF-2

A two to four-place military plane powered with a Wright Cyclone 775 h.p. engine.

A GRUMMAN FOR AL WILLIAMS

It is powered by a Wright G Cyclone engine, carries radio and is built for both cross-country and exhibition flights.

700 h.p. It has a stated top speed of 207 m.p.h. and a range of 800 miles. It is equipped to carry a fixed and flexible gun as well as bombs. The amphibion, identical with the Coast Guard JF-2 model, is basically a two-seat airplane but has a larger lower compartment for a cameraman, radio operator, rescued personnel, or stowage space. This plane is normally equipped with a Wright Cyclone of 750 h.p. but is adaptable to any similar power plant. It has a normal top speed of 175 m.p.h. and lands at 63 m.p.h. It is equipped with the typical Grumman landing gear that completely retracts into the side of the hull. Eight of those planes were built for the Argentine Government. A twin-engined, six-place amphibion was designed for private owners, and ten were being built for 1937 delivery. The plane is a high-wing, full cantilever monoplane with two Pratt and Whitney Wasp Junior 400 h.p. engines mounted in the leading edge of the wing. The estimated top speed is 180 m.p.h. with cruising range up to 750 miles. A special single-seat airplane with a Wright Cyclone "G" engine was built to order for Major Al Williams. This plane is specially designed for acrobatics as well as being exceptionally clean for appearance and high speed. With the Wright G-5 Cyclone it has a stated top speed of 290 m.p.h. at altitude and a cruising radius of



KELLETT KD-1

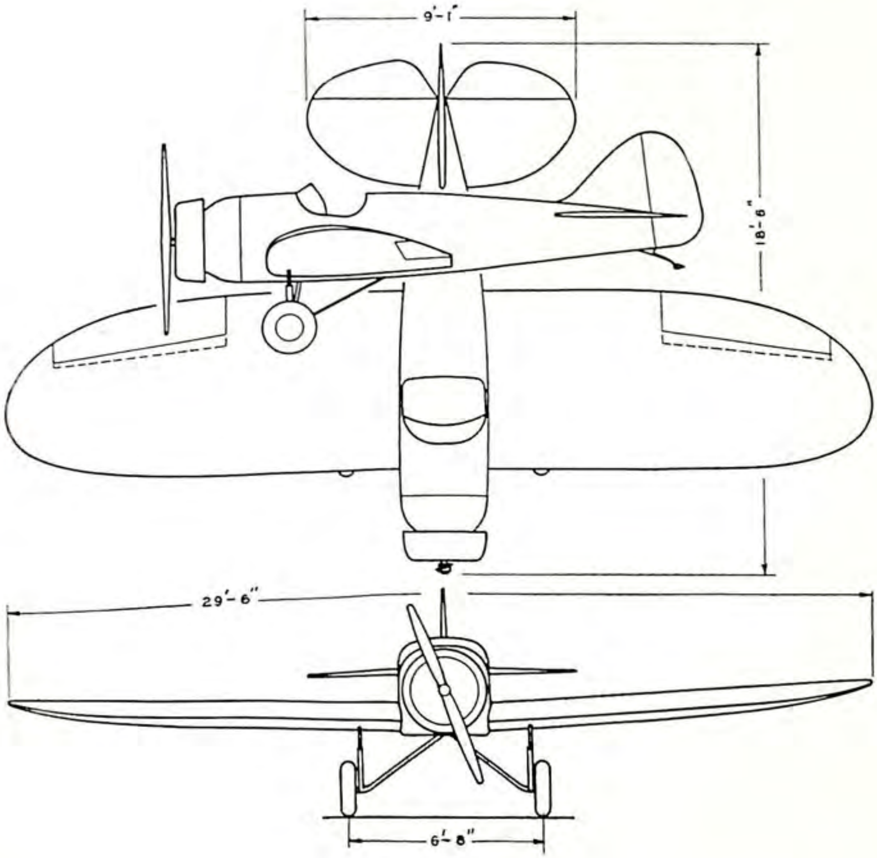
A two-place autogiro for private operations powered with Jacobs engine.

1,000 miles at 220 m.p.h. It was built to withstand a terminal velocity dive followed by an 8 "g" pull-out.

Kellett Autogiro Corporation, Philadelphia, Pa., at the beginning of 1937 was continuing to develop its YG-1 direct control wingless machine, one of which was acquired by the Air Corps. Development work on the KD-1 for commercial use also was continued.

Lambert Aircraft Corporation, Robertson, Mo., reported 1936 the best sales year in its history, with four models in production—

the De Luxe Monocoach, Monosport, Monoprep and twin-engine Monocoach. The De Luxe Monocoupe model 90A, was powered with the Lambert 90 h.p. engine and had a stated cruising speed of 110 m.p.h., and more than 32 were sold in 1936. The Monoprep and the Monosport were two new developments, two-place side-by-side monoplanes. They had a stated cruising speed of 100 and 110 m.p.h. respectively. The Lambert H twin-engine Monocoach was powered with two Lambert 90 h.p. engines. It was a low-wing, cantilever monoplane, its cabin seating four and five persons. The wing span

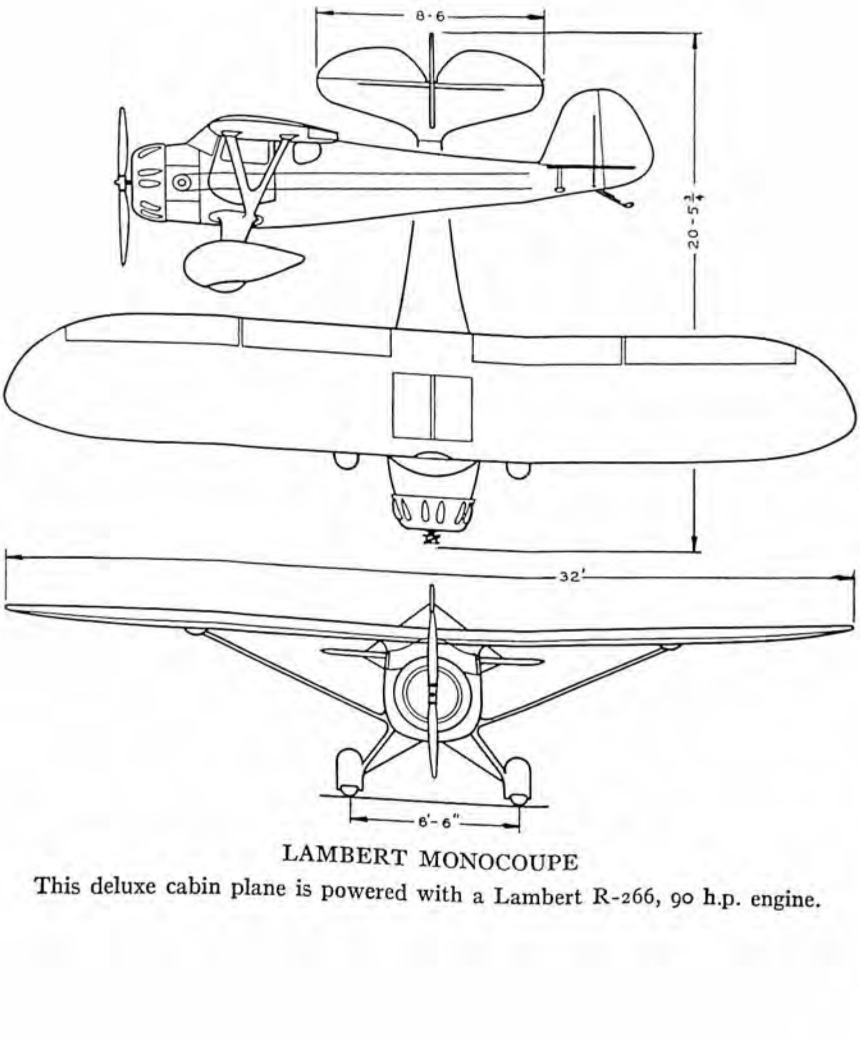


LAMBERT MONOPREP

A two-place plane for the private flyer, powered with a Lambert engine.

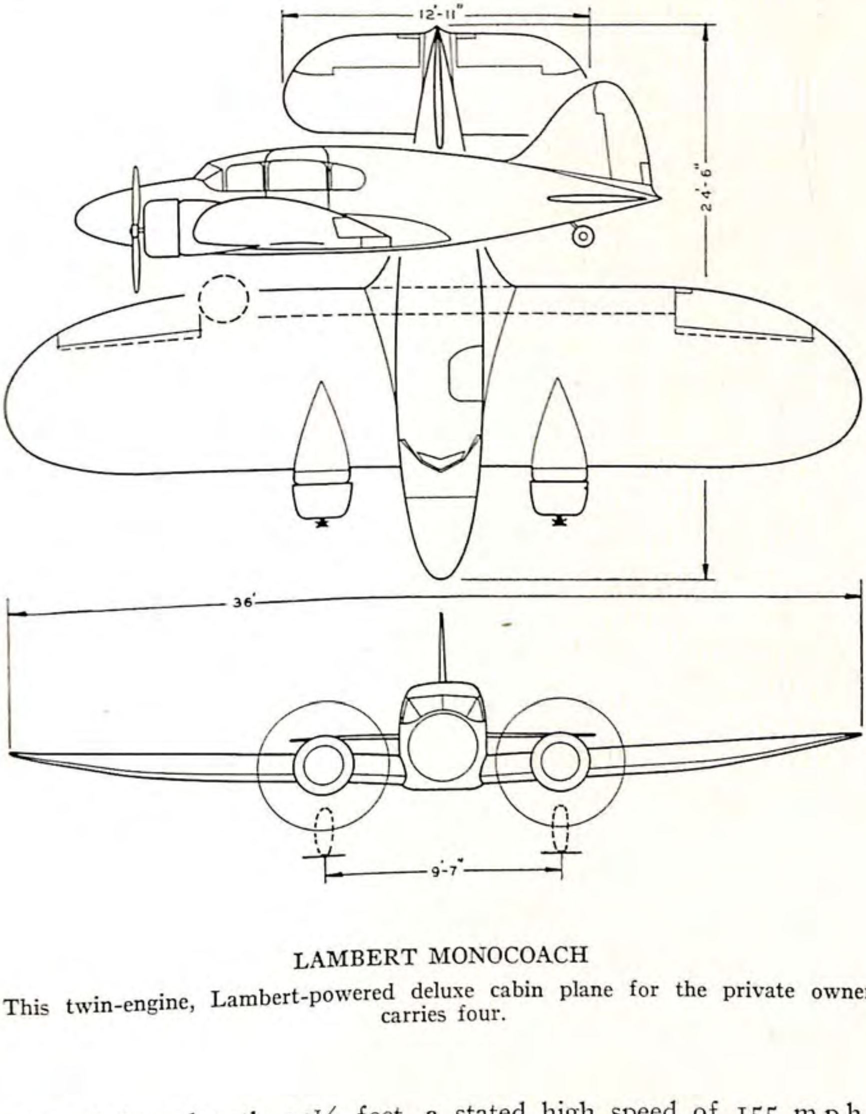
THE LAMBERT MONOCOACH

A four-place cabin ship powered by two 90 h.p. Lambert engines.



LAMBERT MONOCOUPE

This deluxe cabin plane is powered with a Lambert R-266, 90 h.p. engine.

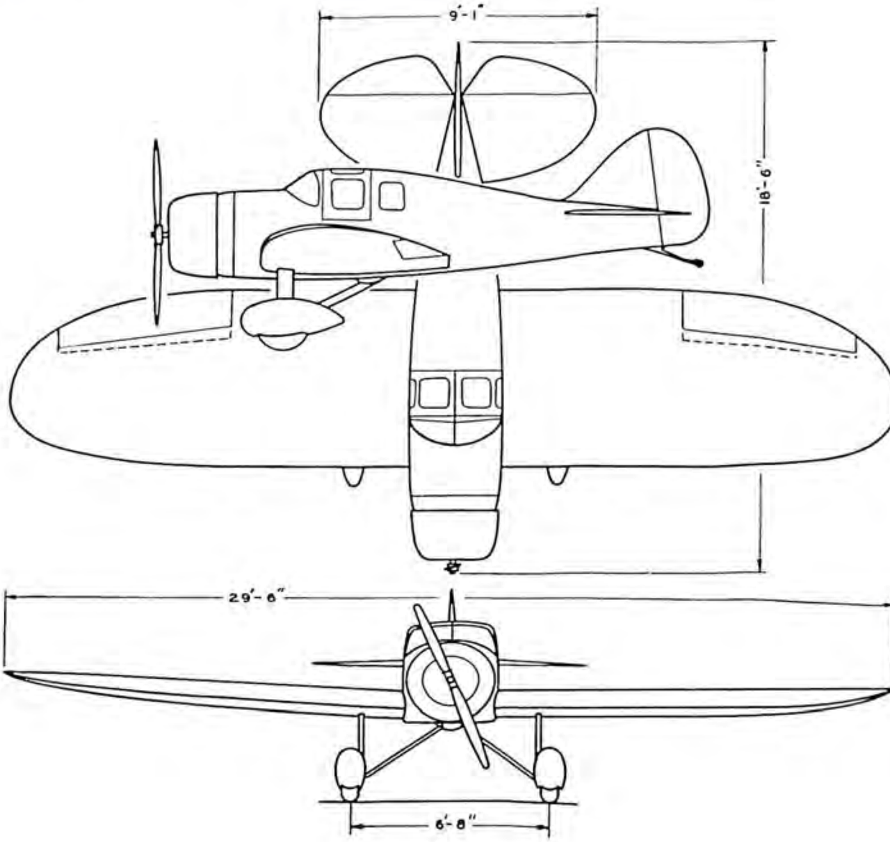


LAMBERT MONOCOACH

This twin-engine, Lambert-powered deluxe cabin plane for the private owner carries four.

was 36 feet, length 24½ feet, a stated high speed of 155 m.p.h., cruising at 135 and 142 m.p.h. The company planned to develop a higher-powered twin-engine ship in 1937.

Lockheed Aircraft Corporation, Burbank, Calif., in 1936 discontinued production of its streamline Vega, Orion and Altair models, devoting the major part of its activity to the production of the fast, twin-engined Lockheed Electra, a 10-passenger, all metal transport which was being used by Delta Air Lines, Braniff Airways, Chicago

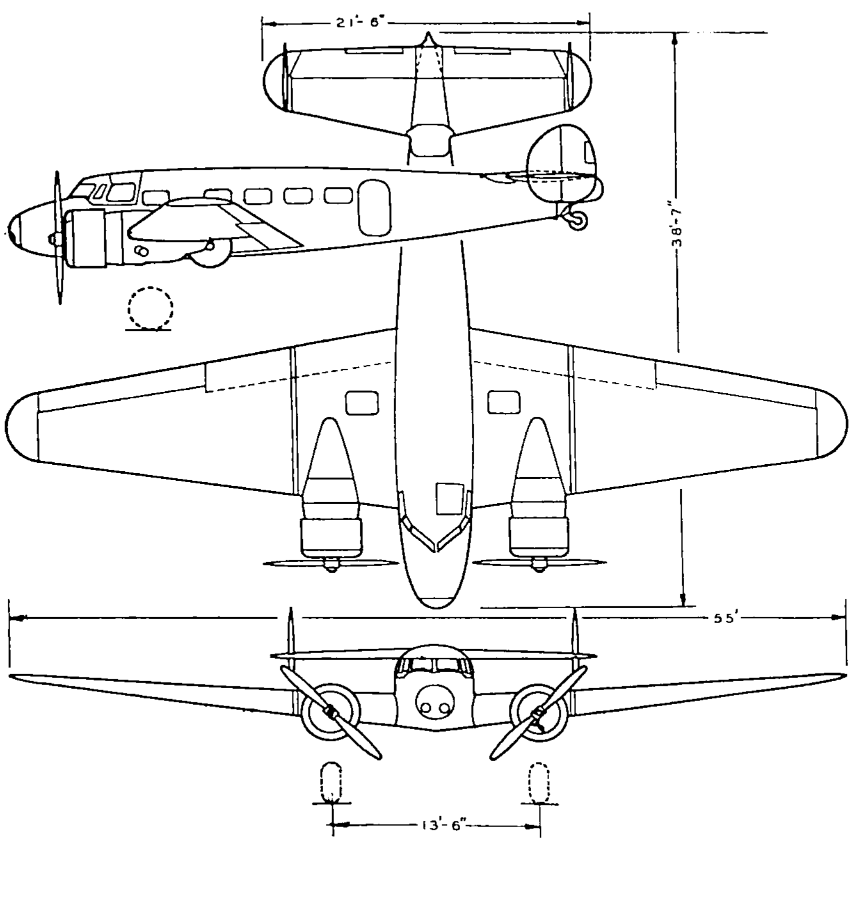


LAMBERT MONOSPORT

A Lambert-powered plane for the sportsman pilot, seating two.

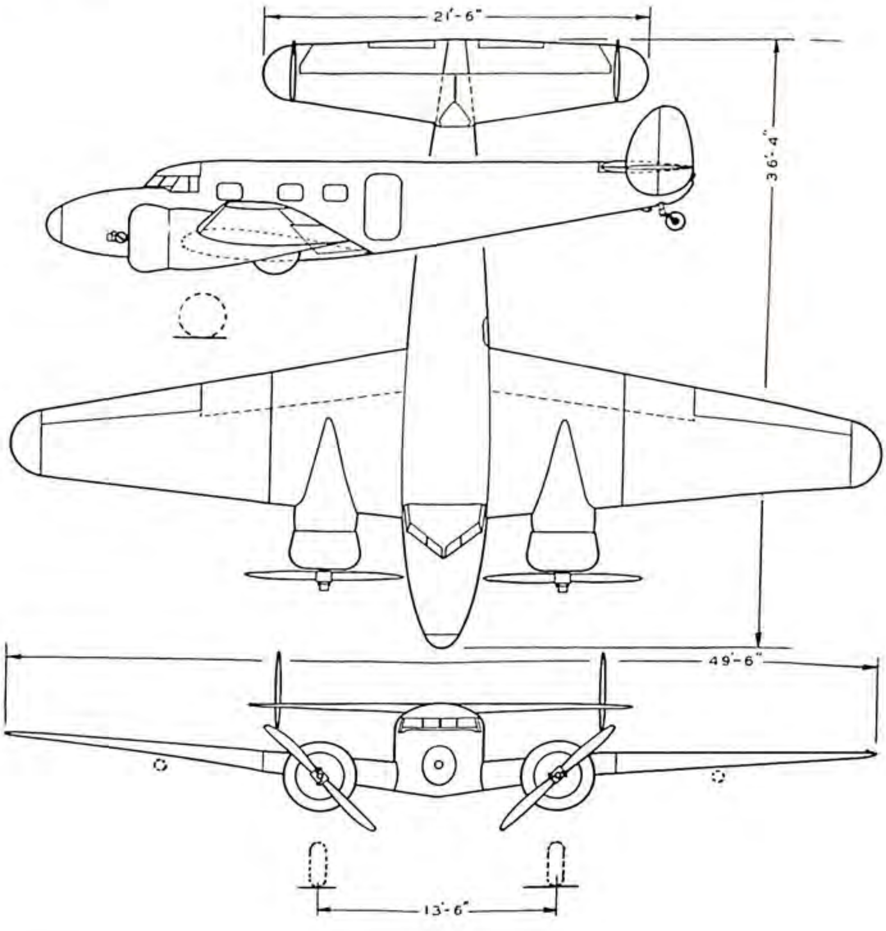
and Southern, Eastern Air Lines, Northwest Airlines, Hanford Air Lines, Boston Maine-Central Vermont Airways, Pan American Airways, Canadian Airways, Guinea Airways, L. O. T. (Polish) Air Lines and many independent corporations and private flyers. Experiencing the most active year in its colorful history, Lockheed was employing 850 men and had added several hangars to its factory. A production schedule of six planes a month was being followed. Orders totalling more than $1,250,000 were recorded at the end of August, 1936. Two new transport models were developed during the early part of the year, a small, six-passenger, bi-motor plane known as the

Lockheed 12, and a large, 14-place bi-motor to be called the Super-Electra. Both of these transports followed the familiar design of the 10-passenger Electra and were of all metal construction. The twin-rudder-and-fin type of empennage which identifies the Electra both here and abroad was carried over into the new models. Model 12, powered by Wasp Junior engines, was a fast commercial bi-motor airplane. It had a stated cruising speed of 213 m.p.h. and a top of nearly 230 m.p.h. Orders for the 12 were being filled at the rate of two planes each month. The Super Electra was to be produced in 1937. Pre-test figures showed that it would be even faster than the



LOCKHEED ELECTRA

A 12-place, twin-engine transport, powered with either two Pratt & Whitney Wasp Junior engines or two Wright Whirlwinds.

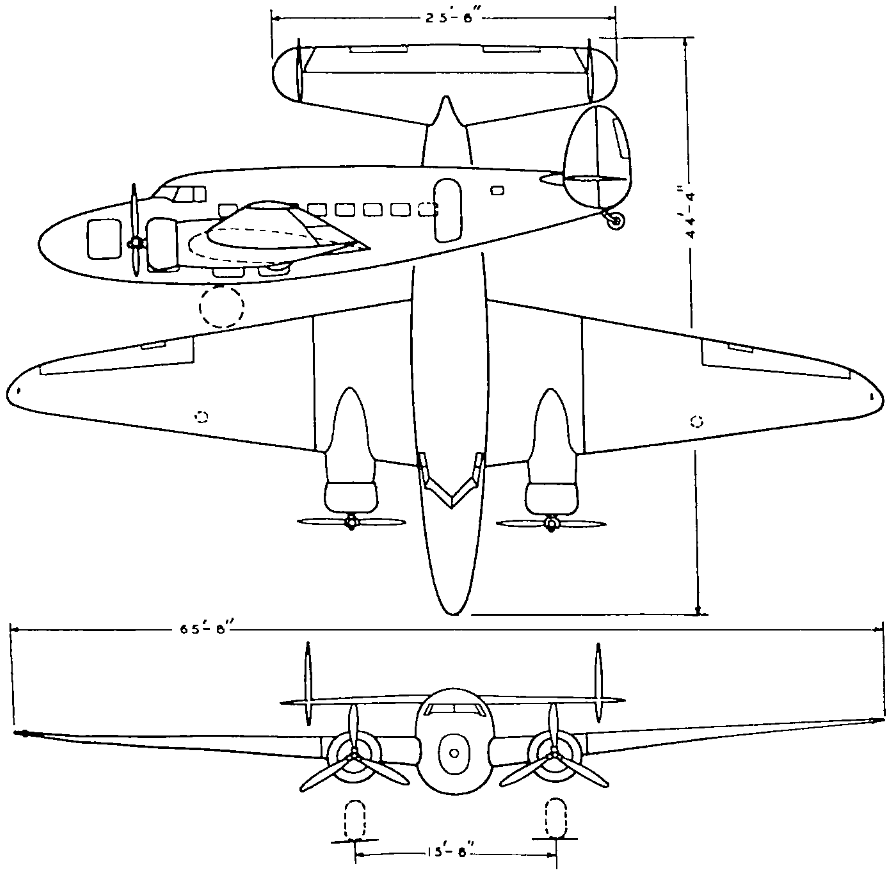


LOCKHEED 12

An eight-place, twin-engine transport with a choice in power plants including Wright Whirlwinds, Pratt & Whitney Wasp Juniors and Menascos.

Lockheed 12, carrying heavier loads. Lockheed entered two foreign fields in 1936, sending planes to Australia for Guinea Airways and to Canada for Canadian Airways. The latter line used its Electras to do experimental flying for the news trans-Canada air mail route.

Other purchasers of Lockheed transports were Continental Oil Company, U. S. Department of Commerce, U. S. Army Air Corps, Bata Shoe Company of Zlin, Czechoslovakia, the world's largest shoe company, and many private owners. For the first time since the company was organized in 1932, Lockheed signed three separate contracts with the Army Air Corps in 1936. A special Electra was built for Amelia Earhart. Equipped with special tankage for a capacity of 1,250 gallons of fuel and fully supplied with all modern aircraft instruments, the Electra, a veritable "flying laboratory," was to be used by Miss Earhart for a series of flights under the sponsorship of Purdue University. Lockheed employment was more than doubled



LOCKHEED SUPER-ELECTRA

This 14-passenger transport is powered with two Wright Cyclone engines, rated at 840 h.p. each.

SIDE VIEW OF THE LOCKHEED 12

An eight-place twin-engine transport for business or air line use.

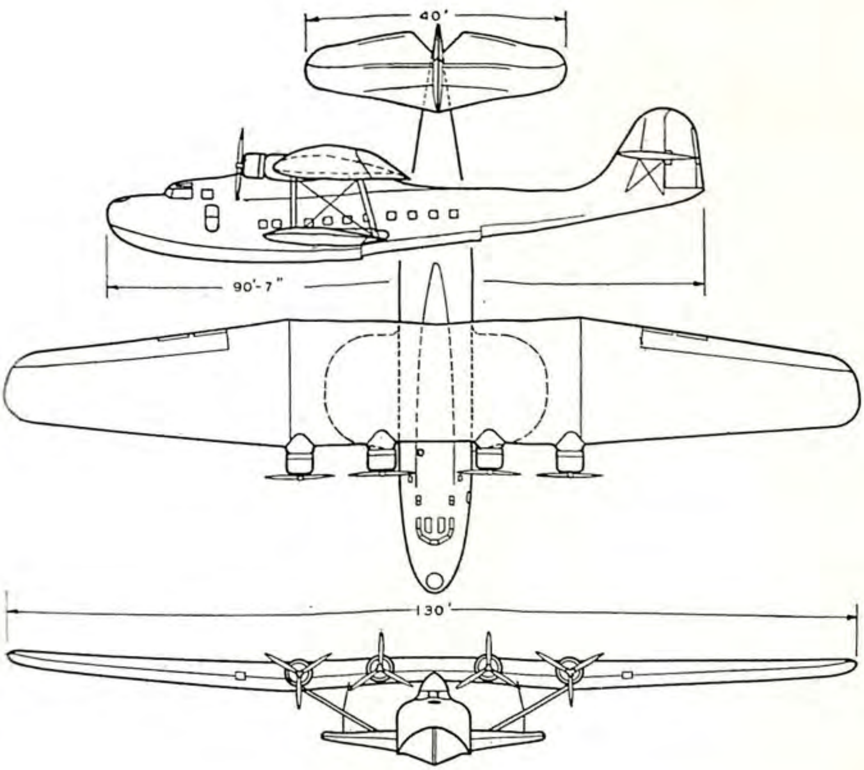
at the beginning of 1937, and prospective contracts were the largest in its history.

The Glenn L. Martin Company, Baltimore, Md., completed an order of Model B-10-B twin-engine bombers for the Army Air Corps, and continued export of the same type as Model 139-W, with Wright Cyclone G engines, a stated high speed of 239 m.p.h. at 14,000 feet, service ceiling 29,000 feet and endurance range nearly eight hours.

Following completion of the first three Martin 130 flying clipper boats for the Pan American Airways the Martin Company continued development work on huge ocean flying craft model 156. The new series flying boat had a gross weight of 62,000 pounds, 157 feet wing span, length overall 90 feet seven inches, height 26 feet four inches. With four Wright Cyclone G-2 engines it had a stated high speed of 190 m.p.h., cruising at 156 m.p.h., and as an 18-passenger sleeper the stated payload totaled 10,000 pounds over a non-stop range of 2,400 miles against a 35-mile headwind. Several new models were on the Martin experimental list.

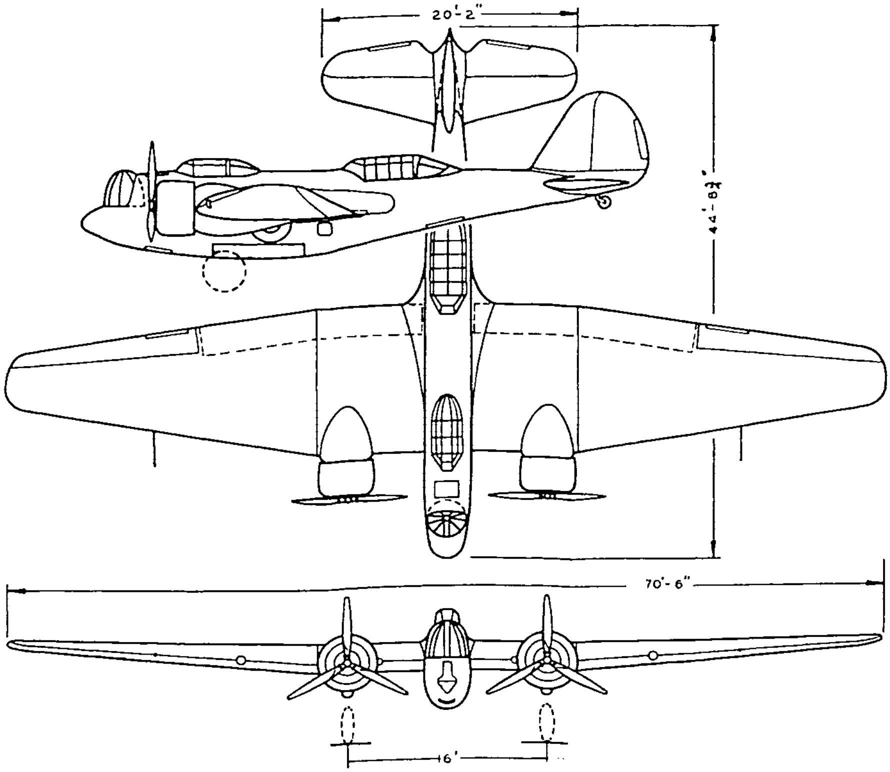
Mercury Aircraft, Inc., Hammondsport, N. Y. produced a two-seat high-wing monoplane with the wing supported above the fuselage by means of Vee struts. The wing and fuselage structures were of steel tubing. Powered with a 90 h.p. LeBlond engine, the T-2 had a gross weight of 935 pounds, a stated top speed of 115 m.p.h. and landed at 40 m.p.h. The wing span was 35 feet eight inches, the length 23 feet, and the cruising range 375 miles.

North American Aviation, Inc., Manufacturing Division, Inglewood, Calif., transferred operations from its previously operated eastern plants, B/J Aircraft and General Aviation, to a newly constructed modern airplane factory, directly on the Los Angeles Municipal Airport. Production on 95 U. S. Army basic trainers was start-



MARTIN 130

A 50-place commercial flying boat powered with four Pratt & Whitney Twin Wasps.

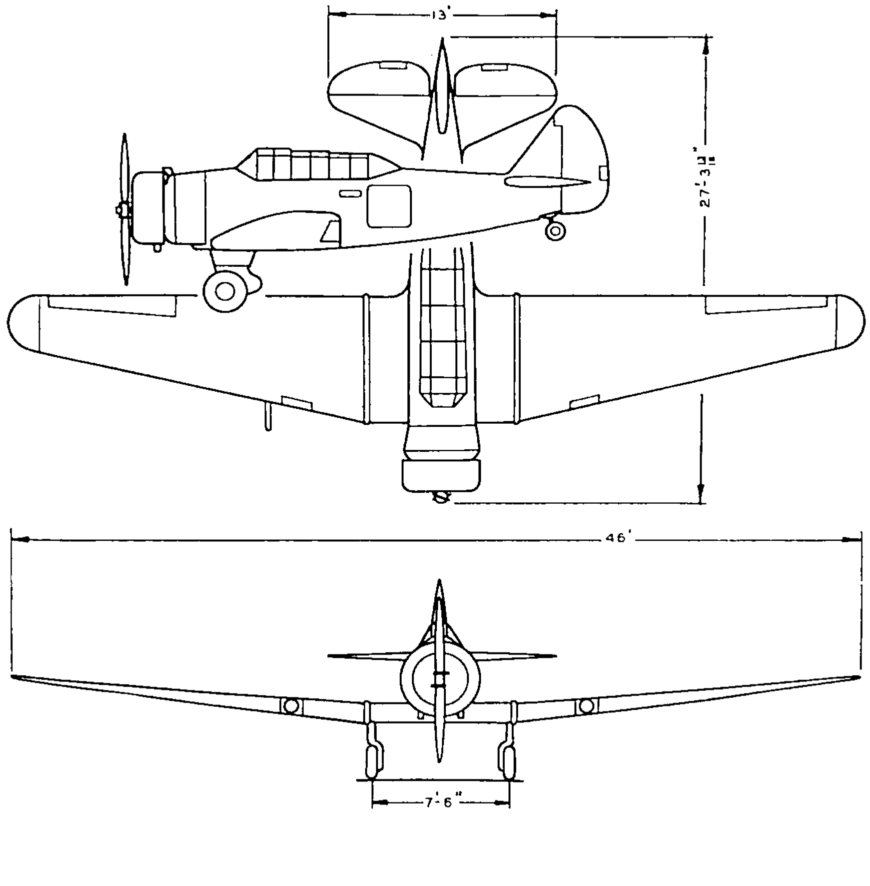


MARTIN 139

A Wright Cyclone-powered twin-engine bomber.

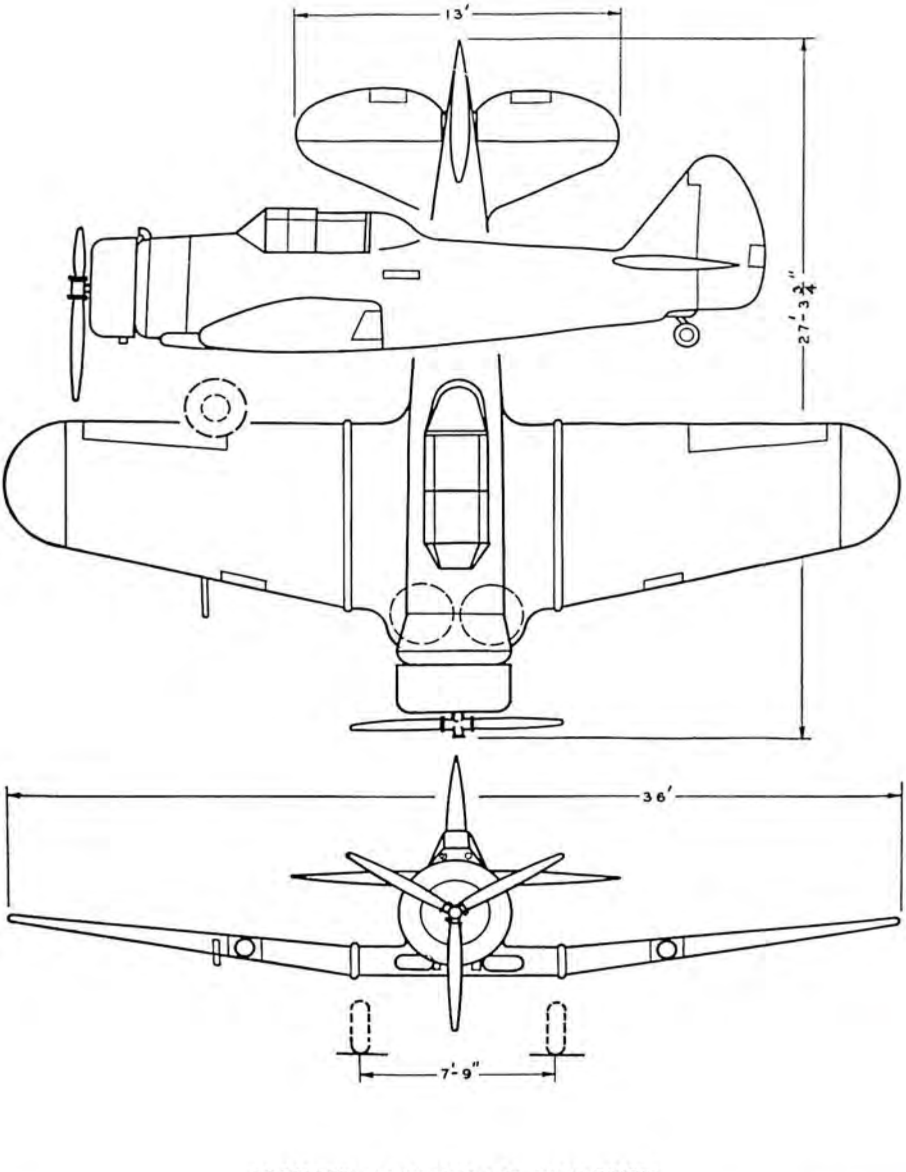
ed early in 1936 in this west coast factory of 175,000 square feet and the entire order was delivered during the year. The Army designation of this basic trainer was BT-9. Features include low-wing, all metal, full cantilever construction, welded steel tube fuselage with quickly removable fabric covered side panels and wide tread landing gear with single leg fork and air and oleo shock absorbers. The entire power plant and accessories were removable as a unit and could be changed in less than an hour. It was powered with a 400 h.p. Wright Whirlwind and had a stated high speed of 175 m.p.h., landing at 56 m.p.h.

For export trade, North American produced five models, all low-wing monoplanes, known as the NA-16. Basically it was the same as the U. S. Army BT-9 and was converted into the several models by substituting different wing panels or changing cockpit arrangement. These five models were two-seat general purpose, two-seat fighter, two-place bomber, two-place advanced trainer, and single-seat fighter. Power plants from 225 h.p. to 850 h.p. could be used, as the airplane had been designed and constructed to accommodate these types. A stated high speed of 270 m.p.h. was obtained on the single seat fighter with Wright Cyclone G-37 engine. North American also delivered to the Air Corps a modern, mid-wing, all metal monoplane observation ship, the XO-47. This is a new design 3-place mid-wing mono-



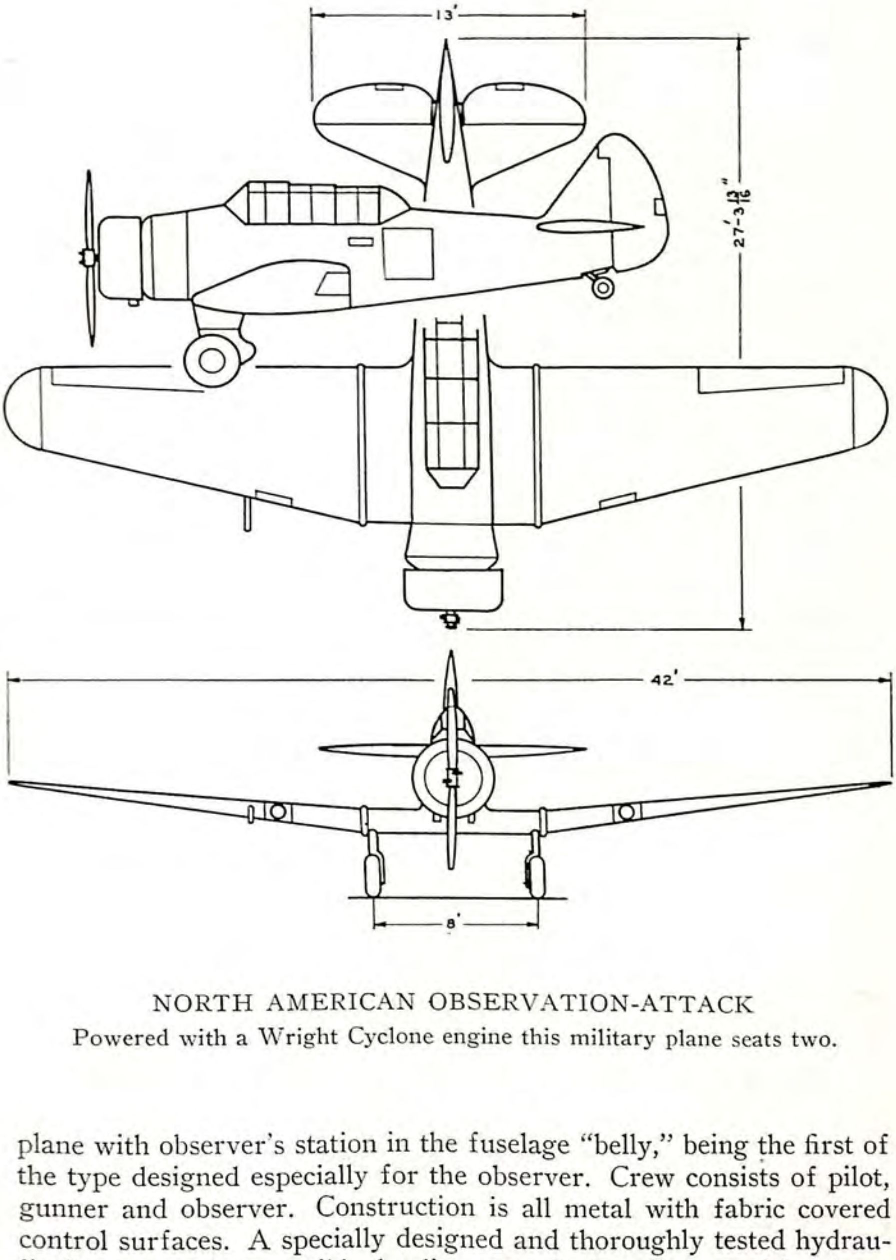
NORTH AMERICAN BOMBER

A two-place military plane, available with of a choice of power plants.



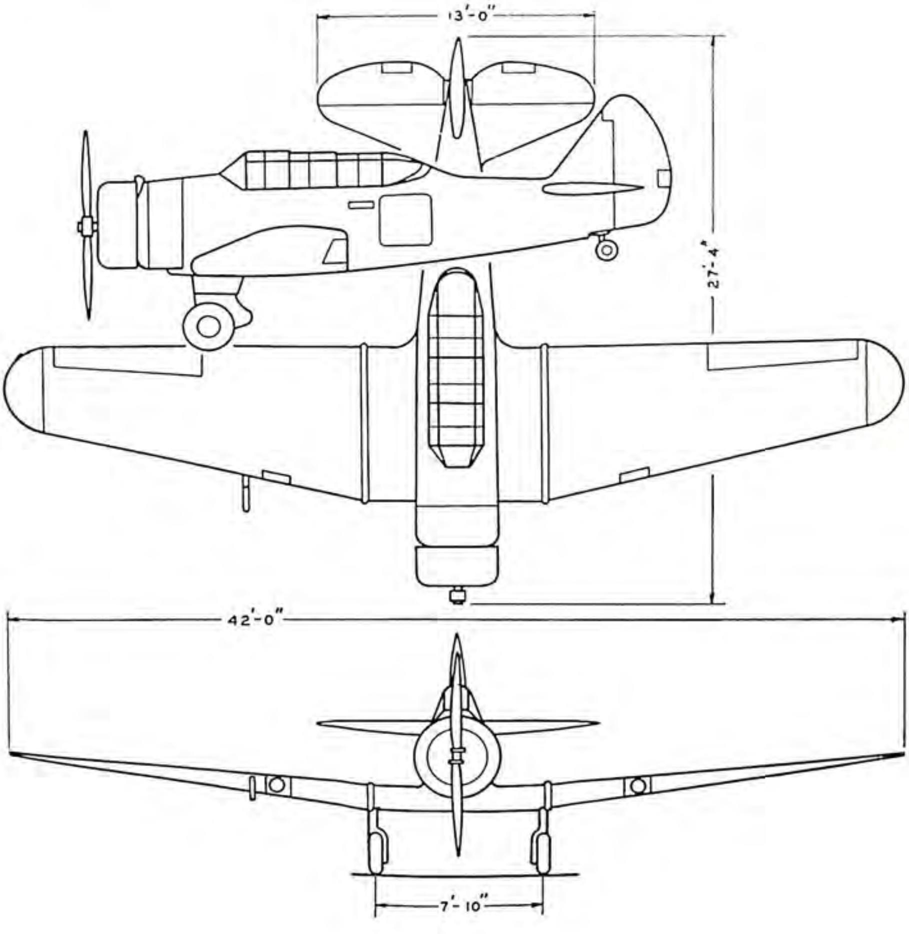
NORTH AMERICAN PURSUIT

This single-seat version of the NA-16 is powered with a Wright G Cyclone engine.



NORTH AMERICAN OBSERVATION-ATTACK
Powered with a Wright Cyclone engine this military plane seats two.

plane with observer's station in the fuselage "belly," being the first of the type designed especially for the observer. Crew consists of pilot, gunner and observer. Construction is all metal with fabric covered control surfaces. A specially designed and thoroughly tested hydraulically operated retractible landing gear is installed on this plane; wing flaps are also hydraulically operated; and has a wing area of 349 square feet. Powered with an 850 h.p. Wright Cyclone engine its



NORTH AMERICAN BT9

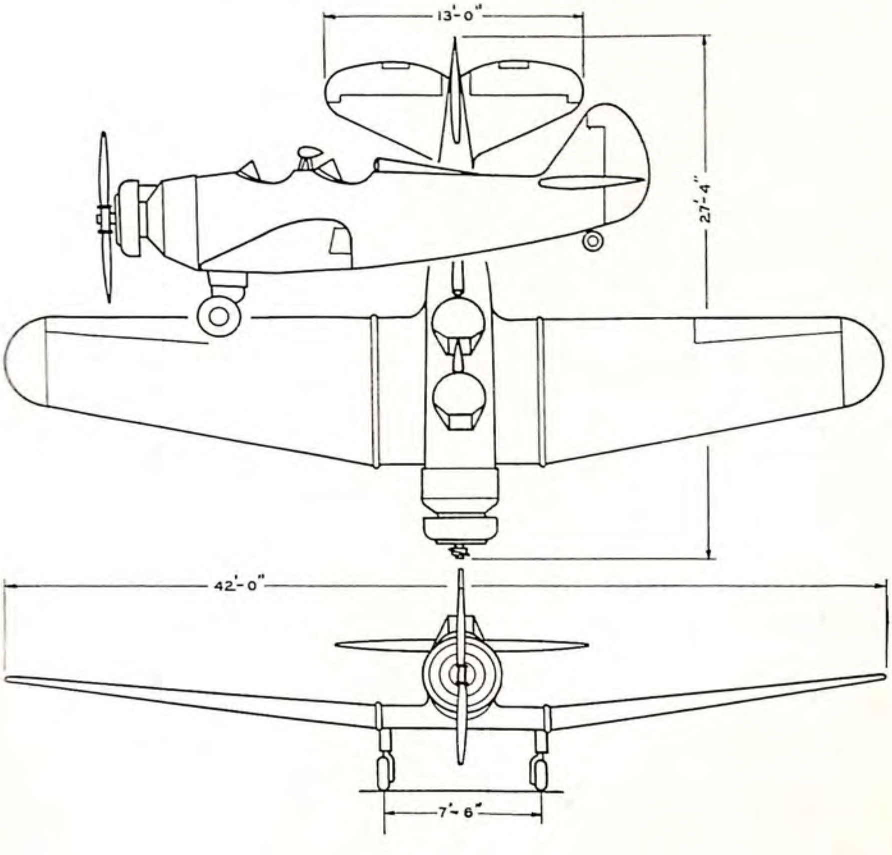
An Army Air Corps trainer, powered with a Wright Whirlwind 400 h.p. engine.

maximum speed is 238 m.p.h. North American also built a two engine bomber, the "Dragon," for the Army Air Corps competition in 1937. Details, of course, were a secret.

The Northrop Corporation, Inglewood, Calif., at the beginning of 1937 was working on production orders for Air Corps attack planes, and dive bombers for the Navy. The Army attack plane model A-17 was a low-wing metal monoplane, and 110 were being built for the

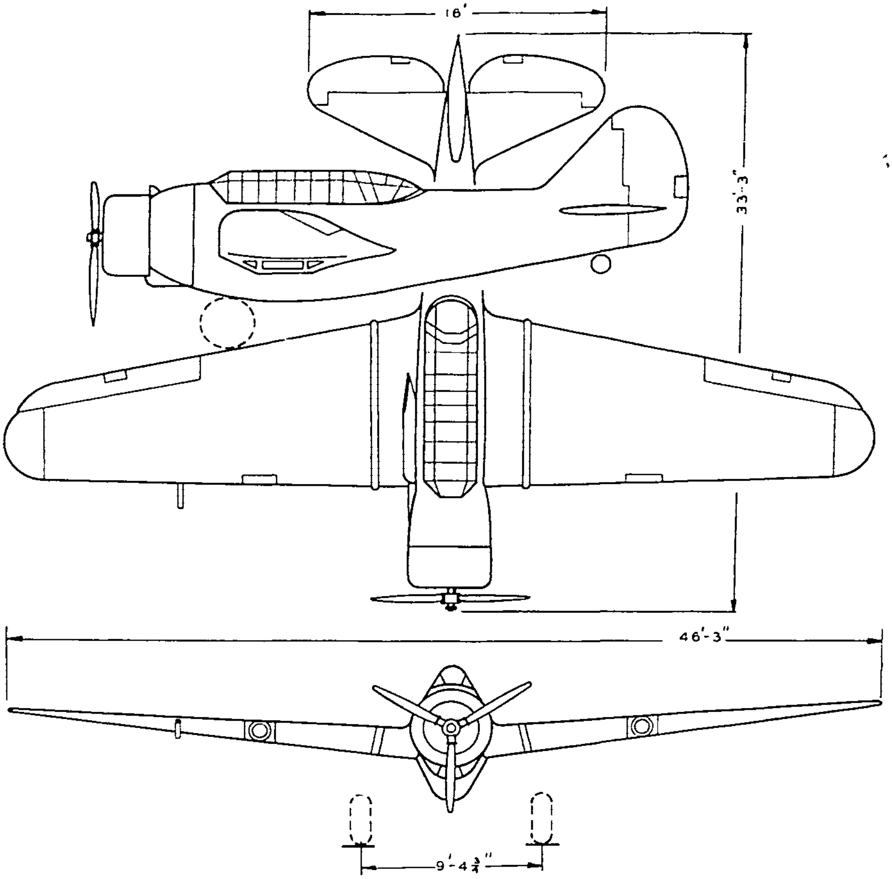
Air Corps. The dive bomber, XBT-1 was also a low-wing metal monoplane, and 54 were being built for the Navy. Northrop also produced the Delta transport, a five to seven-place low-wing metal monoplane with 710 h.p. Wright Cyclone engine, stated speed of 205 m.p.h. cruising, and range of 1,900 miles. The Northrop Gamma bomber, another product, was powered with a Wright Cyclone, had a stated cruising speed of 194 m.p.h. and range of 1,800 miles carrying 10 bombs halfway.

Pitcairn Autogiro Company, Willow Grove, Pa., continued the development of autogiros and delivered to the Bureau of Air Commerce a machine capable of having its wings folded back and then



NORTH AMERICAN PRIMARY TRAINER

This is available with a choice of power plants in various horsepower ratings.

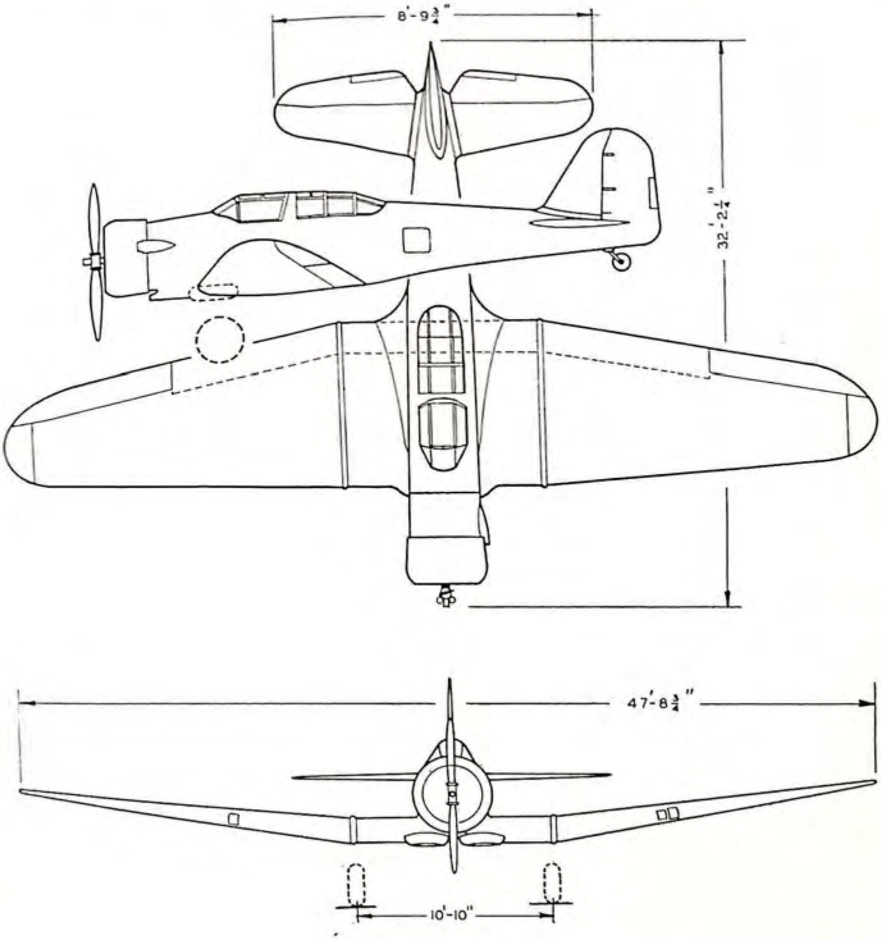


NORTH AMERICAN XO-47
A U. S. Air Corps observation plane.

operating as a motor car. The Pitcairn model AC-35 is a two-place cabin autogiro with folding blades and road drive mechanism. The company reported that it had a high speed in the air of approximately 100 m.p.h. and 30 m.p.h. on the road, with cruising range of about three and one half hours with 90 h.p. engine.

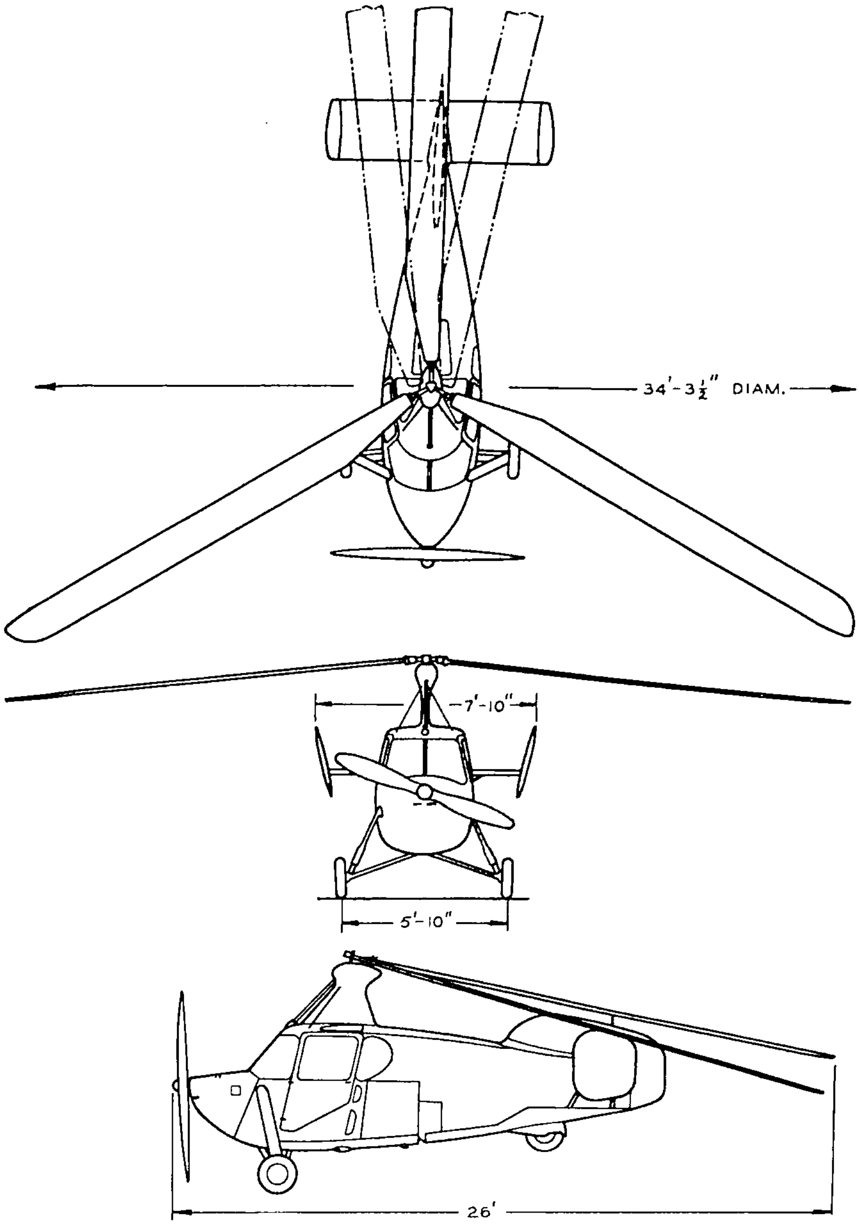
Porterfield Aircraft Corporation, Kansas City, Mo., reported that it was in production on five models of light planes, powered with Warner 90 h.p., Velie 65 h.p. and Le Blond 70 h.p. respectively. The company reported that it had completed satisfactory flight tests on its new Zephyr, powered with the Continental A-40 engine.

Rearwin Airplanes, Kansas City, Mo., produced the Sportster 7,000, with 70 h.p. Le Blond, the 8,500 with 85 h.p. Le Blond, or the 9,000 with 90 h.p. Warner engine. It has a wing span of 35 feet, length 22.3 feet, stated speed of 98 m.p.h., cruising range 475 miles. The Rearwin Speedster with 125 h.p. Menasco had a wing span of 32 feet and a stated speed of 140 m.p.h. cruising.



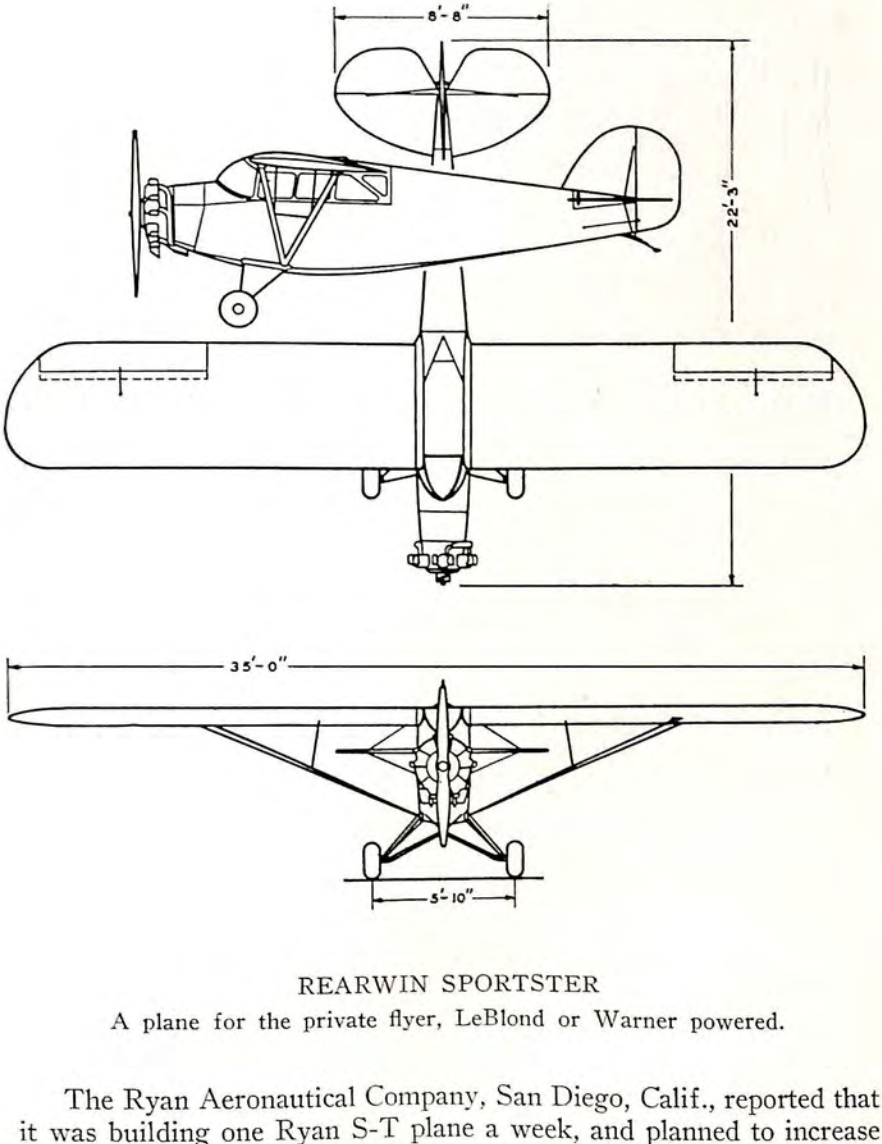
NORTHROP A-17

U. S. Air Corps attack plane powered with Pratt & Whitney Twin Wasp Junior 550 h.p. engine.



PITCAIRN ROADABLE AUTOGIRO

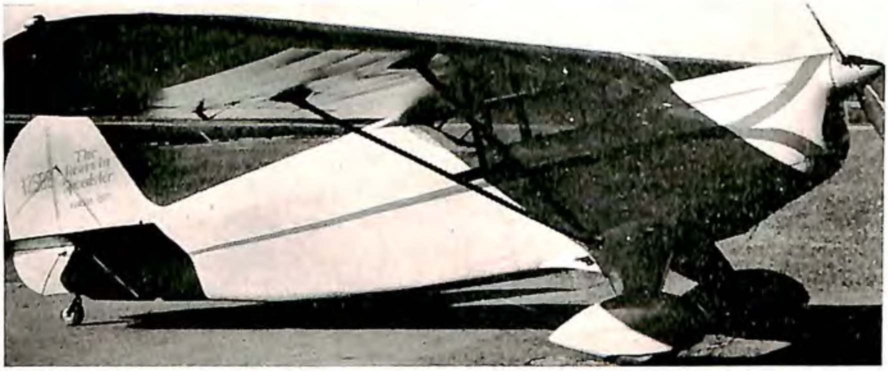
A two-place cabin autogiro with 90 h.p. engine.



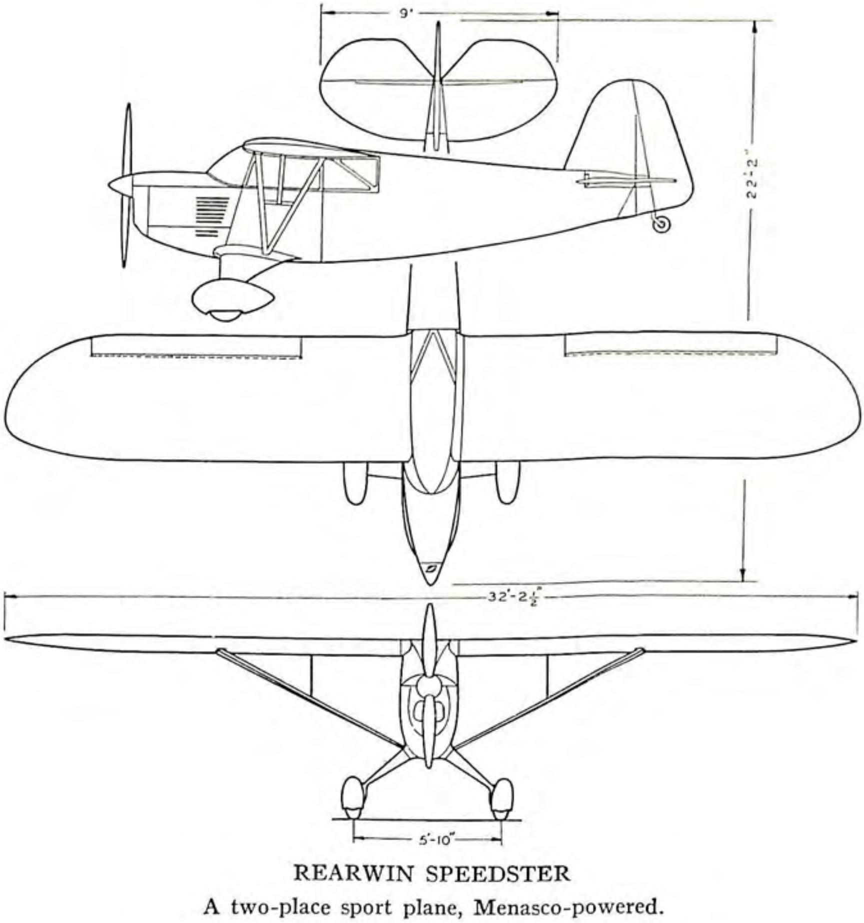
REARWIN SPORTSTER

A plane for the private flyer, LeBlond or Warner powered.

The Ryan Aeronautical Company, San Diego, Calif., reported that it was building one Ryan S-T plane a week, and planned to increase production to 156 planes a year. Three models of the S-T were available, the main difference being the horsepower of their Menasco engine, 95, 125, and 150 h.p. supercharged. The S-T was a two-place machine with stated high speed of 148 m.p.h., cruising at 138 m.p.h., landing at 42 m.p.h., with range of 400 miles and service ceiling as high as 21,000 feet.

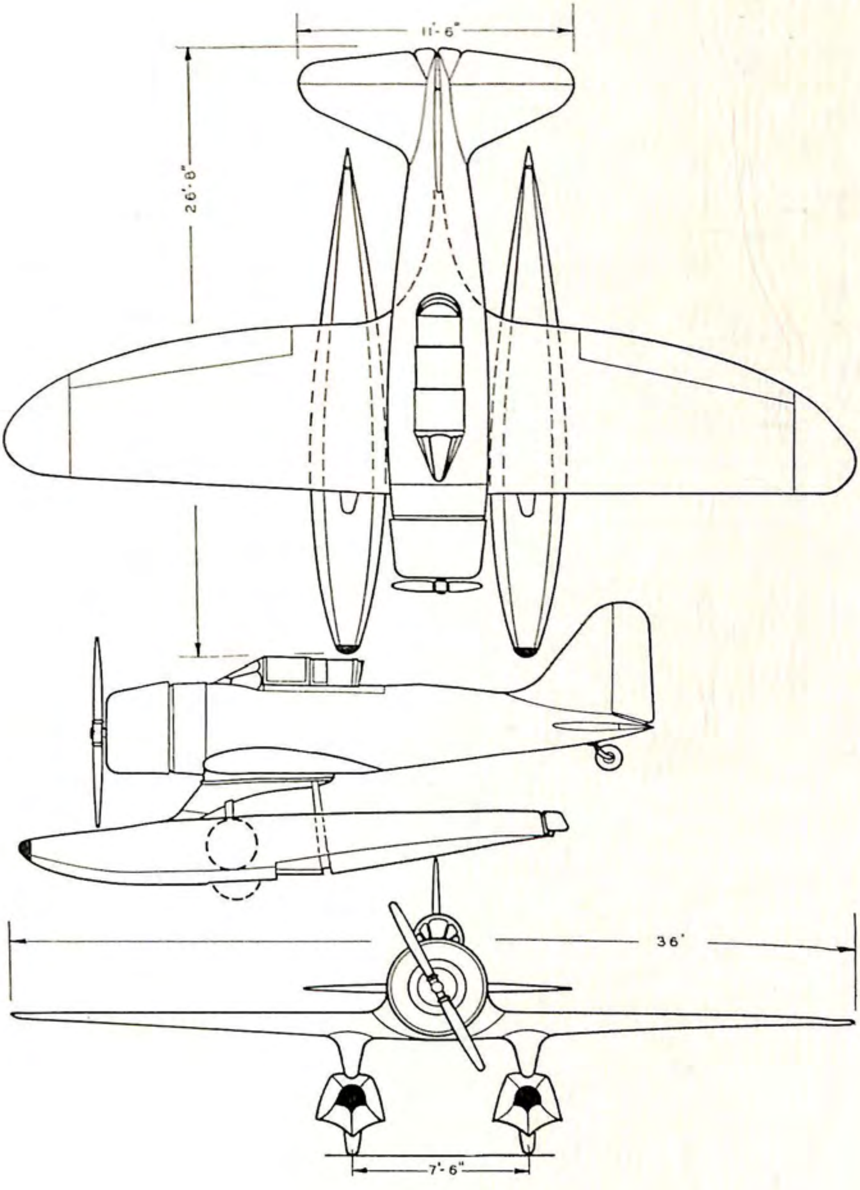


REARWIN HIGH-WING CABIN PLANE



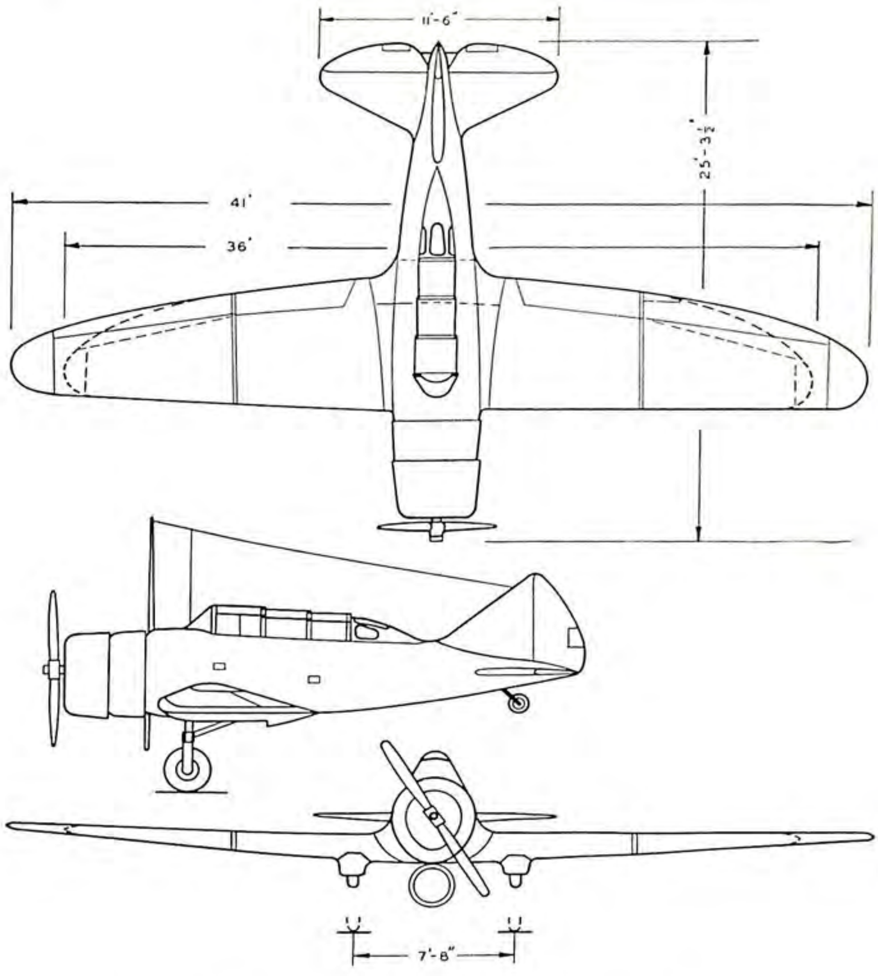
REARWIN SPEEDSTER

A two-place sport plane, Menasco-powered.



SEVERSKY AMPHIBION

A two-place fighter powered with a Wright 440 h.p. engine.

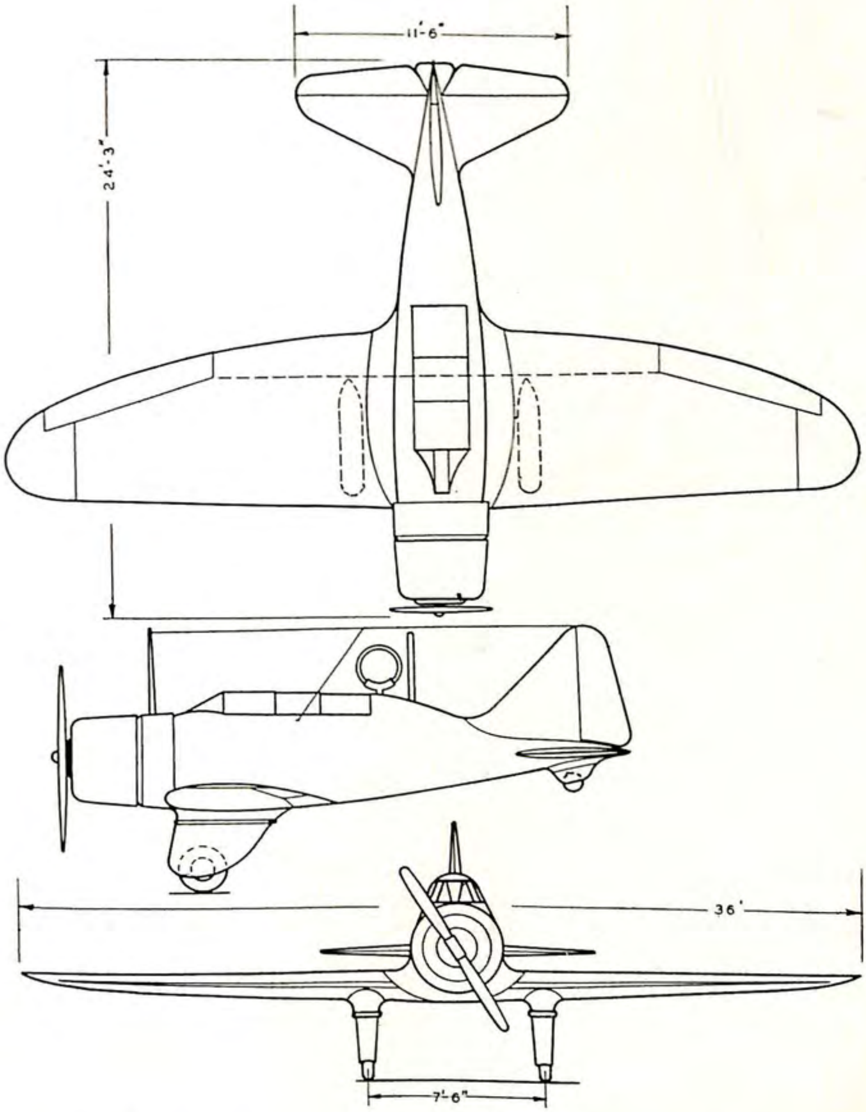


SEVERSKY EXPERIMENTAL BASIC TRAINER

A two-place trainer powered with a 550 h.p. Pratt & Whitney Wasp engine.

St. Louis Aircraft Corporation, St. Louis, Mo., specialized in the design and production of parts for the Air Corps engineering section at Wright Field. At the beginning of 1937 the engineering department had on hand a number of experimental projects for both the Army and the Navy, including airplanes. The company's policy was to maintain advanced engineering to meet the requirements of the military and naval services with regard to technical improvements in planes and auxiliaries. The company built and submitted a primary trainer for the Air Corps.

Seversky Aircraft Corporation, Farmingdale, N. Y., completed

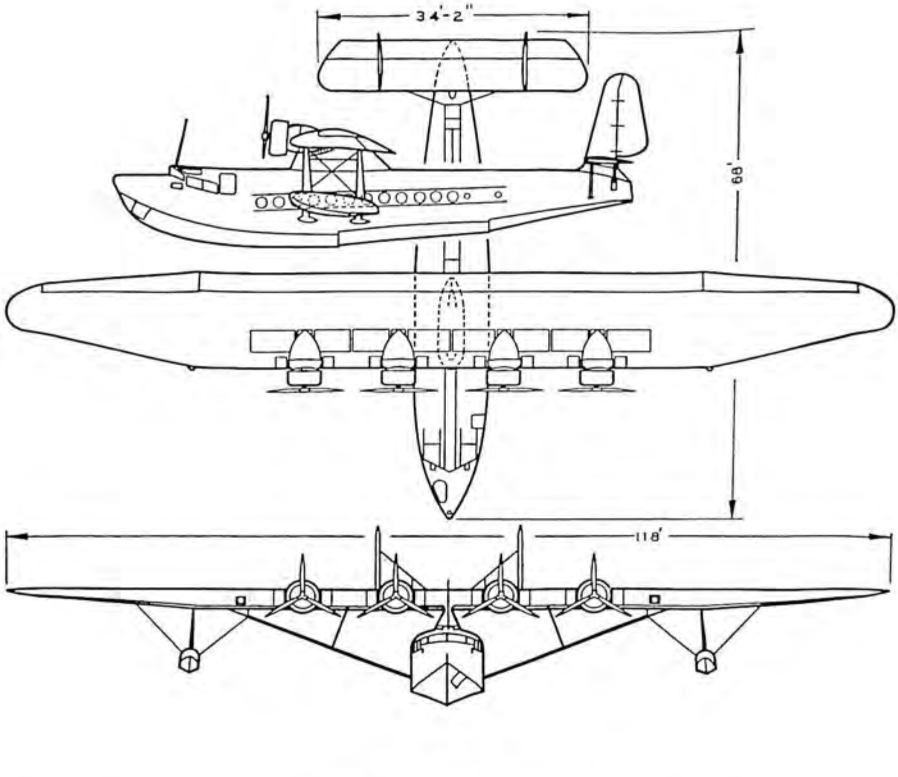


SEVERSKY BT8

A two-place basic trainer powered by a Pratt & Whitney Wasp 450 h.p. engine.

its first order for the Air Corps in 1936, delivering the last of 30 basic training planes.

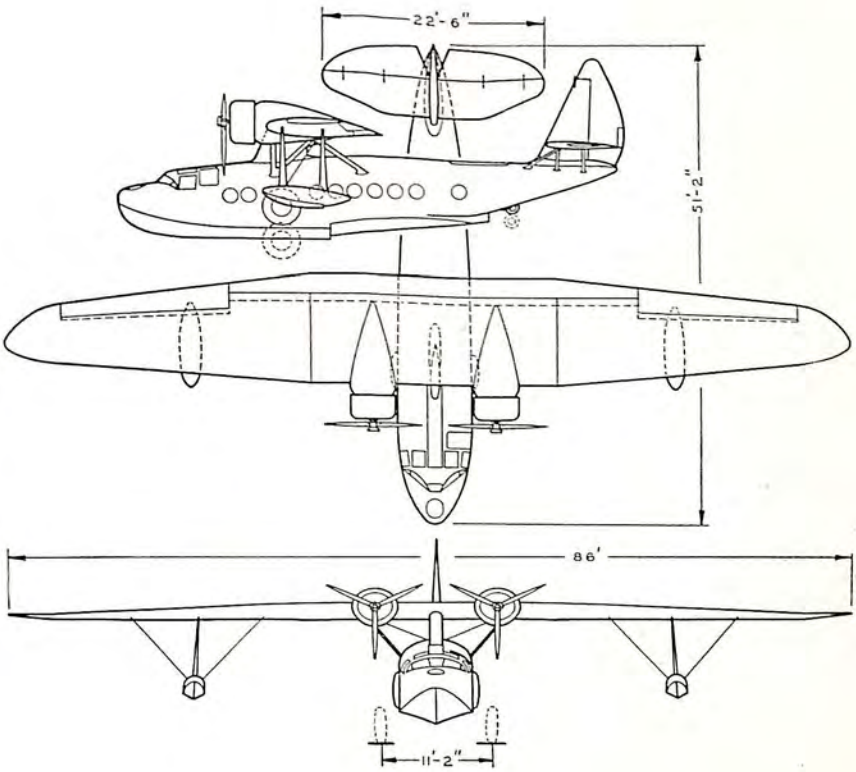
Work was under way on an order for 77 Army pursuit planes with spare parts equal to eight more. This plane, of the familiar Seversky type and design, won the competition at Dayton over three competitors, and, while no definite performance figures have been released by the Air Corps, the company believed it to be the fastest pursuit plane in the world. It was powered with the latest twin-row Wasp radial engine and a Hamilton Standard constant speed propeller. Seversky also developed a basic trainer fitted to take two sets of outer wing panels, to have fixed or retractible landing gear, and to use part or all of the rated power of the engine, according to the mis-



SIKORSKY S-42B

With four Pratt & Whitney Hornets, this flying boat carries 32-40 passengers.

sion being performed. With retractible gear and larger panels, it is an advanced training plane, equipped for blind flying training. When the small panels are used in connection with retractible gear, the plane is suitable for training in actual combat work. The company delivered three amphibion fighters to the Colombian Government, and the planes have been in service for some time on the narrow rivers and high altitude fields of that country. Major James Doolittle, director of the Aviation Division of the Shell Oil Corporation, purchased a Seversky land plane, a commercial version of the new pursuit ship. He will use it for experimental flying and for routine executive travel.



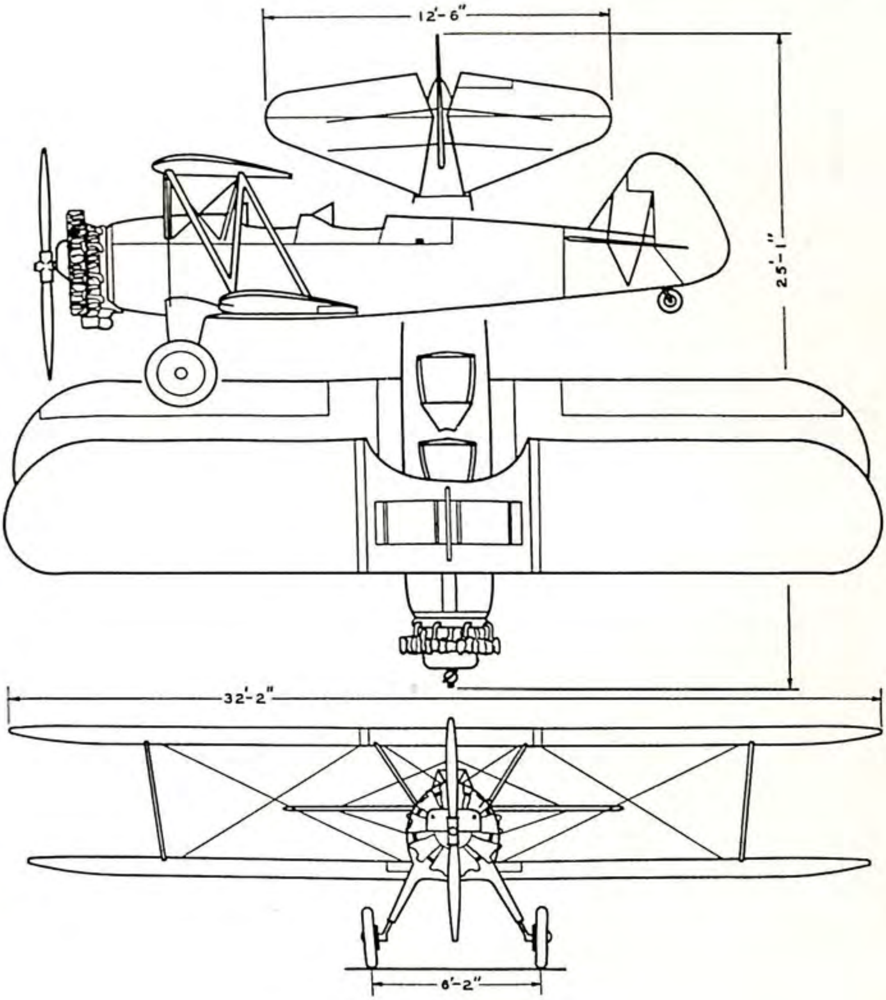
SIKORSKY S-43

A 15-25 place amphibion, powered with two Pratt & Whitney Hornets.

TWO SIKORSKY MODELS

The twin-engine S-43 amphibion and the four engine S-42B flying boat. Both machines are powered by Pratt & Whitney Hornet motors.

Sikorsky Aircraft, Bridgeport, Conn., a division of United Aircraft Corporation, continued with production of S-42 seaplanes and S-43 amphibions during 1936. Construction was also started on a long-range patrol boat for the United States Navy, with trial flights scheduled for the late spring of 1937. A further change was made in the S-42 seaplane. The new model, the S-42-B, having a gross weight of 42,000 pounds, an increase of 2,000 pounds over the previous model S-42-A. The S-42-B also incorporates a few minor changes in hull lines, oil cooling, flaps and cowl, but to all outward appearances is similar to previous S-42 models. Two S-42-B's were delivered to Pan American Airways during 1936 and a third under construction, will swell Pan American's total to ten type S-42 seaplanes in service in 1937. The stated high speed of the S-42-B is 188 m.p.h. and the cruising speed 163 m.p.h. Wing loading is 31.3 lbs./sq. ft.; and power loading 14 lbs./h.p. The S-42-B is powered by four Pratt & Whitney Hornet engines of 750 h.p. each, and is equipped with Hamilton Standard constant speed propellers. It has a span of 118 feet 2 inches; an overall length of 68 feet; and a wing area of 1,340 square feet. Fully equipped and with a standard range of 1,200 miles, the S-42-B has the feature of being convertible from a 32-passenger day plane into a 14-passenger sleeper. Twenty S-43 amphibions for commercial service were delivered to operators in various parts of the world during 1936. Four



STEARMAN NS-1

A two-place primary trainer for the Navy powered with a Wright Whirlwind 220 h.p. engine.

world altitude records were established by this airplane during the year. The S-43 is a Hornet-powered twin-engine amphibion with accommodations for 15 passengers and three in a crew. The gross weight is 19,500 pounds, and the useful load 6,930 lbs. The span is 86 feet; wing area 780.6 square feet; length 51.2 feet; wing loading

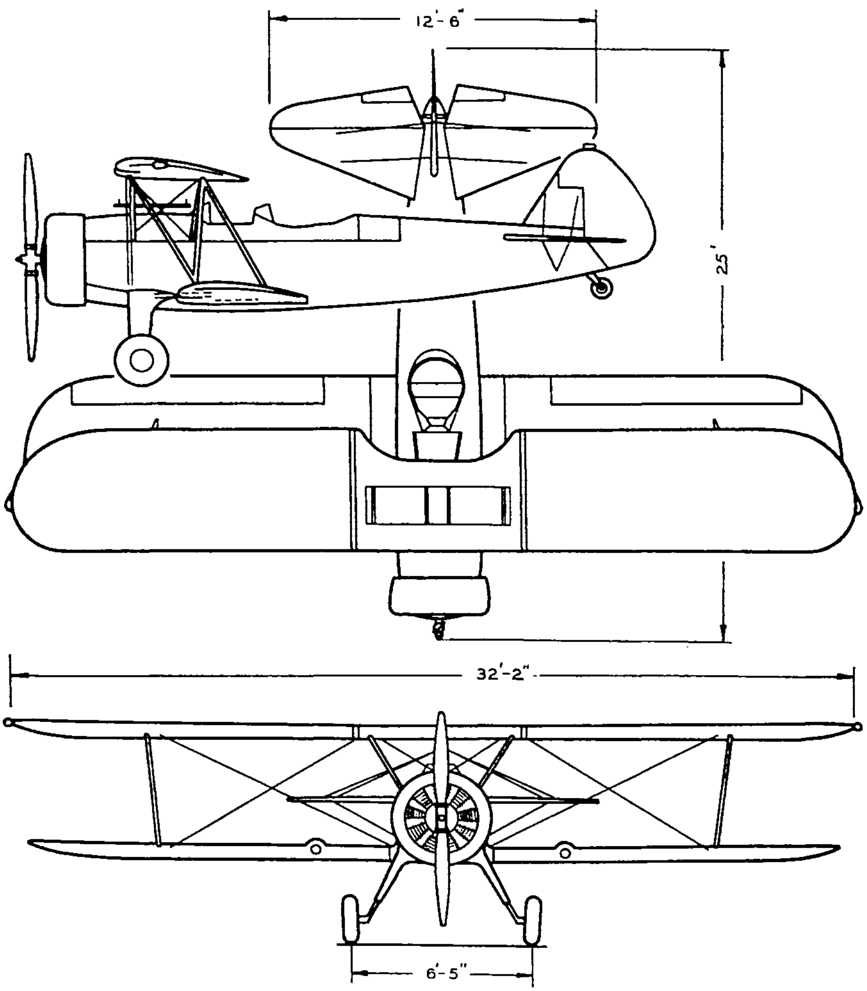
25 lbs./sq. ft.; and the power loading is 13 lbs./h.p. With a top speed of 190 m.p.h.; a cruising speed of 166 m.p.h.; the S-43 has speeded up and modernized many services which heretofore operated the older model S-38 amphibions. The S-43 also inaugurated new air line services in Norway, Africa, and Chile during 1936. Production of the S-43 amphibion will continue in 1937 for both commercial and military service.

The Spartan Aircraft Company, Tulsa, Okla., had on the market two types, one a 55 h.p. Jacobs-powered sport trainer, a two-place, side-by-side, low-wing monoplane with a wing spread of 40 feet; and the other a five-place high-wing cabin monoplane with a wing

A STEARMAN FIGHTER AND TRAINER
It is Model 76-D1, and it carries a machine gunner in the rear cockpit.

spread of 50 feet and powered by a 335 h.p. Pratt & Whitney Wasp engine.

Stearman Aircraft Company, Wichita, Kans., a subsidiary of the Boeing Airplane Company, at the beginning of 1937 was producing training planes for the Army, Navy and for export. The delivery of 39 Stearman Model NS-1 primary trainers to the Navy early in the year made a total of 80 of these planes built for the Navy in two years. The NS-1 was a two-place biplane, powered by a Wright Whirlwind engine, rated at 220 h.p. at 1,800 r.p.m. It had a wing spread of 32 feet two inches, empty weight of 2,007 pounds, useful load of 693 pounds and gross weight 2,700 pounds. It had a fuselage of welded steel tube 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 steel tubing and ailerons of riveted aluminum alloy construction, fabric covered. The tail group was of welded steel tube construction, with fixed stabilizer



STEARMAN ADVANCE TRAINER

This model 76D, powered with a Pratt & Whitney Wasp Junior engine, can also be used as a bombing, scouting or observation plane.

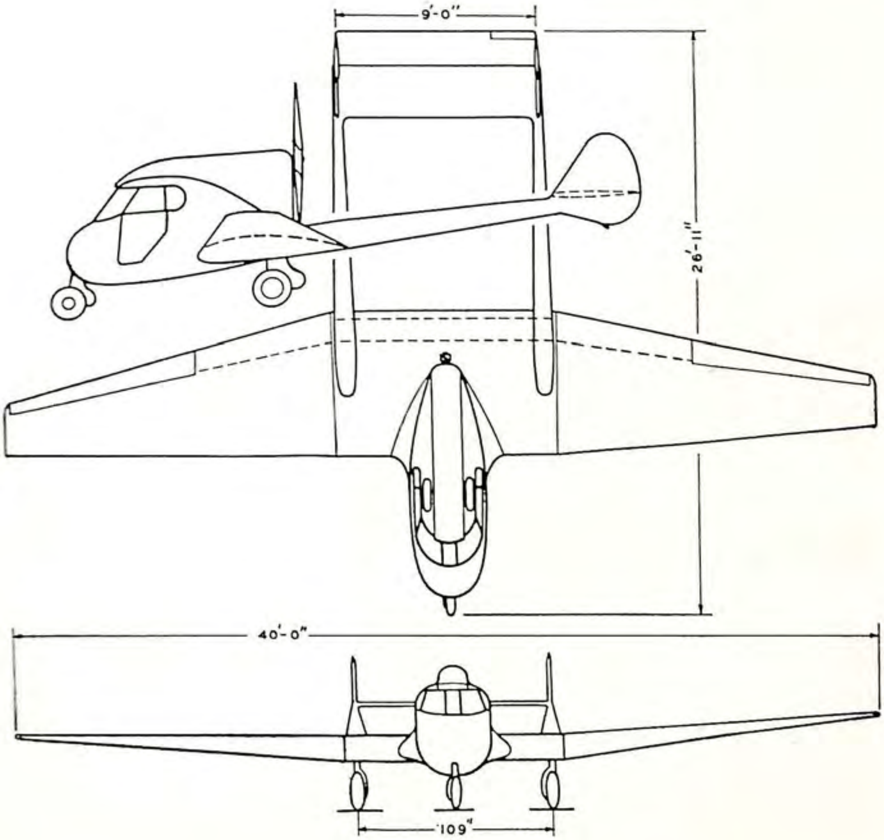
and horizontal trimming, provided by an elevator tab. The full cantilever type landing gear and tail wheel were oleo equipped. Several Stearman Model 73L3 planes similar to the NS-1, but powered by Lycoming R-680-C1 engines, were delivered to the Philippine Government. Twenty-six Stearman PT-13 primary trainers for the Army Air Corps were delivered and were supplemented by a subsequent Air Corps order for 50 more of these planes. This new Army contract brought the total to 190 Stearman trainers for the Air Corps and the Navy in two years. The Stearman PT-13 was generally similar

THE STEARMAN-HAMMOND "Y"

One of the models being developed by the new Stearman-Hammond company.

in design and dimensions to the NS-1. Powered by a Lycoming R-680-5 engine developing 225 h.p. at 2,100 r.p.m. it had a stated high speed of 125 m.p.h., cruising at 105 m.p.h., range 400 miles, climbing to 10,000 feet altitude with a full load in 18 minutes.

A fleet of Stearman Model 76D1 advance trainer and expeditionary planes was delivered to the Argentine Naval Aviation Service. They were two-place biplanes, designed for advanced training, light attack bombing, scouting or observation. In type of construction, they were basically similar to the NS-1 and PT-13. Landing gear, of the cantilever type, was equipped with oil-spring shock absorbers and wheel brakes. The tail wheel was steerable and equipped with an oleo shock absorber strut. Provision is made in this model for the installation of two .30 caliber wing-type machine guns, one flexible machine gun in the rear cockpit and one bomb rack carrying 210 pounds of bombs. The plane had a wing spread of 32 feet two inches, empty weight 2,251 pounds, useful load 1,190 pounds, and gross weight 3,441 pounds. It was equipped with a 320 h.p. Pratt & Whitney Wasp Junior Model T1B engine and Hamilton Standard adjustable



STEARMAN-HAMMOND Y-1

This two-place plane for the private flyer is powered with a choice of two Menasco engines, rated at 125 h.p. and 150 h.p. respectively.

pitch propellers. The fleet of these planes delivered to Argentina was partly equipped with twin seaplane flotation gear of Edo Aircraft Company design. A feature of the model is interchangeability of all main parts, including the complete engine installation and engine mount which can be removed as a unit. It had a stated high speed at sea level of 151 m.p.h., absolute ceiling 19,000 feet, service ceiling 17,200 feet, rate of climb at sea level 1,040 feet a minute and cruising range of 470 miles. Stearman also was building a fleet of Wright Whirlwind-powered Model 76 advanced trainers for the Brazilian Army Air Corps. A successful observation-scout design was developed for the U. S. Navy Bureau of Aeronautics.

Stearman-Hammond Aircraft Corporation, South San Francisco, Calif., grew out of the Hammond Aircraft Corporation, and at the beginning of 1937 started to develop the model Y, a two-place, side-by-side, enclosed low-wing, cantilever monoplane with pusher power plant and three wheel landing gear, the third wheel being under the nose. With Menasco C-4 engine the plane had a stated cruising speed of 110 m.p.h., landing with flaps at 39 m.p.h. The gross weight was 2,150 pounds.

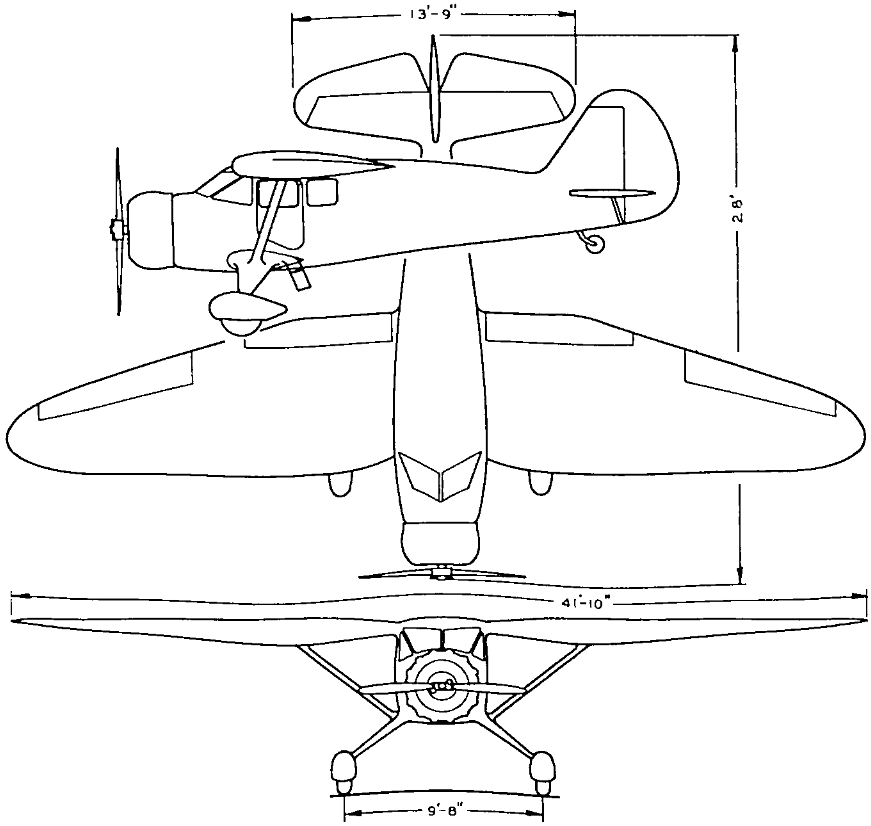
Stinson Aircraft Corporation, Wayne, Mich., a division of Aviation Manufacturing Corporation, at the beginning of 1937 was in production on the Stinson tri-motor Model A air-liner and the Model A for private executive use, both Lycoming-powered. Four models of the Stinson Reliant single-engine high-wing, all metal cabin monoplane were also being produced. Model SR-8A was powered by the

A FIVE-PLACE STINSON

This Reliant SR-8C is powered by a 260 h.p. Lycoming engine.

225 h.p. Lycoming R-680-4 engine and was a four-place machine. Model SR-8B was powered by the 245 h.p. Lycoming R-680-6 motor and was a five-place machine. Model SR-8C was powered by the 260 h.p. Lycoming R-680-5 engine and was a five-place machine. Model SR-8DS, also five-place, had a 285 h.p. Wright Whirlwind engine. The last three were equipped with Hamilton Standard controllable propellers. The Reliant models had a stated cruising speed of 140 m.p.h. The standard equipment included full cantilever landing gear, dual controls, brakes, safety glass, and motor car width cabin. The cabin, as a freighter, was metal-lined.

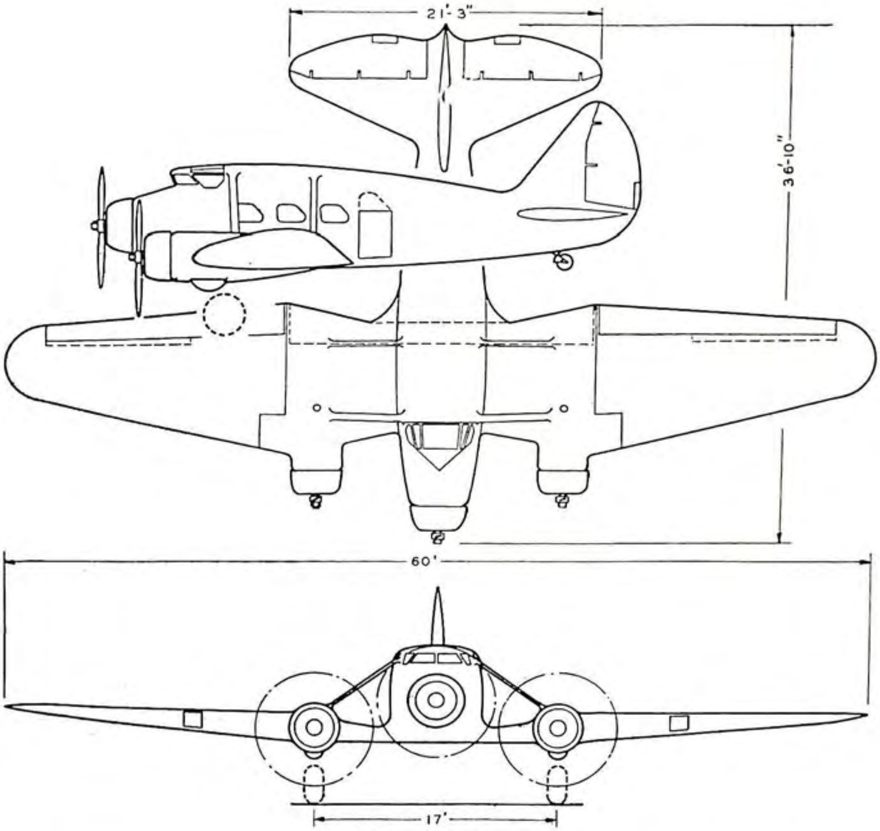
Stinson expanded its distributor system, adding many prominent



STINSON RELIANT

This four-five place plane has either a Lycoming or Wright Whirlwind engine.

THE STINSON AIR LINER



STINSON MODEL A

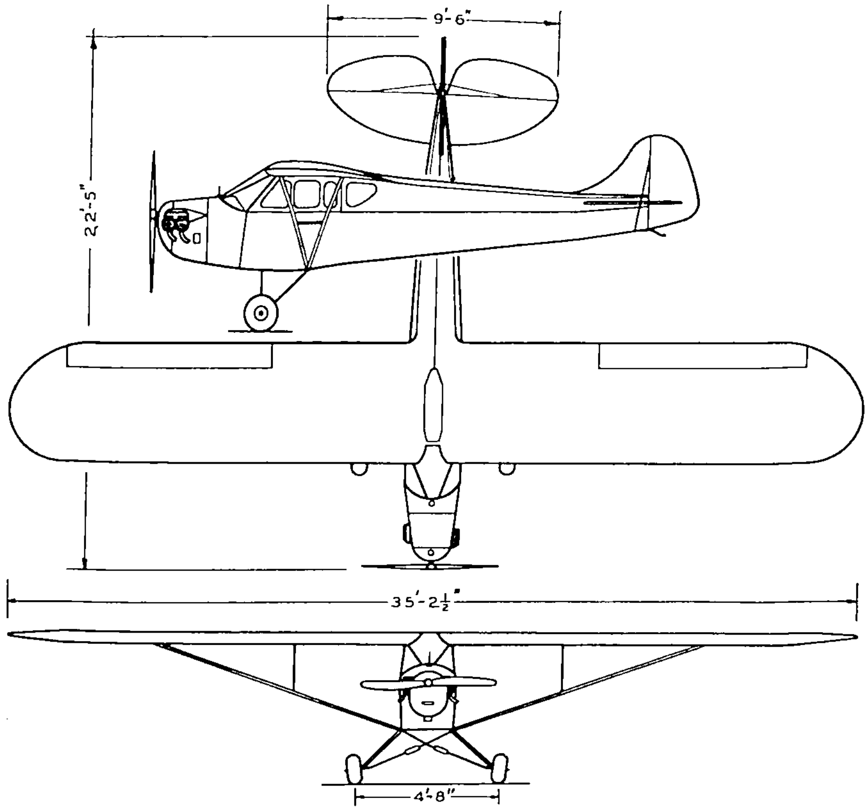
This 10-place transport is powered with three Lycoming engines.

firms as sales representatives. Reports showed that an increasing number of private owners want controllable propellers, two-way radio, gyro instruments and flaps. Growth of foreign sales throughout the world was reported by the company.

Swallow Airplane Company, Wichita, Kans., at the beginning of 1937 was developing a small high-wing cabin monoplane seating two, side-by-side, with a wing span of 36 feet eight inches. The first model was powered by a 125 Menasco C-4 and had a stated top speed of 140 m.p.h.

Taylor Aircraft Company, Bradford, Pa., reported 700 Taylor Cubs flying in the United States and foreign countries, 32 of which had Taylor distributors. Aircraft Associates, Long Beach, Calif., organized a branch to manufacture Cubs for the Pacific coast. A distributor placed an order for 62 Cubs at one time. The factory at Bradford was expanded to triple floor space and the number of employees doubled. Early in 1936 the company placed one order for 400 Continental A40-3 motors for Cub power plants; and then in July ordered 1,050 Continental A40-4 four-cylinder engines, rated 40 h.p. at 2,575 r.p.m. The company reported that standardization and mass production were the twin secrets of Cub sales. The machine sold

THE TAYLOR CUB
It is powered by a Continental motor.



TAYLOR CUB

A two-place plane for the private owner with a Continental 40 h.p. engine.

for $1,470 and used only two gallons of gasoline an hour, it was stated. It had a stated high speed of 80 m.p.h., cruising at 65 m.p.h. and landing at 30 m.p.h.

Taylorcraft Aviation Company, Alliance, O., in 1936 produced its first model Taylorcraft under the supervision of C. G. Taylor. The new model was placed in production for 10 planes a week beginning in April, 1937. It was a two-place, dual control, high-wing cabin monoplane, powered with a Continental A-40-4 engine, a stated cruising speed of 80 m.p.h., climb of 400 feet a minute, take-off run 425 feet and landing speed of 35 m.p.h.

Chance Vought Aircraft, East Hartford, Conn., a division of United Aircraft Corporation, completed 19 years as a manufacturer of high performance military aircraft for the United States Government and many foreign countries. It continued to produce the SBU-1 scout-bomber, 84 of which were delivered to the Navy for service aboard the aircraft carriers. Two new models were developed. Both, in contrast to former Vought practice, were low-wing monoplanes, model XSB2U-1 being a scout-bomber land plane for carrier deck operation and model V-143 an all metal single-seat fighter.

The SBU-1 Vought Corsair was a two-seat scout-bomber, fitted with a 700 h.p. Pratt & Whitney Twin Wasp Junior geared engine, the flapped N. A. C. A. cowl developed by United Aircraft, and a two-blade Hamilton Standard controllable propeller. It was of metal construction with fabric covering on wings, fuselage, and movable tail surfaces. It had tapered wings equipped with split flaps under the lower panel and was designed to combine the scouting and bombing functions hitherto carried out by two distinct types of aircraft.

The Vought model XSB2U-1 was a low-wing scout-bomber land plane, powered by a Pratt & Whitney Twin Wasp Junior engine and a Hamilton Standard controllable propeller. Its structure was composed of metal, with fabric covering on the movable tail surfaces and

THE TAYLORCRAFT

A light plane developed by the Taylorcraft company at Alliance, O. It is powered by a Continental A-40-4 engine.

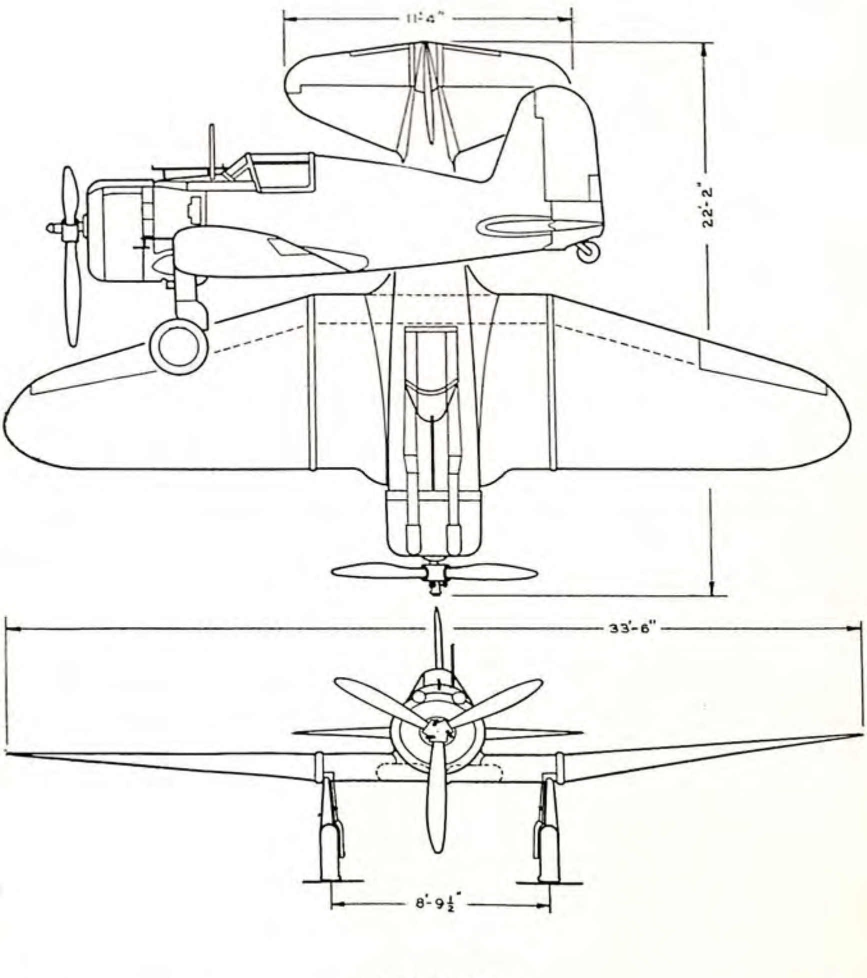
A SINGLE-SEAT FIGHTER

One of the latest Vought combat machines, Model V-143 is an all metal, low-wing monoplane, powered by either a 525 h.p. Wasp Junior or a 700 h.p. Twin Wasp Junior engine.

on the after portions of wing and fuselage. The landing gear was retractile, with the wheels folding into recesses in the wings. Following tests of the experimental airplane, the U. S. Navy ordered 54 airplanes of that type.

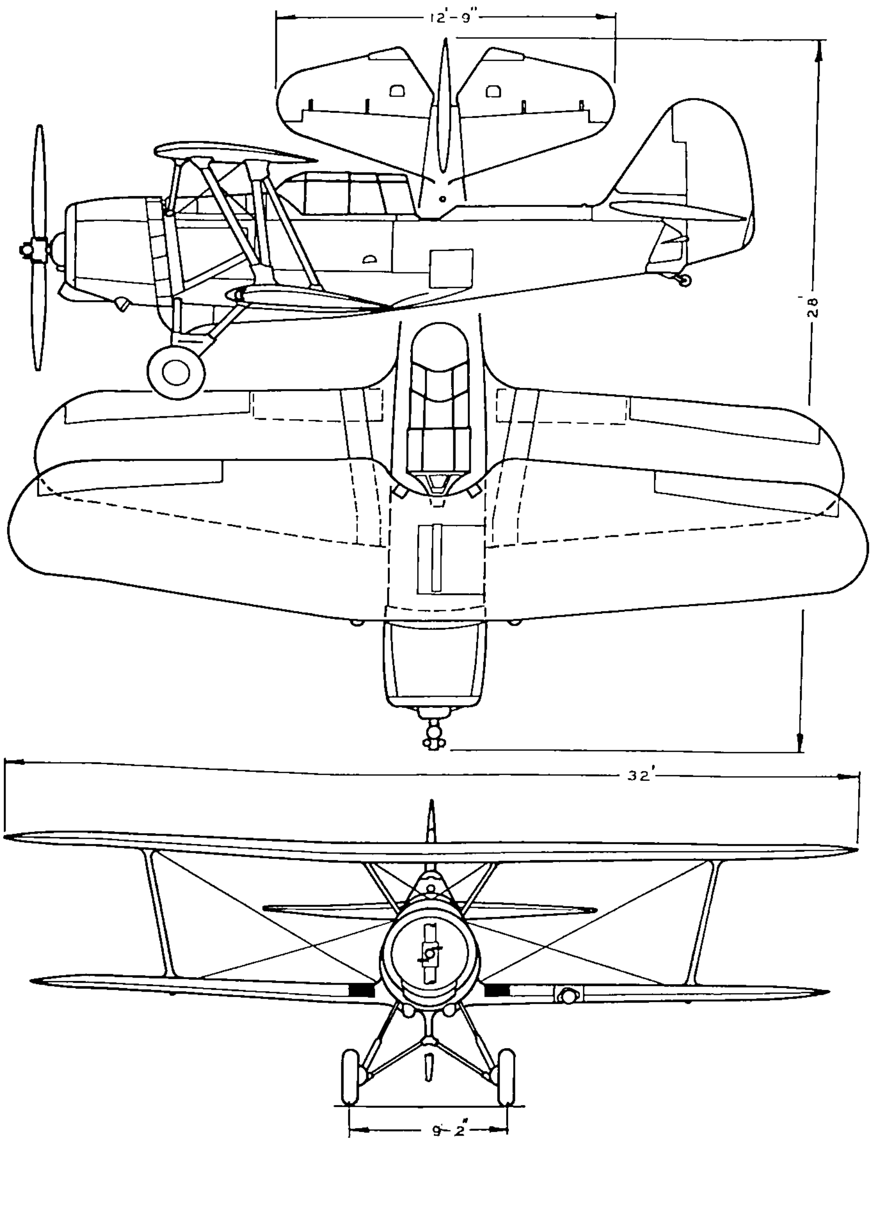
The Vought Model V-143 was a low-wing single-seat fighter of all metal construction and high performance, developed from original designs of the Northrop Corporation. As tested by the Materiel Division, U. S. Army Air Corps, it was equipped with the 14-cylinder 750 h.p. Twin Wasp Junior engine. An alternative power plant installation of the new nine-cylinder Wasp Junior engine developing 525 h.p. at 8,000 feet was also available. With that engine, the airplane was designated model V-150 with a stated top speed of 250 m.p.h., landing at 60 m.p.h., and range of 1,070 miles, cruising at 186 m.p.h.

Vultee Aircraft Division of the Aviation Manufacturing Corporation, Glendale, Calif., in 1936, made deliveries on its single-engine transport plane, with a stated cruising speed of 205 m.p.h. carrying eight passengers and two pilots. The Vultee V-1A was an all metal single-engine low-wing cantilever monoplane with split trailing edge type wing flaps, and was designed as a high speed transport for regular service or as an executive's plane. It was equipped with the Wright Cyclone engine, and had fuel capacity for 1,000 miles of cruising. It was flown at a high speed of 225 m.p.h., landing at 63 m.p.h. As an air-liner the Vultee seated eight passengers two abreast, with a wide aisle between, each chair with individual ventilators, heaters, reading lights, ash trays and foot rests. The cabin contained running ice water. A rear compartment held a fully equipped lavatory. The baggage room and radio installation were in the rear. The cantilever wing was faired into the fuselage. The wheels retracted flush with the bottom surface of the wing. The fuselage was of monocoque type, without longi-



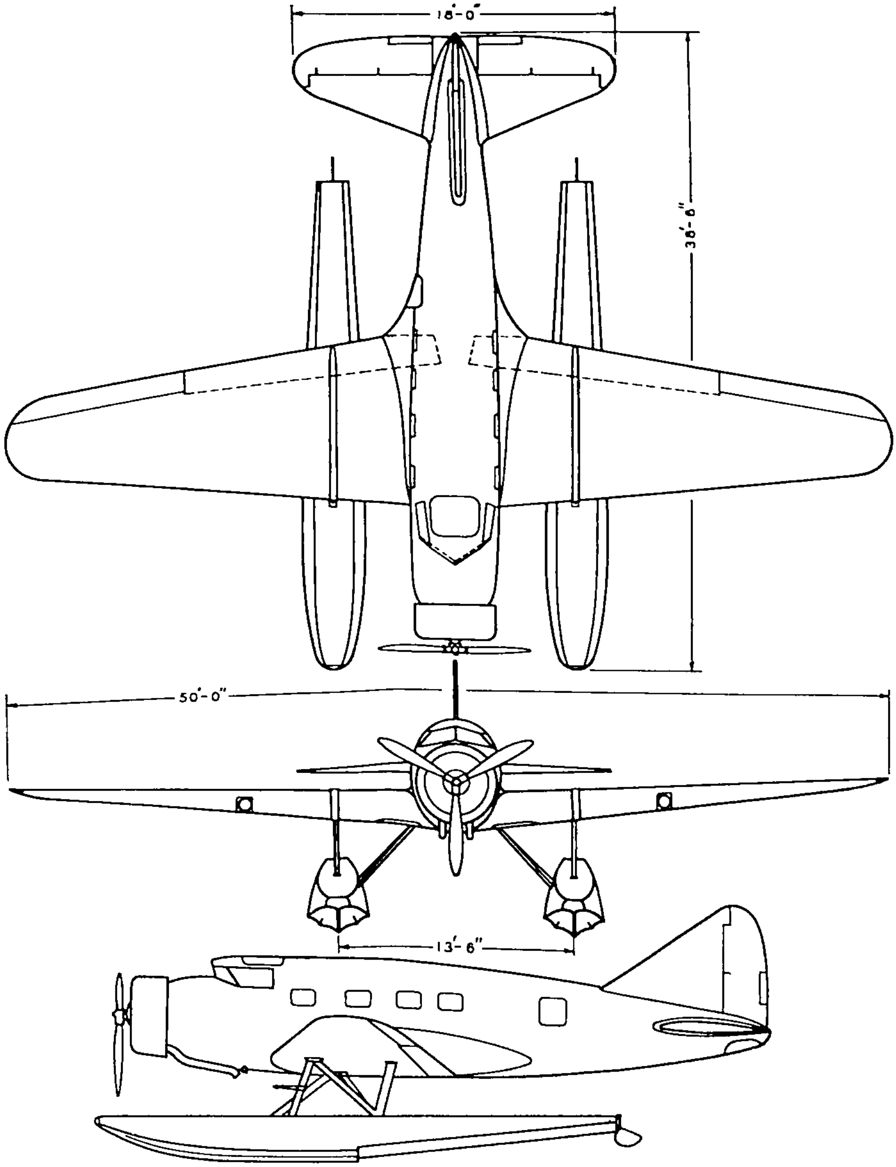
VOUGHT V-143

A single-seat fighter with a 750 h.p. Pratt & Whitney Twin Wasp Junior engine.



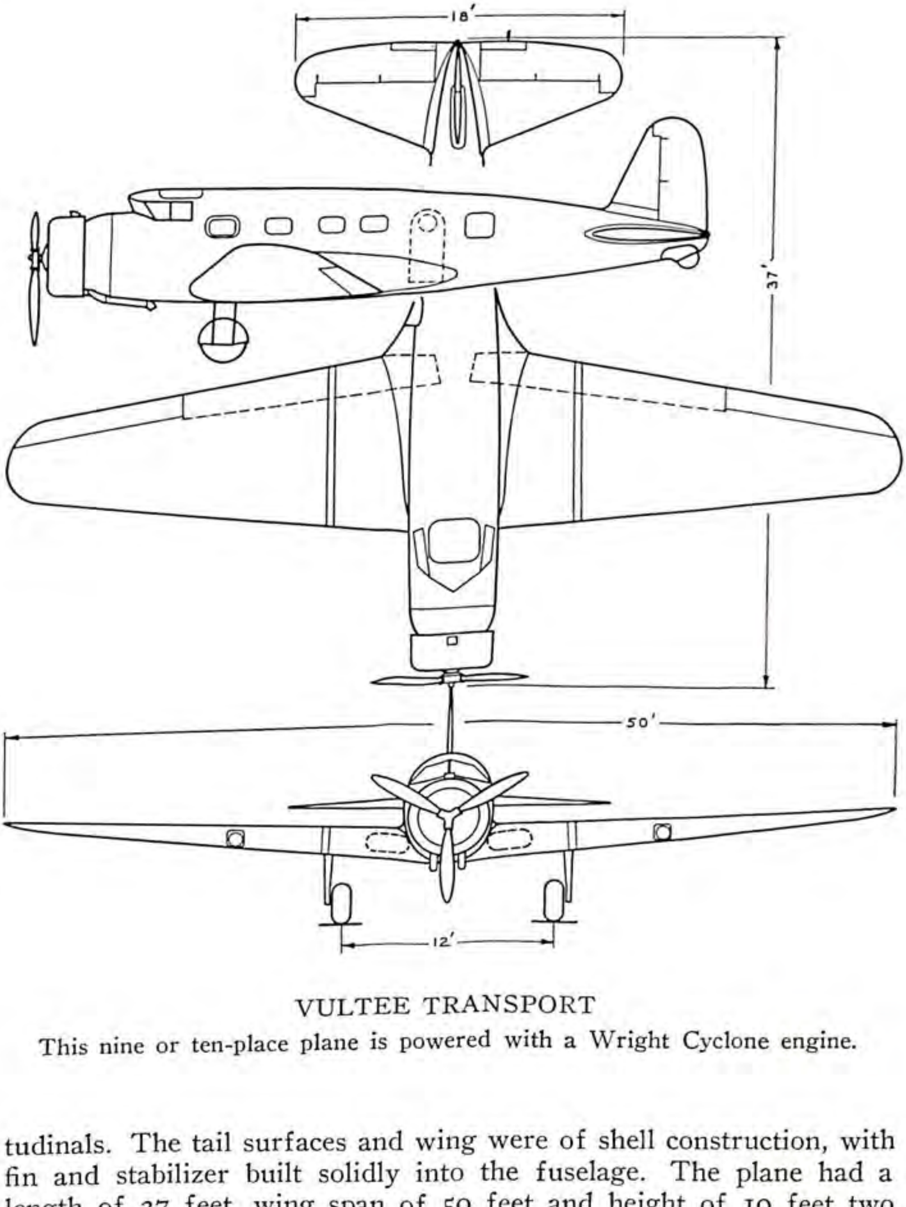
VOUGHT CORSAIR SBU-1

A two-seat scout-bomber with a Pratt & Whitney Twin Wasp Junior engine.



VULTEE V-1AS TRANSPORT

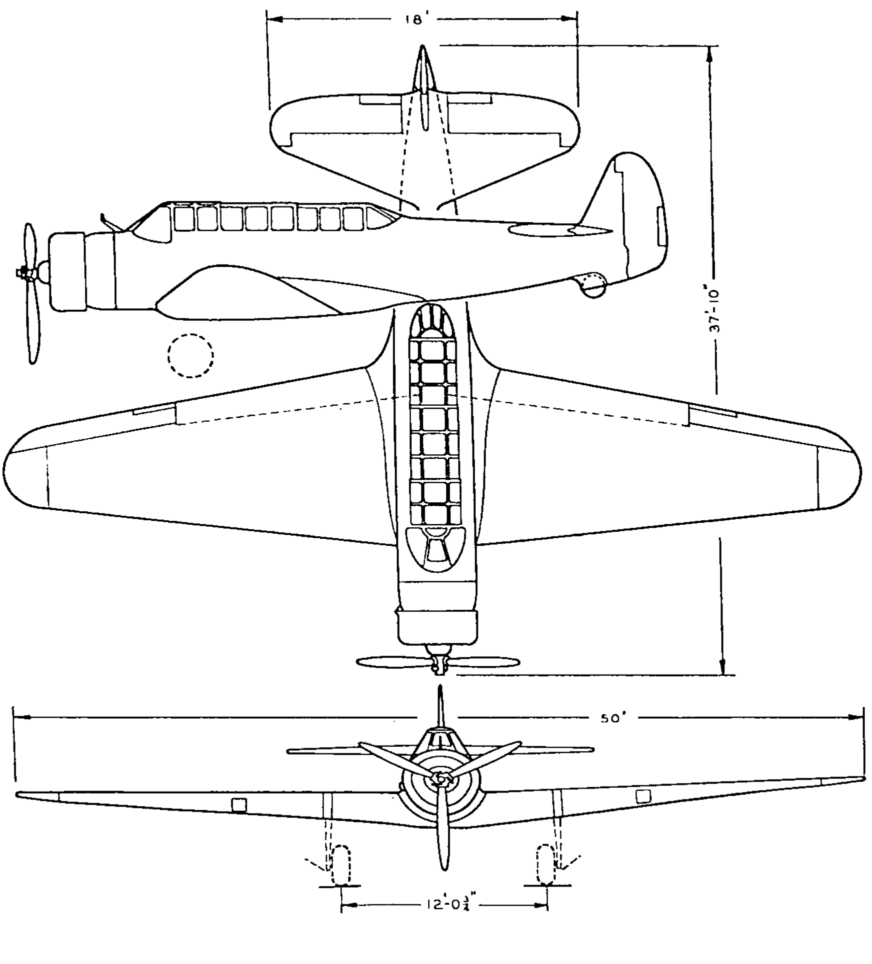
This single-engine transport carries ten, and is powered with a Wright Cyclone engine.



VULTEE TRANSPORT

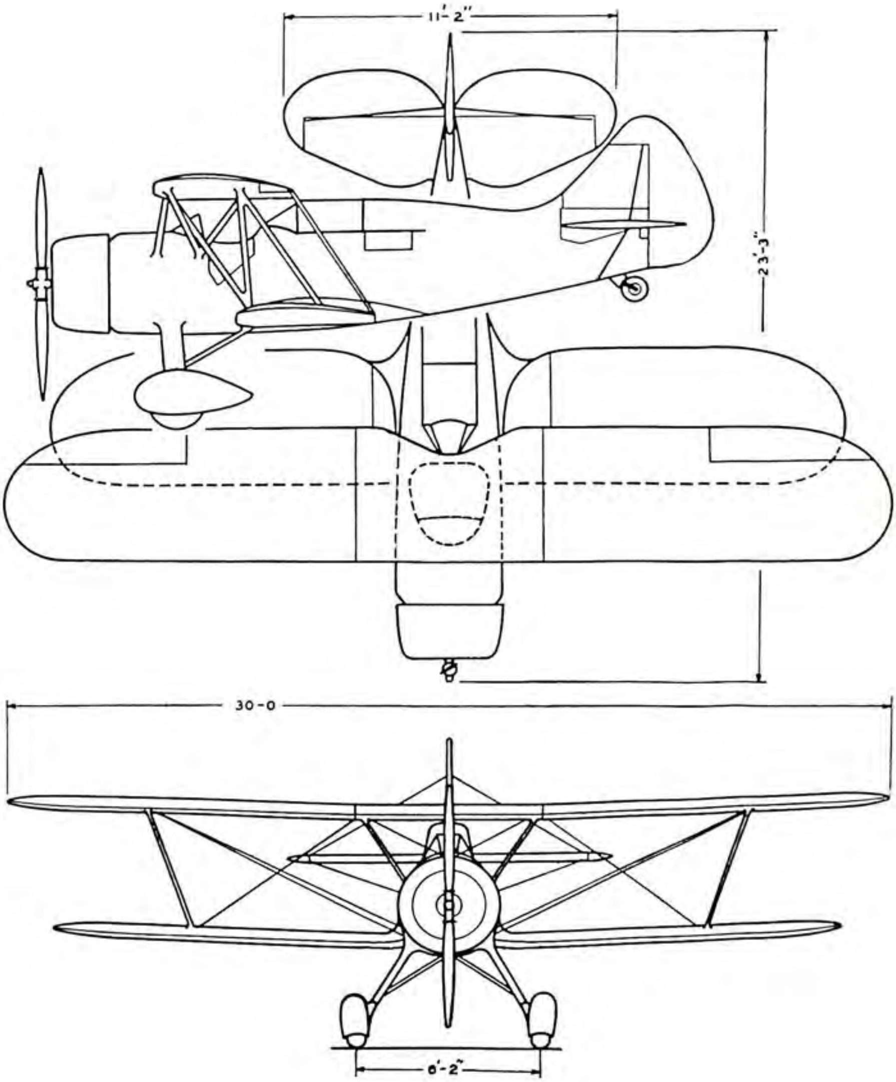
This nine or ten-place plane is powered with a Wright Cyclone engine.

tudinals. The tail surfaces and wing were of shell construction, with fin and stabilizer built solidly into the fuselage. The plane had a length of 37 feet, wing span of 50 feet and height of 10 feet two inches. Its weight empty was 1,236 pounds, its full fuel load 5,457 pounds, payload 1,810 pounds and gross weight 8,500 pounds, with an absolute ceiling of 20,000 feet. Another model was the Vultee attack bomber, V-11, an all metal, low-wing monoplane, with retractible landing gear, for high performance military service. Tandem cockpits under a transparent canopy provided good vision and protection for the pilot and the gunner. Armament included four fixed machine guns, a flexible gun and both internal and external bomb racks for a total bomb load of 1,135 pounds. The fuselage was of monocoque construction without longitudinals. It was 37 feet 10 inches long. The wing span was 50 feet, height 10 feet, weight empty 5,512 pounds, gross weight 8,500 pounds and useful load as an attack



VULTEE ATTACK BOMBER V-11

This two-place attack bomber is powered with a Wright Cyclone F-53 engine.



WACO F-6

A three-place plane for the private flyer powered with a Jacobs engine.

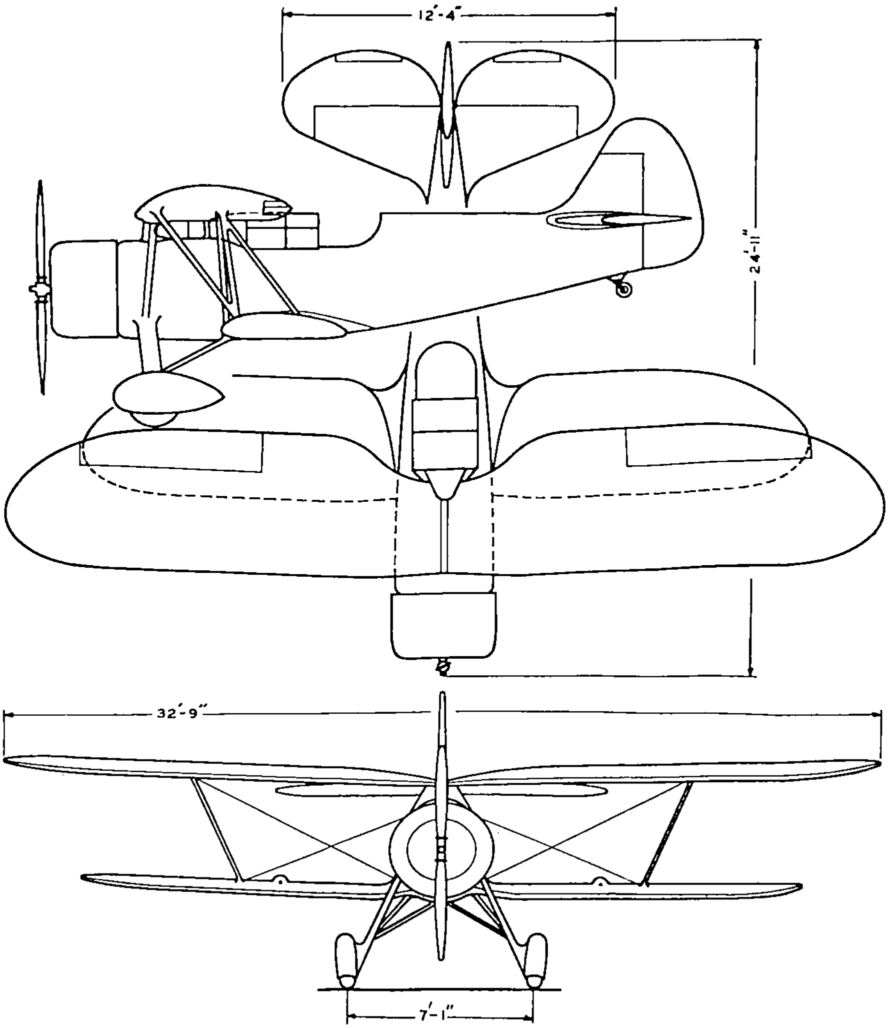
WACO SPORT BIPLANE

This open or closed two-place machine is powered with a Continental, Jacobs or Wright Whirlwind engine.

plane 2,988 pounds. As a bomber the gross weight was 10,800 pounds, useful load 5,288 pounds. Powered with a single Wright Cyclone F-53 engine the Model V-11 had a stated high speed of 230 m.p.h. at 11,000 feet, cruising at 210 m.p.h. at 20,700 feet, service ceiling 24,000 feet, absolute ceiling 26,000 feet, range as an attack plane 900 miles, as a bomber 2,200 miles; landing speed 65 m.p.h.

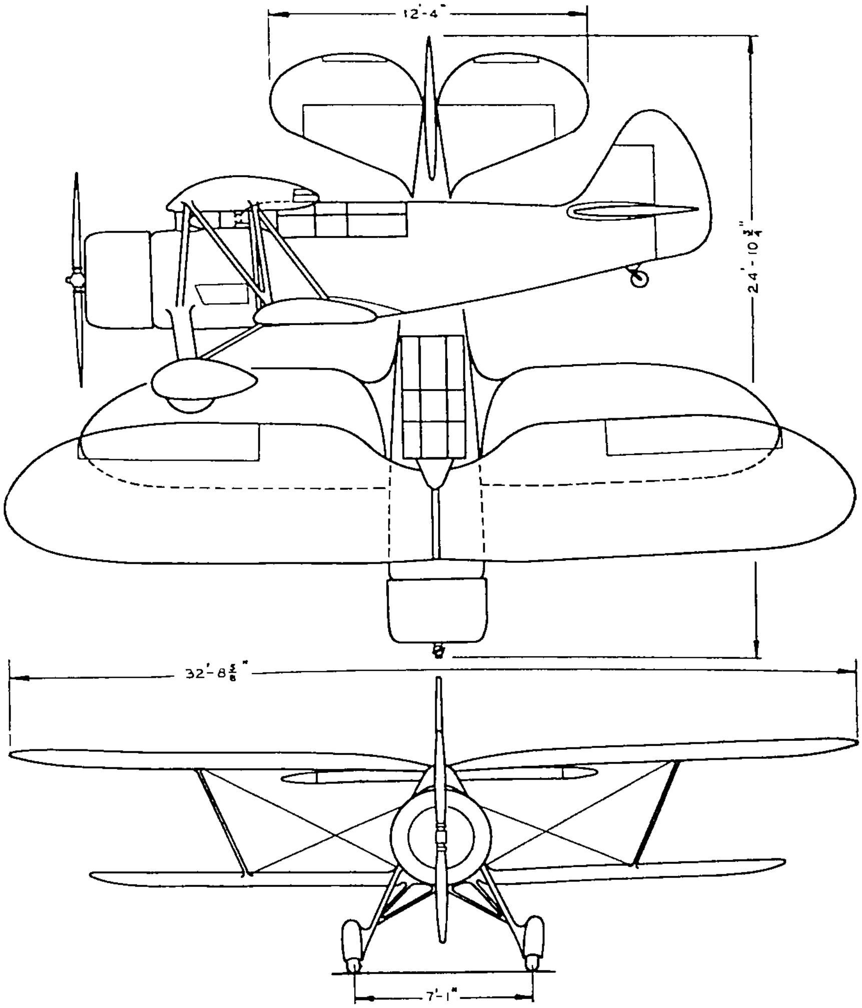
Waco Aircraft Company, Troy, O., in reporting on 1936 activities comments on the addition of three new foreign fields, making a total of 31 countries abroad where the Waco models are in commercial or military use, or both. An increase in domestic sales was reported. They were divided between sportsman pilots and industrial and commercial firms in other lines using airplanes for executive and sales travel. Waco produced two series of cabins and two series of open planes. Both of the cabins were four-five place and represented two distinct price ranges. The lower-priced cabin plane was offered with either the 225 h.p. or the 285 h.p. Jacobs engine. It was designed to appeal to charter operators and business concerns interested in low first cost and low operating costs. The other cabin plane was classified as the deluxe member of the line, offering greater comfort, speed and refinement, every effort being made to build appeal for the sportsman pilot class. It had a selection of the two Jacobs power plants, the Continental 225-240 h.p. engine, or the Wright seven-cylinder Whirlwind series in 250, 285, or 320 h.p.

In its open line the company produced a three-place model, the



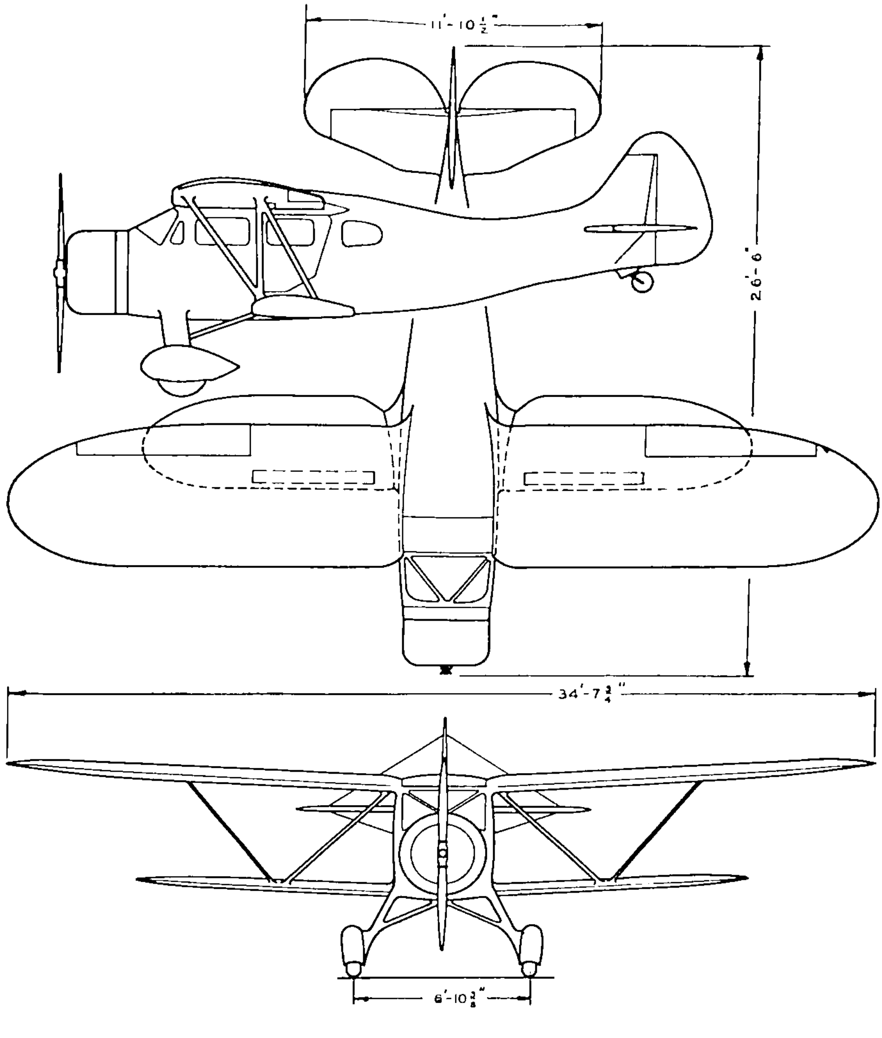
WACO DA-6

This two-place military plane is powered with either a Wright Whirlwind or a Pratt & Whitney Wasp Junior.



WACO D-6

This two-place sport plane is powered with either a Wright Whirlwind or a Pratt & Whitney Wasp Junior.

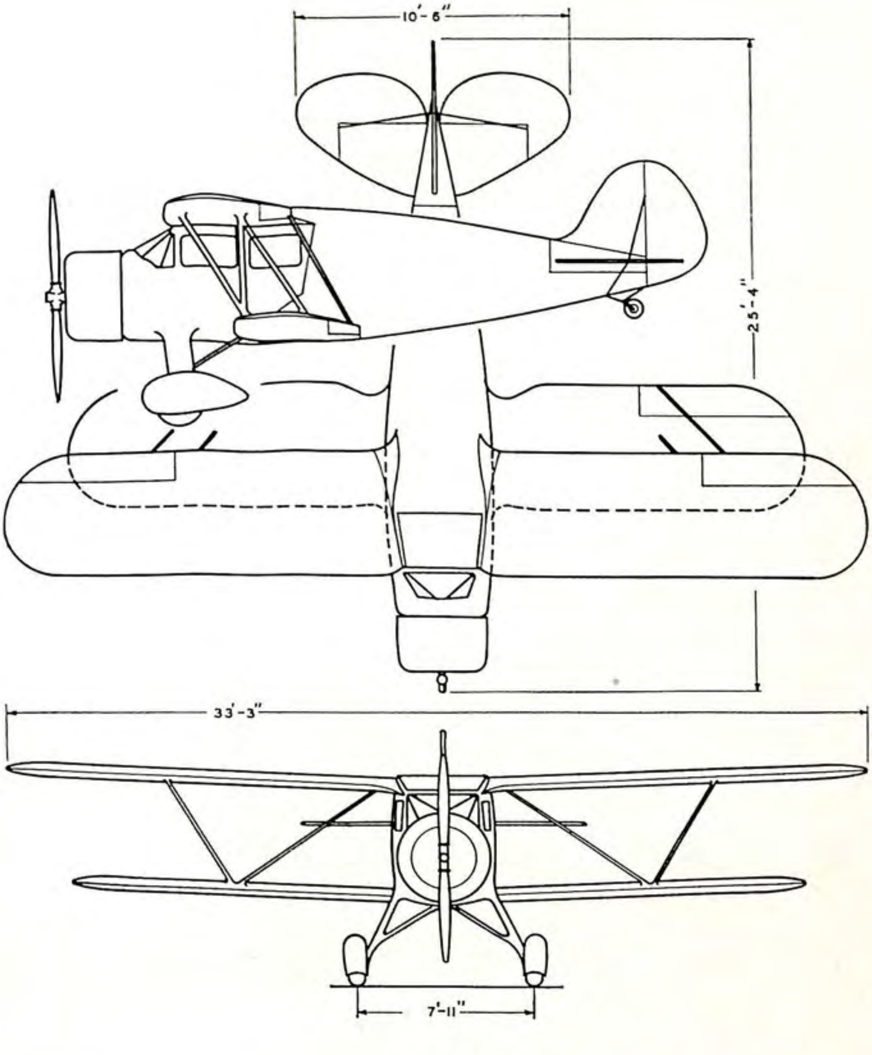


WACO C-6

This four-five place cabin plane offers a choice of power plants including Jacobs, Continental and Wright Whirlwind engines.

F-6 open-closed biplane. The front cockpit was open when occupied, but could be provided with a removable windshield and flush-type cover for pilot operation. The rear pilot's cockpit had a sliding type enclosure for open or closed position during flight. It had the same selection of power plant as the higher-priced cabin plane with the exception of the 320 h.p. Whirlwind.

The fourth Waco model was the D-6, a two-place super-sport biplane in the higher power class, likewise of the open-closed type. Pilot and passenger were seated in tandem, both cockpits enclosed; and both enclosures could be left open in flight. It had the nine-cylinder Wright Whirlwind engine, either 330 or 420 h.p. and the nine-



WACO S-6

A Jacobs-powered cabin plane designed to carry either four or five persons.

cylinder Pratt & Whitney Wasp Junior engine in comparable power ranges. The DA-6 was a military version of the D-6.

In the lower-priced cabin, the S-6, cruising speeds ranged at best altitude from 130 to 140 m.p.h. In the C-6, the deluxe model, cruising speed ranged from 140 to 171 m.p.h. In the F-6, cruising speeds were from 131 to 152 m.p.h., and in the D-6 from 152 to 184 m.p.h.

Both cabin models were offered with a specially designed ambulance equipment to permit carrying a patient and two attendants in addition to the pilot. The C-6 was also offered with an interesting variation as a freighter. So equipped, it was metal and wood-lined to the window line. The rear seat cushions were quickly removable, the rear seat-back could be flattened to the floor, and the customary baggage compartment was eliminated, so that the entire rear seat compartment, plus the baggage compartment, combined to make a sizable freight compartment. An especially large loading door was provided. The freighter model in ambulance service carried pilot, attendant and two patients on litters.

For 1937 the Waco Aircraft Company produced several new models of its single-engine cabin biplane types for private owners. Their specifications are listed in the table at the front of this chapter.

Waterman Arrowplane Corporation, Santa Monica, Calif., reported that it was developing a new ship to the design of Waldo D. Waterman.

THEY DESIGNED THIS SHIP

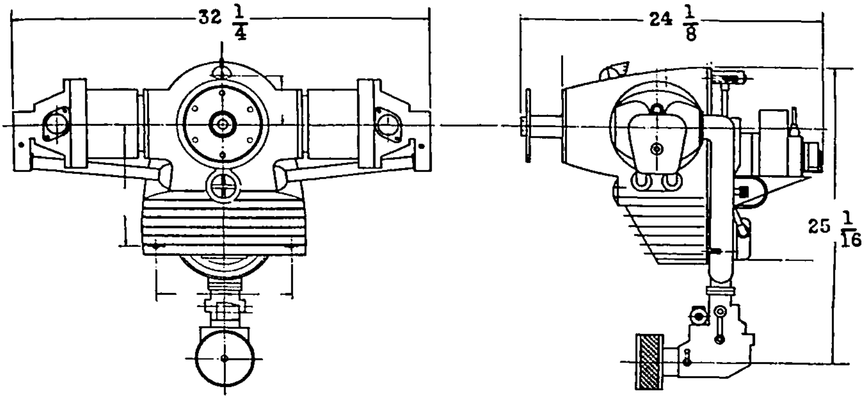
Leon A. Atwood and Leland S. Miles with their Menasco-powered racer which was built by Lawrence W. Brown.

Manufacturers of Engines

Aeronautical Corporation of America, Cincinnati, O., manufactured the Aeronca E-113C engine, a two-cylinder, horizontally opposed motor with a piston displacement of 113.5 cubic inches, bore 4.25 inches and stroke four inches. The compression ratio was 5.4 and the weight, including hub, was 121 pounds. Its official rating was 36 h.p. at 2,400 r.p.m.

Allison Engineering Company, Indianapolis, Ind., a division of General Motors Corporation, continued development work on a series of high-powered, liquid-cooled 12-cylinder V-type engines.

Continental Motors Corporation, Detroit, Mich., produced two models of aircraft engines. Model A-40 was produced in four series—2, 3, 4 and 5. The first two were rated 37 h.p. at 2,550 r.p.m. The latter two were rated 40 h.p. at 2,575 r.p.m. Model W-670 was a seven-



AERONCA C-113E

This is a two-cylinder, opposed, aircooled engine rated at 36 h.p.

cylinder radial with ratings of from 225 h.p. at 2,175 r.p.m. to 250 h.p. at 2,200 r.p.m. Model A-40 could be supplied with single or dual ignition. Model W-670 was offered with carburetor or fuel injector.

Jacobs Aircraft Engine Company, Pottstown, Pa., continued the production of its Models L-4 and L-4M, seven-cylinder, aircooled radial engines, rated at 225 h.p. at 2,000 r.p.m. at sea level, and introduced a new series, Models L-5 and L-5M, rated at 285 h.p. at 2,000 r.p.m. at sea level. Production during the year was about evenly divided between the two series, which powered the majority of Waco and Beechcraft four- and five-place cabin planes sold during the year; and which were standard equipment in several new designs introduced by other companies in 1936. The L-4MA, a special adaptation of the

L-4M model, powered the Kellett autogiros, purchased by the U. S. Army. The Jacobs L-5 was a seven-cylinder, aircooled radial type, similar in design to the L-4, except for the main crank case, which was of the two-piece type, bolted at the center line of the cylinders, carrying the front intermediate bearing in the front half. The front half of the

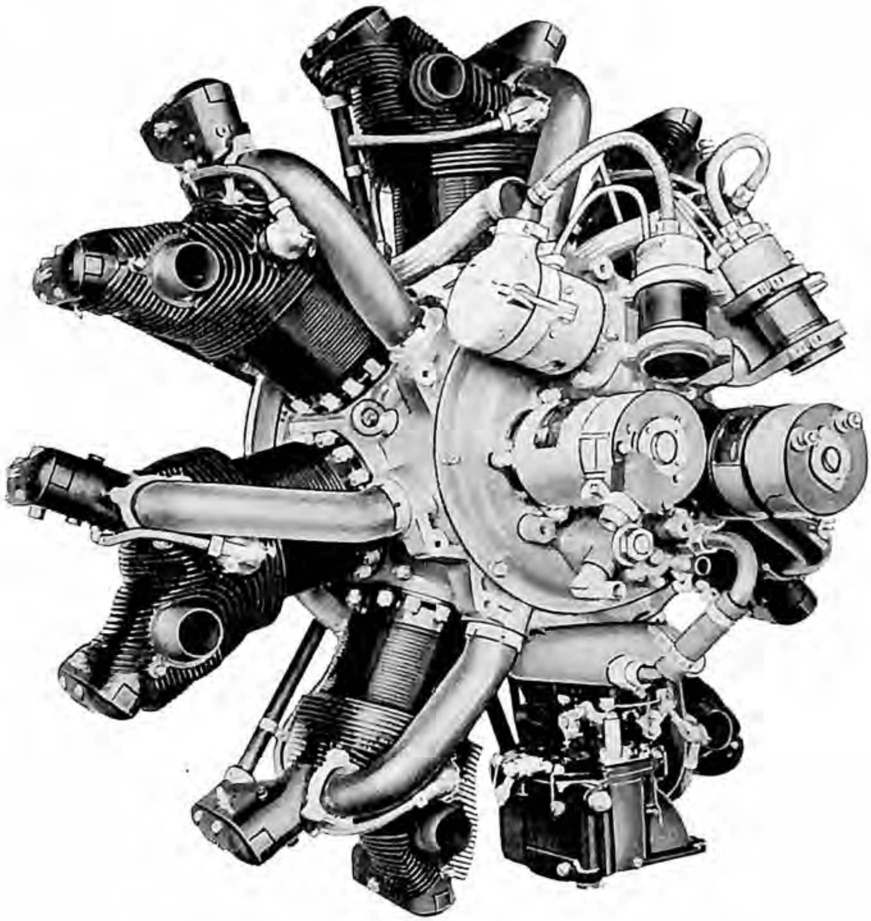
THE CONTINENTAL W-670

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.

case was an aluminum casting, while the rear half was of magnesium alloy. Compression ratio was six to one, using ordinary aviation grade gasoline of 73 octane rating. Scintilla or Bosch double battery ignition and an Eclipse 15 ampere generator were standard equipment on the L-5 model. The dry weight of the L-5 was 475 pounds with complete equipment, including generator, giving the unusually low ratio for that power class of 1.66 pounds per h.p. The L-5M, with Scintilla mag-

THE JACOBS L-4

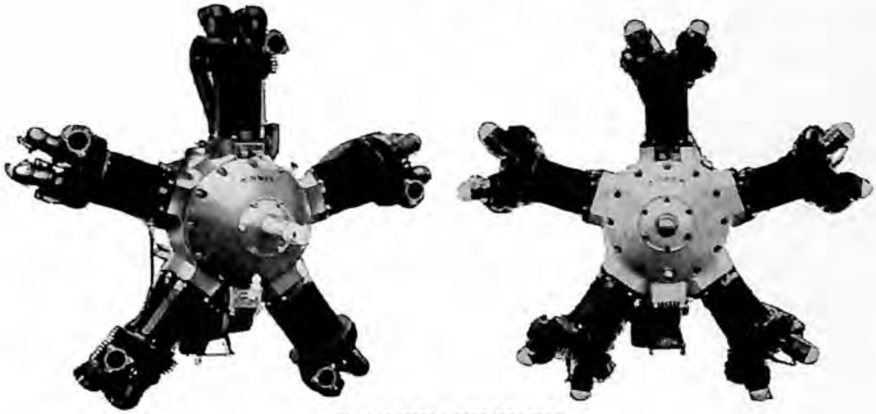
A seven-cylinder, radial, aircooled engine rated at 225 h.p.



THE JACOBS L-5
This seven-cylinder radial engine is rated at 285 h.p.

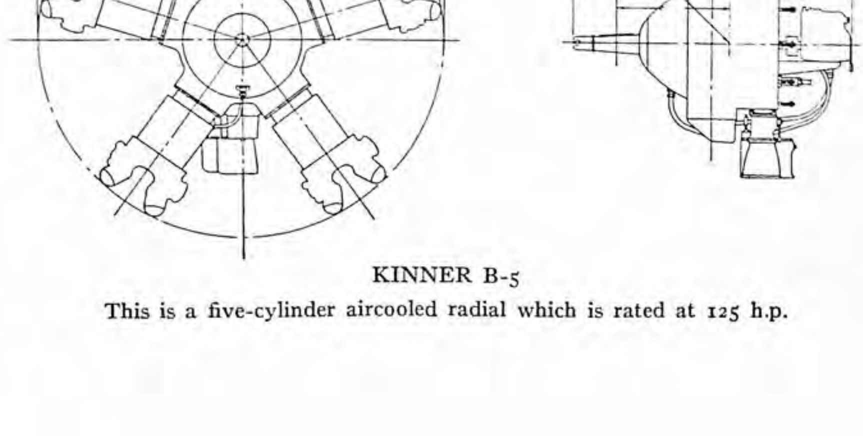
neto ignition, was slightly heavier. All Jacobs engines had forged aluminum pistons and sodium filled Thompson exhaust valves, and magnesium castings were used wherever practicable. All models were equipped for installation of direct electric starter, Breeze radio shielding and all types of propellers, including hydraulic controllable pitch.

Kinner Airplane & Motor Corporation, Ltd., Glendale, Calif., at the beginning of 1937 was producing its series 2 R-5 radial to give



KINNER ENGINES
Kinner K-5, 100 horsepower (left); Kinner B-5, 125 horsepower (right).

160 h.p. at 1,850 r.p.m. at a weight of 315 pounds. Kinner had completed supercharging its model C-7, normally 300 h.p., to develop 350 h.p. at 1,800 r.p.m. at 5,000 feet, 420 h.p. at 2,200 r.p.m. at 5,000 feet and 460 h.p. at 2,400 r.p.m. at 5,000 feet. The supercharger was of General Electric centrifugal blower type with diffuser plate, driven by a train gear equalized for tooth load and balanced to eliminate radial load on impeller bearings, with springs to relieve stress on

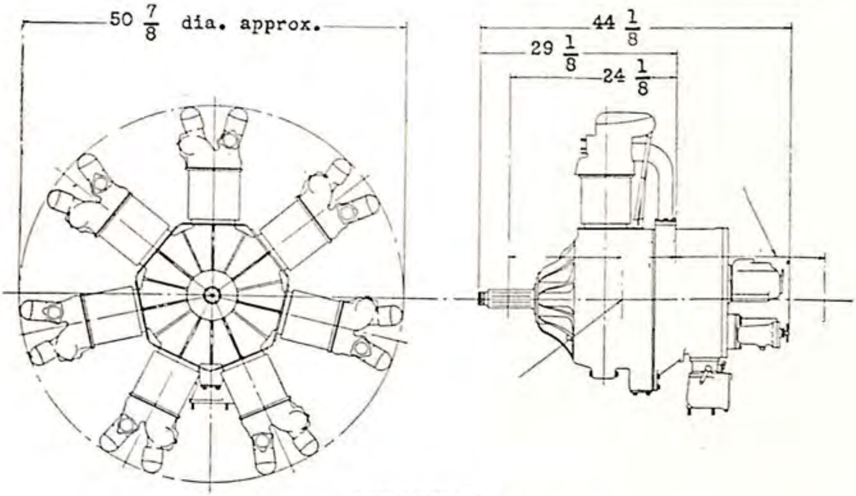


KINNER B-5
This is a five-cylinder aircooled radial which is rated at 125 h.p.

THE KELLETT AUTOGIRO

This wingless, direct control autogiro, the YG-1, is powered with a 225 h.p. Jacobs engine. It was built for the Air Corps.

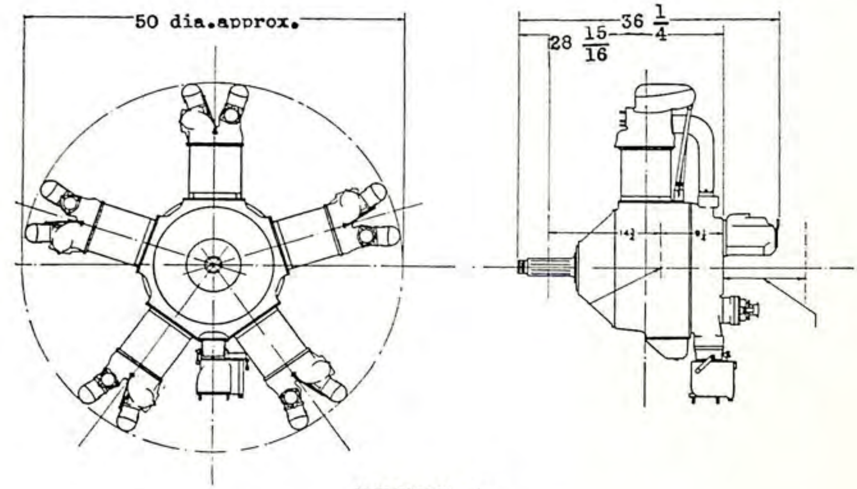
gear train. Auxiliary drives were provided for two magnetos, electric starter, electric generator, fuel pump, vacuum pump, two gun synchronizers and tachometer. Accessories were not run through the supercharger chamber but were driven from an extension of the crankshaft. Among other Kinner products were the B-5, five cylinders, weighing 295 pounds dry with rated 125 h.p. at 1,925 r.p.m., had special bronze valve seats shrunk and rolled into place, with two Scintilla magnetos as standard accessories. The rear exhaust type cylinder head had much closer and longer fins than those formerly used, and increased angle between valves. Battery ignition could be used on the B-5. The C-7, seven cylinders with rated 300 h.p. at 1,800 r.p.m., providing for battery ignition if desired, was designed to meet the demand for an all-purpose motor in that power class. It was suitable for military planes or four- to six-place transports for any use. The C-5, five cylinders, had a rated 210 h.p. at 1,900 r.p.m., weighed 420 pounds, or two pounds per horsepower, and also



KINNER C-7

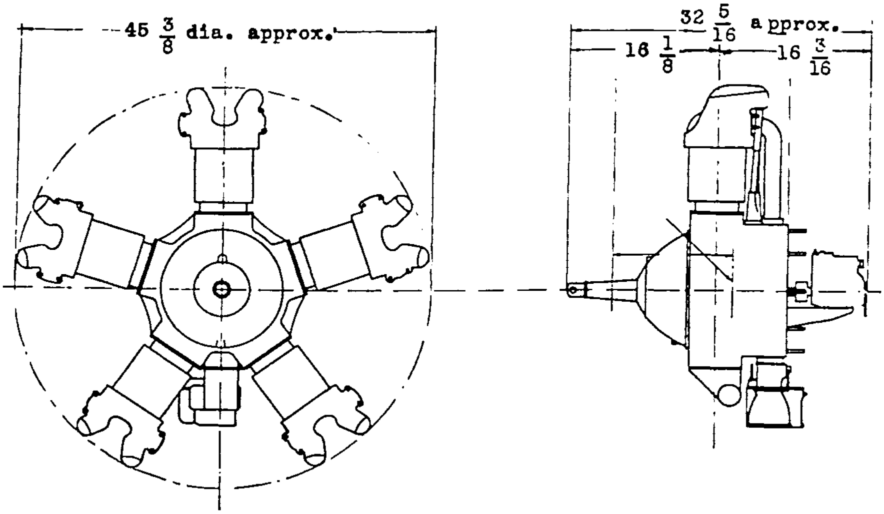
This seven-cylinder aircooled radial engine is rated at 300 h.p.

provided for battery ignition. The K-5, five cylinders, had an improved type of front exhaust cylinder head designed so that nose or front type collector ring could be used if desired. It also had improved exhaust valves and completely enclosed push rods and valve mechanism. It had a rated 100 h.p. at 1,810 r.p.m., weighing 275 pounds. The R-5, five cylinders, was also equipped with rear exhaust cylinder head, provided for battery ignition and had a rated



KINNER C-5

This five-cylinder aircooled radial engine is rated at 210 h.p.

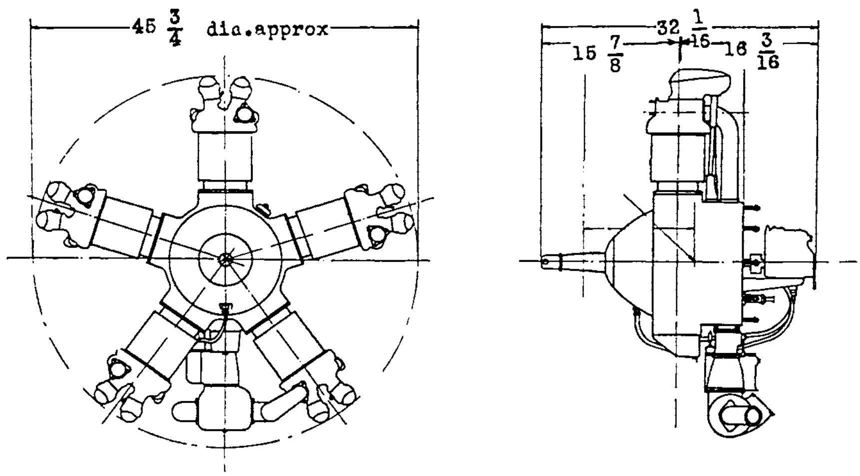


KINNER R-5

This five-cylinder aircooled radial engine is rated at 160 h.p.

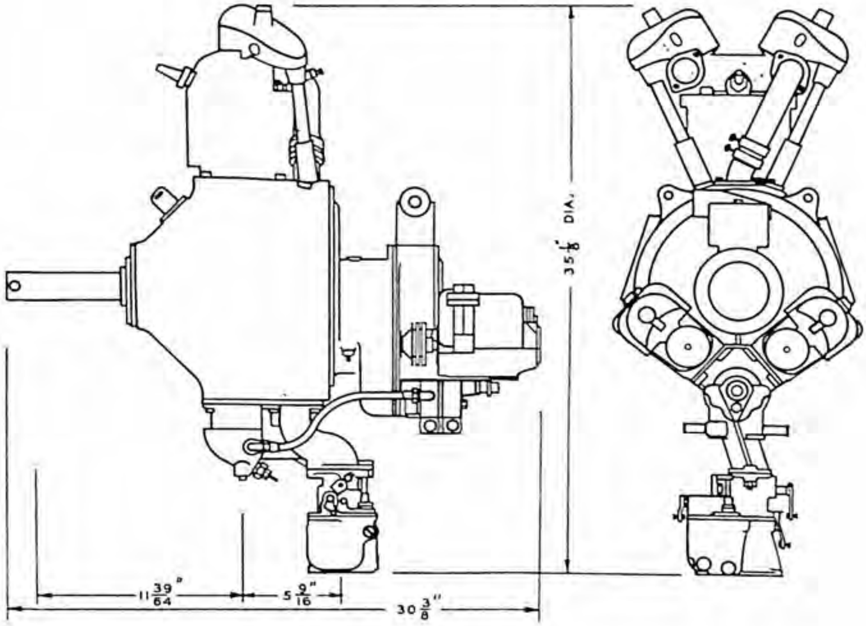
160 h.p. at 1,975 r.p.m. A new Kinner engine was the SC-7, a seven-cylinder radial aircooled motor developing 370 h.p. at 1,900 r.p.m. at 5,000 feet altitude. It weighed 650 pounds.

Lambert Engine & Machine Company, Moline, Ill., was producing the Lambert R-266-A radial aircooled engine rated at 90 h.p. at 2,375 r.p.m., and planned to increase the horsepower in 1937, pos-

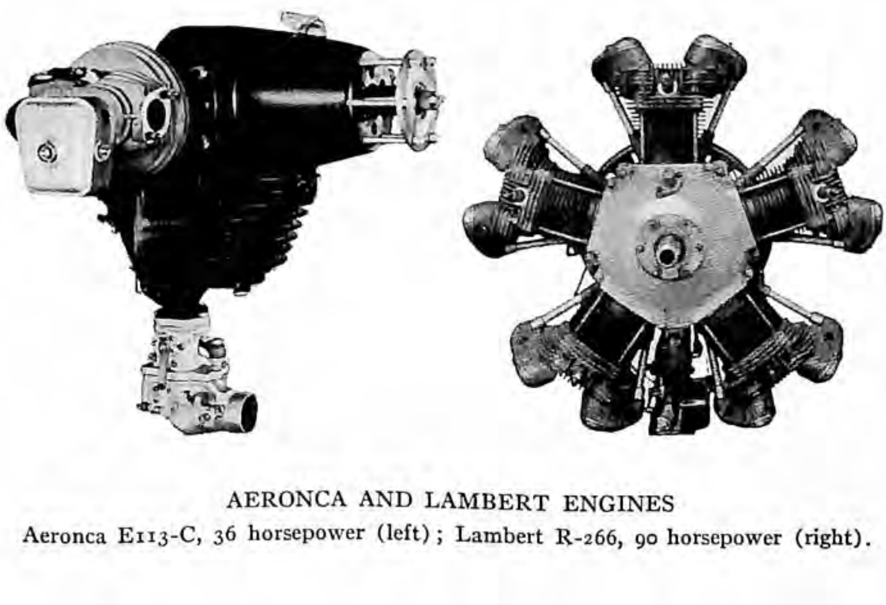


KINNER K-5

This five-cylinder aircooled radial engine delivers 100 h.p.

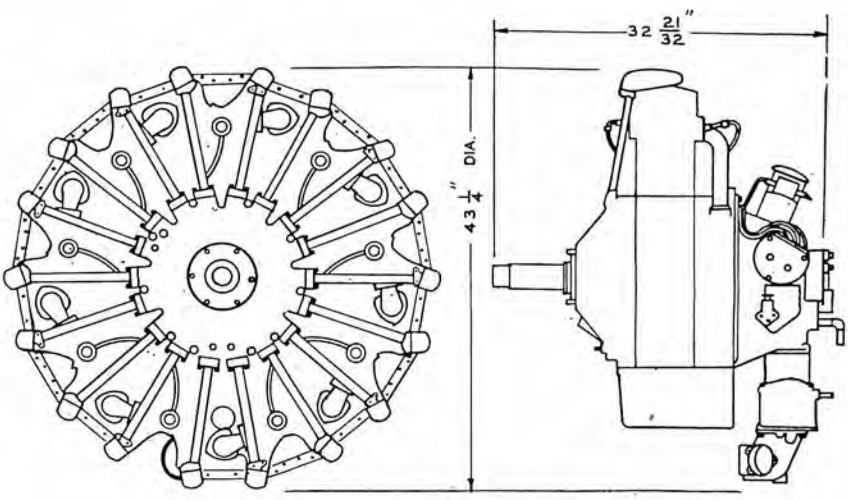


LAMBERT R-266
A five-cylinder aircooled radial engine rated at 90 h.p.



AERONCA AND LAMBERT ENGINES
Aeronca E113-C, 36 horsepower (left); Lambert R-266, 90 horsepower (right).

THE LAMBERT MONOCOUPE
A two-place cabin ship powered by a 90 h.p. Lambert engine.

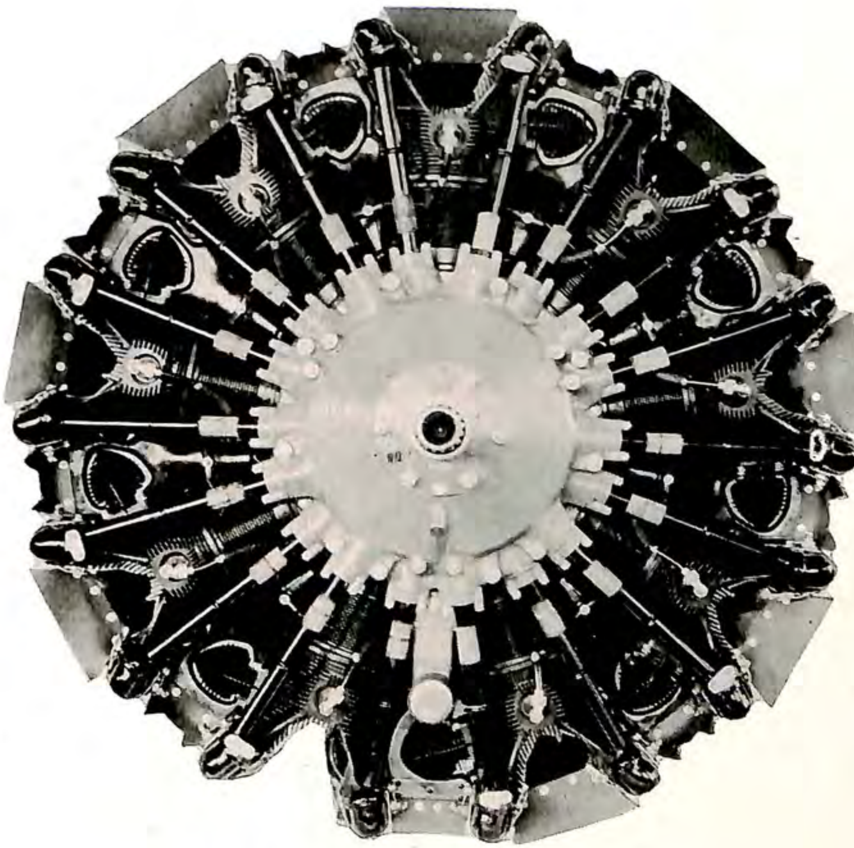


LYCOMING R-680
This radial, aircooled engine is rated at 200-260 h.p.

sibly by supercharging and gearing for the purpose of obtaining greater power output without too much increase in weight.

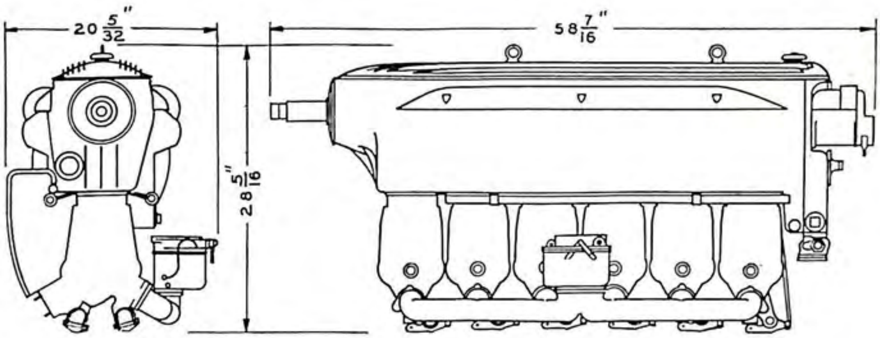
Lawrance Engineering & Research Corporation, Linden, N. J., continued its experimental development work on aircraft motors.

Lycoming division, Aviation Manufacturing Corporation, Williamsport, Pa., made this announcement: "On January 1, 1936, the assets and manufacturing rights of the aviation division of the Lycoming Manufacturing Company, Williamsport, Pa., were acquired by the Aviation Manufacturing Corporation, Chicago, Illinois. The Williamsport, Pa. plant is known as the Lycoming Division of the Aviation Manufacturing Corporation, and the manufacture and sale of



THE LYCOMING R-680 ENGINE

This nine-cylinder model has ratings of from 200 to 260 horsepower.



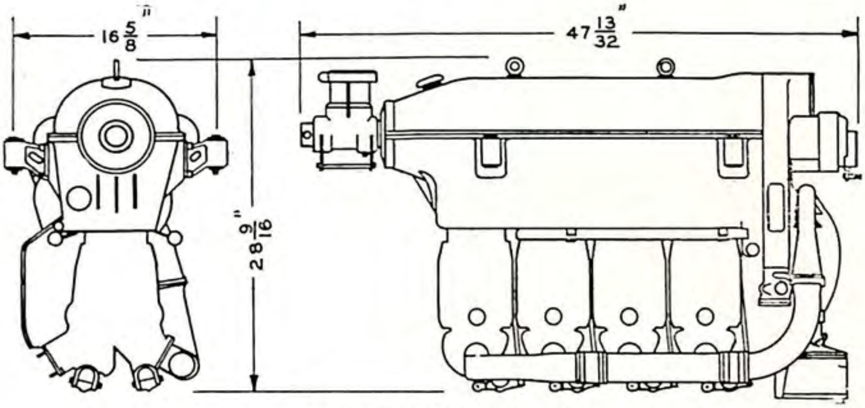
MENASCO B6 BUCCANEER

A six-cylinder inverted in-line aircooled engine developing 160 h.p.

the Lycoming aircraft engine and Lycoming-Smith controllable propeller is being conducted by the Lycoming Division, Williamsport, Pa. Production on the R-680 series radial engines was continued. The model designation, however, was changed to the R-680-B series engines. Lycoming engines, which range from 225 to 260 horsepower, are available with fuel pump, vacuum pump, generator drives and tachometer drive connection, hydro propeller control and individual radio shielding as optional equipment. Lycoming engines are being

THE CURTISS-WRIGHT COUPE

A two-place cabin low-wing monoplane, powered by a 90 h.p. Lambert engine.



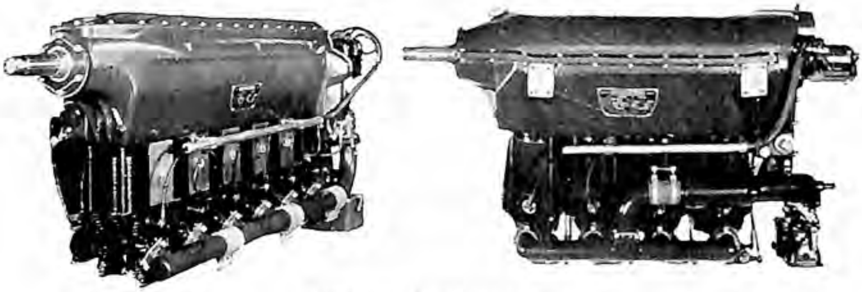
MENASCO C4S PIRATE

This is a four-cylinder inverted in-line aircooled supercharged engine rated at 150 h.p.

used commercially in private planes, on the air lines and in military training planes."

Menasco Manufacturing Company, Los Angeles, Calif., with eight years of practice building engines under the personal supervision of A. S. Menasco, one of the pioneers in inverted, in-line engine designing, at the beginning of 1937 was producing its line of inverted, in-line aircooled engines, ranging from four to six cylinders, supercharged and unsupercharged, and from 95 to 290 h.p. Models in production included the Pirate B4, four cylinders, 95 h.p.;

PORTERFIELD CABIN MONOPLANE



MENASCO ENGINES

Menasco B6S Buccaneer, 160 horsepower (left); B4 Pirate, 95 horsepower (right).

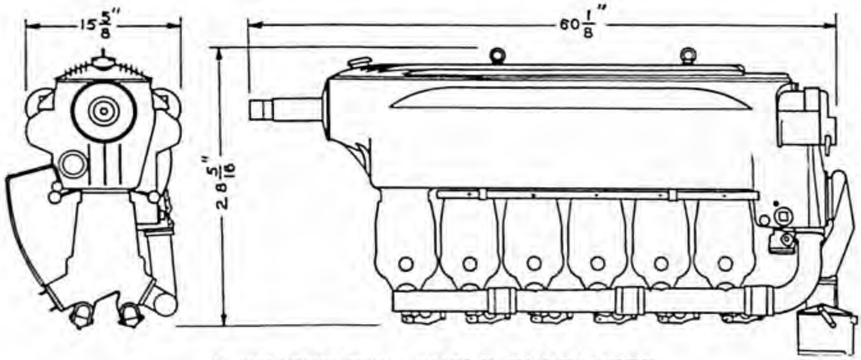
the Pirate C4, four cylinders, 125 h.p.; the Pirate C4S supercharged, 150 h.p.; the Buccaneer B6, six cylinder, 160 h.p.; the Buccaneer B6S supercharged, 200 h.p., and the new Super-Buccaneer C6S-4, 250 h.p. with 290 h.p. allowable maximum take-off rating.

The Menasco Company reported that its engine models were in common use throughout the world, and in England used as power plants in different Miles planes, one of which, the Miles Mohawk, was delivered to Col. Charles A. Lindbergh in 1936. Ryan, Stearman-Hammond, Swallow, Aero Engineering, Ben Jones and Argonaut were among the American types powered with Menasco engines. The company doubled its plant capacity and had a production schedule of 25 engines a month for 1937.

Menasco engines were popular in special light racing planes whose owners used them at power outbursts far in excess of their standard

ANOTHER LIGHT RACER

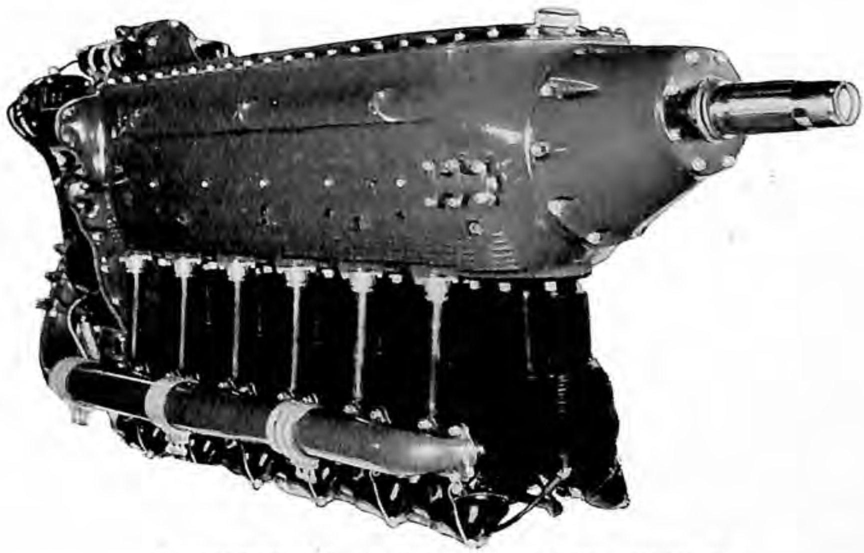
S. J. Whitman and his Menasco-powered monoplane.



MENASCO C6S-4 SUPER BUCCANEER

This six-cylinder inverted aircooled in-line type engine is rated at 250 h.p. with a maximum take-off rating of 290 h.p.

ratings. R. A. Kling made a light plane speed record over 100 kilometers with a Menasco-powered Rider racer at a speed of 228 m.p.h. During the 1936 National Air Races at Los Angeles Menasco-powered racers won 30 out of 35 prizes in free-for-all closed course racing. Harold Neumann, the 1936 race champion in his Menasco-powered Folkerts special racer, won six prizes in four days, including three first, two second and one fourth.



MENASCO C6S-4 SUPER-BUCCANEER ENGINE

A six-cylinder inverted, in-line model supercharged and developing 290 horsepower for take-off.

IN REGULAR PASSENGER SERVICE

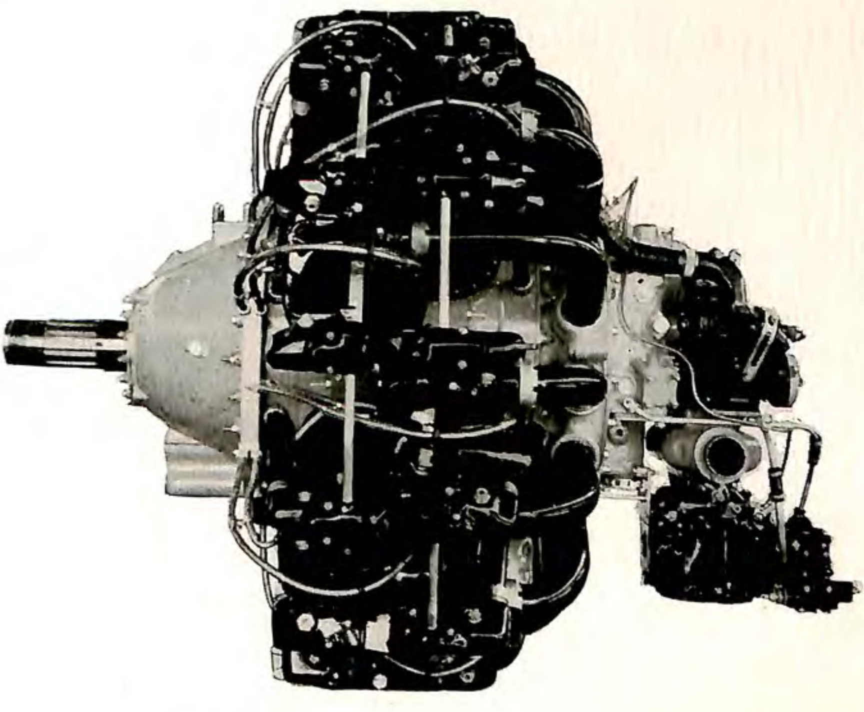
One of the Twin Wasp-powered Martin flying boats with which Pan American Airways started regular passenger service across the Pacific in 1936, the "China Clipper."

Pratt & Whitney Aircraft, East Hartford, Conn., the engine manufacturing division of the United Aircraft Corporation, produced and delivered approximately 1,300 engines during 1936. All were in the higher horsepower classification, ranging from the 420 h.p. Wasp Junior to the 1,000 h.p. Twin Wasp. The total number of engines produced since the organization of the company in 1925 exceeded 11,000.

Basically, two types of Pratt & Whitney radial aircooled engines were in current production, at the beginning of 1937—the nine-cylinder single-row type and the 14-cylinder double-row type. Included in the first group are the Wasp Junior, the Wasp and the Hornet, and in the second, the Twin Wasp Junior and the Twin Wasp. Improvements in all those models made possible higher horsepower ratings both for take-off and for cruising.

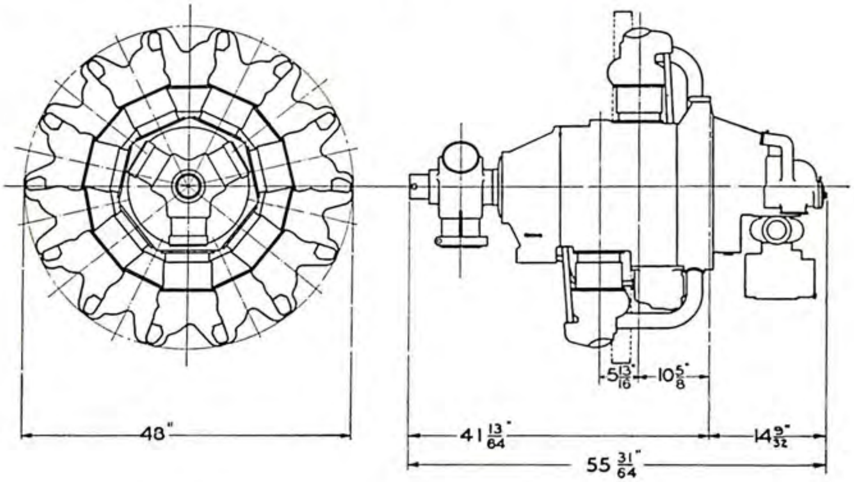
Considerable development in the double-row engine type was announced during the year at the time when the 1,000 h.p. Twin Wasp was offered for service. This development period extended back to 1929 when the company first began its double-row engine experimentation. Much interest for both commercial and military service has been shown in Pratt & Whitney's two double-row engines, and more than 1,000 of them have gone into service to date. The company stated that "advantages of the double-row power plant for aircraft are evident. Large displacement is possible with no increase, but actually a substantial decrease, in frontal area. This lends itself to plane design whether it be multi-engine or single-engine. The use of smaller cylinders permits greater crankspeeds which in turn contribute to smooth operation and the smaller, more frequent power impulses further contribute to smoothness and long life."

Distinctive and exclusive design features of current Pratt & Whitney engines included completely automatic valve gear lubrication, automatic mixture control, and improved cylinder head finning, which together with patented pressure baffles, provided maxi-

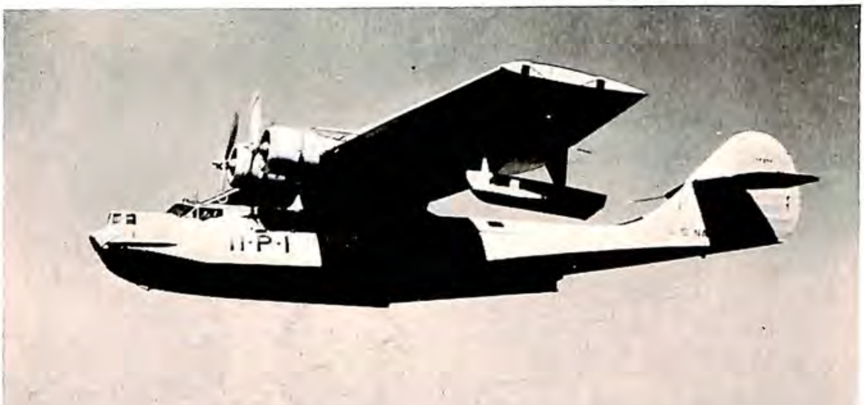


PRATT & WHITNEY TWIN WASP ENGINE

Model SB-Geared, 14 cylinders in two rows, with a rating of 1,000 horsepower at 2,600 r.p.m. for take-off.

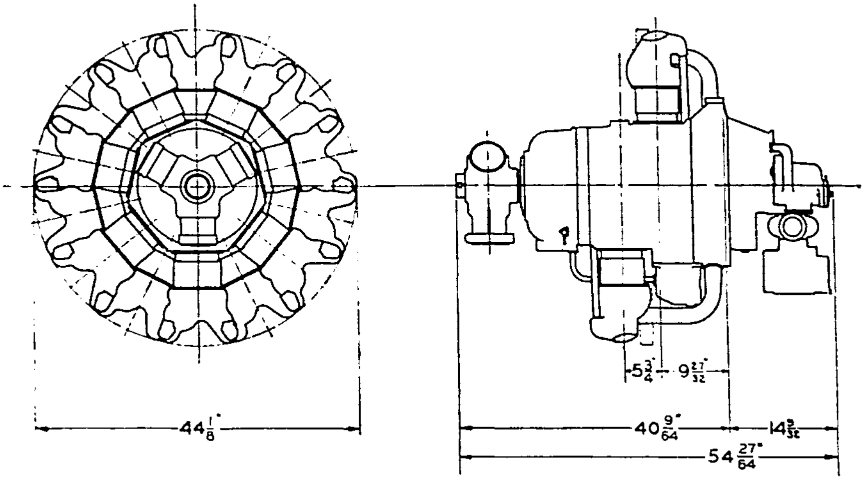


PRATT & WHITNEY TWIN WASP SB-G
A 14-cylinder aircooled radial engine developing 1,000 h.p.

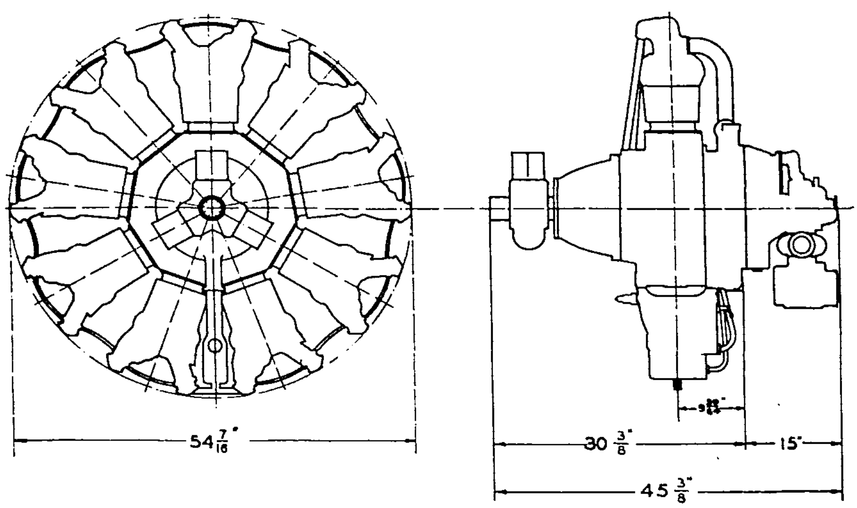


Official Photo U. S. Navy

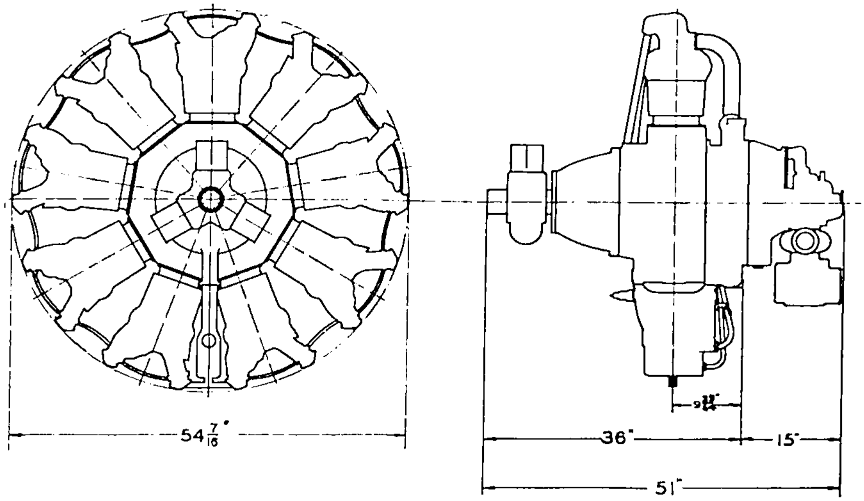
A FAMOUS NAVY PATROL SHIP
The Consolidated PBY-1 long range patrol flying boat, latest of such craft built for the Navy, which soon will have more than a hundred in service. Each ship is powered by two Pratt & Whitney Twin Wasp engines.



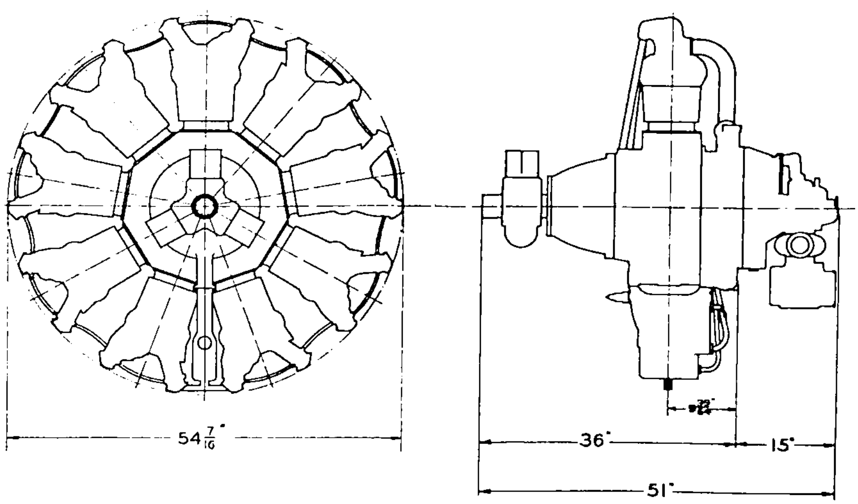
PRATT & WHITNEY TWIN WASP JUNIOR S2A4-G
This is a 14-cylinder, aircooled radial engine rated at 700 h.p.



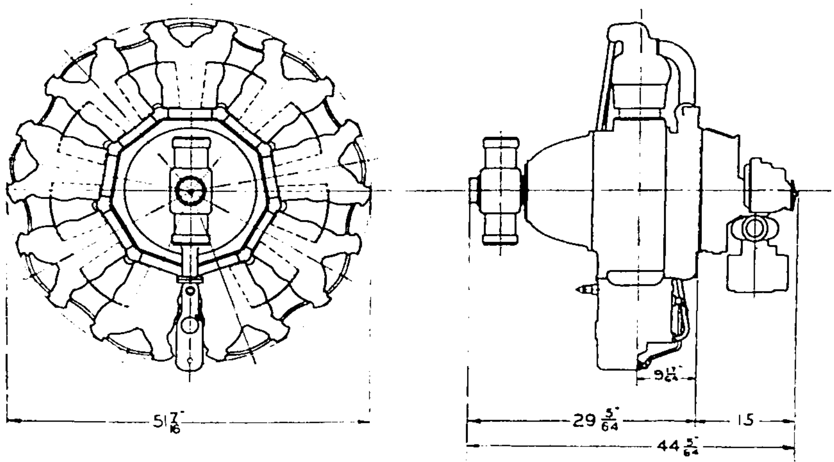
PRATT & WHITNEY HORNET S5E
A 700 h.p. nine-cylinder aircooled radial engine.



PRATT & WHITNEY HORNET S1E-G
An 800 h.p. nine-cylinder aircooled radial engine.



PRATT & WHITNEY HORNET S2E-G
This nine-cylinder aircooled radial engine develops 800 h.p.



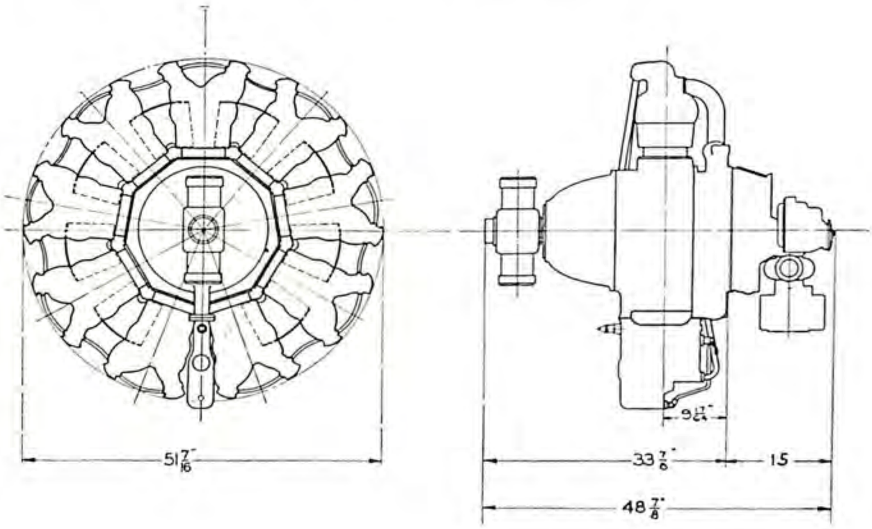
PRATT & WHITNEY WASP S3H1

A 550 h.p. nine-cylinder radial aircooled engine.

mum cooling and minimum fuel consumption. The policy of the company was based on the belief that future requirements for both military and commercial service will call for more horsepower than was available in 1936. Pratt & Whitney announced that the two-row type has the same possibilities for future development as the single-row engine had a decade ago; and company engineers were working on the development and test of larger models of the two-row engine.

Basically, Pratt & Whitney engines were divided into five distinct groups: The Wasp Junior, Wasp, Hornet, Twin Wasp and Twin Wasp Junior. In each engine group there were a number of different engines, each with a separate rating, but the general specifications of all engines in each group were identical. While Pratt & Whitney's available engine list contained a large number of units not referred to here, nevertheless, those which are discussed were the latest models appearing on their current production list at the beginning of 1937.

The Wasp Junior had a displacement of 985 cubic inches, an overall diameter of 46¾ inches, and a bore and stroke of 5 3/16 inches. It could be had with either a geared or direct drive, the former weighing 800 pounds bare and the latter 596 pounds bare. The geared form, Model SC-G, the company reported, produced for take-off 600 h.p. at 2,850 r.p.m. and delivered 525 h.p. at 2,700 r.p.m. at



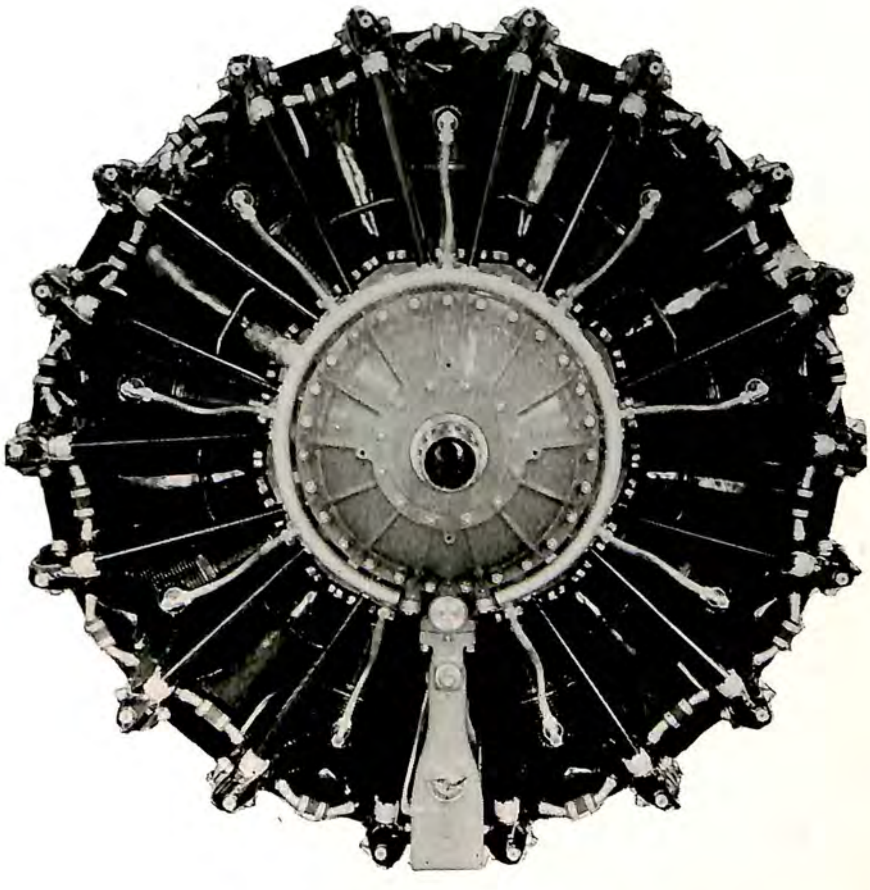
PRATT & WHITNEY WASP S1H1-G

This is a nine-cylinder, radial aircooled engine developing 600 h.p.

8,000 feet as a maximum power for continuous cruising. It had an overall length of 45¾ inches, a compression ratio of 6.7:1, and a blower ratio of 11:1, and 87-octane fuel is specified. Model SB was a direct drive Wasp Junior delivering 450 h.p. at 2,300 r.p.m. for take-off. Its maximum power for continuous operation was 400 h.p. at 2,200 r.p.m. at 5,000 feet. Its overall length was 42⅛ inches, compression ratio 6:1, blower ratio 10:1 and fuel specification 87-octane. Model TB was rated at 420 h.p. at 2,200 r.p.m. at sea level and operated on 80-octane fuel, with a compression ratio of 6:1 and a blower ratio of 8:1.

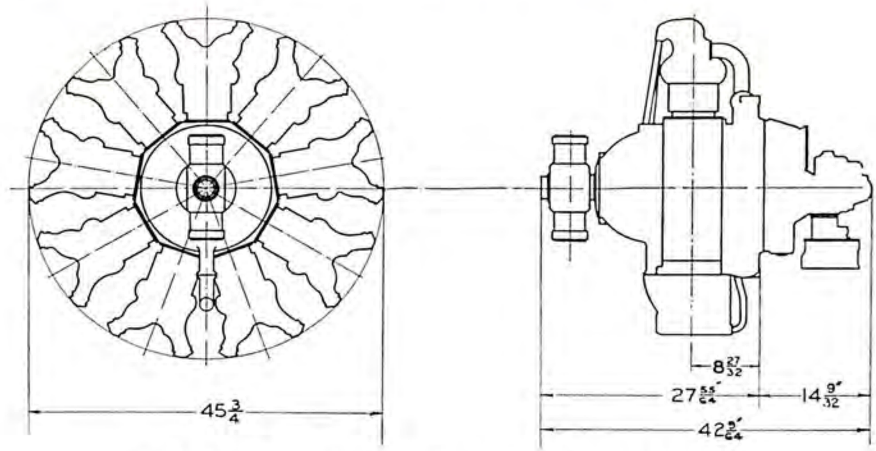
The Wasp group had a displacement of 1,344 cubic inches and an overall diameter of 51 7/16 inches. Its bore and stroke were 5¾ inches and it also could be procured in either the direct drive or geared form. The bare weight of the former was 798 pounds, and of the latter, 883 pounds. Model S1H1-G provided 600 horsepower at 2,250 r.p.m. for take-off. Its compression ratio was 6:1, blower gear ratio, 12:1 and 87-octane fuel was specified. Model S3H1, a direct drive engine, was rated at 550 h.p. at 5,000 feet. It operated on 80-octane fuel, had a compression ratio of 6:1 and a blower ratio of 10:1.

Three engines in the Hornet group in current production had a displacement of 1,690 cubic inches, a bore of 6⅛ inches and stroke of 6⅜ inches. The bare weight of the geared versions was 1,015 pounds and of the direct drive, 920 pounds. Overall diameter was 54$\frac{7}{16}$ inches. Model S1E-G permitted 800 h.p. at 2,300 r.p.m. for take-off, and its maximum power for continuous operation was 750 h.p. at 2,250 r.p.m. at 7,000 feet. It had a compression ratio of 6.5:1, blower ratio of 12:1 and operated on 87-octane fuel. Model S2E-G had a similar take-off rating but its power for continuous opera-



PRATT & WHITNEY S1H1-G WASP

A nine-cylinder geared model, developing 600 horsepower at 2,250 r.p.m. for take-off.

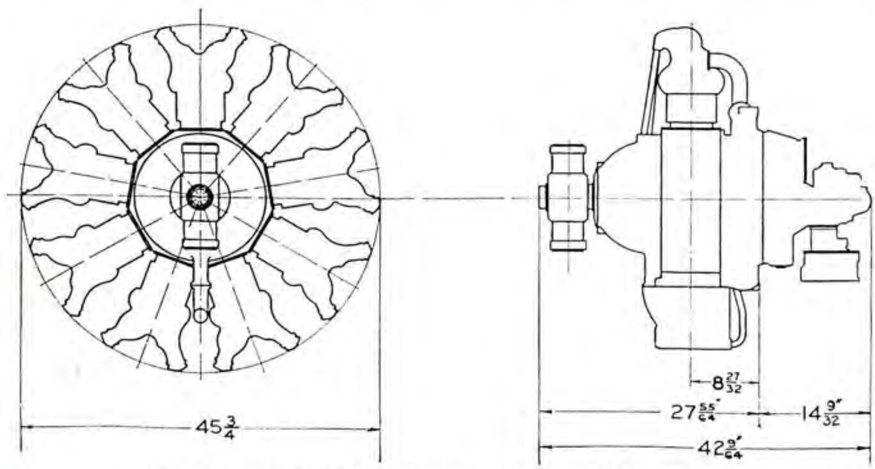


PRATT & WHITNEY WASP JUNIOR MODEL TB

A nine-cylinder, aircooled radial developing 420 h.p.

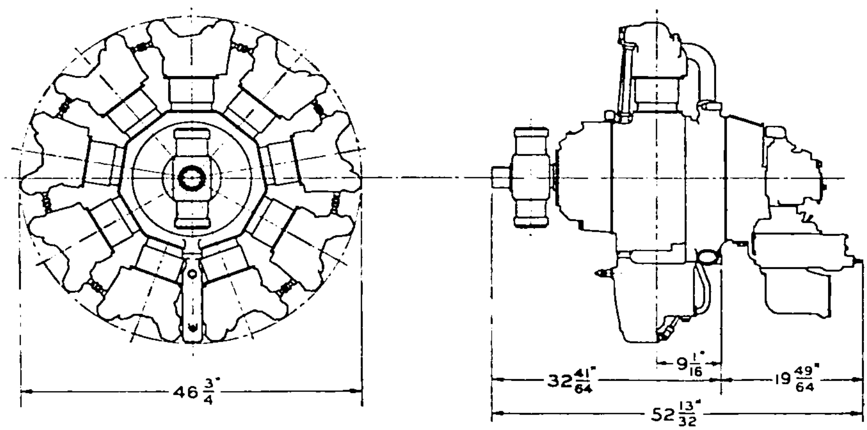
tion was 750 h.p. at 2,250 r.p.m. at 2,500 feet. It had a compression ratio of 6:1, a blower ratio of 10:1 and also operated on 87-octane fuel. Model S5E was a direct drive Hornet rated at 700 h.p. at 2,050 r.p.m. at 6,000 feet. It had a compression ratio of 6.5:1, blower ratio of 13:1 and a fuel specification of 87-octane.

The Wasp Junior, Wasp and the Hornet were nine-cylinder single-row radials, while the Twin Wasp Junior and the Twin Wasp



PRATT & WHITNEY WASP JUNIOR MODEL SB

A 450 h.p. nine-cylinder, radial, aircooled engine.



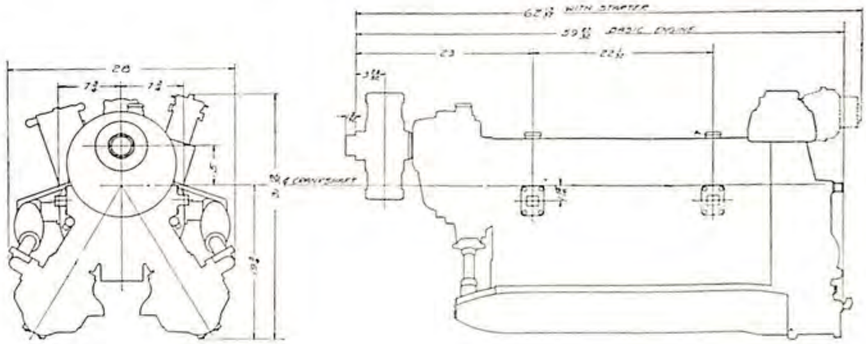
PRATT & WHITNEY WASP JUNIOR MODEL SC-G
This nine-cylinder, radial, aircooled engine is rated at 600 h.p.

were 14-cylinder radial aircooled power-plants of two-row design. The cylinders of these latter engines were arranged in two banks of seven cylinders each and were staggered for the purpose of adequate cooling. The Twin Wasp Junior had a displacement of 1,535 cubic inches while the Twin Wasp's displacement was 1,830 cubic inches.

Twin Wasp Junior Model S2A4-G was rated at 700 h.p. at 2,500 r.p.m. at 8,500 feet. Its overall diameter was 44⅛ inches and its overall length 53¼ inches. It was a geared engine weighing 1,070 pounds and operating on 87-octane fuel; compression ratio, 6.7:1, blower gear ratio, 10:1.

Twin Wasp Model SB-G also was a geared engine with a bare weight of 1,265 pounds. It produced 1,000 horsepower at 2,600 r.p.m. for take-off and 950 horsepower at 2,250 r.p.m. at 5,000 feet as a maximum for continuous cruising. Its bore and stroke were 5½ inches and its overall diameter was 48 inches. Its compression ratio was 6.7:1 and its blower ratio, 12:1 while its fuel specification was 87-octane.

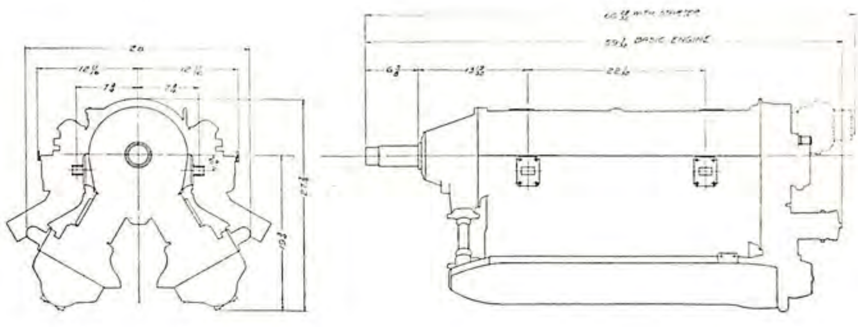
Ranger Engineering Corporation, Farmingdale, N. Y., a division of the Fairchild Aviation Corporation, continued development of inverted, in-line, aircooled engines. At the beginning of 1937 the company was in production on the six-cylinder 6-390-D with a stated horsepower of 150 at 2,350 r.p.m., and the V-770, direct drive, unsupercharged, 12 cylinders, 290 h.p. at 2,300 r.p.m. The six-cylinder model was installed in the Fairchild 24 type plane. Five of the V-770



RANGER SGV-770

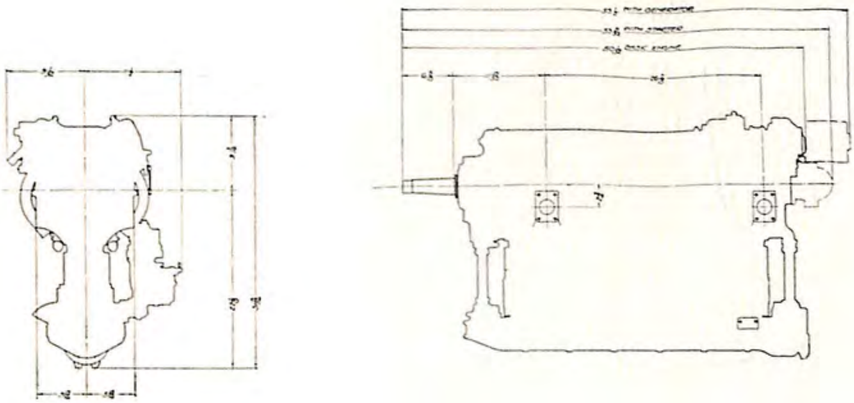
This 12-cylinder, V-type, geared, supercharged aircooled engine is rated at 420 h.p. at 1,870 r.p.m.

were exported. The model SGV-770, 12 cylinders, geared and supercharged, was being developed for military use, and the basic model was available for commercial use, with a rated 420 h.p. at 1,870 r.p.m. It was also available as a geared unsupercharged engine, V-770-G, with a rated 320 h.p. at 1,750 r.p.m. and as a direct drive supercharged engine, V-770-S, with 350 h.p. at 2,400 r.p.m.



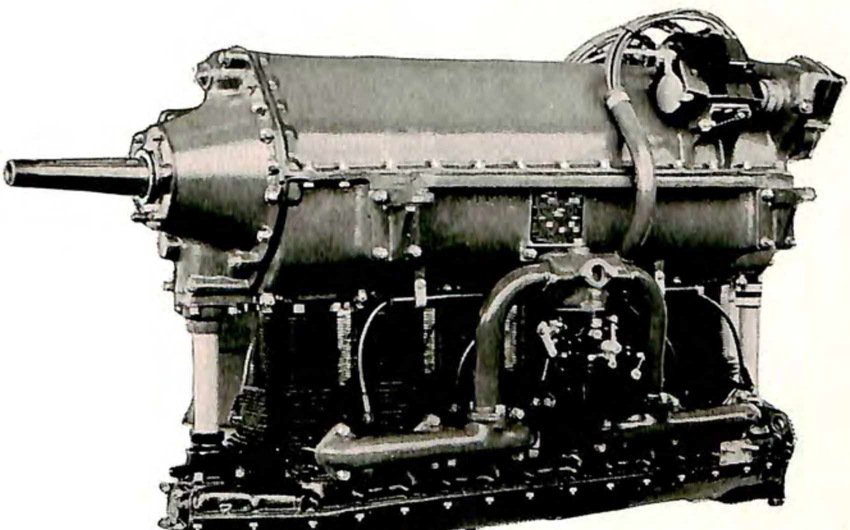
RANGER V-770

This is a direct drive, unsupercharged 12-cylinder engine rated at 290 h.p. at 2,300 r.p.m.



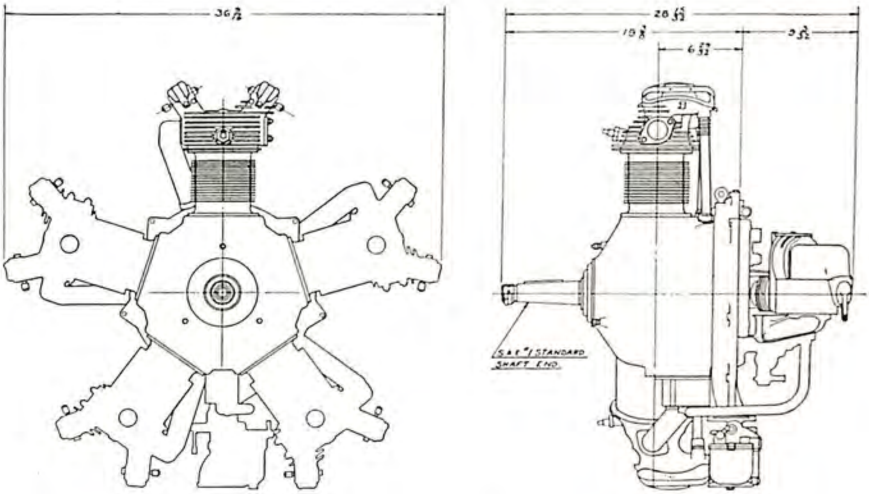
RANGER 6-390-D

This six-cylinder aircooled inverted in-line engine is rated at 150 h.p. at 2,350 r.p.m.



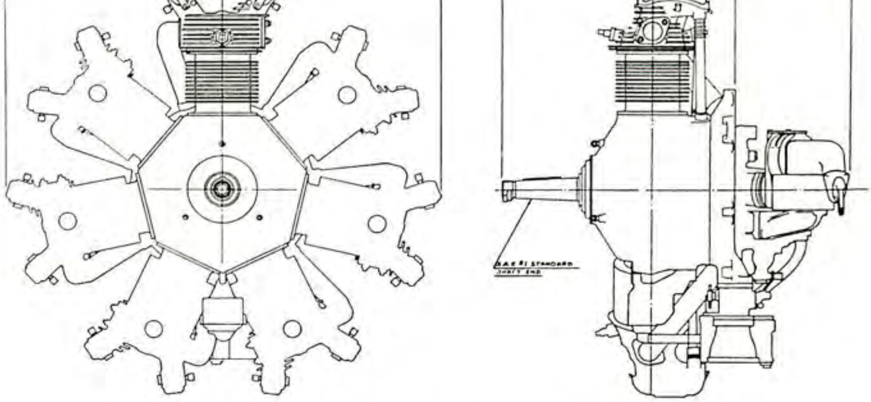
THE RANGER 6-390-D ENGINE

An inverted in-line model with six cylinders, developing 150 horsepower at 2,350 r.p.m.



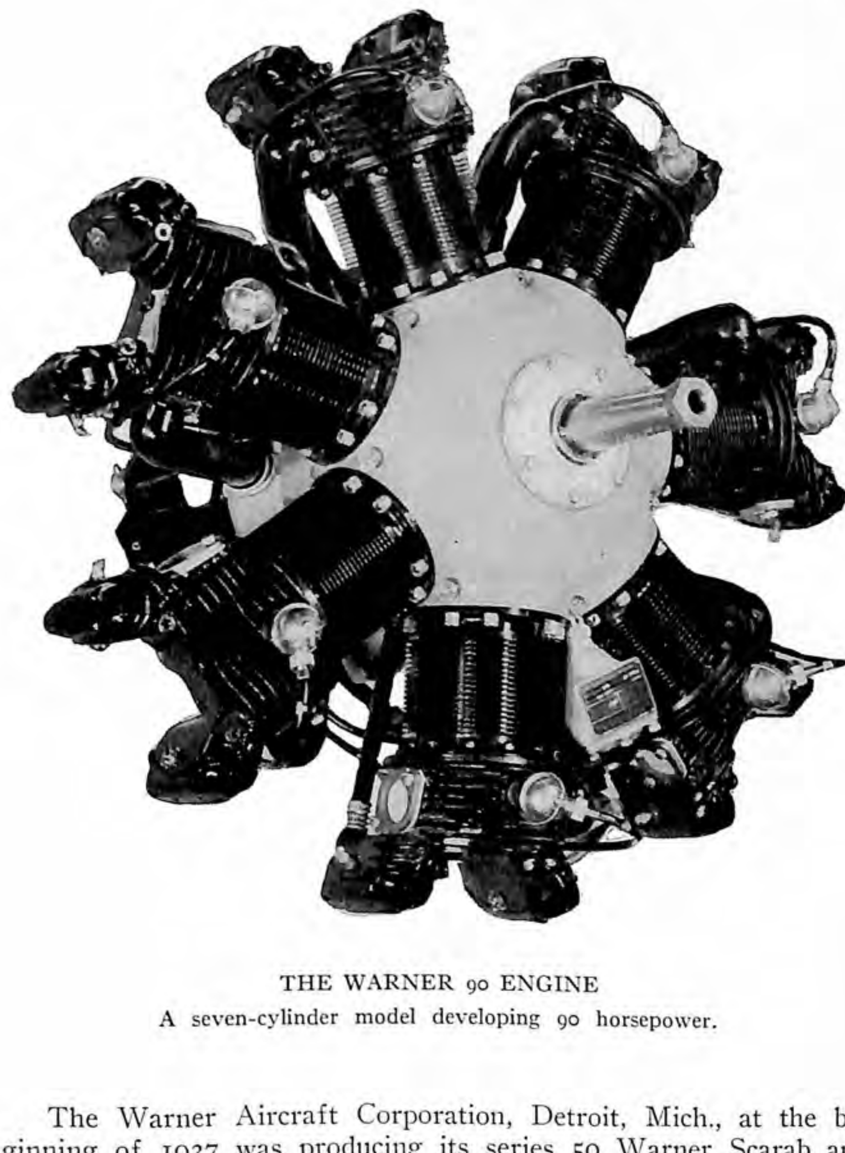
WARNER SCARAB JUNIOR

A five-cylinder aircooled radial engine rated at 90 h.p. at 2,050 r.p.m.



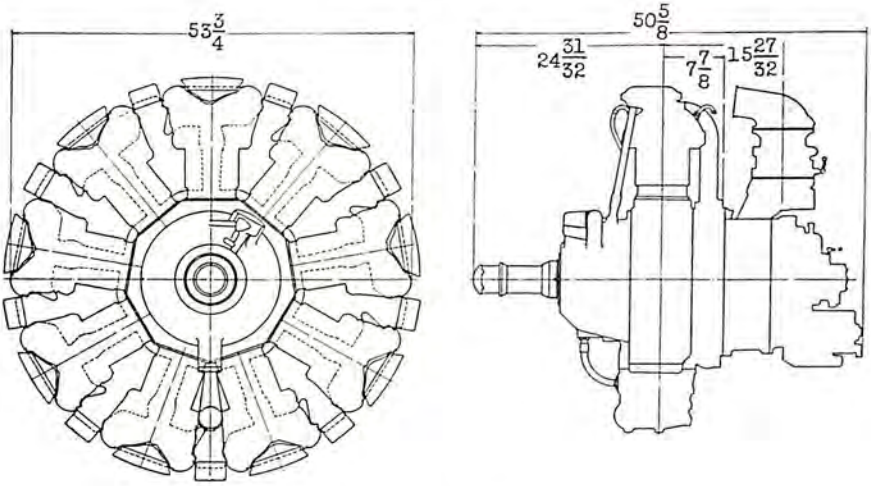
WARNER SCARAB

A seven-cylinder aircooled radial engine rated at 125 h.p. at 2,050 r.p.m.



THE WARNER 90 ENGINE
A seven-cylinder model developing 90 horsepower.

The Warner Aircraft Corporation, Detroit, Mich., at the beginning of 1937 was producing its series 50 Warner Scarab and Super Scarab engines. Four different manufacturers had developed models around the 90 h.p. Warner engines, which the company reported to embody refinements of the basic design, including re-design of the induction housing to bring the carburetor and its intake valve within the overall diameter of the engine, and also stronger master rod and crankshaft to equalize stresses.



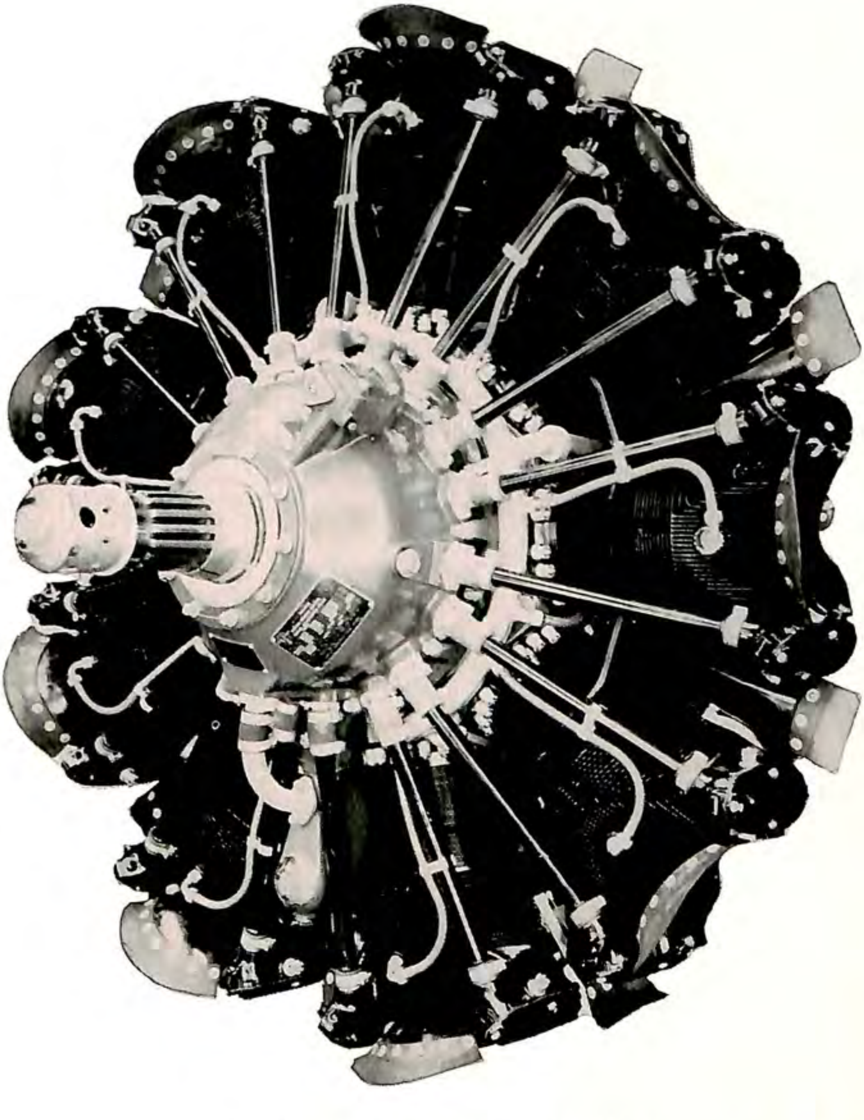
WRIGHT CYCLONE R-1820-G2 GEARED

This engine, a nine-cylinder aircooled radial which is geared 16:11, delivers 1,000 h.p. for take-off and 850 h.p. at 5,500 feet.

Wright Aeronautical Corporation, Paterson, N. J., the aircraft engine manufacturing division of the Curtiss-Wright Corporation, announced that during the first six months of 1936 more than 1,300 of their Wright Whirlwinds and Cyclones had been sold to aircraft manufacturers, air line operating companies and military services throughout the world. These orders represented the sale of more than 1,077,000 h.p. More than 1,000 of the 1,300 engines sold were of the Wright Cyclone type, used extensively in large air transports and military aircraft. The orders for 1,000 Cyclones were believed to represent a new peace time sales record for high-powered aircraft engines over a six months period. Of this number over 700 were Cyclones of the 1,000 h.p. type which was released for domestic and commercial sale during the summer. Designated as the Wright Series G Cyclone, the 1,000 h.p. model was introduced to the commercial market on the 10th anniversary of the Cyclone Series. To date the Wright Aeronautical Corporation has produced over 25,000 engines of which over 11,000 were of the radial aircooled type.

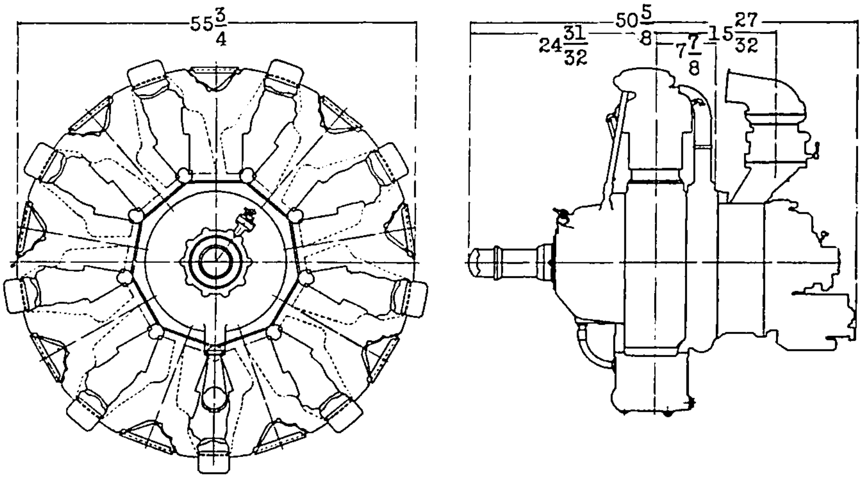
Over 600 of the 1,000 h.p. Cyclones on order were scheduled for delivery to the U. S. Army for installation in the new Douglas twin-engine and Boeing four-engine bombers. Others were used to power the Douglas DST transports placed in service by American Airlines.

During 1936 the Wright Aeronautical Corporation produced five distinct series of aircraft engines. They were the Wright Cyclones F and F-50 and the Wright Cyclone G Series high-powered, nine-cylinder radial aircooled engines; the single-row Whirlwind series of



THE WRIGHT G CYCLONE ENGINE

This version of the nine-cylinder G Cyclone, R-1820-G2, has a rating of 1,100 horsepower for take-off.



WRIGHT CYCLONE GR-1820-52 GEARED

With a gear ratio of 16:11, this nine-cylinder aircooled radial engine, of which there are several models, has a take-off rating of 890 h.p. and an altitude rating of 775 h.p.

five, seven and nine cylinders; the 14-cylinder Wright double-row Whirlwind Series, and the Curtiss Conquerors.

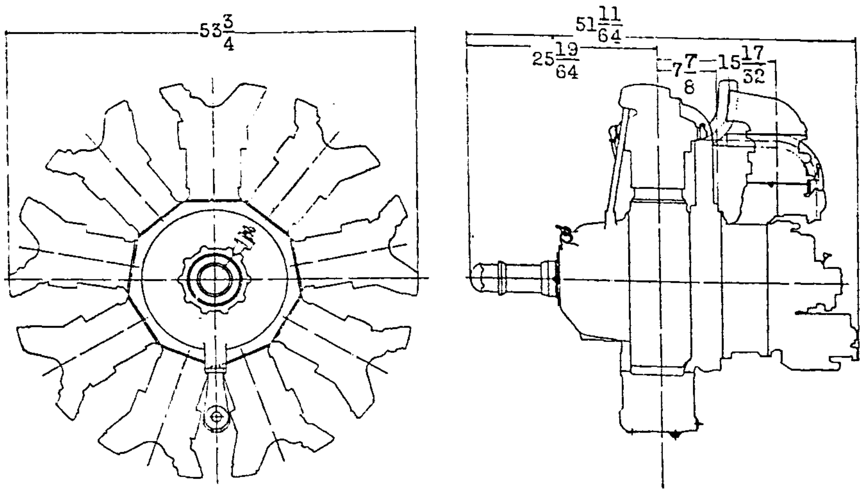
The Wright G Cyclone Series represented the latest aircooled aircraft engine developed by the company. Although of the same displacement (1,820 cubic inches) as the F and the F-50, the G Series engines incorporated many refinements and improvements in design principal. Among them was a new cylinder which has a cooling fin area of 2,800 square inches against 1,000 square inches in other Cyclone models. Advancement in foundry technique in the Wright Aeronautical foundry, made possible the casting of cooling fins on the G cylinder head as closely spaced as the teeth on a comb and nearly two inches in depth over the combustion chamber. Cylinder barrels were of Nitralloy steel, nitrided to obtain a cylinder bore with a surface with three times the wear resistance of ordinary heat-treated cylinder barrels. Five large nitriding furnaces were installed to accommodate the daily output of Cyclone G cylinders. More accurate fuel control and the improved cylinder heads on the G Cyclone engine permitted a rating of 1,000 h.p. at take-off with a weight in certain models of 1.07 pounds per horsepower and fuel consumption of .43 pounds per horsepower at cruising speed.

Other features of the design and construction of the G Series

Cyclones were automatic lubrication of the valve gear from a built-in system devoid of all external lines or tubes, mechanism for the operation of two-position hydro-control and constant speed propellers, an accessory section provided with the driving mechanism necessary to meet all of the requirements of modern military and civil transport service, the dynamic damper counterweight which counteracts torsional vibration at all crankshaft speeds and removes all restrictions in the operating range, full pressure baffling of the cylinders, improved oil seals and refinements in the supercharger and induction systems to increase altitude performance.

The G Cyclone was produced in four geared models and their direct drive counterparts. These were the Cyclone GR-1820-G1 rated at 940 h.p. for take-off, 825 h.p. at sea level, and 850 h.p. at 3,000 feet; the Cyclone GR-1820-G2 rated at 1,000 h.p. for take-off, 810 h.p. at sea level, and 850 h.p. at 5,500 feet; the Cyclone GR-1820-G3 rated at 875 h.p. for take-off, and 840 h.p. at 8,700 feet; and the Cyclone GR-1820-G6 rated at 820 h.p. for take-off and 815 h.p. at 10,500 feet.

The various G Cyclone models differ only with respect to the amount of supercharging applied. The G-1 has a blower gear ratio of 5.95 to 1; the G-2 a blower ratio of 7 to 1; the G-3 a blower ratio



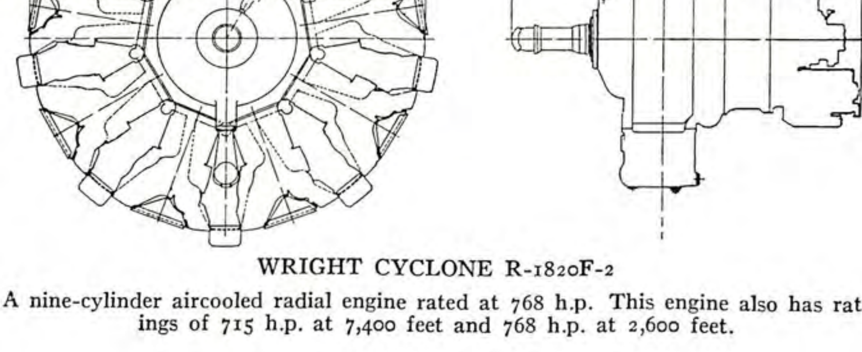
WRIGHT CYCLONE R-1820F-2 GEARED

A 750 h.p. nine-cylinder aircooled radial engine with a gear ratio of 16:11. This engine, known as the GR-1820-3, has a take-off rating of 712 h.p. and an altitude rating of 697 h.p. at 7,400 feet.

THIS IS THE SHRIKE

A Curtiss A-12 Army attack low-wing monoplane powered by a 775 h.p. Wright Cyclone engine.

of 8.31 to 1 and the G-6 a blower ratio of 8.83 to 1. All the G Series engines are of the nine-cylinder radial aircooled type and have the following characteristics: bore, 6.125 inches; stroke, 6.875 inches; compression ratio, 6.45 to 1; diameter, 54¼ inches; length, 43¼ inches; dry weight (geared) 1,163 pounds, (direct drive) 1,068 pounds.



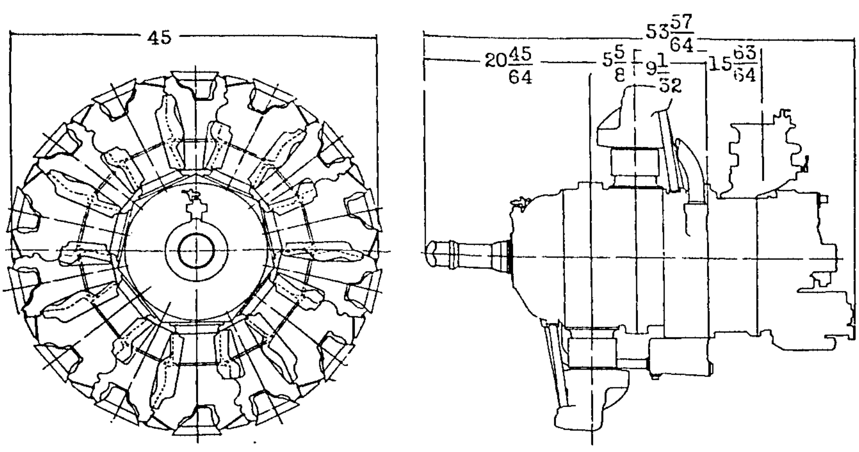
WRIGHT CYCLONE R-1820F-2

A nine-cylinder aircooled radial engine rated at 768 h.p. This engine also has ratings of 715 h.p. at 7,400 feet and 768 h.p. at 2,600 feet.

The F-50 Series Cyclone was produced in four direct drive models and their geared counterparts. These were the Cyclone R-1820-F52 rated at 890 h.p. for take-off, 745 h.p. at sea level, and 775 h.p. at 5,800 feet; the Cyclone R-1820-F53 rated at 785 h.p. for take-off, 685 h.p. at sea level, and 745 h.p. at 9,600 feet; the Cyclone R-1820-F54 rated at 655 h.p. for take-off, 605 h.p. at sea level, and 690 h.p. at 15,300 feet; and the Cyclone R-1820-F56 rated at 785 h.p. for take-off, 695 h.p. at sea level, and 755 h.p. at 11,300 feet.

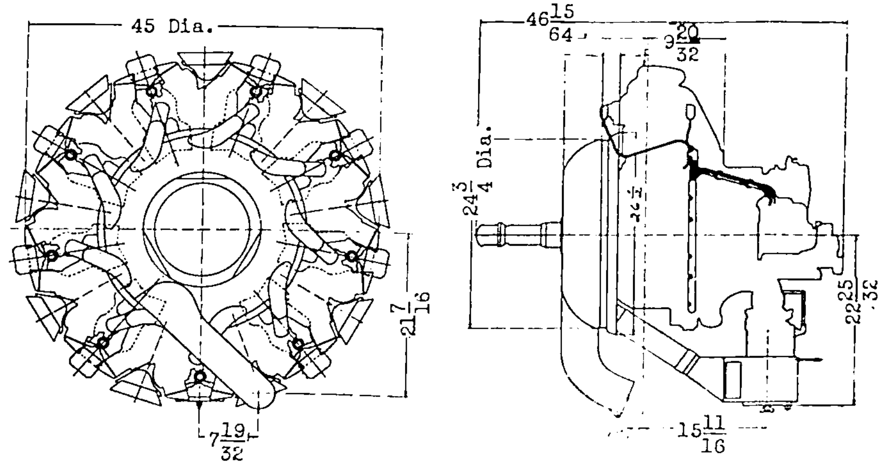
Like the engines of the G Cyclone Series, the models of the F-50 Series are identical except for the amount of supercharging applied. All are nine-cylinder radial, aircooled engines. The F-52 has a blower gear ratio of 7 to 1; the F-53, a blower gear ratio of 8.31 to 1; the F-54 a blower gear ratio of 10 to 1, and the F-56, a blower gear ratio of 8.83 to 1. Characteristics common to all F-50 models are: bore, 6.125 inches; stroke, 6.875 inches; compression ratio, 6.40 to 1; diameter, 54⅛ inches; dry weight, (geared) 1,070 pounds, (direct drive) 975 pounds.

The single-row Whirlwind models of five, seven, and nine cylinders, which have been under development for over 16 years, were also refined during 1936. The ratings of the series were: five-cylinder 175 h.p.; seven-cylinder 235 h.p.; 250 h.p., 285 h.p. and 320-350 h.p. The nine-cylinder Whirlwinds of 330 h.p., 365 h.p., and 420-450 h.p. were characterized as "de luxe equipped" Whirlwinds due to their



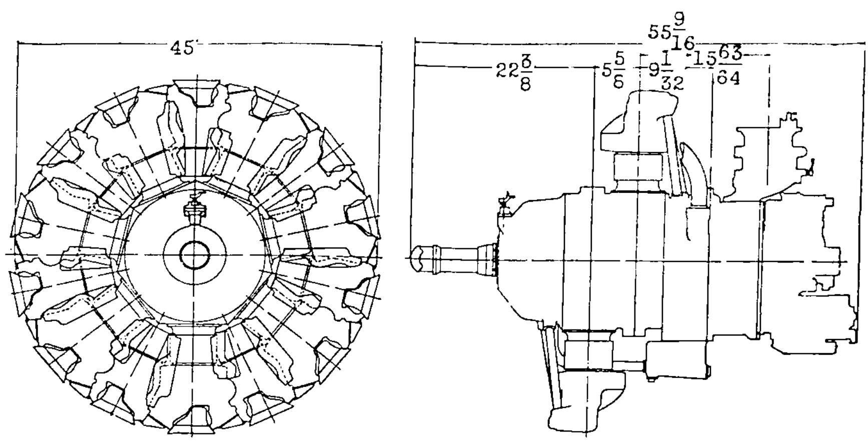
WRIGHT WHIRLWIND DOUBLE ROW

A 14-cylinder aircooled radial engine rated at 705 h.p.



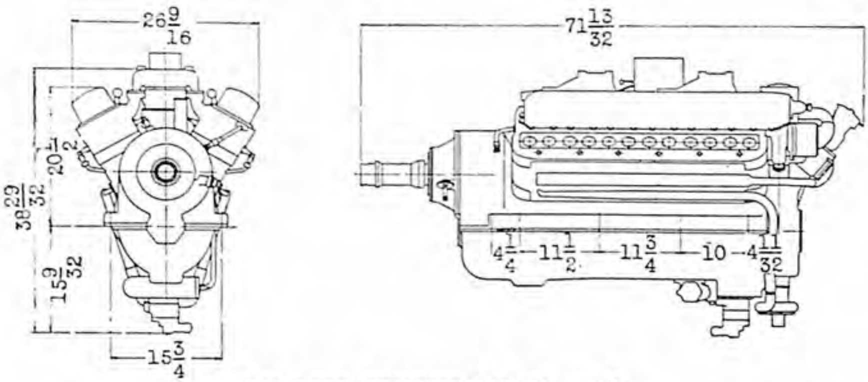
WRIGHT WHIRLWIND R-975-E

A nine-cylinder, aircooled radial engine rated at 330, 365, 420 and 450 h.p.



WRIGHT WHIRLWIND DOUBLE ROW GEARED

With a gear ratio of 4:3 this 14-cylinder aircooled radial engine develops 765 h.p. When geared 16:11 this 14-cylinder aircooled radial engine delivers 900 h.p. for take-off and 800 h.p. at 6,000 feet.



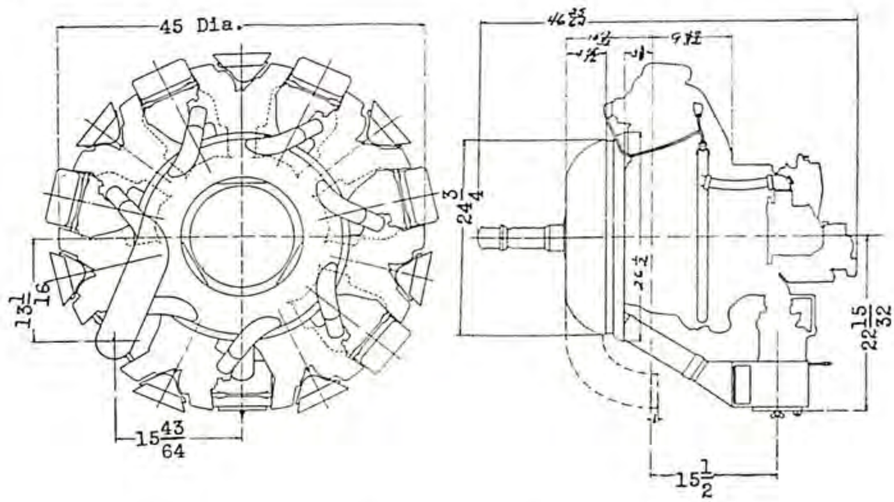
CURTISS CONQUEROR V-1570F-2

This 12-cylinder, V-type liquid-cooled engine, geared 7:5, is rated at 675 h.p.

many standard and special features. These engines were provided with automatic valve gear lubrication, a new type of nose exhaust collector ring with built-in carburetor intake and air heater, dynamic damper counterweight, mechanism for the operation of the two-position hydro-control propeller, a three-way drive for the operation of a vacuum pump, a fuel pump, and a constant speed propeller governor, full pressure baffles provided with blast tubes for the cooling of the accessories and ventilation of the engine compartment and

CURTISS-WRIGHT 19-R BASIC TRAINER

It is powered with a Wright Whirlwind engine.



WRIGHT WHIRLWIND R-760-E

Versions of this seven-cylinder aircooled radial engine are rated at 235, 250, 285, 320 and 350 h.p.

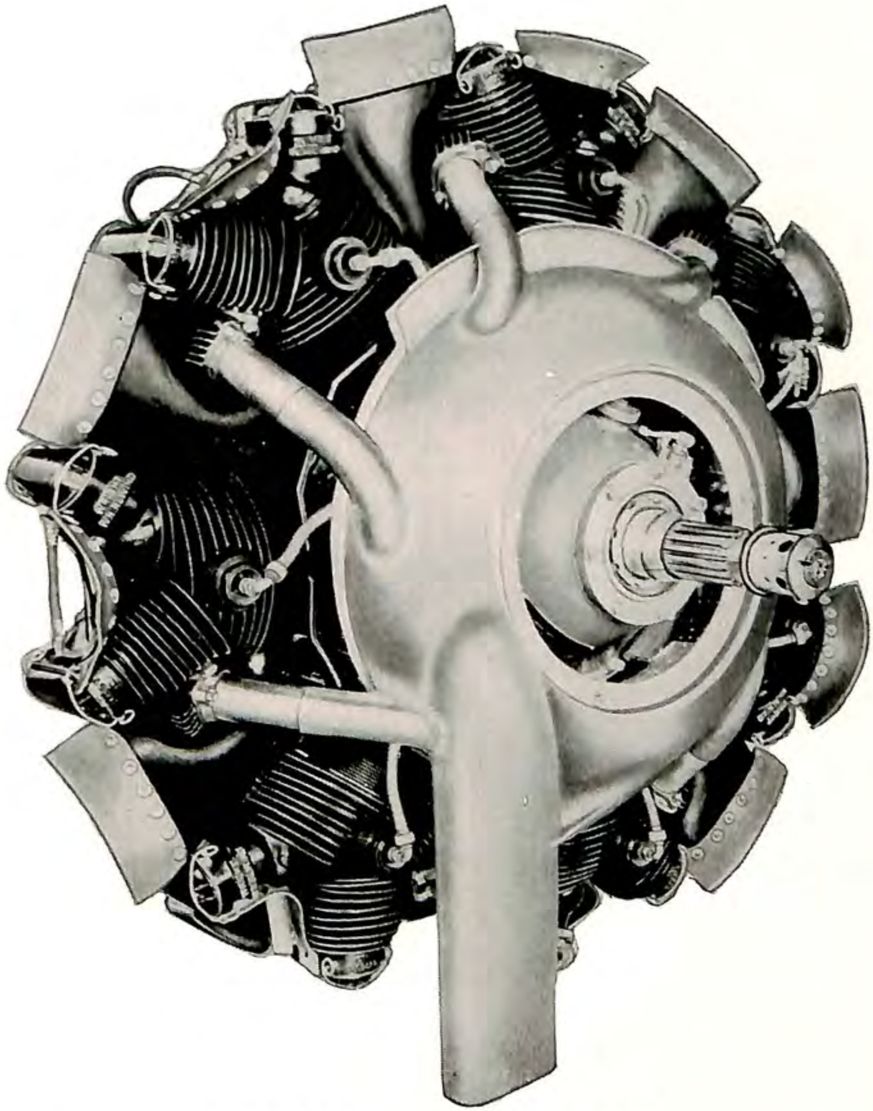
heating or cooling and ventilation of the cabin of the airplane; two mounting diameters provided by two sets of mounting lugs, the larger of which, corresponding with that of the Cyclone, provides greater accessibility in installations where the engine is mounted in rubber; complete radio shielding for ignition wiring, spark plugs, and magnetos, and the dynamic damper.

Some of these features are also provided in the Whirlwinds of 250 h.p., 285 h.p., 330 h.p. and 365 h.p. The following specifications are common to all Whirlwinds, parts of which are over 90 per cent interchangeable: bore, 5 inches; stroke, 5.5 inches and diameter, 45 inches. Weights, compression and blower ratios vary with individual models.

Development was continued in the higher horsepower categories with the double row Whirlwinds designed for military service. These engines now have ratings as high as 900 h.p. for take-off and 800 h.p. at 6,000 feet.

The Curtiss Conqueror, a 12-cylinder V-type engine, used by the Army Air Corps for installation in high speed combat planes, was offered as a geared engine rated at 655 h.p. and 675 h.p. The Conqueror is the only liquid-cooled engine built on a production basis in the United States. It may be operated with either water or Prestone as the coolant.

The factory and foundry of the Wright Aeronautical Corporation at Paterson, N. J., comprises more than 650,000 square feet of floor space. During 1936 the Wright Company pioneered in the installation of Magnaflux testing equipment for the inspection of steel



THE WRIGHT WHIRLWIND ENGINE

This seven-cylinder model has ratings of 235, 250, 285, 320 and 350 h.p.

NEW FAIRCHILD 45

A five-place low-wing monoplane with retractible undercarriage and trailing edge flaps. It is powered by a Wright Whirlwind.

parts, nitriding equipment and furnaces to provide a super-hard bore in Cyclone cylinder barrels and machinery for the grinding of studs. All steel parts of Wright engines are subjected to the Magnaflux test which shows up defects which might not be discernible under microscopes of 10 to 20 diameter enlargement strengths. The Wright installation of Magnaflux equipment, like its installation of nitriding equipment, was the first to be made in this country.

During 1936 the Wright Aeronautical Corporation also set up a modern experimental testing laboratory which is equipped to make endurance tests on engines of outputs up to 2,500 h.p.

Late in the year Wright Aeronautical announced the development of the G-100 Cyclone which represented the latest of the G Cyclone Series. Based on the former G Cyclones and rated at 1,100 h.p. for take-off, this engine incorporated all the special features which had been tested as units on former Cyclones together with several new design features. New developments included a steel main crankcase, replacing the aluminum alloy formerly used, longer pistons for better cooling, and a new type carburetor which resulted in a fuel consumption of .43 pounds per horsepower hour at cruising speeds. The engine, complete with all accessories, was reported to weigh only 1.12 pounds per horsepower.

Manufacturers of Accessories

Aero Supply Manufacturing Company, Inc., Corry, Pa., continued to produce a full line of accessories for the industry.

Air Associates, Inc., Garden City, N. Y., manufactured a line of flying clothes and special aircraft accessories and also acted as foreign distributor for many manufacturers of machines, engines and accessories.

Air Transport Equipment, Inc., Garden City, N. Y., supplied a line of accessories to the industry and private owners.

Aircraft Radio Corporation, Boonton, N. J., produced aircraft radio equipment, and at the beginning of 1936 was expanding its facilities for a new line of radio parts.

Aluminum Company of America, Pittsburgh, Pa., continued to produce its line of aluminum and aluminum alloy materials for aircraft construction. Corrosion resistant and high strength alloys were distributed throughout the industry. Wider application of Alclad materials was developed, Alclad being highly corrosion resistant sheet aluminum alloy products of the heat-treated variety having a high strength core to which were integrally bonded thin coatings of high purity aluminum. The electrolytic production afforded by the high purity coating effectively prevented structural deterioration of the high strength core under ordinary corrosive conditions, including salt water action. The company also produced highly corrosive resistant alloys of the cold rolled variety. Forged aluminum alloy propellers, castings and forgings for engine and fuselage construction advanced in quality in 1936. Other advances noted at the beginning of 1937 were the progress made in spot welding technique, permitting it to be applied to structural members of aircraft. The company expanded its facilities for technical advice and consultation with the industry.

American Telephone and Telegraph Company, Inc., New York, continued to supply the Government and air transport industry with teletypewriter circuits. More than 25,000 miles of the Bell system wires were in use by the Bureau of Air Commerce for dissemination of weather information.

Bendix Products Corporation, South Bend, Ind., produced the dual brake wheels which became standard equipment on the Douglas transport planes, and made a number of detail improvements in other types manufactured by Bendix. At the beginning of 1937 it had available a full line of hydraulic brakes for all wheels produced by the company, together with master cylinders and parking locks. The Bendix pilot seat met with increasing popularity during the year. It conformed to the latest Army and Navy standards requiring difficult strength tests. The seat, weighing less than seven pounds and constructed of electric spot welded high grade aluminum alloy sheet, placed it among the unique developments of the year. Bendix oleo pneumatic struts were continued in production for a number of commercial and military planes, particularly the heavier transport class. The design of the struts was individual to each airplane model, thus there were many variations, including the use of internal submerged splines. One of the most important developments was the

A NEW PITCAIRN AUTOGIRO

Built for the Bureau of Air Commerce it flies at 100 miles an hour, lands and folds its wings over its tail. Then it is ready to be a motor car and roll up the road at 30 miles an hour.

increasing use of magnesium for wheels on land planes, although it had not reached a practical state of development to warrant use on amphibions. The dual brake wheels were produced in magnesium for a number of transports but aluminum was still used for wheels equipping planes in tropical or seacoast service.

The Bendix Radio Corporation, Chicago, Ill., was organized by Vincent Bendix at the beginning of 1937, to develop and market aeronautical radio equipment. It was to have a staff of more than a hundred engineers and technicians, with plants and laboratories in Chicago, Dayton and Washington, D. C., and Oakland, Calif. Four companies were absorbed in the new corporation, including Radio Research Company, Inc., of Washington, Radio Products Company of Dayton, and the W. P. Hilliard Company and Jenkins and Adair, both of Chicago.

Berry Brothers, Inc., Detroit, Mich., in 1936 conducted 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.

The B. G. Corporation, New York, produced a new line of spark plugs for the latest aviation engines. They were made of special materials and were so constructed that they would maintain proper temperatures under all conditions. They were also characterized by cooling fins as an aid in maintaining even temperatures and to eliminate electrode burning. That served to materially lengthen the periods between removals for cleaning and adjustment of the electrodes.

The E. K. Bishop Lumber Company, Aberdeen, Wash., continued to produce airplane spruce, which it supplied to leading aircraft factories in the United States and several other countries.

Breeze Corporations, Newark, N. J., produced aircraft parts and accessories for civil and military equipment, including radio ignition shielding, aeroflex fuel and oil lines, tie rods, ammunition rounds counters, elevator tab controls, flexible shafting and casing and flexible tubing. Breeze radio shielding was recognized as standard. It eliminated electrical interference from the ignition system to the radio set and also protected the entire ignition system against oil and moisture. The Breeze shielding conduit and fixtures saved the manufacturer the trouble of making special parts. The tie rods were designed to save time in installation. Two new items were developed in 1936; the Breeze multiple circuit electric connectors and the Breeze exhaust gas analyzer, the latter an instrument which determines accurately the mixture ratio which the carburetor delivers to an airplane engine during flight.

Champion Spark Plug Company, Toledo, O., continued to produce a full line of spark plugs for aircraft engines, using the Champion Sillment powder to insure absolute tightness and eliminate corona action. The company also was developing new plugs made entirely of American materials, including a new insulation material.

Cities Service Company, New York, during 1936 operated a fleet of three planes, including a Douglas DC-2, a Wright-powered Beechcraft and a Lycoming-powered Stinson. These planes were used for sales promotion within the industry and executive transportation. The company planned to produce an instrument designed to increase fuel economy. It was to be known as the Power Prover, an exhaust gas analyzer weighing approximately 10 pounds, to analyze the exhaust gasses by burning them. The results of this analysis would be recorded on a dial located on the instrument panel, allowing the pilot to make corrections through the mixture control, spark control and manifold pressure. A timing disc for checking ignition timing and magneto synchronization while the motor is running, a compression leakage gauge, a Neon timing lamp and an accurate top-dead-center indicator were to be produced in 1937, in addition to Cities Service special aviation fuels and lubricants.

The Cleveland Pneumatic Tool Co., Cleveland, O., developed the principle of its Aerol strut so that in landing the impact was taken by the strut on oil immediately upon reaching the ground, then in taxiing the impacts were taken on the air. The company developed a cantilever shock absorber for large planes, such as the Lockheed, Consolidated and Kreider-Reisner amphibion. The pneumatic type Aerol strut was used on the Lockheed Orion, and Kingsford-Smith's Lockheed was equipped with it on his transpacific flight. The company also developed a pneumatic B type riveter for dural rivets an eighth of an inch in size for airplane fabrication, and a pneumatic drill with right angle attachment of one-fourth inch for special use in construction.

Curtiss Aeroplane Division of the Curtiss-Wright Corporation, Buffalo, N. Y., during 1936 delivered Curtiss electric controllable pitch propellers for airplanes operating in the United States, South America and China. The testing laboratory was constructed for service testing of various sizes of controllable pitch propellers on actual engines. Development in the actuating controls of the propeller permitted automatic operation for constant engine speeds and constant manifold pressure. Or the pilot might manually adjust the pitch indicator to a desired setting, and the propeller would automatically assume the indicated pitch. The Curtiss electric controllable pitch propeller could be feathered for improved flight on multi-engine airplanes in case one engine was out of operation. Negative pitch was also possible, lending assistance for maneuvering seaplanes while on the water. Production was also continued on the Curtiss anti-drag ring.

The Dow Chemical Company, Midland, Mich., at the end of 1936 reported the aircraft manufacturing industry among its largest users of Dowmetal, the trade name for the group of magnesium-base alloys produced by that company. The alloys contained between 85 and 99 per cent magnesium, and were particularly desirable because of their light weights, machinability and resistance to corrosion—qualities which made them increasingly popular in the manufacture of aircraft, engines and accessories.

Eclipse Aviation Corporation, East Orange, N. J., a subsidiary of

Official U. S. Navy Photo

A NEW SCOUT FOR THE NAVY

One of the Curtiss SOC-1 observation-scouting biplanes delivered to the Navy in 1936.

Bendix Aviation Corporation, developed several new types of accessories in 1936, foremost among them being hydraulic pumps providing a reliable oil pressure source for control of retractible landing gear, wing flaps, automatic pilots and other auxiliaries. The pumps were made in various capacities, and were of both engine and electric motor drive types. Reversible electric motors for operating landing gear and wing flaps, hydraulic remote control units, remote reading flowmeters, which let the pilot know at a glance his fuel consumption, and the engine synchroscope were among important Eclipse developments. The synchroscope was designed to positively synchronize all the engines on a plane, thereby reducing vibration. Eclipse de-icer equipment was made for freeing or preventing ice formations on propellers, wings, windshields and control surfaces. The Eclipse pumps are designed to operate Goodrich de-icers. The motor-driven de-icer distributing valve distributes air pressure to the de-icers in the proper rotation, and has been designed to incorporate an integral valve, which when opened closes the motor circuit and permits air to enter the de-icers. A suction regulating valve is used in conjunction with the vacuum instrument pumps for maintaining a substantially constant suction at the instruments. The propeller anti-icer pump with remote control rheostat provides for the application of ice removing fluids to the propeller hub and slinger ring. The use of the supercharger regulator or automatic mixture control relieves the pilot of frequent manual mixture and throttle adjustments necessary to prevent the exceeding of specified maximum manifold pressures. Auxiliary A. C. power supply systems have been manufactured for various types of large long range aircraft, wherein the power supply and accessory drives available are not sufficient to meet the requirements of large long range aircraft construction. The development and manufacture of new and improved types of aircraft engine starters in various capacities, including hand inertia, electric inertia, direct cranking electric, combustion, air injection and hand turning gears, completed the line of Eclipse starting equipment for all types of installations.

Edo Aircraft Corporation, College Point, N. Y., in 1936 developed a standardized amphibious float gear, thereby throwing open to the whole field of land plane private ownership the opportunity to procure practical land and water operating equipment at a minimum of trouble and expense. Owners of private land planes could acquire Edo amphibious float gear and have an amphibion without the expense of buying another machine. During 1936 a marked increase in interest toward water flying has been noted especially in the private owner field, and as manufacturers of all metal float gear for the ready conversion of standard land planes into seaplanes, Edo continued cooperating with the leading aircraft manufacturers in developing float gear for their new ships, and getting them ATC'd as seaplanes. New models of planes built by fourteen different companies were installed and test flown on Edo floats during the year giving the consumer a very wide range of choice in new seaplane types. The result of this has been greatly increased sales by the aircraft manufacturers of complete seaplane units. The private owner has realized the sport and convenience of water flying where he is not limited by man-made airports, and many are now regularly commuting from their Summer homes direct to their city offices utilizing seaplane bases in waterfront cities. At the end of 1936 more than 170 different types of ships had been equipped and flown on Edo floats. Several new designs were included in the 16 float models regularly supplied by Edo which are suitable on ships ranging from light sport planes of 1,000 pounds gross weight up to large transports weighing 18,000 pounds.

The Egyptian Lacquer Manufacturing Company, New York, continued to supply the aircraft industry with its line of clear and pig-

A BELLANCA FREIGHTER

A cargo and executive transport powered by a Wright Whirlwind engine.

mented dopes, solvents, thinners, lacquer enamels, undercoats and other finishes for fabric, metal and wood parts, including special grades made to Government and other specifications. New developments included refinements in technical points such as covering, ease of working qualities, durability and flexibility.

The Fairchild Aerial Camera Corporation, Woodside, Long Island, N. Y., a division of the Fairchild Engine and Airplane Corporation, expanded its organization and plant equipment during 1936, and added several navigating devices to its large line of instruments, including refinement and production of military and commercial cameras for all purposes. Its new navigating instruments included the Hagner position finder, for marine as well as aeronautical use, the Maxson navigation computer and the commercial models of the Kruesi radio compass, several hundred of which were delivered to the Army Air Corps in 1936. Fairchild developed the world's largest aerial camera, the Fairchild Tandem 10-Lens, for the specific purpose of minimizing the control work required in the course of the Rio Grande Survey in New Mexico for the Soil Conservation Service of the Department of Agriculture. The 10-lens camera consisted of two Fairchild T-3A five-lens cameras coordinated on a special high precision mount of aluminum alloy, highly machined and carefully heat-treated to assure accuracy.

General Electric Company, Inc., Schenectady, N. Y., continued its development program on superchargers, its test set-up measuring the power required and the exact amount of pressure rise obtained from a gear-driven supercharger at various engine speeds. Development was also continued on different types of two-stage superchargers for high altitude operation.

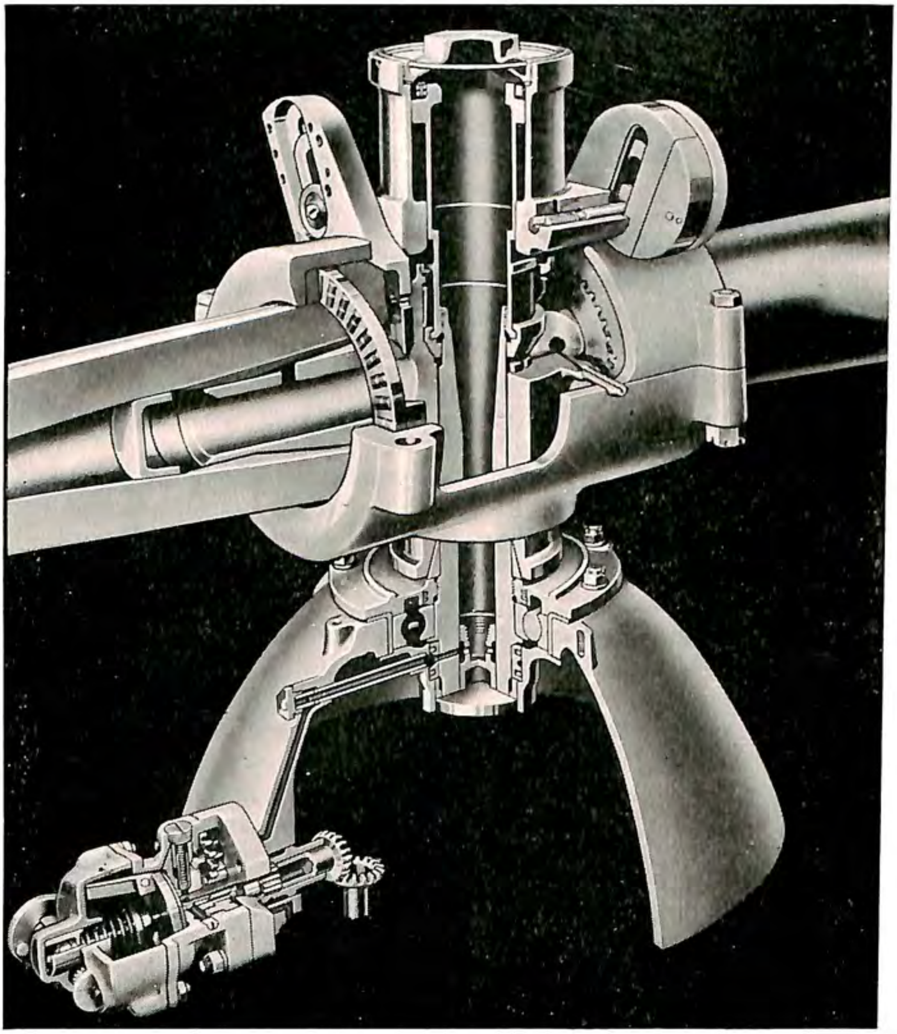
General Tire & Rubber Company, Akron, O., carried a full line of its patented General Streamline Airplane tires, designed to reduce parasitic drag and increase stability and the shock-absorbing qualities of the landing gear. The tire was produced in sizes of from 21 to 65 inches. The company also was developing a new line of Smooth Contour Streamline tires in sizes from 27 to 65 inches. A new line of aeronautical mechanical rubber goods was being manufactured in the new plant at Wabash, Ind.

The B. F. Goodrich Company, Akron, O., developed new rubber products for aviation use, continued refinements in its aircraft tires, and at the beginning of 1936 was manufacturing 50 different things for the aeronautical industry. Working with transport line technicians Goodrich engineers improved the Goodrich de-icers, particularly in the method of fastening them to aircraft surfaces where ice forms during flight. Blind riveting, made possible by a special tool for inserting the rivets, took the place of the former cement process. The company developed the "Rivnut," a hollow, threaded rivet which can be applied entirely from one side of a metal surface, and it is now in use for the mechanical installation of de-icer equipment. The Goodrich "Rivnut" can be obtained with a key underneath the head to prevent turning, and two special tools, also devised and developed by Goodrich, are available, the first to cut a seat for the key and the second, a heading tool with a threaded mandrel which engages all the threads and heads the "Rivnut" on the inaccessible side of the work. "Rivnuts" are also made with closed ends for use in sealed compartments. The Goodrich "Slinger Ring" was generally adopted for air line use. It is a system of keeping the propeller free of ice by means of a spinner over the propeller hub, which feeds an anti-freeze solution along the surfaces of the blades. The flow is controlled by an Eclipse special metering pump. The Goodrich airplane tire and brake testing department, where "laboratory landings" can be made, reproducing with accuracy what happens to tires, wheels and brakes when an airplane tire hits an airport under load, was in use consistently under the direction of tire engineers. This testing equipment was designed to record the "split second" of tire impact and to duplicate almost exactly the actual landing of an airplane in service so that causes and effects can be analyzed and construction changes recommended to improve performances and increase safety. Augmenting this test Goodrich also used the so-called "guillotine" in which tires are subjected to the impacts of a metal plunger dropping down a 96 foot shaft, the drive test in which tires are revolved at high speeds against a dynamometer and the "torture chamber" where tires are inflated with water until they burst. The Goodrich refrigerated wind tunnel, largest of its kind, in which much of the preliminary study of ice was conducted while "de-icers" were being developed, was also in use during 1936 on a number of projects of interest to commercial and military aviation. This tunnel is capable of producing a laboratory blizzard.

Goodyear Tire & Rubber Company, Akron, O., continued its development of airplane tires, tubes, wheels, brakes and brake controls to meet the constantly changing requirements of the industry. Goodyear's most important contribution in 1936 was the development of the airbrake for the huge Boeing bombers. The hydraulic brake seemed to have limitations on the larger wheels so Goodyear resorted to the use of compressed air, a feature of which was an ingenious metering device which permitted the pilot to exert the exact degree of braking power required. The Goodyear tires for the Boeing bombers were 55 inches in diameter and 19 inches wide on a 23-inch wheel. Goodyear continued producing its line of Airwheel tires in sizes from 12 by 5 by 3 inches to 45 by 20 by 10 inches, as well as special sizes for military use. The Goodyear fleet of blimps continued to make annual records for operations without an accident, at the end of 1936 having carried 236,203 passengers without injury in 2,437,413 miles of flying.

Gulf Refining Company, Inc., Pittsburgh, Pa., developed a growing market for its aviation gasoline and lubricants, and through its aviation department carried on a number of important projects in cooperation with various branches of the aviation industry.

Hamilton Standard Propellers, East Hartford, Conn., a division of United Aircraft Manufacturing Corporation, reported that its two-position controllable pitch propellers were becoming standard equipment on many air lines in the United States and other countries. Licensees for the Hamilton Standard propellers included companies in England, France, Italy, Germany and Japan. The Hamilton Standard constant speed propeller was a development of the two-position controllable pitch propeller: Instead of being limited to two positions,



THE CONSTANT SPEED PROPELLER

Cutaway view of the Hamilton Standard controllable pitch propeller and constant speed control unit.

low pitch and high pitch, the constant speed propeller provides an infinite number of pitch settings and automatically selects them as needed without attention from the pilot. It permits the engine to develop full power at any time without overspeeding, and automatically maintains constant engine r.p.m. regardless of altitude or the forward speed of the airplane. Thus, full power can be developed continuously throughout the takeoff and can be regulated as desired by the pilot at all times during flight.

The constant speed propeller is in effect the combination of the controllable propeller with an automatic unit known as the constant speed control. All the safety features of the controllable pitch propeller are retained so that the positive high pitch and positive low pitch may be adjusted to safe values which cannot be exceeded in flight.

In its operation the constant speed control acts as a governor for the engine, holding it to whatever r.p.m. the pilot may select. Any tendency of the engine to speed up or slow down is immediately counteracted by the automatic change of propeller pitch so as to prevent any variation from the r.p.m. which has been selected.

Power is controlled by means of the engine throttle in the conventional manner, but without changing r.p.m. Consequently for any setting of the constant speed control, change of power by opening or closing the engine throttle is manifested only by a corresponding change in the engine manifold pressure and not r.p.m. except of course when throttling the power to such an extent that the engine can no longer perform at the r.p.m. for which the constant speed is set, as when idling. Any combination of manifold pressure and r.p.m. may be obtained, within the operating limitations of the engine, by independent adjustment of the throttle and the constant speed control.

The control unit for the constant speed propeller is a self-contained governor which is mounted on one of the engine accessory pads or on a special pad built in the nose of the engine and driven by the engine. In it is incorporated a small gear pump. This pump takes oil from the engine lubricating system and raises its pressure to approximately two hundred pounds per square inch. A built-in relief valve regulates the pressure and returns all oil to the gear pump except what is actually required to shift the propeller pitch. Consequently only a very small quantity of oil is actually drawn from the engine, inasmuch as the propeller demands oil only when going to lower pitch settings.

The Stewart Hartshorn Company, Inc., New York, continued to supply the industry with streamline wire tie rods for external bracings manufactured by the cold reverse rolling method, the wires being drawn and cold rolled from electric furnace carbon rod, special heat-treating processes creating high tensile strength.

International Flare-Signal Company, Tippecanoe City, O., completed an important development program involving major improvements in its line of parachute flares which represent unusual features of economy, flexiblity of installation, safe and positive operation, and outstanding service efficiency. There is an "approved" International flare specially designed to meet each classification requirement of the Department of Commerce.

The J. V. W. Corporation, Newark, N. J., was organized to handle purchases of aviation equipment for foreign countries, and at the same time became sole distributor for the Link Trainer, used for instrument and radio beam flying training.

Kendall Refining Company, Inc., Bradford, Pa., continued to supply the air line and private flying trade with its line of lubricants, specializing in its Kendall 30-Hour oil.

Walter Kidde & Company, Inc., New York, announced that over 90 per cent of modern transport planes were equipped with their Lux fire control system, which is a cylinder of liquid carbon dioxide under 850 pounds of pressure released through a perforated duralumin ring surrounding the engine. The system can be arranged to operate either manually or automatically. The cylinder may be placed at any convenient point in the fuselage with the control knob on the instrument panel. When released, the carbon dioxide forms a white blanket, resembling snow, which smothers the fire. The company also manufactures portable extinguishers for airplanes and airports, life vests, life rafts, inflatable flotation systems and crash trucks.

Kollsman Instrument Company, Inc., of Brooklyn, New York, again expanded its personnel and plant facilities to keep pace with the continuing growth of its foreign, domestic, and Government business. Many improvements were made in instruments, and many new products released, resulting in a complete line of flight and engine instruments. One of the outstanding improvements was the development of a new vertical speed indicator (rate of climb) of the self-contained type. The usual separate air chamber was eliminated. Development work was continued on the Kollsman rim lighting system of lighting instruments for night flying. Among the new products released were a remote-reading magnetic tachometer, a standard magnetic tachometer, an electrically heated Pitot static tube, a remote indicating system called "Telegon", and an aperiodic compass.

Leece-Neville Company, Cleveland, O., supplied the industry with three sizes of 12-volt, voltage-regulated engine-driven generators and three sizes of two-voltage generators to supply a high voltage for aircraft radio, at the same time making available the normal voltage types.

Lycoming Division of the Aviation Manufacturing Corporation, Williamsport, Pa., was the sole licensee for the manufacture and sale of the Lycoming-Smith controllable propeller, designed to permit aircraft engines to develop rated power for all flight conditions, at most efficient blade angles and for readjustment to particular power and atmospheric conditions at any altitude. The Lycoming-Smith propeller was produced in ten models, five 2-blades and five 3-blades, in diameter sizes ranging from eight feet six inches to 13 feet, covering a complete range of direct and geared engine sizes from 200 to 800 h.p. The change in blade angle was accomplished mechanically from engine power. The blades were turned about their longitudinal axis through a

A NEW COAST GUARD TRANSPORT
Lockheed built this Electra for the flying guardians of our coasts.

series of gears operated by the rotation of the propeller shaft. To change the blade angle the propeller gears were engaged or disengaged by means of a manual control or by an electrical solenoid control. A blade pitch indicator, showing constantly the exact blade angle at which the propeller is operating, was available as special equipment with the electric solenoid control.

Macwhyte Company, Kenosha, Wis., produced a line of streamline sections, showing improvements over the older oval or lenticular sections. Stainless steel rods with better corrosion resisting properties were produced during the year.

The McCauley Aviation Corporation, Dayton, O., as exclusive licensee for the McCauley solid steel airplane propeller and of solid steel blades for controllable hubs, planned to start regular production early in 1937. The solid steel propeller blade has been under development, with the cooperation of the U. S. Army Air Corps at Wright Field, since 1932. Solid steel propellers have been in flying use for two years. Propellers have been made in sizes from 7 feet to 12 feet, and the McCauley Corporation is now building blades for an experimental 13 foot propeller. The problem of weight and rigidity in using steel has been met by use of a slightly arched blade section, with thicker distribution of metal just behind the cutting edge. The company now makes blades for propellers up to 9 feet in diameter, and expects eventually to produce blades commercially for all sizes up to 12 feet.

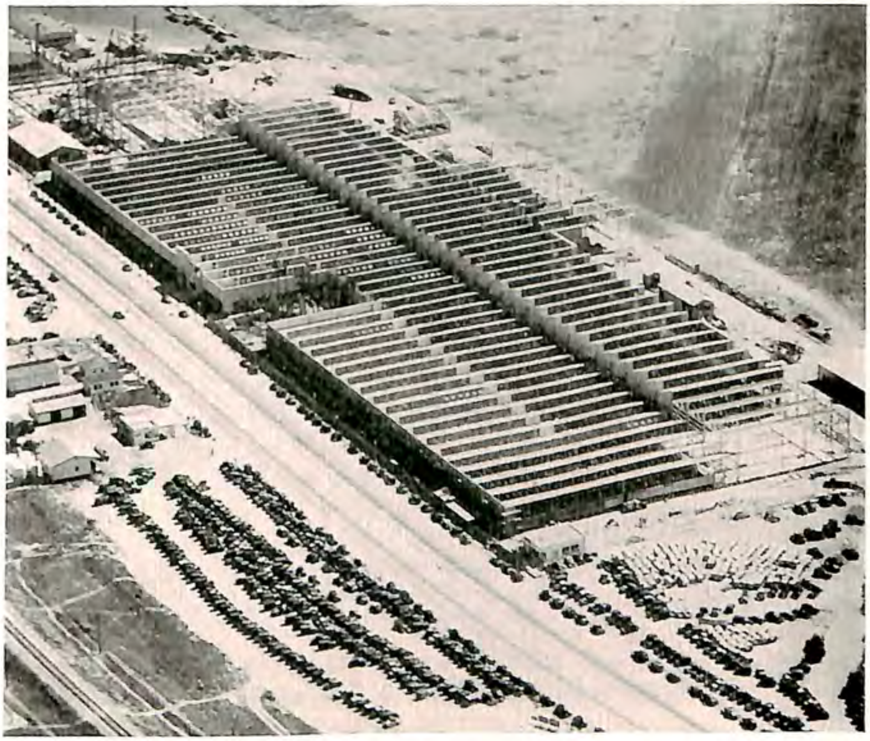
The Merrimac Chemical Company, Boston, Mass., in 1935, supplied the aircraft industry and the Government with its line of acetate fire resistant finishes, dopes, thinners, lacquers, surfacers, primers and synthetics.

Norma-Hoffmann Bearings Corporation, Stamford, Conn., in 1936 developed a number of new types of aircraft control ball bearings, including several new series of completely enclosed felt seal types with removable seals, and also extra light type ball bearings for controls.

Pacific Airmotive Corporation, Ltd., Burbank, Calif., continued to supply the market with parts and special apparatus.

Parker Appliance Company, Cleveland, O., produced its special Parker aircraft piping equipment in brass and aluminum alloys. The connections were based on flanges on each of the tube ends to be joined. The flanges were wedged between the two parts of the pipe fitting screwed together.

Pioneer Instrument Company, Inc., Brooklyn, N. Y., a subsidiary of Bendix Aviation Corporation, developed several new instruments in addition to production of its conventional line of indicators and gauges. The new Pioneer rate of climb indicator is more sensitive to changes in barometric pressure. Consequently, these instruments respond about three times faster than the conventional instrument. The Pioneer sensitive altimeter, in all ranges, is compensated for temperature and altitude changes. The special feature of this instrument lies in the direct reading barometric setting which is in no way connected with the altitude scale. The barometric reading appears in the face of the Veeder counter which enables the operator to make precise settings with ease. The Autosyn system of remote indication and transmission has been expedited for all engine functions as well as position of flaps, wheels and doors. The Autosyn system has been specified for all four-motored aircraft to be built during 1937. This system eliminates the necessity of long tachometer shafting and piping between the instrument and the source to be measured. Besides eliminating this substantial weight, Autosyn erases the recognized fire hazard in that no fuel or oil is carried into the operator's compartment. Consolidation of the indicators makes possible the accommodation of the required instruments on the standard instrument panel. The Pioneer compass, type 941, resolves the unique features of the periodic compass to meet



A MODERN AIRPLANE FACTORY
The great Consolidated Aircraft plant at San Diego, Calif.

the strict requirements for an accurate and stable piloting compass. This unit is indirectly lighted and carries the new universal compensator. The compensating magnets revolve only in a horizontal plane, thus the vertical component remains constant. Compass 941 may be conveniently mounted on the panel within the AN standard dimensions.

Pittsburgh Screw & Bolt Corporation, Pittsburgh, Pa., produced seven different designs of its Dicks hollow steel propeller blades as standard equipment for the Army and Navy, using both adjustable and the latest type of controllable pitch hubs. In diameter the designs ranged between seven feet nine inches for 200 h.p. engines to 13 feet for the 800 h.p. geared engines. All seven designs incorporated results of the latest Government research in resonant vibration frequencies in propeller blades. They were of the welded type, made of special electric furnace chrome vanadium steel and heat-treated after fabrication. During fabrication they were tested by the magnaflux method, which unfailingly reveals any serious defect in the steel or weld of a blade. Constructed of materials which resist corrosion and abrasion the Dick blades were adapted to the new hub designs, because bearing races might be located directly on the blade shank and the buttress threads carrying the centrifugal loads could be cut directly on the shank. At the beginning of 1937, they were being used by the Army, Navy and air lines.

The Pyle-National Company, Chicago, continued to supply the industry with airport and aircraft lighting apparatus, which was standard equipment on several air lines.

RCA Manufacturing Company, Inc., Camden, N. J., a subsidiary of Radio Corporation of America, through its aviation radio section at the beginning of 1937 was developing and improving radio apparatus to reduce the cost of radio communication equipment for air lines, airports and private owners. RCA airport radio traffic control apparatus was supplied to many leading airports in 1936. A new line of equipment for the private owner was produced in the forms of AVR-7 aircraft weather-entertainment receiver and AVR-7-A weather communications receiver and AVT-3-A transmitter. Multi-frequency air line point-to-point and ground-to-ship transmitter equipment was supplied to many air transport companies, including ship receivers types AVR-3 communications, AVR-2 weather and AVR-5 all wave ground station receiver. Crossed loop runway localizers forming an attachment to the standard AVT-1-A airport traffic control transmitter, superseding the AVT-1, were installed at Floyd Bennett Field, New York, and Cleveland Municipal Airport. The trend of the RCA development was to produce non-obsolescent equipment capable of use with improved apparatus year after year. Among developments under way at the beginning of 1937 were equipment for applying facsimile transmitter apparatus to existing point-to-point circuits on the surface, thereby speeding up transmission of that traffic and placing it definitely in a secrecy band. That equipment also was intended to materially reduce interference caused by closely allied frequencies as well as to permit a reduction in personnel at certain outlying point-to-point stations. Modifications of the facsimile equipment were to be developed for mounting in aircraft, as a means of providing typed, written or drafted instructions directly to the pilot without any necessity for decoding.

John A. Roebling's Sons Company, Trenton, N. J., continued to supply the industry with special control cables, welding wire and other wire rope accessories.

Scintilla Magneto Company, Inc., Sidney, N. Y., a subsidiary of Bendix Aviation Corporation, produced the following products for the aircraft industry; single magnetos, double magnetos, battery ignition sets, switches, spark plugs and radio shielded wiring harness.

BELLANCA SENIOR SKYROCKET

Built for the Mexican National Construction Company for executive and personnel transport.

Scintilla magnetos differ from conventional types in having the magnet rotating with coil, breaker and condenser stationary. The coil windings are sealed into hard rubber casings which makes them moistureproof. Both the magnet shaft and the distributor shaft run on ball bearings which have sealed-in lubricant. The platinum breaker contacts are mounted in patented pivotless breakers which are unaffected by vibration. The majority of present day aircraft magnetos are radio shielded in order to prevent ignition noises from interfering with radio reception. Double Scintilla magnetos have one drive shaft and one rotating magnet but two coils and two breakers. They generate two simultaneous sets of sparks for each cylinder of the engine, distribution being through separate distributor heads mounted independently on the engine. These magnetos generate four sparks per rotation of the magnet shaft, which is driven at whatever ratio is needed to produce the required number of sparks. The distributor heads are driven at one-half crankshaft speed in all cases. A new type of magneto for light aircraft engines of 2 to 6 cylinders was placed on the market during 1936. Scintilla battery ignition types differ from automotive timers in many respects. Ball bearings are used throughout, with lubricant sealed in so that it needs no replenishing for many hundreds of hours of operation. Both timers and coils are radio shielded and are supplied for either six or twelve volts. As with magneto systems, two independent sets are used per engine, each timer sparking a separate set of plugs. Scintilla ignition switches are available in practically every possible combination which may be required. Either two magnetos per engine or two battery ignition sets or one magneto with one battery ignition set can be used. Switches are supplied for use with 1, 2, 3 or 4 engines per plane. On any of these switches, all ignition circuits may be made instantly inoperative by pulling a single emergency button. Bendix H-T spark plugs are made in a variety of types, both shielded and unshielded. Bendix shielded wiring harness sets have been designed with simplicity, light weight and ease of installation particularly in view.

Shell Petroleum Corporation, St. Louis, Mo., the Shell Oil Company in the west and Shell Union Oil Corporation, New York, in 1936 sponsored the introduction of two types of fuel; first, high octane unleaded gasoline, and, secondly, high octane fuels with minimum lead content. To this end, the following special fuels were produced: 1. Shell aviation gasoline, 80 octane (C.F.R. Motor Method) unleaded; 2. Shell aviation gasoline, 92 octane (U.S. Air Corps Method) unleaded; 3. Shell ethyl aviation gasoline, 87 octane (C.F.R. Motor Method) of low lead content; approximately ½ cc of tetraethyl lead per gallon; 4. Shell ethyl aviation gasoline, 100 octane (U. S. Air Corps Method). This fuel contains a maximum of 3 cc's of tetraethyl lead to a gallon. The unleaded and low lead content fuels were developed to eliminate or reduce the corrosive effects of lead on the engine parts, thereby materially reducing the maintenance expense. Shell 100 octane Aviation Gasoline enables the operator to obtain the maximum horsepower from his powerplant and will permit more economical fuel consumption, as well as increased output in engines especially designed for this fuel. In 1936 the Shell Union Oil Corporation of New York purchased a new model Stinson Reliant powered with a Lycoming engine and fitted with a Lycoming-Smith controllable pitch propeller. An order was placed with the Seversky Aircraft Corporation for a modified Seversky monoplane to be powered by a Wright G-5 Cyclone and fitted with a Hamilton Standard constant speed propeller. This airplane, was for the personal transportation of Major J. H. Doolittle, the head of Shell's aviation activities in the United States. It was fully equipped with a two-way radio system, auxiliary two-way radio, radio direction finder, Sperry gyro-pilot, de-icers, propeller de-icing device, oxygen equipment, and the usual flight instruments. Many extra engine and temperature recording instruments were provided, as the plane was to be used as a flying laboratory for the testing of Shell aviation products under actual flight conditions.

Sinclair Refining Company, New York, developed the Sinclair

NORTH AMERICAN OBSERVATION

A fast Cyclone-powered ship built for the Army Air Corps by North American Aviation.

Hamilton Propeller Lubricant 228, to maintain a film at all times between the spider arm and the bushing inside the blades of Hamilton Standard controllable pitch propellers. Engineers of the Sinclair Bureau of Standards developed a special lubricant designed to eliminate difficulties in rocker arm lubrication, known as Sinclair Pennsylvania Gear Oil SAE 250. They also developed the Sinclair Pennsylvania Aircraft Motor Oil as an engine lubricant meeting the requirements of the new motors used in air transportation. Sinclair aircraft products were used by the U. S. Navy and leading air lines.

Socony-Vacuum Corporation, New York, marketed its products developed for aviation, including lubricants and a fuel refined especially for aircraft engines and possessing exclusive climatic control characteristics.

Solar Aircraft Company, Ltd., San Diego, Calif., continued manufacture of exhaust collector manifolds and other aircraft parts and accessories. The company had specialized for a number of years on the design and construction of stainless steel exhaust rings, and manufacturers throughout the country made use of the services offered. Among the prominent new ships built during 1936 for which the company supplied collector rings were the Douglas DC-3, Northrop Deltas and Gammas, Lockheed Electra, Sikorsky S-42, Martin flying boats and many single experimental planes built for commercial or military use. While stainless steel was used on the bulk of the rings manufactured, remarkable success was attained with a special iron alloy. Experiments were conducted on the corrosion resistance of nickel-chromium alloy.

Sperry Gyroscope Company, Inc., Brooklyn, N. Y., developed the gyro-magnetic compass, a flight instrument which indicates the magnetic compass course. It combines the principles of the card type magnetic compass and the directional gyro within a single instrument. Bringing together the north indicating facility of the magnetic compass and the virtual fixity of plane of spin of the gyroscope, the gyromagnetic compass is capable of seeking and maintaining an accurate and steady indication of compass course during straight flight or any normal maneuver of the airplane. This is accomplished by utilizing the stability of the gyro to maintain the double pivoted axis of the magnetic element always vertical. The magnetic element in the gyro-magnetic compass performs the double function of pointing north and causing precessional forces to be imposed upon the gyro through the medium of air jets. The effect of these jets is to orient the gyro and its compass card until all forces are balanced, at which time the instrument reads the magnetic heading.

Production was started on a new series of gyropilots, incorporating, among other refinements, a new level flight control capable of maintaining aircraft at a set altitude with but slight variation. The new gyropilot is also equipped with a valve which, when turned right or left, automatically sets a fixed rate of turn until the valve is again centralized. A new type gyro-horizon has been developed for airplanes frequently flown in aerobatics or other extreme maneuvers beyond the limits of the standard instrument. This instrument is known as the caging type, and incorporates a device by which the gyro may be locked in a central position during the maneuver and released immediately after normal flight is resumed. The face of the gyro-horizon has been revised to provide a solid black background with two parallel lines forming the horizon indication in place of the blue and black background with single wide radium horizon bar on previous models. This makes the gyro-horizon similar in appearance and identical to the gyropilot in relative movement. The company soundproofed many air liners for Air France in 1936.

Stanavo Specification Board, Inc., New York, organized in 1929 by the Standard Oil companies of California, Indiana and New Jersey, continued its research and development work directed toward the progressive improvement of aviation fuels and lubricants. A new 100 octane fuel was developed and placed on the market. It was the result of special refining processes which made possible that high anti-knock quality with a minimum quantity of lead. The new aviation

AN EASTERN AIR LINES LOCKHEED
Instrument panel showing Sperry gyro-horizon and directional gyro.

gasoline, 100 octane, was named Stanavo Ethyl Gasoline 100. It was supplied to the Army Air Corps for use in high-speed military planes, to engine manufacturers and air lines for special tests and to others for record flights and racing purposes. The increased power made possible by that fuel, as demonstrated by actual tests in Army planes, was from 25 to 33 per cent. The advantage gained in air transport operations, for take-off purposes, was clearly recognized. Nine grades of aviation fuels were marketed by the Stanavo distributors, including leaded and unleaded gasoline covering all kinds of aircraft operations. Five grades of aviation oil, ranging from 60 to 140 Salbolt viscosity, were made available to the industry, in addition to the regular line of rocker arm greases, two new rocker arm lubricants of 3,000 and 300 seconds viscosity respectively, and specialty products, including magneto oil, compass fluid and utility oil. The Board continued its policy of expanding its distribution facilities to include all points of aviation interest throughout the world, and a large majority of the important flights of the year were serviced by the Stanavo distributing system.

The Standard Oil Company of California, a member of the Stanovo Specification Board, announced appointment of Richard F. Bradley as manager of the aviation department, and continued to supply fuels and lubricants to air lines and other aeronautical interests on the West Coast, maintaining a close contact with the industry there and in the Territories of Alaska and Hawaii. Of particular interest was their close association with Pan American Airways in the supplying of petroleum products necessary for the development and maintenance of this company's new trans-Pacific airmail and passenger service to the Orient.

The Steel Products Engineering Company, Springfield, O., was among the active concerns supplying the industry with special machinery, tools and aircraft parts, including fuel level signal devices, automatic fuel valves and gasoline segregators which positively removed water and other impurities from the fuel supply.

Superior Tube Company, Norristown, Pa., manufactured fuel line tubing for aircraft engines and also other specialties for the aviation industry. Much of its development work has had to do with heat-treating stainless steels. The management of the company is under S. L. Gabel, one of the pioneers in the field of aircraft tubing.

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. An improved lubricant was marketed in 1936. The company operated a fleet of three planes.

Thompson Products, Inc., Cleveland, O., produced for the aircraft engine trade valves of several types, including tungsten, cobalt-chrome and silchrome in both solid and hollow stem forms; also valve insert seats, piston pins and valve stem locks. The Thompson latest sodium-cooled valve had a hollow head as well as a hollow stem. It was made of TPA steel alloy, inlaid on seat and stem tip with Steelite. The sodium in the stem became liquid at 200 degrees, splashing and cooling the entire inside surface as the valve operated.

Thurston Cutting Corporation, New York, marketed its special line of Dartmouth Tex airplane fabric and other accessories.

United Aircraft Products, Inc., Dayton, O., continued their line of AN standard aircraft parts and accessories, oil temperature regulators, gun and bomb controls, electrical conduit boxes and electrical fittings. The company specializes in aircraft fuel system and power plant equipment.

The Vellumoid Company, Worcester, Mass., marketed its new No. 170 Velvestos sheet, compressed asbestos material for use on magnesium or aluminum castings where corrosion is a factor. It also supplied the industry with various packing and gaskets for oil, gasoline, air and water application.

Western Electric Company, Inc., New York, provided the industry and private owners with radio communication facilities, including the 20A aviation radio receiver, which in a single unit embodies superheterodyne reception on four frequency bands. The first band is for beacon and weather stations from 200 to 400 kilocycles. The second band is for commercial broadcast stations from 550 to 1,500 kilocycles. The third band is for aircraft, police and amateur communications from 1,500 to 4,000 kilocycles. The fourth band is for aircraft and amateur communications and foreign broadcast stations from 4,000 to 10,000 kilocycles. In this model the controls are mounted directly on the front panel of the receiver case. The 20B receiver is similar in all respects except that it is arranged for remote control, so that the receiver may be installed in some recess of the plane, with the small control unit mounted either on the instrument panel before the pilot or anywhere within convenient reach of his position. A two-frequency crystal control unit may be had as an accessory to either of these receivers for definite day and night communication frequencies between planes and ground stations, avoiding the "tuning" operation when it is desired to use these channels. The new 13C transmitter is an improved radio telephone-telegraph unit for use in planes, with an output of 50 watts, and is the type used by Harry Richman and Dick Merrill in their trans-Atlantic plane "Lady Peace", which enabled them to maintain direct communication with Newark Airport up to 2,100 miles, at which time they continued their communications via London. The new 631-B microphone designed for use with airplane radio equipment has special characteristics which make it ideal for voice operation in this service. The 14A beacon receiver is designed for installation in planes, so that the pilot may follow radio beams when poor visibility makes "blind" flying necessary. It is very light and compact in construction, and has been designed for maximum reliability. The new 14C airport transmitter has an output of 400 watts, can be used for both telegraph and telephone communication and has facilities for crystal controlled transmission on 10 different frequencies. The shift from one frequency to another is quickly and conveniently accomplished by means of a dial of the familiar telephone type.

INTERIOR OF THE SIKORSKY S-43

Looking forward in the multi-engine land and water amphibion transport. It seats 16 passengers.

Aviation Chronology and Records

CHRONOLOGY FOR 1936

Jan. 10-Feb. 14	Lieut. Antonio Menendez flies from Havana, Cuba, to Seville, Spain, by way of South America. (Lockheed Sirius, Pratt & Whitney Wasp engine.)
Jan. 13-14	Howard Hughes flies from Burbank, Calif., to Newark, N. J., in 9 hrs. 26 min. 10 sec., making west-east record and non-stop transcontinental record. (Northrop Gamma, Wright Cyclone engine.)
Jan. 16	Wright Brothers Medal for 1935 awarded by Society of Automotive Engineers to William Littlewood for paper on "Operating Requirements of Transport Airplanes."
Jan. 16	Guy E. Beardsley receives Manly Memorial Medal from Society of Automotive Engineers for paper on engines.
Jan. 20	Cheney Award for 1935 presented to Lieut. Robert K. Giovannoli, U. S. Army Air Corps, for "extreme bravery in rescuing two men from a wrecked and burning airplane at Wright Field, on October 30, 1935."
Jan. 22	Herbert Schiff Memorial Trophy for the fiscal year 1935 presented to Training Squadron VN2D8, U. S. Naval Air Station, Pensacola, Fla.
Jan. 30	Sylvanus Albert Reed Award for 1935 presented to Frank W. Caldwell by Institute of the Aeronautical Sciences for his work on propellers.
Feb. 1	Twenty-two air lines consolidate their express business under the Railway Express Agency.
Feb. 1	Terris C. Moore makes world altitude record for light seaplanes in the third category of 11,558.364 feet at Boston, Mass. (Aeronautical Corporation Aeronca C-3, Aeronca E113-B engine.)
Feb. 1	Helen Richey makes women's world speed record for 100 kms. for light airplanes in the fourth category of 72.224 m.p.h. at Hampton Roads, Va. (Aeronautical Corporation Aeronca C-2, Aeronca E-113-A engine.)
Feb. 1-9	National Pacific Aircraft and Boat Show held at Los Angeles, Calif.
Feb. 6-9	Thomas Rose flies from Lympne, England, to Capetown, South Africa, in 3 days, 17 hrs. 38 min., making new speed record. (Miles Falcon, De Havilland Gypsy engine.)
Feb. 11	Iona Coppedge and Josephine Garrigus set women's world altitude record for light airplanes in the third category of 15,252.579 feet. (Aeronautical Corporation Aeronca, Aeronca E-113-A engine.)
Feb. 16	New Douglas DST sleeper planes enter air line service.
Feb. 18	Jack Frye flies from Chicago, Ill., to Washington, D. C., in 4 hrs. 22 min., making new intercity speed record for transport airplanes. (Northrop Gamma, Wright Cyclone engine.)
Mar. 3-9	Thomas Rose flies from Capetown, South Africa, to Croydon, England, in 6 days, 7 hrs. 5 min., making new record. (Miles Falcon, DeHavilland Gypsy engine.)
Mar. 31-Apr. 10	Airship "Hindenburg" makes round trip flight between Friedrichshafen, Germany, and Rio de Janeiro, Brazil.
Apr. 14	Boris Sergievsky makes amphibion world altitude record of 24,950.712 feet at Stratford, Conn., also making record for amphibions with payload of 500 kgs. (Sikorsky S-43, 2 Pratt & Whitney Hornet engines.)
Apr. 15	Hubbard Gold Medal awarded by National Geographic Society to Lincoln Ellsworth for "his heroic and extraordinary achievements in Arctic and Antarctic exploration 1925-1936.
Apr. 17	Captain Edwin C. Musick is awarded Harmon Trophy for 1935 for pioneering work in establishing Pan American's air line across the Pacific.

Apr. 17	Amelia Earhart and Jean Batten share award of Harmon Trophy for women.
Apr. 21	Howard Hughes flies from Miami, Fla., to Floyd Bennett Field, N. Y., in 4 hrs. 21 min. 32 sec., making intercity speed record. (Northrop Gamma, Wright Cyclone engine.)
Apr. 24	Benjamin King makes world altitude record for light airplanes in the fourth category of 17,939.578 feet at Langley Field, Va. (Aeronautical Corporation Aeronca C-3, Aeronca E-113-A engine.)
Apr. 25	Boris Sergievsky makes amphibion world altitude record of 19,625.925 feet with payload of 2,000 kgs. making record also in 1,000 kgs. payload classification, at Stratford, Conn. (Sikorsky S-43, 2 Pratt & Whitney Hornet engines.)
Apr. 26	Benjamin King makes world speed record for airplanes in the fourth category for 500 kms. of 74.817 m.p.h. at Hampton Roads, Va. (Aeronautical Corporation Aeronca, Aeronca engine.)
Apr. 26	Annette Gipson, with Mrs. John Buckman as passenger, sets women's American altitude record for light airplanes in the first category of 12,627.915 feet at Fort Lauderdale, Fla. (Lambert Monocoupe, Lambert engine.)
Apr. 29	Orville Wright elected a member of National Academy of Science.
May 4-7	Amy Mollison flies from Lympne, England, to Capetown, South Africa, in 3 days, 6 hrs. 26 min., making a new speed record. (Percival Gull, DeHavilland Gypsy engine.)
May 5-6	Robert D. Buck and Lee Bellingrath make world airline distance record for light airplanes in the first category of 1,986.942 miles from Burbank, Calif., to Columbus, Ohio. (Lambert Monocoupe, Lambert engine.)
May 6-Oct. 10	Airship "Hindenburg" makes ten round trip crossings of the Atlantic between Friedrichshafen, Germany, and Lakehurst, N. J., carrying passengers, mail and express.
May 9	Helen Richey makes women's world altitude record for light airplanes in the fourth category of 18,448.107 feet at Hampton Roads, Va. (Aeronautical Corporation Aeronca, Aeronca E-113-A engine.)
May 10	Daniel Guggenheim Medal for 1936 awarded to Dr. George W. Lewis, National Advisory Committee for Aeronautics, for "outstanding success in the direction of aeronautical research and for the development of original equipment and methods."
May 10-15	Amy Mollison flies from Capetown, South Africa, to Croydon, England, in 4 days, 16 hrs. 16 min., making a new speed record, and also making a new speed record for the round trip of 7 days, 22 hrs. 43 min. (Percival Gull, DeHavilland Gypsy engine.)
May 12	The world's largest high speed wind tunnel is opened at the Langley Field Laboratories of the National Advisory Committee for Aeronautics.
May 14	Howard Hughes flies from Chicago, Ill., to Glendale, Calif., in 8 hrs. 10 min. 25 sec., setting new intercity speed record. (Northrop Gamma, Wright Cyclone engine.)
May 23	Empire Air Day celebrated at Royal Air Force stations in England.
May 27	Wilson L. Mills and Constance Righter make American airline distance record for light airplanes in the third category of 717.061 miles from Miami, Fla., to Winston-Salem, N. C. (Aeronautical Corporation Aeronca, Aeronca engine.)
June 12	Rear Admiral Arthur B. Cook is appointed Chief of the Bureau of Aeronautics, U. S. Navy.

June 20-July 5	Soaring Society of America holds seventh annual meet at Elmira, N. Y.
June 23	Mackay Trophy presented to Major Albert W. Stevens and Captain Orvil Anderson, U. S. Air Corps, for their stratosphere flight of 72,394 feet in the National Geographic-Army Air Corps stratosphere balloon "Explorer II" on November 11, 1935.
June 23	Maryse Hilsz sets women's world altitude record of 46,948.725 feet at Villacoublay, France. (Potez 506 biplane, Gnome-Rhone engine.)
June 25	Helen MacCloskey, pilot, and Mrs. Monro MacCloskey, passenger; set women's world distance record for light airplanes in the first category of 524.126 miles from Chicago, Ill., to Endless Caverns, Va. (Lambert Monocoupe, Lambert engine.)
June 27	U. S. Post Office Department settles air mail suits for $601,511.08, with Northwest Airways, Western Air Express, Transcontinental & Western Air and American Airways.
June 27	Seventeenth Annual Royal Air Force Display held at Hendon, England.
June 29	Major General Frank M. Andrews and Major John Whiteley set world's distance record for amphibions, flying non-stop 1,429.685 miles from San Juan, Puerto Rico, to Langley Field, Va. (Douglas YOA-5, 2 Wright Cyclone engines.)
June 30-July 2	Airship "Hindenburg" makes record east-west crossing of the Atlantic from Friedrichshafen, Germany, to Lakehurst, N. J., in 52 hrs. 49 min.
July 2	Collier Trophy for 1935 presented to Donald W. Douglas for the development of the Douglas DC-2 transport airplane.
July 3	Henry Ford buys for Greenfield Village exhibit, Dearborn, Mich., the old shop in Dayton, O., where the Wright brothers invented the airplane.
July 3-5	National Balloon Races held at Denver, Colo.
July 4	R. A. Kling sets world speed record for 100 kms. of 227.793 m.p.h. for light airplanes in the second category at Denver, Colo. (Keith-Ryder "Special," Menasco engine.)
July 11	Kings Cup Race won by Charles C. Gardner at 164.5 m.p.h. in England. (Percival Gull, DeHavilland Gypsy engine.)
July 30	Annette Gipson sets women's world speed record for 100 kms. of 123.247 m.p.h. for light airplanes in the second category at Newark, N. J. (Lambert Monocoupe, Lambert engine.)
Aug. 1	Louis Bleriot, one of the pioneers in aviation and the first man to fly across the English Channel, dies in Paris, France.
Aug. 1	Fritz Sterling sets South American speed record for transport planes flying from Mendoza, Argentina, to Buenos Aires, Argentina, average speed of 188 m.p.h. (Douglas DC-2, 2 Wright Cyclone engines.)
Aug. 8	Margaret Tanner makes women's world speed record for 100 kms. of 66.672 m.p.h. for seaplanes in the second category. (Aeronautical Corporation Aeronca, Aeronca engine.)
Aug. 9-11	Airship "Hindenburg" makes record west-east crossing of the Atlantic from Lakehurst, N. J., to Friedrichshafen, Germany, in 42 hrs. 53 min.
Sept. 2-3	Harry Richman and Henry T. (Dick) Merrill fly from Floyd Bennett Field, New York, to Llwyncelyn, Wales, in 18 hrs. 38 min. on an attempted flight to London. (Airplane Development Vultee, Wright G Cyclone engine.)
Sept. 4	Louise Thaden and Blanche Noyes make women's east-west transcontinental speed record flying from Floyd Bennett Field, New York, to Los Angeles, Calif., in 14 hrs. 55 min. 1 sec. (Beechcraft, Wright Whirlwind engine.)

Sept. 4-5	Mrs. Beryl Markham flies from Abingdon, England, to Baleine, Nova Scotia, on an attempted flight to New York, in 24 hrs. 30 min. (Percival Vega Gull, DeHavilland Gypsy engine.)
Sept. 4-8	National Air Races held at Los Angeles, Calif.
Sept. 13	Deutsch de la Meurthe Cup Race won by Yves Lacombe at an average speed of 243 m.p.h. at Etampes Aerodrome, France. (Caudron, Renault engine.)
Sept. 14-15	Harry Richman and Henry T. (Dick) Merrill fly from Southport Beach, England, to Musgrave Harbor, Newfoundland, on attempt to reach New York non-stop. (Airplane Development Vultee, Wright G Cyclone engine.)
Sept. 28	Squadron Leader F. R. D. Swain makes world altitude record of 49,944.121 feet at Farnborough, England. (Bristol "Special," Bristol Pegasus engine.)
Sept. 29-Oct. 1	England-to-Johannesburg, South Africa, air race won by Charles W. A. Scott and Giles Guthrie in 52 hrs. 56 min. (Percival Gull, DeHavilland Gypsy engine.)
Oct. 1-19	H. R. Ekins, New York World-Telegram, completes round-the-world trip in 18 days, 14 hrs. 56 min., traveling the 25,000 miles by air.
Oct. 5-11	Jean Batten flies solo from Lympne, England, to Port Darwin, Australia, in a record time of 5 days, 21 hrs. 3 min. (Percival Gull, DeHavilland Gypsy engine.)
Oct. 5-16	Jean Batten makes first solo flight from England to New Zealand in 11 days, 1 hr. 25 min. (Percival Gull, DeHavilland Gypsy engine.)
Oct. 6-7	Kurt Bjorkvall flies from Floyd Bennett Field, New York, on projected flight to Stockholm, Sweden, but is forced down in the Atlantic ocean off the Irish coast and is picked up by a fishing boat. (Bellanca Pacemaker, Pratt & Whitney Wasp engine.)
Oct. 7-24	Pan American Airways System opens new passenger service across Pacific to Manila carrying five newspaper men on a round trip flight.
Oct. 17	Mitchell Trophy Race won by Lieut. John M. Sterling, U. S. Army Air Corps, at a speed of 217.546 m.p.h. at Selfridge Field, Mich. (Consolidated PB-2, Wright engine.)
Oct. 21	Pan American Airways System opens regular commercial passenger service across the Pacific from California to Manila.
Oct. 23	The "Philippine Clipper" lands at Macao on survey flight from Manila to complete Pan American Airways route across the Pacific from California to the Orient.
Oct. 28-30	Capt. James A. Mollison flies from Floyd Bennett Field, New York, to Croydon Airport, London, England, via Newfoundland making a record for the flight from Newfoundland to Croydon of 13 hrs. 17 min. (Bellanca Flash, Pratt & Whitney Wasp engine.)
Nov. 2	John H. Shobe makes new speed record from New York to Boston flying the 190 miles in 50 min. 30 sec. at an average speed of 227.5 m.p.h. (Beechcraft, Jacobs engine.)
Nov. 4	"Hawaiian Clipper" arrives at Alameda, Calif., completing first regular passenger flight to Manila and return.
Nov. 18	André Japy flies from Paris, France, to Hanoi, China, in 50 hrs. 59 min. 49 sec. making world record. (Caudron Simoun, Renault engine.)

Nov. 29-Dec. 4	Captain James A. Mollison and Edouard Corniglion-Molinier fly from Croydon, England, to Weisdrift, South Africa, in an attempt to break the speed record to Capetown. (Bellanca Flash, Pratt & Whitney Wasp engine.)
Dec. 9	Columbian Trophy presented to the third attack group, U. S. Army Air Corps, at Barksdale Field, La., for best safety record in flying for the year.
Dec. 10-12	Ninth annual All-American Air Maneuvers held at Miami, Fla.
Dec. 14	Major Alexander P. deSeversky flies from Floyd Bennett Field, New York, to Miami, Fla., in 5 hrs. 46 min. 30 sec. making new speed record. (Seversky Sev 3, Wright G Cyclone engine.)
Dec. 17	The thirty-third anniversary of the Wright Brothers first flight at Kitty Hawk, N. C., celebrated in a national aviation day.
Dec. 19	Major Alexander P. deSeversky makes a new world's amphibion speed record for 100 kms. of 209.40 m.p.h. at Miami, Fla. (Seversky Sev 3, Wright G Cyclone.)
Dec. 30	Maryse Bastie makes solo flight from Dakar, Senegal, to Natal, Brazil, in 12 hrs. 5 min., a new record. (Caudron Simoun airplane, Renault engine.)

OFFICIAL AIR RECORDS

Established under Rules and Regulations of the

FEDERATION AERONAUTIQUE INTERNATIONALE

Translated and Compiled by the Contest Committee, The National Aeronautic Association, Washington, D. C.
January 23, 1937

OFFICIAL WORLD AIR RECORDS

World records are defined as maximum performance regardless of the class or type of aircraft used.

MAXIMUM SPEED OVER A 3 KILOMETER COURSE 709.209 km.p.h. (440.681 m.p.h.)
Francesco Agello, Italy, October 23, 1934.
AIRLINE DISTANCE........................9,104.700 kilometers (5,657.387 miles)
M. Rossi and P. Codos, France, August 5, 6, and 7, 1933.
DISTANCE, CLOSED CIRCUIT................10,601.480 kilometers (6,587.441 miles)
Bossoutrot and Rossi, France, March 23, 24, 25 and 26, 1932.
ALTITUDE ....22,066 meters (72,394.795 feet)
Capt. Orvil A. Anderson and Capt. Albert W. Stevens, U. S. Army Air Corps, United States, November 11, 1935.
CIRCUIT OF WORLD ....(No record established)
AIRLINE DISTANCE WITH REFUELING....................(No record established)

OFFICIAL INTERNATIONAL AND NATIONAL "CLASS" RECORDS

AIRPLANES—CLASS C

DISTANCE, CLOSED CIRCUIT

International Record..........................10,601.480 kilometers (6,587.441 miles)
Bossoutrot and Rossi, France, Bleriot 110 Monoplane, Hispano-Suiza 500 HP engine, March 23-26, 1932.

National (U.S.) Record............................4,050 kilometers (2,516.55 miles)
Lts. Kelly and Macready, USA, T-2 airplane, Liberty 375 HP engine, Dayton, Ohio, April 16 and 17, 1923.

DISTANCE, AIRLINE

International Record...........................9,104.700 kilometers (5,657.387 miles)
M. Rossi and P. Codos, France, Bleriot-Zapata monoplane, "Joseph Le Brix," Hispano-Suiza 500 HP engine, from Floyd Bennett Field, Brooklyn, New York, U. S. A., to Rayack, Syria, August 5, 6, and 7, 1933.

National (U.S.) Record.........................8,065.736 kilometers (5,011.800 miles)
Russell N. Boardman and John Polando, Bellanca monoplane, Wright J-6 300 HP engine, from Brooklyn, New York, to Istanbul, Turkey, July 28, 29, and 30, 1931.

DISTANCE, BROKEN LINE

International Record...........................9,106.330 kilometers (5,658.400 miles)
M. Rossi and P. Codos, France, Bleriot-Zapata monoplane, "Joseph Le Brix," Hispano-Suiza 500 HP engine, from Floyd Bennett Field, Brooklyn, New York, U. S. A., to Rayack, Syria, August 5, 6, and 7, 1933.

National (U.S.) Record..None established.

ALTITUDE

International Record ....15,223 meters (49,944.121 feet)
Squadron Leader S. R. D. Swain, Great Britain, Bristol "Special" Monoplane, Bristol "Pegasus" P. E. 65 490 HP engine, at South Farnborough, September 28, 1936.

National (U.S.) Record................................13,157 meters (43,165.880 feet)
Lt. Apollo Soucek, Wright "Apache," Pratt and Whitney 450 HP engine, at Anacostia, D. C., June 4, 1930.

MAXIMUM SPEED

International Record.........................Speed, 567.115 km.p.h. (352.388 m.p.h.)
Howard Hughes, United States, Hughes "Special" monoplane, Pratt & Whitney Wasp Junior 1000 HP engine, Santa Ana, California, September 13, 1935.

National (U.S.) Record...Same as above.

SPEEDS FOR SPECIFIED DISTANCES WITHOUT PAY LOAD

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record.........................Speed, 476.316 km.p.h. (295.969 m.p.h.)
Maurice Arnoux, France, Caudron C.460 monoplane, Renault 360 HP engine, Chartres-Bonce-Etampes course, August 10, 1935.

National (U.S.) Record.......................Speed, 428.138 km.p.h. (266.032 m.p.h.)
J. R. Wedell, Wedell-Williams monoplane, Pratt & Whitney Wasp 800 HP engine, New Orleans, Louisiana, February 17, 1934.

SPEED FOR 1000 KILOMETERS (621.369 MILES)

International Record.........................Speed, 450.371 km.p.h. (279.847 m.p.h.)
Raymond Delmotte, France, Caudron C.460 monoplane, Renault 360 HP engine, Istres, August 24, 1935.

National (U.S.) Record.......................Speed, 308.470 km.p.h. (191.674 m.p.h.)
D. W. Tomlinson, pilot; J. S. Bartles, co-pilot; Douglas DC-1 monoplane, 2 Wright Cyclone 710 HP engines, Floyd Bennett Field—Bolling Field—Willoughby Spit—Floyd Bennett Field course, May 18, 1935.

SPEED FOR 2000 KILOMETERS (1242.739 MILES)

International Record........................Speed, 380.952 km.p.h. (236.712 m.p.h.)
Attileo Bisco and Gori Castellani, Italy, S-79 I-MAGO airplane, 3 Alfa-Romeo 125 engines, Monte-Cavo, Monte Nerone, Ansedonia course, September 23, 1935.

National (U.S.) Record........................Speed, 307.234 km.p.h. (190.906 m.p.h.)
D. W. Tomlinson, pilot; J. S. Bartles, co-pilot; Douglas DC-1 monoplane, 2 Wright Cyclone 710 HP engines, Floyd Bennett Field—Bolling Field—Willoughby Spit—Floyd Bennett Field course, May 18, 1935.

SPEED FOR 5000 KILOMETERS (3106.849 MILES)

International Record..........................Speed, 272.030 km.p.h. (169.031 m.p.h.)
D. W. Tomlinson, pilot; J. S. Bartles, co-pilot; United States, Douglas DC-1 monoplane, 2 Wright Cyclone 710 HP engines, Floyd Bennett Field—Bolling Field—Willoughby Spit—Floyd Bennett Field Course, May 16-17, 1935.

National (U.S.) Record..Same as above.

SPEED FOR 10,000 KILOMETERS (6213.698 MILES)

International Record..........................Speed, 149.853 km.p.h. (93.114 m.p.h.)
J. Le Brix and M. Doret, France, Dewoitine airplane, Hispano-Suiza 650 HP engine, Istres, June 7, 8, 9, and 10, 1931.

National (U.S.) Record..None established.

CLASS C—WITH PAY LOAD OF 500 KILOGRAMS (1102.311 lbs.)

ALTITUDE

International Record..................................13,178 meters (43,234.817 feet)
Vladimir Kokkinaki, Russia, C.K.B. 26 monoplane, 2 M.85 800 HP engines, at Moscow, August 3, 1936.

National (U.S.) Record..................................8,578 meters (28,143 feet)
Lieut. H. R. Harris, U.S.A.S., USA-TP-1, Liberty 400 HP engine, at Wright Field, Dayton, Ohio, May 21, 1924.

SPEED FOR 1000 KILOMETERS

International Record..........................Speed, 390.371 km.p.h. (242.565 m.p.h.)
Attileo Biseo and Gori Castellani, Italy, S-79 I-MAGO airplane, 3 Alfa-Romeo 125 engines, Monte Cavo-Monte Nerone-Ansedonia course, September 23, 1935.

National (U.S.) Record.......................Speed, 308.470 km.p.h. (191.674 m.p.h.)
D. W. Tomlinson, pilot; J. S. Bartles, co-pilot; Douglas DC-1 monoplane, 2 Wright Cyclone 710 HP engines, Floyd Bennett Field—Bolling Field—Willoughby Spit—Floyd Bennett Field course, May 18, 1935.

SPEED FOR 2000 KILOMETERS

International Record..........................Speed, 380.952 km.p.h. (236.712 m.p.h.)
Attileo Biseo and Gori Castellani, Italy, S-79 I-MAGO airplane, 3 Alfa-Romeo 125 engines, Monte Cavo-Monte Nerone-Ansedonia course, September 23, 1935.

National (U.S.) Record........................Speed, 307.234 km.p.h. (190.906 m.p.h.)
D. W. Tomlinson, pilot; J. S. Bartles, co-pilot; Douglas DC-1 monoplane, 2 Wright Cyclone 710 HP engines, Floyd Bennett Field—Bolling Field—Willoughby Spit—Floyd Pennett Field course, May 18, 1935.

SPEED FOR 5000 KILOMETERS

International Record...........................Speed, 272.030 km.p.h. (169.031 m.p.h.)
D. W. Tomlinson, pilot; J. S. Bartles, co-pilot; United States, Douglas DC-1 monoplane, 2 Wright Cyclone 710 HP engines, Floyd Bennett Field—Bolling Field—Willoughby Spit—Floyd Bennett Field course, May 16-17, 1935.

National (U.S.) Record..Same as above.

CLASS C—WITH PAY LOAD OF 1000 KILOGRAMS (2204.622 lbs.)

ALTITUDE

International Record....................................12,101 meters (39,701.364 feet)
Kokkinaki, Russia, C.K.B 26 monoplane, 2 M.85 800 HP engines, at Tchelcovo, August 21, 1936.

National (U.S.) Record....................................6,346 meters (20,820 feet)
Waldo Waterman, Bach airplane, Wright J-6 engine, Los Angeles Airport, Los Angeles, California, July 26, 1929.

SPEED FOR 1000 KILOMETERS

International Record..........................Speed, 390.371 km.p.h. (242.565 m.p.h.)
Attileo Bisco and Gori Castellani, Italy, S-79 I-MAGO airplane, 3 Alfa-Romeo 125 engines, Monte Cavo-Monte Nerone-Ansedonia course, September 23, 1935.

National (U.S.) Record........................Speed, 308.470 km.p.h. (191.674 m.p.h.)
D. W. Tomlinson, pilot; J. S. Bartles, co-pilot; Douglas DC-1 monoplane, 2 Wright Cyclone 710 HP engines, Floyd Bennett Field—Bolling Field—Willoughby Spit—Floyd Bennett Field course, May 18, 1935.

SPEED FOR 2000 KILOMETERS

International Record..........................Speed, 380.952 km.p.h. (236.712 m.p.h.)
Attileo Bisco and Gori Castellani, Italy, S-79 I-MAGO airplane, 3 Alfa-Romeo 125 engines, Monte Cavo-Monte Nerone-Ansedonia course, September 23, 1935.

National (U.S.) Record........................Speed, 307.234 km.p.h. (190.906 m.p.h.)
D. W. Tomlinson, pilot; J. S. Bartles, co-pilot; Douglas DC-1 monoplane, 2 Wright Cyclone 710 HP engines, Floyd Bennett Field—Bolling Field—Willoughby Spit—Floyd Bennett Field course, May 18, 1935.

SPEED FOR 5000 KILOMETERS

International Record..........................Speed, 272.030 km.p.h. (169.031 m.p.h.)
D. W. Tomlinson, pilot; J. S. Bartles, co-pilot; United States, Douglas DC-1 monoplane, 2 Wright Cyclone 710 HP engines, Floyd Bennett Field—Bolling Field—Willoughby Spit—Floyd Bennett Field course, May 16-17, 1935.

National (U.S.) Record..Same as above.

CLASS C—WITH PAY LOAD OF 2000 KILOGRAMS (4409.244 lbs.)

ALTITUDE

International Record....................................11,005 meters (36,105.567 feet)
Vladimir Kokkinaki, Russia, C.K.B. 26 monoplane, 2 M.85 800 HP engines, at Tchelcovo, September 7, 1936.

National (U.S.) Record....................................2,049 meters (6,722.420 feet)
Lieut. H. R. Harris, U.S.A.S., Barling Bomber, 6 Liberty 400 HP engines, Wright Field, Dayton, Ohio, October 25, 1923.

SPEED FOR 1000 KILOMETERS

International Record..........................Speed, 390.371 km.p.h. (242.565 m.p.h.)
Attileo Biseo and Gori Castellani, Italy, S-79 I-MAGO airplane, 3 Alfa-Romeo 125 engines, Monte Cavo-Monte Nerone-Ansedonia course, September 23, 1935.

National (U.S.) Record........................Speed, 308.470 km.p.h. (191.674 m.p.h.)
D. W. Tomlinson, pilot; J. S. Bartles, co-pilot; Douglas DC-1 monoplane, 2 Wright Cyclone 710 HP engines, Floyd Bennett Field—Bolling Field—Willoughby Spit—Floyd Bennett Field course, May 18, 1935.

SPEED FOR 2000 KILOMETERS

International Record..........................Speed, 380.952 km.p.h. (236.712 m.p.h.)
Attileo Biseo and Gori Castellani, Italy, S-79 I-MAGO airplane, 3 Alfa-Romeo 125 engines, Monte Cavo-Monte Nerone-Ansedonia course, September 23, 1935.

National (U.S.) Record........................Speed, 307.234 km.p.h. (190.906 m.p.h.)
D. W. Tomlinson, pilot; J. S. Bartles, co-pilot; Douglas DC-1 monoplane, 2 Wright Cyclone 710 HP engines, Floyd Bennett Field—Bolling Field—Willoughby Spit—Floyd Bennett Field course, May 18, 1935.

SPEED FOR 5000 KILOMETERS

Neither International nor National (U.S.) Record has been established.

CLASS C—WITH PAY LOAD OF 5000 KILOGRAMS (11,023 lbs.)

ALTITUDE

International Record....................................8,116 meters (26,627.241 feet)
Major Youmacheff, pilot; Mr. Kalachnikoff, mechanic; Russia, ANT-6 monoplane, 4 AM-800 HP engines, at Tchelcovo, September 11, 1936.
National (U.S.) Record..None established.

SPEED FOR 1000 KILOMETERS
Neither International nor National (U.S.) Record has been established.

SPEED FOR 2000 KILOMETERS
Neither International nor National (U.S.) Record has been established.

SPEED FOR 5000 KILOMETERS
Neither International nor National (U.S.) Record has been established.

CLASS C—WITH PAY LOAD OF 10,000 KILOGRAMS (22,046 lbs.)

ALTITUDE

International Record....................................6,605 meters (21,669.902 feet)
Major Youmacheff, pilot; Mr. Kalachnikoff, mechanic; Russia, ANT-6 monoplane, 4 AM-34 800 HP engines, at Tchelcovo, September 16, 1936.
National (U.S.) Record..None established.

SPEED FOR 1000 KILOMETERS
Neither International nor National (U.S.) Record has been established.

SPEED FOR 2000 KILOMETERS
Neither International nor National (U.S.) Record has been established.

SPEED FOR 5000 KILOMETERS
Neither International nor National (U.S.) Record has been established.

CLASS C—GREATEST PAY LOAD CARRIED TO AN ALTITUDE OF 2000 METERS (6,561.66 feet)

International Record..................................12,000 kilograms (26,455.464 lbs.)
Major Youmacheff, pilot; Mr. Cheverdinsky, mechanic, Russia, ANT-6 monoplane, 4 AM-34 800 HP engines, at Tchelcovo, September 20, 1936.
National (U.S.) Record................................2,000 kilograms (4,409.244 lbs.)
Lt. H. R. Harris, U.S.A.S., Barling Bomber, 6 Liberty 400 HP engines, at Wright Field, Dayton, Ohio, October 25, 1923.

CLASS C—REFUELING IN FLIGHT

AIRLINE DISTANCE WITH REFUELING
Neither International nor National (U.S.) Record has been established.

BROKEN LINE DISTANCE WITH REFUELING
Neither International nor National (U.S.) Record has been established.

LIGHT AIRPLANES—CLASS C—FIRST CATEGORY

Multi-seaters weight empty less than 560 kgs. (1,234.576 lbs.)

AIRLINE DISTANCE

International Record............................3,197.679 kilometers (1,986.942 miles)
Robert D. Buck and Lee Bellingrath, United States, Monocoupe monoplane, Lambert 90 HP engine, from Burbank, California to Columbus, Ohio, May 5-6, 1936.
National (U.S.) Record............................Same as above

ALTITUDE

International Record............................9,282 meters (30,453 feet)
Comm. Renato Donati, pilot, M. Lanciani, passenger, Italy, Fiat A.S.I.c.n.a. airplane, C.N.A.c. 7 engine, Littorio airport, December 30, 1932.
National (U.S.) Record............................5,652 meters (18,543 feet)
Willfred G. Moore, Inland Sport monoplane, Warner 110 HP engine, Kansas City, Missouri, September 30, 1929.

SPEED FOR 100 KILOMETERS

International Record............................Speed, 453.743 km.p.h. (281.942 m.p.h.)
Maurice Arnoux and Mme. Becker, France, Caudron C.450 monoplane, Renault engine, Chartres-Bonce-Etampes course, August 8, 1935.
National (U.S.) Record............................Speed, 277.169 km.p.h. (172.225 m.p.h.)
John H. Wright, pilot; Karl E. Voelter, passenger; Monocoupe monoplane, Warner Super Scarab 145 HP engine, Miami, Florida, January 15, 1935.

SPEED FOR 1000 KILOMETERS

International Record............................Speed, 292.825 km.p.h. (181.953 m.p.h.)
Maurice Arnoux and Mme. Becker, France, Caudron "Rafale" C.660, Renault-Bengali 140 HP engine, Angers, July 7, 1935.
National (U.S.) Record............................None established.

SPEED FOR 2000 KILOMETERS

Neither International nor National (U.S.) Record has been established.

LIGHT AIRPLANES—CLASS C—SECOND CATEGORY

Single-seaters weight empty less than 450 kgs. (992.070 lbs.)

AIRLINE DISTANCE

International Record............................3,582 kilometers (2,225.747 miles)
Captain Skerzinski, Poland, R.W.D. 5-2 monoplane, Gipsy Major 130 HP engine, from St. Louis, Senegal, to Maceio, Brazil, May 7, 1933.
National (U.S.) Record............................2,655 kilometers (1,650 miles)
D. S. Zimmerly, Barling NB-3 airplane, 60 HP LeBlond engine, Brownsville, Texas, to Winnipeg, Canada, July 17, 1929.

ALTITUDE

International Record............................10,008 meters (32,834.546 feet)
Furio Niclot, Italy, E.T.A., C.N.A. airplane, C.N.A.C. 7, 160 HP engine, Littorio Airport, December 24, 1933.
National (U.S.) Record............................7,338 meters (24,074.730 feet)
D. S. Zimmerly, Barling NB-3 monoplane, Lambert R266 90 HP engine, Forest Park Flying Field, St. Louis, Missouri, February 16, 1930.

SPEED FOR 100 KILOMETERS

International Record............................Speed, 366.599 km.p.h. (227.793 m.p.h.)
R. A. Kling, United States, Keith Ryder "Special" monoplane, Menasco 272 HP engine, Denver, Colorado, July 4, 1936.
National (U.S.) Record............................Same as above.

SPEED FOR 1000 KILOMETERS

International Record............................Speed, 332.883 km.p.h. (206.843 m.p.h.)
R. Delmotte, France, Caudron monoplane, type 362, Renault-Bengali 150 HP engine, at Istres, December 26, 1933.
National (U.S.) Record............................None established.

SPEED FOR 2000 KILOMETERS

Neither International nor National (U.S.) Record has been established.

LIGHT AIRPLANES—CLASS C—THIRD CATEGORY

Multi-seaters weight empty less than 280 kgs. (617.288 lbs.)

AIRLINE DISTANCE

International Record............................1,654.750 kilometers (1,028.212 miles)
Captain Jaroslav Polma and Lt. Frantisek Zeleny, Czechoslovakia, Praga E.114 airplane, Praga B 29, 36 HP engine, from Prague, Czechoslovakia to Moscow, Russia, August 30-31, 1936.

National (U.S.) Record..........................1,154.000 kilometers (717.061 miles)
Wilson L. Mills and Constance Righter, Aeronca monoplane, Aeronca 36 HP engine, from Miami, Fla., to Winston-Salem, N. C., May 27, 1936.

ALTITUDE

International Record.................................6,951 meters (22,805.049 feet)
Giovanni Zappetta, pilot; Ragusa Francesco, passenger, Italy, N5 monoplane, Pobjoy 75 HP engine, Montecelio, December, 1933.

National (U.S.) Record.............................4,244 meters (13,923.843 feet)
Edna Rudolph, pilot, Thornton Waggoner, passenger, Curtiss Wright Junior airplane, Szekely 43 HP engine, East St. Louis, Illinois, May 31, 1931.

SPEED FOR 100 KILOMETERS

International Record........................Speed, 222.579 km.p.h. (138.304 m.p.h.)
Sebastiano Bedendo, pilot; Rinaldo Stenico, passenger; Italy, N-5 airplane, Pobjoy 75 HP engine, Ruderi od Infernaccio temporary course, February 17, 1935.

National (U.S.) Record..None established.

SPEED FOR 500 KILOMETERS

International Record.........................Speed, 213.676 km.p.h. (132.772 m.p.h.)
Sebastiano Bedendo, pilot; Rinaldo Stenico, passenger; Italy, N-5 airplane, Pobjoy 75 HP engine, Ruderi od Infernaccio temporary course, February 16, 1935.

National (U.S.) Record..None established.

SPEED FOR 1000 KILOMETERS

International Record........................Speed, 195.760 km.p.h. (121.639 m.p.h.)
Bailly and Reginensi, France, Farman 239 airplane, Pobjoy 75 HP engine, Villesauvage-La Marmogne course, October 6, 1933.

National (U.S.) Record..None established.

LIGHT AIRPLANES—CLASS C—FOURTH CATEGORY

Single-seaters weight empty less than 200 kgs. (440.920 lbs.)

AIRLINE DISTANCE

International Record.............................852.100 kilometers (529.469 miles)
G. Fauvel, France, Maubaussin Peyret Type 10, No. 1 airplane, A.B.C. Scorpion engine. Saint-Inglebert to Pau, September 10, 1929.

National (U.S.) Record...................................723.401 kms. (449.5 miles)
Edward W. Stitt, Aeronca C-2 airplane, Aeronca 107A engine, Toledo, Ohio, to Laurenceville, Virginia, November 24, 1935.

ALTITUDE

International Record...................................5,921 meters (19,425.814 feet)
Miss Irene I. Crum, United States, Aeronca C-2 Scout monoplane, Aeronca E113C 36 HP engine, Gallipolis, Ohio, August 23, 1936.

National (U.S.) Record..Same as above.

SPEED FOR 100 KILOMETERS

International Record...........................Speed, 221.307 km.p.h. (137.513 m.p.h.)
S. J. Whitman, United States, "Whitman Special," Pobjoy "R" 95 HP engine, New Orleans, Louisiana, February 14, 1934.

National (U.S.) Record..Same as above.

SPEED FOR 500 KILOMETERS

International Record.........................Speed, 120.406 km.p.h. (74.817 m.p.h.)
Benjamin King, United States, Aeronca C-2 Scout monoplane, Aeronca E113A 36 HP Engine, Hampton Roads, Virginia, permanent speed course, April 26, 1936.

National (U.S.) Record..Same as above.

SPEED FOR 1000 KILOMETERS

Neither International nor National (U.S.) Record has been established.

SEAPLANES—CLASS C2

AIRLINE DISTANCE

International Record............................5,280.015 kilometers (3,281.402 miles)
Lt. Comdr. Knefler McGinnis, USN, Lt. J. K. Averill, USN, NAP T. P. Wilkinson, USN, pilots; C. S. Bolka, A. E. J. Dionne and E. V. Sizer, crew; United States, Navy XP3Y-1 seaplane, 2 Pratt & Whitney 825 HP engines, from Cristobal Harbor, Canal Zone, to San Francisco Bay, Alameda, California, October 14-15, 1935.
National (U.S.) Record..Same as above.

BROKEN LINE DISTANCE

International Record............................5,541.392 kilometers (3,443.255 miles)
Lt. Comdr. Knefler McGinnis, USN, Lt. J. K. Averill, USN, NAP T. P. Wilkinson, USN, pilots; C. S. Bolka, A. E. J. Dionne and E. V. Sizer, crew; United States, Navy XP3Y-1 seaplane, 2 Pratt & Whitney 825 HP engines, from Cristobal Harbor, Canal Zone, to San Francisco Bay, Alameda, California, October 14-15, 1935.
National (U.S.) Record..Same as above.

ALTITUDE

International Record.................................11,753 meters (38,559.594 feet)
Lieut. Apollo Soucek, U.S.N., United States, "Apache," Pratt and Whitney 425 HP engine, supercharged, at Washington, D. C., June 4, 1929.
National (U.S.) Record..Same as above.

MAXIMUM SPEED

International Record..........................Speed, 709.209 km.p.h. (440.681 m.p.h.)
Francesco Agello, Italy, MC 72 seaplane, Fiat A.S. 6 engine at de Desenzano-Garda, October 23, 1934.
National (U.S.) Record.......................Speed, 395.439 km.p.h. (245.713 m.p.h.)
Lieut. James H. Doolittle, U.S.A.S., Curtiss R3C-2 Curtiss V-1400, 600 HP engine, Bay Shore, Baltimore, Maryland, October 27, 1925.

SPEEDS FOR SPECIFIED DISTANCES WITHOUT PAY LOAD

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record..........................Speed, 629.370 km.p.h. (391.072 m.p.h.)
Guglielmo Cassinelli, Italy, Macchi C.72 seaplane, 2400 HP Fiat AS 6 engine, Falconara-Pesaro permanent course, October 8, 1933.
National (U.S.) Record......................Speed, 338.944 km.p.h. (241.679 m.p.h.)
Lieut. G. T. Cuddihy, U.S.N., Curtiss R3C-2 Curtiss V-1500, 700 HP, at Norfolk, Virginia, November 13, 1926.

SPEED FOR 1000 KILOMETERS (621.369 MILES)

International Record..........................Speed, 313.261 km.p.h. (194.651 m.p.h.)
Mario Stoppani and Amelio Novelli, pilots; Marco Luzzatti and Remigio Visintin, passengers; Italy, Cant Z. 506 seaplane, 3 Fiat A/59 R engines, July 7, 1936.
National (U.S.) Record.........................Speed, 265.606 km.p.h. (165.040 m.p.h.)
Major-Gen. F. M. Andrews, pilot; J. G. Moran and H. O. Johnson, crew; United States, Martin B-12-A seaplane, 2 P & W "Hornet" 700 HP engines, August 24, 1935.

SPEED FOR 2000 KILOMETERS (1242.739 MILES)

International Record.........................Speed, 307.311 km.p.h. (190.954 m.p.h.)
Mario Stoppani and Amelio Novelli, pilots; Marco Luzzatti and Remigio Visintin, passengers; Italy, Cant Z. 506 seaplane, 3 Fiat A/59 R engines, July 7, 1936.
National (U.S.) Record.......................Speed. 253.182 km.p.h. (157.319 m.p.h.)
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 HP "Hornet" engines, August 1, 1934.

SPEED FOR 5000 KILOMETERS (3106.849 MILES)

International Record..........................Speed, 139.567 km.p.h. (86.723 m.p.h.)
Lieut. de Vaisseau Paris, and M. Gonord, France, Latecoere 28-3 seaplane, Hispano-Suiza 600 HP engine, at Arcachon, June 4 and 5, 1931.
National (U.S.) Record.......................................None established

SPEED FOR 10,000 KILOMETERS (6213.698 MILES)

Neither International nor National (U.S.) Record has been established.

CLASS C2—WITH PAY LOAD OF 500 KILOGRAMS (1102.311 lbs.)

ALTITUDE

International Record....................................9,532 meters (31,272.871 feet)
M. Bourdin, France, Liore and Olivier seaplane, 2 Hispano-Suiza 500 HP engines, at Antibes, January 26, 1934.

National (U.S.) Record.................................8,208 meters (26,929.080 feet)
Boris Sergievsky, Sikorsky S-38 seaplane, 2 Pratt and Whitney "Wasp" 420 HP engines, supercharged, Bridgeport, Connecticut, July 21, 1930.

SPEED FOR 1000 KILOMETERS (621.369 MILES)

International Record............................Speed, 313.261 km.p.h. (194.651 m.p.h.)
Mario Stoppani and Amelio Novelli, pilots; Marco Luzzatti and Remigio Visintin, passengers; Italy, Cant Z. 506 seaplane, 3 Fiat A/59 R engines, July 7, 1936.

National (U.S.) Record.........................Speed, 265.606 km.p.h. (165.040 m.p.h.)
Major-Gen. F. M. Andrews, pilot; J. G. Moran and H. O. Johnson, crew; Martin B-12-A seaplane, 2 Pratt and Whitney "Hornet" 700 HP engines, August 24, 1935.

SPEED FOR 2000 KILOMETERS (1242.739 MILES)

International Record............................Speed, 307.311 km.p.h. (190.954 m.p.h.)
Mario Stoppani and Amelio Novelli, pilots; Marco Luzzatti and Remigio Visintin, passengers; Italy, Cant Z. 506 seaplane, 3 Fiat A/59 R engines, July 7, 1936.

National (U.S.) Record.........................Speed, 253.182 km.p.h. (157.319 m.p.h.)
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 HP "Hornet" engines, August 1, 1934.

SPEED FOR 5000 KILOMETERS (3106.849 MILES)

Neither International nor National (U.S.) Record has been established.

CLASS C2—WITH PAY LOAD OF 1000 KILOGRAMS (2204.622 lbs.)

ALTITUDE

International Record....................................8,864 meters (29,081.277 feet)
M. Bourdin, France, Liore and Olivier seaplane, 2 Hispano-Suiza 690 HP engines, at Antibes, December 26, 1933.

National (U.S.) Record.................................8,208 meters (26,929.080 feet)
Boris Sergievsky, Sikorsky S-38 seaplane, 2 Pratt and Whitney Hornets, 575 HP each, at Bridgeport, Connecticut, July 21, 1930.

SPEED FOR 1000 KILOMETERS (621.369 MILES)

International Record............................Speed, 313,261 km.p.h. (194.651 m.p.h.)
Mario Stoppani and Amelio Novelli, pilots; Marco Luzzatti and Remigio Visintin, passengers; Italy, Cant. Z, 506 seaplane, 3 Fiat A/59 R engines, July 7, 1936.

National (U.S.) Record.........................Speed, 265.606 km.p.h. (165.040 m.p.h.)
Major-Gen. F. M. Andrews, pilot; J. G. Moran and H. O. Johnson, crew; Martin B-12-A seaplane, 2 Pratt and Whitney "Hornet" 700 HP engines, August 24, 1935.

SPEED FOR 2000 KILOMETERS (1242.739 MILES)

International Record............................Speed, 307.311 km.p.h. (190.954 m.p.h.)
Mario Stoppani and Amelio Novelli, pilots; Marco Luzzatti and Remigio Visintin, passengers; Italy, Cant Z. 506 seaplane, 3 Fiat A/59 R engines, July 7, 1936.

National (U.S.) Record.........................Speed, 253.182 km.p.h. (157.319 m.p.h.)
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 HP "Hornet" engines, August 1, 1934.

SPEED FOR 5000 KILOMETERS (3106.849 MILES)

Neither International nor National (U.S.) Record has been established.

CLASS C2—WITH PAY LOAD OF 2000 KILOGRAMS (4409.244 lbs.)

ALTITUDE

International Record....................................7,831 Meters (25,692.203 feet)
Mario Stoppani and Vicenzo Baldini, Italy, Cant Z 506 seaplane, 3 Alfa Romeo type 126 RC 680 HP engines, at Monfalcone, November 29, 1936.

National (U.S.) Record.................................6,074 Meters (19,709.259 feet)
Boris Sergievsky, Sikorsky S-38 seaplane, 2 Pratt and Whitney 424 HP "Wasp" engines, at Stratford, Connecticut, August 11, 1930.

SPEED FOR 1000 KILOMETERS (621.369 MILES)

International Record..........................Speed, 313.261 km.p.h. (194.651 m.p.h.)
Mario Stoppani and Amelio Novelli, pilots; Marco Luzzatti and Remigio Visintin, passengers; Italy, Cant Z. 506 seaplane, 3 Fiat A/59 R engines, July 7, 1936.

National (U.S.) Record.......................Speed, 253.601 km.p.h. (157.580 m.p.h.)
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 HP "Hornet" engines, August 1, 1934.

SPEED FOR 2000 KILOMETERS (1242.739 MILES)

International Record..........................Speed, 307.311 km.p.h. (190.954 m.p.h.)
Mario Stoppani and Amelio Novelli, pilots; Marco Luzzatti and Remigio Visintin, passengers; Italy, Cant Z. 506 seaplane, 3 Fiat A/59 R engines, July 7, 1936.

National (U.S.) Record.......................Speed, 253.182 km.p.h. (157.319 m.p.h.)
Edwin Musick, Boris Sergievsky and Charles A. Lindbergh, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 HP "Hornet" engines, August 1, 1934.

SPEED FOR 5000 KILOMETERS (3106.849 MILES)

Neither International nor National (U.S.) Record has been established.

CLASS C2—WITH PAY LOAD OF 5000 KILOGRAMS (11,023.11 lbs.)

ALTITUDE

International Record....................................6,727 meters (22,070.164 feet)
Mario Stoppani, Italy, Cant Z 506 seaplane, 3 Alfa Romeo type 126 RC 680 HP engines, at Monfalcone, December 1, 1936.

National (U.S.) Record.................................6,220 meters (20,406.762 feet)
Boris Sergievsky and Raymond B. Quick, Sikorsky S-42 seaplane, 4 Pratt and Whitney 670 HP "Hornet" engines, Bridgeport, Connecticut, May 17, 1934.

SPEED FOR 1000 KILOMETERS

Neither International nor National (U.S.) Record has been established.

SPEED FOR 2000 KILOMETERS

Neither International nor National (U.S.) Record has been established.

SPEED FOR 5000 KILOMETERS

Neither International nor National (U.S.) Record has been established.

CLASS C2—WITH PAY LOAD OF 10,000 KILOGRAMS (22,046.22 lbs.)

ALTITUDE

Neither International nor National (U.S.) Record has been established.

SPEED FOR 1000 KILOMETERS

Neither International nor National (U.S.) Record has been established.

SPEED FOR 2000 KILOMETERS

Neither International nor National (U.S.) Record has been established.

SPEED FOR 5000 KILOMETERS

Neither International nor National (U.S.) Record has been established.

CLASS C2—GREATEST PAY LOAD CARRIED TO AN ALTITUDE OF 2000 METERS (6,561.660 feet)

International Record....................................Weight, 7,533 kgs. (16,608 lbs.)
Boris Sergievsky, United States, Sikorsky S-42 seaplane, 4 Pratt and Whitney "Hornet" 650 HP engines, Bridgeport, Connecticut, April 26, 1934.
National (U.S.) Record....................................Same as above.

LIGHT SEAPLANES—CLASS C2—FIRST CATEGORY

Multi-seaters weight empty less than 680 kgs. (1,499.128 lbs.)

AIRLINE DISTANCE
International Record....................................568.871 kilometers (353.479 miles)
J. V. Pissemenny, pilot; V. P. Kusnetsov, passenger; Russia, AIR-6 monoplane seaplane, M.11 100 HP engine, from Eisk to Tcheskany, October 19, 1936.
National (U.S.) Record....................................388.978 kilometers (241.699 miles)
Borntraeger and Stafford, Kitty Hawk seaplane, Kinner 125 HP engine, from Miami to Daytona Beach, Florida, March 23, 1935.

ALTITUDE
International Record....................................7,362 meters (24,153.470 feet)
Ingenieur Furio Niclot, pilot; Mariano Lanciani, passenger; Italy, Fiat A.S.I.C.N.A. seaplane, C.N.A. C-7 engine, Littorio airport, December 28, 1932.
National (U.S.) Record....................................None established.

SPEED FOR 100 KILOMETERS (62.137 MILES)
International Record....................................Speed, 189.433 km.p.h. (117.708 m.p.h.)
Lallouette and Boulanger, France, Farman 231 seaplane, Renault 95 HP engine, Draveil-Montereau course, March 28, 1931.
National (U.S.) Record....................................None established.

SPEED FOR 1000 KILOMETERS (621.369 MILES)
Neither International nor National (U.S.) Record has been established.

SPEED FOR 2000 KILOMETERS (1242.739 MILES)
Neither International nor National (U.S.) Record has been established.

LIGHT SEAPLANES—CLASS C2—SECOND CATEGORY

Single-seaters weight empty less than 570 kgs. (1,256.622 lbs.)

AIRLINE DISTANCE
International Record....................................355.988 kilometers (221.20 miles)
Benjamin King, United States, Aeronca C-3 seaplane, Aeronca E113A 36 HP engine, from Port Washington, L.I., N.Y., to Naval Air Station, Anacostia, D. C., June 25, 1935.
National (U.S.) Record....................................Same as above.

ALTITUDE
International Record....................................8,411 meters (27,595.061 feet)
Furio Niclot, Italy, ETA-CNA seaplane, CNA C7 160 HP engine, Littorio airport, Rome, Italy, November 6, 1933.
National (U.S.) Record....................................None established.

SPEED FOR 100 KILOMETERS (62.137 MILES)
International Record....................................Speed, 165.004 km.p.h. (102.554 m.p.h.)
Alfred Grundke, Germany, Junkers J 50-W seaplane, Armstrong Sideley Genet 85 HP engine, at Dessau, June 13, 1930.
National (U.S.) Record....................................None established.

SPEED FOR 1000 KILOMETERS (621.369 MILES)
Neither International nor National (U.S.) Record has been established.

SPEED FOR 2000 KILOMETERS (1242.739 MILES)
Neither International nor National (U.S.) Record has been established.

LIGHT SEAPLANES—CLASS C2—THIRD CATEGORY

Multi-seaters weight empty less than 350 kgs. (771.610 lbs.)

AIRLINE DISTANCE

International Record....................................298.373 kilometers (185.4 miles)
Benjamin King, pilot; Daniel Brimm, co-pilot; United States, Aeronca C-3 seaplane, Aeronca E113A 36 HP engine, from North Beach, L.I., N.Y., to Whitney's Landing, Anne Arundel County, Md., June 16, 1935.
National (U.S.) Record..Same as above.

ALTITUDE

International Record....................................3,523 meters (11,558.364 feet)
Terris Moore, pilot; Mrs. Terris Moore, passenger; United States, Aeronca C-3 monoplane, Aeronca 113-B 36 HP engine, Boston, Mass., February 1, 1936.
National (U.S.) Record..Same as above.

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record..............................Speed, 143.540 km.p.h. (89.191 m.p.h.)
De Viscaya and Chaudet, France, Farman 230 seaplane, Salmson 40 HP engine, Le Pecq-Bonnieres-Le Rhoule, June 26, 1931.
National (U.S.) Record..None established.

SPEED FOR 500 KILOMETERS (310.685 MILES)

Neither International nor National (U.S.) Record has been established.

SPEED FOR 1000 KILOMETERS (621.369 MILES)

Neither International nor National (U.S.) Record has been established.

LIGHT SEAPLANES—CLASS C2—FOURTH CATEGORY

Single-seaters weight empty less than 250 kgs. (551.150 lbs.)

AIRLINE DISTANCE

International Record..................................370.656 kilometers (230.314 miles)
Benjamin King, United States, Aeronca C-2 seaplane, Aeronca E113A 36 HP engine, from Anacostia, D. C., to Croton Bay, Ossining, New York, September 26, 1935.
National (U.S.) Record..Same as above.

ALTITUDE

International Record......................................4,597 meters (15,081.976 feet)
Benjamin King, United States, Aeronca C-2 seaplane, Aeronca E113A 36 HP engine, Anacostia, D. C., September 24, 1935.
National (U.S.) Record..Same as above.

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record..80.931 m.p.h.
Benjamin King, United States, Aeronca C-2 seaplane, Aeronca E113A engine, Miami, Florida, December 11, 1935.
National (U.S.) Record..Same as above.

SPEED FOR 500 KILOMETERS (310.685 MILES)

International Record..70.499 m.p.h.
Benjamin King, United States, Aeronca C-2 seaplane, Aeronca E113A engine, Miami, Florida, December 11, 1935.
National (U.S.) Record..Same as above.

SPEED FOR 1000 KILOMETERS (621.369 MILES)

Neither International nor National (U.S.) Record has been established.

AMPHIBIONS—CLASS C3

AIRLINE DISTANCE

International Record..............................2,300.860 kilometers (1,429.685 miles)
Major General F. M. Andrews, pilot; Major John Whiteley, co-pilot; and crew, United States, Douglas YOA-5 amphibian, 2 Wright "Cyclone" 800 HP engines, from San Juan, Puerto Rico, to Langley Field, Virginia, June 29, 1936.
National (U.S.) Record..Same as above.

BROKEN LINE DISTANCE
Neither International nor National (U.S.) Record has been established.

ALTITUDE
International Record....................................7,605 meters (24,950.712 feet)
Boris Sergievsky, United States, Sikorsky S-43 amphibian, 2 Pratt & Whitney 750 HP "Hornet" engines, Stratford, Connecticut, April 14, 1936.
National (U.S.) Record..Same as above.

MAXIMUM SPEED
International Record..........................Speed, 370.814 km.p.h. (230.413 m.p.h.)
Major Alexander P. de Seversky, United States, Seversky Amphibian, Wright "Cyclone" 710 HP engine, Detroit, Michigan, September 15, 1935.
National (U.S.) Record..Same as above.

SPEED FOR 100 KILOMETERS (62.137 MILES) WITHOUT PAY LOAD
International Record..........................Speed, 279.938 km.p.h. (173.945 m.p.h.)
Lt. R. L. Burke, USCG, United States, U. S. Coast Guard (Grumman) Amphibian No. 167, Wright Cyclone 710 HP engine, Cape May, New Jersey, June 25, 1935.
National (U.S.) Record..Same as above.

SPEED FOR 1000 KILOMETERS (621.369 MILES) WITHOUT PAY LOAD
International Record..........................Speed, 160.854 km.p.h. (99.950 m.p.h.)
Harry Richman and George Daufkirch, United States, Sikorsky S-39 Amphibian, Pratt and Whitney 300 HP engine, Miami, Florida, February 10, 1935.
National (U.S.) Record..Same as above.

SPEED FOR 2000 KILOMETERS (1242.739 MILES) WITHOUT PAY LOAD
Neither International nor National (U.S.) Record has been established.

SPEED FOR 5000 KILOMETERS (3106.849 MILES) WITHOUT PAY LOAD
Neither International nor National (U.S.) Record has been established.

SPEED FOR 10,000 KILOMETERS (6213.698 MILES) WITHOUT PAY LOAD
Neither International nor National (U.S.) Record has been established.

CLASS C3—WITH PAY LOAD OF 500 KILOGRAMS (1102.311 lbs.)

ALTITUDE
International Record....................................7,605 meters (24,950.712 feet)
Boris Sergievsky, United States, Sikorsky S-43 amphibian, 2 Pratt & Whitney 750 HP "Hornet" engines, Stratford, Connecticut, April 14, 1936.
National (U.S.) Record..Same as above.

SPEED FOR 1000 KILOMETERS
Neither International nor National (U.S.) Record has been established.

SPEED FOR 2000 KILOMETERS
Neither International nor National (U.S.) Record has been established.

SPEED FOR 5000 KILOMETERS
Neither International nor National (U.S.) Record has been established.

CLASS C3—WITH PAY LOAD OF 1000 KILOGRAMS (2204.622 lbs.)

ALTITUDE
International Record....................................5,982 meters (19,625.925 feet)
Boris Sergievsky, United States, Sikorsky S-43 amphibian, 2 Pratt & Whitney 750 HP "Hornet" engines, Stratford, Connecticut, April 25, 1936.
National (U.S.) Record..Same as above.
Speed Records not established.

CLASS C3—WITH PAY LOAD OF 2000 KILOGRAMS (4409.244 lbs.)

ALTITUDE
International Record....................................5,982 meters (19,625.925 feet)
Boris Sergievsky, United States, Sikorsky S-43 amphibian, 2 Pratt & Whitney 750 HP "Hornet" engines, Stratford, Connecticut, April 25, 1936.
National (U.S.) Record..Same as above.
Speed Records not established.

LIGHT AMPHIBIONS—CLASS C3

Multi-seaters weight empty less than 750 kgs. (1,653.450 lbs.)

AIRLINE DISTANCE

Neither International nor National (U.S.) Record has been established.

ALTITUDE

Neither International nor National (U.S.) Record has been established.

SPEED FOR 100 KILOMETERS (62.137 MILES)

Neither International nor National (U.S.) Record has been established.

SPEED FOR 1000 KILOMETERS (621.369 MILES)

Neither International nor National (U.S.) Record has been established.

SPEED FOR 2000 KILOMETERS (1242.739 MILES)

Neither International nor National (U.S.) Record has been established.

BALLOONS—CLASS A

FIRST CATEGORY (600 *cubic meters*)

DURATION

International Record....................22 hrs. 34 min.
Georges Cormier, France, August 10 and 11, 1924.
National (U.S.) Record....................None has been established.

DISTANCE

International Record....................804.173 kilometers (499.69 miles)
Georges Cormier, France, July 1, 1922.
National (U.S.) Record....................None has been established.

ALTITUDE

Neither International nor National (U.S.) Record has been established.

SECOND CATEGORY (601-900 *cubic meters*)

DURATION

International Record....................23 hrs. 28 min.
Jules Dubois, France, May 14 and 15, 1922.
National (U.S.) Record....................19 hours.
W. C. Naylor and K. W. Warren, "Skylark," Little Rock, Arkansas, to Crawford, Tennessee, April 29-30, 1926.

DISTANCE

International Record....................1,203.600 kms. (747.881 miles)
Eug. Stuber, pilot; Werner Schafer, passenger; Germany, "Leipziger Messe 11" balloon, from Bitterfeld, Germany, to Pazariche, Russia, March 25 and 26, 1935.
National (U.S.) Record....................660 kilometers (410 miles)
W. C. Naylor and K. W. Warren, "Skylark," Little Rock, Arkansas, to Crawford, Tennessee, April 29-30, 1926.

ALTITUDE

Neither International nor National (U.S.) Record has been established.

THIRD CATEGORY (901-1200 *cubic meters*)

DURATION

International Record....................26 hrs. 46 min.
E. J. Hill and A. G. Schlosser, United States, Ford Airport to Montvale, Virginia, July 4-5, 1927.
National (U.S.) Record....................Same as above.

DISTANCE

International Record....................1,238 kilometers (769.256 miles)
Georges Ravaine, France, from Basle, Switzerland, to Tokary, Poland, September 25 and 26, 1932.
National (U.S.) Record....................920.348 kilometers (571.877 miles)
S. A. U. Rasmussen, Ford Airport to Hookerton, North Carolina, July 4-5, 1927.

ALTITUDE

Neither International nor National (U.S.) Record has been established.

FOURTH CATEGORY (1201-1600 *cubic meters*)

DURATION

International Record...26 hrs. 46 min.
E. J. Hill and A. G. Schlosser, United States, Ford Airport to Montvale, Virginia, July 4-5, 1927.

DISTANCE

International Record.................................1,238 kilometers (769.256 miles)
Georges Ravaine, France, from Basle, Switzerland, to Tokary, Poland, September 25 and 26, 1932.

National (U.S.) Record.............................920.348 kilometers (571.877 miles)
S. A. U. Rasmussen, Ford Airport to Hookerton, North Carolina, July 4-5, 1927.

ALTITUDE

Neither International nor National (U.S.) Record has been established.

FIFTH CATEGORY (1601-2200 *cubic meters*)

DURATION

International Record...57 hrs. 54 min.
Z. J. Burzynski and W. Wisocki, Poland, Gordon-Bennett Balloon Race, September 15-18, 1935.

National (U.S.) Record...51 hours.
T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race, Chicago, Illinois, September 2-4, 1933.

DISTANCE

International Record............................1,650.474 kilometers (1,025.555 miles)
Z. J. Burzynski and W. Wisocki, Poland, from Warsaw to Tiszkino, September 15-18, 1935.

National (U.S.) Record...............................1,550 kilometers (963.123 miles)
T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland, to Daugieliski, Poland, Sept. 25-27, 1932.

ALTITUDE

Neither International nor National (U.S.) Record has been established.

SIXTH CATEGORY (2201-3000 *cubic meters*)

DURATION

International Record...57 hrs. 54 min.
Z. J. Burzynski and W. Wisocki, Poland, Gordon-Bennett Balloon Race, September 15-18, 1935.

National (U.S.) Record...51 hours.
T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race, Chicago, Illinois, September 2-4, 1933.

DISTANCE

International Record............................1,650.474 kilometers (1,025.555 miles)
Z. J. Burzynski and W. Wisocki, Poland, from Warsaw to Tiszkino, September 15-18, 1935.

National (U.S.) Record...............................1,550 kilometers (963.123 miles)
T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland, to Daugieliski, Poland, Sept. 25-27, 1932.

ALTITUDE

International Record...................................8,690 meters (28,508.413 feet)
Capt. Hawthorne C. Gray, United States, Scott Field, Belleville, Illinois, March 9, 1927.

National (U.S.) Record...Same as above.

SEVENTH CATEGORY (3001-4000 *cubic meters*)

DURATION

International Record...57 hrs. 54 min.
Z. J. Burzynski and W. Wisocki, Poland, Gordon-Bennett Balloon Race, September 15-18, 1935.

National (U.S.) Record...51 hours.
T. G. W. Settle and C. H. Kendall, Gordon-Bennett Balloon Race, September 2-4, 1933.

DISTANCE

International Record..........................1,650.474 kilometers (1,025.555 miles)
Z. J. Burzynski and W. Wisocki, Poland, from Warsaw to Tiszkino, September 15-18, 1935.

National (U.S.) Record..............................1,550 kilometers (963.123 miles)
T. G. W. Settle and Wilfred Bushnell, from Basle, Switzerland, to Daugieliski, Poland, Sept. 25-27, 1932.

ALTITUDE

International Record..................................9,437 meters (30,961.193 feet)
Z. J. Burzinski, Poland, at Legjonowo, March 28, 1935.

National (U.S.) Record...............................8,690 meters (28,508.413 feet)
Capt. Hawthorne C. Gray, at Scott Field, Belleville, Illinois, March 9, 1927.

EIGHTH CATEGORY (4001 *cubic meters or more*)

DURATION

International Record...87 hours.
H. Kaulen, Germany, December 13 to 17, 1913.

National (U.S.) Record...51 hours.
Lt. Comdr. T. G. W. Settle and Lt. Charles H. Kendall, Gordon-Bennett Balloon Race, Chicago, Illinois, September 2, 3, and 4, 1933.

DISTANCE

International Record.............................3,052.7 kilometers (1,896.856 miles)
Berliner, Germany, February 8, 9, and 10, 1914.

National (U.S.) Record..........................1,887.6 kilometers (1,172.898 miles)
A. R. Hawley, St. Louis, Missouri, to Lake Tschotogama, Canada, October 17-19, 1910.

ALTITUDE

International Record.................................22,066 meters (72,394.795 feet)
Capt. Orvil A. Anderson and Capt. Albert W. Stevens, U. S. Army Air Corps, United States, take-off 11 miles southwest of Rapid City, S. D., landing 12 miles south of White Lake, S. D., November 11, 1935.

National (U.S.) Record...Same as above.

AIRSHIPS—CLASS B

AIRLINE DISTANCE

International Record...........................6,384.500 kilometers (3,967.137 miles)
Dr. Hugo Eckener, Germany, L.Z. 127, "Graf Zeppelin," 5 Maybach 450-550 HP engines, from Lakehurst, N. J., U.S.A., to Friedrichshafen, Germany, October 29, 30, 31, and November 1, 1928.

National (U.S.) Record..None established.

GLIDERS—CLASS D

DISTANCE, AIRLINE

International Record....................................504.200 kms. (313.295 miles)
Rudolf Oeltzschner, Germany, "D-Leuna" glider, from the Wasserkuppe to Brunn airport, Czechoslovakia, July 29, 1935.

National (U.S.) Record............................254.759 kilometers (158.299 miles)
Richard C. du Pont, United States, du Pont-Bowlus sailplane, "Albatross II" from Elmira, New York to Basking Ridge, New Jersey, June 25, 1934.

DISTANCE WITH RETURN TO POINT OF DEPARTURE

Neither International nor National (U.S.) Record has been established.

DURATION WITH RETURN TO POINT OF DEPARTURE

International Record...36 hrs., 35 min.
Kurt Schmidt, Germany, Grunau Baby glider, "D-Loerzer" at Korschenruh, Prusse Orientale, August 3 and 4, 1933.

National (U.S.) Record...21 hrs., 34 min.
Lieut. William A. Cocke, Jr., Cocke "Nighthawk" glider, Honolulu, Hawaii, December 17 and 18, 1931.

ALTITUDE ABOVE STARTING POINT

International Record.................................4,325 meters (14,189.590 feet)
Heinrich Dittmar, Germany, "D-Condor" glider, at Campo dos Affonsos, Brazil, February 17, 1934.

National (U.S.) Record..............................1,897 meters (6,223.734 feet)
Richard C. du Pont, du Pont-Bowlus sailplane, Albatross I, Elmira, New York, June 30, 1934.

HELICOPTERS—CLASS G

DURATION, CLOSED CIRCUIT

International Record..1 hr., 2 mins., 50 seconds.
Maurice Claisse, France, Breguet helicopter-gyroplane, Hispano-Suiza 300 HP engine, at Villacoublay, November 24, 1936.
National (U.S.) Record..None has been established.

AIRLINE DISTANCE

International Record..1,078.60 meters (3538.706 feet)
Marinello Nelli, Italy, Ascanio helicopter, Fiat A 50 engine, October 10, 1930, at Rome.
National (U.S.) Record..None has been established.

DISTANCE, CLOSED CIRCUIT

International Record..44 kilometers (27.340 miles)
Maurice Claisse, France, Breguet helicopter-gyroplane, Hispano-Suiza 300 HP engine, at Villacoublay, November 24, 1936.
National (U.S.) Record..None established.

ALTITUDE

International Record..158 meters (518.372 feet)
Maurice Claisse, France, Breguet helicopter-gyroplane, Hispano-Suiza engine, at Villacoublay, September 22, 1936.
National (U.S.) Record..None established.

SPEED FOR 20 KILOMETERS

International Record..............................Speed, 44.692 km.p.h. (27.770 m.p.h.)
Maurice Claisse, France, Breguet helicopter-gyroplane, Hispano-Suiza 300 HP engine, at Villacoublay, November 24, 1936.
National (U.S.) Record..None established.

FEMININE RECORDS

AIRPLANES—CLASS C

AIRLINE DISTANCE

International Record..............................3,939.245 kilometers (2,447.728 miles)
Miss Amelia Earhart, United States, Lockheed Vega monoplane, Wasp 450 HP engine, from Los Angeles, Calif., to Newark, New Jersey, August 24 and 25, 1932.
National (U.S.) Record..Same as above.

ALTITUDE

International Record..............................14,310 meters (46,948.725 feet)
Mrs. Maryse Hilsz, France, Potez 506 biplane, Gnome & Rhone 900 HP engine, at Villacoublay, June 23, 1936.
National (U.S.) Record..............................8,761 meters (28,743.352 feet)
Miss Ruth Nichols, Lockheed Vega monoplane, Pratt and Whitney 420 HP "Wasp" engine, at Jersey City Airport, New Jersey, March 6, 1931.

MAXIMUM SPEED

International Record..............................Speed, 445.028 km.p.h. (276.527 m.p.h.)
Miss Helene Boucher, France, Caudron C. 450 airplane, Renault-Bengali 315 HP engine, at Istres, August 11, 1934.
National (U.S.) Record..............................Speed, 405.92 km.p.h. (252.226 m.p.h.)
Mrs. May Haizlip, Wedell-Williams monoplane, Pratt and Whitney 540 HP supercharged "Wasp Jr." engine, Cleveland, Ohio, September 5, 1932.

SPEED FOR 100 KILOMETERS (62.137 MILES) WITHOUT PAY LOAD

International Record..............................Speed, 412.371 km.p.h. (256.235 m.p.h.)
Miss Helene Boucher, France, Caudron C. 450 airplane, Renault 300 HP engine, at Istres, August 8, 1934.
National (U.S.) Record..............................Speed, 281.470 km.p.h. (174.897 m.p.h.)
Amlia Earhart, Lockheed Vega monoplane, Pratt and Whitney "Wasp" 420 HP engine, Detroit, Michigan, June 25, 1930.

SPEED FOR 1000 KILOMETERS (621.369 MILES) WITHOUT PAY LOAD

International Record..............................Speed, 409.184 km.p.h. (254.255 m.p.h.)
Miss Helene Boucher, France, Caudron C. 450 airplane, Renault 300 HP engine, at Istres, August 8, 1934.
National (U.S.) Record..None established.

LIGHT AIRPLANES—CLASS C

First Category—Multi-seaters weight empty less than 560 kgs. (1,234.576 lbs.)

AIRLINE DISTANCE
International Record....................................843.500 kms. (524.126 miles)
Miss Helen MacCloskey, pilot; Mrs. Monro MacCloskey, passenger; United States, Monocoupe monoplane, Lambert 90 HP engine, from Chicago, Illinois to Endless Caverns, Virginia, June 25, 1936.
National (U.S.) Record..Same as above.

ALTITUDE (FIRST CATEGORY)
International Record....................................6,115 meters (20,062.295 feet)
Mrs. Madeleine Charnaux and Miss Clarck, France, Farman 357 monoplane, Renault 120 HP engine, at Orly, January 29, 1935.
National (U.S.) Record..................................3,849 meters (12,627.915 feet)
Annette Gipson, pilot; Mrs. John F. Buckman, passenger; Monocoupe monoplane, Lambert 90 HP engine, Ft. Lauderdale, Florida, April 26, 1936.

SPEED FOR 100 KILOMETERS (62.137 MILES)
International Record............................Speed, 268.169 km.p.h. (166.632 m.p.h.)
Miss Helen MacCloskey, United States, Monocoupe monoplane, Warner Super Scarab 145 HP engine, at Miami, Florida, January 15, 1935.
National (U.S.) Record..Same as above.

SPEED FOR 1000 KILOMETERS (621.369 MILES)
International Record ....Speed, 250.086 km.p.h. (155.396 m.p.h.)
Miss Helene Boucher, France, Caudron "Rafale" airplane, Renault-Bengali 145 HP engine, Istres, July 8, 1934.
National (U.S.) Record ....None established.

SPEED FOR 2000 KILOMETERS (1,242.739 MILES)
Neither International nor National (U.S.) Record has been established.

LIGHT AIRPLANES—CLASS C

Second Category—Single-seaters weight empty less than 450 kgs. (992.070 lbs.)

AIRLINE DISTANCE
International Record.............................2,976.910 kilometers (1,849.763 miles)
Madame Mary Bastie, France, Klemm monoplane, Salmson 40 HP engine, from Le Bourget to Urino, Russia, June 28 and 29, 1931.
National (U.S.) Record..None established.

ALTITUDE
International Record....................................7,338 meters (24,074.731 feet)
Mlle. Maryse Hilsz, France, Mauboussin M22 monoplane, "Corsaire," Salmson 9 A2R3 75 HP engine, Villacoublay, September 24, 1935.
National (U.S.) Record..................................5,516 meters (18,097.058 feet)
Mrs. May Haizlip, Buhl "Bull Pup" monoplane, Szekely 85 HP engine, at St. Clair, Michigan, June 13, 1931.

SPEED FOR 100 KILOMETERS (62.137 MILES)
International Record............................Speed, 198.347 km.p.h. (123.247 m.p.h.)
Annette Gipson, United States, Monocoupe monoplane, Lambert 90 HP engine, Newark, New Jersey, July 30, 1936.
National (U.S.) Record..Same as above.

LIGHT AIRPLANES—CLASS C

Third Category—Multi-seaters weight empty less than 280 kgs. (617.288 lbs.)

AIRLINE DISTANCE
Neither International nor National (U.S.) Record has been established.

ALTITUDE
International Record....................................4,649 meters (15,252.579 feet)
Miss Iona Coppedge, pilot; Mrs. Josephine Garrigus, passenger; United States, Aeronca monoplane, Aeronca E113A 36 HP engine, Dayton, Ohio, February 11, 1936.
National (U.S.) Record..Same as above.

SPEED FOR 100 KILOMETERS (62.137 MILES)
International Record............................Speed, 119.403 km.p.h. (74.193 m.p.h.)
Miss Helen Frigo, pilot; Miss Harriett Sackett, passenger; United States, Aeronca C-3 monoplane, Aeronca E113A 36 HP engine, College Park, Maryland, June 12, 1936.
National (U.S.) Record..Same as above.

LIGHT AIRPLANES—CLASS C

Fourth Category—Single-seaters weight empty less than 200 kgs. (440.920 lbs.)

AIRLINE DISTANCE

Neither International nor National (U.S.) Record has been established.

ALTITUDE

International Record....................................5,921 meters (19,425.814 feet)
Miss Irene I. Crum, United States, Aeronca C-2 Scout monoplane, Aeronca E113C 36 HP engine, at Gallipolis, Ohio, August 23, 1936.
National (U.S. Record)..Same as above.

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record............................Speed, 116.234 km.p.h. (72.224 m.p.h.)
Miss Helen Richey, United States, Aeronca C-2 Scout monoplane, Aeronca E113A 36 HP engine, at Hampton Roads, Virginia, February 1, 1936.
National (U.S.) Record..Same as above.

SEAPLANES—CLASS C2

AIRLINE DISTANCE

Neither International nor National (U.S.) Record has been established.

BROKEN LINE DISTANCE

Neither International nor National (U.S.) Record has been established.

ALTITUDE

International Record....................................5,554 meters (18,221.729 feet)
Marquise Carina Negrone, Italy, Breda 15 seaplane, Isotta-Fraschini-Asso 80 engine, at Genes, May 5, 1934.
National (U.S.) Record................................4,103 meters (13,461.259 feet)
Mrs. Marion Eddy Conrad, Savoia-Marchetti seaplane, Kinner 125 HP engine, Port Washington, Long Island, New York, October 20, 1930.

MAXIMUM SPEED

Neither International nor National (U.S.) Record has been established.

LIGHT SEAPLANES—CLASS C2

Second Category—Single-seaters weight empty less than 570 kgs. (1,256.622 lbs.)

AIRLINE DISTANCE

Neither International nor National (U.S.) Record has been established.

ALTITUDE

International Record....................................5,554 meters (18,221.729 feet)
Marquise Carina Negrone, Italy, Breda 15 seaplane, Isotta-Fraschini-Asso 80 engine, at Genes, May 5, 1934.
National (U.S.) Record..None established.

SPEED FOR 1000 KILOMETERS (62.137 MILES)

International Record............................Speed, 107.299 km.p.h. (66.672 m.p.h.)
Margaret Bain Tanner, United States, Aeronca seaplane, Aeronca E113A 36 HP engine, Hampton Roads, Virginia, August 8, 1936.
National (U.S.) Record..Same as above.

Flying Facts and Figures

AMERICAN FLYING ACTIVITIES

Calendar Years

Summary of Air Transport Operations

Air Lines of the United States

(Corrected by U. S. Bureau of Air Commerce)

Year	*Operators*	*Planes in Service*	*Miles Flown*	*Passengers*	*Passenger Miles*	*Express Pounds*	*Mail Pounds*
1926	13	...	4,318,087	5,782	(1)	3,555	377,206
1927	19	128	5,870,489	8,679	(1)	45,859	1,270,299
1928	36	325	10,273,450	49,713	(1)	216,644	4,063,173
1929	39[2]	525	25,141,499	173,405	(1)	257,443	7,772,014
1930	43[2]	600	36,945,203	417,505	103,747,249	468,571	8,513,675
1931	36[2]	590	47,385,987	522,345	119,968,577	1,151,348	9,643,211
1932	36[2]	564	50,932,967	540,681	146,552,587	1,600,821	7,908,723
1933	28[2]	504	54,642,545	568,940	198,800,079	2,452,812	7,816,532
1934[3]	25[2]	518	48,786,551	561,370	225,267,559	3,449,675	7,871,884
1935[3]	27[2]	459	63,542,233	860,761	360,569,431	5,511,737	13,779,608
1936[3]	23[2]	412	73,371,161	1,146,138	491,523,180	8,340,408	17,737,097

[1] Not requested prior to 1930.

[2] In several cases the same company operates both domestic and foreign services.

[3] Does not include territorial operations.

Monthly Air Transport Operations

Air Lines of the United States[1]

(Corrected tables compiled by U. S. Bureau of Air Commerce)

1934	*Miles Flown*	*Passengers*	*Passenger Miles*	*Mail Pounds*	*Express Pounds*
January	4,052,277	35,673	13,591,962	643,278	263,472
February	3,552,255	36,679	13,542,275	526,903	252,618
March	3,073,198	33,023	12,221,590	198,492	240,593
April	3,083,531	40,193	15,418,781	241,856	257,577
May	3,462,897	45,914	18,091,094	389,721	271,320
June	4,293,500	50,290	20,705,870	544,290	287,434
July	4,769,808	54,453	20,756,388	682,520	271,114
August	4,952,599	62,650	24,694,062	776,173	298,546
September	4,441,672	52,366	21,915,280	736,193	310,480
October	4,837,419	59,215	24,295,252	916,416	338,717
November	4,197,610	47,670	20,696,030	823,737	313,555
December	4,069,785	43,244	19,338,975	931,425	344,249
Total	48,786,551	561,370	225,267,559	7,411,004	3,449,675
1935					
January	3,903,009	37,364	17,281,851	820,286	291,483
February	4,024,541	45,464	20,200,851	858,299	290,200
March	4,833,353	66,815	29,083,998	1,002,269	393,999
April	4,873,508	71,270	30,606,397	1,036,796	378,645
May	5,421,473	73,895	30,709,768	1,108,315	404,185
June	5,673,244	82,531	34,975,881	1,082,819	462,501
July	6,290,606	94,888	37,789,828	1,169,737	470,634
August	6,493,280	99,274	39,576,336	1,224,623	537,950
September	5,990,328	85,753	35,575,638	1,172,265	568,276
October	5,952,435	79,694	32,580,871	1,293,869	618,828
November	4,915,268	59,365	24,707,065	1,181,678	520,003
December	5,169,188	64,448	27,480,947	1,317,774	575,033
Total	63,540,233	860,761	360,569,431	13,268,730	5,511,737
1936					
January	4,945,909	53,615	22,572,842	1,177,753	443,278
February	4,672,635	52,796	22,673,983	1,167,635	447,962
March	5,627,723	84,019	36,929,866	1,396,977	669,785
April	5,632,339	82,116	34,755,907	1,355,200	578,582
May	6,251,010	105,260	43,707,618	1,444,013	589,969
June	6,393,459	105,906	43,861,408	1,476,469	809,499
July	6,853,976	120,549	48,403,255	1,616,191	721,325
August	6,867,100	116,257	47,895,432	1,623,239	674,173
September	6,560,529	111,269	48,148,898	1,559,880	784,804
October	6,746,223	112,689	49,306,143	1,629,711	920,792
November	6,490,739	106,759	48,399,919	1,511,117	872,901
December	6,329,519	94,903	44,867,909	1,778,912	827,338
Total	73,371,161	1,146,138	491,523,180	17,737,097	8,340,408

[1] Does not include territorial operations, but does include Canadian and Latin American extensions.

U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1936.

Mileage and cost of service on Government-operated and contract air mail routes for the fiscal years 1918 to 1936, inclusive

Fiscal year	*Miles flown*	*Cost of service*	*Average cost per mile*
Government operation:			
1918	16,009	$13,604.00	$0.850
1919	160,066	717,177.00	4.481
1920	549,244	1,264,495.00	2.302
1921	1,554,985	2,653,882.00	1.707
1922	1,537,927	1,418,146.00	.922
1923	1,590,637	1,897,151.00	1.193
1924	1,522,763	1,498,674.00	.984
1925	2,076,764	2,743,750.00	1.321
1926	2,256,137	2,782,422.00	1.233
1927	2,329,553	2,255,919.00	.968
1928	173,987	166,314.00	.956
Contract Air Mail Service:			
1926	396,345	89,753.71	.226
1927	2,805,781	1,363,227.82	.486
1928	5,585,224	4,042,777.16	.724
1929	10,212,511	11,169,015.13	1.094
1930	14,939,468	14,618,231.50	.978
1931	21,381,852	16,943,605.56	.792
1932	32,202,170	19,938,122.61	.619
1933	35,909,811	19,400,264.81	.540
1934	29,111,474	[1] 12,129,959.64	.417
1935	31,143,853	[1] 8,813,270.21	.283
1936	38,699,449	[1] 12,034,953.89	.311

(1) Final adjustment pending.

Statistical report showing the miles of service scheduled and actually flown, weight of mails dispatched and the amount paid air mail carriers during the fiscal years 1926-36

Fiscal year	*Miles of route*	*Miles of service*		*Total weight of mails dispatched (pounds)*
		Scheduled	*Actually flown*	
1926	3,597	411,070	396,345	[1] 3,000
1927	5,551	3,092,016	2,805,781	473,102
1928	10,932	5,999,948	5,585,224	1,861,800
1929	14,406	11,032,508	10,212,511	5,635,680
1930	14,907	16,228,453	14,939,468	7,719,698
1931	23,488	22,907,169	21,381,852	8,579,422
1932	26,745	34,509,483	32,202,170	8,845,967
1933	27,679	38,114,425	35,909,811	6,741,788
1934	[2] 28,820	31,223,641	29,111,474	6,476,919
1935	28,884	33,770,091	31,143,853	10,775,248
1936	29,198	40,795,338	38,699,449	15,377,993
Total		238,084,142	222,387,938	72,490,617

(1) Routes 6 and 7 were on a net-weight basis and poundage shown is for these 2 routes only. All other routes were on a count-of-postage basis.
(2) Advertised mileage of new system.

U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1936.

Statistical report showing the pounds of domestic air mail dispatched, by months, during the fiscal years 1933-36

	1933	*1934*	*1935*	*1936*
July	545,060	644,172	682,520	1,169,737
August	568,887	690,177	776,173	1,224,623
September	555,661	643,621	736,193	1,172,265
October	567,006	665,458	916,416	1,293,869
November	533,047	631,748	823,737	1,181,678
December	542,326	657,203	931,425	1,317,774
January	524,721	643,278	820,286	1,177,753
February	493,416	526,903	858,299	1,167,635
March	586,822	198,492	1,002,269	1,396,977
April	568,740	241,856	1,036,796	1,355,200
May	612,653	389,721	1,108,315	1,444,013
June	643,449	544,290	1,082,819	1,476,469
Total	6,741,788	6,476,919	10,775,248	15,377,993

NOTE.—The above poundage figures were determined by ascertaining the weight of mail dispatched monthly on each route, and then consolidating the route totals to obtain monthly totals for all routes combined. As the same mail was frequently carried over 2 or more routes, the figures shown do not, in any sense, represent the weights of originating air mail.

Statistical report showing the domestic air mail pound-miles performed, by months, for the fiscal years 1933-36

	1933	*1934*	*1935*	*1936*
July	411,257,389	455,598,151	454,192,862	728,599,715
August	427,098,755	476,472,388	511,005,729	761,384,770
September	408,683,293	443,327,027	487,706,543	732,874,751
October	406,175,844	463,825,148	580,238,792	807,459,824
November	383,388,622	431,371,394	516,204,870	717,264,459
December	383,850,830	451,217,496	581,405,062	858,099,895
January	361,559,823	436,385,848	508,804,263	761,833,426
February	347,115,128	348,386,704	528,397,869	745,844,995
March	415,780,182	136,922,593	643,043,623	902,748,876
April	402,069,837	188,450,222	632,506,692	885,274,141
May	431,638,354	307,332,754	669,748,719	920,628,971
June	455,922,478	374,590,801	677,231,608	949,827,992
Total	4,834,540,535	4,513,880,526	6,790,486,632	9,771,841,815

U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1936.

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 during the fiscal year ended June 30, 1936

Route	*Contractor*	*Termini*	*Miles of service*			*Pound-miles performed*		*Payments to contractors*[1]	
			Scheduled	*Actually flown*	*Percent flown*	*Total*	*Percent of whole*	*Total*	*Percent of whole*
1	United Air Lines Transport Corp.	Newark-Oakland	6,057,088	5,939,139	98.05	3,153,335,881	32.27	$2,334,556.59	19.40
11	....do	Seattle-San Diego	1,644,560	1,626,395	98.90	396,308,758	4.06	464,484.42	3.86
12	....do	Salt Lake City-Seattle	1,254,284	1,236,790	98.61	225,488,654	2.31	412,229.35	3.43
	Total		8,955,932	8,802,324	98.28	3,775,133,293	38.64	3,211,270.36	26.69
4	American Airlines, Inc.	Forth Worth-Los Angeles	1,945,068	1,928,623	99.15	361,975,183	3.70	501,332.98	4.17
7	....do	Newark-Chicago	1,267,921	1,183,112	93.31	430,720,166	4.41	438,219.94	3.64
18	....do	Boston-Newark	451,590	390,343	86.44	46,247,529	.47	128,529.34	1.07
21	....do	Boston-Cleveland	578,672	464,670	80.30	16,185,654	.17	149,602.39	1.24
22	....do	Cleveland-Nashville	694,803	639,591	92.05	101,194,743	1.04	175,497.24	1.46
23	....do	Newark-Fort Worth	1,925,124	1,779,370	92.43	269,106,473	2.75	449,736.25	3.74
25	....do	Washington-Chicago	623,164	554,205	88.93	53,850,495	.55	180,613.03	1.50
30	....do	Chicago-Fort Worth	814,133	762,864	93.70	107,476,943	1.10	213,563.92	1.77
	Total		8,300,475	7,702,778	92.80	1,386,757,186	14.19	2,237,095.09	18.59
3	Northwest Airlines, Inc.	Fargo-Seattle	1,905,344	1,823,993	95.73	278,422,831	2.85	[2] 583,456.52	4.85
16	....do	Chicago-Pembina	1,246,094	1,175,169	94.31	216,946,876	2.22	[2] 341,022.56	2.83
	Total		3,151,438	2,999,162	95.17	495,369,707	5.07	924,479.08	7.68
5	North American Aviation, Inc.	Newark-New Orleans	1,786,844	1,628,822	91.16	235,476,135	2.41	419,886.30	3.48
6	....do	Newark-Miami	1,750,944	1,672,226	95.50	457,454,241	4.68	463,194.61	3.85
10	....do	Chicago-Jacksonville	1,362,334	1,296,800	95.19	182,887,911	1.87	348,765.03	2.90
	Total		4,900,122	4,597,848	93.83	875,818,287	8.96	1,231,845.94	10.23

U. S. AIR MAIL SERVICE (*Cont.*)

9	Braniff Airways, Inc.	Chicago-Dallas	994,862	918,542	92.33	234,473,236	2.40	$ 256,814.36	2.13
15	....do	Amarillo-Brownsville	811,812	762,241	93.89	92,263,455	.94	205,715.07	1.71
	Total		1,806,674	1,680,783	93.03	326,736,691	3.34	462,529.43	3.84
17	Wyoming Air Service, Inc.	Cheyenne-Pueblo	231,356	223,503	96.61	17,555,770	.18	69,036.38	.57
28	....do	Billings-Cheyenne	305,976	286,828	93.74	5,690,575	.06	83,593.92	.70
	Total		537,332	510,331	94.97	23,246,345	.24	152,630.30	1.27
2	Transcontinental & Western Air, Inc.	Newark-Los Angeles	5,692,913	5,463,227	95.97	2,334,122,764	23.89	1,665,754.82	13.84
8	Chicago & Southern Air Lines, Inc.	Chicago-New Orleans	1,209,143	1,107,825	91.62	62,940,009	.64	331,355.57	2.75
13	Western Air Express Corporation	Salt Lake City-San Diego	979,318	974,317	99.49	212,674,050	2.18	319,634.48	2.66
14	Central Airlines, Inc.	Washington-Detroit	950,892	856,915	90.12	99,001,644	1.01	285,565.34	2.37
19	National Parks Airways, Inc.	Great Falls-Salt Lake City	637,205	609,628	95.67	26,794,377	.27	202,094.19	1.68
20	Wedell-Williams Air Service Corporation	New Orleans-Houston	247,392	239,909	96.98	12,023,933	.12	74,820.79	.62
24	Delta Air Corporation	Charleston-Fort Worth	1,255,711	1,123,118	89.44	77,107,908	.79	314,365.92	2.61
26	Hanford Tri State Airlines, Inc.	St. Paul-Kansas City	742,545	700,949	94.40	29,953,413	.31	224,262.68	1.86
27	National Airways, Inc.	Boston-Bangor-Burlington	367,986	314,014	85.33	4,115,958	.04	104,659.31	.87
29	Varney Air Transport, Inc.	Pueblo-El Paso	396,479	387,962	97.85	12,437,304	.13	112,440.98	.94
31	G. T. Baker	Jacksonville-St. Petersburg	191,784	187,019	97.52	10,185,399	.10	50,473.13	.42
32	Pennsylvania Airlines & Transport Co.	Detroit-Milwaukee	268,961	239,203	88.94	4,813,945	.05	79,142.23	.66
33	Inter-Island Airways, Ltd.	Honolulu-Hilo-Lihue	203,036	202,137	99.56	2,609,602	.03	[3] 50,534.25	.42
	Total		13,143,365	12,406,223	94.39	2,888,780,306	29.56	3,815,103.69	31.70
	Grand total		40,795,338	38,699,449	94.86	9,771,841,815	100.00	[1] 12,034,953.89	100.00

(1) Final adjustment pending.

(2) Included in these amounts are items of $42,516.25 for route 3 and $30,896.32 for route 16 to be paid from a deficiency appropriation.

(3) Included in this amount is an item of $11,117.53, representing an increase in rates of pay ordered by the Interstate Commerce Commission, which is being withheld pending an appeal by the Post Office Department.

NOTE.—Payments for the transportation of mail by automobile and truck amounting to $910.81 were made to air-mail contractors during the fiscal year ended June 30, 1936, making a total expenditure of $12,035,864.70 for air-mail transportation.

DOMESTIC AIR MAIL CONTRACTS

January 1, 1937

A. M. 1—Newark, N. J. to Oakland, Calif.
Date service started: May 8, 1934—United Air Lines, Inc.
Contract transferred to United Air Lines Transport Corp. Dec. 28, 1934.
A. M. 2—Newark, N. J. to Los Angeles, Calif.
Date service started: May 13, 1934—T W A, Inc.
Contract transferred to Transcontinental & Western Air, Inc. Jan. 1, 1935.
A. M. 3—Fargo, N. D. to Seattle, Wash.
Date service started: May 26, 1934—Northwest Airlines, Inc.
A. M. 4—Fort Worth, Tex. to Los Angeles, Calif.
Date service started: May 13, 1934—American Airlines, Inc.
A. M. 5—Newark, N. J. to New Orleans, La.
Date service started: May 16, 1934 (Newark to Atlanta).
May 28, 1934 (Atlanta to New Orleans)—
Eastern Air Lines, Inc.
Contract transferred to North American Aviation, Inc. Jan. 1, 1935.
A. M. 6—Newark, N. J. to Miami, Fla.
Date service started: May 16, 1934—Eastern Air Lines, Inc.
Contract transferred to North American Aviation, Inc., Jan. 1, 1935.
A. M. 7—Newark, N. J. to Chicago, Ill.
Date service started: May 13, 1934—American Airlines, Inc.
A. M. 8—Chicago, Ill. to New Orleans, La.
Date service started: June 3, 1934—Pacific Seaboard Airlines, Inc.
Name of contractor changed to Chicago and Southern Air Lines, Inc. Feb. 1, 1935.
A. M. 9—Chicago, Ill. to Dallas, Tex.
Date service started: May 17, 1934—Braniff Airways, Inc.
A. M. 10—Chicago, Ill. to Jacksonville, Fla.
Date service started: June 1, 1934—Eastern Air Lines, Inc.
Contract transferred to North American Aviation, Inc., Jan. 1, 1935.
A. M. 11—Seattle, Wash. to San Diego, Calif.
Date service started: May 8, 1934—United Air Lines, Inc.
Contract transferred to United Air Lines Transport Corp. Dec. 28, 1934.
A. M. 12—Salt Lake City, Utah to Seattle, Wash.
Date service started: May 8, 1934—United Air Lines, Inc.
Contract transferred to United Air Lines Transport Corp. Dec. 28, 1934.
A. M. 13—Salt Lake City, Utah to San Diego, Calif.
Service started May 8, 1934—General Air Lines, Inc.
Contract transferred to Western Air Express Corp., Jan. 1, 1935.
A. M. 14—Washington, D. C. to Detroit, Mich.
Service started: May 17, 1934—Central Airlines, Inc.
A. M. 15—Amarillo to Brownsville, Tex.
Service started: June 1, 1934—Long & Harman, Inc.
Contract transferred to Braniff Airways, Inc., Jan. 1, 1935.
A. M. 16—Chicago, Ill. to Pembina, N. D.
Service started: June 1, 1934.
Contract transferred to Northwest Airlines, Inc., Jan. 1, 1935.
A. M. 17—Cheyenne, Wyo. to Pueblo, Colo.
Service started: May 15, 1934 (Cheyenne to Denver).
June 1, 1934 (Denver to Pueblo)—
Wyoming Air Service, Inc.
A. M. 18—Boston, Mass. to Newark, N. J.
Service started: May 13, 1934—American Airlines, Inc.
A. M. 19—Salt Lake City, Utah to Great Falls, Mont.
Service started: May 15, 1934—Alfred Frank.
Contract sublet to National Parks Airways, Inc., Dec. 1, 1934.
A. M. 20—New Orleans, La. to Houston, Tex.
Service started: July 25, 1934—Robertson Airplane Service Company.
Contract transferred to Wedell Williams Air Service Corp., Jan. 1, 1935.
A. M. 21—Boston, Mass. to Cleveland, Ohio.
Service started: June 10, 1934—American Airlines, Inc.
A. M. 22—Cleveland, Ohio to Nashville, Tenn.
Service started: June 10, 1934—American Airlines, Inc.
A. M. 23—Newark, N. J. to Fort Worth, Tex.
Service started: June 10, 1934—American Airlines, Inc. (Nashville to Fort Worth).
July 1, 1934 (Newark to Nashville).
A. M. 24—Charleston, S. C. to Fort Worth, Tex.
Service started: July 4, 1934 (Atlanta to Dallas).
July 7, 1934 (Atlanta to Charleston)—
Delta Air Corporation.
A. M. 25—Washington, D. C. to Chicago, Ill.
Date service started: June 10, 1934.—American Airlines, Inc.
A. M. 26—St. Paul and Minneapolis, Minn. to Omaha, Neb.
Service started: July 3, 1934—Hanfords Tri State Airlines, Inc.
A. M. 27—Boston, Mass. to Bangor, Me. and Burlington, Vt.
Service started: June 25, 1934 (Boston and Burlington).
June 26, 1934 (Boston and Bangor)—
National Airways, Inc.

A. M. 28—Billings, Mont. to Cheyenne, Wyo.
Service started: June 20, 1934—Wyoming Air Service, Inc.
A. M. 29—Pueblo, Colo. to El Paso, Tex.
Service started: July 15, 1934.—Varney Speed Lines, Inc.,
Contract transferred to Varney Air Transport, Inc., Feb. 1, 1935.
A. M. 30—Chicago, Ill. to Fort Worth, Tex.
Service started: June 15, 1934.—American Airlines, Inc.
A. M. 31—Daytona Beach to St. Petersburg, Fla.
Service started: October 15, 1934—D. K. Franklin and G. T. Baker.
Contract sublet to G. T. Baker Mar. 1, 1935.
A. M. 32—Detroit, Mich. to Milwaukee, Wis.
Service started: July 1, 1934.—Pennsylvania Airlines and Transport Co.
A. M. 33—Honolulu to Hilo and Lihue, Territory of Hawaii.
Service started: July 8, 1934—Inter-Island Airways, Inc.

POSTAGE RATES

U. S. Air Mail to Possessions and Foreign Countries

January 1, 1937

	Cents per half-ounce
Argentina	55
Bahamas	10
Barbados	20
Bolivia	40
Brazil	50
Canada	6 cents per ounce
Canal Zone	20
Chile	50
Colombia	35
Costa Rica	20
Cuba	10
Dominican Republic	10
Dutch West Indies:	
Curacao, Bonaire, Aruba	30
St. Martins, St. Eustatius, Saba	20
Ecuador	30
Guadeloupe (including Desirade, Les Saintes, Marie Galante, Petite Terre, St. Bartholomew (Barthelemy) and the French part of St. Martins)	20
Guam	50
Guatemala	15
Guianas (British, Dutch, and French)	30
Haiti	10
Hawaii	25
Honduras (British)	15
Honduras (Republic)	15
Jamaica	10
Leeward Islands:	
Anguilla, Antigua, Barbuda, Dominica, Montserrat, Nevis, Redonda, St. Christopher (St. Kitts)	20
British Virgin Islands	10
Martinique	20
Mexico	10
Nicaragua	15
Panama Republic	20
Paraguay (by ordinary means from Buenos Aires)	55
Peru	40
Philippine Islands	75
Puerto Rico	10
Salvador (El)	15
Trinidad	20
Uruguay	55
Venezuela (by air to Maracaibo, Cumarebo, La Guaira, Caripito)	30
Venezuela (including dispatch by Venezuelan air mail service from Maracaibo or La Guaira)	45
Virgin Islands of the United States	10
Windward Islands (Grenada, Grenadines, St. Lucia, St. Vincent)	20

REVIEW OF ANNUAL MILITARY AND COMMERCIAL PRODUCTION IN THE UNITED STATES

Calendar Years

Airplane Production

	Military		Commercial	
Year	*Units*	*Value*	*Units*	*Value*
1925	447	$ 5,174,025	268	$ 1,499,634
1926	532	6,154,708	604	2,716,319
1927	621	7,528,383	1,565	6,976,616
1928	1,219	19,066,379	3,542	17,194,298
1929	677	10,832,544	5,357	33,624,756
1930	747	10,723,720	1,937	10,746,042
1931	812	12,971,028	1,582	6,655,738
1932	593	10,389,316	549	2,337,899
1933	466	9,784,643	591	6,180,900
1934	437	8,836,509	772	9,957,602
1935	459	11,418,382	1,109	10,410,334
1936	1,141	27,836,199	1,559	12,379,835

Airplane Engine Production

	Military		Commercial	
Year	*Units*	*Value*	*Units*	*Value*
1929	1,861	8,600,530	5,517	17,895,300
1930	1,841	10,823,423	1,925	6,255,493
1931	1,800	10,417,718	1,976	4,148,131
1932	1,085	6,370,678	813	2,898,371
1933	860	4,986,181	1,120	4,724,441
1934	688	5,162,710	2,048	10,270,500
1935	991	6,180,311	1,974	6,511,298
1936	1,804	14,569,708	2,433	7,520,900

SUMMARY OF SPARE PART SALES

Aircraft

	Military	*Commercial*	*Miscellaneous*	*Total*
1930	$4,108,167	$3,442,573	$475,002	$8,025,742
1931	4,627,594	1,912,481	499,857	7,039,932
1932	3,701,838	974,439	348,770	5,025,047
1933	3,127,255	945,336	140,340	4,212,931
1934	2,168,856	1,540,564	436,425	4,145,845
1935	2,857,201	2,090,176	755,698	5,703,075
1936	4,445,852	3,147,964	634,373	8,228,189

Aircraft Engine Parts

1930	$2,231,370	$2,487,576	$494,216	$5,213,162
1931	3,904,739	1,747,654	267,400	5,919,793
1932	3,699,848	1,241,878	73,644	5,015,370
1933	1,961,033	1,567,604	67,843	3,596,480
1934	1,543,730	2,517,592	299,377	4,360,699
1935	2,351,238	2,289,244	351,236	4,991,718
1936	3,630,224	2,327,394	619,101	6,576,719

MONTHLY PRODUCTION AND SALES STATISTICS

Military and Salable Commercial Aircraft

PRODUCTION

	1935				*1936*			
	Military		*Commercial*		*Military*		*Commercial*	
	Units	*Value*	*Units*	*Value*	*Units*	*Value*	*Units*	*Value*
January	30	$1,011,887	37	$ 634,984	53	$1,143,537	38	$ 296,957
February	22	885,273	45	610,865	174	1,926,402	60	477,916
March	47	1,462,488	80	1,106,352	68	1,159,957	91	692,084
April	26	962,150	83	1,029,007	50	1,224,523	133	1,602,704
May	8	275,885	102	1,114,801	67	1,791,709	159	1,041,141
June	24	273,094	93	783,062	84	2,184,390	182	1,319,663
July	21	177,875	105	850,127	77	1,716,970	197	1,019,337
August	37	524,640	117	744,709	36	536,768	167	882,284
September	26	626,360	101	523,825	48	1,038,690	137	1,123,411
October	22	492,049	130	561,763	84	1,639,994	160	1,173,154
November	36	1,365,321	91	969,812	79	2,023,440	124	1,220,672
December	45	959,320	65	641,706	94	2,341,438	111	1,530,512
Total	459*	$11,418,382*	1,109*	$10,410,334*	1,141†	$27,836,199†	1,559	$12,379,835

DELIVERIES

January	30	$1,011,887	31	$ 617,662	47	$1,031,139	37	$ 333,703
February	21	867,273	56	773,618	56	923,402	59	492,046
March	47	1,462,488	80	1,111,682	68	1,182,506	87	693,856
April	24	862,150	86	1,034,380	50	1,226,205	136	1,631,625
May	8	275,885	97	1,106,659	67	1,791,709	156	1,036,471
June	31	332,594	92	786,002	84	2,202,414	180	1,323,620
July	21	174,544	107	841,618	77	1,717,571	190	1,005,387
August	37	518,297	115	720,220	37	553,357	162	934,686
September	26	626,360	98	502,951	48	1,040,488	138	1,100,392
October	22	492,049	120	498,307	84	1,646,005	144	1,153,914
November	36	1,365,321	95	995,971	84	2,120,741	117	1,223,508
December	41	887,455	69	680,744	95	2,354,998	122	1,606,318
Total	344	$8,876,303	1,046	$9,669,814	1,024†	$26,898,916†	1,528	$12,535,526

All values represent planes less engines.

* Production totals include additional data reported on an annual basis and not included in the monthly figures, as follows: Military, 115 units valued at $2,402,040; Commercial, 60 units, valued at $839,321.

† Includes 227 military planes, valued at $9,108,381, produced and delivered, and reported for calendar year only, and not entered in monthly reports.

MONTHLY PRODUCTION AND SALES STATISTICS

Military and Commercial Aircraft Engines

PRODUCTION

	1935				*1936*			
	Military		*Commercial*		*Military*		*Commercial*	
	Units	*Value*	*Units*	*Value*	*Units*	*Value*	*Units*	*Value*
January....	15	$ 142,500	117	$ 441,665	130	$ 950,667	145	$ 470,802
February ...	21	187,650	114	510,020	153	1,032,659	142	417,269
March......	32	206,350	141	437,248	143	1,094,325	132	551,351
April.......	72	542,250	119	322,010	117	1,751,364	232	835,717
May.......	89	614,500	164	476,615	169	1,424,756	220	720,889
June.......	75	524,150	177	609,620	116	950,160	255	809,236
July........	98	589,500	183	589,574	155	1,114,615	274	676,983
August.....	68	498,650	209	829,575	121	946,156	255	588,888
September ..	45	262,511	142	330,175	194	1,584,598	183	650,923
October.....	99	654,423	196	603,643	181	1,470,060	196	542,980
November ..	127	734,279	134	427,654	162	1,076,971	191	463,773
December...	150	842,240	130	348,876	163	1,173,377	208	792,089
Total.....	991*	$6,180,311*	1,974*	$6,511,298*	1,804	$14,569,708	2,433	$7,520,900

DELIVERIES

January....	15	$ 142,500	117	$ 439,365	130	$ 950,667	140	$ 494,409
February ...	21	187,650	118	530,720	153	1,050,306	143	439,487
March......	33	226,350	153	562,023	143	1,098,581	185	668,420
April.......	72	542,250	133	416,760	117	1,757,744	250	906,193
May.......	90	634,500	174	517,585	171	1,436,086	238	747,097
June.......	75	524,150	208	664,005	113	964,695	283	955,204
July........	98	589,500	178	592,150	155	1,114,615	274	668,056
August.....	68	498,650	203	816,805	118	939,156	263	615,704
September ..	45	271,693	153	394,364	194	1,584,598	172	635,641
October.....	100	676,323	204	656,282	175	1,458,325	184	554,640
November ..	127	752,073	140	500,598	162	1,085,159	185	452,798
December...	150	860,719	105	307,094	163	1,179,521	210	807,366
Total.....	894	$5,906,358	1,886	$6,397,751	1,794	14,619,453	2,527	$7,946,015

* Production totals include additional data reported on an annual basis, and not included in the monthly figures, as follows: Military—100 units valued at $381,308; Commercial, 148 units valued at $584,623.

PRODUCTION AND DELIVERIES OF SALABLE AIRCRAFT IN THE UNITED STATES

Commercial and Military

Type	*Production—1935*		*Deliveries—1935*		*Production—1936*		*Deliveries—1936*	
	Units	*Value*	*Units*	*Value*	*Units*	*Value*	*Units*	*Value*
Biplanes	0	....	0	....	0	....	0	....
	40	$138,668	40	$138,668	5	$13,563	6	$19,903
Open Cockpit	50	201,383	54	205,384	1	7,734	1	3,828
	0	....	0	....	0	....	0	....
Sub-total	90	$340,051	94	$344,052	6	$21,297	7	$23,731
Cabin Single-Engine	160	939,725	153	949,207	211	1,192,095	214	1,292,918
Cabin Multi-Engine	0	....	0	....	0	....	0	....
Total Biplanes	250	$1,279,776	247	$1,293,259	217	$1,213,392	221	$1,316,649
Monoplanes	1	4,270	0	....	1	1,258	1	1,258
	61	125,935	62	132,852	39	105,250	32	93,815
Open Cockpit	0	....	0	....	0	....	0	....
	0	....	0	....	0	....	0	....
Sub-total	62	$130,205	62	$132,852	40	$106,508	33	$ 95,073
	17	47,425	18	53,100	22	75,595	22	86,450
	436	547,942	433	571,887	888	1,143,241	860	1,134,826
	73	237,370	72	236,380	82	330,280	84	335,910
Cabin Single-Engine	79	282,749	82	291,010	175	592,781	169	562,049
	2	33,900	2	33,900	3	31,920	4	54,660
	4	87,450	3	74,950	2	32,990	4	47,490
	0	....	0	....	3	43,000	3	43,000
	8	316,307	9	333,057	0	....	0	....
Sub-total	619	$1,553,143	619	$1,594,284	1,175	$2,250,207	1,146	$2,264,385
Cabin Multi-Engine	111	5,923,003	111	5,964,533	93	5,795,755	94	5,822,490
Total Monoplanes	792	$7,606,351	792	$7,691,669	1,308	$8,152,470	1,273	8,181,948
Seaplanes	3	485,773	3	485,773	10	958,705	11	991,661
Amphibions	4	199,113	4	199,113	23	2,045,268	23	2,045,268
Autogiros	0	....	0	....	1	10,000	0	....
Sub-total	7	$684,886	7	$684,886	34	$3,013,973	34	$3,036,929
Commercial Total	1,109*	$10,410,334*	1,046	$9,669,814	1,559	$12,379,835	1,528	$12,535,526
U. S. Military Total	459**	$11,418,382**	344	$8,876,303	1,141	27,836,199	1,024	26,898,916
Grand Total	1,568	$21,828,716	1,390	$18,546,117	2,700	$40,216,034	2,552	$39,434,442

All values represent planes less engines.

* Includes 60 units valued at $839,321, obtained from annual production reports, which are not included in above breakdown by types, nor in delivery totals.

** Includes 115 units valued at $2,402,040, obtained from annual production reports, which are not included in delivery totals.

PRODUCTION AND DELIVERIES OF AIRPLANE ENGINES IN THE UNITED STATES

Commercial and Military

Commercial	*Production—1935*		*Deliveries—1935*		*Commercial*	*Production—1936*		*Deliveries—1936*	
Horsepower	*Units*	*Value*	*Units*	*Value*	*Horsepower*	*Units*	*Value*	*Units*	*Value*
Under 75..........	405	$216,364	402	$221,850	Under 75.........	804	$297,822	792	$309,586
76–125...........	244	279,284	231	270,334	76–125..........	266	242,836	255	238,916
126–175...........	97	133,470	87	118,070	126–175..........	160	227,028	155	218,219
176–225...........	171	332,351	151	295,523	176–225..........	100	200,188	132	268,113
226–300...........	200	482,158	229	540,506	226–300..........	293	833,482	377	1,142,842
301–400...........	56	238,785	82	348,495	301–400..........	21	89,150	23	97,730
401–500...........	98	435,100	99	434,700	401–500..........	158	691,900	158	691,900
501–600...........	150	912,690	181	1,099,640	501–600..........	63	371,190	57	348,630
601–700...........	29	193,260	35	228,650	601–700..........	33	193,380	34	199,305
701–Up...........	376	2,703,213	389	2,839,983	701–Up..........	535	4,373,924	544	4,430,774
Totals........	1,974*	$6,511,298*	1,886	$6,397,751	Totals........	2,433	$7,520,900	2,527	$7,946,015
Military					*Military*				
Horsepower					*Horsepower*				
76–125...........	11	$16,755	12	$17,515	76–125..........	0	....	0	....
126–175...........	3	7,900	3	7,839	126–175..........	2	$ 3,450	1	$ 1,500
176–225...........	6	17,400	6	17,400	176–225..........	23	46,300	24	49,300
226–300...........	106	248,123	106	314,779	226–300..........	147	358,365	137	379,245
301–400...........	24	100,435	24	100,435	301–400..........	55	239,800	55	239,800
401–500...........	4	16,750	4	16,750	401–500..........	136	601,610	136	601,610
501–600...........	169	788,050	169	788,050	501–600..........	99	536,311	98	527,901
601–700...........	168	1,461,200	170	1,501,200	601–700..........	40	347,500	40	347,500
701–Up...........	400	3,142,390	400	3,142,390	701–Up..........	1,302	$12,436,372	1,303	12,472,597
Totals........	991**	$6,180,311**	894	$5,906,358	Totals.......	1,804	$14,569,708	1,794	$14,619,453
GRAND TOTAL ..	2,965	$12,691,609	2,780	$12,304,109	GRAND TOTAL ..	4,237	$22,090,608	4,321	$22,565,468

* Includes 148 units valued at $584,623, obtained from annual production reports, which are not included in above breakdown by horsepower, nor in delivery total.

** Includes 100 units valued at $381,308, obtained from annual production reports, which are not included in above breakdown by horsepower, nor in delivery total.

PROGRESS OF CIVIL AERONAUTICS IN THE UNITED STATES

Compiled by U. S. Bureau of Air Commerce

All statistics as of Dec. 31 each year

	1934	*1935*	*1936*
Firms engaged in the industry	1,400	1,500	1,600
Scheduled air-line operations			
Airplanes:			
In service and reserve:			
Domestic[1]	417	356	305 est.
Foreign[1]	101	103	110 est.
Total	518	459	415 est.
Value of	$10,500,000	$12,465,000	$14,750,000 est.
Airways (domestic and foreign[1]):			
Services in operation	98	109	110
Express mileage	50,652	60,377	61,458
Mail mileage	46,003	51,428	51,740
Passenger mileage	49,353	52,387	61,458
Total mileage:			
Domestic[1]	28,084	28,267	28,874
Foreign extensions[1]	22,717	32,184	32,658
Total	50,801	60,451	61,532
Accidents (domestic and foreign[1]):			
Number of fatal	10	8	10
Miles flown per fatal accident	4,878,655	6,922,544	7,337,116
Number of nonfatal	63	54	67
Number of passenger fatalities	21	15	46
Passenger-miles flown per passenger fatality	10,727,026	24,037,962	10,685,286
Express and freight carried (pounds):			
Domestic[1]	2,133,191	3,822,397	6,953,720
Foreign[1]	1,316,484	1,689,340	1,395,688
Total	3,449,675	5,511,737	8,349,408
Express, ton-miles (domestic[1])	....	1,089,802	1,387,083 est.
Fuel (consumed) (domestic and foreign[1]):			
Gasoline . . . gallons	25,136,274	33,260,609	35,000,000 est.
Oil . . . do	838,756	879,775	900,000 est.
Mail:			
Carried by contractors:			
Domestic[1] . . . pounds	7,411,004	13,276,023	16,500,000 est.
Foreign[1] . . . do	460,880	503,585	600,000 est.
Total	7,871,884	13,779,608	17,100,000 est.
Ton-miles of mail (domestic[1])	[2]2,461,411	4,132,708	5,500,000 est.
Income to contractors:			
Domestic[1]	[2]$8,804,479	$10,662,554	12,000,000 est.
Foreign[1]	$6,917,750	$6,603,340	7,000,000 est.
Total	$15,722,229	$17,265,894	19,000,000 est.
Miles of mail airways (domestic and foreign[1])	46,003	51,428	51,740
Miles flown:			
Daily average (domestic and foreign[1])	133,662	174,084	201,017 est.
Mail (domestic and foreign[1])	27,340,293	39,977,189	45,000,000 est.

See end of table for footnotes.

	1934	*1935*	*1936*
Scheduled air-line operations—Continued			
Domestic routes	40,955,396	55,380,353	63,780,228
Foreign routes	7,831,155	8,159,880	9,590,933 est.
Total	48,786,551	63,540,233	73,371,161 est.
Operators, number of:			
Domestic[1]	22	23	21
Foreign[1]	4	7	7
Total	[3] 25	[3] 27	[3] 25
Passenger-miles flown (1 passenger carried 1 mile):			
Domestic[1]	187,858,629	313,905,508	453,381,285
Foreign[1]	37,408,930	46,663,923	56,141,895 est.
Total	225,267,559	360,569,431	491,523,180 est.
Passengers carried:			
Domestic[1]	461,743	746,946	1,020,297
Foreign[1]	99,627	113,815	125,841 est.
Total	561,370	860,761	1,146,138 est.
Passenger-seat-miles flown (domestic)[1]	362,546,746	572,546,530	670,000,000 est.
Passenger-seat-miles, percentage used (domestic)[1]	51.82	54.83	64.18 est.
Passenger fare, average per mile (domestic)[1]	$0.059	$0.057	$0.056 est.
Pay rate of:			
Mechanics, average per month (domestic)[1]	$133	$149	$150 est.
Pilots, average per month (domestic)[1]	$524	$541	$550 est.
Copilots (domestic)[1]	$201	$206	$210 est.
Personnel employed (domestic and foreign):[1]			
Mechanics and ground crew	2,201	2,613	2,725 est.
Pilots	503	652	700 est.
Copilots	248	335	440 est.
Other hangar and field personnel	1,846	1,515	1,550 est.
Operation and office personnel	1,657	3,006	3,425 est.
Total	6,455	8,121	8,840 est.
Trips, percentage completed of those started (domestic)[1]	93.88	95.18	96.00 est.
Miscellaneous flying operations (all domestic)[1]			
Airplanes in operation (licensed and unlicensed)	7,752	8,613	8,750 est.
Accidents:			
Number of fatal	186	164	....
Miles flown per fatal accident	406,463	516,803	....
Number of nonfatal	1,318	1,353	....
Number of passenger fatalities	151	100	....
Miles flown per passenger fatality	500,677	847,556	....
Fuel (consumed):			
Gasoline ... gallons	9,630,869	11,104,259	10,500,000 est.
Oil ... do	348,985	334,420	280,000 est.
Miles flown	75,602,152	84,755,630	88,000,000 est.

See end of table for footnotes.

	1934	1935	1936
Miscellaneous flying operations (all domestic)[1] Continued			
Passengers:			
Carried for hire	1,044,079	1,014,957	1,027,280 est.
Carried for pleasure	353,209	272,418	219,515 est.
Total	1,397,288	1,287,375	1,246,795 est.
Airports and Department of Commerce Intermediate landing fields			
Airports:			
Commercial and private	618	552	525
Municipal	702	739	738
Intermediate—Department of Commerce—lighted	250	282	284
Intermediate—Department of Commerce—unlighted	9	9	12
Auxiliary—marked	580	631	622
Army, Navy, Marine Corps, National Guard, reserve and miscellaneous airports	138	156	161
Total airports in operation	2,297	2,369	2,342
Proposed	26	....	
Lighted, total	664	698	705
Of entry, regular	11	12	12
Of entry, temporary	42	42	43
Federal Airways System and Aids to Air Navigation			
Communication:			
Radio broadcast stations	71	74	80
Radio range beacon stations	112	137	146
Radio marker beacons	84	57	57
Weather reporting airway and airport stations—Weather Bureau and Department of Commerce operated, long line teletypewriter equipped	206	203	213
Miles of teletypewriter service	11,631	13,260	13,120
Weather Bureau—first order stations (does not include airport stations)	185	191	182
Airway lighting:			
Beacons:			
Revolving	1,324	1,657	1,677
Flashing	196	211	241
Beacons, privately owned and certified	310	330	410
Intermediate landing fields, lighted by Department of Commerce	250	282	284
Mileage lighted by Department of Commerce	19,081	22,012	22,245
Miles under construction by Department of Commerce	3,048	338	0
Licenses and approvals			
Approved type certificates (issued by the Department of Commerce):			
Airplanes	560	593	620
Engines	139	154	168
Gliders	4	4	4
Parachutes	53	53	53
Propellers	497	535	567
Wheels	26	34	35

See end of table for footnotes.

	1934	*1935*	*1936*
Licenses and approvals—Continued			
Pontoons	11	14	17
Skis	4	7	13
Flares and signals	4	4	4
Approvals (without approved type certificates):			
Airplanes	496	518	529
Engines	11	11	11
Engines—foreign (temporarily approved)	15	15	15
Gliders	1	2	3
Pontoons	32	32	32
Propellers	119	119	119
Repair stations	148	174	181
Schools	20	24	27
Skis	31	31	31
Flares	2	2	0
Wheels	2	2	0
Unlicensed aircraft (active):			
Airplanes	1,983	1,701	1,805
Gliders	446	387	370
Licensed (active):			
Airplanes	6,339	7,371	7,390 est.
Gliders	40	48	31
Instructors, flying	[4] 105	[4] 85	[4] 103
Instructors, ground	59	55	48
Mechanics	8,156	8,432	8,738
Pilots, airplane	13,949	14,805	15,952
Pilots, glider	109	145	138
Riggers, parachute	358	381	393
Permits (student pilot) issued:			
Airplane	11,994	14,572	17,675
Glider	225	330	209
Production and exports of aircraft			
Exports:			
Airplanes	490	334	400 est.
Airplanes, value	$8,258,484	$6,638,515	$7,000,000 est.
Engines	1,007	568	600 est.
Engines, value	$4,383,101	$2,459,317	$3,000,000 est.
Parts, value	$4,808,130	$5,069,810	$5,650,000 est.
Parachutes and parts, value	$98,466	$163,201	$175,000 est.
Production:			
Airplanes	1,615	1,691	2,400 est.
Airplanes and parts, value	$25,399,078	(5)	$43,000,000 est.
Engines	2,545	(5)	2,750 est.
Engines and parts, value	$15,825,127	(5)	$20,625,000 est.
Equipment (miscellaneous), value	$2,667,720	(5)	3,000,000 est.
Total value, all aircraft engines, parts, and equipment	$43,891,925	(5)	$66,625,000 est.
Number of aircraft manufacturers	91	97	98 est.
Number of aircraft manufacturers producing	48	50	52 est.
Number of engine manufacturers	35	36	36 est.
Number of engine manufacturers producing	17	17	17 est.

(1) Domestic scheduled air lines operate within the continental limits of the United States. Foreign operations cover activities of American air lines in foreign countries.

(2) Includes 224,236 ton-miles of mail carried and $2,249,004 paid to the War Department for carrying the mail from Feb. 20 to Mar. 16, 1934.

(3) In several cases the same company operates both domestic and foreign services.

(4) These figures represent the total number of flying instructors approved.

(5) Figures not available.

UNITED STATES AERONAUTIC EXPORTS

Compiled by U. S. Bureau of Foreign and Domestic Commerce

Total Value for Calendar Years

Country of Destination	*1935 Value*	*1936 Value*
China	$ 2,522,262	$ 7,185,556
Netherlands	1,821,729	1,108,335
Russia	1,020,518	268,725
Japan	950,377	989,100
Brazil	931,073	550,992
Italy	789,826	631,270
Mexico	639,589	680,101
United Kingdom	460,445	461,397
Siam	454,862	489,441
Peru	408,046	460,694
Argentina	401,951	2,269,914
Canada	399,318	706,824
Netherlands Indies	375,758	1,063,509
Switzerland	326,738	35,123
Poland & Danzig	316,876	249,222
Colombia	296,915	396,424
Chile	245,677	41,200
Spain	211,266	118,871
Germany	195,464	411,252
France	155,321	675,546
Sweden	154,161	139,327
Cuba	113,334	59,276
Turkey	112,532	96,653
Rumania	105,254	127,612
Panama	93,601	175,781
Trinidad & Tobago	76,302	73,425
Hong Kong	68,267	195,544
Philippine Islands	67,908	389,111
Australia	66,571	644,587
Netherland West Indies	50,145	1,493
Egypt	47,139	145
Ecuador	45,626	157,088
Union of South Africa	45,128	50,294
Belgium	39,478	31,932
Guatemala	38,185	3,273
Czechoslovakia	25,611	298,989
Nicaragua	24,336	7,892
Bolivia	23,174	105,479
Honduras	21,306	145,242
Costa Rica	19,944	29,783
El Salvador	15,520	2,039
Yugoslavia	15,171	641,403
Portugal	11,776	14,901
Finland	11,069	57,512
Liberia	9,398	382
Venezuela	8,542	37,846
Norway	8,196	258,207
Haiti	7,343	1,754
British Malaya	7,069	250
British India	6,088	22,075
Iran	4,351	9,565
Other British West Indies	4,308	1,604
British East Africa	3,534	155
Dominican Republic	3,309	7,092
Latvia	2,883	2,500
Austria	2,441	64,365
British Guiana	1,919	6,121
Lithuania	1,330	9,752
British Honduras	1,212	62
Bulgaria	942	8,877
New Zealand	788	23,283
Kwantung	728	....
French Guiana	398	2,853
Saudi Arabia	363	22,318
Gibraltar	310	....
Morocco	304	1,192
Jamaica	276	5,396
Barbados	235	33
French West Indies	235	2,493

Country of Destination	1935 Value	1936 Value
Surinam	232	2,121
Greece	179	8,931
Uruguay	97	25,311
Newfoundland & Labrador	8	13,403
Other French Africa	....	251,068
Denmark	....	19,427
Other British South Africa	....	1,532
Aden	....	1,183
Other Asia	....	464
Iraq	....	373
Paraguay	....	294
British Oceania	....	139
Syria	....	65
Bermuda	....	1,000
Totals	$14,290,843	$23,055,761

Airplanes, Seaplanes and Amphibions

Country of Destination	1935 No.	1935 Value	1936 No.	1936 Value
China	81	$ 1,645,062	114	$ 3,759,520
Netherlands	26	1,381,816	5	427,055
Brazil	77	538,598	14	204,135
Mexico	22	521,799	49	501,462
Siam	12	319,200	12	325,800
Japan	4	242,161	11	449,944
Switzerland	4	233,737	...	....
Poland & Danzig	3	193,684	3	162,245
Russia	2	179,719	1	117,676
Chile	8	165,667	3	6,422
Spain	3	160,345	1	80,000
Peru	2	150,000	11	285,248
Canada	8	104,928	35	257,853
Argentina	13	87,412	64	1,505,464
United Kingdom	14	82,507	20	91,869
Colombia	4	81,000	8	210,372
Cuba	2	80,000	1	4,000
Germany	1	72,179	2	15,500
Netherland West Indies	1	50,000	...	....
Turkey	1	43,000	...	....
Ecuador	5	42,900	9	149,010
Guatemala	3	31,500	...	....
France	1	30,000	10	240,265
Union of South Africa	5	25,228	15	28,468
Nicaragua	4	21,000	2	5,500
Hong Kong	4	16,782	1	34,568
Philippine Islands	3	15,575	13	251,529
Italy	3	14,552	1	20,000
Costa Rica	4	13,150	1	6,500
Yugoslavia	1	9,500	...	....
Liberia	1	7,000	...	....
British Malaya	1	7,000	...	....
Panama	3	6,055	5	19,500
British India	1	5,959	3	20,581
Egypt	1	5,800	...	....
Belgium	1	5,325	...	....
Honduras	1	5,000	21	74,898
Norway	1	2,000	8	191,132
Netherlands Indies	1	1,140	11	776,118
Barbados	1	235	...	....
Australia	...	....	21	492,156
Czechoslovakia	4	....	4	273,486
Other French Africa	...	....	2	216,660
Uruguay	...	....	2	20,310
New Zealand	...	....	2	15,000
Arabia	...	....	1	13,937
Venezuela	...	....	1	12,895
Newfoundland & Labrador	...	....	2	12,000
Portugal	...	....	3	7,499
Trinidad & Tobago	...	....	2	6,000
Dominican Republic	...	....	2	2,875
Sweden	...	....	2	2,323
Morocco	...	....	1	1,176
Denmark	...	....	1	500
Totals	333	$ 6,598,515	500	$11,299,451

Aircraft Engines

Country of Destination	1935 No.	1935 Value	1936 No.	1936 Value
Italy	63	$ 549,310	54	$ 457,041
United Kingdom	48	277,905	34	56,251
China	80	264,693	203	1,597,111
Brazil	42	149,926	45	127,386
Japan	25	141,339	20	119,695
Netherlands	22	131,339	57	393,450
Argentina	27	124,752	85	328,668
Russia	21	120,183	11	58,308
Sweden	11	78,745	7	43,653
Mexico	34	69,565	45	114,470
Trinidad & Tobago	24	64,000	15	53,050
Germany	7	55,349	56	304,542
Canada	46	54,491	48	101,469
Peru	10	49,065	7	41,446
Switzerland	6	38,495	1	6,000
Egypt	8	34,784	...	....
Netherlands Indies	6	31,362	9	52,841
Colombia	8	29,847	7	28,867
Poland & Danzig	4	29,690	...	....
Hong Kong	5	24,560	5	17,730
Spain	5	24,169	2	19,554
Panama	14	20,945	20	59,501
Australia	16	18,015	16	59,447
Czechoslovakia	2	16,540	2	19,000
Turkey	3	10,433	1	1,768
Chile	2	8,300	2	10,300
France	1	6,969	28	370,500
Haiti	1	5,000	...	....
Venezuela	2	4,095	2	7,490
Cuba	2	4,000	9	20,750
Philippine Islands	1	3,500	8	23,092
Costa Rica	3	3,300	15	21,841
Union of South Africa	2	3,245	...	....
El Salvador	2	1,750	...	....
Guatemala	2	1,600	5	1,500
Other British West Indies	1	1,600	...	....
Honduras	2	1,500	20	19,148
Portugal	1	1,155	...	....
British Honduras	2	994	...	....
Bolivia	1	930	6	43,701
British Guiana	1	748	1	3,000
Finland	1	410	5	31,586
Morocco	1	304	...	....
Nicaragua	1	225	...	....
Latvia	2	190	...	....
Yugoslavia	...	....	61	627,000
Siam	...	....	12	81,710
Norway	...	....	7	27,664
Denmark	...	....	2	14,000
Austria	...	....	1	8,800
New Zealand	...	....	2	7,340
Arabia	...	....	1	7,000
Jamaica	...	....	2	3,999
French West Indies	...	....	1	2,250
Uruguay	...	....	1	1,250
Newfoundland & Labrador	...	....	1	1,170
Dominican Republic	...	....	1	1,130
Totals	568	$ 2,459,317	945	$ 5,397,489

Parachutes and Parts

Country of Destination	1935 Value	1936 Value
Rumania	$ 96,480	$120,143
Argentina	18,307	72,540
Turkey	10,303	2,275
Spain	8,893	14,744
Hong Kong	6,420	2,750
Portugal	4,250	4,075
Japan	3,342	125

Country of Destination	1935 Value	1936 Value
China	3,012	24,150
Netherlands Indies	3,000	6,534
Siam	3,000	....
Cuba	1,800	14
Union of South Africa	1,746	....
Poland & Danzig	550	....
Bulgaria	458	6,480
United Kingdom	360	880
Russia	315	1,014
Venezuela	300	1,342
Switzerland	275	175
Canada	229	3,730
Philippine Islands	154	....
Haiti	7	....
Brazil	....	19,615
Colombia	....	7,183
Chile	....	3,430
Mexico	....	2,951
Ecuador	....	1,800
Peru	....	778
Australia	....	650
Dominican Republic	....	555
Greece	....	266
Sweden	....	122
Norway	....	37
Totals	$163,201	$298,358

Aircraft Parts and Accessories (Except Tires)

Country of Destination	1935 Value	1936 Value
Russia	$ 720,301	$ 91,727
China	609,771	1,804,775
Japan	563,535	419,536
Netherlands Indies	340,236	228,016
Netherlands	306,574	287,830
Brazil	242,549	199,856
Canada	239,670	343,772
Italy	225,964	154,229
Peru	208,981	133,222
Colombia	186,068	150,002
Argentina	171,480	363,242
Siam	152,662	81,931
France	118,352	64,781
United Kingdom	99,673	312,397
Poland & Danzig	92,952	86,977
Sweden	75,416	93,229
Chile	71,710	21,048
Germany	67,936	91,210
Panama	63,601	96,780
Switzerland	54,231	28,948
Turkey	48,796	92,610
Philippine Islands	48,679	114,490
Australia	48,556	92,534
Mexico	48,225	61,218
Belgium	34,133	31,932
Cuba	27,534	34,512
Bolivia	22,244	61,778
Hong Kong	20,505	140,496
Spain	17,859	4,573
Union of South Africa	14,909	21,826
Honduras	14,806	51,196
El Salvador	13,770	2,039
Trinidad & Tobago	12,302	14,375
Finland	10,659	25,926
Czechoslovakia	9,071	6,305
Rumania	8,774	7,469
Egypt	6,555	145

Country of Destination	1935 Value	1936 Value
Portugal	6,371	3,327
Norway	6,196	39,374
Guatemala	5,085	1,773
Iran	4,351	9,563
Venezuela	4,147	16,119
Yugoslavia	3,671	14,403
British East Africa	3,534	155
Costa Rica	3,494	1,442
Dominican Republic	3,309	2,532
Nicaragua	3,111	2,392
Ecuador	2,726	6,278
Other British West Indies	2,708	1,604
Austria	2,441	55,565
Latvia	2,693	2,500
Liberia	2,398	382
Haiti	2,336	1,754
Lithuania	1,330	9,752
British Guiana	1,171	3,121
New Zealand	788	943
Kwantung	728	....
Bulgaria	484	2,397
French Guiana	398	2,853
Saudi Arabia	363	1,381
Gibraltar	310	....
Jamaica	276	1,397
French West Indies	235	243
Surinam	232	2,121
British Honduras	218	62
Greece	179	8,665
Netherland West Indies	145	1,493
British India	129	1,494
Uruguay	97	3,751
British Malaya	69	250
Newfoundland & Labrador	8	235
Other French Africa	....	34,408
Denmark	....	4,927
Other British South Africa	....	1,532
Aden	....	1,183
Bermuda	....	1,000
Other Asia	....	464
Iraq	....	373
Paraguay	....	294
British Oceania	....	139
Syria	....	65
Barbados	....	33
Morocco	....	16
Totals	$5,069,810	$6,060,483

AERONAUTICAL PURCHASES BY U. S. AIR FORCES

Fiscal Year 1936

The following is a compilation of major purchases and deliveries of aircraft and engines by the United States Army and Navy aviation services during the fiscal year 1936, prepared with the aid of the Army Air Corps and the Bureau of Aeronautics of the Navy Department.

ARMY PURCHASES OF AERONAUTICAL EQUIPMENT

Fiscal Year 1936

Airplanes

Type	*Factory Name*	*Quantity*
O-46A	Douglas observation	19
A-17AS	Northrop attack	2
XC-32	Douglas transport	1
PT-13	Stearman primary trainer	26
BT-9	North American basic trainer	82
C-33	Douglas transport	18
XO-47	North American observation	1
XA-14	Curtiss twin-engine attack	1
XB-17	Boeing bombardment	13
B-18	Douglas bombardment	82
A-17-A	Northrop attack	100
C-34	Douglas transport	2
XFM-1	Bell fighter	1
XC-35	Lockheed transport	1
P-35	Seversky pursuit	77
YG-1A	Kellett autogiro	1
	Total	427

Engines

Type	*Contractor*	*Quantity*
R-975-7	Wright Aeronautical Corporation	164
R-680-5	Aviation Manufacturing Corporation	50
R-1535-7	Pratt & Whitney	19
R-1820-25	Wright Aeronautical Corporation	80
S.G.R.-1820-45	Wright Aeronautical Corporation	328
S.G.R.-1820-30	Wright Aeronautical Corporation	104
R-1535-13	Pratt & Whitney	200
R-1340-S341	Pratt & Whitney	4
R-1830-9	Pratt & Whitney	154
	Total	1,102

Equipment deliveries to the Army Air Corps are unavailable.

NAVY PURCHASES OF AERONAUTICAL EQUIPMENT

Fiscal Year 1936

Airplanes

Type	Factory Name	Quantity
VTB	Douglas torpedo-bomber	114
VN	Stearman trainer	20
VF	Grumman fighter	54
VSO	Curtiss scout-observation	40
	Total	228

Engines

Type	Contractor	Quantity
1830	Pratt & Whitney	148
1535	Pratt & Whitney	78
985	Pratt & Whitney	3
1340	Pratt & Whitney	52
670	Continental Aircraft Engine Co.	4
975	Wright Aeronautical Corporation	3
760	Naval Aircraft Factory	100
	Total	388

EQUIPMENT DELIVERED TO U. S. NAVY

Fiscal Year 1936

Airplanes

Type	Factory Name	Quantity
VB	Great Lakes bomber	16
VSB	Vought scout bomber	84
VF	Grumman fighter	49
VJ	Grumman amphibion	11
VN	Navy trainer	1
VN	Stearman trainer	50
VO	Vought observation	4
VR	Douglas transport	2
VSO	Curtiss scout-observation	135
	Total	352

Engines

Type	Contractor	Quantity
670	Continental Aircraft Engine Co.	2
985	Pratt & Whitney	3
1340	Pratt & Whitney	181
1535	Pratt & Whitney	193
1830	Pratt & Whitney	5
975	Wright Aeronautical Corporation	3
1820	Wright Aeronautical Corporation	58
	Total	445

AIRPORTS AND LANDING FIELDS

January 1, 1937

Compiled by Bureau of Air Commerce, U. S. Dept. of Commerce

	Municipal	*Commercial*	*Intermediate*	*Auxiliary*	*Navy*	*Army*	*Miscellaneous Government, private, and State*	*Totals*	*Partially or fully lighted*
Alabama	7	2	7	15	0	3	1	35	12
Alaska	1	2	0	80	0	0	0	83	2
Arizona	10	4	9	21	0	1	0	45	16
Arkansas	15	2	5	8	0	0	0	30	7
California	45	44	20	50	4	4	14	181	63
Colorado	13	3	3	15	0	1	0	35	7
Connecticut	6	9	1	3	0	0	3	22	7
Delaware	1	2	0	2	0	1	0	6	1
District of Columbia	0	1	0	0	1	1	0	3	3
Florida	43	14	4	44	5	1	5	116	26
Georgia	20	2	12	17	0	1	0	52	19
Idaho	19	0	10	11	0	0	10	50	15
Illinois	13	31	6	0	1	2	3	56	29
Indiana	10	15	8	7	0	2	4	46	19
Iowa	16	6	3	7	0	0	2	34	12
Kansas	22	6	5	8	0	2	0	43	14
Kentucky	7	0	3	7	0	1	0	18	4
Louisiana	11	3	3	10	0	1	2	30	11
Maine	5	6	0	15	0	0	1	27	3
Maryland	2	8	1	1	1	3	3	19	7
Massachusetts	6	26	1	5	1	0	1	40	7
Michigan	55	13	0	16	1	3	35	123	22
Minnesota	10	4	3	15	0	1	0	33	7
Mississippi	13	0	6	12	1	0	0	32	12
Missouri	11	6	13	4	0	0	4	38	18
Montana	24	0	15	28	0	0	10	77	18
Nebraska	16	3	5	5	0	2	1	32	15
Nevada	3	3	9	6	1	0	0	22	12
New Hampshire	6	4	0	8	0	0	0	18	0
New Jersey	4	16	0	2	2	2	2	28	8
New Mexico	6	5	10	12	0	0	2	35	13
New York	28	38	5	15	0	4	6	96	28
North Carolina	13	4	3	5	0	1	0	26	8
North Dakota	19	3	5	16	0	0	1	44	8
Ohio	34	32	9	16	0	4	11	106	22
Oklahoma	20	6	7	8	0	1	0	42	21
Oregon	15	3	10	11	0	0	2	41	19
Pennsylvania	14	63	11	10	1	1	11	111	39
Rhode Island	0	4	0	1	1	0	1	7	1
South Carolina	10	2	4	6	3	0	2	27	7
South Dakota	15	4	0	6	0	0	0	25	1
Tennessee	10	2	8	6	0	0	0	26	12
Texas	56	10	25	29	0	13	1	134	50
Utah	5	1	16	2	0	0	0	24	18
Vermont	6	3	0	1	0	1	0	11	1
Virginia	9	8	8	15	2	1	2	45	15
Washington	21	7	9	6	1	3	4	51	13
West Virginia	8	4	0	12	0	0	1	25	2
Wisconsin	21	17	4	8	0	0	3	53	18
Wyoming	14	0	10	15	0	0	0	39	13
Totals	738	451	296	622	26	61	148	2,342	705

AIRCRAFT APPROPRIATIONS, UNITED STATES

Fiscal Year		*Department Appropriations*	*Total*	*Increase or Decrease*	*Net*
1924-25	Army.........	$13,476,619(1)		+$1,050,619	
	Navy.........	15,150,000		+502,826	
	N.A.C.A......	470,000	$ 29,096,619	+187,000	+$1,740,445
1925-26	Army.........	18,061,191(2)		+4,584,572	
	Navy.........	15,130,000		−20,000	
	Air Mail......	500,000		+500,000	
	N.A.C.A......	534,000	34,225,191	+64,000	+5,128,572
1926-27	Army.........	18,256,694(3)		+195,503	
	Navy.........	19,065,288		+3,935,288	
	Air Mail......	2,000,000		+1,500,000	
	N.A.C.A......	513,000		−21,000	
	Commerce....	550,000(4)	40,384,982	+550,000	+6,159,791
1927-28	Army.........	25,612,494(5)		+7,355,800	
	Navy.........	20,100,000		+1,034,712	
	Air Mail......	4,650,000(6)		+2,650,000	
	N.A.C.A......	550,000		+37,000	
	Commerce....	3,791,500(7)	54,703,994	+3,241,500	+14,319,012
1928-29	Army.........	33,911,431(8)		+8,298,937	
	Navy.........	32,189,000		+12,089,000	
	Air Mail......	14,480,000(9)		+9,830,000	
	N.A.C.A......	628,770		+78,770	
	Commerce....	5,519,350(10)	86,728,551	+1,727,850	+32,024,557
1929-30	Army.........	34,910,059		+998,628	
	Navy.........	31,430,000		−759,000	
	Air Mail......	19,300,000(11)		+4,820,000	
	N.A.C.A......	1,508,000		+879,230	
	Commerce....	6,416,620(12)	93,564,679	+897,270	+6,836,128
1930-31	Army.........	38,892,968(13)		+3,982,909	
	Navy.........	32,033,211		+603,211	
	Air Mail......	24,600,000(14)		+5,300,000	
	N.A.C.A......	1,321,000		−187,000	
	Commerce....	9,204,830(15)	106,052,009	+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 $514,900 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.)

Fiscal Year		*Department Appropriations*	*Total*	*Increase or Decrease*	*Net*
1931-32	Army.........	$31,850,892(16)		−$7,042,076	
	Navy.........	31,145,000		−888,211	
	Air Mail......	27,000,000(17)		+2,400,000	
	N.A.C.A......	1,051,070		−269,930	
	Commerce....	10,362,300(18)	$101,409,262	+1,157,470	−$4,642,747
1932-33	Army.........	25,673,236		−6,177,656	
	Navy.........	32,745,420(19)		+1,600,420	
	Air Mail......	26,460,000(20)		−540,000	
	N.A.C.A......	920,000		−131,070	
	Commerce....	8,553,500(21)	94,352,156	−1,808,800	−7,057,106
1933-34	Army.........	34,037,769(22)		+8,364,533	
	Navy.........	21,957,459		−10,787,961	
	Air Mail......	22,000,000(23)		−4,460,000	
	N.A.C.A......	695,000		−225,000	
	Commerce....	7,660,780(24)	86,351,008	−892,720	−8,001,148
1934-35	Army.........	30,917,702(25)		−3,120,067	
	Navy.........	34,842,253(26)		+12,884,794	
	Air Mail......	19,003,291(27)		−2,996,709	
	N.A.C.A......	726,492		+31,492	
	Commerce....	5,681,029(28)	91,170,767	−1,979,751	+4,819,759
1935-36	Army.........	50,287,197(29)		+19,369,495	
	Navy.........	40,732,310		+5,890,057	
	Air Mail......	18,700,000(30)		−303,291	
	N.A.C.A......	1,177,550		+451,058	
	Commerce....	5,909,800(31)	116,806,857	+228,771	+25,636,090
1936-37	Army.........	62,607,727(32)		+12,320,530	
	Navy.........	38,588,270(33)		−2,144,040	
	Air Mail......	20,230,000(34)		+1,530,000	
	N.A.C.A......	2,544,550		+1,367,000	
	Commerce....	6,850,000(35)	130,820,547	+940,200	+14,013,690
1937-38	*Army.........	60,525,074(36)		−2,082,653	
	*Navy.........	49,500,000(37)		+10,911,730	
	*Air Mail......	24,876,000(38)		+4,646,000	
	*N.A.C.A......	1,280,850		−1,263,700	
	*Commerce....	9,460,000(39)	145,641,924	+2,610,000	+14,821,380

(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) Contract authorization $10,462,000. For combat planes $21,210,461.
(37) $13,000,000 contract authorization. For new aircraft $27,186,000.
(38) $14,250,000 for domestic and $9,876,000 for foreign air mail.
(39) Includes $3,000,000 for new air navigation facilities. $980,000 for aircraft in commerce.
* Proposed expenditures.
\+ Shows amount of increase over preceding year.
— Shows amount of decrease from preceding year.

U. S. FOREIGN AIR MAIL

From report of the Postmaster General for fiscal year 1936.

Service to Foreign Countries During Fiscal Year 1936

Route	Service scheduled	Service performed	Compensation	Percentage of performance
	Miles	*Miles*		
1. New York to Montreal (1 way)	104,542.0	88,878.0	$53,326.80	85.01
2. Seattle to Victoria	21,682.0	21,682.0	11,582.13	100.00
5. Miami to Cristobal (direct)	349,957.0	349,709.0	683,477.76	99.93
Miami to Cristobal (via Central America)[1]	57,828.5	57,081.5	112,265.00	98.71
Miami to Merida[2]	19,485.0	18,738.0	37,476.00	96.17
Miami to Habana	106,170.5	105,494.0	209,725.20	99.36
Habana to Belize[3]	57,876.0	57,876.0	104,176.80	100.00
San Salvador to Cristobal	172,900.0	172,775.9	315,767.56	99.93
Port of Spain to Paramaribo	61,957.0	61,957.0	120,848.60	100.00
Barranquilla to Port of Spain	206,272.6	206,233.6	381,471.76	99.98
6. Miami to San Juan	361,591.0	360,469.5	683,271.20	99.69
San Juan to Port of Spain	78,697.5	78,697.5	153,497.60	100.00
7. Miami to Nassau (1 way)	31,208.0	31,208.0	39,010.00	100.00
8. Brownsville to Mexico City	341,112.0	341,097.0	631,123.40	99.99
Mexico City to San Salvador	170,538.5	170,219.3	315,132.48	99.81
9. Cristobal to Montevideo	933,270.1	931,445.4	1,446,121.07	99.80
10. Paramaribo to Buenos Aires	485,866.6	485,245.6	873,442.08	99.87
12. Bangor to Halifax (suspended)	....	....	....	....
14. San Francisco to Manila	215,730.0	215,730.0	437,913.46	100.00
Travel expense chargeable to air mail	....	....	642.25	....
Total	3,776,684.3	3,754,537.3	6,610,271.15	99.41

(1) From July 1 to Sept. 30, 1935, only. Pay waived for 36.5 miles each trip until route was changed, Sept. 30, 1935.
(2) From July 1 to Sept. 30, 1935, only.
(3) From Oct. 1, 1935, to June 30, 1936, only.

NON-MILITARY AIRCRAFT IN THE UNITED STATES

January 1, 1937

Compiled by Bureau of Air Commerce, U. S. Dept. of Commerce

State	*Licensed*	*Unlicensed*	*Total*	*Gliders*
Alabama	45	25	70	3
Arizona	51	8	59	0
Arkansas	42	15	57	1
California	840	116	956	46
Colorado	52	16	68	8
Connecticut	113	12	125	6
Delaware	36	0	36	0
District of Columbia	108	12	120	2
Florida	154	33	187	2
Georgia	67	43	110	0
Idaho	41	3	44	1
Illinois	526	41	567	22
Indiana	202	101	303	20
Iowa	129	29	158	4
Kansas	121	80	201	7
Kentucky	50	14	64	0
Louisiana	78	7	85	1
Maine	62	11	73	0
Maryland	78	33	111	3
Massachusetts	166	17	183	22
Michigan	339	102	441	45
Minnesota	163	56	219	10
Mississippi	60	14	74	0
Missouri	183	50	233	2
Montana	45	36	81	1
Nebraska	81	43	124	5
Nevada	13	9	22	0
New Hampshire	30	9	39	2
New Jersey	213	23	236	29
New Mexico	20	8	28	0
New York	817	42	859	45
North Carolina	80	52	132	0
North Dakota	46	28	74	0
Ohio	422	82	504	42
Oklahoma	170	36	206	2
Oregon	87	54	141	4
Pennsylvania	519	137	656	28
Rhode Island	37	4	41	1
South Carolina	27	27	54	0
South Dakota	60	9	69	3
Tennessee	72	17	89	3
Texas	342	169	511	3
Utah	34	3	37	5
Vermont	32	3	35	0
Virginia	90	33	123	2
Washington	142	27	169	13
West Virginia	59	11	70	1
Wisconsin	142	87	229	7
Wyoming	28	15	43	0
Alaska	79	1	80	0
Canada[1]	1	0	1	0
Canal Zone	0	0	0	0
Hawaiian Islands	23	2	25	0
Mexico[1]	0	0	0	0
Philippine Islands[2]	...	...	...	...
Foreign, Miscellaneous[1]	7	0	7	0
Totals	7424	1805	9229[3]	401[4]
Percentages				

[1] Figures for these countries mean pilots and aircraft licensed or identified by the United States.
[2] Civil aircraft in the Philippines are now registered with the local government.
[3] This figure includes 38 licensed autogiros.
[4] This figure includes 31 licensed gliders and 370 unlicensed gliders.

LICENSED PILOTS IN THE UNITED STATES

January 1, 1937

Compiled by Bureau of Air Commerce, U. S. Dept. of Commerce

State	*Transport*	*Limited Commercial*	*Private*	*Amateur*	*Total*	*Glider Pilots*
Alabama	56	5	67	4	132	1
Arizona	32	6	64	4	106	0
Arkansas	45	2	30	0	77	0
California	1212	114	1581	121	3028	7
Colorado	48	10	27	8	93	0
Connecticut	83	10	122	7	222	3
Delaware	14	0	22	0	36	1
District of Columbia	121	6	92	5	224	3
Florida	272	14	163	12	461	8
Georgia	85	6	50	2	143	0
Idaho	27	5	22	4	58	0
Illinois	455	38	452	34	979	19
Indiana	139	26	167	22	354	2
Iowa	91	15	91	1	198	0
Kansas	102	14	63	10	189	1
Kentucky	36	8	35	4	83	0
Louisiana	113	4	73	9	199	0
Maine	35	6	19	1	61	0
Maryland	69	9	83	4	165	0
Massachusetts	163	28	227	25	443	11
Michigan	285	33	282	56	656	8
Minnesota	149	31	61	9	250	0
Mississippi	25	4	27	0	56	1
Missouri	261	12	112	5	390	0
Montana	40	6	45	7	98	0
Nebraska	78	12	66	11	167	0
Nevada	9	1	8	4	22	0
New Hampshire	17	5	22	3	47	0
New Jersey	270	13	238	21	542	16
New Mexico	19	2	15	1	37	0
New York	586	117	782	62	1547	25
North Carolina	49	5	63	4	121	0
North Dakota	36	2	20	0	58	0
Ohio	350	66	383	44	843	14
Oklahoma	112	13	106	5	236	0
Oregon	70	10	86	15	181	0
Pennsylvania	293	74	459	35	861	10
Rhode Island	17	2	24	7	50	0
South Carolina	22	8	29	1	60	0
South Dakota	32	6	34	2	74	1
Tennessee	77	8	107	2	194	0
Texas	448	35	261	30	774	0
Utah	44	4	27	1	76	1
Vermont	16	6	15	3	40	0
Virginia	169	10	75	2	256	3
Washington	158	20	142	26	346	1
West Virginia	34	15	46	10	105	0
Wisconsin	89	25	71	16	201	1
Wyoming	40	2	13	1	56	0
Alaska	57	2	12	2	73	0
Canada	10	0	8	0	18	0
Canal Zone	42	1	3	0	46	0
Hawaiian Islands	69	3	23	2	97	0
Mexico	3	0	7	1	11	0
Philippine Islands	13	0	1	0	14	0
Foreign, Miscellaneous	63	1	31	3	98	1
Totals	7250[1]	880	7154	668	15,952[2]	138[3]
Percentages	45.44	5.52	44.85	4.19		

[1] This figure includes 842 pilots who hold scheduled air transport ratings.
[2] This figure includes 444 women pilots, divided as follows: 71 transport, 23 limited commercial, 295 private and 55 amateur.
[3] This figure includes 1 woman glider pilot.

AVIATION GASOLINE TAX SUMMARY

January 1, 1937

State	*Tax*	*Dispositions of Receipts*	*Applicable to Aircraft Fuel*	*Exemption or Refund*
Alabama	6c	Highways	Yes	No
Arizona	5c	Highways; R.F.C. Fund	Yes	Refund
Arkansas	6½c	Highways; Airports	No	Exemption
California	3c	Highways	Yes	Refund
Colorado	4c	Highways; Relief	Yes	Refund
Connecticut	3c	Highways	Yes	Refund
Delaware	4c	Highways	Yes	Refund
Dist. of Columbia	2c	Highways	Yes	Refund
Florida	7c	Roads; Schools	Yes	Exemption
Georgia	6c	Roads; Schools	Yes	No
Idaho	5c	Airfuel tax to Aeronautics Fund	Yes	2½c per gal. tax on aircraft fuels
Illinois	3c	Highways; Schools	Yes	Refund
Indiana	4c	Highways	Yes	Refund
Iowa	3c	Highways	Yes	Refund
Kansas	3c	Highways	Yes	Exemption
Kentucky	5c	Highways	Yes	No
Louisiana	7c	Highways; Relief	Yes	No
Maine	4c	Highways	Yes	Refund 3c per gal.
Maryland	4c	Highways	Yes	Refund
Massachusetts	3c	Highways; General Fund	Yes	Refund
Michigan	3c	Highways; Aeronautics	Yes	Refund 1½c
Minnesota	3c	Highways	Yes	Refund
Mississippi	6c	Highways	Yes	Refund 5c
Missouri	2c	Highways	Yes	Refund
Montana	5c	Highways	Yes	Refund
Nebraska	4c	Highways	Yes	No
Nevada	4c	Highways	Yes	Refund
New Hampshire	4c	Highways	Yes	Refund
New Jersey	3c	Traffic; Waterways	Yes	Refund
New Mexico	5c	Highways	Yes	Refund
New York	4c	Highways; General Fund	Yes	Refund
North Carolina	6c	Highways	Yes	Refund
North Dakota	3c	Highways	Yes	Refund
Ohio	4c	Highways; Schools; Poor Relief	Yes	Refund
Oklahoma	4c	Highways	Yes	No
Oregon	5c	Highways; Aeronautics	Yes	Refund
Pennsylvania	4c	Highways; Relief; Aeronautics	Yes	No
Rhode Island	2c	Highways	Yes	Refund
South Carolina	6c	Highways	Yes	No
South Dakota	4c	Highways	Yes	Refund 2c
Tennessee	7c	Highways; General Fund except $50,000 to Airways	Yes	No
Texas	4c	Highways; Schools	Yes	Refund
Utah	4c	Highways	Yes	No
Vermont	4c	Highways	Yes	No
Virginia	5c	Highways; Bridges	Yes	Refund
Washington	5c	Highways	Yes	Refund
West Virginia	4c	Highways	Yes	Refund
Wisconsin	4c	Highways	Yes	Refund
Wyoming	4c	Highways	Yes	Refund 2c

COMPARATIVE TABULATION OF ACCIDENTS IN CIVIL AERONAUTICS

1933, 1934, 1935, and the First Six Months of 1936

Compiled by Bureau of Air Commerce, U. S. Dept. of Commerce

Mileage Flown Per Accident

	*January-June, 1933**	*July-December, 1933*	*January-June, 1934**	*July-December, 1934*	*January-June, 1935**	*July-December, 1935*	*January-June, 1936**
Miles flown in scheduled transport operations	25,862,120	28,780,425	21,517,658	27,268,893	28,729,128	34,811,105	33,523,075
Miles flown in miscellaneous operations including student instruction and experimental flying	32,748,485	38,474,360	36,780,157	38,821,995	40,234,185	44,521,445	41,517,085
Total	58,610,605	67,254,785	58,297,815	66,090,888	68,963,313	79,332,550	75,040,160
Accidents, all services	813	891	676	901	737	842	831
Miles flown per accident, all services	72,091	75,482	86,239	73,353	93,573	94,219	90,301
Accidents, scheduled transport operations	48	53	27	46	29	33	42
Miles flown per accident, scheduled transport operations	538,794	543,027	796,950	592,802	990,660	1,054,882	798,168
Accidents, miscellaneous operations	765	838	649	855	708	809	789
Miles flown per accident, miscellaneous operations	40,808	45,912	56,672	45,406	56,828	55,032	52,620
Fatal accidents, all services**	85	106	93	103	86	86	65
Miles flown per fatal accident in all services	689,536	634,478	626,858	641,658	801,899	922,470	1,154,464
Fatal accidents, scheduled transport operations**	5	4	6	4	5	3	5
Miles flown per fatal accident, scheduled operations	5,172,424	7,159,106	3,586,276	6,817,223	5,745,826	11,603,701	6,704,615
Fatal accidents, miscellaneous operations**	80	102	87	99	81	83	60
Miles flown per fatal accident, miscellaneous operations	409,356	377,200	422,760	392,141	496,718	536,403	691,951
Pilot fatalities, all services	72	90	74	84	72	70	52
Miles flown per pilot fatality, all services	814,036	747,275	787,808	786,796	957,824	1,133,322	1,443,080
Pilot fatalities, scheduled transport operations	4	4	6	4	5	3	4
Miles flown per pilot fatality, scheduled transport operations	6,465,530	7,159,106	3,586,276	6,817,223	5,745,826	11,603,701	8,380,769
Pilot fatalities, miscellaneous operations	68	86	68	80	67	67	48
Miles flown per pilot fatality, miscellaneous operations	481,595	447,376	540,885	485,275	600,510	664,499	864,939

* It should be borne in mind that weather conditions during the last 6 months of the calendar year are more favorable for flying than during the first 6 months, hence, in making comparisons, figures for corresponding periods should be used in each case.

** A fatal aircraft accident is one in which 1 or more persons (passenger, pilot, or crew) were killed or fatally injured.

CAUSES OF ACCIDENTS
Scheduled Air Transport Operations

Causes	Percentages						
	January-June, 1933	*July-December, 1933*	*January-June, 1934*	*July-December, 1934*	*January-June, 1935*	*July-December, 1935*	*January-June, 1936*
Number of accidents involved	48	53	27	46	29	33	42
PERSONNEL:							
Pilot:							
Error of judgment	1.04	5.28	14.45	4.02	12.07	3.03	9.52
Poor technique	3.12	1.89	15.74	4.90	1.72	3.03	9.76
Disobedience of orders	0	.47	0	0	3.45	0	0
Carelessness or negligence	7.29	13.21	11.67	6.95	13.79	9.09	10.12
Miscellaneous	2.08	0	0	0	0	0	0
Total pilot errors	13.53	20.85	41.86	15.87	31.03	15.15	29.40
Other personnel:							
Supervisory	0	0	6.48	2.06	4.31	0	7.14
Miscellaneous	2.08	0	3.70	4.35	2.93	3.03	4.58
Total personnel errors	15.61	20.85	52.04	22.28	38.27	18.18	41.07
MATERIAL:							
Power Plant:							
Fuel system	7.30	8.49	3.70	3.04	6.90	15.15	5.95
Cooling system	0	0	0	0	0	0	0
Ignition system	0	0	0	0	0	0	0
Lubrication system	0	0	0	4.34	0	0	0
Engine structure	2.08	7.55	0	2.18	0	3.03	4.76
Propellers and accessories	4.17	5.66	7.41	2.17	3.45	6.06	0
Engine-control system	2.08	0	0	2.18	0	0	0
Miscellaneous	0	0	0	0	3.45	0	0
Undetermined	6.25	3.77	.74	8.70	0	9.09	2.38
Total power-plant failures	21.88	25.47	11.85	22.61	13.80	33.33	13.09
Structural:							
Flight-control system	0	0	0	0	0	0	0
Movable surfaces	0	0	0	0	0	0	0
Stabilizing surfaces	0	0	0	0	0	0	0
Wings, struts, and bracings	0	0	0	0	0	0	0
Undercarriage	4.17	10.94	11.11	10.65	6.90	3.03	9.53
Wheels, tires and brakes	4.17	9.34	3.70	0	0	3.03	4.76
Pontoons or boats	0	0	0	0	0	0	0
Fuselage, engine mountings and fittings	0	0	0	0	0	0	0
Tail-skid assembly	2.08	0	3.70	4.35	3.45	15.15	7.14
Miscellaneous	0	0	0	0	0	0	0
Undetermined	0	0	0	0	0	0	0
Total structural failures	10.42	20.28	18.51	15.00	10.35	21.21	21.43
Handling qualities	2.08	3.78	0	6.52	0	0	2.38
Instruments	0	0	0	0	0	0	0
Total airplane failures	12.50	24.06	18.51	21.52	10.35	21.21	23.81
MISCELLANEOUS:							
Weather	27.09	18.30	14.82	17.39	20.34	15.15	6.55
Darkness	0	0	0	0	0	0	0
Airport and terrain	14.59	7.55	.93	9.57	13.79	3.03	10.72
Other	8.33	0	1.85	6.63	0	6.06	4.76
Total miscellaneous causes	50.01	25.85	17.60	33.59	34.13	24.24	22.03
Undetermined and doubtful	0	3.77	0	0	3.45	3.04	0
Total percentages	100	100	100	100	100	100	100

CAUSES OF ACCIDENTS
Non-Scheduled Flying

Causes	*Percentages*						
	January-June, 1933	*July-December, 1933*	*January-June, 1934*	*July-December, 1934*	*January-June, 1935*	*July-December, 1935*	*January-June, 1936*
Number of accidents involved	765	838	649	855	708	809	789
PERSONNEL:							
Pilot:							
Error of judgment	7.00	9.18	8.07	6.73	8.96	7.76	10.23
Poor technique	36.62	33.09	34.72	33.95	30.77	36.04	28.35
Disobedience of orders	1.01	1.40	1.29	.83	.65	.69	.43
Carelessness or negligence	6.01	7.25	8.28	11.35	11.51	7.20	9.37
Miscellaneous	.36	.42	.36	.29	0	.37	.23
Total pilot errors	51.00	51.34	52.72	53.15	51.89	52.06	48.61
Other personnel:							
Supervisory	0	.12	0	.06	.07	0	0
Miscellaneous	.39	.24	0	.39	.28	.49	.51
Total personnel errors	51.39	51.70	52.72	53.60	52.24	52.55	49.12
MATERIAL:							
Power Plant:							
Fuel system	7.90	7.06	5.68	5.68	5.72	4.40	4.12
Cooling system	.59	.71	.31	.76	.14	.62	.38
Ignition system	1.37	1.75	2.62	1.06	1.63	1.62	1.90
Lubrication system	.23	.30	0	.35	.67	.12	.11
Engine structure	4.09	1.86	3.41	3.33	2.93	2.60	2.73
Propellers and accessories	.52	.60	.46	.94	.14	.62	1.20
Engine-control system	.52	.24	.28	.23	.57	.37	0
Miscellaneous	0	.29	.55	1.16	.99	.42	.13
Undetermined	4.67	2.78	2.94	4.22	3.50	5.53	5.23
Total power-plant failures	19.89	15.59	16.25	17.73	16.29	16.30	15.80
Structural:							
Flight-control system	.66	.71	.46	.56	.42	1.24	.25
Movable surfaces	.13	.12	.28	.23	.57	0	0
Stabilizing surfaces	0	.36	0	.12	.28	.12	0
Wings, struts, and bracings	1.11	1.91	1.19	1.89	1.56	.80	.79
Undercarriage	4.74	6.36	4.82	4.73	4.67	7.08	4.31
Wheels, tires and brakes	.92	2.00	1.54	2.48	.60	1.67	2.33
Pontoons or boats	0	0	0	0	0	.25	0
Fuselage, engine mountings and fittings	.26	.24	.15	.35	.14	.06	.25
Tail-skid assembly	0	.12	0	.12	0	0	.76
Miscellaneous	.26	.12	.15	.18	.31	.25	.25
Undetermined	0	0	.15	0	0	0	0
Total structural failures	8.08	11.94	8.74	10.66	8.55	11.47	8.94
Handling qualities	2.35	2.05	1.76	.93	1.06	1.36	1.43
Instruments	0	0	0	0	0	.12	.01
Total airplane failures	10.43	13.99	10.50	11.59	9.61	12.95	10.38
MISCELLANEOUS:							
Weather	7.69	7.46	7.67	4.80	7.89	6.29	9.07
Darkness	.02	0	0	.28	.21	.37	.84
Airport and terrain	7.54	8.37	10.24	9.74	11.07	7.21	11.30
Other	2.39	1.94	2.00	2.14	2.69	3.40	3.11
Total miscellaneous causes	17.64	17.77	19.91	16.96	21.86	17.27	24.32
Undetermined and doubtful	.65	.95	.62	.12	0	.93	.38
Total percentages	100	100	100	100	100	100	100

INJURIES CLASSIFIED

July-December, 1935

Kind of Flying	Total Persons Involved	Pilots					Co-Pilots or Students				
		Fatal	Severe	Minor	No Injury	Total	Fatal	Severe	Minor	No Injury	Total
Schedule......	274	3	0	4	26	33	3	1	1	20	25
Student instruction....	355	15	21	30	199	265	7	4	2	43	56
Experimental..	18	4	1	1	7	13	0	0	0	0	0
Commercial....	441	20	9	16	155	200	3	2	0	1	6
Pleasure.......	651	28	25	48	245	346	4	1	3	6	14
Total.....	1,739	70	56	99	632	857	17	8	6	70	101

Kind of Flying	Total Persons Involved	Passengers					Aircraft Crew				
		Fatal	Severe	Minor	No Injury	Total	Fatal	Severe	Minor	No Injury	Total
Schedule......	274	11	4	15	168	198	2	1	3	12	18
Student instruction....	355	8	11	3	12	34	0	0	0	0	0
Experimental..	18	0	0	0	1	1	4	0	0	0	4
Commercial....	441	17	7	19	189	232	0	0	2	1	3
Pleasure.......	651	26	16	37	207	286	0	0	0	5	5
Total.....	1,739	62	38	74	577	751	6	1	5	18	30

January-June, 1936

Kind of Flying	Total Persons Involved	Pilots					Co-Pilots or Students				
		Fatal	Severe	Minor	No Injury	Total	Fatal	Severe	Minor	No Injury	Total
Schedule......	367	4	3	2	33	42	2	1	2	26	31
Student instruction....	340	17	16	23	207	263	4	1	6	41	52
Experimental..	39	1	3	2	18	24	0	0	1	5	6
Commercial....	376	9	11	18	144	182	2	0	0	2	4
Pleasure.......	593	21	16	35	258	330	2	0	1	5	8
Total.....	1,715	52	49	80	660	841	10	2	10	79	101

Kind of Flying	Total Persons Involved	Passengers					Aircraft Crew				
		Fatal	Severe	Minor	No Injury	Total	Fatal	Severe	Minor	No Injury	Total
Schedule......	367	27	5	48	184	264	2	2	7	19	30
Student instruction....	340	3	6	5	10	24	0	0	0	1	1
Experimental..	39	0	0	0	1	1	0	0	1	7	8
Commercial....	376	11	10	21	140	182	0	0	0	8	8
Pleasure.......	593	27	11	19	197	254	0	0	0	1	1
Total.....	1,715	68	32	93	532	725	2	2	8	36	48

AIRPLANE ACCIDENTS, U. S. ARMY

(Including Air Corps and Organized Reserve Corps)

Fiscal Year	*1927*	*1928*	*1929*	*1930*	*1931*	*1932*	*1933*	*1934*	*1935*	*1936*
Airplane Hours	140,909	182,903	263,381	325,273	396,961	371,254	432,966	374,235	449,583	500,704
Number of Accidents	227	249	390	468	456	423	442	412	452	430
Number of Fatal Accidents	28	25	42	37	21	32[1]	28	35	33	42
Number of Fatalities	43	27	61	52	26	49[1]	46	54	47	59
Number Injured	60	52	72	82	75	89	82	83	69	69
Details of Fatalities which have	*occurred*	*in above*								
Regular Army Officers	18	12	9	19	8	12[1]	9	15	12[2]	21
Warrant Officers, U. S. Army	0	0	0	0	0	0	0	0	0	0
Regular Army, Enlisted Men	5	5	26	9	3	9	13	14	12	17
Regular Army, Flying Cadets	9	4	10	9	3	6	3	8	3	3
Regular Army, Graduate Cadets	0	0	0	0	0	0	0	0	7	8
Reserve Corps, Officers	9	4	13	11	9	20	18	16	7	9
Reserve Corps, Enlisted Men	0	0	1	0	1	0	1	1	0	0
Cadets, U. S. Military Academy	0	0	0	0	0	0	0	0	0	0
Naval Officers	1	0	1	0	0	0	0	0	0	0
Civilians	1	2	1	3	2	2	2	0	5	1
Foreign Officers	0	0	0	1	0	0	0	0	1	0
National Guard Officers	0	0	0	0	0	0	0	0	0	0
National Guard Enlisted Men	0	0	0	0	0	0	0	0	0	0
Totals	43	27	61	52	26	49	46	54	47	59

[1] Excludes one accident in National Guard airplane in which one Regular Army officer was killed.
[2] Includes one officer of the Philippine Constabulary, student at A. C. T. C.

U. S. ARMY AIR CORPS TRAINING
Students Trained During Fiscal Year 1936

	Under Training 7-1-'35	*Reported*	*Total*	*Graduated*	*Relieved*	*Killed*	*Under Training 6-30-'36*
PRIMARY FLYING SCHOOL, Randolph Field							
Regular Army Officers........	6	75	81	48	29	0	4
Flying Cadets, U. S. A.........	60	259	319	140	138	2	39
Foreign Students.............	2	5	7	4	3	0	0
Totals................	68	339*	407	192	170	2	43
ADVANCED FLYING SCHOOL, Kelly Field							
Regular Army Officers........	32	48	80	45	1	0	34
Flying Cadets, U. S. A........	33	140	173	130	4	1	38
Foreign Students.............	3	4	7	5	0	0	2
Totals................	68	192	260	180	5	1	74
TACTICAL SCHOOL, Maxwell Field							
Air Corps Officers............	0	60	60	59	1	0	0
Detailed Regular Army Officers.	0	6	6	6	0	0	0
Marine Corps Officers.........	0	3	3	3	0	0	0
Naval Officer................	0	1	1	1	0	0	0
Totals................	0	70	70	69	1	0	0
ENGINEERING SCHOOL Wright Field (Aero. Eng.)							
Air Corps Officers............	7	10	17	7	0	1	9
TECHNICAL SCHOOL, Chanute Field (A. C. Officers)							
Communications.............	0	13	13	12	1	0	0
Maintenance Engineering-Armament..................	0	11	11	11	0	0	0
Photography.................	0	3	3	3	0	0	0
Totals................	0	27	27	26	1	0	0
TECHNICAL SCHOOL, Chanute Field (A. C. Enlisted)							
Airplane Mechanics...........	0	124	124	19	2	0	103
Armorers....................	0	39	39	20	3	0	16
Machinists..................	0	32	32	14	2	0	16
Parachute Riggers............	0	20	20	20	0	0	0
Photography.................	0	58	58	0	1	0	57
Radio Operators..............	0	164	164	34	4	0	126
Radio Repairers..............	0	24	24	24	0	0	0
Radio Operators & Repairers...	0	16	16	16	0	0	0
Welders-Sheet Metal Workers..	0	33	33	23	1	0	9
Air Corps Supply & Technical Clerks....................	0	40	40	36	3	0	1
Instrument Inspection & Maintenance..................	10	18	28	26	2	0	0
Totals................	10	568	578	232	18	0	328

* 1 officer and 25 flying cadets reporting, were physically disqualified prior to starting flying training, and are not included in the above figures.

U. S. ARMY AIR CORPS TRAINING
Students Trained During Fiscal Year 1936 (*Cont.*)

	Under Training 7-1-'35	*Reported*	*Total*	*Graduated*	*Relieved*	*Killed*	*Under Training 6-30-'36*
TECHNICAL SCHOOL, Chanute Field (N. G. Personnel)							
Maintenance Engineering (officers)	0	7	7	7	0	0	0
Airplane Mechanics (enlisted)	0	7	7	7	0	0	0
Armorers (enlisted)	0	1	1	1	0	0	0
Radio Operators & Repairers (enlisted)	0	5	5	5	0	0	0
Parachute Riggers (enlisted)	0	2	2	2	0	0	0
Totals	0	22	22	22	0	0	0
TECHNICAL SCHOOL, Chanute Field (Marine Corps)							
Maintenance Engineering-Armament (officer)	0	1	1	0	1	0	0
Armorers (enlisted)	0	1	1	1	0	0	0
Photography (enlisted)	0	1	1	0	0	0	1
Totals	0	3	3	1	1	0	1
TECHNICAL SCHOOL, Chanute Field (Philippine Const.)							
Airplane Mechanics (enlisted)	0	4	4	3	0	0	1
Armorers (enlisted)	0	1	1	1	0	0	0
Photography (enlisted)	0	1	1	0	0	0	1
Radio Operator & Repairer (enlisted)	0	1	1	0	0	0	1
Parachute Rigger (enlisted)	0	1	1	1	0	0	0
Totals	0	8	8	5	0	0	3
TACTICAL UNIT TRAINING (1 Yr. Course)							
Flying Cadets U. S. A.	143	130	273	131	8	8	126
A. C. Officers attending other Service Schools							
Command & General Staff School (2d Yr.)	18	0	18	18	0	0	0
Command & General Staff School (1 Yr. Course)	0	17	17	17	0	0	0
Army War College	0	9	9	9	0	0	0
Army Industrial College	0	8	8	8	0	0	0
Chemical Warfare School: Line & Staff Course	0	3	3	3	0	0	0
Special Air Corps Course	0	20	20	20	0	0	0
Totals	18	57	75	75	0	0	0
A. C. Enl. Men attending other Service Schools							
QMC Motor Transport School	0	54	54	52	2	0	0
Signal Corps School: Meteorological Observers Course	0	6	6	6	0	0	0
Radio Communications Course	0	2	2	0	0	0	2
Totals	0	62	62	58	2	0	2

U. S. FOREIGN AIR MAIL ROUTES

January 1, 1937

Route No.	*Contractor*	*One Way Distance*
F. A. M. 1	Canadian Colonial Airways, Inc. 4848 West 63rd St., Chicago, Ill. New York, N. Y. via Albany, N. Y. to Montreal, Canada	334 miles
F. A. M. 2	Seattle Victoria Air Mail, Inc. 56 Roanoke St., Seattle, Washington Seattle, Washington to Victoria, B. C., and return	74 miles
F. A. M. 5	Pan American Airways, Inc. 135 East 42nd St. New York, N. Y. Miami, Fla. via Havana and Cienfuegos, Cuba; Kingston, Jamaica and Barranquilla, Colombia to Cristobal, Canal Zone and return.	1,721.8 miles
	Miami, Fla. via Havana, Cuba; and Merida, Mexico, to Belize, British Honduras and return	967.5 miles
	San Salvador, El Salvador via Tegucigalpa, Honduras; Managua, Nicaragua; San Jose, Costa Rica; David and Panama City, Panama; to Cristobal, Canal Zone, and return	953 miles
F. A. M. 5 (Extended)	Barranquilla, Colombia via Maracaibo, Cumarebo, La Guaira and Caripito, Venezuela to Port of Spain, Trinidad and return	987.4 miles
	Port of Spain, Trinidad via Georgetown, British Guiana to Paramaribo, Dutch Guiana and return	589.5 miles
F. A. M. 6	Pan American Airways, Inc. 135 East 42nd St., New York, N. Y. Miami, Fla. via Nuevitas, Cuba; Port au Prince, Haiti; San Pedro de Macoris, Dominican Republic; San Juan, Puerto Rico; St. Thomas, U. S. V. I.; St. John, Antigua to Port of Spain, Trinidad and return	1,909.5 miles
F. A. M. 7	Pan American Airways, Inc. 135 East 42nd St., New York, N. Y. Miami, Fla., to Nassau, Bahamas	188 miles
F. A. M. 8	Pan American Airways, Inc. 135 East 42nd St., New York, N. Y. Brownsville, Texas via Tampico, Mexico City, and Tapachula, Mexico, and Guatemala City, Guatemala to San Salvador, El Salvador and return	1,277.5 miles
F. A. M. 9	Pan American-Grace Airways, Inc. 135 East 42nd St., New York, N. Y. Cristobal, Canal Zone via Buenaventura and Tumaco, Colombia; Guayaquil, Ecuador; Talara, Trujillo, Lima, Arequipa and Tacna, Peru; Arica, Antofagasta and Santiago, Chile; Mendoza and Buenos Aires, Argentina; to Montevideo, Uruguay and return	4,497.1 miles
F. A. M. 10	Pan American Airways, Inc. 135 East 42nd St., New York, N. Y. Paramaribo, Dutch Guiana via Cayenne, French Guiana; Para, Maranhao, Natal, Pernambuco, Bahia, Victoria, Rio de Janeiro, Santos and Porto Alegre, Brazil; and Montevideo, Uruguay to Buenos Aires, Argentina and return	4,651.8 miles
F. A. M. 12	Pan American Airways, Inc. 135 East 42nd St. New York, N. Y. (Not in operation at present). Bangor, Maine via St. John, New Brunswick to Halifax, Nova Scotia	281 miles
F. A. M. 14	Pan American Airways, Inc. 135 East 42nd St., New York, N. Y. San Francisco, Calif. via Honolulu, Hawaii; Midway Island; Wake Island; Guam and Manila, Philippine Islands to Canton, China or adjacent point and return (Service to be operated to Macao at present).	8,705.5 miles*

* Subject to adjustment.

FOREIGN AIR MAIL CONTRACTS

Dates of Contract Awards, Terminals and Contractors

F. A. M. 1 From New York to Montreal, Canada, via Albany, N. Y.
Contract awarded July 9, 1928 to Canadian Colonial Airways, Inc. (American Airways), for a period of 10 years beginning with date of inauguration of service on October 1, 1928.

F. A. M. 2 From Seattle to Victoria, B. C., and return.
Contracts have been let as follows:
October 15, 1920 to June 30, 1923 to Edward Hubbard.
July 1, 1923 to June 30, 1924 to Alaska Airways Co.
July 1, 1924 to June 30, 1925 to Edward Hubbard.
July 1, 1925 to June 30, 1926 to Edward Hubbard.
July 1, 1926 to June 30, 1927 to Edward Hubbard.
July 1, 1927 to June 30, 1928 to Northwest Air Service, Inc.
July 1, 1928 to June 30, 1929 to P. F. Barnes and Vern C. Gorst.
On May 10, 1929, a 4 year contract beginning July 1, 1929 was awarded to Seattle-Victoria Air Mail, Inc.
On July 1, 1933, a 4 year contract was awarded to Seattle-Victoria Air Mail, Inc.

F. A. M. 5 From Miami, Florida to Cristobal, C. Z., with an extension to Port-of-Spain, Trinidad, and Paramaribo, Dutch Guiana, and return, including stops in Cuba, Mexico, British Honduras, Guatemala, El Salvador, Republic of Honduras, Nicaragua, British Guiana, Dutch Guiana, Trinidad, Costa Rica, Panama, Jamaica, Colombia and Venezuela.
Contract was made July 13, 1928 with Pan American Airways, Inc. for a 10 year term to begin with the inauguration of service on February 4, 1929.

F. A. M. 6 From Miami, Florida to San Juan, Porto Rico with an extension to Port-of-Spain, Trinidad and return, including stops in Cuba, Haiti, Dominican Republic, Porto Rico, U. S. Virgin Islands, Antigua and Trinidad.
Contract was made July 13, 1928 with Pan American Airways, Inc. for a term of 10 years beginning with the inauguration of service on January 9, 1929.

F. A. M. 7 From Miami, Florida to Nassau, Bahama Islands, Bahaman mail carried on return trip.
Contract made on October 24, 1928 with Pan American Airways, Inc. for a 10 year term beginning with the inauguration of service on January 2, 1929.

F. A. M. 8 From Brownsville, Texas to San Salvador, El Salvador and return including stops in Mexico and Guatemala.
Contract made February 16, 1929 with Pan American Airways, Inc. (subcontractor: Compania Mexicana de Aviacion, S.A.) for a 10 year term beginning March 9, 1929.

F. A. M. 9 From Cristobal, C. Z. to Montevideo, Uruguay and return, including stops in Colombia, Ecuador, Peru, Chile and Argentina.
Contract made March 2, 1929 with Pan American-Grace Airways, Inc. for a 10 year term beginning with the date of inauguration April 1, 1929.

F. A. M. 10 From Paramaribo, Dutch Guiana to Buenos Aires, Argentina and return, with stops in French Guiana, Brazil and Uruguay.
Contract made September 24, 1930 with Pan American Airways, Inc. for the period between October 20, 1930 and January 8, 1939.

F. A. M. 14 From San Francisco, California, to Canton, China,* and return, including stops at Honolulu, Hawaii, Midway Island, Wake Island, Guam, Manila, P.I., and Macao, Portuguese Territory.
Contract made October 25, 1935 with Pan American Airways Inc. for a 10 year term beginning with inauguration of service on November 22, 1935.

* Service to Canton if landing privileges can be secured. Otherwise the western terminus will be Macao, Portuguese Territory, where landing rights have been granted.

FLYING SCHOOLS GRANTED APPROVED CERTIFICATES BY U. S. DEPARTMENT OF COMMERCE

January 1, 1937

The Aeronautical University, Inc., 1330 South Michigan Ave., Chicago, Ill. Airplane & Engine Mechanic.

Baltimore Flying Service, Inc., Curtiss-Wright Airport, Smith & Greenspring Aves., Baltimore, Md. Flying and Ground, Private and Amateur.

Boeing School of Aeronautics, Oakland Municipal Airport, Oakland, Calif. Flying and Ground, Transport, Lim. Com., Private, Amateur, Airplane and Engine Mechanic.

California Air Service, Ltd., Alhambra Airport, Alhambra, Calif. Flying and Ground, Private, Amateur.

Curtiss-Wright Technical Institute of Aeronautics, Grand Central Air Terminal, Glendale, Calif. Airplane & Engine Mechanic.

D. W. Flying Service, Inc., LeRoy Airport, LeRoy, N. Y. Flying and Ground, Lim. Com., Private, Amateur.

Dallas Aviation School and Air Col., Love Field, Dallas, Texas. Flying and Ground, Transport, Lim. Com., Private, Amateur.

Erickson & Remmert, Floyd Bennett Field, Brooklyn, N. Y. (In conjunction with New York University Ground School) Flying and Ground, Private, Amateur.

Grand Central Flying School, Grand Central Air Terminal (Flying), Glendale, Calif. In combination with Curtiss-Wright Technical Institute of Aeronautics, Grand Central Air Terminal (Ground), Glendale, Calif. Flying and Ground, Transport, Lim. Com., Private, Amateur.

Inter City Airlines, Inc., Boston Municipal Airport, East Boston, Mass. Flying and Ground, Transport, Lim. Com., Private, Amateur.

Casey Jones School of Aeronautics, Inc., 534 Broad St., Newark, N. J. Airplane and Engine Mechanic.

Lincoln Airplane & Flying School, 2415 O Street (Ground), Municipal Airport (Flying), Lincoln, Nebr. Flying and Ground, Transport, Lim. Com., Private, Amateur, Airplane and Engine Mechanic.

Los Angeles Aircraft, Ltd., Los Angeles Municipal Airport, Inglewood, Calif. Flying and Ground, Private.

Muncie Aviation Corporation, Center Pike, Muncie, Ind. Flying and Ground, Lim. Com., Private, Amateur.

New England Aircraft School, 126 Newbury Street, Boston, Mass. Airplane & Engine Mechanic.

North-Suburban Flying Corporation, Shermer Avenue, Glenview, Ill. (In conjunction with The Aeronautical University, Inc., 1336 South Michigan Ave., Chicago, Ill.) Flying and Ground, Transport, Lim. Com., Private, Amateur.

Pal-Waukee Airport, Inc., Mount Prospect, Ill. (In conjunction with: Aeronautical University, Chicago, Ill.) Flying and Ground; Transport, Limited Commercial; Private and Amateur.

Parks Air College, Inc., Parks Airport, East St. Louis, Ill. Flying and Ground, Transport, Lim. Com., Private, Amateur, Airplane and Engine Mechanic.

Rising Sun Aircraft School, Inc., 857 East Luzerne Street, Philadelphia, Pa. Airplane and Engine Mechanic.

Roosevelt Aviation School, Inc., Roosevelt Field No. 1, Mineola, L. I., N. Y. Flying and Ground, Transport, Lim. Com., Private, Amateur, Airplane and Engine Mechanic.

Ryan School of Aeronautics, Ltd., Lindbergh Field, San Diego, Calif. Flying and Ground, Transport, Lim. Com., Private, Amateur.

Safair, Inc., Hangar B, Roosevelt Field, Garden City, L. I., N. Y. (In combination with New York University, 51 West Fourth Street, New York.) Flying and Ground, Transport, Lim. Com., Private, Amateur.

Capt. Sansom's Aviation School, 157 Charter Oak Ave., Hartford, Conn. Airplane & Engine Mechanic.

Scott Flying Service, Municipal Airport, Long Beach, Calif. Flying and Ground, Private, Amateur.

Spartan School of Aeronautics, Apache Blvd. & Chamberlain Drive, Tulsa, Okla. Flying and Ground, Transport, Lim. Com., Private, Amateur.

The Stewart Technical Trade School, 253-5-7 West 64th Street, New York, N. Y. Airplane and Engine Mechanic.

Ray Wilson Flying School, Park Hill Airport, Denver, Colo. (In conjunction with: Aviation Ground School, University of Colorado, Denver, Colo.) Flying and Ground; Limited Commercial, Private and Amateur.

Aeronautical Directory

AERONAUTICAL CHAMBER OF COMMERCE OF AMERICA, INC.

729 Fifteenth Street, N.W., Washington, D. C. — 30 Rockefeller Plaza, New York

Officers for 1937

(Elected January 28, 1937)

President	Leighton W. Rogers
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Courtlandt Gross
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135 South LaSalle St., Chicago, Ill.

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30 Rockefeller Plaza, New York

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(Elected January 26, 1937)

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Vice President	Wm. E. Valk, Jr.
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S. M. Fairchild	Fairchild Engine & Airplane Corporation
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Glenn L. Martin	The Glenn L. Martin Company
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Frank H. Russell	President
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Eugene E. Wilson	United Aircraft Corporation

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30 Rockefeller Plaza, New York

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NATIONAL AERONAUTIC ASSOCIATION

National Headquarters, Dupont Circle, Washington, D. C.

Representative in U. S. A. of the Fédération Aéronautique Internationale

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Alaska	Joe Crosson
Arizona	John B. Crowell
Arkansas	Earl Ricks
California	W. P. Balderston
Colorado	Fred W. Bonfils
Connecticut	Charles L. Morris
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Dist. of Columbia	Louis R. Inwood
Florida	J. R. Puckett
Georgia	Wiley R. Wright
Hawaii	Emil Williams
Idaho	Ralph L. Fry
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Kansas	Fred F. Swinson
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Michigan	Floyd E. Evans
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Mississippi	John J. O'Keefe
Missouri	John D. Brock, M.D.
Montana	William Ferguson
Nebraska	Harry S. Sidles
Nevada	Pat McCarren
New Hampshire	Alvin A. Lucier
New Jersey	Gill Robb Wilson
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New York	Roger Wolfe Kahn
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North Dakota	S. W. Baldwin
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Oklahoma	Duncan McIntyre
Oregon	H. K. Coffey
Pennsylvania	George H. Earle
Puerto Rico	Ramon Valdes Cobian
Rhode Island	William Fletcher
South Carolina	Dexter C. Martin
South Dakota	T. B. Roberts, Jr.
Tennessee	Gordon Browning
Texas	Helen R. Johnson
Utah	Joel Nibley
Vermont	F. W. Shepardson
Virginia	Ralph W. Howe
Washington	W. W. Conner
West Virginia	Howard Mayes
Wisconsin	S. J. Wittman
Wyoming	J. Kirk Baldwin

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Floyd E. Evans
Director, Dept. of Aeronautics
Michigan

Second Vice President
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Connecticut

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State of Illinois

South West
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State of Nevada

North West
Raymond R. Staub
Chairman, Board of Aeronautics
State of Oregon

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 W. 39th Street, New York

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Chairman..Alexander Klemin
Secretary..Jerome Lederer

C. H. Dolan — R. V. Morse
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SOCIETY OF AUTOMOTIVE ENGINEERS, Inc.

29 West 39th Street, New York

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Vice President....Fred E. Weick
(Representing Aircraft Engineering)
Vice President....A. L. Beall
(Representing Aircraft Engine Engineering)
Vice President....A. W. Pope, Jr.
(Representing Diesel Engine Engineering)
Secretary and General Manager....John A. C. Warner

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Aircraft Engine Committee....A. L. Beall, Chairman
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Aircraft Division....J. F. Hardecker, Chairman
Aircraft Engine Division....Robert Insley, Chairman

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Vice President....Earl M. Bennetsen, Minnesota
Secretary-Treasurer....C. Dan Martin, Harvard
Honorary President, Grover C. Loening

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Brig. Gen. H. H. Arnold....Assistant Chief of the Air Corps
Major T. T. Handy....War Plans Div., General Staff

Navy

Rear Admiral A. B. Cook....Chief, Bureau of Aeronautics
Commander A. C. Davis....Head of Plans Div., Bureau of Aeronautics
Captain Wm. Baggaley....War Plans Div., Naval Operations
Secretary, Jarvis Butler

U. S. AIR CORPS, WAR DEPARTMENT

Washington, D. C.

Harry H. Woodring, Secretary of War

Officers on Duty in Washington

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Assistant Chief of the Air Corps..............................Brig. Gen. Henry H. Arnold
Commander, G. H. Q. Air Force..........................Major Gen. Frank M. Andrews
Colonels—Chalmers G. Hall, Alfred H. Hobley, Rush B. Lincoln, William C. McChord, H. H. C. Richards.
Lieut. Colonels—Rosenham Beam, G. E. Brower, H. S. Burwell, H. C. Davidson, M. F. Davis, V. B. Dixon, Ross G. Hoyt, L. B. Jacobs, Wm. E. Lynd, R. L. Walsh, H. H. Young.
Majors—K. S. Axtater, C. Y. Banfill, R. C. W. Blessley, A. E. Easterbrook, M. C. Grow, Edw. V. Harbeck, Jr., R. Kauch, Alvan C. Kincaid, M. H. McKinnon, Alfred W. Marriner, L. W. Miller, J. A. Mollison, David A. Myers, C. P. Prime, E. W. Raley, L. H. Smith, Wm. B. Souza, G. L. Usher, G. S. Warren.
Captains—Evers Abbey, James C. Cluck, A. H. Foster, Mervin Gross, J. J. Honan, L. S. Smith, James W. Spry, Donald F. Stace, Stewart W. Towle, Jr.

Materiel Division

Brigadier General A. W. Robins, Chief of the Division

Acting Executive and Commanding Officer........................Col. Frederick L. Martin
Assistant Executive..Maj. A. W. Brock
Adjutant..Maj. A. W. Brock
Supply Officer..Capt. J. A. Madarasz
Chief, Administration Section..Lt. Col. D. B. Howard
Chief, Engineering Section...Lt. Col. Oliver P. Echols
Chief, Procurement Section...Lt. Col. Harold A. Strauss
Chief, Field Service Section..Col. F. D. Lackland
Chief, Industrial War Plans Section.................................Lt. Col. H. V. Hopkins
Finance Officer..Capt. J. F. Connell
Asst. Commandant A. C. Engineering School....................Lieut. R. P. Swofford, Jr.
Quartermaster...Maj. R. C. Bower
Signal Officer...Capt. R. P. Lyman
Engineer Corps Representative.......................................Capt. Louis J. Rumaggi
Ordnance Corps Representative...Maj. F. F. Reed
Navy Representative.....................................Lt. Comdr. Byron J. Connell

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Assistant Director for Commercial Standardization........................A. S. McAllister
Assistant to Director (in charge of Office)..............................Henry D. Hubbard

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- Weights and Measures.................................F. S. Holbrook and H. W. Bearce
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- Optics...C. A. Skinner
- Chemistry..P. H. Walker
- Mechanics and Sound...H. L. Dryden
- Organic and Fibrous Materials...W. E. Emley
- Metallurgy...H. S. Rawdon
- Clay and Silicate Products...P. H. Bates
- Simplified Practice..E. W. Ely
- Trade Standards...I. J. Fairchild
- Codes and Specifications...A. S. McAllister
- Office..Henry D. Hubbard
- Plant..O. L. Britt
- Shops...O. G. Lange

BUREAU OF AERONAUTICS, U. S. NAVY

Washington, D. C.

Claude A. Swanson, Secretary of the Navy
Charles Edison, Asst. Secretary of the Navy

Officers on Duty in Washington

Chief of Bureau........Rear Admiral Arthur B. Cook
Assistant Chief of Bureau........Captain A. C. Read
Captains........S. M. Kraus, H. C. Richardson (CC) (Ret.), G. P. Shamer (SC)
Commanders........A. D. Bernhard, A. C. Davis, G. Fulton, J. T. Matthews (CEC), A. C. Miles, M. S. Mitscher, W. Nelson.
Lieutenant Commanders......J. B. Anderson, G. H. DeBaun, W. S. Diehl, A. K. Doyle, H. F. Fick, A. Gavin, L. M. Grant, L. T. Hundt, T. C. Lonnequest, R. D. MacCart, I. M. McQuiston (USNR), C. A. Nicholson, J. Perry, J. E. Pixton, A. M. Pride, L. C. Ramsey, W. L. Rees, A. O. Rule, H. B. Sallada, W. D. Sample, M. T. Seligman, W. G. Switzer, L. D. Webb, J. E. Wegforth.
Lieutenants........J. F. Bridget, C. F. Cotton, C. E. Ekstrom, W. L. Erdman, R. Goldthwaite, J. F. Greenslade, T. J. Hedding, C. L. Helber, R. L. Johnson, W. D. Johnson, J. W. King, G. T. Mundorff, J. B. Pearson, A. R. Sanborn, S. B. Spangler, T. T. Tucker, D. E. Wilcox.
Lieutenant (jg)........C. L. Miller
Marine Corps Aviation........Col. R. E. Rowell; Major Field Harris; Major H. C. Major; Capt. C. T. Bailey; Capt. A. W. Kreiser; Capt. W. D. Saunders; Capt. O. O. Schrider.
U. S. Army Liaison Officer........Capt. D. F. Stace, USA.

Naval Air Stations

Lakehurst, N. J........Comdr. C. E. Rosendahl
Anacostia, D. C........Comdr. V. C. Griffin
Norfolk, Va........Capt. W. G. Child
San Diego, Calif........Capt. A. L. Bristol, jr.
Seattle, Wash........Lieut. Comdr. H. S. Kendall
Pensacola, Fla........Rear Admiral C. A. Blakely
Pearl Harbor, T. H........Captain K. Whiting
Coco Solo, C. Z........Capt. J. S. McCain

Marine Corps Flying Fields

Quantico, Va........Col. R. S. Geiger
San Diego, Calif........Lt. Col. R. S. Mitchell
St. Thomas, V. I........Lt. Col. J. T. Moore

Carrier Division

Commander........Vice Admiral F. J. Horne
(Aircraft Battle Force)
Chief of Staff........Captain J. H. Towers
U. S. S. SARATOGA........Captain W. F. Halsey
U. S. S. LEXINGTON........Captain A. W. Fitch
U. S. S. RANGER........Capt. P. N. L. Bellinger
U. S. S. YORKTOWN........Captain E. D. McWhorter

Naval Aircraft Factory

Philadelphia, Pa........Comdr. W. W. Webster

BUREAU OF AERONAUTICS, U. S. NAVY (Continued)

Special Aviation Duty

Aide to Commander-in-Chief, U. S. Fleet............................Comdr. R. P. Molten
Aide to Commander, Battle Force..............................Lt. Comdr. G. L. Compo
Aide to Comdr. Cruisers, Scouting Force.........................Lt. Comdr. W. M. Dillon
Office of Naval Operations.....Captain N. H. White, Lt. Comdr. O. B. Hardison, Lt. Comdr. D. Ketcham
Naval Examining Board..Lt. Comdr. C. G. Halpine
Board of Inspection and Survey...............................Lt. Comdr. R. E. Jennings
Bureau of Navigation.........Lt. R. L. Bowman, Lt. Comdr. J. B. Lynch (USNR), Lt. Comdr. C. W. Wieber.
Bureau of Ordnance.......................Lt. S. E. Burroughs, Lt. Comdr. M. F. Schoeffel
Bureau of Engineering...Lieut. W. P. Cogswell
Bureau of Medicine and Surgery..........................Lt. Comdr. L. E. Mueller (MC)
Hydrographic Office..........Lieut. Comdr. C. W. Sinton, Lieut. Comdr. H. M. Martin, Lieut. A. W. Wheelock

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

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, 1929. The members are appointed by the President, and serve as such without compensation.

Joseph S. Ames, Ph.D., Chairman, President-Emeritus, Johns Hopkins University, Baltimore, Md.
David W. Taylor, D.Eng., Vice Chairman, Washington, D. C.
Charles G. Abbot, Sc.D., Secretary, Smithsonian Institution.
Lyman J. Briggs, Ph.D., Director, National Bureau of Standards.
Arthur B. Cook, Rear Admiral, United States Navy, Chief, Bureau of Aeronautics, Navy Department.
Willis Ray Gregg, B.A., United States Weather Bureau.
Harry F. Guggenheim, M.A., Port Washington, Long Island, N. Y.
Sydney M. Kraus, Captain, United States Navy, Bureau of Aeronautics, Navy Department.
Charles A. Lindbergh, LL.D., New York City.
William P. MacCracken, Jr., Ph.B., Washington, D. C.
Augustine W. Robins, Brig. Gen., United States Army, Chief, Materiel Division, Air Corps, Wright Field, Dayton, Ohio.
Eugene L. Vidal, C.E., Director of Air Commerce, Department of Commerce.
Edward P. Warner, M.S., Los Angeles, Calif.
Oscar Westover, Major General, United States Army, Chief of Air Corps, War Department.
Orville Wright, Sc.D., Dayton, Ohio.

George W. Lewis, Sc.D., Director of Aeronautical 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

BUREAU OF AIR COMMERCE
U. S. DEPARTMENT OF COMMERCE

Washington, D. C.

Daniel C. Roper, Secretary of Commerce

J. M. Johnson, Asst. Secy. of Commerce in Charge of Transportation Bureaus

Director of Air Commerce..Frederick D. Fagg, Jr.
Assistant Director..R. W. Schroeder
Assistant to the Director...N. B. Sangree
Administrative Section, Chief....................................John S. Collins
Aeronautic Information Section, Chief...............................Frederick R. Neely
Airport, Marking and Mapping Section, Chief..........................John S. Wynne
Development Section, Chief.......................................John H. Geisse

Air Navigation Division

Chief Airways Engineer..Charles I. Stanton
Chief, Radio Development Section.................................W. E. Jackson
Chief, Engineering Section...H. A. Hook
Chief, Construction Section...G. E. Stratton
Superintendent of Maintenance...Alvin O. Preil
Chief, Communication Section...Eugene Sibley
Airways District Managers and Headquarters:
No. 1, Newark, N. J......................................D. G. Van De Water
No. 2, Atlanta, Ga..I. H. Polk
No. 3, Chicago, Ill..Carl McClure
No. 4, Fort Worth, Tex..L. C. Elliott
No. 5, Salt Lake City, Utah...C. C. Lange
No. 6, Oakland, Calif...H. T. Bean

Air Regulation Division

Assistant to Assistant Director...R. S. Boutelle
General Inspection Service, Chief.....................................Joe T. Shumate
Manufacturing Inspection Service, Chief...................................L. V. Kerber
Supervising Aeronautical Inspectors and Headquarters:
District No. 1, Garden City, L. I., N. Y...........................S. L. Willits
District No. 2, Los Angeles, Calif..................................J. S. Marriott
District No. 3, Atlanta, Ga.......................................Wiley R. Wright
District No. 4, Detroit, Mich......................................H. R. Neely
District No. 5, Chicago, Ill...G. W. Vest
District No. 6, Kansas City, Mo..................................L. W. Jurden
District No. 7, Dallas, Tex..C. A. Rowe
District No. 8, Oakland, Calif...................................R. D. Bedinger
District No. 9, Anchorage, Alaska................................Hugh Brewster

Chief, Medical Section...Dr. R. E. Whitehead
Chief, Registration Section...R. R. Reining
Chief, Safety Section...J. W. Lankford

FEDERAL COMMUNICATIONS COMMISSION

Washington, D. C.

Commissioners

Anning S. Prall, Chairman

Thad H. Brown	Irvin Stewart
Norman S. Case	Eugene O. Sykes
George Henry Payne	Paul Walker

Herbert L. Pettey, Secretary

U. S. COAST GUARD
DEPARTMENT OF THE TREASURY

Henry Morgenthau, Jr., Secretary of the Treasury

Stephen B. Gibbons, Asst. Secy. in Charge of Customs, Coast Guard, and Narcotics

Officers on duty in Washington

Commandant, U. S. Coast Guard............Rear Admiral R. R. Waesche
Chief Aviation Officer............Captain L.T. Chalker
Aviation Operations............Lieut. C. B. Olsen
Aviation Materiel............Lieut. G. H. Bowerman,
Chief Machinist W. R. Kenly
Aviation Finance............Pay Clerk C. F. Erickson
Senior Aeronautical Engineer............H. S. Cocklin
Civil Engineer............E. L. McGandy

Coast Guard Air Stations

Salem, Massachusetts............Lieut. Commander F. A. Leamy
Cape May, New Jersey............Lieut. R. L. Burke
Charleston, South Carolina............Lieut. Commander W. J. Kossler
Miami, Florida............Commander C. C. von Paulsen
St. Petersburg, Florida............Lieut. W. A. Burton
Biloxi, Mississippi............Lieut. Commander R. L. Raney
San Diego, California............Lieut. S. C. Linholm
Port Angeles, Washington............Lieut. C. F. Edge

Coast Guard Air Patrol Detachment

Del Rio, Texas............Lieutenant Commander N. M. Nelson

Inspectors of Coast Guard Aircraft

Lieut. W. S. Anderson   Chief Machinist F. F. Crump   Chief Carpenter O. G. Tobiason

U. S. FOREST SERVICE
DEPARTMENT OF AGRICULTURE

Washington, D. C.
Henry A. Wallace, Secretary of Agriculture
Chief of the Forest Service: F. A. Silcox

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
R. H. Rutledge, Regional Forester
California Region............Headquarters: San Francisco, Calif.
S. B. Show, Regional Forester
North Pacific Region............Headquarters: Portland, Oregon
C. J. Buck, 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.
Alaska Region............Headquarters: Juneau, Alaska
Charles H. Flory, Regional Forester

POST OFFICE DEPARTMENT AIR MAIL SERVICE

Washington, D. C.

Postmaster General....................James A. Farley
Second Assistant Postmaster General....................Harllee Branch
Deputy Second Assistant Postmaster General....................J. W. Cole
General Superintendent, Air and Railway Mail Service....................S. A. Cisler
Superintendent, Air Mail Service....................Charles P. Graddick
Assistant Superintendent, Air Mail Service....................J. W. Sutherin

J. A. Cruickshank, Assistant Superintendent....................New York, N. Y.
R. E. Pollard, Assistant Superintendent....................Chicago, Ill.
A. O. Willoughby, Assistant Superintendent....................San Francisco, Calif.
Alva Sole, Assistant Superintendent....................Fort Worth, Tex.
Ben H. Lockett, Assistant Superintendent....................Atlanta, Ga.
J. E. Lamiell, Director, Division of International Postal Service (Foreign Air Mail)

U. S. WEATHER BUREAU

DEPARTMENT OF AGRICULTURE

Washington, D. C.

Henry A. Wallace, Secretary of Agriculture

Chief....................Willis Ray Gregg
Assistant Chief....................Charles C. Clark
Chief, Division of Business Administration....................William Weber

Aerological Division

Chief....................Delbert M. Little
Assistant....................Leroy T. Samuels
Airways....................Paul A. Miller
In Charge South Washington Airport Station....................Eugene M. Barto

Forecast Division

Chief....................Edgar B. Calvert
Assistant....................Thomas R. Brooks

District Forecasting

District Forecaster....................Charles L. Mitchell
District Forecaster....................R. Hanson Weightman

Instrument Division

Chief....................Benjamin C. Kadel
Assistant....................Roy N. Covert

Library

Chief....................Richmond T. Zoch

Field Organization—District Forecasting

Chicago....................Charles A. Donnel
Denver....................Julius M. Sherier
Jacksonville....................Walter J. Bennett
New Orleans....................Willard F. McDonald
San Francisco....................Edward H. Bowie

U. S. WEATHER BUREAU (Continued)

General Supervising Airway Stations

(Six-hourly Airway Forecast Centers)

Atlanta	Glen Jefferson
Chicago	Vincent E. Jakl
Cleveland	Clarence G. Andrus
Dallas	Henry P. Adams
Kansas City	Leslie A. Warren
Los Angeles (Burbank)	George M. French
New York (Newark)	Homer W. Ball
Portland, Ore.	Julius C. Smith
Salt Lake City	Harry M. Hightman
San Francisco (Oakland)	John A. Riley

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION

Standing Committees of the 75th Congress 1st Session, 1937

Senate

Appropriations

Carter Glass (chairman) (D)

Kenneth McKellar	(D)	William Gibbs McAdoo	(D)
Royal S. Copeland	(D)	Harry S. Truman	(D)
Carl Hayden	(D)	F. Ryan Duffy	(D)
Elmer Thomas	(D)	Edward R. Burke	(D)
James F. Byrnes	(D)	Herbert E. Hitchcock	(D)
Millard E. Tydings	(D)	Theodore F. Green	(D)
Richard B. Russell, Jr.	(D)	Frederick Hale	(R)
Alva B. Adams	(D)	Gerald P. Nye	(R)
Patrick McCarran	(D)	Frederick Steiwer	(R)
John H. Overton	(D)	John G. Townsend, Jr.	(R)
John H. Bankhead	(D)	H. Styles Bridges	(R)
Joseph C. O'Mahoney	(D)		

Interstate Commerce

Burton K. Wheeler (chairman) (D)

Ellison D. Smith	(D)	Sherman Minton	(D)
Robert F. Wagner	(D)	A. Harry Moore	(D)
Alben W. Barkley	(D)	Harry S. Truman	(D)
M. M. Neely	(D)	C. O. Andrews	(D)
William H. Dieterich	(D)	Edwin C. Johnson	(D)
Augustine Lonergan	(D)	H. H. Schwartz	(D)
Fred H. Brown	(D)	Wallace H. White, Jr.	(R)
Homer T. Bone	(D)	James J. Davis	(R)
Vic Donahey	(D)	Warren R. Austin	(R)
Henrik Shipstead	(FL)		

Military Affairs

Morris Sheppard (chairman) (D)

Hugo L. Black	(D)	Edwin C. Johnson	(D)
J. Hamilton Lewis	(D)	Josh Lee	(D)
M. M. Logan	(D)	Harry H. Schwartz	(D)
Robert R. Reynolds	(D)	Ernest Lundeen	(FL)
Nathan L. Bachman	(D)	Warren R. Austin	(R)
Elbert D. Thomas	(D)	Gerald P. Nye	(R)
Sherman Minton	(D)	H. Styles Bridges	(R)
Claude Pepper	(D)	Henry Cabot Lodge, Jr.	(R)

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION (Continued)

Naval Affairs

David I. Walsh (chairman) (D)

Millard E. Tydings	(D)	Peter G. Gerry	(D)
Ellison D. Smith	(D)	Rush D. Holt	(D)
George McGill	(D)	C. O. Andrews	(D)
Richard B. Russell, Jr.	(D)	Guy M. Gillette	(D)
Homer T. Bone	(D)	Frederick Hale	(R)
Harry Flood Byrd	(D)	James J. Davis	(R)
William H. Dieterich	(D)	Hiram W. Johnson	(R)
Fred H. Brown	(D)	Ernest W. Gibson	(R)

Post Office and Post Roads

Kenneth McKeller (chairman) (D)

Carl Hayden	(D)	Rush D. Holt	(D)
Josiah William Bailey	(D)	Allen J. Ellender	(D)
W. J. Bulow	(D)	Theodore F. Green	(D)
James F. Byrnes	(D)	Ernest Lundeen	(FL)
M. M. Logan	(D)	Lynn J. Frazier	(R)
Fred H. Brown	(D)	Robert M. La Follette, Jr.	(P)
Joseph C. O'Mahoney	(D)	Ernest W. Gibson	(R)
James E. Murray	(D)	H. Styles Bridges	(R)
Dennis Chavez	(D)		

House of Representatives

Appropriations

James P. Buchanan (chairman) (D)

Edward T. Taylor	(D)	Millard F. Caldwell	(D)
Clarence Cannon	(D)	David D. Terry	(D)
Clifton A. Woodrum	(D)	John M. Houston	(D)
John J. Boylan	(D)	John P. Higgins	(D)
Louis Ludlow	(D)	J. Burwood Daly	(D)
Thomas S. McMillan	(D)	Joe Starnes	(D)
Malcom C. Tarver	(D)	Ross A. Collins	(D)
Jed Johnson	(D)	Charles H. Leavy	(D)
J. Buell Snyder	(D)	John Tabor	(R)
William B. Umstead	(D)	Robert L. Bacon	(R)
William R. Thom	(D)	Richard B. Wigglesworth	(R)
John F. Dockweiler	(D)	W. P. Lambertson	(R)
James McAndrews	(D)	D. Lane Powers	(R)
Emmet O'Neal	(D)	J. William Ditter	(R)
George W. Johnson	(D)	Albert E. Carter	(R)
James G. Scrugham	(D)	Robert F. Rich	(R)
James M. Fitzpatrick	(D)	Charles A. Plumley	(R)
Louis C. Rabaut	(D)	Everett M. Dirksen	(R)
Joachim O. Fernandez	(D)	Fred L. Engel	(R)

Interstate and Foreign Commerce

Clarence F. Lea (chairman) (D)

Robert Crosser	(D)	Henry Ellenbogen	(D)
Alfred L. Bulwinkle	(D)	Herron Pearson	(D)
Virgil Chapman	(D)	Jerry J. O'Connell	(D)
Paul H. Maloney	(D)	George B. Kelly	(D)
William P. Cole, Jr.	(D)	Lyle H. Boren	(D)
Samuel B. Pettengill	(D)	Gardner R. Withrow	(P)
Edward A. Kelly	(D)	Carl E. Mapes	(R)
Edward A. Kenney	(D)	Charles A. Wolverton	(R)
George G. Sadowski	(D)	James Wolfenden	(R)
John A. Martin	(D)	Pehr G. Holmes	(R)
Edward C. Eicher	(D)	B. Carroll Reece	(R)
Theodore A. Peyser	(D)	James W. Wadsworth	(R)
Thomas J. O'Brien	(D)	Charles A. Halleck	(R)

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION (Continued)

Military Affairs

Lister Hill (chairman) (D)

Andrew J. May	(D)	G. Heyward Mahon, Jr.	(D)
R. Ewing Thomason	(D)	C. Arthur Anderson	(D)
Dow W. Harter	(D)	Stephen Pace	(D)
Charles I. Faddis	(D)	Overton Brooks	(D)
Clarence W. Turner	(D)	Paul J. Kvale	(FL)
Andrew Edmiston	(D)	Walter G. Andrews	(R)
Edwin M. Schaefer	(D)	Dewey Short	(R)
J. Joseph Smith	(D)	Leslie C. Arends	(R)
Matthew J. Merritt	(D)	Charles R. Clason	(R)
Maury Maverick	(D)	Albert G. Rutherford	(R)
Frank J. G. Dorsey	(D)	J. Parnell Thomas	(R)
John M. Costello	(D)	Samuel W. King	(R)
J. Mark Wilcox	(D)		

Naval Affairs

Carl Vinson (chairman) (D)

Patrick Henry Drewry	(D)	Joseph E. Casey	(D)
Stephen W. Gambrill	(D)	Michael J. Stack	(D)
John J. Delaney	(D)	Alfred N. Phillips, Jr.	(D)
Frank C. Kniffin	(D)	Warren G. Magnuson	(D)
Patrick J. Boland	(D)	Norman R. Hamilton	(D)
Leonard W. Schuetz	(D)	Charles D. Millard	(R)
William H. Sutphin	(D)	Melvin J. Maas	(R)
Joseph B. Shannon	(D)	Ralph E. Church	(R)
John J. McGrath	(D)	James W. Mott	(R)
W. D. McFarlane	(D)	Ralph O. Brewster	(R)
John M. O'Connell	(D)	Fred L. Crawford	(R)
Byron N. Scott	(D)	W. Sterling Cole	(R)
		Samuel W. King	(R)

Post Office and Post Roads

James M. Mead (chairman) (D)

Milton A. Romjue	(D)	Joe Hendricks	(D)
Harry L. Haines	(D)	Noble J. Gregory	(D)
Thomas G. Burch	(D)	Donald L. O'Toole	(D)
Martin L. Sweeney	(D)	John Luecke	(D)
John C. Taylor	(D)	Hugh M. Rigney	(D)
Fred H. Hildebrandt	(D)	Fred A. Hartley, Jr.	(R)
William A. Ashbrook	(D)	Bertrand W. Gearhart	(R)
Arthur W. Mitchell	(D)	Frank Carlson	(R)
Henry C. Luckey	(D)	E. Harold Cluett	(R)
B. Frank Whelchel	(D)	Noah M. Mason	(R)
Edward W. Patterson	(D)	Paul W. Shafer	(R)
Aime J. Forand	(D)	Arthur B. Jenks	(R)

DIPLOMATIC SERVICE TO THE UNITED STATES

The following foreign aeronautical representatives may be addressed at their respective embassies in Washington, D. C., or as indicated.

Argentina..........Commander Horacio M. Smith, Naval Attaché.
Belgium............Count Robert van der Straten-Ponthoz, Ambassador E. and P.
Bolivia............Hon. Guillermo Alborta, Consul, 90 Broad St., New York, N. Y.
Brazil.............Commander Oscar F. Coutinho, Naval Attaché.
Bulgaria...........Mr. C. Bear, Consul.
Canada.............Mr. Merchant M. Mahoney, First Secretary.
Chile..............Senor Don Fernando Illanes Benitez, Second Secretary.
China..............Mr. Zaung teh Ing, Counselor of Legation.
Colombia...........Commercial Attaché.
Costa Rica.........Senor Don Ricardo Castro-Beeche, Minister Resident.
Cuba...............Secretary of Legation.
Czechoslovakia.......Mr. Josef Nemecek, Counselor of Legation.
Denmark............Mr. Otto Wadsted, E. E. and M. P.
Egypt..............Mr. M. Amine Youssef, Minister.
El Salvador.........Senor Dr. Don Hector David Castro, E. E. and M. P.
Finland............Dr. Sigurd von Numers, Secretary of Legation.
France.............Major Norbert Champsaur, Air Attaché.
Germany............Lt. General Friedrich von Boetticher, Air and Military Attaché.
Great Britain.......Group Captain T. E. B. Howe, Air Attaché.
Greece.............Mr. Nicholas G. Lély, Counselor of Legation.
Guatemala..........Senor Dr. Don Enrique López-Herrate, First Secretary.
Honduras...........Senor Dr. Don Julian R. Caceres, First Secretary and Charge d'Affaires ad interim.
Hungary............Mr. Anthony de Balázy, Counselor of Legation.
Irish Free State.....Mr. Robert Brennan, Secretary of Legation.
Italy...............Colonel Vincenzo Coppola, Air and Military Attaché.
Japan..............Commander K. Miura, Assistant Naval Attaché.
Lithuania..........Secretary of Legation.
Mexico.............Senor Dr. Don Francisco Castillo Najera, Ambassador E. and P.
Netherlands........Jonkheer H. M. van der Wyck, Secretary of Legation.
Norway.............Mr. Francis Irgens, Secretary of Legation.
Panama.............Mr. C. de la Guardia, Secretary of Legation.
Peru...............Commander Althaua, Naval Attaché.
Poland.............Mr. Edward Kulikowski, Secretary of Legation.
Portugal...........Mr. João de Deus Ramos, Secretary of Legation.
Roumania...........Mr. George Boncesco, Financial Counselor of Legation.
Siam...............Phya Abhibal Rajamaitri, E. E. and M. P.
South Africa........Mr. Barry Lambooy, Commercial Attaché.
Spain..............Senor Don Enrique de la Casa, Charge d'Affaires.
Sweden.............Mr. Per Wijkman, Commercial Counselor of Legation.
Switzerland.........Mr. Edward Feer, Counselor of Legation.
Turkey.............Mehmet Münir Ertegün, Ambassador.
U. S. S. R..........Colonel Vladimir Begunov, Military Attaché.
Uruguay............Mr. J. Richling, E. E. and M. P.
Venezuela..........Mr. A. Lares, Secretary of Legation.
Yugoslavia.........Mr. Rastka Petrovich, Secretary of Legation.

STATE AVIATION OFFICIALS

ALABAMA:	Alabama State Aviation Commission Theodore Swann, Chairman, 930 Brown-Marx Bldg., Birmingham
ARIZONA:	No aeronautical regulatory body. (Arizona Corporation Commission, Charles R. Howe, Chairman, Phoenix, has jurisdiction over aircraft common carriers.)
ARKANSAS:	No aeronautical regulatory body.
CALIFORNIA:	No aeronautical regulatory body.
COLORADO:	No aeronautical regulatory body. (Some control exercised by Colorado Public Utilities Commission and Neil W. Kimball, Adjutant General of Colorado, State Museum Bldg., 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:	No aeronautical regulatory body.
IDAHO:	Department of Public Works William R. Graham, Director of Aeronautics, Boise.
ILLINOIS:	Illinois Aeronautics Commission L. P. Bonfoey, Chairman, Quincy. (Illinois Commerce Commission, 1 N. La Salle St., Chicago, 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:	Division of Aviation, Military Department of Kentucky, Frankfort.
LOUISIANA:	Louisiana Aeronautics Commission, D. O. Langstaff, Chairman, New Orleans.
MAINE:	Office of Secretary of State Secretary of State, State House, Augusta.
MARYLAND:	Maryland Aviation Commission Dr. Hugh H. Young, Chairman, Stewart Bldg., Baltimore.
MASSACHUSETTS:	Registrar of Motor Vehicles Frank A. Goodwin, Registrar, 100 Nashua St., Boston.
MICHIGAN:	Michigan Board of Aeronautics William B. Mayo, Chairman, 2272 First National Bank Bldg., Detroit.
MINNESOTA:	Minnesota Aeronautics Commission Major Ray S. Miller, Chairman, Athletic Club, St. Paul.

STATE AVIATION OFFICIALS (Continued)

MISSISSIPPI:	No aeronautical regulatory body.
MISSOURI:	No aeronautical regulatory body.
MONTANA:	Montana Aeronautics Commission Fred B. Sheriff, Commissioner, Helena. (Promotion work only.)
NEBRASKA:	Nebraska Aeronautics Commission Clinton J. Campbell, Chairman, 1523 Sharp Bldg., Lincoln.
NEVADA:	No aeronautical regulatory body. (Nevada Public Service Commission, Harley A. Harmon, Chairman Carson City, has jurisdiction over aircraft common carriers.)
NEW HAMPSHIRE:	New Hampshire Public Service Commission Nelson Lee Smith, Chairman, Concord.
NEW JERSEY:	New Jersey Department of Aviation Gill Robb Wilson, State Director of Aviation, Trenton.
NEW MEXICO:	State Corporation Commission Don R. Casados, Chairman, Santa Fe.
NEW YORK:	No regulatory body.
NORTH CAROLINA:	No aeronautical regulatory body.
NORTH DAKOTA:	No aeronautical regulatory body. (Board of Railroad Commissioners, Ben C. Larkin, President, Bismarck, has limited relugatory powers.)
OHIO:	State Bureau of Aeronautics Columbus.
OKLAHOMA:	Oklahoma State Highway Commission J. M. Gentry, Member-Secretary and State Aircraft Officer, State Capitol, Oklahoma City.
OREGON:	Oregon State Board of Aeronautics Dr. Raymond R. Staub, Chairman, 619 Lumbermens Bldg., Portland.
PENNSYLVANIA:	Department of Revenue, Division of Aeronautics Cammy Vinet, Chief of Aeronautics, Harrisburg
RHODE ISLAND:	Department of Public Works, Division of State Airports Daniel J. Kiely, State Office Bldg., Providence.
SOUTH CAROLINA:	South Carolina Aeronautics Commission J. P. Williamson, Chairman, Greenville.
SOUTH DAKOTA:	South Dakota Aeronautics Commission T. B. Roberts, Jr., Chairman, Pierre.
TENNESSEE:	State Aeronautics Commission Briggs Smith, Chairman, Nashville.
TEXAS:	No aeronautical regulatory body.
UTAH:	No aeronautical regulatory body.

STATE AVIATION OFFICIALS (Continued)

VERMONT:	Motor Vehicle Department Murdock A. Campbell, Commissioner of Vehicles, Montpelier.
VIRGINIA:	State Corporation Commission R. E. Steele, Director of Aviation, Richmond.
WASHINGTON:	Washington State Patrol, William Cole, Chief, Olympia.
WEST VIRGINIA:	West Virginia Board of Aeronautics David M. Giltinan, Acting Chairman, Charleston.
WISCONSIN:	No aeronautical regulatory body.
WYOMING:	No aeronautical regulatory body.

AERONAUTICAL MAGAZINES 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.
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	Dupont Circle, Washington, D. C.
OFFICIAL AVIATION GUIDE OF THE AIRWAYS	608 S. Dearborn Street, Chicago, Ill.
PILOT	Grand Central Air Terminal, Glendale, Calif.
POPULAR AVIATION	608 S. Dearborn Street, Chicago, Ill.
SOUTHERN FLIGHT	Ledger Building, Fort Worth, Tex.
SPORTSMAN PILOT	515 Madison Avenue, New York, N. Y.
U. S. AIR SERVICES	Transportation Building, Washington, D. C.
WESTERN FLYING	420 South San Pedro Street, Los Angeles, Calif.

WILCOX AIR DEFENSE LAW OF 1935

[PUBLIC—No. 263—74TH CONGRESS] [H. R. 7022]

AN ACT

To authorize the selection, construction, installation, and modification of permanent stations and depots for the Army Air Corps and frontier air-defense bases generally.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War is hereby authorized and directed to determine in all strategic areas of the United States, including those of Alaska and our overseas possessions and holdings, the location of such additional permanent Air Corps stations and depots as he deems essential, in connection with the existing Air Corps stations and depots and the enlargement of the same when necessary, for the effective peace-time training of the General Headquarters Air Force and the Air Corps components of our overseas garrisons. In determining the locations of new stations and depots, consideration shall be given to the following regions for the respective purposes indicated: (1) The Atlantic Northeast—to provide for training in cold weather and in fog; (2) the Atlantic Southeast and Caribbean areas—to permit training in long-range operations, especially those incident to reinforcing the Panama Canal; (3) the Southeastern States—to provide a depot essential to the maintenance of the General Headquarters Air Force; (4) the Pacific Northwest—to establish and maintain air communication with Alaska; (5) Alaska—for training under conditions of extreme cold; (6) the Rocky Mountain area—to provide a depot essential to the maintenance of the General Headquarters Air Force, and to afford, in addition, opportunity for training in operations from fields in high altitudes; and (7) such intermediate stations as will provide for transcontinental movements incident to the concentration of the General Headquarters Air Force for maneuvers.

In the selection of sites for new permanent Air Corps stations and depots and in the determination of the existing stations and depots to be enlarged and/or altered, the Secretary of War shall give consideration to the following requirements:

First. The stations shall be suitably located to form the nucleus of the set-up for concentrations of General Headquarters Air Force units in war and to permit, in peace, training and effective planning, by responsible personnel in each strategic area, for the utilization and expansion in war, of commercial, municipal, and private flying installations.

Second. In each strategic area deemed necessary, there shall be provided adequate storage facilities for munitions and other essentials to facilitate effective movements, concentrations, maintenance, and operations of the General Headquarters Air Force in peace and in war.

Third. The stations and depots shall be located with a view to affording the maximum warning against surprise attack by enemy aircraft upon our own aviation and its essential installations, consistent with maintaining, in connection with existing or contemplated additional landing fields, the full power of the General Headquarters Air Force for such close and distant operations over land and sea as may be required in the defense of the continental United States and in the defense and the reinforcement of our overseas possessions and holdings.

Fourth. The number of stations and depots shall be limited to those essential to the foregoing purposes.

SEC. 2. To accomplish the purposes of this Act, the Secretary of War is authorized to accept, on behalf of the United States, free of encumbrances and without cost to the United States, the title in fee simple to such lands as he may deem necessary or desirable for new permanent Air Corps stations and depots and/or the extension of or addition to existing Air Corps stations or depots; or, with the written approval of the President, to exchange for such lands existing military reservations or portions thereof; or, if it be found impracticable to secure the necessary lands by either of these methods, to purchase the same by agreement or through condemnation proceedings.

SEC. 3. The Secretary of War is further authorized and directed to construct, install, and equip, or complete the construction, installation, and equipment, inclusive of bomb-proof protection as required, at each of said stations and depots, such buildings and utilities, technical buildings and utilities, landing fields and mats, and all utilities and appurtenances thereto, ammunition storage, fuel and oil storage and distribution systems therefor, roads, walks, aprons, docks, runways, sewer, water, power, station and aerodrome lighting, telephone and signal communications, and other essentials, including the necessary grading and removal or remodeling of existing structures and installations. He is authorized, also, to direct the necessary transportation of personnel, and purchase, renovation, and transportation of materials, as in his judgment may be required to carry out the purposes of this Act. The Secretary of War is further authorized to acquire by gift, purchase, lease, or otherwise, at such locations as may be desirable, such bombing and machine-gun ranges as may be required for the proper practice and training of tactical units.

SEC. 4. There is hereby authorized to be appropriated, out of any money in the Treasury of the United States not otherwise appropriated, such sums of money as may be necessary, to be expended under the direction of the Secretary of War for the purposes of this Act, including the expenses incident to the necessary surveys, which appropriation shall continue available until expended: *Provided,* That the provisions of section 1136, Revised Statutes (U.S.C., title 10, par. 1339), shall not apply to the construction of the aforesaid stations and depots.

Approved, August 12, 1935.

AIR MAIL ACT OF 1934

As amended by H. R. 6511

Signed by the President August 14, 1935

Italics are amendments of 1935

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act of April 29, 1930 (46 Stat. 259, 260; U.S.C., Supp. VII, title 39, secs. 464, 465c, 465d, and 465f), and the sections amended thereby are hereby repealed.

SECTION 2. (a) Effective July 1, 1934, the rate of postage on air mail shall be 6 cents for each ounce or fraction thereof.

(b) When used in this Act—

(1) The term "air mail" means mail of any class prepaid at the rate of postage prescribed in subsection (a) of this section.

(2) The term "person" includes an individual, partnership, association or corporation.

(3) The term "pilot" includes copilot.

SECTION 3. (a) *The Postmaster General is authorized to award contracts for the transportation of air mail by airplane between such points as he may designate, and for initial periods of not exceeding three years, to the lowest responsible bidders tendering sufficient guaranty for faithful performance in accordance with the terms of the advertisement at fixed rates per airplane-mile: Provided, That where the Postmaster General holds that a low bidder is not responsible or qualified under this Act, such bidder shall have the right to appeal to the Comptroller General, who shall speedily determine the issue, and his decision shall be final: Provided further, That the base rate of pay which may be bid and accepted in awarding such contracts shall in no case exceed 33 1/3 cents per airplane-mile for transporting a mail load not exceeding three hundred pounds. Payment for transportation shall be at the base rate fixed in the contract for the first three hundred pounds of mail or fraction thereof plus one-tenth of such base rate for each additional one hundred pounds of mail or fraction thereof, computed at the end of each calendar month on the basis of the average mail load carried per mile over the route during such month, except that in no case shall payment exceed 40 cents per airplane-mile.*

(b) No contract or interest therein shall be sold, assigned, or transferred by the person to whom such contract is awarded, to any other person without the approval of the Postmaster General; and upon any such transfer without such approval, the original contract, as well as such transfer, shall at the option of the Postmaster General become null and void.

(c) *If, in the opinion of the Postmaster General, the public interest requires it, he may grant extensions of any route: Provided, That the aggregate mileage of all such extensions on any route in effect at one time shall not exceed two hundred and fifty miles, and that the rate of pay for such extensions shall not be in excess of the rate per mile fixed for the service thus extended.*

(d) *The Postmaster General may designate certain routes as primary or as secondary routes. He shall designate as primary routes at least three transcontinental routes with such termini as he may deem advisable, and, in addition thereto, such other routes as he may consider in the public interest, but no route less than seven hundred and fifty miles in length shall be designated as a primary route: Provided, That the present routes from Seattle to San Diego and from Newark (or New York, as the case may be) to Miami, Florida, may be held and regarded as other than primary routes: Provided further, That the Southern Transcontinental Route from Boston via New York (or Newark, as the case may be) and Washington to Los Angeles, shall be designated as a primary route.* The character ofe th designation of such routes shall be published in the advertisements for bids, which bids may be asked for in whole or in part of such routes.

(e) If on any route only one bid is received, or if the bids received appear to the Postmaster General to be excessive, he shall either reject them or submit the same to the Interstate Commerce Commission for its direction in the premises before awarding the contract.

(f) *The Postmaster General shall not award contracts for air-mail routes or extend such routes in excess of an aggregate of thirty-two thousand miles, and shall not pay for air-mail transportation on such routes and extensions in excess of an annual aggregate of forty-five million airplane-miles. Subject to the foregoing, the Postmaster General shall prescribe the number and frequency of schedules, intermediate regular stops, and time of departure of all planes carrying air mail, with due regard for the volume of mail carried over each route and for connecting schedules, and he may, under such regulations as he may prescribe, authorize and, notwithstanding any other provisions of this Act, compensate for a special schedule or an extra or emergency trip in addition to any regular schedule over air-mail routes or portions thereof at the same mileage rate paid for regular schedules on the contract route or routes, or at a lesser rate if agreed to by the contractor and the Postmaster General, and he may utilize therefor any scheduled passenger or express flight of the contractor between the terminal points or over a portion of any route whenever the needs of the service may so require: Provided, That the Postmaster General may, upon application by an air-mail contractor, authorize said contractor for his own convenience to transport air mail on any nonmail schedule or plane, with the understanding that the weights of mail so transported will be credited to regular mail schedules and no mileage compensation will be claimed therefor and the miles flown in such cases will not be computed in the annual aggregate of flown mileage, authorized under this section.*

(g) Authority is hereby conferred upon the Postmaster General to provide and pay for the carriage of mail by air in conformity with the terms of any contract let by him prior to the passage of this Act, or which may be let pursuant to a call for competitive bids therefor issued prior to the passage of this Act, and to extend any such contract for an additional period or periods not exceeding nine months in the aggregate at a rate of compensation not exceeding that established by this Act nor that provided for in the original contract: Provided, That no such contract may be so extended unless the contractor shall agree in writing to comply with all the provisions of this Act during the extended period of the contract.

SECTION 4. The Postmaster General shall cause advertisements of air-mail routes to be conspicuously posted at each such post office that is a terminus of the route named in such advertisement, for at least twenty days, and a notice thereof shall be published at least once a week for two consecutive weeks in some daily newspaper of general circulation published in the cities that are the termini for the route before the time of the opening of bids.

SECTION 5. After the bids are opened, the Postmaster General may grant to a successful bidder a period of not more than thirty days from the date of award of the contract to take the steps necessary to qualify for mail services under the terms of this Act: Provided, That, at the time of the award, the successful bidder executes an adequate bond with sufficient surety guaranteeing and assuring that, within such period, said bidder will fully qualify under the Act, faithfully to execute and to carry out the terms of the contract: Provided further, That, if there is a failure so to qualify, the amount designated in the bond will be forfeited and paid to the United States of America.

SECTION 6. (a) *The Interstate Commerce Commission is hereby empowered and directed, after notice and hearing, to fix and determine by order, as soon as practicable and from time to time, the fair and reasonable rates of compensation within the limitations of this Act for the transportation of air mail by airplane and the service connected therewith over each air-mail route, and over each section thereof covered by a separate contract, prescribing the method or methods by weight or space, or both, or otherwise, for ascertaining such rates of compensation, and to publish the same, which shall continue in force until changed by the said Commission after due notice and hearing, and so much of subsection (g) of section 3 of this Act as is in conflict with this section is hereby repealed.*

(b) *The Interstate Commerce Commission is hereby directed at least once in each calendar year from the date of the award of any contract to examine the books, accounts, contracts, and entire business records of the holder of each air-mail contract, and to review the rates of compensation being paid to such holder in order to be assured that no unreasonable profit is being derived or accruing therefrom, and in order to fix just rates. In determining what may constitute an unreasonable profit the said Commission shall take into consideration the income derived from the operation of airplanes over the routes affected, and in addition to the requirements of section 3 (f) of this Act, shall take into consideration all forms of expenditures of said companies in order to ascertain whether or not the expenditures have been upon a fair and reasonable basis on the part of said company and whether or not the said company has paid more than a fair and reasonable market value for the purchase or rent of planes, engines, or any other types or kind, or class, or goods, or services, including spare parts of all kinds, and whether or not the air-mail contracting company has purchased or rented any kind of goods, commodities, or services from any individuals who own stock in or are connected with the said contracting companies or has purchased such goods and services from any company or corporations in which any of the individuals employed by or owning stock in the air-mail contracting company have any interest or from which such purchase or rents any of the employees or stockholders of air-mail contracting companies would be directly or indirectly benefitted. Within thirty days after a decision has been reached upon such review by the Interstate Commerce Commission touching such profit a full report thereof shall be made to the Postmaster General, to the Secretary of the United States Senate, and to the Clerk of the House of Representatives.*

(c) *Any contract (1) let, extended, or assigned pursuant to the provisions of this Act, and in full force and effect on March 1, 1935, or (2) which may be let subsequent to such date pursuant to the provisions of this Act and shall have been satisfactorily performed by the contractor during its full initial period, shall, from and after such date, or from and after the termination of its initial period, as the case may be, be continued in effect for an indefinite period, and compensation therefor, on and after March 1, 1935, during such period of indefinite continuance, shall be paid at the rate fixed by order of the Commission under this Act, subject to such additional conditions and terms as the Commission may prescribe, upon recommendation of the Postmaster General, which shall be consistent with the requirements and limitations contained in section 1 of this Act; but any contract so continued in effect may be terminated by the Commission upon sixty days' notice, upon such hearing and notice thereof to interested parties as the Commission may determine to be reasonable; and may also be terminated, in whole or in part, by mutual agreement of the Postmaster General and the contractor, or for cause by the contractor upon sixty days' notice.* On the termination of any air-mail contract, in accordance with any of the provisions of this Act, the Postmaster General may let a new contract for air-mail service over the route affected, as authorized in this Act.

(d) All provisions of section 5 of the Act of July 28, 1916 (39 Stat. 412; U.S.C., title 39, secs 523 to 568, inclusive), relating to the administrative methods and procedure for the adjustment of rates for carriage of mail by railroads shall be applicable to the ascertainment of rates for the transportation of air mail by airplane under this Act so far as consistent with the provisions of this Act. For the purposes of this section the said Commission shall also have the same powers as the Postmaster General is authorized to exercise under section 10 of this Act with respect to the keeping, examination, and auditing of books, records, and accounts of air-mail contractors, and it is authorized to employ special agents or examiners to conduct such examination or audit, who shall have power to administer oaths, examine witnesses, and receive evidence.

(e) In fixing and determining the fair and reasonable rates of compensation for air-mail transportation, the Commission shall give consideration to the amount of air mail so carried, the facilities supplied by the carrier, and its revenue and profits from all sources, and from a consideration of these and other material elements, shall fix and establish rates for each route which, in connection with the rates fixed by it for all other routes, shall be designed to keep the aggregate cost of the transportation of air mail on and after July 1, 1938, within the limits of the anticipated postal revenue therefrom.

In arriving at such determination the Commission shall disregard losses resulting, in the opinion of the Commission, from the unprofitable maintenance of nonmail schedules, in cases where the Commission may find that the gross receipts from such schedules fail to meet the additional operating expense occasioned thereby. In fixing and determining such rates, if it shall be contended or alleged by the holder of an air-mail contract that the rate of compensation in force for the service involved is insufficient, *the burden of establishing such insufficiency and the extent thereof shall be assumed by him. In no case shall the rates fixed and determined by the said Commission hereunder exceed the limits prescribed in section 3 (a) of this Act.*

The Commission is hereby authorized and directed, after having made a full and complete examination and audit of the books, and after having examined and carefully scrutinized all expenditure and purported expenditures, of the holders of the contracts hereinafter referred to, for goods, lands, commodities, and services, in order to determine whether or not such expenditures were fair and just, and were not improper, excessive, or collusive, in the cases of the eight air-mail contracts which are allowed, by a previous report of the Commission, the rate of 33 1/3 cents per mile, under the provisions of the Act of June 12, 1934, on routes Numbered 7, 12, 13, 14, 19, 25, 27, and 32, and the Commission shall make a report to the Congress, not later than January 15, 1936, whether or not, in its judgment, a fair and reasonable rate of compensation on each of said eight contracts, under the other provisions and conditions of said Act, as herein amended, is in excess of 33 1/3 cents per mile; together with full facts and reasons in detail why it recommends for or against any claim for increase.

(f) Each holder of an air-mail contract shall file with the Interstate Commerce Commission, in such form as the Commission shall require, on July 1st and January 1st of each year, a full statement of all free transportation hereafter furnished during the preceding semiannual period to any persons, including in each case the regular tariff value thereof, the name and address of the donee, and a statement of the reason for furnishing such free transportation.

SECTION 7. (a) After December 31, 1934, it shall be unlawful for any person holding an air-mail contract to buy, acquire, hold, own, or control, directly or indirectly, any shares of stock or other interest in any other partnership, association, or corporation engaged directly or indirectly in any phase of the aviation industry whether so engaged through air transportation of passengers, express, or mail, through the holding of an air-mail contract, or through the manufacture or sale of airplanes, airplane parts, or other materials or accessories generally used in air transportation, and regardless of whether such buying, acquisition, holding, ownership, or control is done directly, or is accomplished indirectly, through an agent, subsidiary, associate, affiliate, or by any other device whatsoever: Provided, That the prohibitions herein contained shall not extend to interests in landing fields, hangars, or other ground facilities necessarily incidental to the performance of the transportation service of such air-mail contractor, nor to shares of stock in corporations whose principal business is the maintenance or operation of such landing fields, hangars, or other ground facilities.

(b) After December 31, 1934, it shall be unlawful (1) for any partnership, association, or corporation, the principal business of which, in purpose or in fact, is the holding of stock in other corporations, or (2) for any partnership, association, or corporation engaged directly or indirectly in any phase of the aviation industry, as specified in subsection (a) of this section, to buy, acquire, hold, own, or control, directly or indirectly, either as specified in such subsection (a) or otherwise, any shares of stock or other interests in any other partnership, association, or corporation which holds an air-mail contract.

(c) No person shall be qualified to enter upon the performance of an air-mail contract, or thereafter to hold an air-mail contract, if at or after the time specified for the commencement of mail transportation under such contract, such person is (or, if a partnership, association, or corporation, has and retains a member, officer, or director that is) a member, officer, director, or stockholder in any other partnership, association, or corporation, whose principal business, in purpose or in fact, is the holding of stock in other corporations, or which is engaged in any phase of the aviation industry, as specified in subsection (a) of this section.

(d) *No person shall be qualified to enter upon the performance of, or thereafter to hold an air-mail contract (1) if, at or after the time specified for the commencement of mail transportation under such contract, such person is (or, if a partnership, association, or corporation, has a member, officer, or director, or an employee performing general managerial duties, that is) an individual who has theretofore entered into any unlawful combination to prevent the making of any bids for carrying the mails: Provided, That whenever required by the Postmaster General or Interstate Commerce Commission the bidder shall submit an affidavit executed by the bidder, or by such of its officers, directors, or general managerial employees as the Postmaster General or Interstate Commerce Commission may designate, sworn to before an officer authorized and empowered to administer oaths, stating in such affidavit that the affiant has not entered nor proposed to enter into any combination to prevent the making of any bid for carrying the mails, nor made any agreement, or given or performed, or promised to give or perform, any consideration whatever to induce any other person to bid or not to bid for any mail contract, or (2) if it pays any officer, director, or regular employee compensation in any form, whether as salary, bonus, commission, or otherwise, at a rate exceeding $17,500 per year for full time: Provided further, That it shall be unlawful for any officer or regular employee to draw a salary of more than $17,500 per year from any air-mail contractor, or a salary from any other company if such salary from any company makes his total compensation more than $17,500 per year.*

SECTION 8. Any company alleging to hold a claim against the Government on account of any air-mail contract that may have heretofore been annulled may prosecute such claim as it may have against the United States for the cancellation of such contract in the Court of Claims of the United States, provided that such suit be brought within one year from the date of the passage of this Act; and any person not ineligible under the terms of this Act who qualifies under the other requirements of this Act, shall be eligible to contract for carrying air mail, notwithstanding the provisions of section 3950 of the Revised Statutes (Act of June 8, 1872).

SECTION 9. Each person desiring to bid on an air-mail contract shall be required to furnish in its bid a list of all the stockholders holding more than 5 per centum of its entire capital stock, and of its directors, and a statement covering the financial set-up, including a list of assets and liabilities; and in the case of a corporation, the original amount paid to such corporation for its stock, and whether paid in cash, and if not paid in cash, a statement for what such stock was issued. Such information and the financial responsibility of such bidder, as well as the bond offered, may be taken into consideration by the Postmaster General in determining the qualifications of the bidder.

SECTION 10. *All persons holding air-mail contracts shall be required to keep their books, records, and accounts under such regulations as may be promulgated by the Postmaster General, and he is hereby authorized, if and when he deems it advisable to do so, to examine and audit the books, records, and accounts of such contractors, and to require such contractors to submit full financial reports in such form and under such regulations as he may prescribe.*

Whenever an audit of the books, records, or accounts of any air-mail contractor is made by the auditors of the Interstate Commerce Commission, a full and complete report thereof shall be made to the Post Office Department within thirty days, and that report shall contain all instances in which the contractor has failed to comply with any of the provisions of the uniform system of accounts prescribed by the Post Office Department; and the Postmaster General shall, upon request, have at all times access to the records and reports of the Commission concerning air mail and air-mail contracts. There is authorized to be used from the appropriations for Contract Air Mail Service for the fiscal year ending June 30, 1936, a sum not in excess of $25,000 for the purpose of auditing the books and records of air-mail contractors by the Post Office Department.

SECTION 11. Before the establishment and maintenance of an air-mail route the Postmaster General shall notify the Secretary of Commerce, who thereupon shall certify to the Postmaster General the character of equipment to be employed and maintained on each air-mail route. In making this determination the Secretary of Commerce, in his specifications furnished to the Postmaster General, shall determine only the speed, load capacity, and safety features and safety devices on airplanes to be used on the route, which said specifications shall be included in the advertisement for bids.

SECTION 12. The Secretary of Commerce is authorized and directed to prescribe the maximum flying hours of pilots on air-mail lines, and safe operation methods on such lines, and is further authorized to approve agreements between air-mail operating companies and their pilots and mechanics for retirement benefits to such pilots and mechanics. The Secretary of Commerce is authorized to prescribe all necessary regulations to carry out the provisions of this section and section 11 of this Act.

SECTION 13. *It shall be a condition upon the holding of any air-mail contract that the rate of compensation and the working conditions and relations for all pilots and other employees of the holder of such contract shall conform to decisions heretofore or hereafter made by the National Labor Board, or its successor in authority, notwithstanding any limitation as to the period of its effectiveness included in any such decision heretofore rendered. This section shall not be construed as restricting the right of any such employees by collective bargaining to obtain higher rates of compensation or more favorable working conditions and relations.*

SECTION 14. The Federal Radio Commission shall give equal facilities in the allocation of radio frequencies in the aeronautical band to those airplanes carrying mail and/or passengers during the time the contract is in effect.

SECTION 15. *After June 30, 1935, no person holding a contract or contracts for carrying air mail on a primary route shall be awarded or hold any contract for carrying air mail on any other primary route, nor on more than three additional routes other than primary routes. In case one person holds several contracts covering different sections of one air-mail route as designated by the Postmaster General, such several contracts shall be counted as one contract for the purpose of the preceding sentence. It shall be unlawful for air-mail contractors, competing in parallel routes, to merge or to enter into any agreement, express or implied, which may result in common control or ownership. After June 30, 1935, no air-mail contractor shall be allowed to maintain passenger or express service off the line of his air-mail route which in any way competes with passenger or express service available upon another air-mail route, except that off-line competitive service which has been regularly maintained on and prior to July 1, 1935, and such seasonal schedules as may have been regularly maintained during the year prior to July 1, 1935, may be continued if restricted to the number of schedules and to the stops scheduled and in effect during such period or season.*

Upon application of the Postmaster General or of any interested air-mail contractor, setting forth that the general transport business or earnings upon an air mail route are being adversely affected by any alleged unfair practice of another air-mail contractor, or by any competitive air-transport service supplied by an air-mail contractor other than that supplied by him on the line of his prescribed air-mail route, or by any service inaugurated by him after July 1, 1935, through the scheduling of competitive nonmail flights over an air-mail route, the Interstate Commerce Commission shall, after giving reasonable notice to the air-mail contractor complained of, inquire fully into the subject matter of the allegations and if the Commission shall find such practice or competition or any part thereof to be unfair, or that such competitive service in whole or in part is not reasonably required in the interest of public convenience and necessity, and if the Commission shall further find that in either case the receipts or expenses of an air-mail contractor are so affected thereby as to tend to increase the cost of air-mail transportation, then it shall order such practice or competitive service, or both, as the case may be, discontinued or restricted in accordance with such findings, and the respondent air-mail contractor named in the order shall comply therewith within a reasonable time to be fixed in such order. If the Commission shall find after like application, notice and hearing that the public convenience and necessity requires additional service or schedules and such service or schedules do not tend to increase the cost of air-mail transportation, it may permit the institution and maintenance of such schedules and prescribe the frequency thereof. The compensation of any air-mail contractor shall be withheld during any period that it continues to violate any order of the Commission or any provision of this Act.

SECTION 16. The Postmaster General may provide service to Canada within one hundred and fifty miles of the international boundary line, over domestic routes which are now or may hereafter be established and may authorize the carrying of either foreign or domestic mail, or both, to and from any points on such routes and make payment, for services over such routes out of the appropriation for the domestic Air Mail Service: Provided, That this section shall not be construed as repealing the authority given by the Act of March 2, 1929. (U.S.C., Supp. VII, title 39, sec. 465a).

SECTION 17. The Postmaster General may cause any contract to be canceled for willful disregard of or willful failure by the contractor to comply with the terms of its contract or the provisions of law herein contained and for any conspiracy or acts designed to defraud the United States with respect to such contracts. This provision is cumulative to other remedies now provided by law.

SECTION 18. Whoever shall enter into any combination, understanding, agreement, or arrangement to prevent the making of any bid for any contract under this Act, to induce any other person not to bid for any such contract, or to deprive the United States Government in any way of the benefit of full and free competition in the awarding of any such contract, shall, upon conviction thereof be fined not more than $10,000 or imprisoned for not more than five years, or both.

SECTION 19. If any person shall willfully or knowingly violate any provision of this Act his contract, if one shall have been awarded to him, shall be forfeited, and such person shall upon conviction be punished by a fine of not more than $10,000 or be imprisoned for not more than five years.

SECTION 20. The President is hereby authorized to appoint a Commission composed of five members to be appointed by him, not more than three members to be appointed from any one political party, for the purpose of making an immediate study and survey, and to report to Congress not later than February 1, 1935, its recommendations of a broad policy covering all phases of aviation and the relation of the United States thereto. Members appointed who are not already in the service of the United States shall receive compensation of not exceeding the rate of compensation of a Senator or Representative in Congress.

SECTION 21. Such Commission shall organize by electing one of its members as chairman, and it shall appoint a secretary whose salary shall not exceed the rate of $5,000 per annum. Said Commission shall have the power to pay actual expenses of members of the Commission in the performance of their duties, to employ counsel, experts, and clerks, to subpena witnesses, to require the production by witnesses of papers and documents pertaining to such matters as are within the jurisdiction of the Commission, to administer oaths, and to take testimony, and for such purpose there is hereby authorized to be appropriated the sum of $75,000.

Approved August 14, 1935.

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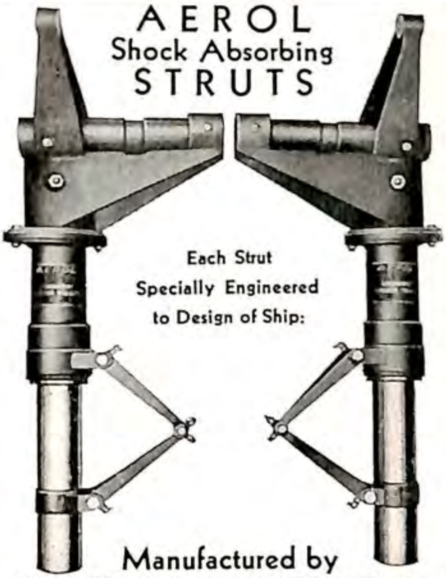

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