The AIRCRAFT YEAR BOOK

For 1938

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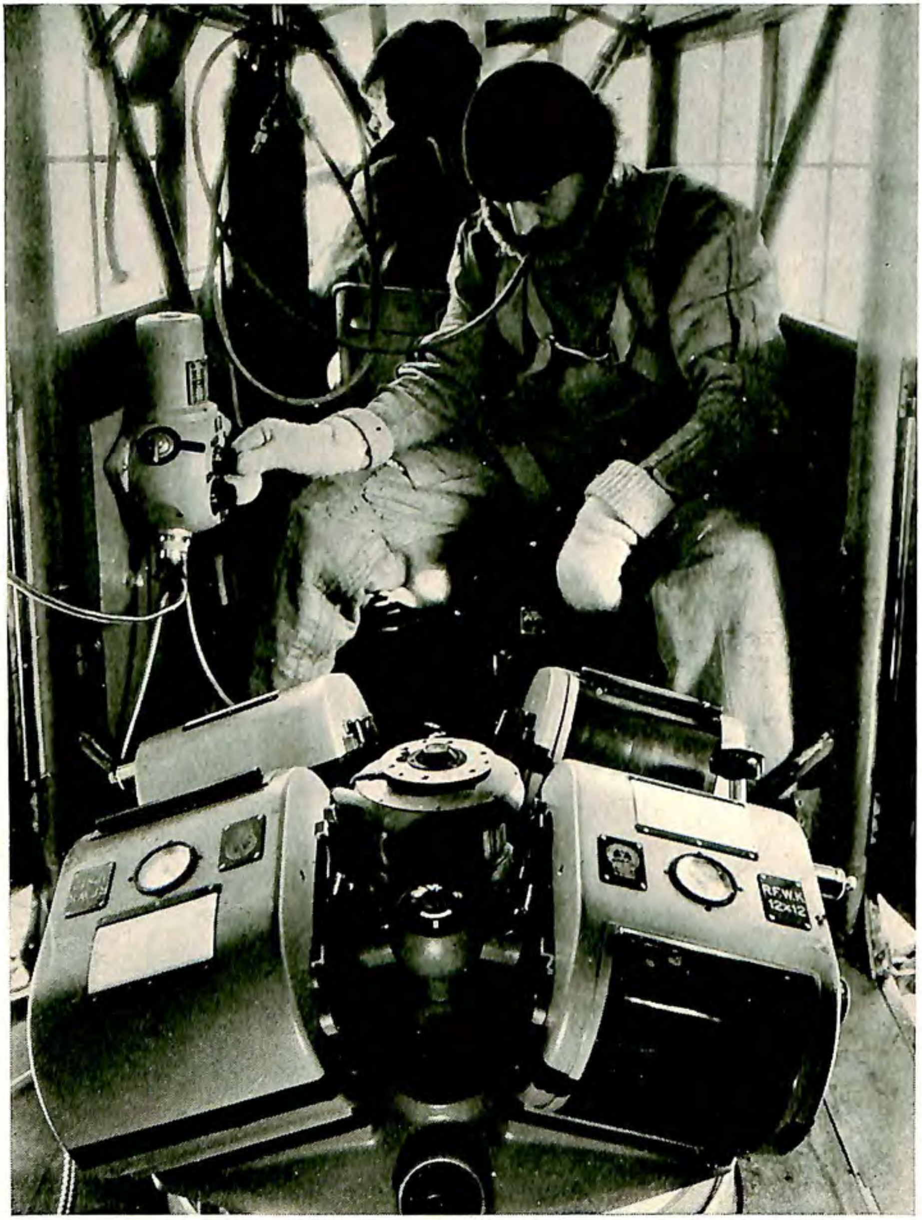
AIRCRAFT YEAR BOOK FOR 1938



AERIAL PHOTO SURVEY

This aerial camera, worth about $20,000, was used by Fairchild Aerial Surveys in mapping vast areas of the West for the U. S. Department of Agriculture.

The AIRCRAFT YEAR BOOK

(Registered U. S. Patent Office)

For 1938

TWENTIETH ANNUAL EDITION

HOWARD MINGOS
Editor

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Official U. S. Army Photo

BOEING BOMBERS OVER NEW YORK

Part of the Army Air Corps formation of Boeing "flying fortresses" during the 1937 American Legion parade. Each bomber is powered by four Wright Cyclone engines.

CHAPTER I

THE WORLD IN THE AIR

Foreign Nations Prepare for War—Germany Boasts of Supremacy—Great Britain's Plans—The French Mistake—Italy's Progress—Russia Improves Aircraft—The Japanese Expansion—Need for More Aerodynamic Research in the United States.

AT the beginning of 1938 all the principal powers of the world were striving to lead in the race for supremacy in the air, and in whatever light one might view it the goal was plainly apparent. It lay in attaining dominant air force strength, complete mastery of the air in preparation for a war that seemed to become more imminent with each passing month. When Germany's official spokesmen came out frankly and boasted of a military air force second to none, at the same time betraying an impatient desire to go to war and prove it, the trend in world aviation no longer could be concealed, even by rigid censorship and all the secrecy of which officialdom is capable.

Some of the other European powers had tried to disguise their military aviation programs under the cloak of civil aircraft development or, at the most, moderate defensive measures. This was especially true of nations such as Great Britain, France, Czechoslovakia, Poland and others. They had disclaimed any plan toward intensive rearmament, when as a matter of fact, they were doing their utmost to rearm on an unprecedented scale. There was real justification for it, of course, because Germany, Russia and Italy were known to be building up huge air forces, which might conceivably force an early decision in any conflict, and might in fact encourage the precipitation of war if other possible belligerents remained unprepared in the air.

Germany's assertion that the aerial squadrons of the Reich were capable of backing up any demands that Germany might make, therefore, struck the rest of the world with all the impact of a mailed fist,

Official Photo U. S. Navy

CONSOLIDATED PATROL BOMBER

One of the Navy's fleet of Pratt & Whitney Twin Wasp-powered long range ships manufactured by the Consolidated Aircraft Corporation.

a mailed fist with wings, wings capable of hurling tons of explosives on the most distant confines of European countries at a speed of not less than three miles a minute. Just when war would occur or precisely what form the alignment of nations would take was largely a matter for conjecture; but that all European governments were striving frantically to build up air forces to meet such an emergency no longer could be denied.

Great Britain's policy was to postpone hostilities, if possible, until her air strength surpassed Germany's. The British plan was to

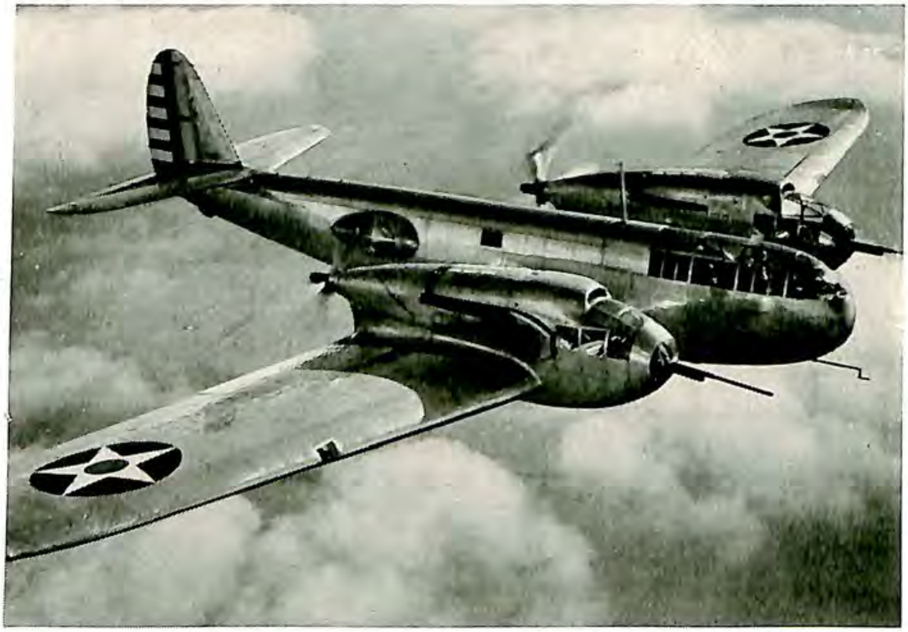
GLENN L. MARTIN FLYING BOAT

The 65,000-pound ocean transport, 156, produced by the Glenn L. Martin Company for the Russian Government. It is powered by four Wright Cyclone engines.

acquire at least twice the number of war planes possessed by Germany before permitting a conflict, if it could be delayed. The British program probably was the most elaborate in Europe early in 1938. The British airplane factories were operating day and night to produce machines of the most modern and effective types.

France was in pitiful condition. Political unrest and a wayward program of testing socialistic theories by nationalizing the French aircraft factories had combined to place her air strength in serious jeopardy. The technicians were losing their initiative under the nationalization scheme. Products of the French plants were neither as numerous nor as efficient as the machines coming off the assembly lines in neighboring countries. Nor was the training of war pilots and auxiliary personnel so extensive. More than half of the machines in the French air forces were not fit for active service against a first class power.

Italy's program of air force development flowered into full bloom



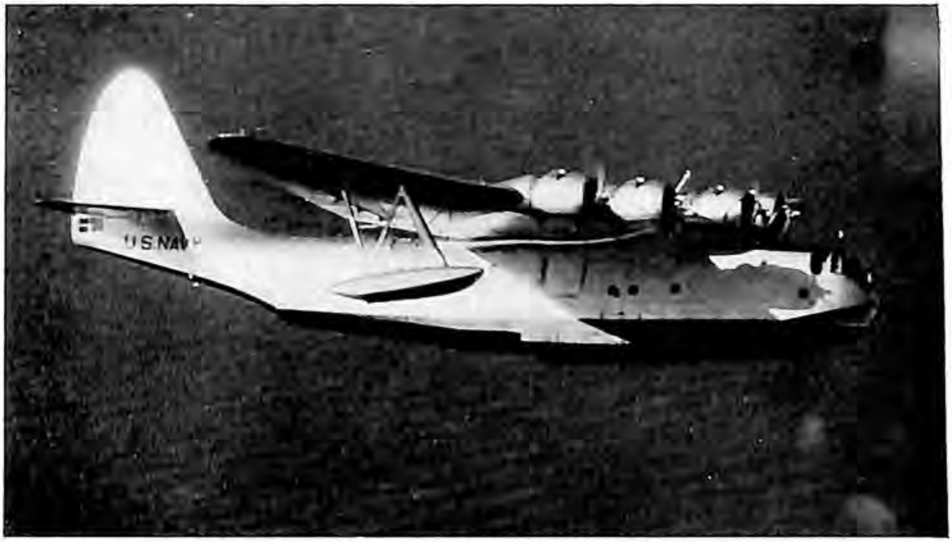
Official U. S. Army Photo

AIR CORPS BELL FIGHTER

The XFM-1, multi-engine pusher fighter, carries airplane cannon. It is powered by Allison engines, and is the product of the Bell Aircraft Corporation, Buffalo, N. Y.

at the close of the Ethiopian campaign, after which Spain became a proving ground for Italian airmen. Under the stimulus of actual war conditions Italian personnel and equipment received exhaustive tests. New knowledge acquired in bomber raids or in fighting off enemy pursuit planes went back to Italy in official reports, and was immediately applied to new development work. Under such conditions Italy's aviation program gained headway, based solidly on laboratory investigation at home, practical research in the field and a policy of making Italy the equal of any possible rival.

Russia, too, made considerable progress technically. Russian planes produced in 1937 were vastly improved over former models. They were much cleaner in design, and this was reflected in better performance. Russia's flying personnel, like Italy's, had extensive practical experience in Spain, where Russian planes flying for the Loyalist cause were matched with both Italian and German machines operating under the banner of the Insurgents. Both the German and Russian equipment proved capable, and Italy was forced to send in her latest machines to prevent being maneuvered out of the air.



Official Photo U. S. Navy

NAVY'S SIKORSKY PATROL BOMBER

The XPBS flying boat is powered by four Pratt & Whitney Twin Wasp engines of 1,050 h.p. each, with Hamilton Standard constant speed propellers.

The Russian aircraft plants improved their production in 1937, so that by the end of the year the new military models were leaving the assembly lines at an increasingly rapid rate. Another notable fact was the revelation that the Russians no longer had to depend on men as aircraft artisans. Russian women had demonstrated that they could perform much more effectively than men in nearly every branch of aircraft manufacture. They learned their trade more quickly. They were more adept with precision work; and they were more adaptable to the rigorous discipline and care required in airplane construction. The result was that Russian factories were able to increase their output, and at the same time train numerous women aircraft mechanics. Insofar as her air power was concerned, Russia was bound to prove a formidable foe. Russia had an air force peculiarly adapted to Russian needs, whether from campaigns with neighbors in the West or the East. The Russian air force was trained and equipped for any possible conflict with either Germany or Japan.

Knowing that, the Japanese in 1937 speeded up their program,

CONSOLIDATED PATROL BOMBER XPB2Y-1

The Navy's new Consolidated Patrol Bomber in flight, showing wing tip floats down for a landing.

with emphasis on augmenting their army air corps, for three different eventualities. The immediate concern was home defense, and the fear that in any large-scale campaign the chief industrial and political centers of Japan might be subjected to air raids that would prove destructive. Japan had under way early in 1938 the improvement of her aerial defense system regardless of cost. The second reason for building up the army air corps was the campaign in China. Japan was brought to full realization that the campaign might be long enough to deplete her air forces, exhaust both men and equipment to the point where she would be at the mercy of any power such as Russia. Japanese strategists did not want to invite a war with Russia by being unprepared. The third reason, of course, was that war might come at any time, and Japan with her far-flung lines of conquest had to enlarge her air force to maintain communications and at the same time support those lines with all the facilities required by modern warfare.

Meanwhile, although building planes and training airmen on an unprecedented scale, the European powers and Japan did not neglect their research and development programs. On the principle that air

NORTH AMERICAN'S ARMY BOMBER

One of the twin-motored NA-21 bombers built by North American Aviation for the U. S. Army Air Corps. It is powered by two Pratt & Whitney Twin Row Wasp engines with Curtiss electric constant speed propellers.

strength is not only superior numbers but is primarily superiority of equipment those powers undertook to keep at least abreast of one another. Their aerodynamic laboratories were undergoing extensive expansion at the beginning of 1938. The scientific staffs of these laboratories were being built up with the best talent available. Technicians were being placed on a par with air force pilots in the national scheme for preparedness, and air force pilots were the aristocrats of the armed services in countries where the military was supreme. This recognition of the importance of constant aerodynamic research was of unusual importance to the United States.

In the United States aerodynamic research for years had been a model for the rest of the world to envy. It finally resulted in emulation. The scientists of other powers came to the United States and saw what Americans were doing, not only in their factory research and engineering laboratories but in the great Government laboratories maintained by the National Advisory Committee for Aeronautics. Then those foreign observers went home, to England, France, Germany, Italy, Russia and Japan; and over a period of years they set up their own aerodynamic research plants on a scale never before attempted abroad, but which had for an incentive the work of the National Advisory Committee for Aeronautics in the United States and its cooperation with the American aircraft manufacturers. The proof of its value lay in the superiority of American planes, the performance of which is still unexcelled despite the breakneck speed with which other nations have been trying to improve their own equipment.

At the beginning of 1938 it was apparent that the United States must increase its research and development work, both in the laboratories of the National Advisory Committee for Aeronautics and in the plants of its manufacturers. Otherwise, foreign powers, using all the means at their disposal, and these means seem unlimited, will develop aviation far beyond that stage which will be possible here.

HULL OF THE BOEING 314

First of Pan American Airways new fleet of six ocean transports to leave the factory of the Boeing Aircraft Company in Seattle, Wash. The hull is 109 feet long from bow to tail and 19 feet high, and it had to be launched before the wings were attached. Their span is 152 feet from tip to tip. The four Wright Cyclone engines in this liner aggregate 6,000 horsepower.

CHAPTER II

AVIATION IN THE UNITED STATES

Growth of Air Transport—Giant Land Planes and Flying Boats—Plans for 100-Passenger Planes—Progress in Air Defense—Importance of the National Advisory Committee for Aeronautics—Aircraft Manufacturers Contribute to Development—Record Year for Sales and Exports—Pilots—Airports—Work of Aeronautical Organizations—Capacity of the Aircraft Plants to Double Production.

WHILE other world powers are concentrating on aerial armaments, the United States continues to make progress in all branches of peacetime aviation; without neglecting its national defense, however.

In scheduled transportation the air lines of the United States flew 76,996,163 airplane miles in 1937, as compared to 73,303,836 airplane miles in 1936. Passengers increased from 1,147,969 to 1,267,580, and passenger miles from 491,774,053 to 549,628,407, during the same period. Air express increased from 8,350,010 pounds to 8,914,067 pounds. Air mail increased from 11,482,872,622 pound miles in 1936 to 13,396,460,117 pound miles in 1937. The Railway Express Agency reported 1937 business as a 35 per cent increase in shipments, 12½ per cent increase in weight and a 27 per cent increase in gross revenues over 1936.

While the number of transports in service on air lines of the United States increased from 380 to 390 during the year, that alone did not represent the major changes in facilities. More significant was the new equipment which entered service in 1937, including the larger and faster transports such as the Douglas DC-3 and the Lockheed 14. Even more striking changes were promised in the immediate future.

All land transports in scheduled operations inside the United States at the beginning of 1938 were two-engine machines. But nearing completion in the Douglas and the Boeing airplane plants were four-engine land transports vastly larger and capable of carrying much greater loads in passengers and cargoes. The new four-engine transports to be completed in 1938 were to be capable of operating in regular service across the United States, carrying full loads with only one stop between the Atlantic and Pacific coasts. Moreover, these land planes were designed for sub-stratosphere operations, carrying passengers over routes at altitudes heretofore prohibitive because of the impossibility of supplying passengers with air of

A MODERN SKY LOUNGE

This club plane is a Douglas DC-3 in United Air Lines Mainliner service. It has 14 swivel chairs in a cabin large enough for 21 standard seats.

sufficient oxygen content at great heights. The new four-engine transports have been built to permit "supercharging" the passenger cabins with air like that prevailing at not more than 10,000 feet above the surface. The development of such equipment will mark another epochal achievement in aviation.

Meanwhile, over-water transportation received further impetus in 1937. The North Atlantic was pioneered, preparatory to regular service being established between the United States and Europe. Pan American Airways planned to start this regular service as quickly as possible, using a fleet of 86,000-pound flying boats, six of which were under construction at the plant of the Boeing company at the beginning of 1938. Other interests also were investigating the possibility of operating Atlantic flying boat services; and several manufacturing companies were preparing to have available designs for large flying boats which could be built when ordered.

TWA SKYSLEEPER

Interior showing part of the eight berths and nine lounge chairs in TWA's Wright Cyclone-powered Douglas DC-3 transports.

Not content with flying boats carrying 40 passengers and three tons of cargo over the Atlantic in regular service, Pan American Airways late in 1937 invited the American aircraft manufacturing industry to submit plans for transports carrying 100 passengers, a crew of 16 to each ship and cargo to make a total payload capacity of 25,000 pounds, capable of flying 5,000 miles non-stop at cruising speeds of not less than 200 miles an hour. Eight American aircraft manufacturing companies received the invitation to submit plans, including Boeing, Consolidated, Curtiss-Wright, Douglas, Lockheed, Glenn L. Martin, North American Aviation and Sikorsky. The fact that a responsible operating company has invited eight leading builders of big planes to make plans for 100-passenger transports is a positive indication of the developments to be expected within the next few years.

In national defense the Army and the Navy air forces of the United States reported many developments of recent months, notably

Official U. S. Army Photo

EQUIPPED FOR BREATHING OXYGEN

This is what the well-dressed Army Air Corps pilots wear on high altitude flights. These are pilots of the 55th Pursuit Squadron before leaving Barksdale Field, Shreveport, La., in their Wasp-powered Boeings. Surface temperature was 71 degrees. At 21,000 feet they found it below zero.

in improved equipment and other facilities for maintaining the air force personnel in training for any emergency.

The Army Air Corps acquired improved types of pursuit planes, such as the Curtiss P-37, reported to be the fastest fighting machine in the world. The Bell multi-seater pusher fighter, including one-pound cannon as part of its armament, represented a new type of military aircraft with extraordinary promise. The Boeing four-engine "flying fortress" bombers repeatedly demonstrated their efficiency as swift, high-flying, long range bombardment planes. While the Boeing B-17 "flying fortresses" were creating deep interest by long formation flights during which they often covered thousands of miles non-stop, the Air Corps received an advanced model of the same type, the Boeing B-15, larger and even more effective in range and other performance characteristics.

The air forces of the Navy, too, acquired new types, including advanced models of fast fighting planes for operations on aircraft carriers and four-engine patrol-bomber flying boats, such as the Consolidated and Sikorsky ships delivered and the Glenn L. Martin flying boats for which orders were placed late in 1937.

Official sentiment concerning the new American policy of providing adequate aerial defense in view of the intense air force pro-

MODEL OF THE DOUGLAS DC-4

This small model of the new four-engine air liner shows the tricycle landing gear. The prototype will be powered by Pratt & Whitney Twin Hornets.

grams in process abroad was expressed by Secretary of War Harry H. Woodring in his annual report for 1937. He said in part:

"Foreign countries are making heavy increases in the strength of their air arms, and most of the first class powers have many more airplanes on hand or under construction than we have. However, in quality our new planes are at least the equal and probably the superior, type for type, of any military airplanes in the world. Our program of airplane procurement does not contemplate attaining the numbers possessed by other countries.

"It should be borne in mind that modern aircraft cannot be quickly improvised. The construction of airplanes necessarily takes considerable time. Hence, our peacetime strength should approximate rather closely our requirements in war. Furthermore, in a major war our air arm would probably be engaged almost immediately on the opening of hostilities. Therefore, it is desirable that it be practically on a war footing in time of peace.

"While we are procuring up-to-the-minute aircraft in sufficient quantities to bring our air strength gradually up to our requirements, we are at the same time encouraging the experimental development of new types so that we may continually improve the quality of our

Official U. S. Army Photo

AIR CORPS CURTISS Y1A-18 ATTACK

A twin-engine fighter equipped with two Wright Cyclone engines and Curtiss constant speed feathering propellers. The propeller in the foreground is shown in feathered position.

equipment. In this way we guard against over-standardization of airplanes, and we are able to take advantage of technical improvements as rapidly as they are developed."

To meet the increasing demands for further technical knowledge the National Advisory Committee for Aeronautics has expanded its research facilities to the limits permitted by Congressional appro-

Official U. S. Army Photo

NORTHROP A-17 ATTACK FORMATION

U. S. Army Air Corps squadrons with Pratt & Whitney Twin Wasp Junior-powered Northrop attack planes over the Rockies.

priations for that purpose. The Committee explained this in the concluding statement of its annual report for 1937, as follows:

"The greatly extended use of aircraft for both military and civil purposes has been reflected in an increased activity on the part of progressive nations in extending their aeronautical research facilities. The demands made upon the Committee by the War, Navy and Commerce Departments for new information are increasing in number and in difficulty with the increase in the speed and size of aircraft. The Committee fully realizes its enlarged responsibility to make provision not only to take care of research needs arising from current problems, but also to look well into the future and to anticipate the needs that will arise as a result of the trend toward the construction of much larger land planes and seaplanes."

That the laboratory research facilities of the National Advisory Committee for Aeronautics need still further expansion as quickly as possible is a fact borne out by knowledge of the rapid progress being made abroad. The key to improved aircraft, for both defense

FOR REGULAR ATLANTIC SERVICE

This is a cutaway drawing of the Boeing 314 transocean flying boat. Six of these giant ships are being built by the Boeing Aircraft Company for Pan American Airways service between the United States and Europe. Each will be powered by four 1,500 h.p. Wright Cyclone engines. It will carry 40 passengers, in berths, and several tons of express across the Atlantic within 30 hours.

and commercial uses, is scientific and technical research. If the United States permits other nations to forge ahead in research, then other nations soon will have superior aircraft.

In an effort to maintain their position as producers of the world's best flying machines, the aircraft manufacturers of the United States annually spend millions of dollars on experimental and engineering development work. The need for more extensive efforts in that direction became more acute when, early in 1938, it was learned that all other world air powers had expanded the experimental programs in their own aircraft industries, making available huge government appropriations calculated to supply these industries with plenty of money for development work.

The year 1937 brought record peacetime sales to the American aircraft industry. It was the first year in which deliveries passed a hundred million dollars.

Sales of airplanes, aircraft engines and spare parts totalled $115,-076,950 in 1937, an increase of 50 per cent over the 1936 sales of

Official Photo U. S. Navy

GRUMMAN F2F-1 FIGHTERS

This is a Navy formation. The planes are powered by Pratt & Whitney Twin Wasp Junior engines.

$76,804,818. Commercial airplane deliveries amounted to 2,238 valued at $19,230,650, less engines, as compared to 1,528 valued at $12,535,526 in 1936. The increase in the number of planes was most pronounced in the light, two-place machines, a total of 1,542 being delivered in 1937 as against 898 in 1936. The number of planes in the transport class also increased 100 per cent, 188 multi-engine planes being delivered in 1937 as compared to 94 in 1936.

WALLACE BEERY CHECKS HIS RADIO

The noted motion picture star is "checking out" his transmitter in his Whirlwind-powered Stinson Reliant.

Military airplane deliveries in 1937 totalled 949 valued at $37,-095,528, less engines, as compared to 1,024 military planes valued at $26,898,916 in 1936. The increase in dollar volume with decrease in units delivered is explained by the fact that larger and more costly multi-engine machines were delivered in 1937.

Commercial aircraft engines delivered in 1937 totalled 4,020 valued at $15,243,571, as compared to 2,527 valued at $7,946,015 in 1936. Military aircraft engines delivered in 1937 totalled 1,994 valued at $14,894,113, as compared to 1,794 engines valued at $14,619,453 in 1936.

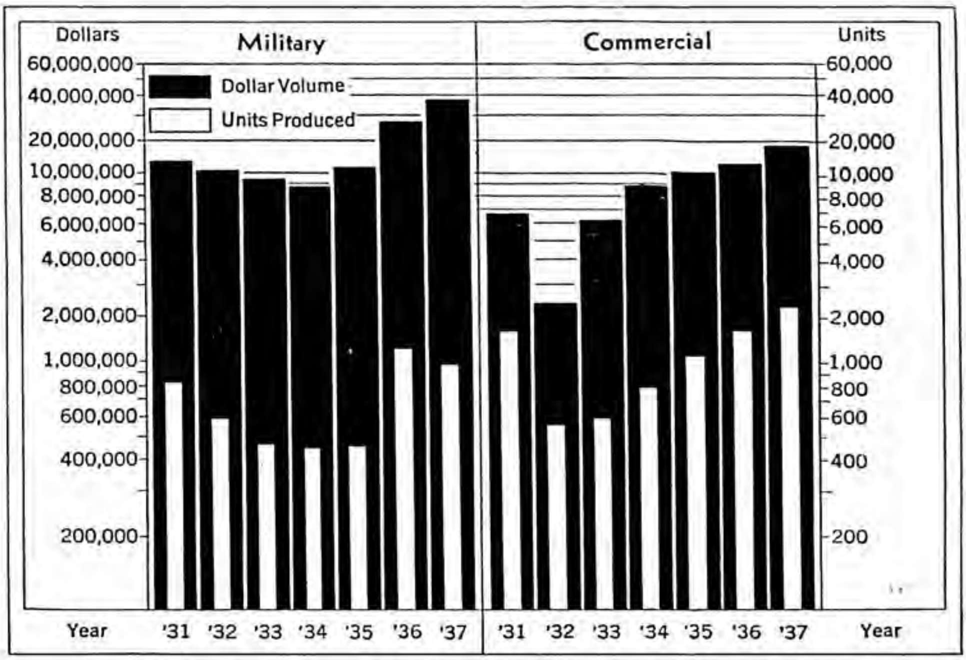
Airplane spare part sales aggregated $19,617,151 in 1937, as compared to $8,228,189 in 1936. Engine spare parts totalled $8,995,937, as compared to $6,576,719 the previous year.

Deliveries kept pace with production, as shown by the following summary:

Production and Deliveries

Calendar Year 1937

	Production		*Deliveries*	
	Units	*Value*	*Units*	*Value*
Commercial airplanes	2,281	$19,188,945	2,238	$19,230,650
Military airplanes	949	37,071,160	949	37,095,528
Commercial engines	4,095	15,290,820	4,020	15,243,571
Military engines	1,989	14,828,850	1,994	14,804,113
Airplane spares	....	19,617,151	....	19,617,151
Engine spares	....	8,995,937	....	8,995,937
Total		$114,992,863		$115,070,050



AIRPLANE PRODUCTION IN THE UNITED STATES

Ample proof of the superiority of American aircraft products was found in the growth of foreign sales. Exports totalled $39,405,473 in 1937, as compared to $23,143,203 in 1936, which also was a record. The number of airplanes shipped abroad in 1937 was 629, valued at $21,036,361, as compared to 515 planes, valued at $11,386,893, in 1936. While deliveries to China fell off drastically, owing to the Japanese invasion, many countries purchased more planes than the year before, including Canada, Mexico, Brazil, Argentina, Great Britain, Russia, Turkey, Netherlands and Sweden.

In sales of American aircraft engines abroad all the foreign markets were maintained save in four countries. Italy took fewer American engines because her own factories had increased their output; likewise Great Britain. Yugoslavia bought fewer American engines because she could secure more advantageous terms from Italy under a new treaty. Chinese deliveries fell off because of hostilities. But Brazil, Japan, Mexico, Canada, Turkey and Siam bought more engines; and many other countries took normal deliveries. The number of American aircraft engines shipped abroad in 1937 totalled 1,047, valued at $5,944,004, as compared to 945 engines, valued at $5,397,469, in 1936.

Aircraft parts and accessories sold abroad aggregated $12,157,337 in 1937, as compared to $6,060,483 in 1936.

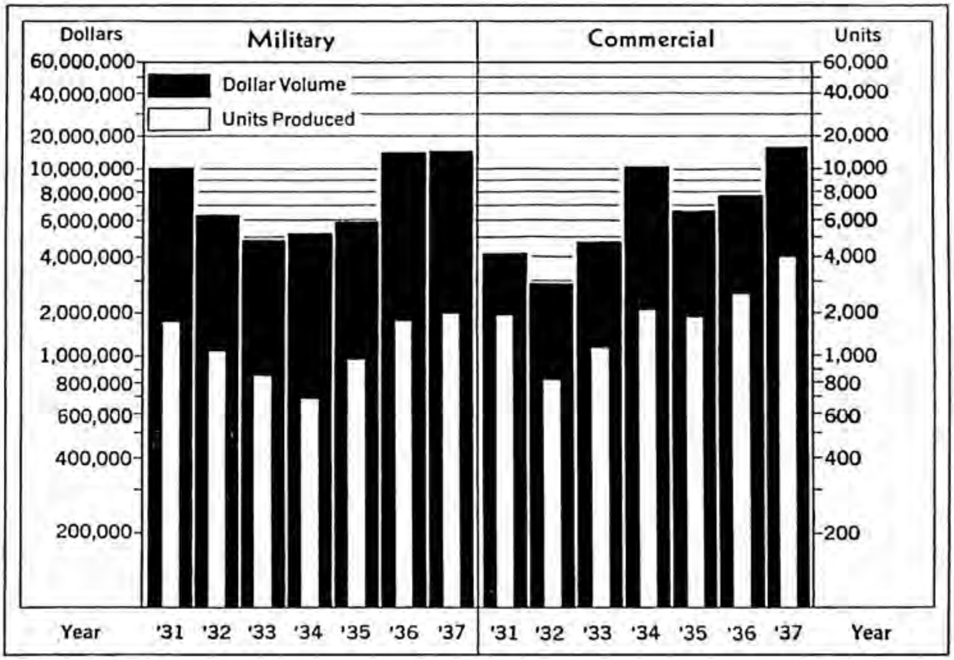
A LOCKHEED 14 ABROAD

One of the Wright Cyclone-powered Lockheed 14 transports for the Royal Dutch Airlines.

At the beginning of 1938 there were 17,681 licensed aircraft pilots in the United States. That number was satisfactory from the viewpoint of numbers alone; but it did not indicate to any satisfactory degree the actual training that the pilots were receiving, training of the kind necessary to keep them pilots. A large percentage of the total, it was known, lacked facilities for using flying machines regularly, as evidenced by the fact that 8,604, nearly half the total, held only private pilot licenses, and 631 others held solo licenses. Another 971 possessed limited commercial licenses. The number of pilots with sufficient training to let them fly the high-powered machines under modern conditions was 7,475, that number holding transport licenses, 1,064 of them with scheduled air transport ratings. Of the grand total, 494 licensees were women, 72 of them with transport licenses.

The number of civil aircraft in the United States was nowhere near the number of pilots. Licensed airplanes totalled 9,152, which with 1,684 unlicensed but identified machines, brought the number to 10,836.

The number of airports and landing fields had increased during 1937, largely through the WPA projects. At the beginning of 1938 there were in the United States a total of 2,299 landing places,



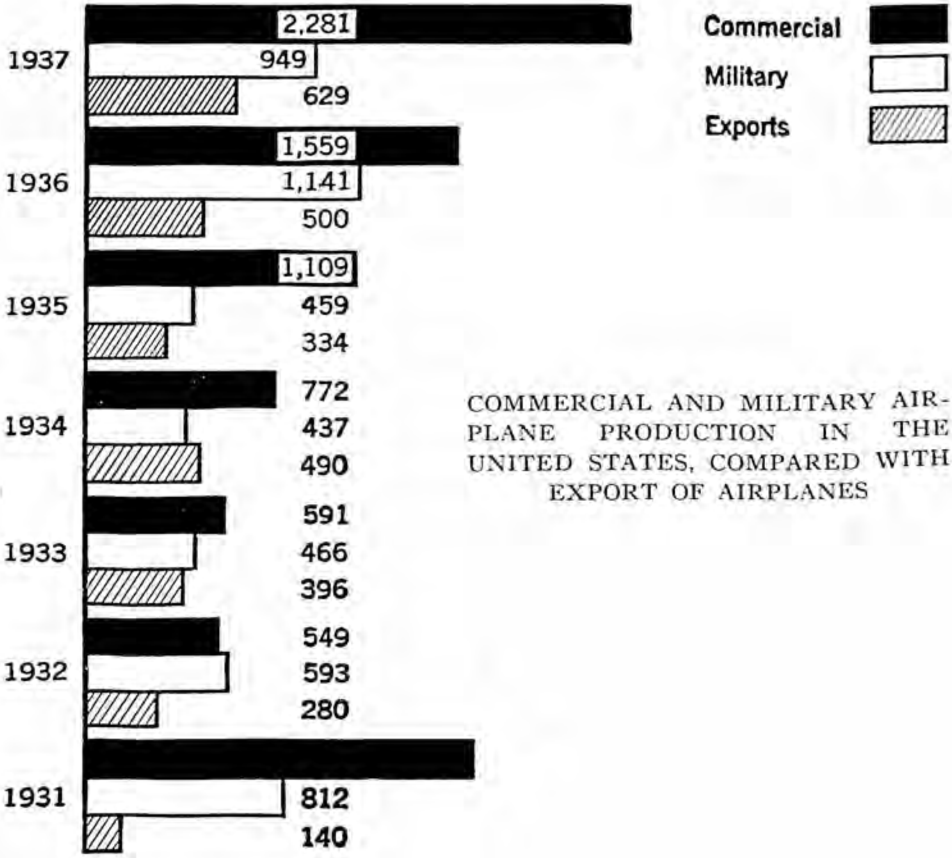
AIRPLANE ENGINE PRODUCTION IN THE UNITED STATES

including 764 municipal airports, 414 commercial airports, 283 intermediate fields, 602 auxiliary fields, 26 Navy fields, 61 Army fields and 149 miscellaneous, including State-owned airports.

Among the organizations interested in the promotion of American aviation for its value to the public at large were the Aeronautical Chamber of Commerce of America, the Air Transport Association of America, the Institute of the Aeronautical Sciences, the National Aeronautic Association, the Manufacturers Aircraft Association and the Society of Automotive Engineers.

Aeronautical Chamber of Commerce of America

As the trade association for the aircraft manufacturing industry in the United States, the Aeronautical Chamber of Commerce of America in 1937 kept in close touch with practically all phases of aviation both in the United States and abroad. The Chamber issued 149 bulletins during the year, one bulletin alone forming an analytical



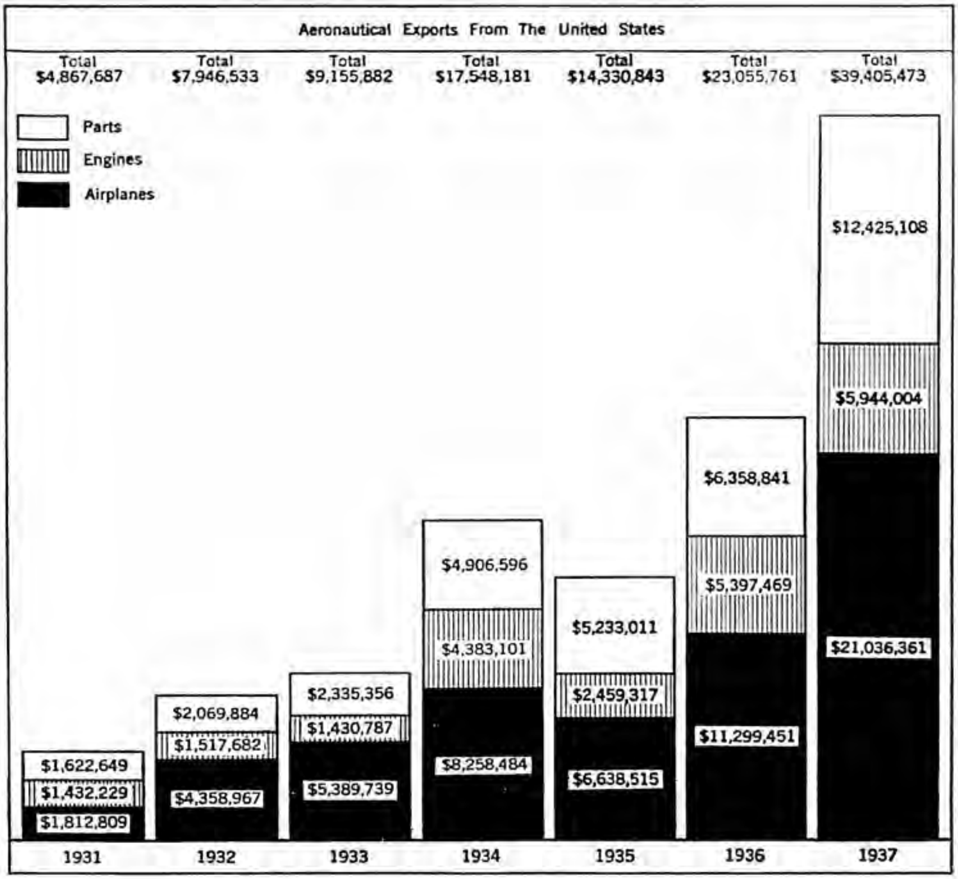
COMMERCIAL AND MILITARY AIRPLANE PRODUCTION IN THE UNITED STATES, COMPARED WITH EXPORT OF AIRPLANES

digest of 245 measures introduced in Congress, dealing directly or indirectly with aviation.

Those bills concerned air transport, appropriations, general industrial, Government contracts, Government manufacture, lighter-than-air development, national defense, neutrality and export trade, profits restrictions and miscellaneous legislation. Only 24 of the measures became law, and they were mostly appropriation bills.

The Chamber also presented to the U. S. Maritime Commission a report entitled: "Superiority of Flying Boats in Transocean Service." Following conferences with the Treasury and Navy Departments, the Chamber compiled an accounting manual setting forth all accounting regulations of the Treasury applying to the Vinson-Trammell Act and the changes made since the beginning of that work.

The Chamber represented the industry in making a survey for the



AERONAUTICAL EXPORTS FROM THE UNITED STATES

Department of Labor relative to wages and hours in aircraft manufacturing, that data being required in connection with the Walsh-Healey Public Contracts Act and other labor legislation still pending. Through its Engineering Committee the Chamber compiled and submitted to the Department of Commerce a detailed set of recommended changes in the Bureau of Air Commerce regulations, submitted to Congressional committees briefs on the need for development of high-output engines, expansion of research and development work in both military and commercial aeronautics, reasons for the desirability of amending the profits-limitation provisions of the Vinson-Trammell Act and similar proposed measures, and proposed changes in the Air Corps Act of 1926. The Chamber also appeared before various Departments and Bureaus of the Government as the spokesman for the industry, these agencies including the Office of

NEW BOEING BOMBER B-15

This giant bomber for the U. S. Army Air Corps is even larger than the famous Boeing YB-17 "flying fortress." It is powered by four 1,000 h.p Pratt & Whitney Twin Wasp engines. It carries two other engines solely for its extensive electrical system, and has complete living accommodations for the crew.

Arms and Munitions Control, the Committtee on Civil Aviation Legislation and others.

In its work of promoting the growth of private flying the Chamber sponsored a Commercial Airplane Sales Conference, sanctioned aircraft shows and at the end of the year had in course of preparation an industrial flying promotional booklet, designed to introduce a campaign to have business and industrial organizations acquire their own aircraft for company transportation purposes. The Chamber, through its Export Committee, represented the industry before the State Department in connection with the negotiation of reciprocal trade treaties.

In January, 1938, Leighton W. Rogers, president of the Aeronautical Chamber of Commerce of America, announced the results of a survey showing that American aircraft manufacturing plants possessed the capacity and other facilities to turn out twice their current production.

"During the fiscal year 1937 the industry was producing airplanes, aircraft engines, propellers, instruments and accessories valued at $158,000,000, and that production could be stepped up to $345,000,000

STEARMAN PLANES FOR BRAZIL

One of a fleet of Wright Whirlwind-powered advanced training and expeditionary planes built by the Stearman Aircraft Company for the Brazilian Army Air Corps.

during the next fiscal year and still remain on a peace-time basis," Mr. Rogers stated in his report.

"The survey indicated that of the total capacity business of $345,000,000 the airplane plants would account for $263,000,000, less engine values, with the balance of $82,000,000 being apportioned among the plants producing engines, instruments and other accessories.

"The capacity of the plants to produce more than 100 per cent of their current output is based on conservative estimates from the manufacturers who appreciate the public interest in knowing the present capabilities of this industry. After giving the dollar volume of production during the fiscal year ending June 30, 1938, the manufacturers then made conservative estimates as to the volume which they could produce during the fiscal year ending June 30, 1939.

"Their estimates were based on the equipment they are now manufacturing without contemplating new models or types. They did not provide for new factory space or other facilities requiring refinancing. In other words, this survey did not cover the vast production facilities which the aircraft industry is prepared to use in an emergency, when

INTERIOR OF BEECHCRAFT 18

Luxurious accommodations in the twin-engine Beechcraft powered by two Jacobs engines.

the plants can be quickly expanded and additional machinery purchased and installed. It is based on existing facilities at present available, either installed or stored and capable of being utilized to remove bottle necks in the assembly lines should conditions warrant.

"Only one kind of expansion is provided for in the estimates supplied by the manufacturers. It involves labor. The combined reports show that a total of 36,000 men are now employed in current production, whereas the industry could handle the $345,000,000 worth of business during the fiscal year ending June 30, 1939, by employing 38,000 additional men, and operating the plants in three eight-hour shifts daily.

"It is interesting to note that the aircraft manufacturing industry employed not more than 14,000 men in 1934, the number increasing steadily until 36,000 are now employed, while the industry, if working at full capacity, would employ a total of 74,000 men. That number, of course, does not include the vast number of additional workers who would be employed in allied industries contributing to the manufacture of aircraft.

"The survey also reveals the actual relationship between military

THE NEW THREE-WHEEL WACO N-7

This is a four-place plane for the business executive or private owner. It is powered by a 285 h.p. Jacobs engine.

and commercial production of planes, engines, propellers, instruments and principal accessories. Of the $158,000,000 worth in production during the present fiscal year, 1938, $63,000,000 is commercial business. That compares with the $43,000,000 worth of commercial business out of the total of $100,000,000 in dollar volume during the previous fiscal year, 1937.

"It was also brought out in the reports from the industry that the manufacturers are continuing to spend millions of dollars annually in research, engineering and development work, and that substantial portions of their revenues from sales of both commercial and military equipment are put back into projects for improvement of American planes, engines and auxiliaries.

"That this costly development work by the industry is producing the world's best flying equipment is evidenced by the increased sales abroad. Exports of American aeronautical products amounted to less than $15,000,000 in 1935, more than $23,000,000 in 1936 and more than $39,000,000 in 1937.

Institute of the Aeronautical Sciences

On October 15, 1937, the Institute of the Aeronautical Sciences observed the fifth anniversary of its incorporation by holding simultaneous meetings in New York, Philadelphia, Washington, San Francisco and Los Angeles for the purpose of organizing branches of the Institute. The Institute also has student branches at 21 universities and colleges.

THE 1938 CUB
This two-place cabin plane is produced by the Piper Aircraft Corporation at Lock Haven, Pa. It is powered by a Continental engine.

The first of the Wright Brothers' Lectures, under auspices of the Institute, was given on December 17, 1937, at Columbia University, and repeated later at the California Institute of Technology, by Prof. B. Melvill Jones of Cambridge University, England. In the evening the Institute's Honors Night Meeting was held in New York at which the following honors were conferred: Honorary Fellowship to Glenn L. Martin and A. H. R. Fedden; Fellowship to Lt. Comdr. Ralph S. Barnaby, B. C. Boulton, Dr. Karl T. Compton, Prof. A. V. de Forest, Prof. E. P. Lesley, A. A. Priester, Comdr. C. E. Rosendahl, Prof. C. G. Rossby, Philip B. Taylor, Dr. L. B. Tuckerman; Honorary Membership to Dr. Lyman J. Briggs, Director of the National Bureau of Standards; Rear Admiral Arthur B. Cook, Chief of the Bureau of Aeronautics of the Navy; Fred D. Fagg, Jr., Director of Air Commerce; Dr. W. R. Gregg, Chief of the U. S. Weather Bureau; Harry F. Guggenheim, member of the National Advisory Committee for Aeronautics; Dr. George W. Lewis, Director of Research of the National Advisory Committee for Aeronautics; Major General Oscar Westover, Chief of the U. S. Army Air Corps; H. E. Wimperis, President of the Royal Aeronautical Society.

The Sylvanus Albert Reed Award was presented to Eastman N. Jacobs of the National Advisory Committee for Aeronautics "for his contribution to the aerodynamic improvement of airfoils used in modern military and commercial aircraft." The Lawrence Sperry Award was presented to Clarence L. Johnson of the Lockheed Aircraft Cor-

VOUGHT CORSAIRS FOR MEXICO

A group of Pratt & Whitney Wasp-powered Vought Corsair observation planes ready for delivery to the Mexican Army Air Corps.

poration "for important improvement of aeronautical design of high speed commercial aircraft." The Daniel Guggenheim Medal was conferred in absentia upon Dr. Hugo Eckener of the Luftshiffbau Zeppelin G.m.b.H. "for notable contributions to transoceanic air transport and to international cooperation in aeronautics." The Wright Brothers' Lecture and the Honors Night Meeting will be held annually on this date, the anniversary of the first flights of the Wright Brothers at Kitty Hawk. Edmund C. Lynch, of New York, made a gift of $10,000 to enable the Institute to continue the work. The Fund was named the Vernon Lynch Fund in memory of the brother of the donor.

The sixth annual meeting of the Institute in New York, January 24-27, 1938, comprised four days of technical sessions. A review of the annual meeting was held in Los Angeles, as well as two other technical meetings during 1937. The Institute held sessions at the American Association for the Advancement of Science summer meeting in Denver and at its annual meeting in Indianapolis. A session on "Engineering for Speed" was held at the National Air Races in Cleveland.

During the year the Aeronautical Index compiled by the W.P.A. under the supervision of the Institute published and distributed technical bibliographies on 18 subjects.

Manufacturers Aircraft Association

Operations under the Cross-License Agreement administered by

THE FAIRCHILD 45

A five-place low-wing cabin monoplane powered by a Wright Whirlwind engine.

the Manufacturers Aircraft Association during 1937 continued to show an increase in the proportion of the manufacturing industry represented by its membership, as well as in the number of new patents acquired. A total of 119 airplane patents was licensed to all members during 1937. As in previous years, the primary objective of the cross-licensing plan, namely the prevention of wasteful patent litigation within the industry, was attained, no suits for patent infringement having been filed on any of the 800 or more unexpired patents coming within the operation of the license agreement.

The Association continued to maintain its Patent Research division and library for the use of its members, and the publication of its Digest of all current American and British aircraft patents, including abstracts of the specifications and official drawings, which keeps members informed regarding patented developments in the United States and foreign countries. The Research Library of the Association included copies of United States and foreign airplane patents, books and other publications and documents which are used by members for engineering research and in connection with validity and infringement investigations. The library is one of the most comprehensive on the engineering and scientific aspects of aviation.

Facilities were also provided whereby the Manufacturers Aircraft Association may negotiate licenses for members under patents controlled by parties who are not subscribers to the Cross-License Agree-

BELLANCA 28-90 PLANES

Group of fast low-wing monoplanes known as Model 28-90 produced by the Bellanca Aircraft Corporation. They are powered by the Pratt & Whitney Twin Row Wasp Junior engine.

ment, including manufacturers of aircraft in foreign countries who may desire to make their patented developments available to the American industry. The contract relationship between the Association and the United States Government, which enables the War and Navy Departments to obtain licenses under all the patents coming within the scope of the Cross-License Agreement on the same terms as members of the Association, was also continued throughout the year.

By continuing to make technical progress available to all manufacturers, the Association not only made possible the application of advanced ideas to all current models of aircraft, but encouraged engineering and research without interference from controversy over patented inventions.

National Aeronautic Association

The National Aeronautic Association acted to affiliate the National Intercollegiate Flying Club, The Soaring Society of America and the Academy of Model Aeronautics as the first step in the development of a broad nation-wide program for youth aeronautic education and flight training, in accordance with its policies designed to advance American aviation, foster the development of air defense and promote the interests of scheduled air transport and private flying. Under N.A.A. sponsorship the first national aviation program, encompassing 52 points, was subscribed to by participating organizations. The N.A.A. is the American member of the Federation Aeronautique Internationale, and as such homologates all national and international record flights. The N.A.A. sanctioned all official flying meets and record attempts. Major events included the International Aerobatic Competition at St. Louis and the Annual National Air Races at Cleveland, 10th Annual All-American Air Maneuvers at Miami, 8th Annual Soaring Contest, Third Annual Intercollegiate Air Meet and 10th Annual Model Meet.

In 1937 the N.A.A. had 193 Chapters, of which 69 were Junior, located in cities throughout the country. Its membership at the end of the year, senior and junior, totalled 11,535, according to the report of the association.

THE BELL XFM-1 FIGHTER

Known by its U. S. Army Air Corps title of experimental fighter, multi-seater, this product of the Bell Aircraft Corporation is a radical departure from the conventional pursuit ship. The propellers are behind the wings. A machine gunner is stationed in each of the two engine nacelles; and the entire crew of five can change places during flight. The XFM-1 is powered by two Allison liquid-cooled engines, and is designed to be fast enough to overtake any other aircraft.

CHAPTER III

THE ARMY AIR CORPS

Marked Progress in Air Corps Equipment—Automatic "Blind" Landings—Description of the Bell Two-Engine Fighter—High Altitude Laboratory—Lockheed Sub-Stratosphere Plane—General Westover's Description of Activities—Pilots from West Point—Awards and Trophies—Cadet Training.

IN his annual report for 1937 Secretary of War Harry H. Woodring reported "marked progress" in modernizing Army equipment, adding: "The most noticeable recent advances have been in aircraft. We now have on hand approximately 1,000 new military airplanes, nearly all of them less than 3 years old, and another 1,000 are under order. In addition, we have on hand several hundred serviceable planes, classified as obsolete. These older planes will all be replaced within the next year or two.

"Our goal in airplane strength is 2,320 modern, serviceable planes, to be attained not later than June 30, 1940. This number was recommended as highly desirable by the Baker Board 3 years ago. Subsequent studies have confirmed the conclusions of the Baker Board with respect to this number. Recent aviation developments have produced military airplanes of much greater speeds, with much greater range, and much more effective than any visualized 3 years ago. Hence, an air fleet of 2,320 planes today is several times more powerful than one of a comparable numerical strength a few years ago.

"Foreign countries are making heavy increases in the strength of their air arms and most of the first-class powers have many more airplanes on hand or under construction than we have. However, in quality our new planes are at least the equal and probably the superior, type for type, of any military airplanes in the world. Our program of airplane procurement does not contemplate attaining the numbers possessed by other countries. With our favorable geographic position and our determination to use our military strength only for defensive purposes, we believe that 2,320 military airplanes will be sufficient for our needs. If funds are made available we hope to attain this number by 1940. Thereafter, it will be necessary to procure approximately 500 new airplanes each year to replace obsolete and unserviceable craft and to keep our equipment abreast of current developments.

"It should be borne in mind that modern aircraft cannot be quickly improvised. The construction of airplanes necessarily takes con-

Official U. S. Army Photo

WRIGHT FIELD AT DAYTON

An aerial view of the Army Air Corps engineering center in the Ohio city.

siderable time. Hence, our peacetime strength should approximate rather closely our requirements in war. Furthermore, in a major war our air arm would probably be engaged almost immediately on the opening of hostilities. Therefore, it is desirable that it be practically on a war footing in time of peace.

"While we are procuring up-to-the-minute aircraft in sufficient quantities to bring our air strength gradually up to our requirements, we are at the same time encouraging the experimental development of new types so that we may continually improve the quality of our equipment. In this way we guard against over-standardization of airplanes and we are able to take advantage of technical improvements as rapidly as they are developed."

After two years of research and preparation daring pilots and engineers of the Army Air Corps in 1937 began to make automatic "blind" landings without any control from the occupants of the

Official U. S. Army Photo

A ONE-TON AERIAL BOMB

This live bomb weighing 2,000 pounds is being hung on a Martin bomber for Army Air Corps target practice.

airplane or observers on the surface. On Monday, August 23, a day when the air was bumpy and the wind decidedly adverse, a big Army plane swung over the horizon near Wright Field, at Dayton, O., and glided straight down on the runway, rolling a few yards and then coming to a stop as if it had been at all times in the hands of an expert pilot. But nobody had anything to do with this landing; nothing had in fact save a complex system of electrical and radio instruments. There were three men in the Army's cargo plane, and they were the three experts who had developed the apparatus. Like true scientists they had gone up and come down on this first test to see for themselves just how their creation would work. But let them tell the story of this amazing achievement.

Official U. S. Army Photo

A PARACHUTE DROP

An Army Air Corps pilot practising "bailing out."

The three who sought and received first hand knowledge that a machine can be flown cross-country and brought into a safe landing absolutely by automatic control were Captain Carl J. Crane, director of the Air Corps instrument and navigation laboratory at Wright Field, Captain George V. Holloman, assistant director, and Raymond K. Stout, the project engineer in automatic landing. The officers wrote the following description:

"For more than a year Air Corps test airplanes have been flown automatically over distances that have indicated the thorough reliability of the devices employed. This was one step in the perfection of automatic landing. The features that are built into the automatic landing system are not only useful for the landing, but are used throughout the entire flight. Test airplanes from Wright Field have been flown automatically from Wright Field as far as Texas and return under automatic control. Several flights have been made to Buffalo, Newark, thence to Langley Field, Va., and return to Wright Field. Obviously the automatic landing involves other factors besides control of direction. These factors are control of altitude, engine control, glide control and further engine control after landing.

AIR CORPS DOUGLAS BOMBER
Details of this twin-motored ship are held military secrets.

"In the execution of the automatic landing, using the Air Corps system, it is necessary for the pilot to bring the plane to a definite altitude, determined by the sensitive altimeter, and to place the machine within the range of radio reception of the ground radio facilities. It is, of course, desirable to place the airplane generally in the direction in which it is expected to land, but this is not necessary, as was determined in flight."

The authors went on to describe that they made automatic landings after turning on the automatic controls with the plane headed 180 degrees away from the direction in which the landing was to be made. In other words, they switched on their landing control with their machine going in the opposite direction. The system provides for the control to be turned on within 20 miles of the field; then "the master landing switch is closed and the plane proceeds through the following routine:

"The selected altitude is automatically maintained and the plane's heading is changed (automatically) so that it flies in the direction of the radio guiding station most remotely located from the landing runway.

"The altitude control device maintains the proper altitude during the initial approach. The directional relay interlocks the radio com-

THE SEVERSKY ARMY PURSUIT

The U. S. Army Air Corps bought 77 of these fast planes for pursuit squadrons. This model is powered by a Pratt & Whitney Twin Row Wasp engine and a Hamilton Standard constant speed propeller.

pass and the Sperry gyro pilot, and therefore causes the change in the heading of the plane. Adjacent to this relay is the radio compass, the frequency of which is automatically set by the interaction of the marker beacon receptor working in conjunction with the frequency selector. The pilot is informed as to the correctness of automatic settings by observing the frequency selector indicator. Through the automatic and cooperative action of these devices the airplane heads to the compass guiding station farthest from the field. Upon reaching that station the frequency is automatically changed to Station No. 3, where it is again automatically changed to the frequency of Station No. 2, where the frequency is again automatically changed to that of Station No. 1, while at the same time the engine throttle is automatically operated by the throttle engine. The throttle engine is interconnected with the altitude control in such a manner that should the plane reach its minimum altitude prior to reaching radio Station No. 1, the throttle engine will be so actuated as to control the plane and keep it at the minimum altitude required for the operation of the automatic landing system.

"After passing Station No. 1, the throttle system is so actuated that the plane maintains a selected glide angle and rate of descent until ground contact is made. When ground contact is made, the landing gear switches further actuate the throttle engine, which

NORTH AMERICAN O-47A

An Army Air Corps observation plane powered by a Wright Cyclone engine with Hamilton Standard constant speed propeller.

in turn causes the engines to be idled and the proper brake application made.

"At this writing the automatic landing system has been used so that all the landings made to date have been under cross wind conditions of varying intensity and as high as 11 miles an hour. In at least 50 per cent of the landings air conditions have been rough."

Perfection of the automatic landing system will relieve the pilot of the strain imposed on him by the present need for watching and handling a large number of instruments which are required for high performance aircraft. It promises soon to take a great deal of hard work off the pilot's hands, even when he is flying in weather that prevents his seeing outside the machine; yes, and when he comes down for a landing on a field obscured by fog or other bad weather conditions.

Another Air Corps secret came to light during recent months when Lieut. Benjamin S. Kelsey flew a new, high-powered twin-engine low-wing fighter which had just emerged from the plant of the builders, the Bell Aircraft Company, at Buffalo, N. Y. Known by its terse Air Corps designation as XFM-1, the Bell machine is de-

Official U. S. Army Photo

U. S. AIR CORPS CURTISS PURSUIT P-37

Believed to be one of the fastest fighters in the world this new pursuit ship is powered by a 1,000 h.p. Allison 12-cylinder Ethylene Glycol-cooled engine.

signed to fly fast enough and fight hard enough to whip the fastest bomber that it may encounter. During 1938 the GHQ Air Force at Langley Field will work out a new set of tactics for this latest of the Army's mystery planes. The following official description gives all the information permissible at this time.

"The Bell multi-seater fighter contains some radical departures from conventional military design. It is a pusher. Its propellers are behind the wings. This is a revolutionary change in modern airplane construction. Engineers believe that this will give increased propeller efficiency. This arrangement permits the wing gunners, one in the front of the engine nacelle on each wing, to have a free field of fire and observation to the front, uninterrupted by engine or propeller. This change in design also frees the gunners from having to work in the propeller blast, a handicap to gun maneuver and accuracy. It is believed this plane will develop sufficient speed to overhaul any air targets.

"It has six guns, more powerful armament than ever before carried on a fighter. It also carries light bombs. It accommodates a crew of five, pilot, co-pilot-navigator, radio operator-gunner and two out-

BOEING'S NEW ASSEMBLY PLANT

Showing progress of construction on Wright Cyclone-powered bombers for the U. S. Army Air Corps.

board wing gunners. It is powered by two engines recently developed by the Allison Engineering Corporation in conjunction with Air Corps engineers. All gasoline is carried in compartments in its giant wings, thus reducing the fire hazard.

"Its landing gear and tail wheel are electrically retractible. It carries flaps to reduce its landing speed. It provides heated compartments for all members of the crew, who will need heat at this plane's fighting ceiling, which is more than 30,000 feet.

"An auxiliary power plant, apart from the two big engines, drives nine electric motors which operate the retracting gear, lights, radio and engine starters. The plane can continue to transmit radio even after its main power plants are stilled by a forced landing. A feature is the interchangeability of all the crew. The wing gunners can travel from their main stations to the fuselage during flight. The co-pilot can change places with the pilot. The radio operator can man the guns. All stations have inter-communication by telephone."

The Air Corps also completed its high altitude laboratory at Wright Field in 1937. This contains three pressure chambers which simulate conditions to be encountered by aviators flying as high as 80,000 feet. The official description is of interest because this is believed to be the most complete high altitude laboratory in the world.

NORTHROP A-17 ATTACK PLANES

An Army Air Corps squadron over the San Bernadino valley in California.

The largest and newest of the three chambers is a great cylindrical steel tube, 31 feet long and eight feet inside diameter. The interior is divided into three sections, a central compartment six feet long bisecting two identical end compartments, each 12 feet long. From the center one enters either of the end compartments through two gas-tight heavy metal doors, with ball bearing hinges, and capable of being operated by hand both from within and without. The end compartments are two separate pressure chambers in which different tests can be made simultaneously under the same or entirely different pressure conditions. Or, if desired, the large doors into the center compartment may be left open to form one 31-foot pressure chamber. The chief purpose of the central compartment, however, is to serve as a lock through which one can enter the end compartments during tests without disturbing their pressure conditions. Here human beings and instruments are placed under observation under high flying conditions such as atmosphere as rare as that encountered at heights up to 80,000 feet and temperatures as low as 65 degrees below zero.

In one of the end compartments is a smaller tubular chamber large enough for a man to crawl into, in which the conditions of the supercharged pressure cabin stratosphere airplane can be duplicated while the surrounding air of the compartment is like that prevailing at high

THE CURTISS A-18 ATTACK

A twin-engine Army Air Corps attack plane with two 1,000 h.p. Wright Cyclone engines. It has a retractible undercarriage and tail wheel, and carries six machine guns and a load of bombs.

altitudes. Six observation windows 28 inches in diameter, three for each compartment, enable those sealed inside to communicate with observers outside during the tests.

This equipment is expected to accomplish a very great deal in showing precisely all the physical reactions of aviators flying high, while they themselves remain safely on the ground. Among the still pestiferous problems which the laboratory may solve are the effect of extreme cold on efficiency, effectiveness of present flying clothing against extreme cold, tests of oxygen equipment, the physical and mental reaction of pilots to oxygen over varying periods of time, the effect of carbon monoxide at high altitudes and low temperatures, the efficiency of supercharged cabins under high altitude flying conditions and other similar questions that remain to be answered before stratosphere flying becomes practicable.

In line with its interest in high altitude work the Air Corps in 1937 took delivery on a Lockheed XC-35 sub-stratosphere plane, designed solely for experimental flying at great heights. It has a sealed, pressure cabin, supercharged engines and instruments. The Air Corps stated definitely that this plane will not be used in an effort to estab-

Official U. S. Army Photo

AIR CORPS SUB-STRATOSPHERE PLANE

This is the Lockheed XC-35, produced for the Army Air Corps for use as an experimental laboratory for new equipment and engineering practice involved in high altitude operations. This plane has a sealed, pressure cabin equipped to maintain the air and oxygen content at sea level pressure at great heights.

lish records, but that it will be employed as a flying laboratory for the development of numerous items of equipment and engineering practices involved in high altitude operations of military and commercial aircraft. The cabin will maintain sea level air pressures and oxygen content at high altitudes, while the various instruments will facilitate tests on the occupants and materials in the plane.

Commenting on the activities of the Army Air Corps, Major General Oscar Westover, its Chief, stated:

Official U. S. Army Photo

MARTIN BOMBER FORMATION

A U. S. Army Air Corps squadron flying high on a cross-country practice flight.

"We have found, which we long suspected, that the airplane pilot is really a professional. There was a time when with but a few hours instruction a man could fly a military airplane. Even then, of course, his ability to take an Army plane off the ground and get it safely back to earth again did not make of him a competent Army flier. He had to be taught how to take that weapon, the airplane, and with it accomplish a definite and important military mission. That was always true. Today the task of the military pilot has increased many fold.

Our bombers cost about a quarter of a million dollars. They have a radius of over 3,000 miles; they can operate effectively above 25,000 feet. They carry a minimum crew of nine. The chief pilot of one of these tremendous ships is in reality captain of a ship. He guides with his judgment a powerful war machine, and in the skill of his hands the Army imposes a vast financial responsibility. It takes several years to train him—as long as it takes to train a doctor or a lawyer. That is why I call him a professional.

"I am glad that I can say to you confidently," continued General Westover, "regarding quality, that our new fighting aircraft, type for

Official U. S. Army Photo

A FAST AIR CORPS FIGHTER

This is the Curtiss P-36. The U. S. Army Air Corps bought 230 of these planes for its pursuit squadrons. The P-36 is an all-metal single-place plane powered by a Pratt & Whitney Twin Wasp engine developing 1,100 h.p. for take-off. Its speed is greater than 300 miles an hour.

type, are the equals and in many cases the superior of any war machines found in the leading countries of the world. During and shortly after the World War our tactical doctrines led us to believe that we should have about 60 or 70 per cent of pursuit planes, little single seaters, and only about 30 to 40 per cent of bombers and other types. Tactical and strategic conceptions now point to the fact that we should have between 50 and 60 per cent of bombardment planes and less than 40 per cent of pursuit aircraft."

General Westover also pointed out the change in military airports, saying: "Now, with military airplanes in existence weighing from 16 to 26 tons they require extensive runways. The air base is not only a landing field; it is a complicated and integrated center. There must be vast shops and repair facilities; there must be great hangars, preferably underground; there must be tremendous storehouses for gasoline, bombs, ammunition and essential supplies; there must be radio and homing devices—all these and many other facilities, such as barracks and quarters, make the air base really an industrial center. These bases are absolutely vital to the proper operation of mod-

NORTH AMERICAN BASIC COMBAT PLANE

One of the new ships of the U. S. Army Air Corps. It is powered by a Pratt & Whitney Wasp engine.

ern military aircraft. Also, they must be located strategically to fit our war plans."

The Chief of the Army Air Corps called attention to the excellent opportunities for young men to make a career for themselves in that branch of the service.

West Point Military Academy provided the Air Corps with a large number of prospective pilots when 106 second lieutenants, 36 per cent of the June, 1937, graduating class, reported at Randolph Field, Texas, for training at their own request. Those who complete the first year's training will be awarded the rating "Airplane Pilot" and transferred to the Air Corps. Those who fail to make the grade will return to the branch of the service in which they were commissioned. A total of 911 West Point graduates, more than 23 per cent of the entire graduating roster, were assigned to the Army Air Corps during the last 15 years.

The General Headquarters Air Force, comprising all combat units of the Air Corps, with general headquarters at Langley Field, Va., and three wings, or sections, with stations on the Atlantic and Pacific coasts and in the central part of the United States, demonstrated its speed and mobility by concentrating at a pre-determined point within 24 hours. This performance was considered excellent

STEARMAN ARMY TRAINER
It is the PT-13, powered by a Lycoming engine.

evidence of the GHQ Air Force's ability to defend the coasts on short notice.

Captain Richard E. Nugent and six other airmen won the Mackay Trophy for the most meritorious Air Corps flight in 1936. They took off from Langley Field, Va., in three Martin bombers, and in extremely bad weather. Their objective was a bombing target near Allegan, Mich., 600 miles from their Virginia base. Thunder storms and dense fog menaced the three ships from the start. The commanding officer's ship flew solely by instruments for more than 50 miles, and the fog was so dense that the men in the wing ships, although in close formation, could not see the navigation lights of the lead ship. Ordered to fly individually on a compass course and reassemble in formation at a designated point, the intrepid pilots carried on, each bringing his ship to the appointed place, where the haze was so thick that the bombers circled about for 15 minutes in imminent danger of collision before falling into their usual formation. Captain Nugent then led his flight above the clouds and directly over the target at the hour set for the attack. It was a peacetime maneuver, but it would have been mighty effective under the most strenuous conditions of a real war.

The Cheney Award for valor and self-sacrifice for 1936, was presented to Major Frederick D. Lynch and Sergeant Joseph L. Murray

VULTEE ATTACK BOMBER

Carrying five machine guns and a load of bombs it is powered by a Wright Cyclone engine.

for their valiant work in attempting to rescue their two companions on a balloon flight. Lack of sufficient ballast led to their making a dangerous landing in a small clearing. As they pulled the ripcord the balloon exploded and the entire area soon was a mass of flame. The major and the sergeant suffered severe burns when they rushed into the flames and brought out their comrades who were fatally burned.

The Harmon Efficiency Trophy for 1936 was awarded to the 90th Attack Squadron at Barksdale Field, Shreveport, La.

The Air Corps supplied the following information regarding flight training at Kelly and Randolph Fields, Texas. Three classes start training annually, beginning March 1, July 1 and October 15. The course lasts one year. The students undergo four months of primary training, and are then advanced to basic training for another four months, with larger and more powerful planes. After completing the basic course the students are graduated to the Advanced Flying School at Kelly Field where special training is given in military flying, pursuit, attack, bombardment and observation.

The primary flight training consists of approximately 188 hours dual and solo instruction, during which time the student is trained in all the maneuvers necessary to operate military planes. Besides this time in the air the student is taught ground school subjects, including aerial navigation, airplanes, engine maintenance, buzzer practice, ground gunnery, maps, theory of flight, military law and Air Commerce Regulations.

While in training the flying cadet is paid $75 a month, including food, quarters and clothing. Upon graduation he receives the rating of "Airplane Pilot" and is commissioned a Second Lieutenant in the Air Corps Reserve. He is then assigned to active duty for three years with tactical squadrons, during which period he receives the same base pay, flying pay and allowances as a second lieutenant in the Air Corps, Regular Army. Second lieutenants are promoted to the rank of First Lieutenant after three years of active duty, and should they desire, are placed on active duty for a further period of two years. Reserve officers receive a bonus of $500 after three or five years of active duty.

Official Photo U. S. Navy

U. S. NAVY CARRIER "YORKTOWN"

This is the Navy's latest aircraft carrier.

CHAPTER IV

THE NAVY AIR FORCES

High Standards of Performance—Epic Flight in Consolidated Flying Boat—The "Lexington" in Earhart Search—Admiral Cook's Report on Activities in Naval Aviation—Lack of Seaplane Tenders—Cooperation with Aircraft Manufacturing Industry—New Developments—Description of Sikorsky Navy Bomber—Awards.

IN his annual report for 1937 Secretary of the Navy Claude A. Swanson stated that naval aviation "has continued to maintain high standards of performance. Gains have been made in the fields of material and personnel, while operations of aircraft with the fleet have been extended, and their coordination with other elements of fleet strength has been advanced. The performance of patrol planes now being procured in quantity is so outstanding as to deserve particular comment, mass air deliveries having been made to points as far distant as Hawaii and the Canal Zone.

"The Navy's policy with regard to rigid lighter-than-air craft is still under consideration and is being carefully studied."

Early in the evening of July 2, 1937, a Consolidated flying boat from the U. S. Navy's Patrol Squadron Six took off from Pearl Harbor at Honolulu and nosed out over the Pacific in a southwesterly direction, its mission one of the most daring in aviation annals, although it received scant attention at the time. Lieut. Warren W. Harvey and his crew of five Navy airmen had received orders to fly to Howland Island, 1,897 statute miles distant, and search the trackless, watery waste for Amelia Earhart and her navigator, Fred Noonan, who had disappeared before reaching Howland which they had chosen for a refueling stop in the course of their round-the-world flight. Their orders were to arrive at Howland soon after daylight, search all day for the Earhart plane, land at sunset and take on fuel which had been stored there for the globe fliers. It was a simple order, and a good trick if they could do it, meaning only a night flight of 1,897 miles overseas without any preparation and regardless of weather conditions. Well, they set out, and this is what happened, as described in the succinct phraseology of an official report.

"The trip progressed very nicely, the night being clear for the start and continuing so until the early morning hours. At 2:40 a.m. the plane passed directly over the aircraft tender 'Swan' a little over halfway on the course to Howland. Shortly afterward lightning appeared in the south and southeast. About 5:15 a.m. we began passing through clouds at regular intervals all the way up to 12,000 feet. The electrical display got worse, and we discontinued use of radio because of electrical discharges every time the transmitter was used.

THE VOUGHT V-143

A single-seat fighter with retractible landing gear, including tail wheel. It is powered by a 750 h.p. Pratt & Whitney Twin Wasp Junior engine.

"Ice began forming on the plane and even on the windshield until it was a quarter of an inch thick. It apparently formed in large enough pieces to break and be thrown against the fuselage by the propeller, because distinct sounds were noted. The automatic pilot became sluggish due to iced controls, and at this time a descent was started, hoping to get under the storm.

"Coming down we noted sleet from 12,000 to 10,000 feet, then snow down to about 4,000 feet. From there on to the surface it was violent rain. The air bumps were of considerable violence."

When a Navy aviator refers to air bumps as being of considerable violence they must have been terrific, bouncing the huge patrol boat up and down like a cork in a cataract. But let us continue.

"After about two hours of this, and continuously trying to find a way around the storm, the flight was turned back. Because of the great amount of fuel used in climbing around the storm it became necessary to reach a decision whether to attempt to push further or return. After completing about 250 miles off course and still being unable to get through, we turned back. We estimated that at least three hours fuel would remain on our arrival at Pearl Harbor; but after a flight through decreasing wind we arrived back in Honolulu

Official Photo U. S. Navy

GRUMMAN F3F-2 FIGHTER

A Wright Cyclone-powered plane for U. S. Navy aircraft service. It has retractible landing gear.

with six hours gasoline remaining, after a total of 24 hours and five minutes of continuous flying."

Most amazing was the fact that at three o'clock that afternoon the aviators calculated the probable time of their arrival as 7:30 p.m. They landed three minutes ahead of their schedule, thus ending a flight of 3,000 miles over water.

On July 3 the great aircraft carrier "Lexington" lay in Los Angeles harbor, where six squadrons were assembled during the holiday period which found all the ship's population that could be spared off on various trips ashore. When the orders came for the "Lexington" to join the search for the Earhart plane all leaves were recalled and the carrier took on fuel, provisions and gasoline. Thus equipped, the "Lexington" sped toward Howland Island. On arriving in the vicinity of Howland the planes of the various squadrons were sent out in different directions. The squadrons included VT-2, Lieut. Comdr. Sinton, with nine planes; VS-2, Lieut. D. F. Smith, with 11 planes; VS-3,

Official Photo U. S. Navy

THE CARRIER "LEXINGTON"

One of the Navy's aircraft carriers passing under the new bridge between San Francisco and Oakland

Lieut. Comdr. MacMahon, with nine planes; VS-41, Lieut. Comdr. Taylor, with 14 planes; VS-42, Lieut. Hoskins, with nine planes; and VB-4, Lieut. Comdr. Roswell, with 10 planes. During the six day search for the Earhart plane or its survivors the 52 planes from the "Lexington" flew over an area covering 151,556 square miles at an average height of only 200 feet above the surface, all without the slightest accident.

In January, 1937, 12 Consolidated flying boats, new model PBY-1, forming Patrol Squadron 11, commanded by Comdr. McDade, flew from San Diego, Calif., to Honolulu, a distance of 2,600 miles in 21 hours and 40 minutes.

Appearing before the House Appropriations Committee, Rear Admiral Arthur B. Cook, Chief of the Bureau of Aeronautics of the Navy, reported that 293 planes were needed to replace obsolete equipment in 1938, and also 104 additional planes to equip the new cruisers "St. Louis" and "Helena" and the aircraft carrier "Wasp" and also to equip a new patrol squadron, VP-20. He said that the Navy air station at Pensacola, Fla., would have 763 students in training in 1938. The service planned to have 3,945 fliers in the Navy and 531

Official Photo U. S. Navy

ABOARD THE "SARATOGA"

Aviators' ready room on the U. S. Navy carrier. The pilots are awaiting the call to flight duty.

in the Marine Corps on completion of its development program. Most of the new bombing planes on Navy ships have speeds of more than 200 miles an hour, Admiral Cook reported.

Later, in his annual report for 1937 Admiral Cook described the activities of naval aviation as follows:

"Shore facilities to support the operating aircraft continue to lag behind the authorized Treaty Navy expansion, and serious congestion continues at operating and repair bases, and has reached the point where it may prove impracticable to operate all carrier aircraft on the West Coast with the fleet until additional facilities become available. The development of the Naval Air Station at Alameda, Calif., now authorized, will relieve this situation appreciably. It is earnestly hoped that complications regarding transfer of the site to the Navy will be settled at an early date.

"The scope of operations of Aircraft Scouting Force has been limited seriously by a lack of seaplane tenders. Realization of the auxiliary building program which was intended to meet the developing demands for seaplane tenders has been delayed to such an extent that an acute emergency exists to fulfill immediate needs of Commander Aircraft Scouting Force. The situation is especially aggravated because of the advancement in patrol aircraft which now admit of considerably extended operations. The possibilities of present squadrons

CONSOLIDATED XPB2Y-1 PATROL BOMBER

This four-engine flying boat was built for the Navy by the Consolidated Aircraft Corporation. It is powered by four Pratt & Whitney 1,050 h.p. Twin Wasp engines and Hamilton Standard constant speed propellers.

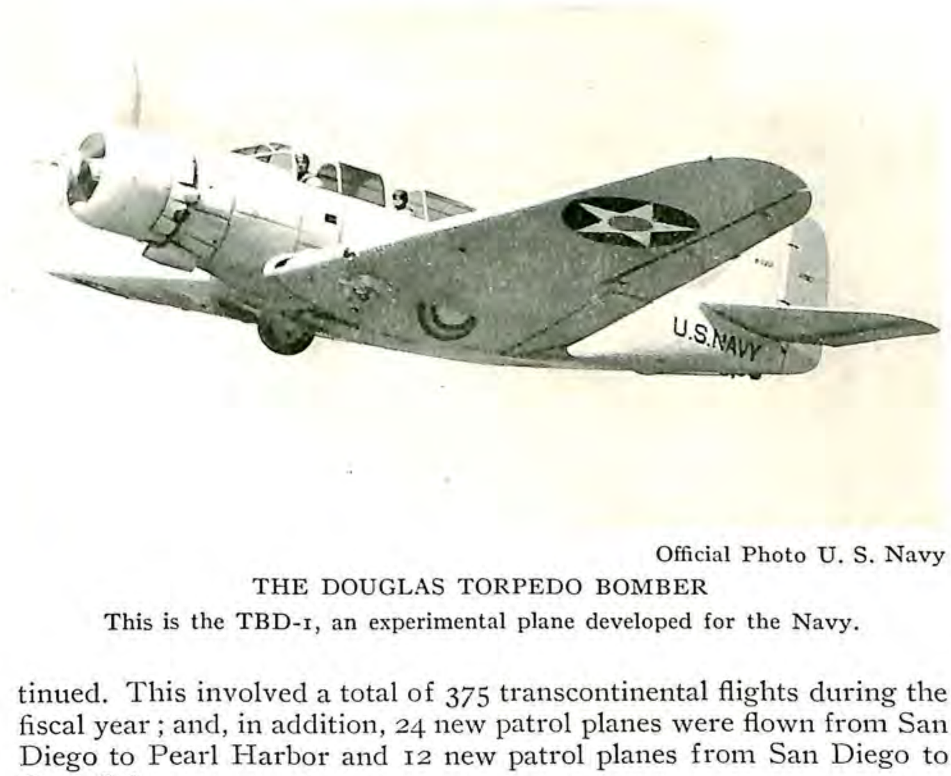
cannot be realized, nor even explored, until the deficiency of tenders is accommodated.

"In meeting the Operating Force Plan, the Bureau has endeavored to equip the forces afloat with aircraft and equipment of proven reliability and advanced design. Illustrative of the results of these endeavors have been the new long range patrol bomber, (Consolidated) PBY airplanes now being furnished the fleet as replacement for older types and to equip new squadrons.

"Appropriate Government research and test agencies, as well as the industry, have been utilized to carry out experimental projects as practicable and as funds permitted. This experimental program has resulted in marked improvements in airplanes and engines and varied aeronautic equipment. New aircraft designs have been sought on a competitive basis from the industry, and aircraft of advanced design are becoming available for procurement in quantity.

"On June 30, 1937, the Navy had 927 service and 195 obsolescent aircraft on hand and 820 new aircraft on order. This represents an increase of 216 airplanes over the total on hand and on order as of June 30, 1936. Of the large number on order the majority are due or overdue for delivery and will be delivered within the next few months.

"The policy of delivering new aircraft by air and of ferrying some old aircraft to East Coast stations for overhaul and return was con-



Official Photo U. S. Navy

THE DOUGLAS TORPEDO BOMBER

This is the TBD-1, an experimental plane developed for the Navy.

tinued. This involved a total of 375 transcontinental flights during the fiscal year; and, in addition, 24 new patrol planes were flown from San Diego to Pearl Harbor and 12 new patrol planes from San Diego to Coco Solo.

"Lighter-than-air activities continued to be concentrated at the Naval Air Station, Lakehurst, where four non-rigid airships operated an average of 508 hours apiece in a program of training and experimentation which included exercises with submarine activities. The 'Los Angeles' was used in a non-flight status for instruction and for experiments in mooring and handling tests.

"The activities at the Naval Reserve Aviation Bases have been tremendously stimulated by the adoption of the aviation cadet program. Candidates for appointment as aviation cadets are selected in the various Naval Districts in accordance with specified qualifications and assigned quotas. Preliminary selections are made by boards of officers appointed by various Commandants, and final selection is made by the Bureau of Navigation. Selected students are given thirty days of active duty as seamen V-5 U. S. N. R. and a course in elimination flight training with twelve hours flying, including, in most cases, at

THE CURTISS NAVY SCOUT BOMBER

It is model SBC-3, a two-place biplane with metal fuselage and enclosed tandem cockpits behind the wings. This is one of the U. S. Navy's latest types. It is powered by a Pratt & Whitney Twin Wasp engine.

least one solo flight. The course also includes indoctrination in Naval subjects. Upon successful completion of elimination training, candidates are appointed aviation cadets and ordered to the Naval Air Station, Pensacola, for regular Naval flight training course. During the fiscal year 1937, 300 cadets successfully completed the course at Pensacola and were ordered to the fleet. It is expected that approximately 200 more will be ordered to active duty with the Fleet during the fiscal year 1938.

"During the fiscal year 1937, as compared with the fiscal year 1936, the total number of hours flown increased 26.5 per cent. Total output in repairs to airplanes and engines increased 25.7 per cent, while the increased overhaul expenditures, including labor, material and overhead, increased only 22.2 per cent. It will thus be seen that the efforts of the Bureau toward obtaining increased output without proportionate increases in expenditures are slowly taking effect. The above is all the more noteworthy when consideration is given to the fact that cost of materials increased approximately 13 per cent during 1937.

"Efforts have been continued to increase the operating interval of airplanes between overhauls, and this interval actually will be increased an average of about 25 per cent for all operating airplanes during the fiscal year 1938.

Official Photo U. S. Navy

SIKORSKY PATROL BOMBER FOR THE NAVY

Front view of the PBS-1 flying boat built for the Navy by the Sikorsky Aircraft division of the United Aircraft Corporation. It is powered by four Pratt & Whitney Twin Wasp engines. The wheels are attached to take the boat from the water.

"Aircraft overhaul facilities have not been enlarged in proportion to the rapidly increasing number of airplanes operating. Overhaul shops are now congested, and any attempt to further increase the output of present facilities to any great extent will prove inefficient and uneconomical. Unless the proposed aircraft overhaul shops at Alameda are rushed to an early completion, we will be faced with the undesirable necessity of resorting to night shifts in shops now in use.

"With the advent of engines designed for 100-octane gasoline in sight, the Army and Navy acted jointly in sponsoring the development of a fuel which would meet this requirement. The development was successful, and during the fall of 1936 a gasoline became available which, with the use of practically no tetraethyl lead, is rated at 87 octane and which can be brought to 100 octane by the use of less lead than was used with the old gasoline to obtain 87 octane. The new fuel was given extensive service tests by using it exclusively in all the patrol planes based at Coco Solo during the last half of the year. Results were extremely gratifying. Increased engine reliability and consequent increased safety of operations immediately followed, due to freedom from previously-encountered corrosion, valve burning, untimely cylinder changes and various related troubles.

"At the time the new gasoline was purchased in quantity there

Official Photo U. S. Navy

BREWSTER SCOUT BOMBER

The SBA-1, an experimental ship built for the Navy. It is powered by a Wright Cyclone engine.

were only two refineries capable of producing it, and the cost per gallon was about eight cents greater than the old type. Due to its use by the Army and Navy, there are now seven refineries which can produce the new fuel, with several others which are installing equipment for it, as a result of which the price differential has been reduced from eight to three cents. It is anticipated that the new fuel will be used exclusively in high-powered engines, both military and commercial, within the next two years.

"The policy of supplying the service with engines of maximum performance consistent with reliability and endurance has been maintained by continuous development and improvement of advanced types of engine in cooperation with engine manufacturers, together with an uninterrupted program of proof testing. The latter includes not only laboratory tests, but also standardized flight service tests in new airplane types, supplemented by the necessary special tests required to cover the needs of naval aviation. As a result of this policy and based on the results of the test program and of developments in the experimental field, it has been possible to provide a growing list of improvements to service equipment. The two-row radial engine has continued its service history with marked success, as evidenced by the recent mass long distance flights of large patrol airplanes.

"Late models of all current service type engines have shown gratifying increases in power output and altitude ratings. Crankshaft torsional vibration dampers and full pressure lubrication to cylinder

ONE OF THE NAVY'S TRAINERS

A two-place North American NJ-1, powered by a Pratt & Whitney Wasp engine.

valve gear, now standard in recent service types, have been so satisfactory that similar equipment has been supplied to certain earlier engine types when mechanical characteristics and economical considerations warranted such action.

"Similar development and test programs are in progress on accessory devices to meet the increasing complexities of modern power plant installations, particularly as regards automatic regulation, for the purpose of minimizing the demands upon the pilot's attention made by the power plant while in flight. The entrance of additional manufacturers into the accessory field and the improvement of present standard type devices have been among the recent developments. Improvement in equipment and methods for starting under cold or wet weather conditions has continued to be actively pressed. In the propeller field the service application of automatic constant speed propellers has been continued.

"Experimental airplanes have been procured almost entirely for the purpose of serving as prototypes from which satisfactory production airplanes may be ordered in quantity, providing adequate competition among the manufacturers at the same time. Sufficient experimental procurement was contracted for during the past year to meet the needs of the service in this respect, and orders for experi-

Official Photo U. S. Navy

THE VOUGHT SB2U-1

A two-place scout bomber for the U. S. Navy. It is powered by a 700 h.p. Pratt & Whitney Twin Wasp Junior engine.

mental airplanes were placed to make it possible to continue orderly procurement in the immediate future.

"The increased speed and size of airplanes has necessitated more extensive structural testing, both in flight and in the laboratory, as a check on strength and to assist in correlating design data with actual flight conditions. In connection with these studies, the development of improved instruments for obtaining reliable data has been pursued and the availability of some promising equipment is expected in the near future.

"There have been marked advances made as the result of basic research coordinated with Service tests on various textiles, metals, protective coatings, and shop processes. Spot welding, flush riveting, quick drying protective coatings, light weight alloys, and similar items have reached a high state of development and are now in production. An outstanding contribution to the advancement of aeronautics has been the development and adoption during the past year of a protective treatment for magnesium alloys which will doubtless increase the

BUILDING WRIGHT ENGINES

Inspecting Cyclone engine cylinder heads and barrels at the plant of the Wright Aeronautical Corporation.

use of such materials. Light weight cotton fabrics of domestic origin have been developed which appear to be satisfactory substitutes for parachute silk. A development of a new series of landing gear wheels has been prosecuted and will result in a marked saving in weight for such equipment. The last year has also seen the development of oxygen breathing apparatus of efficient design for high altitude flying.

"Very gratifying progress has been made in the application of recent aerodynamic data in the design of naval aircraft, with marked improvement in efficiency and general performance. Further improvement is anticipated as it becomes practicable to incorporate the research findings of the National Advisory Committee for Aeronautics.

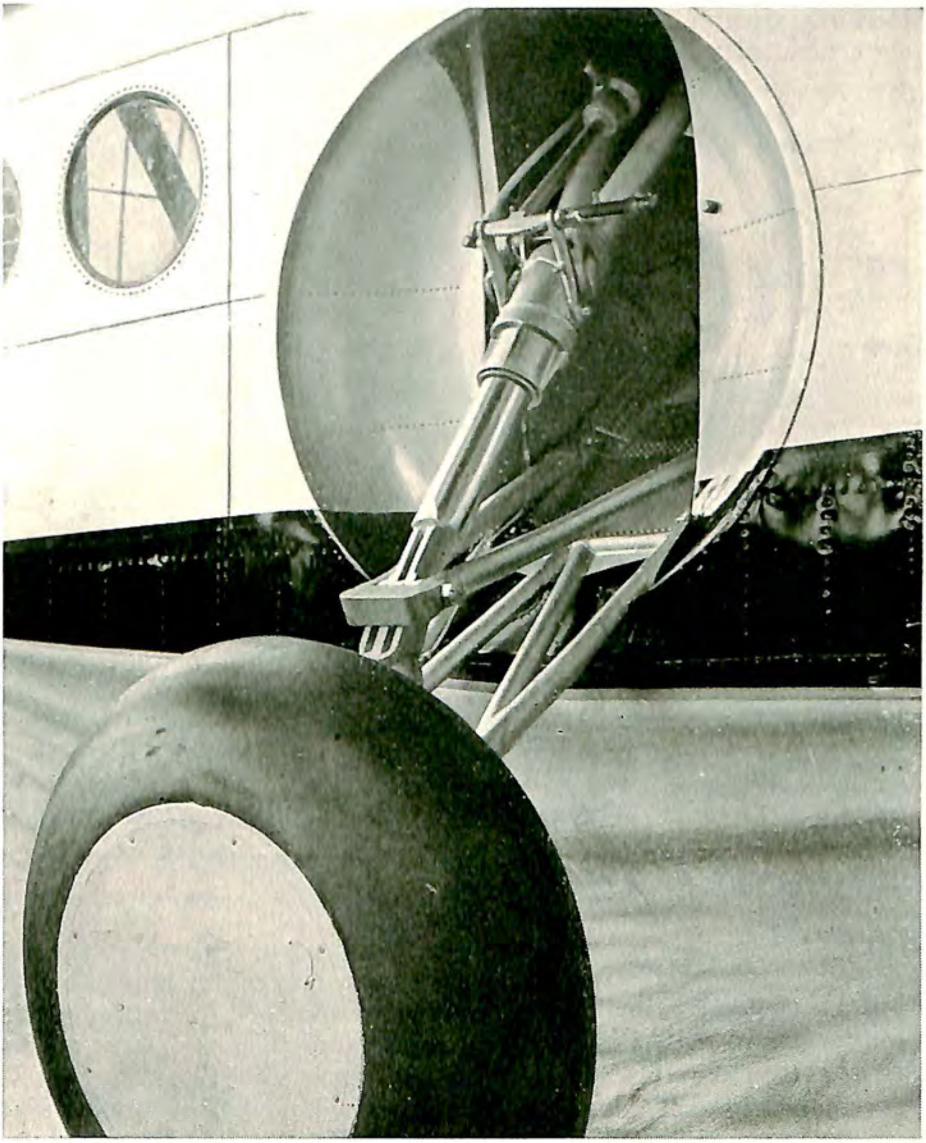
"The Bureau has obtained the fullest cooperation from the National Advisory Committee for Aeronautics on all questions involving pure research and on many problems concerned with particular design features. In accordance with long established policy those aerodynamic problems of a purely research nature are assigned to the

AN AIRCRAFT ENGINE PLANT

Interior of the Pratt & Whitney aircraft engine factory at East Hartford, Conn.

Committee for study at Langley Field, and in so far as it is practicable the specific design problems are investigated in the Bureau of Construction and Repair wind tunnels at the Washington Navy Yard. During the past year, the increased importance of careful aerodynamic study has made it necessary to rely on the Committee's facilities for investigation of design problems on large scale models beyond the capacity of the Washington Navy Yard. This assistance has been obtained in extensive tests in the Full Scale Tunnel, Free-Spinning Tunnel, High Speed Tunnel, Propeller Research Tunnel and Atmospheric Tunnel. The work involved has ranged from studies of simple wing models to the investigation of airflow and control on full scale airplanes.

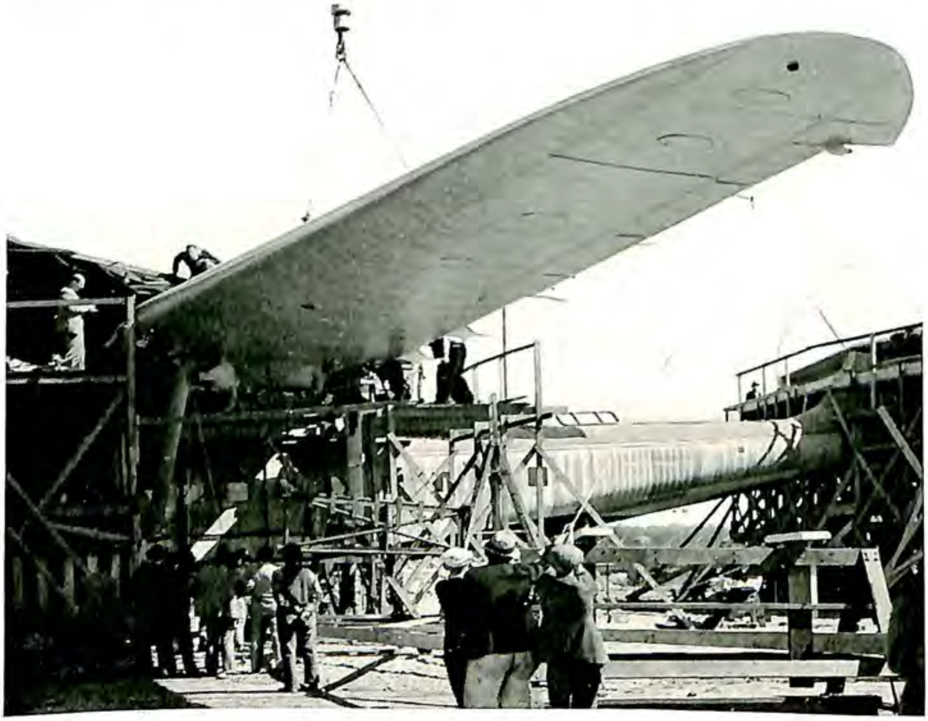
"Research and design development of improved flying boat hull



LANDING GEAR DETAIL, SIKORSKY S-43
Showing one of the retractible wheels down on the large amphibion.

lines have been very active, but the present limited capacity, especially in the matter of trying out indicated changes, is a severe handicap to rapid progress. The new Navy Model Basin is expected to supply ample facilities for testing systematic design modification.

"The Naval Aircraft Factory has continued to operate as a combined experimental and industrial plant. Its supply department acts as a central distributing agency for the purchase and distribution of



COMPLETING A SHIP OF THE AIR

Attaching the wing of the new Glenn L. Martin Cyclone-powered transocean flying boat, Model 156.

materials to the aviation organization of the Navy Department. The laboratories are continuously engaged in testing of aircraft, engines, equipment and materials used in aeronautics. The test may be on equipment submitted from other sources or, as in the case of developments peculiar to naval aviation of equipment of a confidential nature, the apparatus to be tested may be developed in the shops or laboratories of the Factory.

"Completely equipped workshops are maintained for the manufacture of experimental equipment, for the overhaul of aircraft and equipment and for a limited amount of manufacture of new aircraft and engines. The Factory has completed its first order of 85 airplanes and is currently engaged in the manufacture of additional training planes and of scout observation planes.

"The new engine manufacturing shop has been completed and placed in operation. The first engine of a production order has been completed and passed all tests. The remainder of the order is now in production.

"The principal addition to the Factory during the last year was

Official Photo U. S. Navy

THEY FLEW TO HONOLULU

Consolidated patrol bombers of the Navy Squadron VP-6 after their non-stop flight from San Diego to Honolulu.

the completion of improvements to the flying field and the provision of additional facilities for the test, both in the laboratory and in the air, of improved equipment and methods for handling aircraft on board ship.

"The aircraft building program continued to be based on the Vinson-Trammell Act which provides for the procurement of 'the necessary naval aircraft for vessels and other naval purposes in numbers commensurate with a treaty navy.' Aircraft for the 'Boise,' 'Honolulu,' 'Phoenix,' and 'Wichita' and for VP Squadrons 17 and 18 are being purchased with 1937 funds. The 1938 appropriation provides funds for airplanes for the 'St. Louis,' 'Helena,' 'Wasp,' and for VP Squadron 20 and minor miscellaneous shore station increases.

"Development of airplanes of increased range and striking power will continue, and greater simplicity of operation will be sought. It is expected that it will be possible to obtain improved maintenance characteristics in new designs under construction.

"Engines of improved reliability with greater horsepower and higher efficiency are in prospect. Experiments are being undertaken for the purpose of providing automatic functioning of certain power plant instruments and accessories in order to relieve the demands on flying personnel.

"Possible expansion of the instrument section of the Naval Aircraft Factory is being studied to permit a more thorough test of experimental as well as service installations.

"Important developments in radio, fuels, equipment, and launching and arresting gears on naval vessels are in prospect.

"Approximately 256 airplanes and 494 engines were delivered during the fiscal year." (1937)

During the year the Navy took delivery on a new kind of war craft, a bombing flying boat built by the Sikorsky division of the United Aircraft Corporation, and designated PBS-1. It was officially described as follows:

"It is a four-engine all metal, high-wing, full cantilever monoplane flying boat of new design, built under a contract awarded in June, 1936. It is powered by four Pratt & Whitney Twin Wasp engines of 1,050 horsepower each, and is equipped with Hamilton Standard constant speed propellers. Its armament will include bow, rear and center gun turrets incorporating many new features in armament design.

"Construction of this plane was undertaken by the Navy Department to explore the value of large flying boats in national defense, as for years it has sponsored their development by well-regulated experiments. This flying boat represents one of the most powerful bombing planes in the United States, having a military load carrying capacity comparable with that of any known existing airplane. It also will have the long range demanded of Navy patrol bombers.

"The designing and construction of this plane under Government control has been in progress for two years. Thousands of detail drawings were required during its building, and hundreds of thousands of man hours of engineering and shop labor were spent in its construction. The mock-up, constructed of wood and fabric, took six months to complete, and when finished was a full scale replica representing to the most minute detail the ship about to be built.

"Every important part of the flying boat was static tested to destruction, and safety factors far in excess of requirements have been built into this ship. Every known approved device for safety and ease of operation is incorporated in the construction. Aileron and flaps are of all metal construction, fabric-covered, with the full trailing edge flap permitting rapid take-off and slow landing speeds. A complete radio compartment is installed, with radio equipment comparable to that aboard a destroyer. Sound-proofed throughout and equipped with commodious living accommodations for the crew, a mechanic's workshop, cook's galley with electric stove, water distiller and dry ice refrigerator, sustained operation is possible with this ship and the physical endurance of the crew materially increased. It exceeds previous Sikorsky commercial flying boats by some five or six tons.

"While former Sikorsky flying boat designs have employed the wing up and above the hull, using semi-cantilever construction, the wing of this new Sikorsky patrol bomber is full cantilever and flush with the top deck. An auxiliary gasoline engine, besides the main power plant, drives the generator supplying a complete 110-volt electrical system for flaps, anchor winch, lighting, bomb controls and electric appliances in the galley. There are thousands of feet of electric wiring, all wires being carried through conduits and junction boxes. A complete telephone system makes possible immediate communication from bow to tail."

The Navy in August awarded the Goodyear-Zeppelin Corporation a contract for two non-rigid airships. One, of 125,000 cubic feet gas capacity, will be used for training and general utility purposes, and the other, 400,000 cubic feet capacity, will be for coast patrol. The new ships will be based at the Naval Air Station at Lakehurst, N. J.

Lieut. Carl O. Petersen was awarded the Distinguished Flying Cross for his services as photographer and radio operator with the Byrd second Antarctic expedition. He was on a flight over hitherto unexplored Antarctic waters filled with icebergs and the situation became extremely critical; but Petersen with apparatus hardly suitable for rough weather operations showed extreme courage and ability, and was able to obtain radio bearings which let the ship get back to its base.

The Herbert Schiff Memorial Trophy for the highest record of safe flying was awarded to VN Squadron 8D5 at the Naval Academy. While under the command of Lieut. Comdr. Andrew C. Mc-

Fall the squadron flew a total of 4,154 hours and won out against 82 other Navy units.

The Rear Admiral William A. Moffett Memorial Trophy for safe flying by battleship or cruiser based units was won by the aviation contingent aboard the battleship "California."

The Naval Air Station at Lakehurst learned something about pigeons during the year. A statement from the Bureau of Aeronautics reads: "It was found that during a series of experiments made by releasing the birds from a radio station at Ocean Gate, N. J., while the station was transmitting the pigeons circled in an erratic and confused manner very close to the station and were from 42 to 52 minutes returning to their home station at Lakehurst, only 10 miles away. Pigeons released from the radio station while it was not broadcasting circled in the conventional manner and departed for home within five minutes, arriving in from 19 to 21 minutes. From such a short series of tests it is only possible to say that there appears to be some foundation for the press stories that carrier pigeons are affected when released at a radio transmitting station. Exhaustive tests would be required to provide conclusive results."

A COAST GUARD AIR STATION

The station at Biloxi, Miss., with two Grummans and a Douglas amphibion ready for action.

CHAPTER V

COAST GUARD AVIATION

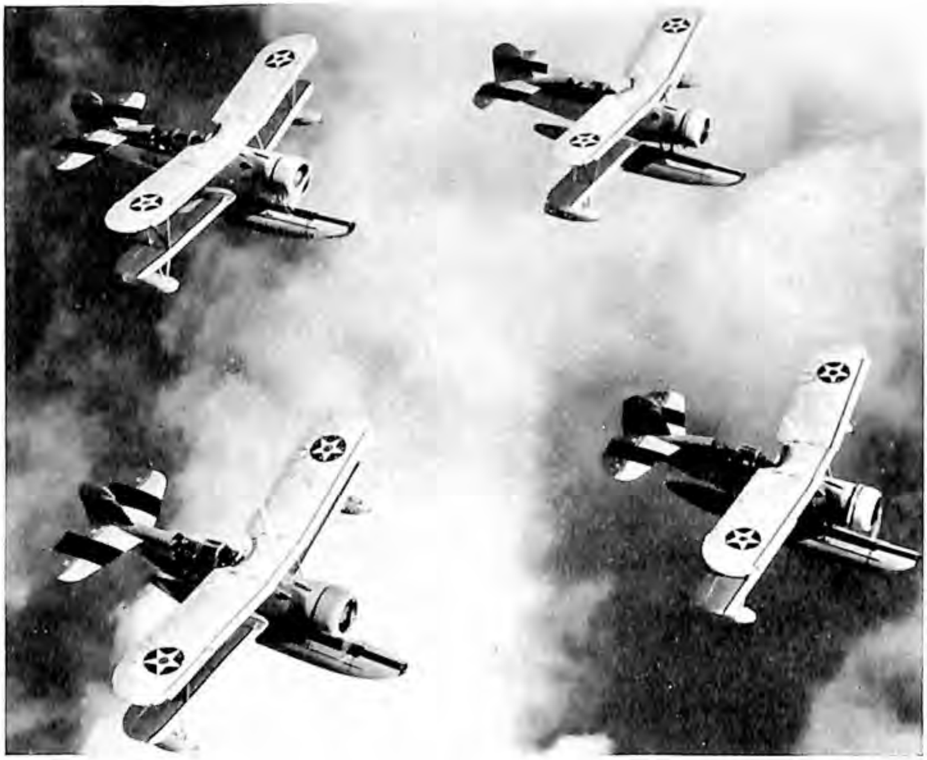
An Amazing Record—Night Flights—Life-Saving—Heroic Adventures—New Air Stations.

DURING the fiscal year 1937 the aviation division of the U. S. Coast Guard made an astounding record both in the number of hours flown and the different activities in which the flying Guardsmen were engaged. Coast Guard aviators flew more than nine thousand hours in the course of 3,842 flights during the 12 months. They made 254 flights at night, mostly out over the open sea, and they made 99 landings on these open seas off the coasts of the United States.

They flew a total of 780,545 miles and searched areas aggregating 5,862,618 square miles. They located 360 illicit distilleries which later were seized and destroyed. They identified 34,844 vessels at sea during the year; and they identified 6,444 airplanes. They located 37 smuggling vessels and two smuggling airplanes, and they seized nearly 42,000 gallons of contraband liquors valued at more than twenty thousand dollars. They reported 57 obstructions to navigation, flew out and dropped messages to 168 vessels warning them of impending hurricanes. They located 154 disabled ships, responded to a total of 506 requests for assistance. They flew out from their bases and rendered help to 293 persons, in many cases saving their lives. They took off from disabled vessels 11 persons who otherwise would have drowned. They took aboard a grand total of 948 persons in need of assistance in one form or another. They transported 185 medical cases, mostly from ships at sea where all other facilities were lacking for help of any kind. They rendered assistance to other Government departments in 428 cases.

Every official report of these Coast Guard flights offers striking evidence of the heroic deeds accomplished in the course of what is set down as routine duty. It was simple routine duty that sent three

Guardsmen flying into Assateague Anchorage, Va., one cold winter's night. They were Lieut. Luke Christopher, hero of scores of daring exploits, Chief Radioman Gay A. York and Aviation Machinist's Mate Ralph A. Green. At Assateague they took aboard one John Barrina who was desperately ill. Soon they were off again on the flight back to Norfolk where Barrina could be placed in a hospital. But they never reached Norfolk.



Official Photo U. S. Navy

CURTISS SOC-1 SCOUTS

This is one of the formations during the U. S. Navy maneuvers. The SOC-1 is a convertible land plane or seaplane adaptable for use on aircraft carriers, battleships and cruisers, as well as for land service. It is powered by a Pratt & Whitney Wasp engine.

Two miles offshore the flying boat crashed. Here we quote the official report: "Lieut. Christopher was badly injured. Barrina and Green were seriously cut and lapsed into a semi-conscious condition. York, who had been thrown out of the hull with his radio equipment in the crash, was also seriously cut and otherwise hurt, but he remained conscious and alert. He saw that the plane was sinking. Only one wing remained on the surface with the top of the hull which was smashed. York, although his vision was hindered by the flow of blood, discovered the hole that he had made in the hull and swam to it, managing to climb inside again. The first man he found was Barrina and he was able to get him out of the wreckage, pull him through the hole and out on the wing. Then York went back into the hull and found

HURRICANE WARNING

A Coast Guard plane dropping a message to a small vessel lacking radio, telling of the approaching storm.

Green whom he pulled, tugged and finally pushed up through the hole and out on the protruding wing.

"York next looked for Lieut. Christopher, feeling his way forward to the pilot's seat, where he found the officer partly submerged in the wrecked seat. He loosened the safety belt and tried to pull the helpless pilot out into the hull, but his feet were entangled in a mass of bent metal and wires. York had to feel his way under water several times before he could disentangle the lieutenant's feet. He then succeeded in pulling the injured officer through the hole, and with great difficulty swam with him to the wing of the wrecked plane where the other men were still holding on. Green assisted York in getting Lieut. Christopher on the wing, after which York crawled up himself and bathed his wounds in salt water to staunch the flow of blood.

"Green, meanwhile, had been yelling for help without response, and he and York now shouted in the direction of the surf station dock, but received no response. York next tried to ascertain the depth of the water by forcing himself down alongside the hull, but after several attempts he was forced to desist on account of the cold. He then told Green he was going to swim to shore and bring help, but

WACOS FOR THE COAST GUARD

This is Waco Model EQC-6, powered by a Wright Whirlwind engine.

Lieut. Christopher, who had momentarily regained consciousness, begged York not to leave him. York placed the officer's head and shoulders on his lap, and was endeavoring to comfort him when the surfboat from the Assateague Coast Guard Station arrived."

Lieut. Christopher died shortly after being taken ashore. Both he and York were awarded gold life saving medals. Medals also were awarded to Lieut. Stanley C. Linholm, Lieut. Arthur J. Hesford, Chief Pharmacist's Mate Thomas A. Montgomery and Radioman John E. Reiley for rescue work described in the following official report:

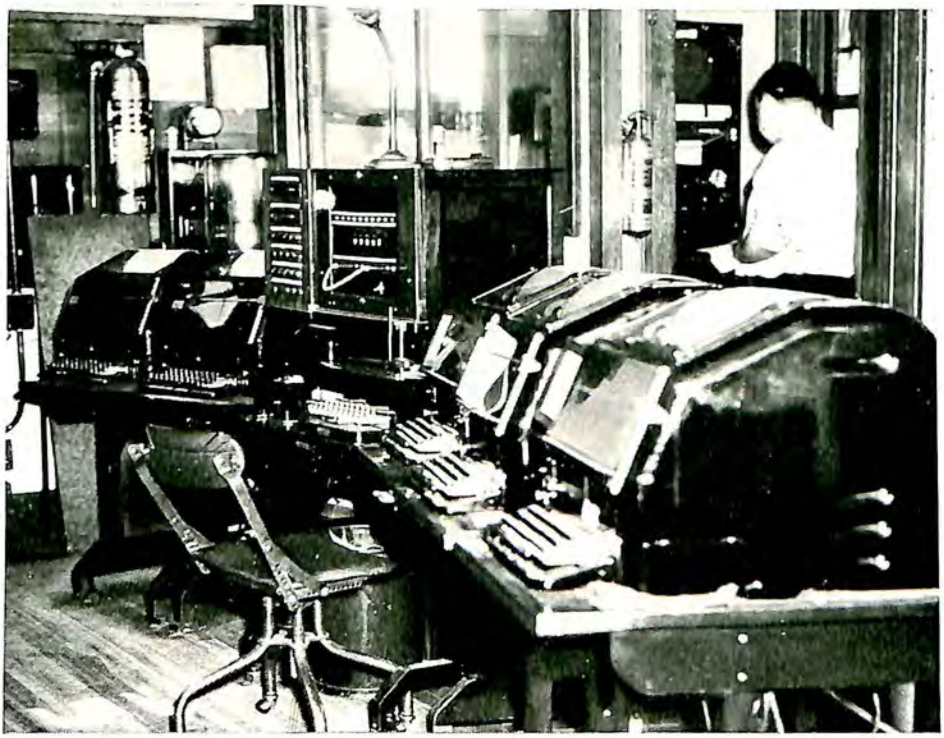
"Early in the afternoon on May 10, 1937, the police of San Diego, Calif., telephoned the local Coast Guard station that two youths in a small boat were in distress off Mission Beach. The Guardsmen soon had their plane in the air. Arriving over the scene they saw two young men clinging to an overturned boat about 300 yards from the channel at the outer edge of the breakers. They circled several times looking over the situation, and found there was a very heavy surf running at this point due to the strong current through the channel. There also was a very heavy swell running in from the sea. At this time they noted that the Mission Beach life guards who had been trying to reach the victims had had their surfboat capsized in the outer breakers. So Lieut. Linholm risked a landing in the open sea outside the breakers.

INTERIOR OF SIKORSKY S-43

This is the main compartment of the twin-motored Sikorsky. It is powered by Pratt & Whitney Hornet engines.

It was a dangerous and difficult task, because the full force of the swells struck the bottom of the plane. But they landed and taxied around toward the beach, turned through the outer surf and headed into the wind in a manner which brought them near the capsized boat. When the plane came adjacent to the young men, a line was thrown to them from the bow and after-hatch, and the now semi-conscious men were hauled aboard the plane where they collapsed. The chief pharmacist's mate rendered the necessary medical assistance. Lieut. Linholm then taxied about nine miles into a lee where a take-off could be made."

The Coast Guard completed new air stations at Charleston, S. C., and San Diego, Calif. The air patrol detachment at San Antonio, Tex., was transferred to El Paso. When the air station at Floyd Bennett Field, New York, is completed the Cape May, N. J., station will go out of commission. Other stations are located at Salem, Mass., Miami, Fla., St. Petersburg, Fla., Biloxi, Miss., and Port Angeles, Wash. Several Hall-Aluminum flying boats with a range of 2,000 miles are being built for the Coast Guard, which also has ordered a number of Curtiss-Wright SOC-4 scout planes to be carried aboard Coast Guard vessels.



A FEDERAL AIRWAYS STATION

Interior of a Department of Commerce airways teletypewriter station showing teletypewriter machines and radio broadcast booth from which is broadcast the data gathered from points along the airways. The operator is making an hourly broadcast to airmen.

CHAPTER VI

FEDERAL GOVERNMENT ACTIVITIES

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

MORE than a score of the departments and bureaus of the United States Government are actively engaged in aeronautical work, and much of it is as fascinating and thrilling as the adventurous stunt flights undertaken by heroes of the air.

Bureau of Air Commerce

The Bureau of Air Commerce, Department of Commerce, which is the agency of the Federal Government charged with supervision over civil aviation, has made an excellent job of supervising the construction of aeronautical equipment so that it will be airworthy and free from structural defects when used by the public. The manufacturers, of course, have their own rigid requirements before their planes, engines, propellers and other equipment leave their plants, but they welcome this control by the Government because it prevents careless or unscrupulous competition by upstart builders or promoters who otherwise might produce inferior and dangerous machines or import them from abroad for sale to the trusting public here. Thus the aircraft manufacturing industry in the United States cooperates wholeheartedly with the Bureau of Air Commerce. As a matter of record the aircraft manufacturers started asking for this Federal regulation soon after the World War; but they did not receive it until 1926. The present system accounts for the unexcelled reputation of American aircraft, even among competing manufacturers abroad.

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

LIKE A BRIDGE STRUCTURE

This massive truss type metal spar forms part of the framework of a wing on the Boeing 314 flying boats built for Pan American Airways transocean service.

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 "Aircraft Engine

THE AERONCA KC

It is powered by the Continental engine.

Airworthiness" (CAR 13), 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

SEVERSKY AMPHIBION FIGHTER

These two-place Wright Cyclone-powered machines were purchased by the governments of Russia and Colombia.

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.

Bureau of Fisheries

The Bureau of Fisheries, of the Department of Commerce, chartered airplane service for patrol of fisheries in Alaska, employing six companies on 31 days. Total flying time was 91 hours, during which the planes traversed 9,335 miles. In addition planes were chartered for transport purposes.

Bureau of Foreign and Domestic Commerce

As commerce follows the flag, a corollary axiom would be that the flag creates commerce. In promoting American aeronautical business abroad, the Bureau of Foreign and Domestic Commerce has put an old saying into practical application. Celebrating its twenty-fifth anniversary, the Bureau of Foreign and Domestic Commerce supplied a stream of information to American business on the prospects for marketing aeronautical products. In its 34 offices in foreign countries, in charge of commercial attaches and trade commissioners, the data were collected and forwarded to Washington. There it was correlated by the various office divisions and disseminated to business interests, either directly or through the Bureau's 79 district and cooperative offices in principal cities.

Governing the flow of information to the aeronautic industry is the Automotive-Aeronautics Trade Division of the Bureau.

In recent years approximately one-third of our production of planes, aircraft engines, and parts has been sold abroad. The service facilities of this division are of special interest to manufacturers and agents of aeronautical products and domestic air transport operators. The division, through its aeronautics trade section, supplies specific leads on foreign sales opportunities, as well as export statistics and information regarding foreign civil aeronautic operations, equipment purchases, equipment and airport construction, aviation ground facilities and air regulations. It supplies basic figures and other factual data of use for long-range planning by firms, individuals and public agencies concerned with the encouragement and stimulation of sound development in industry and commerce. "Aeronautical World News," a tri-monthly publication issued by the division, offers a concise cross section of current civil aviation developments abroad.

Federal Communications Commission

Something new in the emergency issuance of aircraft radio licenses was started in 1937 by the Federal Communications Commission. When conditions warranted, the commission announced, requests for such permits would be honored. But, it added, they must be specific and complete as to the nature of the authorization requested and, moreover, must justify the emergency. The commission continued to make provision for the growth in the communications system associated with the aviation service. During the year there was organized a communication system to serve aviation in Alaska. This will permit

A DOUGLAS DC-3 ABROAD

One of the Wright Cyclone-powered Douglas DC-3 transports operated by Royal Dutch Airlines.

the issuance of licenses to those interested in this field with the greatest economy of frequencies. In addition, provision was made for the allocation of frequencies above 30,000 kilocycles to the aviation service, effective October 13, 1938. The allocation plan provides frequencies for student instruction, for instrument landing and airport control. The latter frequencies will replace 278 kilocycles heretofore allocated for that purpose. It is believed that these new frequencies will make a valuable addition to aviation communications. The frequencies 3105, 3120 and 6210 kilocycles, day only, are still available for the private flier. All stations of the Department of Commerce and many stations licensed by the Commission maintain a continuous watch on 3105 kilocycles.

Geological Survey

The planned city and the planned countryside of the future—if not indeed of the present—depends on the fine art of aerial photography. The development of both urban and rural areas, the use of land and changes in the courses or borders of rivers and lakes can be followed and guided by the gimlet eye of the camera. Hence the work of the Geological Survey, U. S. Department of the Interior, during the year 1937, although of a slow and tedious nature, constituted valuable research work in the field of natural resources.

During the year ended June 30, 1937, the Geological Survey completed the compilation from aerial photographs of base maps without contours (planimetric) of 18 quadrangles (7½-minute) and parts of quadrangles in Louisiana, a total of 1,045 square miles. Line map bases (planimetric) of 26 quadrangles (15-minute and 7½-minute) and parts of quadrangles in other States (Arkansas, Massachusetts and Missouri), with a total area of 1,720 square miles, were also compiled from aerial photographs. A topographic map of a part of one 15-minute quadrangle in Virginia was made by means of stereophotogrammetric methods. The total area of planimetric maps compiled amounted to approximately 2,765 square miles.

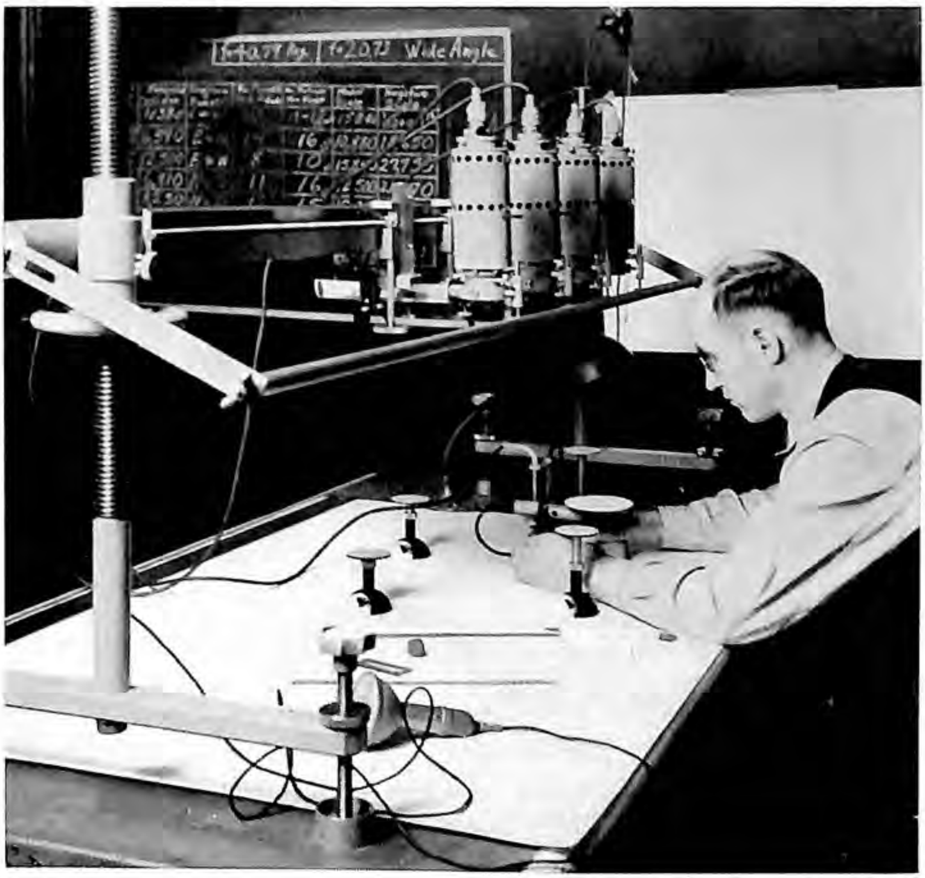
Commercial firms photographed for the Geological Survey 471 square miles, and photographs covering 4,916 square miles were purchased from commercial firms, these photographs having previously been taken of areas later planned for mapping by the Geological Survey. The Army Air Corps photographed 245 square miles for the Survey, and negatives covering approximately 3,000 square miles were borrowed from other Government agencies in order to make contact prints for use in map compilation work. The practice of borrowing negatives from other Federal agencies has resulted from the use of standard specifications for aerial photography for general map work and land studies (approved by the Secretary of the Treasury May 27, 1937). The specifications set forth the scale of photographs that will meet the requirements of all Government services, as well as the type of photograph and conditions governing the actual photography.

The Geological Survey now has two complete multiplex aerial projector units engaged in topographic mapping for the Tennessee Valley Authority. Previously, only one of these instruments was in use. It proved to be very successful and a second one was purchased in order to speed up production. Other units have been ordered. Another stereoscopic apparatus (the aerocartograph) has been in constant use since its overhauling and partial reconstruction at Wright Field.

The Geological Survey's principal interest in the use of aerial photographs is in its standard topographic mapping activities. Aerial photographs, however, are of great value to the geologist and during the past year the use of them by geologists increased materially.

The value of vertical aerial photographs for planning and land-use purposes is set forth in the following extract from the report of the Pennsylvania State Planning Board:

"In order to plan intelligently, it is necessary to have an inventory



Official Photo Geological Survey

THE AEROCARTOGRAPH

The Geological Survey of the U. S. Department of the Interior uses this instrument in making topographic maps from aerial photographs.

of the physical and topographic features of the area together with cultural improvements such as highways, reservoirs, parks, forests, agricultural land, homes and industrial buildings. Air photographs provide an accurate and economical inventory of the topographic features of an area and of its physical cultural improvements. Since they show every feature on the surface of the earth visible to the eye, they are of extreme value in planning for State, county and municipal improvements. Air photographs show houses and factories, streets, railroads, farms and forests, parks, airports, streams and lakes. From the photographs experts can detect the types of crops, abandoned farm land, and in many cases the boundaries of soil classes and evidences of erosion. When taken at periodic ten-year intervals, air photographs serve as a reliable land-use census. The growth and development of urban areas, the extension of transportation networks, the additions to park and farm lands, and the progress of reforestation can be determined by comparing the photographs."

It cannot be too strongly emphasized, however, that a vertical aerial photograph or a mosaic constructed by the assemblage of several single prints is not a map. The single print or mosaic is a perspective picture with many different planes of elevation on which no accurate scaling can be done without correction of displacement caused by relief.

The aerial photograph is a valuable aid in mapping, giving details of the terrain that are practically impossible to map by the usual surveying methods without prohibitive cost of time and money; but it must be borne in mind that ground control is an absolute necessity in the compilation of these data in map form, by either graphical or stereoscopic methods, in order that all features may be accurately located in their true relative positions.

Hydrographic Office

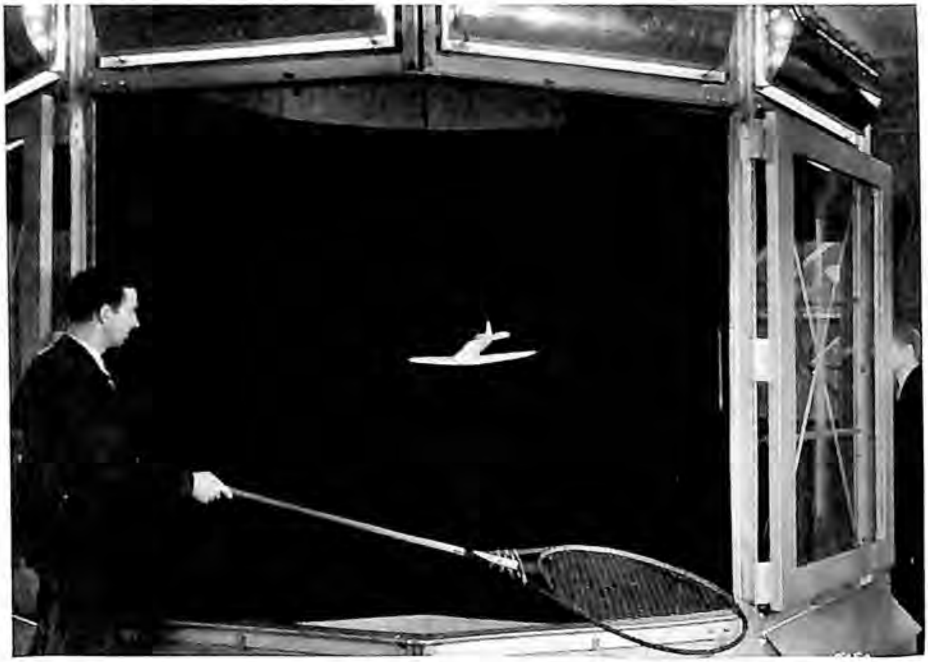
The Hydrographic Office, of the Navy Department, publishes and supplies aviation charts to air pilots covering certain areas outside the United States; collects and disseminates timely information, and furnishes various other aids contributing to the safe navigation of aircraft. The office has on file considerable data pertaining to the principal airports and seaplane bases of foreign countries. This information will be supplied upon specific request to pilots contemplating extended 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."

Increasing interest in international air transport services was re-



Official Photo N A C A

N A C A FREE-SPINNING WIND TUNNEL

When a model is allowed to spin in the air shaft of this tunnel, clockwork built into the model automatically sets the controls for recovery, the results being recorded by a motion-picture camera. These tests indicate whether an airplane will be stable and controllable before the plane is put into production.

flected in the numerous meetings held by the Interdepartmental Committee on Civil International Aviation during 1937. Arrangements with the Governments of the United Kingdom, Ireland and Canada for the operation of transatlantic air services, which had engaged the attention of the Committee for many months, were concluded in April.

A number of meetings were occupied with discussions pertaining to the extension of services by American operators in South America.

These services have now been extended to include all of the South American republics.

The Committee devoted considerable time to the consideration of problems connected with United States participation in the Inter-American Technical Aviation Conference which was held at Lima, Peru, in September. Consideration was also given to arrangements for an aviation conference with Canadian officials to be held in Washington in January, 1938.

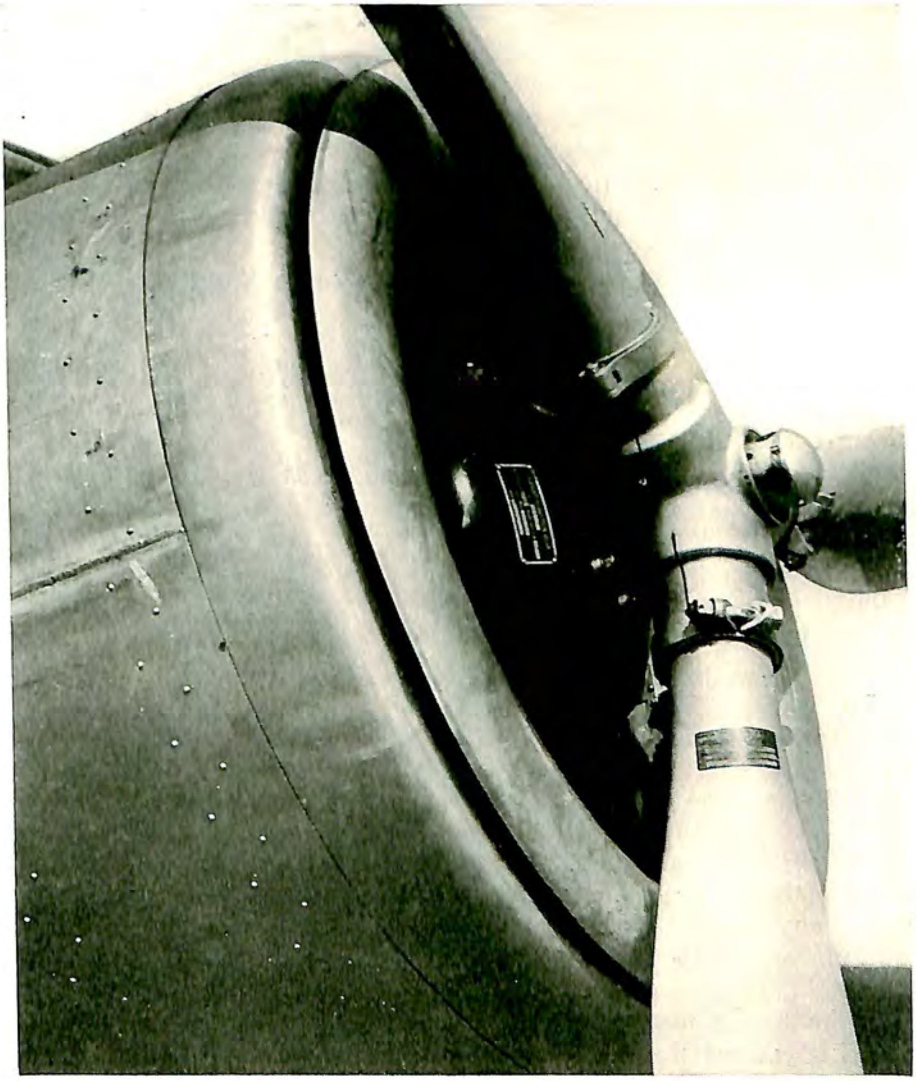
National Advisory Committee for Aeronautics

It was 1918—wartime! In battle-torn France, high above no man's land, Allied and German planes hurtled through the air, spitting death at each other. As they fought for position—twisting, diving, and dodging—mighty air pressures tore at the frail machines. Often, even before screaming bullets hit their marks, the planes went into crazy spins from which they never recovered. Frequently wing fabric ripped away, throwing the craft out of control and dashing pilots to swift death.

Officials of the United States air forces were baffled. Why did wing fabric rip so easily? The solution of this mystery would mean a saving of lives as well as airplanes. So, at the request of the army Uncle Sam's aeronautical research organization—the National Advisory Committee for Aeronautics—went into action. They welcomed problems. It was their job to translate the mysteries of the air into cold, tangible facts.

The Advisory Committee's engineers rolled up their sleeves, dug in, and before long emerged with a report. Tests revealed that during flight the air "load" at the leading edge of a wing was 10 times greater than at any other place on a plane. No wonder wing fabric ripped so easily. The weak forward portion of a wing was an invitation for unrelenting wind forces to take their toll. According to the NACA, reinforcement of the leading edge was the logical way to prevent similar air disasters. Before long every airplane wing in the world had reinforced leading edges, something they had never had before.

With the solving of this early aeronautical problem, the National Advisory Committee for Aeronautics, or the NACA, established itself firmly in aviation's scheme of things. Since then, down through the years, the NACA has been supplying the missing pieces in aviation's jig-saw puzzle, scoring technical triumphs which have paved the way for man's conquests in the air. The NACA's important laboratory findings have made flying safer, shrunk the gaps between distant



Official Photo N A C A

A NEW ENGINE COWLING

This is the latest achievement of the National Advisory Committee for Aeronautics in motor cowling. It is the "nose slot" type, developed in 1937, making possible improved cooling of airplane engines at low speeds.

places, and meant an annual saving of millions to the aviation industry.

Created in 1915 by act of Congress, the NACA was charged with the duty of supervising, directing and conducting fundamental scientific research in aeronautics. From its very beginning the Committee has literally thrived on the problems of flight. Its buildings and apparatus have grown steadily until today its workshop, the Langley Memorial Aeronautical Laboratory at Langley Field, Va., is recognized as the largest and best equipped aeronautical research laboratory in the world.

Of all the NACA's amazing research apparatus, however, the wind tunnels are most spectacular. In all, there are 14 of these machines which, at the touch of a switch, create streams of air. In these magic "caves of wind", engineers make vital aerodynamic tests, using experimental equipment ranging from frail model planes to full-size aircraft.

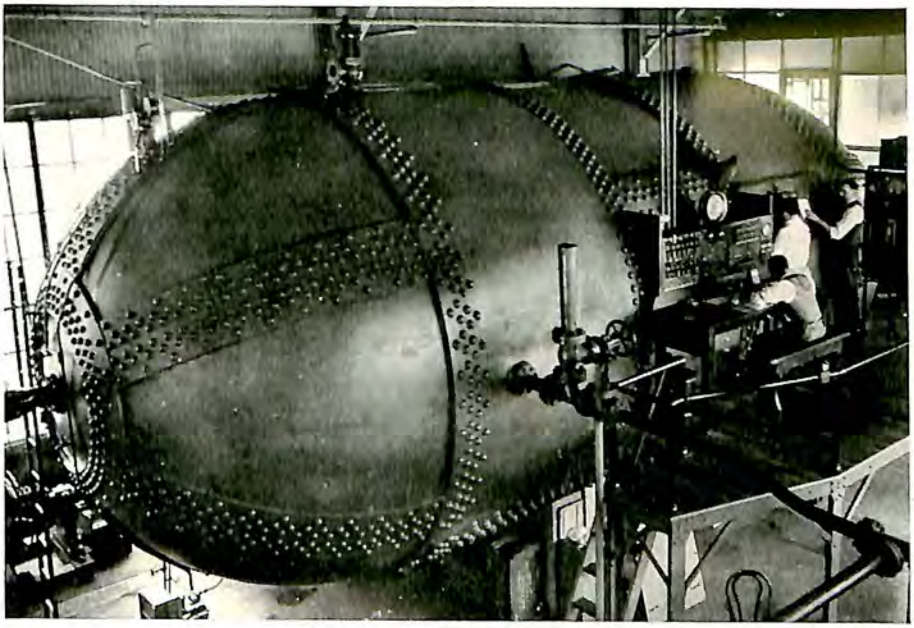
Man assumes dwarfed proportions when he steps into the gargantuan-sized full-scale tunnel. Here any airplane, up to a wing span of 45 feet, may be set on delicate balances, above a control house. With the twist of a dial, the tunnel's huge propellers start whirling, sending an ever-increasing blast of wind swishing past the plane. Driven by motors totaling 8,000 horsepower, the propellers tower nearly 36 feet in height, yet are balanced so delicately that a child's touch can move them.

Today, one of the NACA's further contributions to the high speed era is its new 500-miles an hour wind tunnel. With all countries striving to develop lightning-fast air forces, the real necessity of the high speed tunnel in research circles is quickly perceived. The Army and Navy look to the NACA for new technical data, making possible the continued development of military aircraft superior to that of any other nation.

Impressively modern in design, the high speed tunnel is the realization of engineers' labors and dreams of the last generation. Dome-shaped and with walls of thick concrete, the test chamber of the new tunnel is entered through air locks. When the tunnel is operated at high speeds the pressure inside drops to that experienced at an altitude of 14,000 feet. At the same time the chamber itself withstands an outside air "load" of 15 million pounds.

The Langley Field visitor, inspecting for the first time the vast laboratory, finds that each wind tunnel serves a distinct purpose. In the smoke flow tunnel, streamers of smoke are directed into the air stream, thus making possible the visualization of the nature of air flow around objects. In the refrigerated wind tunnel, conditions of rain, sleet, snow and ice formation on airplanes are simulated and studied.

Among the newer tunnels, the "free-spinning tunnel" is of especial interest. In this workspot, tiny model planes, their controls set for spins, are launched into a vertically flowing column of air. As the tiny craft spins, engineers jot down notes and cameramen grind away on moving picture machines. The spins continue until the upward air flow is cut off; or, until tiny robot pilots guide the model planes to recovery.



Official Photo N A C A

N A C A VARIABLE-DENSITY WIND TUNNEL

This variable-density tunnel at the laboratories of the National Advisory Committee for Aeronautics is built within a steel tank, so that small airplane models may be tested in compressed air to give results comparable to those obtained in actual flight tests.

From the free-spin experiments come data so accurate that actual test flights are planned from them. Often, NACA pilots take planes aloft and guide them spiraling earthward, depending only on predetermined laboratory data for everything to come out all right. And this faith is quite justified. Never has this procedure brought grief to plane or pilot. Because of the dependability of free-spinning tunnel tests, American airplane designers are saved the expense and danger of constructing and flying full-size craft before knowing their true merits in a spin.

Located near the broad mouth of the Chesapeake Bay, less than 100 miles from the windswept sand dunes of Kitty Hawk, N. C., where the Wright brothers gave aviation its first successful push upward, the NACA's vast laboratory is the Mecca for air-minded people from every corner of the globe. Foreign aviation missions, the industry's leaders, military and civil officials as well as everyday citizens find the "lab" a most amazing place with eye-filling wonders to stagger a Barnum and unique technical apparatus to delight the most exacting scientist.

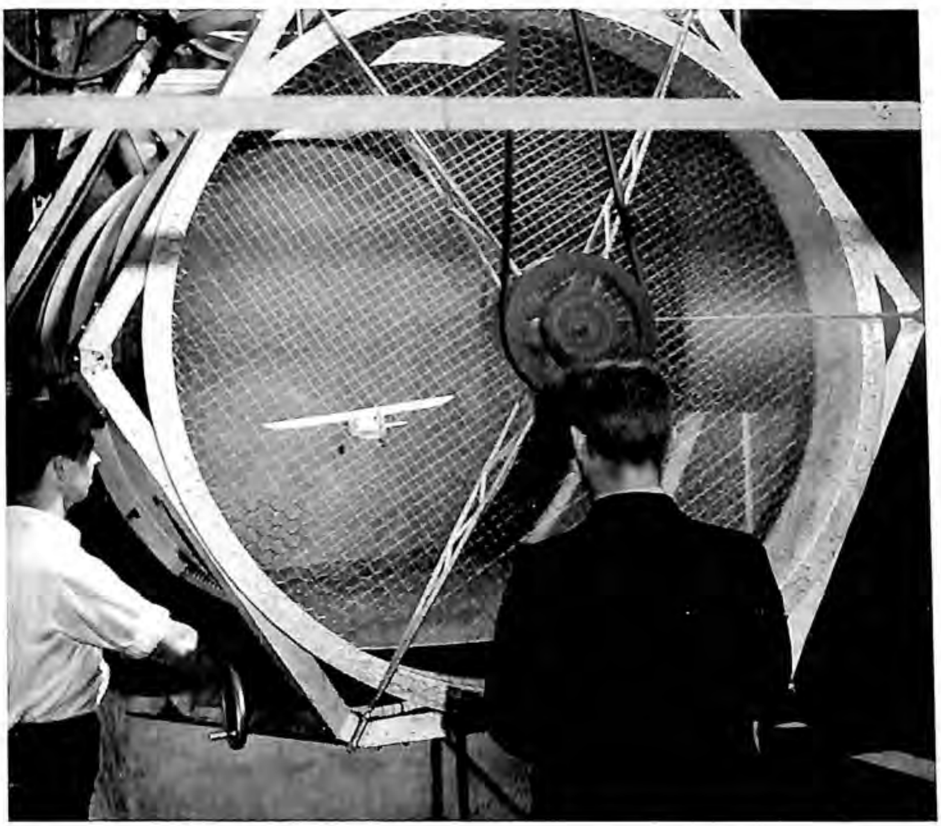
There is magic in the air at Langley Field. Wind tunnels roar, sleek clipper hulls race through seaplane testing tanks and model planes go into dizzy spins. Surrounded by a maze of mechanisms, diligent scientists toil over graphs and formulas while outside, far above the NACA buildings, steady-nerved test pilots point "flying laboratories" cloudward, in quest of practical facts of flight, that theoretical figures may be verified.

Of all the wind tunnels at Langley Field, the so-called "full-scale" is the largest. In fact, it is the largest in the world and until a very few years ago was the only one of its kind in existence—the envy of every foreign power. In this tunnel are studied the flight characteristics of full-size airplanes. Therein lies the real importance of this piece of equipment. Without leaving the ground and without being disturbed by vagaries of weather, NACA engineers simulate actual flight.

When a full-scale experiment is in progress, an engineer may settle down in the cockpit of the experimental airplane and enjoy the sensation of "flying" at 118 miles an hour—without actually traveling a foot! As the chilly wind rushes by, he shifts the controls, maneuvering rudder and ailerons while gauges record air pressures on the plane. The most dangerous part of this thrilling "trip" is the dizzy climb up a high ladder by which the "pilot" gets into the plane.

Another wind tunnel which holds a favored spot in the hearts of NACA men goes by the name "20-foot propeller research tunnel". If an NACA engineer speaks at length about this 20-foot tunnel the reason is soon apparent. For in this tunnel was completed a series of investigations so sweepingly successful that aviation was advanced many years ahead in one giant step. And, although it is true that aeronautical history is being made day and night in the NACA laboratories, these achievements were sparkling highlights in the annals of flight.

It happened about 10 years ago. Humans had ceased pinching themselves over their miraculous ability to fly. Aviation wanted to take stock of itself. It was evident that the airplane offered more than certain well-defined advantages in warfare. Already the world had been girdled by sturdy planes; oceans had been humbled; the banner of exploration had been flown over hitherto inaccessible



Official Photo N A C A

NEW N A C A FREE FLIGHT WIND TUNNEL

Here at the laboratories of the National Advisory Committee for Aeronautics is the first wind tunnel of its kind, where the airplane model is unrestrained and flies freely, making possible a new method of studying airplane stability and control characteristics.

lands. Trade winds now smiled favorably upon men of the air. And now, more than ever before, the industry yearned for airplanes larger, safer and swifter.

Aviation's leaders were fully aware of their major problems. So they laid them before the NACA: "How may airplanes better overcome air resistance? What are the main contributing forces of drag on a plane?"

In the NACA 20-foot propeller research tunnel, a vigorous program got underway. First, an airplane was completely stripped. Patiently, the engineers studied the resistance of each of its parts. After investigations were well along, the men were surprised to find that nearly 70 per cent of a plane's resistance was caused by the engine and landing gear, while the balance of its drag was caused by the rest of the structure.

Before they had completed their job, engineers evolved the NACA cowling, a streamlined metal hood which slipped over the engine. It was hailed, at the time, as the NACA's greatest contribution to aeronautics. Little wonder! A plane flying, say, 118 miles an hour was stepped up to 138 miles an hour by placing the cowling over the engine. An increase of 20 miles an hour without touching the throttle! It meant a tremendous saving in fuel as well as faster transportation schedules. Then too, the cooling properties of engines were improved considerably.

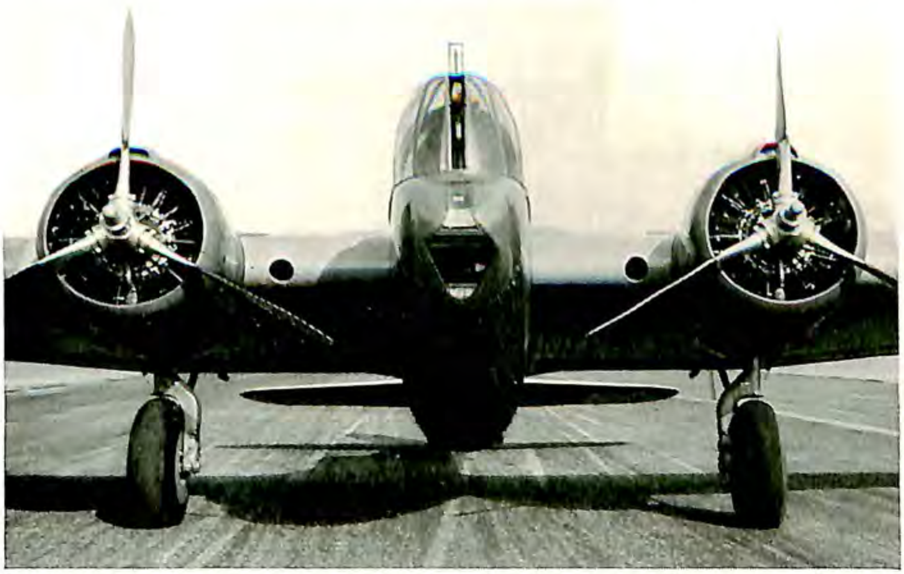
Important as was the cowling, it soon was eclipsed by other discoveries made in the NACA 20-foot propeller research tunnel. There engineers determined the best relative position of engines and wings; developed wing fillets; and showed the urgent need for retractible landing gear. These findings did more than any other research achievements to send aviation whizzing off into the era of high speed travel.

Overnight a new military airplane—the Glenn L. Martin bomber—hurtled into prominence. Of startling advanced design based on NACA research, this flying war machine could speed more than 200 miles an hour. Government air officials were amazed! At that time the Army's standard bomber could travel only 125 miles an hour. Not only was this new bomber swifter than any other of its class, it could actually overtake the fastest pursuit plane then in existence. Before long it revolutionized air defense tactics throughout the world.

Commercial transportation, also, gained much from the vigorous research program pursued in NACA research tunnels. Cruising speeds of air transports were increased. And, remarkable to note, as speed of passenger ships shot upward transportation costs plunged downward. It is estimated that during 1936 alone the use of the NACA cowling and the data on engine-wing position meant a saving of approximately 74 million dollars to American flying.

The NACA's maritime version of a wind tunnel is the seaplane tank. Here are studied scale models of hulls of flying boats. The "tank", the longest testing basin of its kind in the world, is over a half mile in length, 24 feet wide and 12 feet deep. Giant clippers, which today are leaving endless wastes of ocean in their wakes, first had their hull designs tested in the NACA tank.

When a seaplane hull test is underway, the laboratory guest may get the most exciting ride of his life. The towing carriage, to which the model hulls are attached, is capable of speeding over a mile a minute. Few vehicles on earth give so great an impression of terrific speed. Slicing through the smooth waters of the basin, the sleek hull tosses up silvery showers of spray. Narrow walls and overhanging



MARTIN EXPORT BOMBER

It is equipped with Wright Cyclone engines and Curtiss constant speed feathering propellers.

girders seem to reach out for the rider. Just when this dash for the sake of science seems destined to crash into the fast approaching end of the building, multiple sets of brakes swing into action and the carriage slides silently to a stop.

During 1937 more than a quarter of a million dollars was spent to lengthen the seaplane tank. This filled a pressing need in aviation. Today the network of aerial trade routes is becoming more widespread. Flying boats are becoming larger and swifter. Now, with the improved testing basin, the NACA is better able to study hulls at greater take-off and landing speeds, thus laying the groundwork for superior flying boats, enabling America to maintain her lead in the international struggle for commercial supremacy in the air.

At Langley Field, the NACA's buildings are nestled among those of the Army's General Headquarters Air Force. It is a fitting place for Uncle Sam's famed aeronautical research organization. For if the visitor wanders over to the Army's huge landing field, he will see the latest in military airplanes, perhaps, a new Boeing bomber. This "flying fortress", today is the world's fastest bomber, another symbol of America's aerial leadership. Likewise, it is a symbol of the NACA's practical research through the years. A quick inspection of one of these fighting giants reveals the NACA's work as represented by such features as cowling, engine housing, engine position, propeller position, wing section design, wing fillets, VG recorder, data on pressure distribution upon wings and tail surfaces made use of in the construction, and data on flaps.

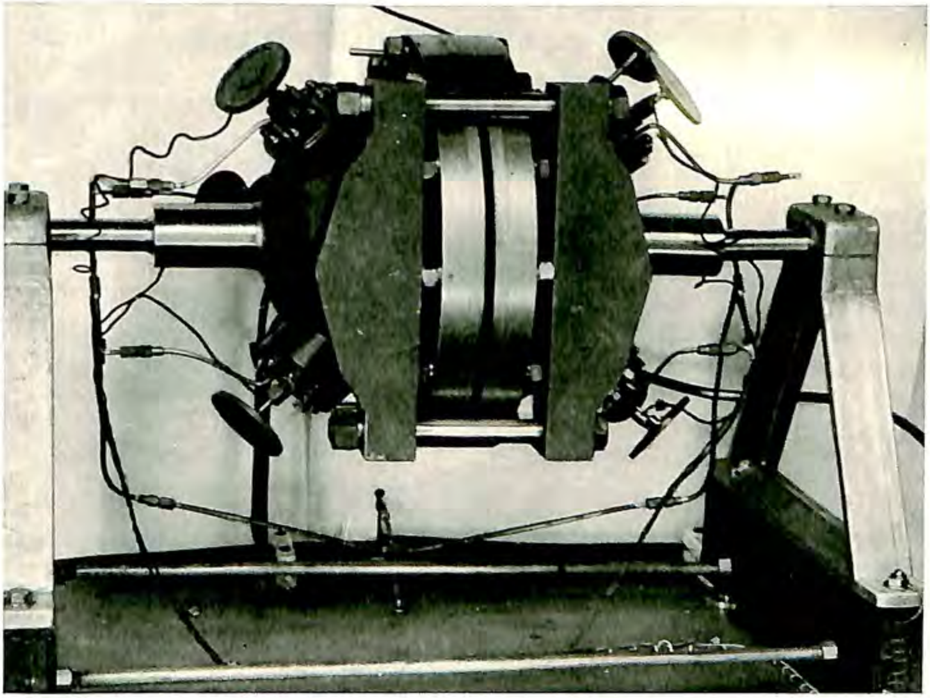
In Washington, D.C., the NACA headquarters are located in the Navy Building. Here is assembled the technical data gathered at the laboratory. Busy editors and draftsmen compile the information into neat publications. Finally, this endless stream of priceless knowledge flows over the mail lanes throughout the United States.

A separate and distinct Government organization like, for example, the Interstate Commerce Commission, the NACA is attached to no Cabinet Department. Fifteen members serve on the Committee. Appointed by the President, they serve without compensation. These Committeemen are a distinguished group, drawn from the ranks of science and the Government's air bureaus. Orville Wright is a member. Dr. Joseph S. Ames, one of the world's foremost physicists, is chairman of the group. Dr. George W. Lewis as director of research heads a large staff of scientific experts.

National Bureau of Standards

During the year 1937, the National Bureau of Standards studied the aerodynamic characteristics of aircraft structures, the materials from which these structures can be built with the maximum strength and least possible weight, the performance of aircraft power plants, the characteristics of fuels and lubricants, the improvement of aircraft instruments, the development of new materials such as synthetic plastics for aircraft windows, and requirements for airport and airway lighting. In general, specific investigations were undertaken at the request of governmental agencies, such as the Army Air Corps, the Bureau of Aeronautics of the Navy, and the National Advisory Committee for Aeronautics. Under certain conditions, tests of materials and apparatus are also made for private individuals and organizations, upon payment of a fee.

Transparent plastics for aircraft windshields. Various transparent organic plastics, including both commercially available and experimental materials, have been examined to determine their suitability for use as flexible windshields on aircraft. The properties studied include transmission of light, haziness, distortion, resistance to weathering,



FOR BUREAU OF STANDARDS TEST

This is a spherical bomb for studying the explosions of gases, part of the work toward improving the internal combustion engine.

scratch and indentation hardnesses, impact strength, dimensional stability, resistance to water and various cleaning fluids, bursting strength at normal and low temperatures, and flammability. A report of this investigation has been published.

Cellulose-acetate plastic was found to have excellent impact strength, bursting strength, and flexibility, but the commercial products varied considerably in resistance to weathering, and all were subject to marked shrinkage in a year's time. The shrinkage produces warping and sets up strains in the plastic sheets, which cause them to craze and crack. These strains are believed to be the cause of the spontaneous cracking of cellulose-acetate windshields after being in service six months or longer. This is particularly true of windshields which are used at high altitudes where the low temperatures cause thermal contraction, thereby introducing additional strains in the windshield. A great deal of variation was observed in the weathering resistance between cellulose-acetate sheets received from different manufacturers, and also between different lots of the material from the same manufacturer.

The acrylate-resin plastic was found to be remarkably transparent, more stable to light and weathering and more resistant to scratching than cellulose acetate, but its impact strength is lower and it is not so flexible. Surface crazing of the acrylate resins was noted after a year's exposure on the roof, and also after storage for a similar period. It is claimed, however, that a method of processing has been developed which eliminates this tendency to craze. Further tests on modified samples of both cellulose-acetate and acrylate resins and on other types of plastics are in progress to determine whether more uniformly durable products than have been on the market to date can be made available to the aircraft industry.

Textiles for parachutes. Work was continued on the development of wholly domestic parachute cloth, shroud lines, and webbing. Cotton webbing equal in strength to the linen webbing now used by the military services was obtained. Parachute cloths made from cotton and from synthetic yarns were manufactured for practical trials. The tests have not been completed.

Aerodynamics. The Bureau continued its studies of the fundamental laws of air flow, in cooperation with the National Advisory Committee for Aeronautics. Reports have been published on the relation between the intensity and scale of turbulence in wind tunnels and the critical Reynolds number of spheres, on the flow in the boundary layer near a flat plate, and on a new theory of isotropic turbulence. The boundary layer of an elliptic cylinder has been studied in air streams of varying turbulence, and the boundary layer of a plate has been examined by the method of thermal diffusion.

Metals for aircraft construction. Tests started four years ago in cooperation with the National Advisory Committee for Aeronautics, Bureau of Aeronautics, and Army Air Corps for determining the stability of light-alloy sheet metal commonly used in aircraft construction, when exposed continuously to the weather under different climatic conditions, have been brought to completion. A new series has been started to learn the effects of fabrication processes such as welding and riveting, as well as to determine the merits of protective coatings for light alloys. The work on the surface treatment of magnesium has been continued; the anodic treatment reported in 1936 still is unsurpassed, but further improvement is believed possible.

Metallic structural materials used in aircraft often owe their high strength to the mechanical cold-working received during fabrication. Their true elastic properties are only nominal, and, therefore, exceedingly low. Study of the elastic properties of these materials

AMERICAN PLANES FOR BRITAIN

One of a fleet of Lockheed Electra transports, powered by Pratt & Whitney Wasp Junior engines, purchased by British Airways for its service to Scandinavia.

has been continued to determine more definitely their value and practical significance in design and performance.

Long continued subjection of a structural metal member to fatigue stressing has been claimed by some to have a deleterious effect, even though the stress is well below the endurance limit. Continued investigation on this subject so far has failed to substantiate that theory.

Investigation of the properties of aircraft structural metals at the low temperatures approximating those of service has shown that, in general, a lowering of impact resistance is the only marked change. The work is being extended to welded structures.

The numerous examinations of failed aircraft structural parts which the Bureau is called upon to make, continue to demonstrate the part played by fatigue-stresses in such failures, and to emphasize the danger of square corners or notches with insufficient filleting in localizing and promoting such failures.

Problems of aircraft structures. Investigations of aircraft structures in cooperation with the Bureau of Aeronautics, Navy Department, and the National Advisory Committee for Aeronautics include: endurance of wing beams under longitudinally reversed stress; strength of wing beams under combined loads; strength of sheet-stiffener combinations; performance and method of attachment for strain gauges suitable for measuring vibrational strains; and strength of tubing under combined loads.

During the last year comprehensive reports were completed on three divisions of the general program of strength of tubes, namely, torsion of tubes, column strength of tubes with free and restrained ends, and the strength of welded joints in tubes.

The torsion tests on several hundred tubes of chromium-molybdenum steel and of 17ST aluminum alloy show the dependence of the torsional strength on the dimensions of the tube and the mechanical properties of the material. Most of the tubes failed by a combination of plastic shear and two-lobe buckling. The torsional strength can be expressed by an empirical formula involving only the tensile properties of the tube material in addition to the dimensions of the tube.

Column tests on about two hundred round and streamline tubes of chromium-molybdenum steel, duralumin, stainless steel, and heat-treated chromium-molybdenum steel gave data for the development of empirical formulas representing the column strength in terms of the tensile yield-strength. A more accurate method than any previously available, but still a practical method, was developed for designing compression members in riveted or welded structures.

The strength of tubular welded joints in chromium-molybdenum steel has been determined both "as welded" and in the heat-treated condition under tensile, compressive, and bending stresses. Tests were made on three kinds of welds, including the recently developed "carburizing flux" process.

Aeronautic power plants. Experiments are being conducted in cooperation with the National Advisory Committee for Aeronautics to secure basic information on flame propagation in gaseous explosive mixtures. Apparatus has been developed for recording flame travel and pressure rise during explosions in a spherical bomb with central ignition. This equipment will be used to determine the individual effects of some of the numerous factors which operate simultaneously to influence combustion in the engine cylinder. Power plant temperature surveys for the Bureau of Aeronautics have been continued, surveys again having been made on some 15 types of airplanes, both on the ground and in flight.

In prepared papers a detailed analysis of heat flow in spark plugs was given in such form that the results could be applied to the design of spark plugs of desired characteristics. Another paper described a method of using a cathode-ray oscillograph to obtain the electrical characteristics of an ignition discharge, including frequency, decrement, resistance of the gap and the flow of energy during the discharge.

A convenient method for obtaining a frequency analysis of engine noise has been developed, and the possibility of using acoustical methods for the detection of knock in full-scale engines is being studied.

The Bureau has continued to cooperate with the CFR Aviation Fuels Section in studying the relative tendency of high octane fuels to knock in representative aircraft engines of high output and in examining the design of current airplane fuel systems from the standpoint of vapor lock.

Problems incident to the testing of aircraft engines have included the control of test stand noise by sound absorption, the investigation of flexible exhaust lines for use when a rubber-mounted engine must be tested under approximate altitude conditions, the development of hydraulic gasoline scales which are safer and more convenient than the usual method of determining fuel consumption by weighing, and the design of torque stands for endurance tests of engines developing over 1,000 horsepower.

Lubrication and liquid fuels. The study of the stability of aircraft engine lubricating oils has been continued in cooperation with the Navy Bureau of Aeronautics and the National Advisory Committee for Aeronautics. The validity of the laboratory method, chosen from those studied during the last two years, for predicting the stability of aviation oils has been verified by data on oil samples taken from aircraft engines of various types in actual service. Some data have been obtained by a new laboratory method in which the oils are treated under conditions more closely simulating those in an aviation engine, and the possibility of correlating this method with engine tests appears promising.

An investigation of compounding agents to be added to aviation lubricating oils has been started and the effect of these materials on the stability of the oils is at present being determined.

In cooperation with the Air Corps, the Bureau of Aeronautics, and the National Advisory Committee for Aeronautics, an investigation is being made with the object of developing a significant test method for determining the wear characteristics of aviation engine oils. This involves extensive laboratory wear measurements on mineral and compounded aviation oils, and correlation of these data with service and full-scale test data.

Aircraft instruments. Studies of aircraft instrument performance were continued for the Bureau of Aeronautics, Navy Department, and the National Advisory Committee for Aeronautics. For the Bureau of Aeronautics, development work has been under way on an aerograph test apparatus for field use with special reference to measurement and control of relative humidity. Further progress has been made in developing a satisfactory synthetic lubricant for fine mechanisms. Laboratory tests have been developed and specifications prepared for fuel-air mixture indicators for aircraft engines. An airspeed-acceleration recorder and a helium purity meter utilizing a porous plug were designed and constructed.

In cooperation with the National Advisory Committee for Aeronautics, a study of the performance of venturi tubes used for operating air-driven gyroscopic instruments has been completed, and an investigation of the effects of vibration on aircraft instrument performance is in progress.

Airport lighting. Through cooperation with the Weather Bureau and manufacturers of ceiling-light projectors, a considerable improvement has been made in this type of lighting by using the highly-efficient 12-volt landing-light lamp in place of the 115-volt lamps previously used. Similar cooperation with manufacturers of contact lights has resulted in the development of several types of improved contact lights for marking runways. At the most useful angles these new units have more than five times the candlepower of the old runway marker lights.

Airway lighting. An investigation of the visibility of beacons is being carried out to determine whether or not the present optical design and speed of rotation make the most efficient use of the available light flux. The apparent intensity of the 24-inch beacon rotating at the standard rate, six r.p.m., is approximately one-third that of the same beacon fixed and pointed directly at the observer.

Office of Arms and Munitions Control

Vested in the Office of Arms and Munitions Control in the Department of State is the duty, among others, of supervising the application of the nation's neutrality act.

The part played by aircraft in modern warfare has brought restrictions on the sale and shipment of airplanes and their component parts to foreign States engaged in warfare or to a foreign country torn by civil strife.

A proclamation issued by the President on May 1, 1937, designated Spain as a nation to which American business could not export arms, ammunition and implements of war, and included among the implements of war were aircraft of all types.

Amended and extended last year, the neutrality act actually came into being through a joint resolution of both houses of Congress in 1935.

Among the most important of the permanent provisions of the amended Joint Resolution is Section 5, which establishes a system of

AMERICAN PLANES FOR SWEDEN

North American Aviation's Wright Whirlwind-powered NA-16 basic trainer for the Swedish air forces.

supervision and control of the international traffic in arms. Under the provisions of this section, which replaces Section 2 of the Act of August 31, 1935, there has been established the National Munitions Control Board, which is made up of 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, ammunition, and implements of war and other munitions of war, the Secretary of State has created an office within the Department known as the Office of Arms and Munitions Control.

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 May 1, 1937, with the advice of the National Munitions Control Board, includes:

"*Category III*

"(1) Aircraft, unassembled, 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, unassembled, 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, unassembled, assembled, or dismantled."

All persons who are engaged either in the manufacture or the export or the import of any of the aircraft or aircraft parts listed in these two categories are required to register with the Secretary of State under the provisions of Section 5 of the Joint Resolution of May 1, 1937. Furthermore, licenses must be obtained for the export of each individual shipment of such articles and these licenses may, under the provisions of the law, be issued only to persons who are registered.

The following regulations are quoted from the pamphlet:

"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 5 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 of ultimate destination. . . . The Secretary of State may refuse to grant an application for an export license until he is informed of the country of ultimate destination in order that he may assure himself that the license may be legally issued.

"The originals of licenses for the export and the import of arms,

THE NORTHROP MODEL 8A

A two-place export bomber produced by the Northrop Division of the Douglas Aircraft Company.

ammunition, and implements of war must be presented to the collector of customs at the port through which the shipment authorized by the license is being made. 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.

"Arms and implements of war which have been legally exported from the United States, and which are returned to the United States worn or damaged for repair and re-export, will not be considered as imported within the meaning of section 5 of the joint resolution. An export license must be obtained, however, before such articles are reexported.

"Licenses are required for the export or the import of those articles only which are specifically mentioned in the President's proclamation of May 1, 1937. No license is required for the export or the import of the component parts of the articles or units enumerated in that proclamation, unless those parts are shipped in such a manner as to constitute, in fact, a complete unit or article in unassembled form. The only exceptions to this ruling are in the case of aircraft wheels and aircraft propeller blades, which are considered as constituting to such an unusual degree the main body of aircraft undercarriage units and aircraft propellers that a license is required for the export of wheels and propeller blades, even when they are shipped alone. . . .

"Airplanes flown or shipped from the United States will not be considered as exported within the meaning of section 5 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 May 1, 1937, in any foreign country. . . ."

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 in part as follows:

"The Secretary of State will not issue a license authorizing the exportation 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 if, in their opinion, they involve military secrets of interest to the national defense."

Office of Education

The United States Department of the Interior, Office of Education, has been providing a limited amount of assistance to aviation education in response to requests from individuals, schools and the aviation industry. The service differs from that rendered by other Governmental agencies in that all information and assistance provided conforms with the principles of education. The Office has recognized contact with all public and other educational institutions, and it is the acknowledged source for assistance in certain types of educational matters. Many letters are answered concerning aviation occupations and training in addition to letters from boys and girls who are making general study of occupations in regular school classes.

In 1937, "Aviation in the Public Schools" came from the Government Printing Office. The bulletin discusses aviation subjects in regular school courses and as complete high school subjects. It devotes a section to aircraft models and model airplane clubs and competitions. A chapter is given over to aviation occupations, and includes lists of all types of work carried on both by aircraft manufacturers and airline operators. The last chapter discusses the fundamentals of training and aviation occupations.

A member of the Office of Education staff spent some time conducting conferences with personnel at the repair base of a major air line in order to arrange for the setting up locally of extension courses for the training of employed personnel living in the city where the repair base is located. The major purpose of the conferences was to see what could be done for recognized aviation apprentices in the locality. As a result, the local school board, in cooperation with the State and Federal governments, is providing courses of study in aviation subject matters to meet definite local training needs.

For a number of years, the States have used limited amounts of Federal moneys for reimbursement of teachers conducting courses in recognized vocational aviation classes. During the fiscal year 1937 nearly 4,000 persons were enrolled in Federally-aided vocational education courses in public schools, and about $25,000 of Federal funds were spent for teachers of classes in which these students were enrolled. The Office also has cooperated with aviation organizations and other branches of the Government in aviation education matters.

Soil Conservation Service

Closely allied with the photographic work of the geological survey was the activity of the soil conservation service of the Department of Agriculture. Chief among its accomplishments was completion of a picture-map of that vast area known as the nation's "dust bowl," mother of storms which turn mid-day into midnight. The "bowl," consisting of some 68,420 square miles, is the largest single piece of territory ever photographed from the air.

The facilities of three aerial survey companies were used, and in spite of dust storms, rain, and snow, the survey was completed considerably ahead of schedule. Although each company was required to operate one airplane, two additional planes were used at times to expedite the work. The entire area, which required more than 45,000 lineal miles of flying, was completed without an accident.

The work was done by contract, and during the year a new contract was awarded for the photographing of 30,820 square miles in Colorado, Utah and Wyoming. The area covered by this contract ranges in elevation from 5,000 feet to 14,000 feet above sea level. Most of it is inaccessible, mountainous land. Flying was started in June but adverse weather conditions and snow forced postponement of operations early in October. During this time, however, approximately 10,000 square miles were photographed. In addition to photographing the area, the contractor was required to establish and identify ground control as well as use such control as basis for the extension of radial control. After the radial control has been extended to the accuracy specified, ratio factors must be computed and photographs made to exact scales suitable for compilation into mosaics at a scale of two inches equal to one mile.

The completed mosaics showing all physical features of the region, such as the general topography, the location of streams, mountains, lakes, roads, and farms will be used by the Service as a base for planning programs of soil conservation, flood control, and related activities. In areas where intensive work is done upon the land, such detailed information as the degree of erosion, present land use, type of soil, and degree of slope, is superimposed on the mosaics.

In addition to actual photographic activities in 1937, the Service established in Washington an aerial survey laboratory for the servicing of aerial photographs from other Federal agencies. During 1937 approximately 500,000 negatives, representing the largest single collection of aerial survey data in the world, was placed on file in this laboratory.

Tennessee Valley Authority

During 1937 the Tennessee Valley Authority operated three airplanes, a Monocoach, Bellanca, and Stearman. These airplanes were used in the control of malarial mosquitos and in reconnaissance surveys. Charged with the long range development of the Tennessee River drainage area, embracing a territory of 41,000 square miles, the Authority has found that necessary information about the rivers, forest growth, soil, erosion and other physical features can be determined by plane in less time than that required by surface methods.

U. S. Coast and Geodetic Survey

During 1937, the nine-lens aerial camera of the Coast and Geodetic Survey photographed several areas for mapping. In four days enough photographs were taken to furnish topographic data for three new charts and to revise four others—enough to keep the small compiling force available busy for a year. The areas photographed included the northeastern part of Chesapeake Bay, the Dismal Swamp Canal and Pasquotank River (an alternate route for the Intracoastal Waterway via Elizabeth City), and the Barrier Beach from Currituck around Cape Hatteras to Cape Lookout.

An eight by 10 reduction of a nine-lens photograph of Dayton, Ohio, showing in one corner the transcontinental airport ten miles from the city, can be furnished after February first.

The Coast and Geodetic Survey publishes a series of 87 sectional aeronautical charts on a scale of 1:500,000, or about eight miles to the inch. For the first time this series has provided pilots with charts covering the entire country on a uniform scale especially designed to meet the needs of air commerce. The strip maps formerly published have been canceled.

WACO F-7 ENCLOSED COCKPIT
Two of the six ships of this type sold to Guatemala.

The publication of this series does not mark the end of the work on the sectional charts. Some 25,000 miles of lighted airways and nearly 2,500 airports are included on the charts. The many changes in the aids, in addition to the completion of new topographical surveys, necessitate frequent revision, as it is the intention of the Department to maintain these charts to show existing conditions accurately for safe navigation.

To meet the needs of high-speed long-distance flying, an additional series known as regional aeronautical charts was begun. This series is on a scale of 1:1,000,000, or about 16 miles to the inch. Three charts of this series had been published by December, 1937, and several others are in course of preparation.

With the development of radio direction finding, there arose a need for specialized charts for this purpose and the first of these charts was issued near the end of the year. Six charts of this series are required to cover the entire United States on a scale of 1:2,000,000, or about 32 miles to the inch. Work is in progress for the preparation of other charts in this series.

Chart No. 3060a, "Aeronautical Planning Chart of the United States", is a valuable supplement to the sectional and regional series. It shows the principal airports and broadcasting stations with the names and limits of the sectional charts on a scale of 1:5,000,000, or about 80 miles to the inch. It is a useful chart in planning long flights.

The first edition of the publication "Practical Air Navigation and the Use of the Aeronautical Charts of the Department of Commerce" was exhausted early in 1937. A revised and enlarged edition (covering chart reading, piloting, dead reckoning, radio and celestial navigation, and meteorology) has been prepared and should be available early in 1938.

An index to the growth of air traffic is provided by the increased use of aeronautical charts. During the fiscal year 1935, 70,478 charts were issued, while during 1937 the number had increased to 277,878 charts.

U. S. Forest Service

The U. S. Forest Service made some long strides in the use of aviation services during 1937. The last fire season in the national forests was notable for its lack of adverse climatic conditions, and fliers had less opportunity to achieve the spectacular; nevertheless it was an outstanding year in development of the use of aircraft as a practical aid to protection of the forests.

More effective use of planes for scouting forest fires is recorded in the field records of the Forest Service. New emergency landing fields have been built or improved in the regions least accessible by roads. Extensive experimental work has been carried on in California in fighting fires by dropping chemicals from the air. There has been noteworthy development of technique for the delivery of supplies by plane to crews on the firelines at remote and inaccessible points in the forests.

The Forest Service first tried fire patrol by airplane in 1920. Aviators covered routes in daily flights over the forest lands. But the percentage of discovery of fires by airplane patrolmen was found to be low in comparison to discoveries by ground crews and lookouts. Many elements contributed to the low record of detection, principally the fact that a given spot of forest was subject to only momentary ob-

SUPPLIES BY PARACHUTE

U. S. Forest Service Officer about to drop supplies by parachute for forces fighting a forest fire.

servation from the air during a patrol flight. A few years later scheduled patrol was dropped. The Forest Service, however, hard pressed by fire detection and fire suppression problems, continued to experiment with aircraft. Within a few years the airplane had established its value for a number of forest jobs. Mapping of burned and beetle-infested areas, transportation of officers, fire fighting crews and supplies to convenient airports and emergency landing fields, scouting around big going fires and other activities kept aviation alive in the national forests. Since 1929 the use of planes under contract has been introduced into most of the western forest regions.

Improvement in scouting going fires has come about through using planes for definite purposes, such as scouting the windward side of a conflagration, the observer confining his work largely to sectors of the burning area not easily studied from the ground. In detection work, however, the plane is now called on to patrol newly established units, particularly in the Lake States, so far unequipped with lookout towers. Other detection work by fliers is the inspection of certain areas after severe lightning storms which may start scores of fires.

Hundreds of experiments and tests of delivering supplies in quantity in the vicinity of forest fires have been carried out. In 1937 anything from axes to eggs and rolled oats to radio sending-and-receiving sets were let down from the sky by parachute, with but negligible breakage.

When a fire is discovered in rugged back-country, ground crews are dispatched from the most convenient points and set to building fire control lines. They must have food, camp equipment, tools and medicines. When the fire was in a remote, roadless area, these things used to be carried laboriously over rough trails on the backs of men and animals. Now, where there are no roads, the airplane can be called into service and bundles of tools, and supplies of all kinds arrive in a few short hours by plane.

Foods packed with great ingenuity may be assembled, flown to the designated area which has been marked with flags or a smudge fire by the ground crew, and dropped either with or without parachutes to the waiting men below. A package may contain vegetables on top, canned goods in the middle and loaves of bread on the bottom. Bread has been found to be such an excellent and indestructible shock absorber, that forest workers have dubbed the lower layer of such packages "bread-springs."

Much of the 200,000 pounds of such air-borne commissary carried in a year now settles down from the planes, attached to parachutes. The Forest Service has devised a special parachute made from the almost universally available burlap woolsack material, which can be made at very low cost. A good woolsack will make a parachute about seven by seven feet. To its corners are fastened rope shrouds 17 feet long, to be tied to the bundle of food, to cans of gasoline, or to sacks of parts for the pumps. To its top is attached a streamer of cloth 30 to 50 yards long, preferably of chrome yellow color. This gay streamer is especially useful because it usually floats above the brush and small trees and makes it easier for the ground crew to spot packages that fall some distance from the target.

In many parts of the national forests the package dropped from airplanes is, and will continue to be, a vast aid in equipping and supplying fire-fighting crews. Foresters have accustomed themselves to use of such terms as free descent, loose package and retarded descent.

In the loose package system, a quantity of supplies is discharged from the plane loosely tied in large sacks with flapping ends. The loose flapping end meets a certain amount of air resistance and the packages land with less impact. This plan is useful in delivering small articles on a small scale.

CURTISS-WRIGHT 19-R TRAINERS FOR CUBA

They are powered by Wright Whirlwinds and they are being assembled at the plant of the St. Louis Airplane Division of the Curtiss-Wright Corporation.

For heavier articles and larger quantities, the parachute method is most practicable. Even cases of eggs and radio apparatus are dropped with minimum damage to container and contents. Applying the same principles of retardation, special packs are devised to spread the load and other types to prevent the articles in the bottom of the package being damaged by the impact of the articles on top.

In the last year Forest Service engineers have advanced to the point of developing standardized packages. Cans of fruit, and vegetables are placed one layer deep on a ply-wood board about 22 inches square and tied round with a twine. Another board is placed on top and tied securely, and the package suspended flat from the parachute. In general the smaller the can the better it stands the ride to earth.

Fresh and cured meats are placed in individual sacks, and all the small sacks placed in a gunny sack well tied. Glass jars of food and the like are wrapped individually in flour sacks and loaded like canned goods. But beneath the board is placed the bread shock-pad, made by loading loaves of bread sliced and placed in a sack side by side. The sack is drawn tight and tied underneath the pack. Usually the bread also arrives undamaged.

A sack of bread tied to a loose wool sack may simply be dumped overboard, and it will land safely. Vegetables are packed loosely, lettuce on top. Potatoes are dropped in 50-pound lots. Dry foods like sugar and rice are packed in small sacks in a shallow load within a larger sack or box. Butter can be lowered in lots of not over 10 pounds. Lard, well wrapped in paper and a small sack, is dropped safely in a tied gunny sack. Nine dozen eggs in an ordinary half-crate, the top stuffed with rags and with a "bread-spring" underneath the box, are parachuted down without breakage. But the foresters do not guarantee safe conduct at all times.

Waterbags, half full are delivered intact. Gasoline, water, and milk are lowered in milk cans. Three-gallon cans are filled to the cone, slung in a rope harness and dropped. A piece of board fitted inside the flange under the bottom serves as a buffer. Boxes of matches are put in individual sacks, several of them put into a gunny sack and pitched overside. Cooking kettles and tins are simply tied in gunny sacks, one to the sack and several sacks tied in a circle a foot apart.

The type of plane generally used is a high-wing cabin monoplane, with the door preferably back of the wing struts, and the door and all chairs except the pilot's seat removed. The assembled packages with parachute and colored streamer attached are rolled up carefully. Strong material and fastenings are necessary to prevent the opening chute from ripping the package. Wire fastenings are not used for that reason.

The pilot approaches the target while heading directly into the wind. When the bundle is dropped, the pilot begins to turn, so that the dropper may watch his marksmanship. The dropper spots the landing and marks each landing on a map with reference to the marking signal or smudge fire built by the ground crew. When all packages have been dropped, the map also is dropped to the ground crew to assist in finding all the packages.

The dropper has no easy job. He has to wear goggles to keep oil particles from his eyes; and he wears a lineman's belt and strap securely fastened to a structural member inside the fuselage. He sights his target by the vertical door jamb, and drops the pilot load when directly over the target. He then drops the first load of supplies at the same distance on the approach side as the pilot load fell beyond the target. If he has made a good landing he will aim subsequent packages at the same spot. By a slight change in direction, the pilot can make allowances for wind drift. The dropper holds both the load and the chute with one hand, sometimes assisting the shove with a foot. In dropping the chute he must be sure the load also is free, or he may foul the tail parts of the plane and cause a wreck. The chutes act with surprising uniformity. Very few catch in trees, apparently because the weighted shrouds tend to push them away from the branches.

The Forest Service receives excellent cooperation from private fliers, air transport lines and the aviation groups in other departments of the Government. At present there is under consideration a plan whereby the roofs of lookout houses in the Forest Service may be uniformly marked with numbers to correspond with numbers on aviation maps of the United States, so that any flier sighting a lookout house on a peak or ridge may be better able to keep his bearings while crossing the national forests.

The Forest Service is air-minded, having tried the airplane for many uses, and found it especially adapted for forest protection work in certain fields. Study and experiment go on. Recently tests have been made with "hovering types" of planes, autogiros with slow speeds and easy take-offs, to adapt them for use in undeveloped country. Every new use found for the plane means more wings over the forests.

U. S. Maritime Commission

On November 13, 1937, the U. S. Maritime Commission sent to Congress a report recommending legislation "to make applicable to aircraft engaged in foreign commerce certain provisions of the Merchant Marine Act of 1936. The report also embodied results of the Commission's study of the present and future values of aircraft in transocean service. In transmitting the report, Joseph P. Kennedy, then Chairman of the Commission, acknowledged the assistance rendered by the Commission's aeronautical advisor, Grover C. Loening.

The following paragraphs are from the Commission's report:

"The recent development and performance of long-range ocean-going aircraft has opened to the shipping business of the world a new field requiring its most thorough consideration.

"Direct competition between aircraft and ships in carrying mails and passengers on the world's trade routes is clearly indicated in the near future. Large flying boats of 100,000 to 250,000 pounds and capable of carrying 40 to 150 passengers may well supersede highly expensive superliners of the 'Queen Mary' and 'Normandie' class in all cases where speed above that of the cabin class ships is important.

"Thirty years have elapsed since the old 'Mauretania' established its Atlantic record of five days and two hours. The 'Normandie' has succeeded in lowering that time by only 24 hours. Even if the horsepower of the 'Normandie' were doubled—at a prohibitive expense—the time of crossing would be reduced by only 11 hours.

"Yet flying boats, in their present stage of development, promise a non-stop trip to Europe in 20 hours, while dirigibles have repeatedly made the crossing in 48 hours.

"The established regular services of Air France, Lufthansa and Imperial Airways over the Mediterranean and South Atlantic and of Pan American Airways over the Caribbean, the Pacific and to Bermuda, have compiled an enormous air mileage. The San Francisco to Honolulu crossing has now passed its experimental stage with a record of having successfully completed a year of operation—with a performance comprising 96 per cent of previously announced schedules. This distance of approximately 2,400 miles is the longest over-water jump now being negotiated regularly on any of the world's airways and represents a rapid increase from previous distances regularly flown.

"The problem of transoceanic aviation is essentially one of range and size of aircraft. The work now going on in this country in design and actual manufacture will result in the immediate future in the construction of 120,000-pound flying boats of 5,000-mile non-stop range, carrying 40 to 50 passengers at an average speed of 175 miles an hour. The non-stop range of these new flying boats will change the potentialities of over-ocean air travel, as the weather hazards and delays will be greatly reduced.

"The elimination of intermediate landings in the Atlantic, whether in the ice and fog of Newfoundland or the rain and low ceilings of the Azores, will make not only for a reduction of added take-off and landing risks, but will give a wider choice of routes to find the best weather or the shortest air distance. Such flying boats will thus acquire the great advantage possessed for years by the dirigible airship alone—sufficient range to circumnavigate weather obstacles and to make non-stop voyages.

"During the winter, ice conditions may hinder take-offs and landings in New York so as to require operation from Baltimore or Nor-

"With four engines, however, any two of which can fly the plane, forced landings are most remote and already the Martin and Sikorsky Clippers in the Pacific have flown 7,000,000 passenger miles without an accident of any kind.

"The dirigible, of course, cannot make a very satisfactory landing at sea. But the necessity for this is largely overcome by its ability to float in the air with engines stopped.

"Reliability of aircraft presently available indicates, therefore, that the time is at hand when transoceanic airlines are becoming increasingly practical.

"The very much higher wing loadings now being used on long-range ocean-going aircraft have greatly reduced the effect on the airplane of rough air. Furthermore, the air itself on these long over-water stretches is very much smoother than overland. And at the economical altitude for low fuel consumption—generally over the ordinary weather strata around 10,000—the air is of course considerably smoother than at lower levels. A large part of the ocean crossing is done at night when the air is definitely smoother than in the day time. The noise on the larger sized aircraft has been reduced by modern soundproofing methods to less than that of a Pullman car with the windows closed, and conversation may easily be carried on in ordinary tones.

"In the case of dirigibles, it is almost the unanimous opinion of those who traveled on the 'Hindenburg' that there is no means of transportation either on sea, land or in the air that is quieter, smoother or more comfortable than the airship. Their interiors are soundproofed. The engines are hundreds of feet away from the passengers. These features combined with the large bulk and floating characteristics of the airship give it a smoothness of riding in the air that is not yet approached by the airplane. A dirigible's equilibrium can be disturbed only by a very severe storm.

"With regard to ventilation, the easiest of all transports to air-condition is the airplane. This is due to the small volume of its passenger compartments. Air conditioned airplanes are already being constructed with full control not only of humidity and temperature, but also of atmospheric pressure.

"The general question of passenger comfort should be considered from the standpoint of the amount of time spent on the vessel. Accommodations equal to a Pullman train with smoking room, lounge, and comfortable berths are ample on a 24-hour airplane trip. On dirigibles the 2½ day voyage requires the addition of more commodious and better equipped lounges and a promenade. In the case of superliners, the five-day trip has demanded installation of everything that passengers could ask for at an expensive pleasure resort.

"The berths in the flying boat designs are much wider and more comfortable than those in a Pullman, and the new designs also include a cocktail lounge and bar as well as a few private cabins with private toilets and dining saloon.

"The comfort to be offered in transoceanic aircraft appears to be equal to that of a Pullman train and, because of the short time taken by a crossing, not inferior to that offered by competing forms of transportation.

"When considering the cost of delivering passengers to Europe, there is one revealing comparison—the horsepower hours per passenger crossing. In the total expenditure of power for the number of hours used is found an indication of the cost of hull and machinery and of operating personnel that is properly attributable to each passenger.

"The superliner (surface vessel) uses 8,800 horsepower hours per passenger crossing, and the flying boat uses only about one-fifth as much—1,680 horsepower hours per passenger crossing. The dirigible uses but slightly more than the flying boat—1,692. The large installed power of aircraft and the small number of passengers carried is more than counterbalanced by the brevity of a flying boat crossing. The flying boat has only recently approached the dirigible in this regard, and it was this very point that for years gave the dirigible an outstanding position. When it comes to still further increases in speed and consequent decrease in horsepower hours expended, the flying boat has by no means attained its limit. The superliner, however, even with its power doubled, could increase its speed only a few knots, saving perhaps half a day and with a greatly increased power consumption per passenger crossing.

"To achieve an absolutely direct comparison, it probably would be necessary to consider moving the same number of passengers per year. This would be still further to the advantage of both the dirigible and the flying boat due to their smaller investment and consequent lesser depreciation cost. There is considered here only the minimum which is immediately practicable:

(1) One superliner making one crossing per week;
(2) Two dirigibles making 1½ day crossings on seasonal schedules of two to four per week; and
(3) Six flying boats making daily crossings both ways.

In each case, these are the minima of a reasonable service. Since the costs are reduced to a per passenger basis, the comparison to the full capacity of the superliner would require 18 flying boats (three a day) and 12 dirigibles, (four a week) of the present designs.

"The American construction cost of the superliner is estimated to be $50,000,000. The construction cost of an equivalent passenger capacity in dirigibles would be about the same. The cost of equivalent passenger capacity in flying boats it is estimated will be $18,000,000. The superliner is depreciated on a 20-year basis, the dirigible on an eight-year basis, and the flying boat on a five-year basis for present designs and an eight-year basis for future designs. Thus a $50,000,000 superliner has to be used for many years when it may have become out of date, while at the end of five or eight years new aircraft will be obtained and the old equipment retired.

"Crew man hours per passenger are very much less on the flying boat than on the superliner or the dirigible, chiefly because of the fact that on a one night passage, less service is required for the passengers' comfort than would be the case for a longer period.

"In the daily service outlined with six airplanes, the depreciation allowances are based on 3,000 flying hours per year. Formerly this would have been considered quite high, but there are now in service on domestic air lines transport planes that are averaging 4,000 hours a year, and on the San Francisco-China run, Martin Clippers have already attained the rate of over 2,000 hours per year.

"The items of depreciation, fuel, and crew cost of the three present major methods of crossing the Atlantic give a very interesting comparison. The superliner figures out to $67.58 per passenger crossing, the dirigible to $131.83, and the flying boat to $73.10.

"The 250,000-pound flying boat, which it is believed will be built within 10 years, will reduce these cost items to almost one-half of that of the superliner and at the same time will carry the passenger six times as fast. Six of these large boats could carry 109,500 passengers a year at an estimated construction cost of $19,700,000 as against the superliner carrying 96,000 passengers a year at a construction cost estimated at $50,000,000.

"The significance of this fact should not be overlooked when it is realized that the airplane offers by far the faster service. It is extremely rare in the history of transport development of any kind, be it railroad, bus or any other, that the faster passenger service proves to be the cheapest in its early stages.

"The proposed daily schedule of the flying boats is an additional advantage over the other two, and it is not beyond sound judgment to foresee in the very near future a 10 o'clock one-day plane for Europe leaving with just as much regularity and effectiveness as the daily departures now from New York to California.

"The volume of transatlantic first class mail is approximately 7,000 to 8,000 pounds per business day, and the average number of first-class express passengers paying somewhere near the proposed airplane fare (estimated at $450 a passage) is twenty thousand a year. The suggested service of a daily airplane of the new proposed designs with a 40-passenger capacity can, on a basis of a 60 per cent load factor (24 passengers average) and 85 per cent scheduled maintenance (which is low according to experience on the present over ocean air lines), still have a capacity of well over 6,000 pounds of mail. In other words, when running low on passenger fares, these aircraft could carry very nearly all the daily first class mail. The

THE STINSON RELIANT

It is powered by the 260 h.p. Lycoming engine and Lycoming controllable propellor.

five-cent ordinary rate to Europe, based on Post Office experience of 40 letters to the pound, would amount to $2 a pound. Even if this low rate were to be maintained for air mail service, 6,000 pounds of mail would bring an added income of $12,000 per day to the air lines, if they were paid an amount equal to the full postage.

"Operator's estimates have been presented showing that a minimum of 24 passengers a day is required for successful operation of a daily transatlantic air service. This represents six per cent of the first class and cabin traffic available without regard to whatever new traffic will be created. It seems fairly evident that the volume of passengers, or failing that, the volume of mail and express is ample to create the income necessary for an eventual profitable operation.

When the possibility of an air mail poundage rate considerably higher than the ordinary first class rate is considered, there is no question whatever that—in the transatlantic run at least—very little subsidizing will be necessary other than to start its development. Other routes, however, where the traffic is lighter, will need substantial help. The North Atlantic route offers the first opportunity for the establishment of a simple poundage rate system sufficiently high to give a prospective air line using these new designs of long-range flying boats enough revenue for current operation with a reasonable postage charge. Assistance through the engineering development stage, by inclusion of aircraft in the construction loan provision of the Merchant Marine Act, 1936, should insure successful establishment of such services.

"The business of a shipping company is to transport passengers, mail and goods on a trade route. The vehicle used varies with the progress of engineering development. With its trade route prestige, its foreign connections, traffic procuring facilities, terminals and even docks to which flying boats could come, there are many cogent reasons why a progressive shipping company might well add flying boats to its cabin liners and its freighters.

"The reasonableness of the cost of passenger aircraft operation as already indicated when weighed with the effect of competition a shipping company might experience from an outside air line company, and the advertising value a shipping company could obtain by becoming 'air minded,' seem to indicate the advisability of shipping companies adding over-ocean aircraft to their fleets.

"Already there is evident a close relationship and community of interest between shipping concerns and air line operations. The Grace Line is half owner of Pan American-Grace Air Lines. The Matson interest owns a large share of Inter-Island Airways in Hawaii. Lufthansa, Hapag and the German Zeppelin Company are associated. Air-France Company and the Compagnie Generale Transatlantique have formed a new combination, the Air France Transatlantique, and so on. In this country, United States Lines and American Export Lines are already studying plans to add air services to their operations.

"If the shipping companies are not to add aircraft to their fleets, they will undoubtedly lose considerable traffic to independent air line companies. The ocean-going flying boat or dirigible is nothing less than another vessel—a very much faster vessel—and eventually cheaper to operate. For shipping companies not to make use of this new vessel on their trade routes may prove quite short-sighted.

"There appears to be no question of the great value of heavier-than-air flying boats, both commercially and as naval auxiliaries. But, since there remains some question of the commercial value of dirigible airships, a statement from the Navy of their value for national defense is desirable to warrant their further construction.

"Amendments necessary to accomplish the suggested inclusion of aircraft in the Merchant Marine Act, 1936, should be drawn with due regard to their applicability to air line companies which now, or may in the future, operate over the oceans—as well as to those air operations that may be developed as an adjunct to the present activities of shipping companies.

"It appears that the use of over-ocean aircraft is not only related to shipping in foreign commerce but will be an important part thereof. It is recommended, accordingly, that legislation be enacted to make applicable to ocean-going aircraft the principles of Titles V, VI, and VII of the Merchant Marine Act, 1936. With reference to Section 212 (b)(2) of that Act, it is believed that American vessel owners should not build superliners but that they might well give attention in the field of high speed passenger and express transportation to trans-oceanic aircraft."

U. S. Public Health Service

One of the most pressing problems confronting the U. S. Public Health Service in its effort to prevent the introduction of quarantinable diseases into this country, is the prevention of the transmission of yellow fever by aircraft. During 1936 it became definitely established that there exists in monkeys, and possibly in other animals, of the Brazilian jungles, a reservoir of yellow-fever virus which may be expected to persist for many years. The flying time between ports in South America as far south as Brazil and the port of Miami, Fla., having been shortened to four days, and a further reduction of such time being in prospect by the anticipated institution of night flying, it is evident that the United States is faced with the possibility of aircraft passengers from localities infected with yellow fever arriving in highly infectible territory in this country while still within the incubation period of the disease.

In an endeavor to meet this contingency, the following control measures have been instituted by the Public Health Service in cooperation with the corporations operating aircraft between North and South America: (1) Immunization of aircraft personnel by vaccination against yellow fever; (2) efficient disinsectization of aircraft at points enroute and just prior to landing at United States ports, and (3) the institution of a system of surveillance of air travelers by means of certificates showing the area from which their travel originated, and the further determination of their itinerary after arrival to complete nine days from their departure from infected territory. There is also planned a definite campaign to secure, as far as possible, the eradication of mosquitoes which might constitute vectors for the transmission of yellow fever from regions surrounding airports of entry located in infectible territory in the United States.

During the fiscal year 1937, 4,094 airplanes, carrying 45,936 passengers, arrived at airports of entry in the United States from foreign countries. Of these, 2,499 planes, carrying 38,926 passengers, 5,841 of whom were aliens, were subjected to quarantine inspection, the others entering the country from Canada under circumstances rendering quarantine inspection unnecessary.

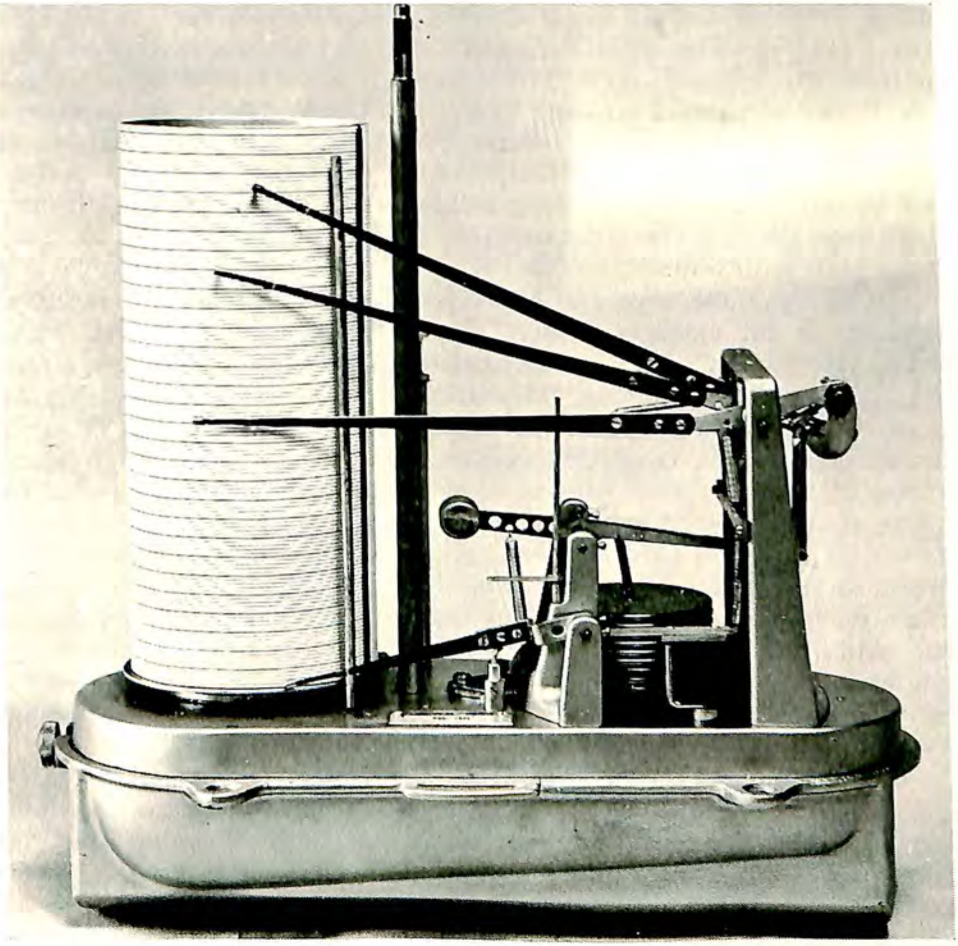
Airplanes arriving from foreign ports	4,094
Airplanes inspected by the Public Health Service	2,499
Persons arriving from foreign ports or places	45,936
Persons inspected by the Public Health Service	38,926
Aliens inspected by the Public Health Service	5,841
Aliens certified for disease	24

The principal service performed by airplanes in connection with the health activities for the relief of flood sufferers during the Ohio-Mississippi flood disaster in January and February, 1937, was the transportation of biological supplies required for protection against communicable diseases. Commercial planes were used rather extensively for shipping such supplies from the factories and warehouses to distribution points adjacent to the flooded territory. From these focal points Army and Coast Guard planes were employed in many instances to forward these materials to isolated points within the flooded areas. In one such instance a shipment of biological supplies was picked up at St. Louis by an Army plane and carried to Madisonville, Kentucky, where, because the soft condition of the landing field made it impossible to land, the packages were landed by parachute.

U. S. Weather Bureau

The year 1937 was one of continued progress in the services rendered by the U. S. Weather Bureau in cooperation with the Bureau of Air Commerce of the Department of Commerce for the protection of air traffic. As of June 30, 1937, there was a total of 782 stations in the Weather Bureau system, making meteorological reports for air navigation over approximately 33,000 miles of airways in the United States, Hawaii, and Alaska. This represented an increase of about 150 stations in a year.

The total includes 52 airport stations where commissioned Weather Bureau personnel render 24-hour service, and disseminate and receive reports by teletype. At 11 of these stations, one more than the preceding year, airway weather forecasts are prepared for, and general supervision of the service exercised over, designated districts. About 228 airway stations, equipped with teletype or radio communication facilities and manned by employees of the Bureau of Air



Official Photo U. S. Weather Bureau
A WEATHER RECORDING INSTRUMENT

Commerce, or by non-commissioned airway observers of the Weather Bureau, render hourly or more frequent reports 24 hours each day. All this service is under the jurisdiction of the Weather Bureau. An additional 370 stations, designated as "on-call", and manned by non-commissioned airway observers, render observations for specific flights over the airways or when sudden changes in weather conditions make special reports desirable. Finally, 132 first- or second-order Weather Bureau stations also telegraph reports every six hours in the airway network. The meteorological reports from this network are supplemented by pilot-balloon upper-air wind observations made at 77 Weather Bureau stations and by airplane weather observations made at 29 stations, including 12 Weather Bureau, under contract with private flying companies which furnish planes and pilots; eight Army, with Air Corps planes and pilots, but Weather Bureau equipment and personnel to record and work up the data; and nine Navy, with its own planes, pilots, equipment and personnel.

While the aviator is pushing back the boundaries of the earth over both land and sea the meteorologists are expanding their activities to keep pace with him.

Four events in 1937 promised progress in the realm of weather service on an enlarged scale. First, the transpacific flights from Alameda, Calif., of Pan-American Clippers and the transatlantic flights on an experimental basis from Port Washington, N. Y., of Pan-American Airways, British Imperial Airways, and German Lufthansa planes, developed further need for meteorological information. The Weather Bureau cooperated by making available to these companies at their terminals the same observational data and forecasts supplied to domestic companies. Moreover, arrangements were satisfactorily completed whereby ship meteorological observations collected by radio for the Weather Bureau were placed at the disposal of Pan-American Airways by the local official stations or by the collecting agencies.

Second, the growth of flying activities in Alaska brought about an aviation and communication conference at Juneau, Alaska, in August. It was attended by representatives of various Government departments and other interested organizations. The Weather Bureau had two delegates present. The plans laid down at the meeting and the surveys of aeronautical and communication facilities in Alaska made after its close should lead to considerable progress in the services provided for aviation.

Third, the multiplicity of organizations in the world dealing with meteorological matters and the rapid development of commercial flying on an international scale have shown a need for an agency to coordinate the work of the various meteorological bodies and conferences of international scope. Such an agency was created during the course of the Conference of directors of the meteorological services of the world held at Warsaw, Poland, in September, 1935.

The new body was given the name "International Commission of Aeronautical Meteorology", and its first president, Capt. R. Bureau, Sub-Director of the National Meteorological Office of France, was appointed by the Conference. The Commission will function within the framework of the International Meteorological Organization, which for 59 years, with the active support of the meteorological services of all countries, has served as a recognized agency for standardization of meteorological practices, for coordination of efforts along meteorological lines through international cooperation and for exchange of information. The new Commission held its first meeting at Paris in June, 1937, with a representative of the U. S. Weather Bureau attending. It adopted a number of important resolutions, one of which provided for the establishment of universal rules in the form of "General Regulations for the International Meteorological Protection of Flight", which it is hoped will lead to action for the provision of improved meteorological services to commercial aviation in the international field. The U. S. Weather Bureau will participate actively in the functions of the new organization, and assist in adoption of measures necessary for the continued advancement of meteorological aids to aeronautics.

Fourth, cooperative efforts for the promotion of international meteorological services in the Western Hemisphere were begun in September, 1937, at the Pan-American Technical Aviation Conference at Lima, Peru, attended by delegates of all the republics of North and South America. Regional Commission III of the International Meteorological Organization, composed of the official meteorological services of South America, also held meetings during the early stage of the conference. The Regional Commission decided, among other things, that weather reports for 84 South American stations would be collected and broadcast twice daily beginning January 1, 1938, from Rio de Janeiro in international figure code messages, similar to those now broadcast by Naval radio stations NAA/NSS from Washington, D. C., and NPG from San Francisco, Calif., to cover reports for North America.

In the meteorological field, the Conference recognized the lack of adequate meteorological services in some South American countries, and urged the respective governments to create in each country unified official services provided with sufficient funds.

On July 1, 1937, a program for expansion of meteorological service in aid of air navigation was launched. It included:

With reference to the 228 airway stations referred to above as equipped with teletype or radio communication facilities, a full complement of commissioned Weather Bureau personnel is being placed at 10 airway stations mostly located at important airports, to render 24-hour service, thus making a total of 62 teletype-equipped Weather Bureau airport stations with commissioned personnel giving such service; while one commissioned Weather Bureau employee is being added to the already existing airway-observer personnel at 26 stations.

The Weather Bureau is supplying complete airway meteorological instrumental equipment to about 50 new airway stations established by the Bureau of Air Commerce, which is providing teletype communication facilities and personnel for making hourly weather observations. A selected group of about 20 of the present six-hourly reporting off-airway stations render observations at the intermediate three-hourly intervals. These augment the regularly available hourly reports from airway stations during the period half-way between the standard six-hourly observations and largely fill in gaps in synoptic weather charts previously existing to some extent along the coasts.

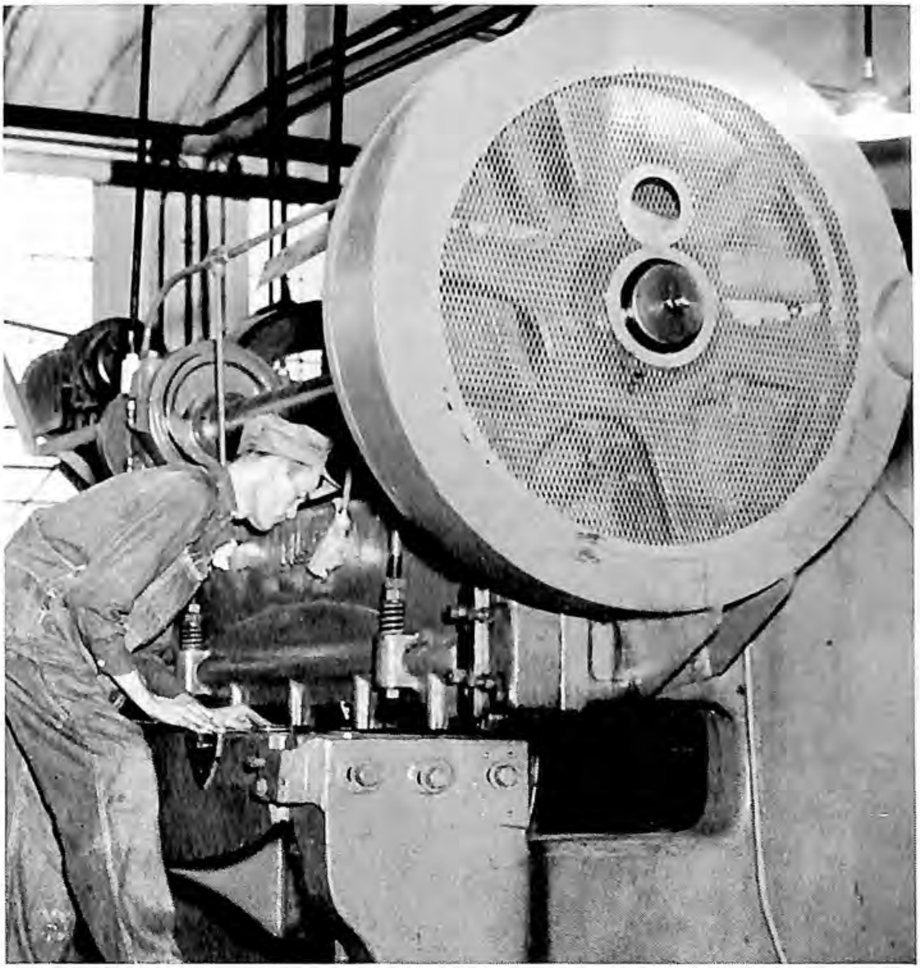
All the 73 pilot balloon stations in continental United States make four observations daily, instead of the previous two to four. This means an increase from 240 upper-air wind observations daily to a total of 292. It is planned to make pilot balloon observations at three to possibly six stations where such observations had hitherto not been made. Some stations will use 16-inch pilot balloons instead of the six-inch balloons thus far employed. The larger balloons have about one and a half times the ascensional rate of the smaller balloons, give information regarding upper-air winds in less time, and up to higher levels.

Three additional trained Weather Bureau employees are being assigned to each of the 11 airway forecast centers to aid in the work of forecasting.

An inspection and maintenance service for the airway meteorological system are being established to insure a higher standard of training in respect to the personnel and efficiency in the instruments.

One additional trained employee is being assigned to each of the 11 airway forecast centers to provide for the increased duties.

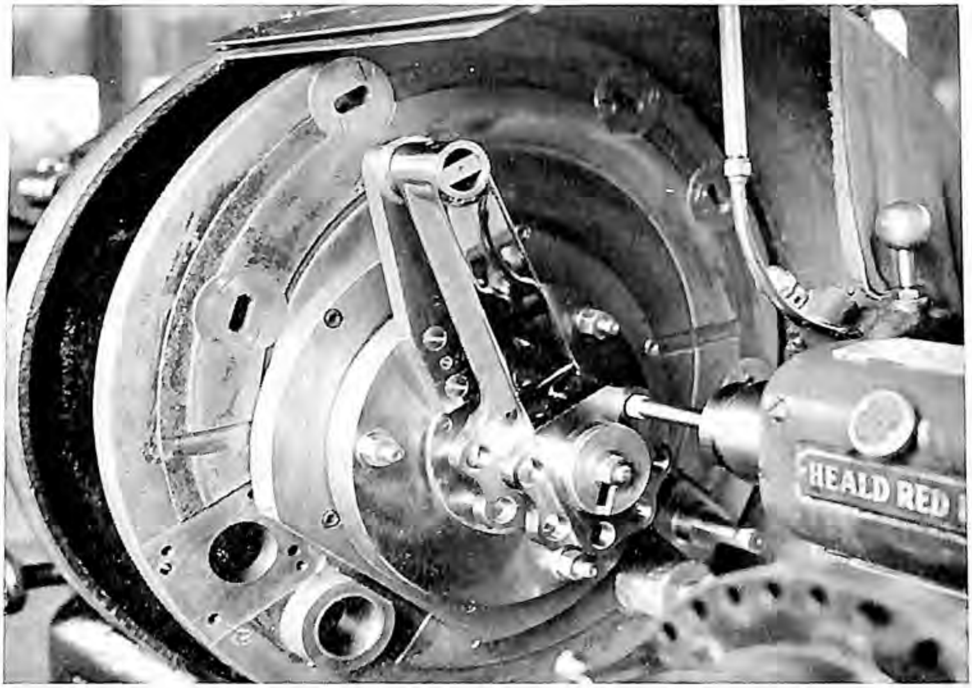
A program aimed at the modernization and augmentation of instrumental equipment for airway stations was started. At from 100 to 150 airport and airway stations the following equipment was being installed: (a) Powerful ceiling light projectors recently developed by the National Bureau of Standards, and designed to throw a more intense beam of light than the older projectors, and to permit the measurement of ceilings up to 10,000 or more feet; (b) Mercurial barometers which, in many cases, replace aneroid barometers, thus making it possible to determine atmospheric pressures with greater accuracy for use in the construction of weather charts and checking of altimeters; (c) Open-scale barographs which permit the measurement of pressure changes with great precision so that the needs of air-mass analysis and forecasting for such data may be fulfilled; (d) Wind vanes and indicators to show the wind direction to 16 points with resultant improvement of observations in comparison to those made with eight-point indicators; (e) Anemometers to give the wind velocity at stations which have lacked such instruments; (f) Ceiling balloons to permit the measurement of ceilings during daylight at stations not previously equipped.



A "PAIR" OF SHEARS

Metal shears for cutting flat sheets of alloy steel and other metals. Photo taken in the Beech Aircraft factory.

With the great increase in number of weather stations and in reports the communication facilities had become more and more congested. To ameliorate this condition, the Bureau of Air Commerce on July 20, 1937, increased the speed of teletype transmission from 240 to 368 operations per minute. It is now possible to receive more meteorological information in the allotted time and more promptly, with consequent improvement in service.



BUILDING JACOBS ENGINES

Grinding the knuckle pin holes in a master rod in the plant of the Jacobs Aircraft Engine Company. These holes are held to an accuracy of two ten-thousandths of an inch. The lustrous polish on the rod is not for appearance, but so that any scratches or hair lines in the rod can be detected.

Recognizing the value of weather reports from high elevations the Bureau established six-hourly reporting stations on Mount Mitchell, N. C. (at 6,639 ft.) late in 1936, and on Whiteface Mountain, N. Y. (at 4,616 ft.) late in 1937. These were additional to similar stations already established at Mt. Hamilton, Calif. (4,209 ft.), Mt. Wilson, Calif. (5,577 ft.), Mt. Washington, N. H. (6,290 ft.), Sexton Summit, Oreg. (3,841 ft.), Siskiyou Summit, Oreg. (4,524 ft.), Donner

Summit, Calif. (7,189 ft.), and other high points where possible.

Upper-air observations by means of airplanes were continued at the same total number of stations as in the preceding year, but the observations were brought to a close at Miami, Fla., in June, and similar observations were started at Chicago, Ill., in July.

The great strides being made by aeronautical engineers in the development of planes for sub-stratosphere flight and the desire of meteorologists for immediate information regarding weather conditions at high elevations above the present average levels which are reached in airplane weather observations, 16,500 feet, have confronted the Weather Bureau with new and difficult problems. To solve these problems the Bureau has actively engaged in a program leading to the development and use of radiometeorographs. They are devices weighing from three-quarters to one and a half pounds (depending on the make) which are attached to rubber sounding balloons six feet in diameter when inflated with hydrogen on the ground. They are carried to heights of 10 to 20 miles, all the while automatically broadcasting radio signals that give the pressure, temperature and relative humidity of the air traversed. The signals are recorded automatically at the ground on a moving sheet or strip of paper from which the data may be evaluated while the instrument is ascending.

Daily radiometeorograph observations began on September 1, 1937, at Burbank, Calif., using the "Galcit" instrument developed by Capt. O. C. Maier of the Army Air Corps and L. E. Wood at the Guggenheim Aeronautical Laboratory of the California Institute of Technology. Also, similar daily observations began on October 1, 1937, at East Boston Airport, Mass., using the instrument developed by Dr. K. O. Lange, A. E. Bent and collaborators at Blue Hill Observatory of Harvard University, under the direction of Dr. C. F. Brooks.

Under a grant from the Bankhead-Jones Special Research Fund, which was made available by Act of Congress for carrying out fundamental research projects in aid of agriculture, daily radiometeorograph ascents started in October, 1937, at Fairbanks, Alaska. Under that grant, too, airplane weather observations every third day were begun at Fairbanks in September. The upper-air data obtained from these ascents are to be specially used for the purpose of investigating the structure of polar air and the development of cold waves. The radiometeorographs employed at Fairbanks were developed by Julien P. Friez and Sons in cooperation with the Weather Bureau.

At the other extreme, a project for the investigation of conditions within tropical disturbances (hurricanes) was carried out during the latter half of 1937. In a cooperative endeavor with the Massachusetts Institute of Technology, along the latter line, the Weather Bureau shipped to three stations in the South, Macon, Ga., Maxwell Field at Montgomery, Ala., and Vicksburg, Miss., sounding balloons with special instruments weighing but 1.6 ounces and capable of automatically making a record of the air pressure, temperature and humidity on a smoked-glass plate about twice the size of a postage stamp. Similar equipment was shipped to Raleigh, N. C., and about 40 radiometeorographs were sent to Cuba with two of the Institute's observers.

The plan was to wait for a tropical disturbance to pass near the stations and to release the balloons with instruments at short intervals. On October 2, 1937, a tropical rainstorm covered almost the entire southeast. The balloons were released from the four stations at three-hour intervals, beginning on the afternoon of that day and continuing until the morning of October 4. A slight tropical disturbance approached the Louisiana coast and crossed it shortly after noon on October 3. From the data which will be obtained from the instruments after they are returned and the records deciphered, it is hoped to learn more about the conditions and processes within tropical storms, and thus to improve forecasts of such weather.

WHERE WACO PLANES ARE BUILT

Air view of the Waco Aircraft Company's plant and airport at Troy, Ohio.

CHAPTER VII

NOTABLE FLIGHTS OF 1937

The Russian Flights from Moscow to the United States—The Russian Polar Camp—Merrill and Lambie Make Round Trip to England—The Earhart Tragedy—Lieut. Adam Makes Altitude Record—Japanese Flight to London—Howard Hughes Makes Record Across Continent—Other Flights.

FOR sheer adventure and thrills the Russian Arctic flights easily took first place among all the world's exploits in the air during 1937. Early in the year the Russians flew up to the North Pole and established a base camp under the direction of Professor Otto J. Schmidt. Several planes participated in the expedition; one was forced down by bad weather about 40 miles from the spot near the Pole where the main party had established a camp designed to remain for at least a year while weather and climatic conditions could be studied and analyzed firsthand. Later this plane joined the main party; and for weeks the expedition ferried supplies back and forth between the polar camp and their base nearer home.

To test the ice floes before landing the pilots dropped cannon balls, making sure that their heavily-laden craft would not break through. To get the direction of the wind they threw out paper bags full of brightly colored powder, and as it blew across the floes the pilots could tell just how to head in for landings. Concentrated foods such as 5,000 chickens made up into 600 pounds of powdered chicken, sausages and the like were flown into the camp. A windmill was set up to generate electricity, with a gasoline engine for emergency use. A hut lined with eiderdown, with air space between the double walls, a radio, a ton of scientific equipment, a dog to warn of prowling animals, guns and in fact everything to make life comfortable, if lonely, for a year at the North Pole, all were flown in by the Russian crews. This was a real epic of the North.

Not satisfied with that, the Russian Government announced casually in June that one of its airplanes with a crew of three had left Moscow for the United States on a non-stop flight by way of the North Pole. That was something that the world had been talking and thinking about ever since Admiral Robert E. Peary went up there by dog team and discovered the place. But the best that anybody could do with aircraft was to hop over the Pole from land to land points, such as those flights by Amundsen and Ellsworth, Byrd and Floyd Bennett, Sir Hubert Wilkins and a number of others who made heroic flights across the Polar Sea. So the world waited, but not for long. On June 20 the Russian ANT-25, with its single 950 horsepower M-34-R engine purring like a kitten glided gracefully into the airport at Vancouver, Wash., and out stepped the three members of its crew, Valeri Chkaloff pilot, Georgi Baidukoff co-pilot, and Alexander Beliakoff navigator, unshaven, hungry, tired and very sleepy, but otherwise jubilant. They had flown non-stop from Moscow to the United States on a great circle, the shortest course, a distance of 5,288 miles in 63 hours 17 minutes.

They had set out for Oakland, Calif. On leaving Moscow Chkaloff had climbed to 9,000 feet, all that the heavily loaded plane could do, and not enough to avoid dense clouds and snow. Into this the plane plunged. Soon the airmen saw the windows frosted with ice; then their wings commenced taking on ice, then the propeller. They set the de-icers going—an American development by the way—and this equipment cleared the ice from the propeller and the wings; otherwise they must have been forced down.

Over the Kola Peninsula they encountered a cyclone, and were tossed about in nerve-wracking suspense until they managed to climb above it. After that they had no further trouble, except that their drinking water froze and they had to suck ice when thirsty. Occasionally at great heights they "smoked" oxygen, and pushed on through air that was below zero. They passed the North Pole 20 miles from the camp, flew down on this side of the roof of the world to Prince Patrick Island, thence to Great Bear Lake, Fort Simpson, Sitka, and down the West Coast to Eugene, Ore., where they found such thick weather that further flying was impossible; so they reluctantly turned about and headed for the nearest airport that they could find in the fog. It proved to be at Vancouver.

While the world was continuing to acclaim that feat the Russian Government announced, this time during the middle of July, that another plane, exactly like the first, had left Moscow for the United States, just to show that the first flight was not a stunt. On July 14 this machine landed at San Jacinto, Calif., and out stepped another trio of smiling airmen, Mikhail Gromov, Andree Yumashev and Serge Danilin, pilot, co-pilot and navigator respectively, unshaven, eyes bloodshot from lack of sleep but even more jubilant than the first arrivals; and with cause, for this second flight—taking 62 hours 17 minutes—had covered 6,295.6 miles, thereby breaking the world non-stop record established in 1933 when the Frenchmen Codos and Rossi flew 5,653 miles from New York to Syria. These Russians, however, had flown even farther than their official record. They had gone down as far as San Diego, Calif., and there hopped around and around for an hour or more trying to find a hole in the fog through which they could come down for a landing. They actually had enough fuel left for several hundred miles into Mexico, but as they asserted, they had orders to fly to the United States, and that meant stopping there, not flying beyond it. They said that nothing unusual had occurred on their flight, just a couple of cyclones, a blizzard now and then, frozen drinking water, ice on the wings and propeller and the recurrent need for using oxygen as they climbed high to avoid disaster.

Regular commercial schedules between Russia and the United States by way of the North Pole—such was the promise of the Russian press, and the world did not doubt it, when in August Sigismund Levanevsky, peerless aviator and known as the "Russian Lindbergh," flew out of Moscow with five companions in a huge four-motored monoplane bound for what had now become a not unusual destination, the United States. On Friday, August 13, the superstitious will note that date, Levanevsky's craft was somewhere over the Polar Sea believed to be approaching Alaska when radio watchers picked up this broken message:

"No bearings . . . having trouble with . . . wave band. . . ."

That was all. Within five hours Joe Crosson, veteran Alaskan pilot, headed north over 500 miles of terrain to the Arctic coast, others flew out in all directions, scouring a hundred thousand square miles of Alaskan area, without finding any trace of the lost machine. Jimmie Mattern, whom Levanevsky had helped to rescue when the American was lost in Siberia on his world flight effort, flew into the Polar area. Sir Hubert Wilkins and Herbert Hollick-Kenyon flew into northern Alaska on the search, making the trip from New York in a Consolidated flying boat bought by the Russian Government which also sent out legions of its own pilots on what had proved to be a futile search at the time this book went to press. But the Russian flights proved that airplanes, engines and instruments such as radio are vastly improved, and the men who fly them are capable of still greater achievements in the air. Around the world from pole to pole in eight days or so may be the great adventure flight a few years hence. After that, what? Possibly it will be regular scheduled services around the world, a world so shrunken by flying speed that one might spend a two weeks vacation on a world trip, all of which would bring about more mutual understanding between nations, more international goodwill, and eventually world peace.

Henry T. (Dick) Merrill, famous as the pilot who flew, with Harry Richman, to England and back in 1936, took his Eastern Air Lines Douglas transport south on its regular flight out of Newark on April 15, 1937, and when he landed at his regular stop at Miami, Fla., found that he had made the trip in five hours and 26 minutes. Then the following month Dick and his co-pilot John S. Lambie

NEW YORK-LONDON IN 21 HOURS

Henry T. (Dick) Merrill and Jack Lambie landing at Croydon airport, London, after their flight from New York. Their plane was a Lockheed Electra powered by two Pratt & Whitney Wasp engines.

flew from New York to London and back to New York again with pictures of the coronation of George VI. It was the highlight in American adventures, although there were many during the year. Merrill and Lambie flew a Lockheed Electra transport powered by two Pratt & Whitney Twin Wasp engines. They left New York on the afternoon of May 9. After passing out to sea near Newfoundland thick weather set in, and they saw nothing until they spotted the Irish coast. Everything was running smoothly save for a gauge which did not seem to be checking their gasoline supply accurately; so they made a brief stop in Essex, England, checked their gas supply and hopped into Croydon Airport, London, after a trip which took only 20 hours and 59 minutes. As quickly as they could procure the pictures of the Coronation, they set out again, leaving from a beach on the coast because it would permit them a longer runway with their heavy load of fuel. Again thick weather rose before them and remained there throughout their flight across the Atlantic; and again the laggard fuel gauge harassed them, until they landed at Squantum, Mass., for a brief check of their gasoline supply, taking off for the last hop into Floyd Bennett Field, New

JACQUELINE COCHRAN

With this Pratt & Whitney Twin Wasp-powered Seversky, she established a new women's international speed record of 292 m.p.h., at Detroit. Here she is talking with Alexander P. deSeversky, builder of the plane.

York. They covered the round trip in about five days in bad weather, on a commercial mission, using a regular air transport plane.

The world flight of Amelia Earhart and Fred Noonan seemed doomed to failure almost at the start. They took Miss Earhart's famous Lockheed "flying laboratory" out of Oakland, Calif. on March 17, and made a record trip of about 16 hours into Honolulu. There the ship was wrecked by a blown tire when the voyagers attempted to continue on their world flight east to west. After the ship had been brought back to the United States and repaired, the aviators again set out, this time projecting their trip from west to east. They flew to Miami, San Juan, P. R., Venezuela, thence to Brazil and across to Africa, traversing the continent and hopping across southern Asia—from May 21 to about the end of June, when they flew from Port Darwin, Australia, to Lae, New Guinea. Leaving New Guinea on July 2 they planned to reach Howland Island in the Mid-Pacific, where fuel supplies awaited them.

"We must be on you but cannot see you. Gas is running low. We are circling but cannot see island." That was the last authentic message picked up from the Earhart plane by a surface vessel near Howland Island trying to guide the plane in on its own radio beam. The U. S. Navy led in the search with all the ships and planes available, but no word had been received concerning the plane or its occupants when the search was abandoned officially. Thus was a great adventure turned into tragedy.

Lieut. M. J. Adam of the British Royal Air Force on June 30, 1937, went up in his Bristol high altitude plane and climbed to the world record height of 53,937 feet, beating by 2,575 feet the record established by the Italian army aviator, Lieut. Col. Mario Pezzi in a Caproni biplane in May. Lieut. Adam wore a special rubber suit and helmet so arranged that they could be inflated with air of sea level density, thus offsetting the various hardships and difficulties incident to flying in the stratosphere. He flew a special Bristol machine powered by a Pegasus engine. When he reached a height about six miles above the earth, Adam reported, the visibility became so bad that he could see nothing below him. By the time he had reached 50,000 feet he had not seen the surface for more than half an hour. When he landed he found himself 60 miles from his starting point. One incident provided a thrill. At the top of his climb, when the pressure of the air inside the cabin was much greater than that outside, the transparent top of his cabin split wide open with a bang that he could hear above the roar of the engine. But it was not serious enough to jeopardize operations.

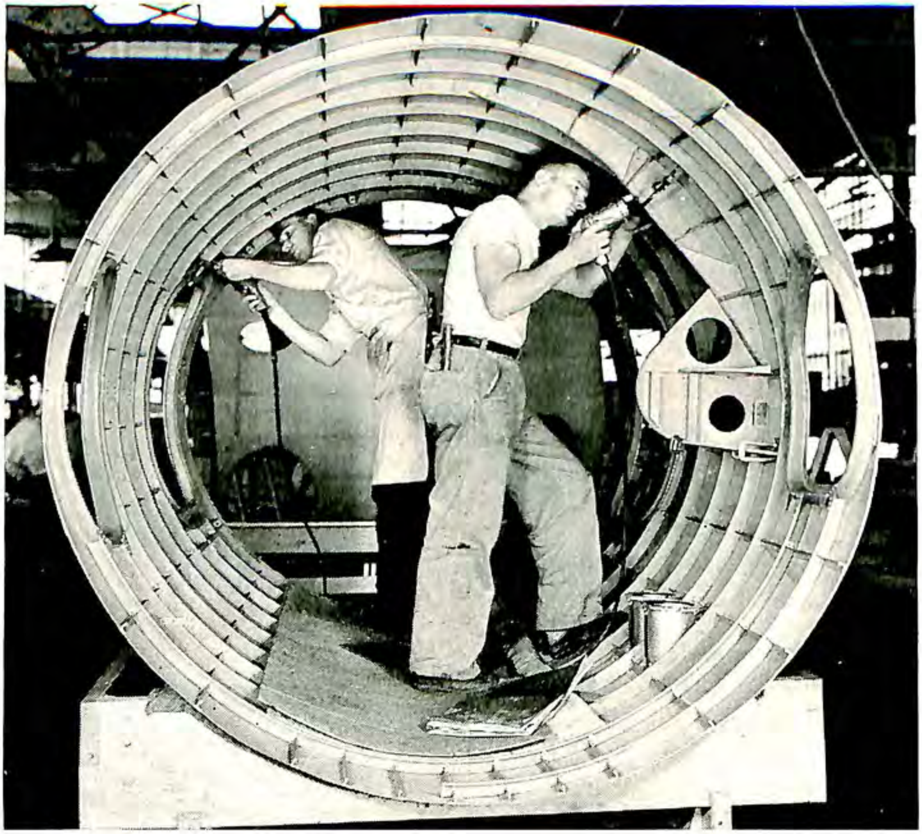
The Japanese people, long accustomed to reading of daring flights by foreign airmen, were thrilled in May when two of their own pilots, Masaaki Iinuma and Kenji Tsukagaski, flew back from London to Tokio with pictures of the Coronation,

TO PREVENT CORROSION

Painting a fuel tank aluminum, using an air spray gun. All oil and gasoline containers are sprayed in this manner to prevent corrosion. This photo was taken in the Lockheed plant.

making a record flight across two continents in 94 hours and 18 minutes.

In the United States Howard Hughes took off from Burbank, Calif., on January 20, sent his Twin Wasp Junior-powered racer to a fair altitude and made a bee-line flight clear across the continent, landing at Newark Airport in seven hours, 28 minutes and 25 seconds, a record non-stop transcontinental flight made at an average speed of 332 miles an hour. In September Jacqueline Cochran set the woman's world speed record when at Detroit she flew a Seversky Twin Wasp-powered Executive model over an official course at an average speed of 293 miles an hour. Another record was established for land flights by flying boat when Richard Archbold, Russell Rogers and four others flew a Consolidated Navy patrol type flying boat non-stop from San Diego, Calif. to New York, mostly at night. They flew direct from San Diego to Dallas, Texas, and then headed straight for New York, where they arrived 17 hours after leaving the West Coast.



A CLIPPER'S ENGINE ROOM

Inside one of the four engine nacelles of the Boeing 314 transocean flying boats for Pan American Airways service. These nacelles, each as large as the fuselage on a small plane, are mounted on the 152-foot wings of the giant ocean craft. They are accessible during flight through wing corridors.

CHAPTER VIII

AIR LINES OF THE UNITED STATES

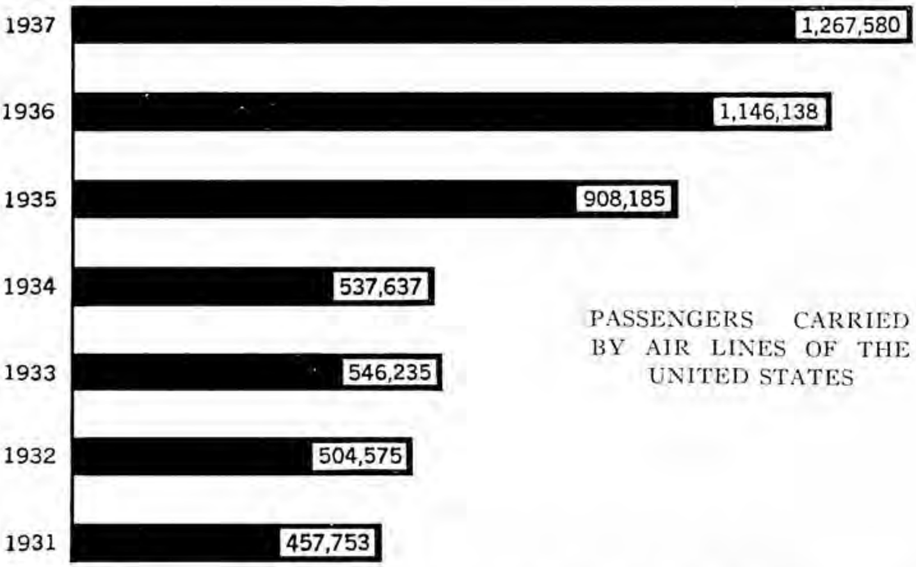
Increase in Speed—Development of Luxurious Air Liners—Growth of Air Express—Pan American Airways Operations—Air Lines in the United States.

FIFTEEN hours from coast to coast, three and a half days between New York and Rio de Janeiro, five hours between New York and Bermuda, New York to China in a week—those were only a few of the highlights in American air transportation at the beginning of 1938. Approximately 3,500 men, women and children were flying over the air lines of the United States, as an average, every 24 hours. Those lines also carried during each average 24-hour period 12 tons of air express and 29 tons of air mail. The lines had in service about 375 transport planes and employed about 12,000 persons, including approximately 700 pilots, an equal number of co-pilots, 3,300 mechanics and riggers, 2,500 other hangar and field personnel, 300 hostesses, 125 stewards and 4,000 office workers, besides the executives and management. Their scheduled flying totaled more than 223,000 miles every 24 hours over about 64,000 miles of routes. Of those totals 20,687 miles of daily scheduled flying over 32,100 miles of American-controlled routes were carried on by American lines operating from and outside the United States, notably Pan American Airways. The rest of the mileage was in continental United States.

Amazing as this development had been in recent months, the operators planned even more astonishing achievements for 1938. Four-engine transports carrying from 30 to 50 passengers were under construction and scheduled to enter active service during the new year, and, too, regular passenger, mail and express service between the United States and Europe requiring less than 30 hours each way by the longer route and less than 25 hours by the shorter course. Developments were following one another so rapidly that it was not difficult to peer into the very near future and see people speeding off to London or Paris for week-end trips just as they were flying to Bermuda or Honolulu in 1937, or a two-weeks' vacation spent on a flying trip to Asia or a tour of Europe or South America. In fact, the idea of one day making a flying trip entirely around the world during a two-weeks' vacation did not appear altogether visionary, so rapid has been the growth of international and national air transportation, in both speed and comfort of the passenger service.

Growth of Air Express

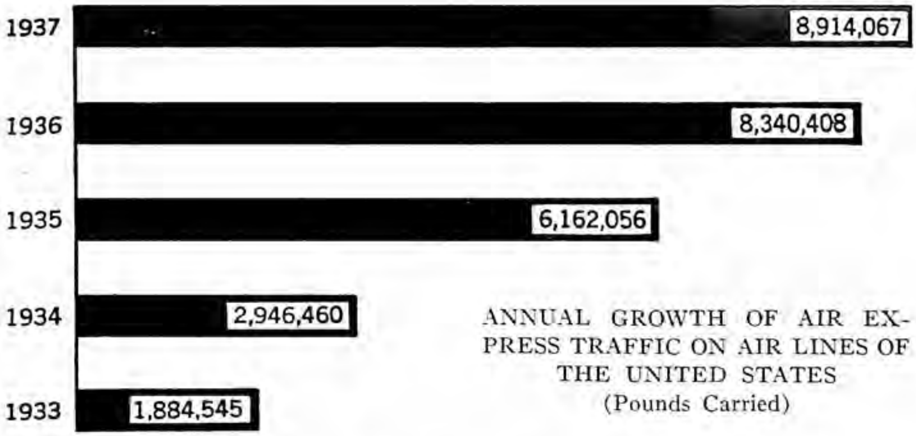
Important in speeding up trade between all sections of the



United States and its neighbors abroad the growth of air express service has been remarkable. Air express as Americans know it was only 10 years old on September 1, 1937. It started with four lines carrying shipments for the Railway Express Agency over 4,450 miles of routes. On the tenth anniversary the system included 19 lines covering 30,160 miles of routes. During the 12 months of 1937 the Railway Express Agency handled 628,048 air express shipments weighing a total of 2,157 tons. The average length of haul was 850 miles, and the average weight per shipment was 6.87 pounds. Over the 10 year period air express rates fell about two-thirds. At the beginning of 1938, for example, a five-pound package could be air-expressed from Boston to San Francisco for $4.80 as compared to $15.00 in 1927.

Speed doubled in the last decade. Transcontinental service that required 33 hours in 1927 was reduced to 15 hours eastbound and 17 hours westbound, the difference in time being caused by the prevailing winds from west to east.

Frequency of plane departures and coordination of air and rail services, with higher speed and lower rates, contributed to the increased use of air express in the first ten years. For example, between New York and Chicago, where more express probably was flown than between any other two cities in the world, there were forty-four regularly scheduled flights daily by



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

three major lines at the beginning of 1937. This provided the express company with a wide choice of routes over which goods could be shipped. Coordination of services between planes to airport cities and trains to off-air line points extended the air-rail service to 23,000 off-air line offices. About 30 per cent of all air express shipments either started or finished, or both started and finished, by rail.

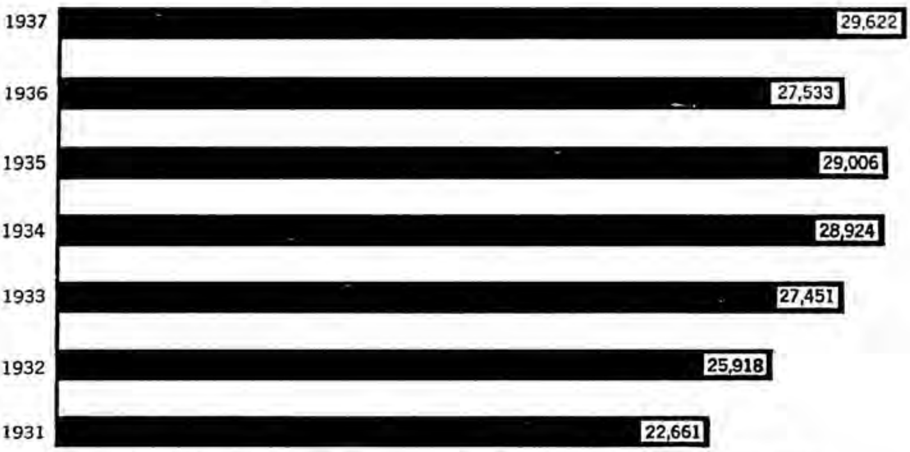
In its coordinated air-rail service Railway Express covered 230,000 miles of railroads in the United States as well as the 30,160 miles of airways. This service was handled by 57,000 employees. Night and day and holiday pick-up and delivery were expedited by 10,000 motor vehicles.

To speed up the air express service, Railway Express had an arrangement with the Western Union whereby a hurry call to any

Western Union office would bring a boy, without extra charge to the shipper, to pick up an air express package.

The largest increase in shipments by air express are in commodities the manufacturers of which have learned from experience that there is profit in speedy transportation. Included in this category are news photographs, news reels, electrotypes, printed matter, clothing, broadcasting transcription records, drawings, manuscripts, furs, cancelled checks, music and liquor.

The service was particularly welcome to news photograph and news reel syndicates, which prior to 1927 had spent a great deal of money on chartered planes in which to fly their photographic prints and reels to distant centers. Now, with frequent departures of regular flights, chartered planes no longer are necessary except

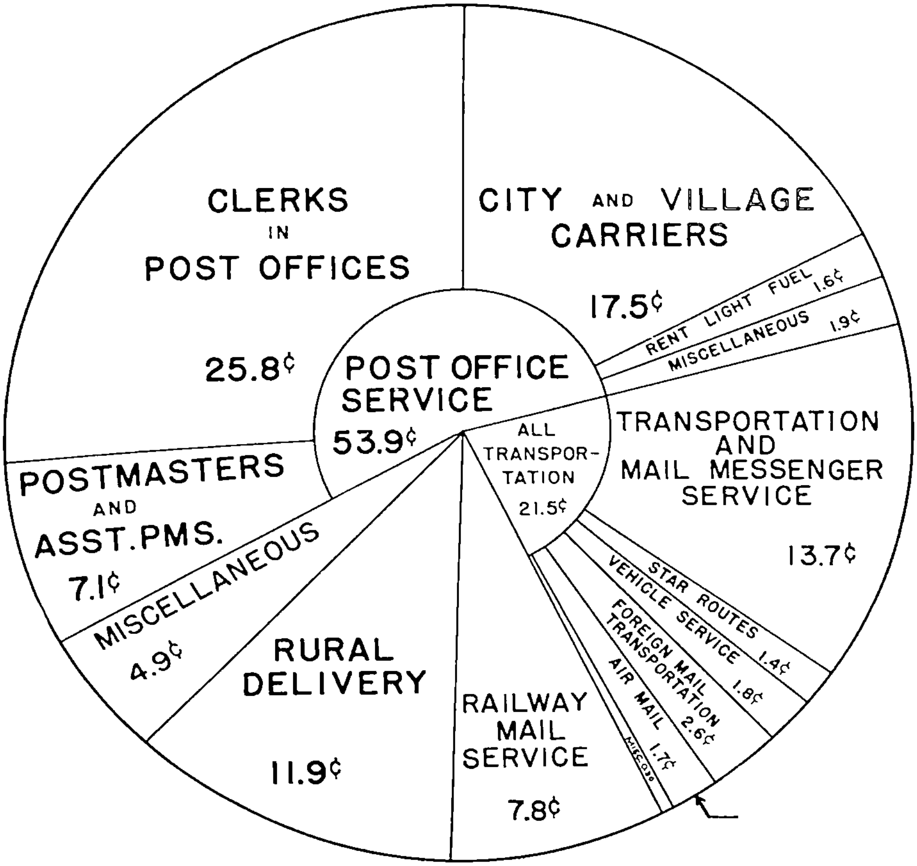


MILES OF AIR MAIL ROUTES IN THE UNITED STATES

where shipments originate far off the air lines, and the expense is materially reduced. When big news breaks, some of the news photograph services make as many as 300 air express shipments of prints a day.

Electrotype makers have been consistent users of air express from the beginning. By this means they are able to blanket the whole country overnight with advertisements scheduled for simultaneous publication. An outstanding single shipment of electrotypes was made by the Rapid Electrotype Company from Cincinnati of an advertisement ordered for insertion in newspapers in all parts of the country within 48 hours. Six hundred and seventy-nine of these shipments weighing 5,448 pounds were forwarded by air. Three extra planes were utilized. One for Newark Airport carried 210 shipments weighing 1,580 pounds; one for Chicago carried 309 shipments weighing 2,472 pounds, and one for Fort Worth, Texas, carried 120 packages weighing 960 pounds. Forty packages weighing 336 pounds were sent by regular plane to Detroit.

Same-day and overnight deliveries to any part of the United States have revolutionized buying and selling methods. This is particularly



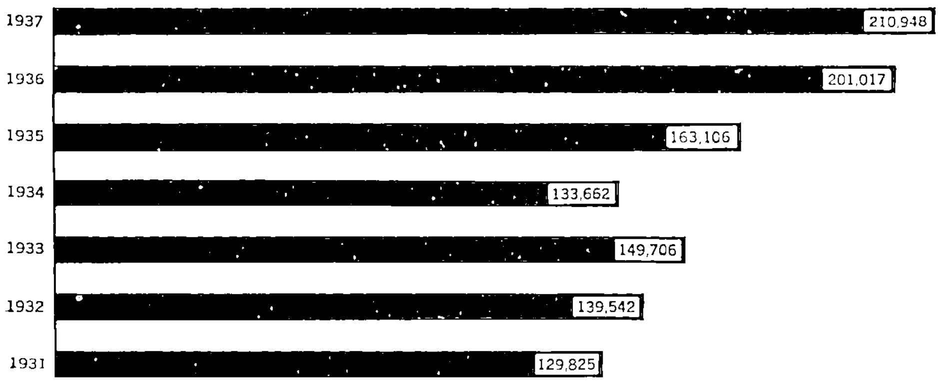
THE POSTAL DOLLAR

During the fiscal year 1937 only 1.7 cents out of every dollar of expenditures by the U. S. Post Office Department were spent for flying mail in the United States.

true in the clothing industry. Not only does air express permit decreased inventories; it places stores in remote towns on a level with those in larger cities in the matter of showing up-to-the-minute styles. Smart merchandizing managers of specialty shops are taking full advantage of this. A Palm Beach shop ordered 60 gowns by air express from which a customer was to select one to wear at a big function the following evening. Department stores frequently make same-day delivery of dresses to customers several hundred miles away.

A huge generator in a manufacturing plant at Emeryville, Calif. burned out. The plant was paralyzed. The loss of money from idle machinery was insured by an underwriting company, which paid $1,000 a day during the enforced idleness. Complete new armature windings weighing 2,657 pounds were air-expressed from Pittsburgh, saving days of idleness and expense.

Red scale was costing millions of dollars annually to California growers of citrus fruits. Insects were air-expressed from South Africa to fight that pest. Other insects were air-expressed from Honolulu to South Africa to save a sugar cane crop.



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

A New York printer air-expressed overnight to a mid-western city prospectuses weighing 9,000 pounds. Extra planes were used. Scarcely a week passes without shipments by air of steam shovel parts for machines broken down on remote projects.

Air express enables banks to establish a collection service that precludes all avoidable delay in converting out-of-town items into available cash. Night deliveries are made by Railway Express to night-working banks.

A Wurlitzer symmetrical grand piano weighing 300 pounds was air-expressed from Chicago to a music industries convention in New York. Passengers on the non-stop flight were invited by the stewardess of the plane to play the piano as it soared through the air at 10,000 feet.

Mrs. Constance E. Georg, wife of Dr. Carl Th. Georg, director of a hospital at San Pedro de Marcoris, Dominican Republic, placed a standing order with Slama's Bakery in New York City for two six-pound loaves of rye bread to be air-expressed to her every other week. These shipments left New York on Wednesday evening and reached San Pedro on Thursday afternoon.

A buyer for Wanamaker's New York store ordered 120 one-pound cakes of the first of the 1937 maple sugar crop air-expressed from St. Albans, Vt., to New York. The New York Herald Tribune featured the shipment in its food columns, and by mid-afternoon every one of the 120 cakes of maple sugar had been sold and customers were asking for more.

Pan American Airways System

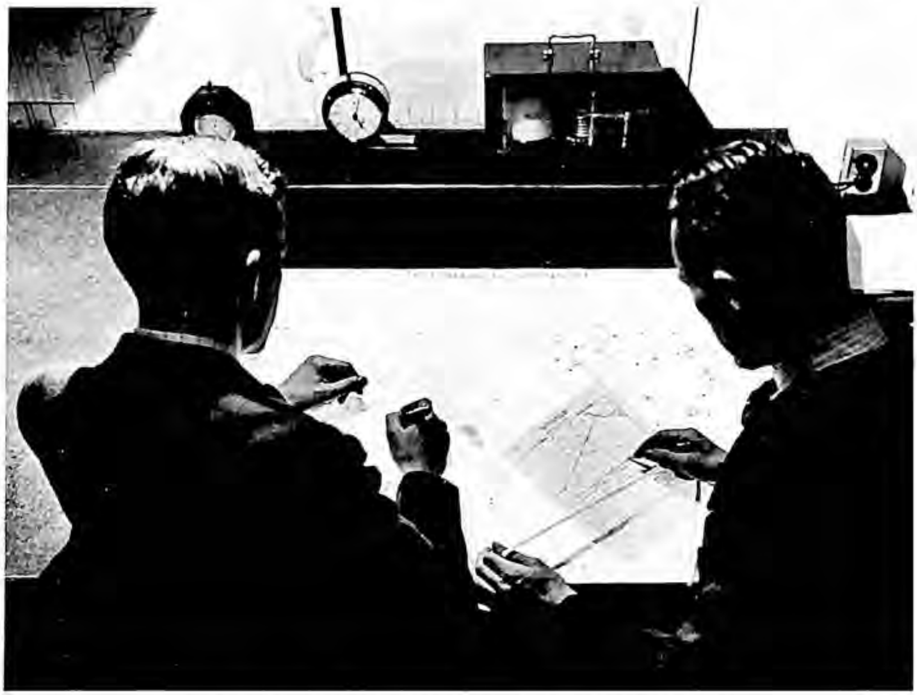
The Clipper ships of Pan American Airways made flying history

PAN AMERICAN'S HOTEL AT MIDWAY ISLAND
Here passengers flying the Pacific enjoy shore leave.

in 1937 by surveying for new routes over both the Atlantic and the Pacific and starting scheduled service over the Atlantic as far as Bermuda; meanwhile continuing regular speedy service with passengers, mail and express over 45,000 miles of airways, linking important centers in nearly half the world, including its 8,700 mile route across the Pacific.

Over the Atlantic, Pan American was repeating what it had done previously between California and China over the Pacific, and even before that over the Caribbean, achievements for which Pan American Airways in 1937 was awarded the Collier Trophy, high honor in American aviation. Pan American Airways was chosen, in the words of the citation, "for the establishment of scheduled air mail, passenger and express service across the Pacific Ocean, and for the successful execution of extended over-water air navigation in its regular operation."

As long ago as 1931, Pan American Airways pioneered in ocean flying operations which fundamentally were the same as those represented by the Pacific flights and the promised Atlantic service. The 600-mile jump from Jamaica straight across the Caribbean to Barranquilla represented an amazing step forward in air transportation when Pan American Airways began flying it in that year.



PLOTTING WEATHER FOR A PACIFIC TRIP

Pan American Airways service involves most thorough study of weather reports before departure.

From that flight laboratory came operations, navigating, communication procedures and new ideas for flying equipment which were used and further developed during subsequent ocean operations. All this background was available for mapping the Pacific surveys and more recently for the surveys toward regular service across the Atlantic and over the Pacific to New Zealand.

Between the United States and Europe Pan American flew its 22-ton Hornet-powered Sikorsky flying boat, "Pan American Clipper," back and forth across the ocean with clock-like regularity in six Atlantic crossings, including two round trips from New York by way of Canada and Ireland to England, and one in each direction on the "southern" arc by way of Bermuda and the Azores. But long before any actual flying took place, Pan American engineers and pilots were working on the ground correlating weather data and mapping out flight plans. Also, the company was setting up facilities for servicing

PACIFIC COAST TERMINAL

One of the Pan American Clippers leaves the hangar at Alameda, Calif., base as a recently arrived Clipper goes in for overhaul.

planes, for communicating with them in the air and for assisting them to remain on their courses and operate efficiently.

When the time came for the beginning of the first flight on July 3, 1937, the plan was so well formulated and had been rehearsed so carefully on the ground that the actual flying of the course was nothing more than a day's work for the members of the crew. All of them insisted afterward, quite seriously, that this first Atlantic survey crossing by Pan American was precisely like hundreds of other flights that they had made in the same type of equipment by the same methods.

In these three round trip flights Capt. Harold E. Gray, the Clipper's commander, and his crew of four flight officers and two stewards, not only surveyed the two ocean routes and made landings and takeoffs at all the points enroute, but also had a chance of observing a very good cross section of the conditions to be encountered in scheduled flying.

Operating ordinarily at the relatively high altitude of 10,000 feet at which the Sikorsky Clippers are designed to give their best cruising efficiency, the "Pan American Clipper" also did some flying at lower levels close to the ocean. In addition, at certain times, the Clipper's crew deliberately flew into heavy weather, plunging through the center of the storm front in order to gather data and get additional experience with the navigating methods over the Atlantic.

While Pan American Airways was following out these surveys other nations were busily engaged on the Atlantic scene. Both Great Britain and Germany undertook survey operations. France went so far as to send a weather ship to mid-ocean. Other nations, including the Netherlands and Italy, were known to be avidly studying the situation.

Great Britain's Imperial Airways had two survey ships in operation over the Atlantic. The "Caledonia" and the "Cambria," both of the Short Empire flying boat type, made five surveys for a total of ten Atlantic crossings, all over the northern route.

As Imperial Airways intends to have an air line station at Montreal, the two British boats included that Canadian city in their itineraries between London and New York.

At Port Washington, Long Island, where Pan American Airways has established a temporary Atlantic service base, pending completion of the new municipal airport and seaplane base for New York City at North Beach, and the municipal hangar at Baltimore, Imperial Airways boats were provided with all the facilities needed for their operation on this end, including weather and radio service. The same arrangement was in effect for Pan American Airways' boats at the British bases in Canada, Ireland and England.

Similarly, Pan American cooperated with Deutsche Lufthansa of Germany, which operated Diesel-powered seaplanes, the "Nordmeer" and the "Nordwind," between the Azores and New York City. The Germans made a number of ocean crossings over this route.

The unique feature of the German operation was the catapulting of the airplanes. Germany, lacking airplanes in the category represented by the Clipper ships, turned to catapulting for greater flying range. The catapult permits the plane to take off with a much larger fuel load than would be possible for a take-off from the water, and the Germans have become very expert in this operation, without carrying passengers, however.

While this was happening on the Atlantic, Pan American Airways was preparing for another new service on the other side of the world. For years the company had been eyeing the south Pacific, the stretch between the Hawaiian Islands and New Zealand, and had made studies looking to the possibilities of service there. Arrangements were concluded with the New Zealand Government, and in the spring of 1937, Capt. Edwin C. Musick, who already had commanded other Pacific survey flights, set out from Hawaii in a Sikorsky Clipper for New Zealand.

BRIDGE OF AN OCEAN AIR LINER

Pan American Airways crew about to take off on a long trip in a Sikorsky S42-B Clipper ship.

This ship made an 8,000 mile survey flight to Kingman Reef, which is a tiny spot in the south Pacific, barely visible above the water, thence to Pago Pago in Samoa and on to Auckland, New Zealand, and then back over that route to Hawaii.

As on every survey flight, the Clipper's crew gathered file upon file of data on weather, navigation, radio communication and operations procedure in general. Pan American Airways engineers immediately went to work on this data, in order to draw further plans for this very important service.

Not as exciting, perhaps, as transatlantic flying, the New Zealand route poses just as many problems in flying and operation, and it is exceedingly important to the people who live on the two islands 1,460 miles southeast of Australia. So far away from the large capitals and trade centers of the world, they want and need air transportation. That projected Pan American Airways service is important to the commerce and industry of the United States.

First of the newly surveyed ocean routes to have regular service was the one between New York and Bermuda. Preliminary flights over that section were undertaken in May, 1937, and the first regular plane with passengers flew to Bermuda on June 18th.

The "Bermuda Clipper," sister ship of the "Pan American Clipper" of Atlantic survey fame, has been flying regularly between Port Washington and Bermuda, first on a basis of one round trip weekly and later with two round trips scheduled each week. Alternating with the Pan American Airways plane is the Imperial Airways "Cavalier," which operates the same number of trips weekly as does Pan American Airways. The service is attractive to persons who wish to spend vacations or holidays in Bermuda. For one thing air transportation permits one to fly to Bermuda for a week-end visit, going down on Thursday or Friday and returning on Sunday or Monday. The "Bermuda Clipper" makes the journey in five hours, as does the "Cavalier," compared with 40 hours for the journey by steamer.

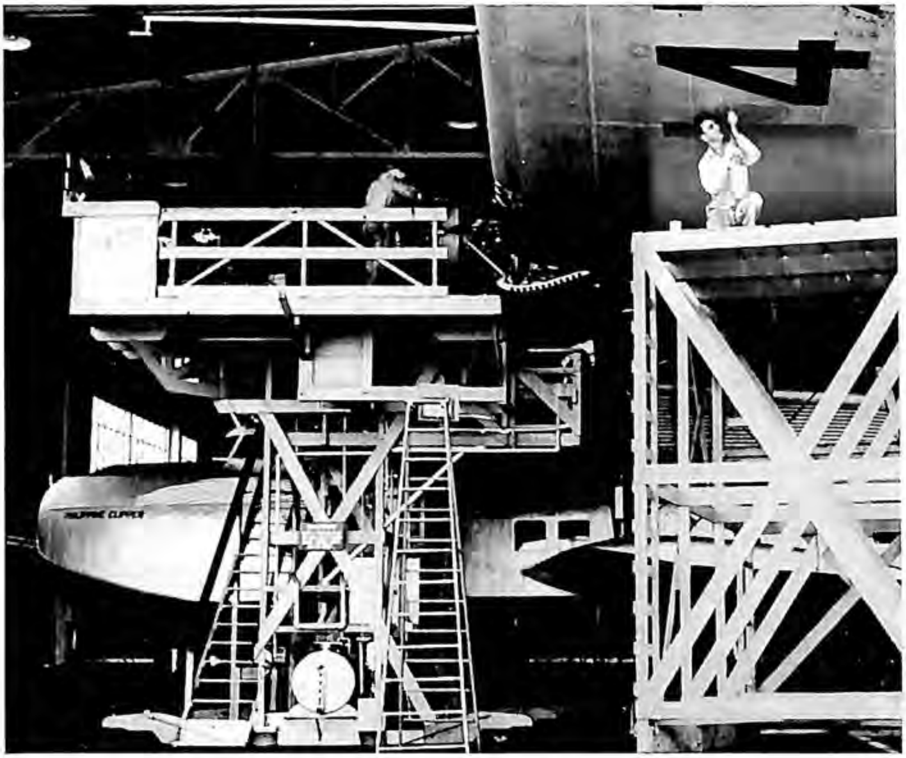
In the fall the base on the American side was moved to Baltimore, Md., because the temporary service base at Port Washington, Long Island, was not suitable for winter operations and the new municipal airport, under construction by New York City at North Beach, would not be ready before the spring or summer of 1938.

The flying activities in preparation for new ocean air transport, as represented by the Atlantic and Pacific services and the beginning of Bermuda service, are of course important to this development program, but by no means the entire story. Much of the preparation is carried out in offices and factory buildings. For example, the next big flying boat for ocean service was under construction during the year in the plant of the Boeing Aircraft Company at Seattle, Wash. This giant of the sea and air—the Boeing 314—will be twice the size of the Sikorsky ships and half again as large as the Glenn L. Martin ships. In fact, the Boeing actually will be larger than the ships in which Columbus crossed the Atlantic, and will have a top speed of around 200 miles per hour. They will be able to carry 75 passengers on relatively short trips; 50 on long ones up to 3,000 or more miles. They will carry a crew of 10, including two stewards.

Representing the best in flying comfort and luxury, the new

Boeing will accommodate passengers in comfortable compartments with seats that can be made up into berths for passengers at night. There will be a lounge, also used for dining room. There will be a galley for preparation of meals; dressing rooms for the passengers—there will even be a de luxe stateroom at the rear of the passenger cabin.

The Pan American Airways' initial order is for six of the Boeings



OVERHAUL OF AN OCEAN AIR LINER

One of the Glenn L. Martin Clipper ships in Pan American Airways Pacific service undergoing overhaul at Alameda, its Pacific coast base.

—for the Atlantic and the South Pacific. Construction of the big Boeings is one more job in the steady progress of the Pan American Airways System.

The year 1937 was one in which so many new developments took place that there is a temptation to let them overshadow what was going on along the 45,000 miles of routes over which Pan American Airways flies throughout the western hemisphere and across the Pacific to the

Orient on regular, established flight schedules. But this routine operation of air line services is very significant. First in the Caribbean and then throughout Latin America, Pan American Airways has cut travel, mailing and shipping times. The Caribbean is completely encircled with service down through the center of Mexico and Central America. Pan American Airways' planes fly down both coasts of South America. Already operating the fastest transportation service ever known to South America—and by a tremendous margin over boat and rail transportation—the air line in 1937 put into effect new schedules still further reducing travel time.

From Miami to the Canal Zone is only 12 hours by air. Continuing from the Canal Zone via Pan American Grace Airways down the west coast of South America passengers can speed to Santiago, Chile, and across the Andes to Buenos Aires in 3½ days out of Miami.

This west coast service includes one stretch of flying that has special significance for the future. It is the route from Santiago to Buenos Aires over the backbone of the Andes. Airplanes must go up to an altitude of around 18,000 feet to make this journey. Flying on this basis since this route was inaugurated the line recently has flown Douglas DC-2's like those which made such a remarkable record in domestic airline operation. New planes purchased for the service in 1937 are Douglas DC-3 transports, especially fitted out for this high altitude operation with the latest thing in supercharged engines and also with improved oxygen equipment for passengers. Flying at such altitudes it is not unusual for the passenger to require an occasional whiff of oxygen to keep him feeling fit.

Three Douglas DC-3 transports have been purchased for the east coast service in South America and three for service in Mexico. In these areas also, travel times are being consistently cut down and the journey between Rio de Janeiro and New York now takes but 3½ days. There also was added to the South American network a so-called diagonal service from Arequipa, Peru, southeast to La Paz, Bolivia, down through Bolivia to Cordoba, Argentina. Also a new service was mapped linking Paraguay with the rest of the Pan American Airways network. This line extending from Rio de Janeiro to Ascuncion, Paraguay, to Buenos Aires, passes over Iguassu Falls, one of the really wonderful falls of the world. Those improvements in service further strengthen the cordial relations between citizens of the United States and the various Latin American countries, an important result of air transportation in the Western Hemisphere.

The shrinking of distance is one thing that is strikingly apparent throughout Pan American Airways operations. Out on the Pacific the San Francisco-Orient division completed its second year of air mail service and its first of passenger service, with six-day flights to China. Every week now a Clipper ship leaves Alameda airport, near San Francisco, for Hawaii, the Philippines and China. Every week also, a plane comes in from the Orient.

Just another means of established transportation now, the Pacific Clipper service has come to be taken much for granted, as is naturally the case when planes come in and out with no more fuss or excitement than with a steamer or a railroad train. There is, of course, excitement

INTERIOR OF A CLIPPER SHIP

Passenger accommodations aboard the Glenn L. Martin flying boats operated by Pan American Airways in Pacific service.

at a Clipper's arrival or departure. It isn't the old excitement of seeing an airplane flying the ocean that once gripped the crowd at an airport, but the excitement of bidding farewell to friends or greeting them on their return, such as is seen at the steamer dock or in the railway station. Passengers who have crossed the Pacific have done so for the same reasons that they would cross in a boat—choosing the airplane because of the opportunity for safety or for the pleasure that this type of travel affords. There have been people rushed to hospitals, and on the happier side, there have been people hurrying across the miles to participate in important family occasions. Of course, there have been business men hurrying to carry out commercial missions and get back to their offices with a minimum of delay. There have been passengers who flew to the Orient and back simply because they "wanted to go somewhere."

The summer of 1937 saw exceptional transportation service in the quick delivery of photographic and motion picture films which had been taken in China showing scenes of the hostilities there, and in the delivery of medicines and anti-tetanus serum to the Red Cross in China.

One of the most interesting services operated by Pan American Airways is the one in Alaska. Before the coming of the airplane, dog teams afforded the only practicable form of transportation in many parts of the territory during the long winter months. Dog teams traveled slowly and somewhat uncertainly, but now the airplane covers in a few hours a journey that would require days on the snow.

More than in any other part of the world the airplane is the future transportation vehicle in Alaska. All the mail now goes by plane, instead of only that for which extra postage has been paid. Miners and businessmen do not even think of traveling by any other means if they are going from Juneau to Fairbanks or Nome.

The pilots and mechanics have developed special techniques for flying in Alaska, using skis for snow landings and stoves to heat engines which must be started up in sub-zero weather. Special equipment including emergency rations, firearms and ammunition against possible forced landings in the wilds are always carried aboard the airplanes.

All in all, Pan American Airways has in operation 45,546 miles of air routes serving 44 countries and colonies. On these routes, the Clipper planes have carried more than 800,000 passengers a total of nearly 300,000,000 passenger miles. There are nearly 150 air liners in operation served by 142 ground radio stations. In its far-flung operations, the company has maintained a regularity of mail schedules averaging 99.82 per cent.

Reflecting both the greater capacity of the big four-engine Clippers added to the Pan American Airways fleet and the increased importance of high speed transportation to American foreign trade in this highly competitive field, every department of traffic on the international system showed record gains during 1937. Preliminary traffic totals indicate that 225,000 passengers were carried over the Pan American Airways System during the year 1937—an increase of 57,000 (34 per cent) over the 168,000 passengers, best previous year's record, in 1936.

Showing an even greater percentage gain, a record of 90 million passenger miles flown was set during 1937, 25 million miles (or 38 per cent) more than the 65 million passenger miles flown the year before. Air express—an increasingly important item in modern foreign trade—showed the highest percentage improvement of all departments of traffic—with a total of 2,750,000 pounds carried, as compared with an even 2 million pounds for 1936, a gain of 40 per cent. The annual report of the Postmaster General cites an increase of 44 per cent in air mail poundage on the foreign air mail routes for the fiscal year 1937. In terms of pound miles and ton miles flown the figures are; pound miles 90 billion, or 45 million ton miles for 1937.

On December 9, 1937, Pan American Airways invited eight American aircraft manufacturers to submit plans for air liners carrying at least 100 passengers. The eight manufacturers included Boeing, Consolidated, Curtiss-Wright, Douglas, Lockheed, Glenn L. Martin, North American Aviation and Sikorsky division of United Aircraft Corporation. They were invited to consider a project which Pan American Airways described, in part, as follows:

"Further developments in the field of long range ocean service by the Pan American Airways System indicate a need for aircraft representing increases in size, payload and cruising speeds over those now in use or available.

"It is contemplated that such an aircraft should have a payload capacity of 25,000 pounds and in this condition be capable of flying 5,000 statute miles in still air when operated at cruising speeds of not less than 200 miles per hour at sea-level. ('Sea-level' is strictly an engineering term and is indicative of the practical speed of the airplane. A truer description of the speed is this; minimum cruising speeds required range from 233 m.p.h. at present 'normal' flight levels up to 299 m.p.h. at altitude.)

"Further, it should have stateroom accommodations for at least 100 passengers with dressing rooms, dining room and a galley having adequate facilities for the preparation and storage of food. Crew accommodations should allow for a crew of 16, and cargo compartments should be provided for mail, baggage and express permitting full use of all payload capacity not utilized by passengers.

"You are invited to submit one or more proposals for the construction and equipment of three, six or 12 aircraft (and lots of three, six and 12 additional aircraft subject to option) to be designed and made by you in conformity with the foregoing general description. . . . Each proposal must, of course, relate to a different design."

United States Air Transport Routes

U. S. Bureau of Air Commerce Statistics

Routes	Air-way miles[1]	Schedule (round trips)	Plane miles scheduled daily average[2]	Present operator
DOMESTIC				
New York-Springfield, Mass.	127	12 times weekly	218	Airline Feeder System
New York-Boston	192	6 times daily	2,304	American Airlines
New York-Boston	192	Daily	384	"
New York-Boston via Hartford & Providence	219	"	438	"
New York-Boston via Hartford & Providence	219	"	438	"
Boston-Buffalo via Albany	414	"	828	"
New York-Chicago via Buffalo & Detroit	779	7 times daily	10,906	"
New York-Buffalo via Wilkes-Barre & Syracuse	370	Daily	740	"
Detroit-Chicago via Battle Creek	261	"	522	"
New York-Detroit	509	"	1,018	"
New York-Albany	134	"	268	"
Chicago-Ft. Worth via St. Louis & Tulsa	940	2 times daily	3,760	"
Chicago-St. Louis	273	Daily	546	"
Washington-Nashville	489	"	978	"
Cleveland-Nashville	469	2 times daily	1,876	"
Washington-Chicago via Cincinnati	684	"	2,736	"
Washington-Cincinnati	423	Daily	846	"
New York-Los Angeles via Memphis & Ft. Worth	2,649	"	5,298	"
New York-Los Angeles via Washington, Nashville & Dallas	2,649	2 times daily	10,596	"
New York-Washington	209	Daily	418	"
Buffalo-Cleveland	177	"	354	"
Boston-Bangor	213	2 times daily	852	Boston-Maine Airways
Boston-Burlington	188	Daily	376	"
Bangor-Caribou, Me.	164	"	328	"
Chicago-Dallas via Kansas City & Wichita	965	2 times daily	3,680	Braniff Airways
Amarillo-Dallas-Galveston	618	Daily	1,236	"
Dallas-Galveston	273	"	546	"
Dallas-Brownsville	546	"	1,092	"
Dallas-San Antonio	281	"	562	"
Houston-Corpus Christi	186	"	372	"
Chicago-New Orleans	892	3 times daily	5,352	Chicago & Southern Air Lines

United States Air Transport Routes—Continued

Routes	Air-way miles[1]	Schedule (round trips)	Plane miles sched-uled daily aver-age[2]	Present operator
DOMESTIC—continued				
Denver-El Paso..........	622	Daily.........	1,244	Continental Air-lines
Charleston, S. C.-Atlanta..	311	"	622	Delta Air Lines
Atlanta-Birmingham......	140	"	280	"
Atlanta-Dallas...........	754	2 times daily...	3,016	"
Boulder City-Grand Can-yon..................	269	Daily.........	538	Grand Canyon Airlines
Tulsa-Omaha............	383	"	766	Hanford Air Lines
Minneapolis-Kansas City..	529	"	1,058	"
Huron-Bismarck.........	221	"	442	"
Boston-Springfield, Mass..	79	2 times daily...	316	Mayflower Air-lines
Miami-Key West.........	130	3 times weekly.	56	Miami-Key West Airways
St. Petersburg-Daytona Beach................	149	2 times daily...	596	National Air Line System
St. Petersburg-Miami.....	204	Daily.........	408	"
New York-Washington....	209	4 times daily...	1,672	Eastern Air Lines
New York-Washington....	209	3 times daily...	1,254	"
New York-Miami via Charleston............	1,209	2 times daily...	4,836	"
New York-New Orleans via Atlanta...........	1,218	"	4,872	"
New York-Richmond.....	305	"	1,220	"
Chicago-Miami via Atlanta & Jacksonville.........	1,267	"	5,068	"
New Orleans-Houston.....	329	"	1,316	"
New York-Atlanta........	786	Daily.........	1,572	"
Fargo-Pembina..........	146	2 times daily...	584	Northwest Air-lines
Chicago-St. Paul via Mil-waukee................	405	Daily.........	810	"
Chicago-St. Paul (direct)..	364	"	728	"
Chicago-Fargo via Mil-waukee................	620	"	1,240	"
Fargo-Seattle............	1,264	3 times daily...	7,584	"
Chicago-Fargo (direct)....	571	"	2,284	"
Washington-Detroit via Pittsburgh & Cleveland .	469	6 times daily...	5,628	Penna.-Central Airlines
Washington-Detroit via Pittsburgh & Cleveland .	469	Daily.........	938	"
Detroit-Milwaukee.......	259	2 times daily...	1,036	"

United States Air Transport Routes—Continued

Routes	Airway miles[1]	Schedule (round trips)	Plane miles scheduled daily average[2]	Present operator
DOMESTIC—continued				
Pittsburgh-Charleston	181	Daily	362	Penna.-Central Airlines
Washington-Buffalo via Harrisburg	318	"	636	"
New York-Los Angeles via St. Louis	2,555	3 times daily	15,342	Transcontinental & Western Air
New York-Chicago via Pittsburgh	747	Daily	1,494	"
New York-Chicago via Pittsburgh & Ft. Wayne	809	"	1,618	"
New York-Pittsburgh	329	4 times daily	2,632	"
New York-San Francisco	2,746	Daily	5,492	"
Winslow-San Francisco	691	"	1,382	"
New York-Chicago	717	9 times daily	12,906	United Air Lines
Cleveland-Philadelphia	415	Daily	830	"
Chicago-San Francisco	1,935	3 times daily	11,610	"
Chicago-Salt Lake City	1,302	2 times daily	5,208	"
Salt Lake City-Seattle	816	Daily	3,264	"
Salt Lake City-Portland	672	"	1,344	"
Pendleton-Spokane	169	"	338	"
San Diego-Seattle	1,198	"	2,396	"
Los Angeles-Seattle	1,103	"	2,206	"
Los Angeles-San Francisco	348	4 times daily	2,736	"
San Diego-San Francisco	253	Daily	506	"
Portland-Seattle	144	"	288	"
Cheyenne-Denver	96	4 times daily	768	"
Chicago-Cheyenne	917	Daily	1,834	"
Salt Lake City-San Diego	702	3 times daily	4,212	Western Air Express
San Diego-Los Angeles	95	2 times daily	380	"
Salt Lake City-Great Falls	489	"	2,046	"
Wilmington-Avalon	31	3 times daily	186	Wilmington Catalina Airline
Great Falls-Cheyenne	572	Daily	1,144	Wyoming Air Service
Total domestic[3]	31,584		195,012	
FOREIGN				
New York-Montreal	332	Daily	664	American Airlines
Burlington-Montreal	73	"	146	Boston-Maine Airways
Pembina-Winnipeg	65	2 times daily	260	Northwest Airlines
Miami-Havana	229	Daily	458	Pan American Airways

United States Air Transport Routes—Continued

Routes	Airway miles[1]	Schedule (round trips)	Plane miles scheduled daily average[2]	Present operator
FOREIGN—continued				Pan American
Miami-San Juan	1,161	3 times weekly.	1,046	Airways
San Juan-Rio de Janeiro	4,571	2 times weekly.	2,612	"
Rio de Janeiro-Buenos Aires	1,471	"	420	"
Miami-Cristobal via Kingston & Barranquilla	1,713	Weekly	244	"
Barranquilla-Port of Spain	1,021	4 times weekly.	583	"
Miami-Nassau	188	2 times weekly.	54	"
Brownsville-Mexico City via Tampico	466	Daily	932	"
San Francisco-Hong Kong via Manila, P. I., Honolulu, Midway, Wake and Guam	8,748	Weekly	2,499	"
Havana-Belize	742	"	212	"
Fortaleza, Brazil-Rio de Janeiro, Brazil	1,764	"	504	"
Rio de Janeiro, Brazil-Porto Alegre, Brazil	617	"	233	"
Mexico City-Cristobal via Guatemala	1,764	3 times weekly.	1,512	"
Guatemala-Cristobal	1,068	2 times weekly.	305	"
Merida-Mexico City	736	6 times weekly.	1,262	"
San Juan-Kingston	817	Weekly	233	"
Maracaibo-Port of Spain	757	2 times weekly.	433	"
New York-Hamilton, Bermuda	770	Weekly	220	"
Los Angeles-Mexico City	1,684	3 times weekly.	1,433	Pan American Airways (Aerovias Centrales)
Cristobal-Canal Zone-Montevideo, Uruguay via Santiago, Chile	4,552	2 times weekly.	2,548	Pan American-Grace Airways
Arica, Chile-Uillazon, Bolivia via Tacna, Peru	872	Weekly	249	"
Seattle-Vancouver	123	Daily	236	United Air Lines
Total foreign[3]	31,964		19,298	
Grand total[3]	63,548		214,310	
TERRITORIAL				
Honolulu-Hilo	223	Daily	446	Inter-Island Airways
Honolulu-Lihue	106	"	212	"

[1] Airway miles here given are the air line distances between cities.
[2] Plane miles scheduled to be flown, averaged on a daily basis.
[3] Airway miles total corrected for duplications when airways are used for two or more services.

Summary of United States Air Transport Operations

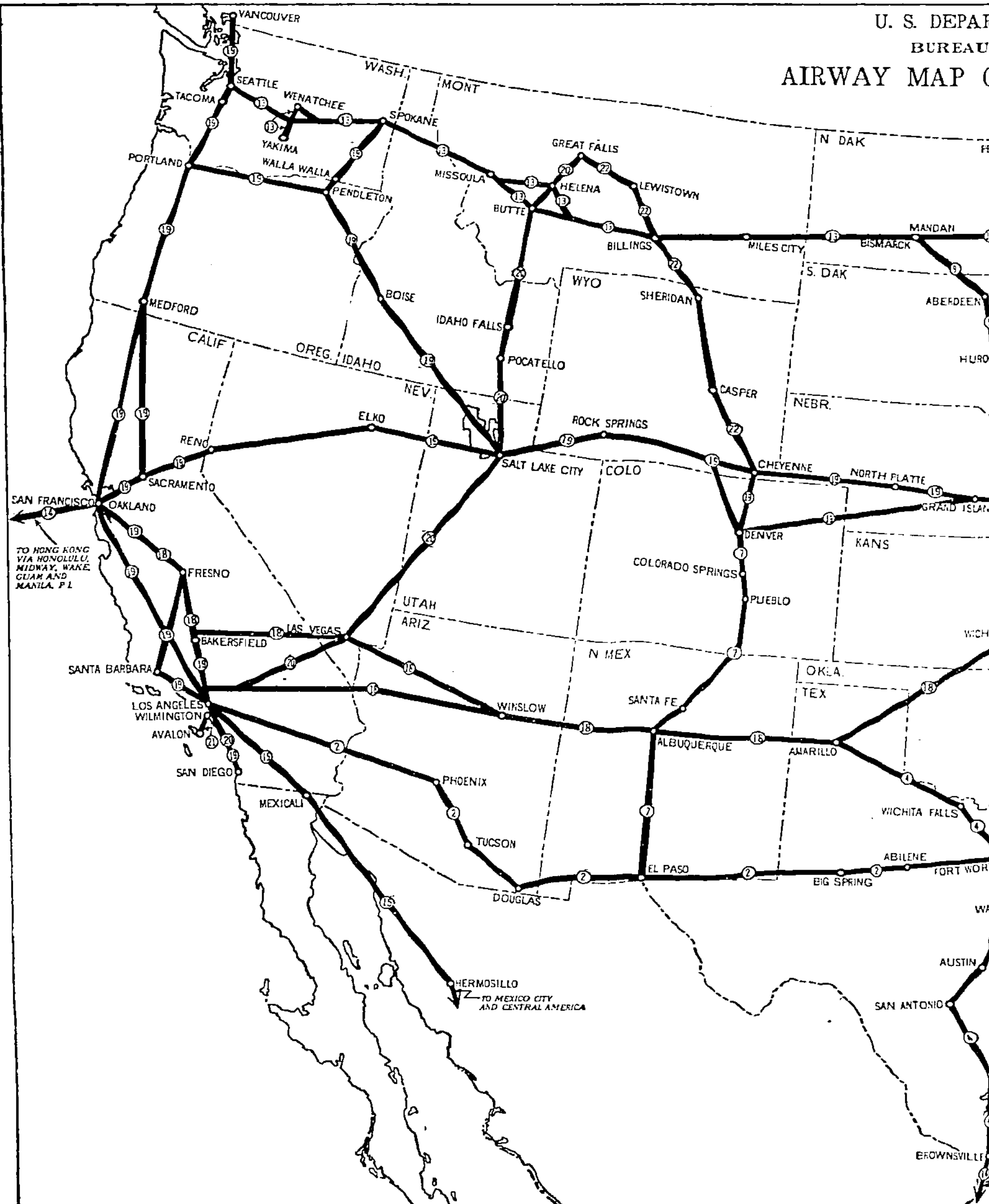
U. S. Bureau of Air Commerce Statistics

January 1, 1938

Miles of American-operated air transport routes:	
Domestic	31,084
Foreign	32,572
	63,656
Miles in operation with United States mail:	
Domestic	31,029
Foreign	26,454
	57,483
Miles in operation with passengers and express:	
Domestic	31,084
Foreign	26,544
	57,628
Airplane-miles scheduled daily (Average):	
Domestic	180,312
Foreign	19,410
	199,722
With United States mail:	
Domestic	168,040
Foreign	14,804
	182,844
With passengers and express:	
Domestic	180,312
Foreign	19,410
	199,722

Number of Air Transport Services in operation	108
Mail	87
Passenger	108
Express	108
Domestic routes	83
Mail	72
Passenger	83
Express	83
Foreign routes	25
Mail	15
Passenger	25
Express	25
Number of scheduled air transport operators[1]	20
Domestic	17
Foreign	7

[1] Four companies operated both domestic and foreign services.



U. S. DEPAR
BUREAU
AIRWAY MAP (
VANCOUVER
SEATTLE
TACOMA
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YAKIMA
SPOKANE
WALLA WALLA
PORTLAND
PENDLETON
MISSOULA
GREAT FALLS
HELENA
LEWISTOWN
BUTTE
BILLINGS
MILES CITY
BISMARCK
MANDAN
ABERDEEN
SHERIDAN
BOISE
IDAHO FALLS
POCATELLO
MEDFORD
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NEV.
NEBR.
CASPER
ELKO
ROCK SPRINGS
RENO
SALT LAKE CITY
COLO
CHEYENNE
NORTH PLATTE
GRAND ISLAN
SACRAMENTO
SAN FRANCISCO
OAKLAND
DENVER
KANS
TO HONG KONG VIA HONOLULU, MIDWAY, WAKE, GUAM AND MANILA, P.I.
FRESNO
COLORADO SPRINGS
PUEBLO
UTAH
ARIZ
BAKERSFIELD
LAS VEGAS
N MEX
OKLA.
TEX
SANTA BARBARA
LOS ANGELES
WILMINGTON
AVALON
SAN DIEGO
WINSLOW
SANTA FE
ALBUQUERQUE
AMARILLO
PHOENIX
MEXICALI
TUCSON
WICHITA FALLS
EL PASO
ABILENE
BIG SPRING
FORT WOR
DOUGLAS
AUSTIN
SAN ANTONIO
HERMOSILLO
TO MEXICO CITY AND CENTRAL AMERICA
BROWNSVILLE

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OF AIR COMMERCE
OF THE UNITED STATES
WINNIPEG
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MINNEAPOLIS
ST. PAUL
ROCHESTER
MILWAUKEE
MUSKEGON
GRAND RAPIDS
LANSING
FLINT
BATTLE CREEK
JACKSON
DETROIT
SIOUX CITY
ILL
DES MOINES
IOWA CITY
MOLINE
CHICAGO
SOUTH BEND
TOLEDO
OMAHA
BURLINGTON
PEORIA
FT WAYNE
IND
OHIO
LINCOLN
IOWA
MO
SPRINGFIELD
DAYTON
COLUMBUS
INDIANAPOLIS
CINCINNATI
ST JOSEPH
KANSAS CITY
ST LOUIS
LOUISVILLE
SPRINGFIELD
KY
TULSA
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NASHVILLE
KNOXVILLE
OKLA CITY
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CHATTANOOGA
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LITTLE ROCK
ATLANTA
BIRMINGHAM
GREENWOOD
DALLAS
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MONROE
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SHREVEPORT
JACKSON
MERIDIAN
MONTGOMERY
MACON
MOBILE
FLA.
BEAUMONT
HOUSTON
NEW ORLEANS
GALVESTON
CORPUS CHRISTI
TO MEXICO CITY, VERA CRUZ GUATEMALA CITY AND SAN SALVADOR
OTTAWA
MONTREAL
N Y
ROCHESTER
BUFFALO
SYRACUSE
ALBANY
CLEVELAND
WILLIAMSPORT
PA.
SCRANTON
WILKES-BARRE
AKRON
HARRISBURG
PITTSBURGH
ALLENTOWN
PHILADELPHIA
CAMDEN
N. J.
BALTIMORE
WASHINGTON
DEL.
MD.
W. VA.
ELKINS
CHARLESTON
RICHMOND
VA
N. C.
BRISTOL
GREENSBORO
RALEIGH
CHARLOTTE
GREENVILLE
SPARTANBURG
S. C.
COLUMBIA
AUGUSTA
CHARLESTON
SAVANNAH
JACKSONVILLE
DAYTONA BEACH
ORLANDO
LAKELAND
TAMPA
ST PETERSBURG
SARASOTA
VERO BEACH
WEST PALM BEACH
FT MYERS
MIAMI
NASSAU
KEY WEST
TO HAVANA, CRISTOBAL, C.Z., SANTIAGO CHILE AND MONTEVIDEO URUGUAY
TO SAN JUAN, PORT OF SPAIN, PARA RIO DE JANEIRO, MONTEVIDEO AND BUENOS AIRES
TO CRISTOBAL VIA KINGSTON, PORT OF SPAIN TRINIDAD, SANTIAGO, CHILE AND MONTEVIDEO, URUGUAY
TO HAMILTON, BERMUDA
CARIBOU
PRESQUE ISLE
ME.
HOULTON
MILLINOCKET
BANGOR
WATERVILLE
AUGUSTA
AUBURN LEWISTON
PORTLAND
BURLINGTON
MONTPELIER
VT
N. H.
CONCORD
MANCHESTER
MASS
BOSTON
PROVIDENCE
R. I.
SPRINGFIELD
HARTFORD
CONN
NEW HAVEN
BRIDGEPORT
NEW YORK
NEWARK

SCHEDULED AIRWAY OPERATIONS

January 1, 1938

Operator	*Routes Operated*	*Route Mileage*	*Class of Service*
Airline Feeder System, Inc.	New York to Springfield	127	PE
American Airlines, Inc.	New York to Los Angeles (via Washington, Nashville & Dallas)	2,649	MPE
	New York to Boston (direct)	192	MPE
	New York to Boston (via Hartford & Providence)	219	MPE
	Boston to Buffalo (via Albany)	414	MPE
	New York to Chicago (via Buffalo & Detroit)	779	MPE
	Detroit to Chicago (via Battle Creek)	261	MPE
	Buffalo to Cleveland	177	MPE
	Chicago to Fort Worth (via St. Louis & Tulsa)	968	MPE
	Chicago to St. Louis (direct)	257	MPE
	Cleveland to Nashville	469	MPE
	Washington to Chicago (via Cincinnati)	684	MPE
Boston-Maine Airways, Inc.	Boston to Bangor	220	MPE
	Boston to Montreal	261	MPE
	Bangor to Caribou	164	MPE
Braniff Airways, Inc.	Chicago to Dallas (via Kansas City & Wichita)	965	MPE
	Amarillo to Dallas	345	MPE
	Dallas to Galveston	273	MPE
	Dallas to Brownsville	546	MPE
Canadian Colonial Airways, Inc.	New York to Montreal	332	MPE
	Montreal to Ottawa	111	PE
Chicago & Southern Air Lines, Inc.	Chicago to New Orleans	892	MPE
Continental Airlines, Inc.	Denver to El Paso	595	MPE
Delta Air Corporation	Charleston, S. C. to Dallas	1,065	MPE
Hanford Airlines, Inc.	Tulsa to Omaha	383	MPE
	Minneapolis to Kansas City (via Huron)	682	MPE
	Huron to Bismarck	221	MPE
Miami-Key West Airways, Inc.	Miami to Key West	130	PE
National Airlines, Inc.	Daytona Beach to Miami (via St. Petersburg)	353	MPE
North American Aviation, Inc. (Eastern Air Lines Division)	New York to Miami (via Charleston, S. C.)	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
Northwest Airlines, Inc.	Chicago to St. Paul (via Milwaukee & Rochester)	416	MPE
	Chicago to Winnipeg (via Milwaukee)	834	MPE
	Chicago to St. Paul (direct)	364	MPE
	Fargo to Seattle	1,264	MPE
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
	Havana to Belize	742	MPE

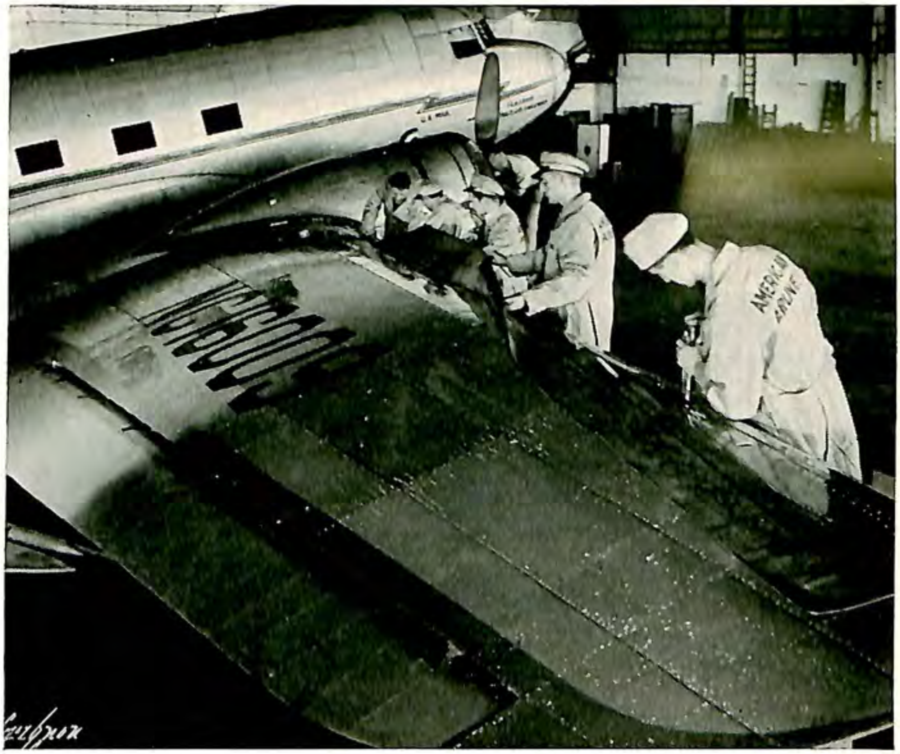
See next column

Route No.	Operator	Routes Operated	Route Mileage	Class of Service
14	Pan American Airways, Inc.	San Francisco to Hong Kong (via Manila, P. I., Honolulu, Midway, Wake & Guam)	8,748	MPE
		Mexico City to Cristobal (via Guatemala)	1,764	MPE
		San Juan to Kingston	817	PE
		Baltimore, Md., to Hamilton, Bermuda	726	PE
15	Pan American Airways, Inc. (Cia Mexicana de Aviacion, S. A.)	Los Angeles to Mexico City	1,684	PE
		Mexico City to Merida	736	PE
16	Pan American-Grace Airways, Inc.	Cristobal, Canal Zone to Montevideo, Uruguay (via Santiago, Chile)	4,552	MPE
		Arica, Chile, to Villazon, Bolivia (via Tacna, Peru)	872	PE
17	Pennsylvania-Cental Airlines Corporation	Washington to Detroit (via Pittsburgh & Cleveland)	469	MPE
		Detroit to Milwaukee	259	MPE
		Washington to Buffalo (via Harrisburg)	318	MPE
18	Transcontinental & Western Air, Inc.	New York to Los Angeles (via St. Louis)	2,555	MPE
		New York to Chicago (via Pittsburgh)	747	PE
		New York to Chicago (via Pittsburgh & Ft. Wayne)	809	MPE
		New York to San Francisco	2,812	MPE
19	United Air Lines Transport Corporation	New York to Chicago	717	MPE
		Philadelphia to Cleveland	415	MPE
		Chicago to San Francisco	1,935	MPE
		Salt Lake City to Seattle	816	MPE
		Pendleton to Spokane	154	MPE
		San Diego to Seattle (via Bakersfield & Fresno)	1,198	MPE
		Los Angeles to San Francisco (direct)	348	MPE
		Los Angeles to San Francisco (via Santa Barbara & Fresno)	413	MPE
		Cheyenne to Denver	96	MPE
		Chicago to Cheyenne	917	MPE
20	Western Air Express Corp.	San Diego to Salt Lake City	702	MPE
		Salt Lake City to Great Falls	489	MPE
21	Wilmington-Catalina Airline, Ltd.	Wilmington to Avalon	31	PE
22	Wyoming Air Service, Inc.	Cheyenne to Great Falls	572	MPE

M—Mail P—Passengers E—Express

American Airlines

Anticipating an increasing market for faster and more comfortable services on its nation-wide transport system, American Airlines operated Douglas DC-3 and DST Flagships, among them 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.



AMERICAN AIRLINES DE-ICERS

Installing de-icing boots on the wings of a Cyclone-powered Douglas DC-3, one of the American Airlines Flagships.

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 also installed.

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 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, powered with two 1,000 horsepower Wright Cyclone engines, had 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.

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.

Supplementing the non-stop and sleeper services, American Airlines made numerous improvements in schedules during 1937. 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.

The company announced that it carried 300,571 passengers in 1937, as compared to 255,324 in 1936. It reported an increase of 22 per cent in the number of passenger miles flown in 1937.

Boston-Maine Airways

Operating four Lockheed Electra transports between 15 cities in Northern New England the Boston-Maine Airways was flying about 2,200 airplane miles daily at the beginning of 1938. The line made connections with American Airlines at Boston and with Canadian Airways at Montreal.

Chicago and Southern Air Lines

Marking its fourth year of operations over the "Valley Level Route" between Chicago and New Orleans, Chicago and Southern Air Lines during 1937 started a third daily round trip schedule between those cities, providing morning, afternoon and evening service with an enlarged fleet of 10-passenger Lockheed Electra transports. In contrast with a monthly mileage of 54,000 in 1934, the company was operating over 160,000 miles a month in 1937, an increase of 300 percent over 1934 and 60 percent over 1936. Mail poundages had increased 500 percent over 1934 and 230 percent over 1936. The increase in passengers carried averaged 100 percent over the last year.

The company entered the winter of 1937-38 with many improvements in operating facilities. New radio ranges had been installed at Tylertown, Miss., and Advance, Mo. A new simultaneous range and broadcast had been completed at St. Louis, Mo., and the line had increased the power of its own short wave station at New Orleans. All planes were newly equipped with statically shielded loop antennas, resulting in an increasingly high standard of operating performance over

EASTERN AIR LINES STEWARD

While some of the air lines have hostesses E.A.L. features its flight steward service.

the Chicago-New Orleans Federal airway, one of the best equipped airways in the world.

Coincident with these improvements in frequency of service and dependability of performance, the company doubled its traffic staff in New Orleans and Memphis, and increased it by 50 percent in Chicago. General advertising expenditures were increased 60 percent.

Vast improvements were made on the company's southern airports by the completion of PWA projects at both Memphis, Tenn., and Jackson, Miss., at a total cost of $600,000. Modern passenger stations of great architectural beauty were built, in addition to enlarging and surfacing the landing areas. Thus with the exceptionally fine airports already existing at St. Louis and New Orleans, the line was able to offer its passengers unsurpassed facilities.

The importance of Chicago and Southern as the "great mid-continent connective" was increased by the evening departures from Chicago and New Orleans. The 9:00 p.m. departure from Chicago provided by connections the latest close of business day departures for St. Louis and the deep south from most eastern cities, and gave Chicago an after-dinner schedule for the south with convenient night arrivals at all stations.

Eastern Air Lines

Serving 16 Atlantic, southern and middle-western States, Eastern Air Lines, under the supervision of Captain E. V. Rickenbacker,

THE GREAT SILVER FLEET

Eastern Air Lines Douglas transports ready for scheduled departures to all points of the system. They are powered by Wright Cyclone engines.

general manager, at the beginning of 1938 was operating over a total of 3,493 miles of passenger, mail and express routes. During 1937 Eastern Air Lines operated a daily flying schedule of 23,068 miles as compared with 18,918 scheduled daily miles in 1936. A 26 per cent increase in revenue passenger traffic was reported.

Eastern Air Lines operates north and south from New York to Miami, from Chicago to Miami and from New York to New Orleans and Houston. Traditionally, the heaviest traffic seeks these routes in the late fall, winter and early spring months. However, with the steady growth of public confidence in air travel and its manifold advantages, Eastern Air Lines has succeeded in stimulating summer air travel in the States it serves. The retirement of five 10-passenger airplanes during 1937 and the acquisition of 10 Douglas DC-3 Wright Cyclone-powered 21-passenger transports gave momentum to this increase in air travel. At the beginning of 1938 the company was operating 11 Douglas DC-2 14-passenger and 10 Douglas DC-3 21-passenger transports.

During 1937, 334 route miles were added to the company opera-

EASTERN AIR LINES OVERHAUL

In the maintenance shops at Miami a mechanic is dressing propeller blades, to leave the surface, particularly the leading edge, free from cracks or scratches which might cause failure by fatigue.

tions, through purchase of the Wedell-Williams Transport Corporation, operating an air mail route between New Orleans and Houston. That route made possible two daily round-trip schedules between New Orleans and Houston and through trips to New York.

A statistical picture of Eastern Air Lines' history from the inception of its organization to December 31, 1937, is suggested in these figures: A total of 39,848,757 miles were flown. Of that total, 29,521,985 were revenue miles. The line carried 473,386 revenue passengers, 9,991,721 pounds of mail and 1,531,175 express pounds.

In token of its fine record of safety, the National Safety Council, Inc., an organization devoted to securing increased safety to human life, presented to Eastern Air Lines a Certificate of Special Commendation "in recognition of its continued high standard of safe operation among the major air transport companies of the United States." The commendation states in part: "Winner of the First Aviation Safety Award covering the operating period including years 1930-1936, Eastern Air Lines increased its safe operating record during the year 1937 to include approximately 180,000,000 passenger miles without a passenger fatality."

An outstanding contribution to the field of perfected flying aids was made during 1937 by the research divisions of the Eastern Air Lines radio and engineering departments in the form of the direction finding rotatable loop. Although this radio equipment has been used by major air lines for several years, the industry has acknowledged its definite limitations because of snow, rain and dust static problems. Using standard radio equipment made in the Eastern Air Lines shops, company engineers improved the direction finding rotatable loop to a high degree, warranting its installation on all Douglas DC-2 and DC-3 airplanes operated by the company. Extending fullest cooperation to other air transport companies, the knowledge of its engineers has been shared liberally with the industry at large. The direction finding rotatable loop has proved an invaluable flying aid for the repelling of snow, rain and dust static and as an instrument for positively identifying the location of the airplane while in flight. On Eastern Air Lines, this flying aid is used constantly, in good weather and bad. It has already demonstrated that it is a vital part of an airplane's navigation equipment, serving as a double check (with the radio beam when the plane passes over a station) on the location of the craft.

Hanford Airlines

In July, 1937, Hanford Airlines, Inc., linking the key cities of Minnesota, North and South Dakota, Iowa, Nebraska, Missouri and Oklahoma, completed its first year under new executive management. One of the first moves of the new management was to bring all equipment up to date. The original Fords and Lockheed Vega aircraft were replaced with 10-passenger, twin-engine, Lockheed Electra transports capable of 60 per cent greater speed.

All ships were equipped with two-way Western Electric radios of the one transmitter and three receiver type. The Siebenthaler radio compass was adopted as standard equipment, which permitted night flying operations over a limited lighted airway, thereby instituting an entirely new night flying navigation procedure. Traffic volume increased 75 per cent. The city of Tulsa, Okla., was added to the system, which covered 1,114 airway miles.

Inter-Island Airways

Inter-Island Airways, of Hawaii, completed eight years of operation November 11, 1937, with a record of carrying more than 100,000 passengers and flying in excess of 12,000,000 passenger miles over water without accident during 24,000 hours in the air. This is the

SIKORSKY FLEET AT HAWAII

The Inter-Island Airways amphibions at the operating base in Honolulu, including three new Sikorsky S-43 amphibions.

most westerly domestic U. S. air mail line in America. The 21,641 passengers carried during 1937 was 19 percent greater than the previous year and three times greater than in 1933. Starting service in 1919 with two Sikorsky S-38 amphibions, the fleet has been increased to three S-38's and three S-43's, the latter the first of their type built. During 1937 new hangars, maintenance shops and radio stations were constructed.

Daily scheduled round trips are operated among the islands, with practically all mileage over water. Planes operate out of the main base in 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. Operations headquarters are maintained at John Rodgers Airport in Honolulu, 10 minutes from the heart of the city.

All flying is done from the land bases which are steadily being improved and enlarged. During 1937 the Territorial and Federal Governments spent nearly $1,000,000 on this program. Much work still remains to be done, especially on Maui, Hawaii and Kauai, for which funds have been appropriated.

Commercial aviation is of primary importance in Hawaii where

NORTHWEST AIRLINES LOCKHEED 14

One of the new "Sky Zephyr" ships of the Northwest Airlines showing the rotatable radio compass loop aerial in the Plexiglass nose.

the 380,000 persons living in the Territory are divided among six inhabited islands, some of which have only twice-a-week steamer service. Emergency and special charter calls are frequent. Inter-Island Airways' schedules make it possible to reach Honolulu from any island within an hour and a half. Planes are equipped with two-way radio and homing compasses, and are in constant communication with the main base at Honolulu and the Hilo base, southerly terminal on the island of Hawaii.

Enlargement of John Rodgers field is anticipated in connection with the $3,000,000 "international seaplane base" which has been tentatively approved by the Federal Government. This base will adjoin John Rodgers field and the Army's new $18,000,000 Hickam Field which is already under construction.

Northwest Airlines

In 1937 Northwest Airlines completed eleven years of continuous operation. During this period it flew 63,000,000 passenger miles.

TRANSCONTINENTAL AIR LINER

Coast-to-coast service at more than 200 m.p.h. with a load of 24,800 pounds is TWA's proud claim for these Douglas DC-3 transports. They are powered by Wright Cyclone engines with Hamilton Standard constant speed propellers. The ring under the nose is the radio direction finder loop antenna.

Its new fleet of Lockheed 14 Sky Zephyrs had a cruising speed of 230 miles an hour, a cruising range of 2,000 miles, and was equipped with robot pilot, direction finder, oxygen tanks and many other new safety devices. Spacious cabins afford ample room to seat 10 persons comfortably. Operating between Chicago and Seattle, Northwest was flying two and one quarter million passenger miles a month.

Pennsylvania-Central Airlines

Pennsylvania-Central Airlines late in 1937 started its new Washington-Buffalo route, serving Baltimore, Williamsport, Harrisburg and Buffalo. Other cities may be added to the division at a later date, if adequate facilities are made available. The new route added more than 500 miles to Pennsylvania-Central's service to the industrial capitals of the East. Flying from the "Great Lakes to the Nation's Capital," PCA served Milwaukee, Muskegon, Grand Rapids, Lansing, Flint, Detroit, Cleveland, Akron, Pittsburgh, Charleston, W. Va., and Washington. With the addition of the Washington-Buffalo division this line served 15 major cities in eight states.

Transcontinental & Western Air

A general equipment program, plans for the introduction of four-engine transports in 1938 and an expansion of routes featured Transcontinental & Western Air's year. The company's Douglas-built and Wright Cyclone-powered Skysleepers and Skyclubs were introduced on the coast-to-coast system. The Skysleeper, licensed to carry 25 passengers, was put into service on the transcontinental overnight schedules while the Skyclubs were introduced on daylight runs and on the TWA non-stop service to Chicago.

Designed as a combination type airplane, offering chairs as well as berths, the Skysleepers carried berths for eight persons in the forward section and chairs for nine in the rear section. During daylight flights the forward berth compartments were converted into lounge compartments accommodating 16 passengers.

Eastbound the new equipment flew over the TWA route in 15 hours and 10 minutes between Los Angeles and New York, while a 17-hour schedule was set up for the westbound flights between those two terminals.

TWA announced that a contract had been signed with the Boeing Airplane Company of Seattle, Wash., for six new 32-passenger transports, to be powered by four engines each. Scheduled to go into service in the spring of 1938, these ships were to be the largest airplanes in service in the United States. Their gross weight was to be 42,000 pounds. The company had an option on 17 additional transports of the same type.

At the same time that the Boeing order was placed, TWA ordered 36 additional Wright Cyclone engines to power those ships. Capable of producing 1,220 horsepower, the new Cyclones were the same models as those installed in TWA's Douglas Skysleepers and Skyclubs. Installation of four Wright Cyclones in the new TWA Boeings will give each ship a total of 4,880 horsepower. A company announcement stated:

"The purchase of these planes, which will be the first of the modern four-engine transports to go into service in this country, is a step in a general expansion program being undertaken by TWA. In all, approximately $5,000,000 is being spent by the company. The new Boeing fleet, together with spares and equipment, will cost approximately $2,043,000. Recently TWA completed a series of experiments in high

TWA'S SLEEPER VERSION

"The Lindbergh Line" had this picture made to illustrate the comfortable quarters on its Skysleeper planes.

altitude flying which convinced us of the practicability of seeking higher levels. These experiments were carried on in the Northrop Gamma 'overweather' airplane, flown by D. W. Tomlinson. Whereas our experiments were conducted at altitudes of between 30,000 and 36,000 feet, we do not plan to operate the new planes at that level; but expect ultimately to carry passengers at a height of 20,000 feet in the new Boeing four-engine transports, through the addition of cabin pressure equipment.

"The passenger cabins of the Boeings will be structurally designed and built for supercharging, maintaining the air at sea level pressure and oxygen content. At the present time our Douglas Skyliners are flying at levels of between 6,000 and 10,000 feet, and we expect to start operating the new Boeings at about this level. Later, when we have been able to adapt high altitude experience to the four-engined transports, and when the installation of the necessary equipment is perfected, we will gradually start flying at higher levels. Using only 3,600 horsepower, the speed of the airplanes will be about 240 miles an hour at the higher cruising levels.

"The new four-engined transports, in addition to a passenger capacity of 32, will be equipped for carrying 3,750 pounds of cargo, in itself a greater load than the entire payload carried in the present day twin-engine transport airplane."

Most important of the several cities added to the TWA system during 1937 was San Francisco, Calif. First flights into San Francisco were flown in September, with mail, passengers and express. Transcontinental schedules terminating at San Francisco flew the TWA route westward as far as Albuquerque, N. M., where they turned toward the northwest and continued to San Francisco over one of the most scenic airways in the world.

In addition to a new express transcontinental schedule terminating at San Francisco, and a new eastbound companion schedule, TWA added mail, passenger and express service to Las Vegas, Nev., and Fresno, Calif., terminating this schedule at San Francisco. A companion schedule was flown eastbound with a stop at Albuquerque.

With the granting of the air-mail contract to TWA, to fly into San Francisco, a new aerial route was opened. San Francisco became linked directly with air line service to Texas, Colorado, Louisiana, Alabama and Georgia by way of Continental, Braniff and Delta airlines; Nebraska and South Dakota, Minnesota and Iowa by way of Hanford and Braniff; and Kentucky, Tennessee and the District of Columbia over Eastern Airlines and Pennsylvania-Central.

The new TWA service into San Francisco also provided passengers with a direct connection with Pan American planes to and from the Orient. However, no change was made in schedules terminating at Los Angeles.

In September, TWA became one of the contract carriers for the Air Express Division of the Railway Express Agency. The Company discontinued its General Air Express in order to cooperate with the other air lines in developing a coordinated air express system tied in with the ground transportation facilities of the Railway Express Agency.

W. A. Hamilton, maintenance superintendent of TWA, won the first annual award established by Aviation Magazine for outstanding achievement in the field of aircraft maintenance. The award to Mr. Hamilton was made "in recognition of outstanding contribution to the field of maintenance of air transport equipment."

United Air Lines

United Air Lines in 1937 completed its new equipment program,

ACROSS THE CONTINENT IN A NIGHT

TWA Passengers leaving a Skysleeper Douglas DC-3 transport at Los Angeles after a night flight from New York.

placing in service a fleet of 30 Douglas DC-3 Mainliners of three types: sleeper, Skylounge, and 21-passenger day planes. United operated non-stop three hour 55 minute schedules between Chicago and New York with the exclusive Skylounge type, affording the extra comfort of only 14 swivel chairs in a cabin large enough for 21 passengers. It established coast-to-coast service on 15⅓ hour schedules with similar planes, and also provided three coast-to-coast flights with sleepers. In addition, the company continued operation of 30 Boeing

247-D three-mile-a-minute transports providing intermediate and local service.

United flew 13,400,000 passenger miles for an international air traffic record for a single month. Despite a comparatively light traffic period during the early months of the year, the volume carried with United's planes during the summer reached an all high peak and required flying approximately 1,600,000 airplane miles a month.

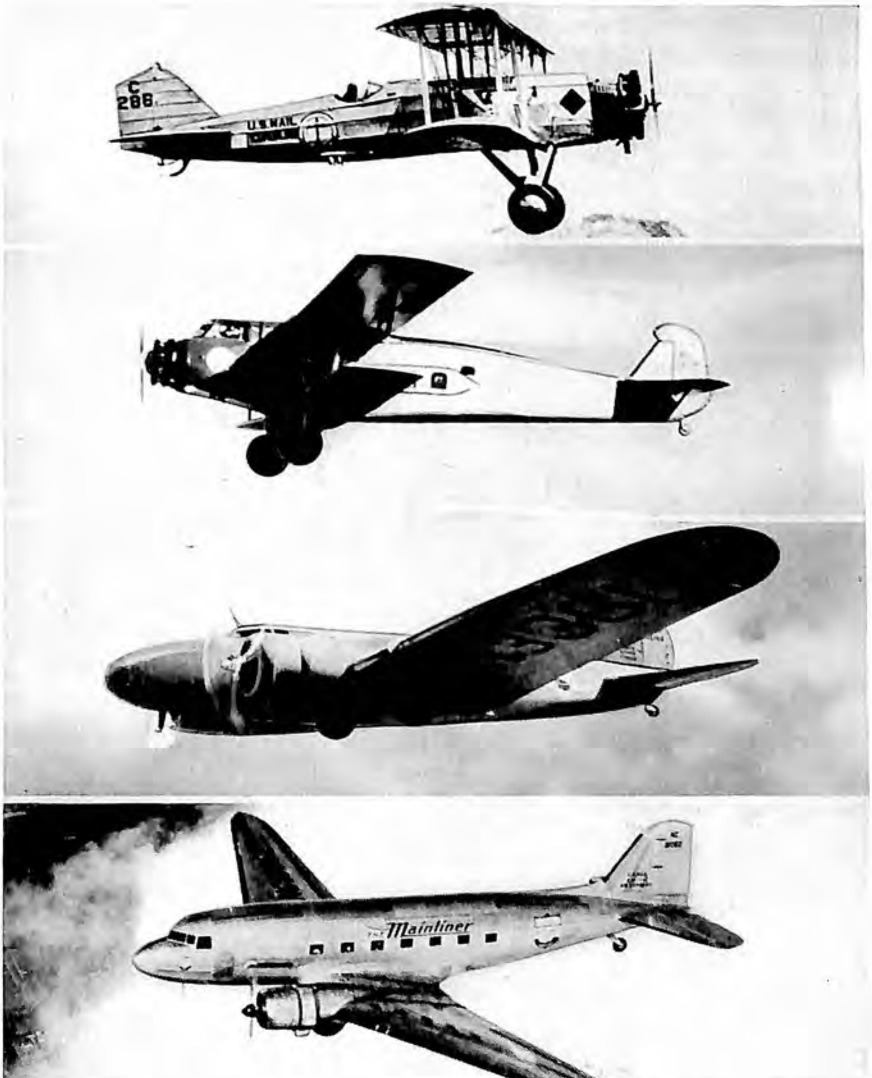
A milestone in air transportation was passed by United Air Lines when the company observed its tenth anniversary of coast-to-coast operations which marked likewise the tenth anniversary of commercial coast-to-coast air travel. It was September 1, 1927, that predecessor companies of United established the first passenger-carrying schedules over the New York-Chicago-California airway which had been operated for eight years previously by the Post Office Department as a strictly air mail service. During its 10 years of coast-to-coast operations United Air Lines carried 1,075,359 revenue passengers, flew 450,862,210 revenue passenger miles, flew 120,209,435 airplane miles, carried 42,357,951 pounds of air mail and air express.

When the company started its first schedules in 1927 passengers rode across the continent in single-engine mail and mail-passenger planes requiring 33 hours to make the coast-to-coast trip, stopping 14 times enroute. In sharp contrast were the tenth anniversary standard services operated by 12-ton twin-engine Douglas Mainliners, crossing the continent in 15⅓ hours with only three stops.

Several outstanding achievements in technical advance were recorded during the year. The company set aside a standard Boeing 247-D transport as a "flying laboratory." Chairs in the passenger cabin were removed to make room for testing apparatus. As the only modern twin-engine transport in air line use for strictly research purposes, United's flight research plane was engaged in the development of several important projects. In charge of flying the plane was Ben O. Howard, former United pilot and previously racing pilot and test flier.

One of the projects was the flight research on rain and snow static. For three months United Air Lines engineers, representatives of equipment manufacturers and college professors of science devoted their entire time to the study of the radio static problem. This divulged new facts on the cause of static and paved the way for the elimination of this obstacle to clear reception of aircraft radio signals.

A second project in which the United Air Lines' "flying laboratory" played an important part during the year was the refinement of the instrument landing system being developed jointly by air lines and an equipment manufacturer at the Oakland Municipal Airport. A long series of flight tests was successfully completed at the Oakland Airport



PROGRESS IN AIR TRANSPORT

This shows the development of transport planes used by United Air Lines in 10 years of operations. At top is the Boeing 40-B, next the Boeing 80-A, then the Boeing 247-D, and at bottom the Douglas DC-3 Mainliner.

to demonstrate satisfactorily that the landing system met the requirements laid down by air line, Bureau of Air Commerce, and other experts, and proved the safety and feasibility of instrument landings regardless of visibility. Many completed "blind" landings were effected in the "flying laboratory" on the new system at Oakland.

Other projects which United Air Lines' engineers advanced during the year included the fuel injection system, which eliminates the difficulty of icing of carburetors during winter season flying, a comprehensive flight study of thunderstorm activity, and various mechanical developments and refinements. United Air Lines also installed six

COMFORT AT NIGHT

United Air Lines produced this picture to show the comfortable berths in its sleeper planes. The berths are as wide as a twin bed and six and a half feet long.

Link trainers, placing them at strategic points over its system for the use of the flight department in checking pilots on instrument flying.

In September United Air Lines placed an order for 28 Pratt & Whitney Model 1830-C two-row 14-cylinder Wasp engines of increased horsepower over the present two-row Wasps in use on the Mainliners. This order was placed simultaneously with the purchase of 10 more Douglas DC-3 Mainliners for delivery early in 1938, to raise United's total of DC-3 equipment to 40 and its twin-engine total to 70 transports. These 10 DC-3's will be equipped with the new type

Series 1830-C Wasps which are expected to effect an improvement in power and efficiency of the airplane performance. These planes likewise will be equipped with the new type feathering propellers of the Hamilton Standard Propeller Company.

Another technical advance achieved by United Air Lines during the year was the development and installation of "flight analyzers" on all planes. The "flight analyzer" is a small device providing an automatic and constant record of altitude of flight from block to block, rate of climb and descent, exact record of the use of the plane's automatic pilot, and radio transmitter. After every flight this record is checked

UNITED AIR LINES MAINLINER
It is a Douglas DC-3, powered by Pratt & Whitney Twin Wasp engines with Hamilton Standard constant speed propellers.

by the chief dispatcher and the pilot. Besides serving as a complete chart of the trip, it is a check on the company's regulation that no trips shall be flown at elevations lower than 2,000 feet above the surface.

In expansion of service United Air Lines gave Denver its first through coast-to-coast air service in 1937, making it an important stop on its route from coast to coast. Walla Walla, Wash., was added to the company's Pacific Northwest route following discontinuance of service to Pasco, Wash. Allentown, Pa., was added to the company's network.

The company planned to expand its research and laboratory projects, one of which is a ground direction finding system which is expected to materialize early in 1938. The company will participate actively in preliminary testing of the Douglas DC-4, the four-motored transport planned for flight tests early in 1938.

FAIRCHILD SOLAR NAVIGATOR

For greater accuracy in aerial mapping, this instrument, in the dome on top of the plane, keeps the pilot informed of the slightest deviation from his straight course, so he can correct it quickly.

CHAPTER IX

AERIAL SERVICE

Airplanes Chartered for Emergencies—Civil Aircraft in the United States—Activities of the Air Taxi Pilot—Aerial Photography—Weather Reporting—Crop Dusting.

DESPITE the rapid growth of scheduled air line transportation, the vast majority of pilots, aircraft mechanics and airplanes in the United States are engaged in aerial service operations, employed in flying on countless missions where speed is essential or the job is either impractical or too expensive by surface vehicles.

The U. S. Bureau of Air Commerce on January 1, 1938, listed a total of 10,836 flying machines in the United States. Of that number 9,152 were licensed and 1,684 were identified but without certificates. There were 36 licensed autogiros. Not included in the total were 273 gliders, of which 47 were licensed.

California led all other states with 1,219 flying machines and 37 gliders. New York was second with 958 planes and 31 gliders; Ohio, Pennsylvania and Illinois followed in the order named. The table will be found in the Appendix. While the airplane totals included all the air line and sportsman pilot machines, it was believed that a majority of the planes and airmen in the United States were employed in the various fields of aerial service.

Aerial service started soon after the World War, when barnstorming pilots gave up their itinerant careers in stunt and exhibition flying for the more prosaic but more substantial business of fixed base operations—aerial hacking, charter flying, student instruction, crop dusting, aerial advertising and the manifold and extraordinary tasks that come to a good pilot with a good plane and a yearning to fly anywhere at any hour of the day or night on any kind of a mission.

Aerial service operators performed magnificent services during the floods that afflicted many sections of the country in 1937. They flew into isolated areas with foods, medicines and clothing. They brought in doctors and nurses. They brought out the sick and the injured. They flew aerial photographers and officials over flooded areas making accurate surveys so that damage might be checked and human misery and suffering more quickly alleviated.

Pilots of the aerial service, without uniform or rank other than the aviator's license that entitled them to wear wings, were aroused from sleep at night, to set out shortly thereafter, in many instances, over a smoke-clouded, mountainous countryside to help fight raging forest fires. Or a hurried call might send one out to scout for some individual or group reported lost in the trackless wilderness laid down by a blizzard. Aerial service operators repeatedly saved lives and property in all States during the last 12 months.

GRUMMAN COMMERCIAL AMPHIBION

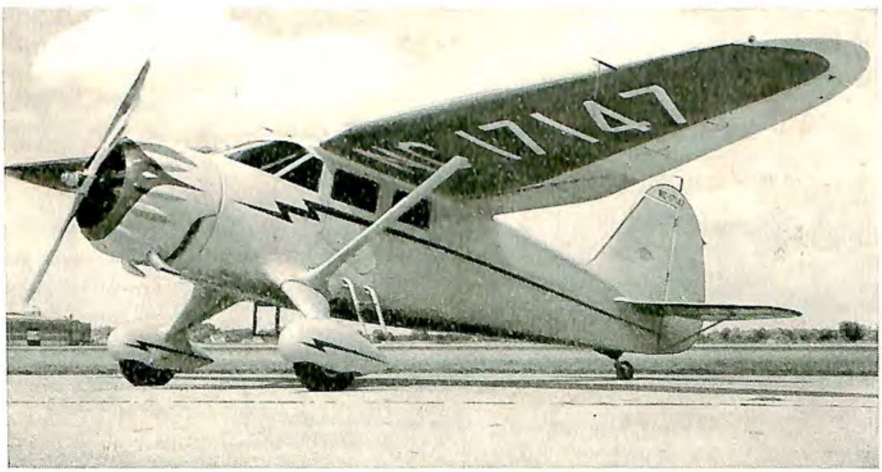
It carries six to eight persons, has its landing gear retractible into the side of the hull, and is powered with two Pratt & Whitney Wasp Junior engines.

Some of them flew out with huge loads of grain to feed birds in snow or ice-blocked sanctuaries. Others went up with hunters to track down wolves preying on cattle. Many carried supplies into mountain camps isolated by winter conditions. Scores of pilots were called upon to carry officers of the law in quest of fugitives from justice. But more often a night flight in high winds meant carrying somebody in an emergency brought about by accident or serious illness—physicians, nurses and relatives, for example.

Much of aerial service, however, is regular business activity with established hours and fees. It may be training a student pilot, or rent-

MILO BURCHAM AND LOCKHEED 12

The famous test pilot with F. C. Hall's private Lockheed 12, equipped with Pratt & Whitney Wasp Junior engines.



THE STINSON RELIANT

For business, executive and private use.

ing him a fly-yourself plane. It may be aerial advertising—sky-writing with smoke, electric signs under the wings, banners trailing behind the plane, or a loud-speaker carrying the human voice from the plane to an entire community announcing a new motion picture, a new brand of soap or a political candidate's special and individual attributes that fit him for public office. All those things and more are done in the name of aerial advertising.

Crop-dusting is another profitable form of flying, although it requires special equipment. Motorists along the highways of nearly every State are accustomed to seeing machines flying low over fields or orchards, spraying poison in clouds to kill an infinite variety of bugs and worms and insects, almost everything in fact, that infests the farms, plantations and orchards of the United States.

Aerial photography is equally varied. It is a highly specialized activity. For map-making the photographer flies over an area taking pictures in strips, just as a farmer plows a field in furrows. Each negative exposed is automatically marked so it can be identified. Pieced together in a mosaic all the prints form an aerial map.

The ordinary aerial photograph is used for many purposes; by cities for tax-assessment, smoke nuisance abatement, tracing of water pollution, city planning, highway traffic surveys, park and parkway planning; by industrial companies for countless kinds of information about the scene of their operations in laying out new buildings, power lines and roads; by explorers for preliminary surveys, and by hundreds of others with as many different objectives.

Supplying the plane and flying it efficiently and safely at a minimum of expense to his patron is just one of the aerial service operator's jobs; and the variety of his jobs increases every year.

THE PORTERFIELD 90

CHAPTER X

PRIVATE FLYING

Planes for Private Owners—Licensed Pilots—Requirements for Licenses—Aircraft and Engine Mechanics.

AT the beginning of 1938 private pilots in the United States, those who fly for sport and pleasure or personal and company business, had their choice of nearly 100 different types and models of aircraft ranging in price from $1,200 to more than $100,000. They could buy machines carrying two persons or twenty, planes making a mile a minute or planes tearing through the air at three and a half miles a minute, planes that could stay up three hours without coming down for gas or machines capable of making non-stop flights of two or three thousand miles.

The Bureau of Air Commerce reported a total of 17,681 active airplane pilot licenses on January 1, 1938, besides 161 glider pilot licenses. Of the airplane pilot licenses 7,475 were transport grade, including 1,064 pilots with scheduled air transport ratings; 971 limited commercial, 8,604 private pilot licenses and 631 amateur. There were 494 women pilot licenses, 72 of them in the transport class. There also were 36,414 student pilot permits at the beginning of the year.

The seven leading States in numbers of pilots were, in the order named, California, New York, Illinois, Pennsylvania, Ohio, Texas and Michigan.

The Bureau of Air Commerce published the following regulations relative to Federal licenses:

"Licensed pilots are classed as commercial or noncommercial pilots. Commercial pilots are licensed as transport, limited commercial, or as commercial glider pilots. Noncommercial pilots are designated as private, amateur, student pilots, or noncommercial glider pilots. A person may hold a plurality of licenses; for example, he may be a licensed pilot and in addition hold a mechanic's license or a glider pilot's license.

"The first step in the procedure of becoming a licensed pilot is taken not at the airport, but in the office of one of the Commerce Department's 700 medical examiners. These men, all physicians actively engaged in the practice of medicine in their own communities, have been designated by the Bureau of Air Commerce to examine candidates for pilot licenses.

"The prospective student pilot reports to a medical examiner for a thorough physical examination and, if he passes, receives from the doctor a student-pilot license authorizing him to receive flight instruction. This student license also indicates whether or not the student is qualified physically for a commercial grade of license, and if he ever

THE BEECHCRAFT E17L

A five-place biplane powered with a 225 h.p. Jacobs engine.

wishes to apply for a limited commercial or transport license he will have to produce this student-pilot license (or other adequate evidence) to show that he has been found physically fit for the higher grades.

"A fee is charged by the medical examiner for this examination and for less exacting examinations made later when licenses are renewed. These fees, $10 for an original and $6 for a renewal examination, are remunerations for the physicians' professional services and are the only charges made in connection with licenses.

"Having obtained his student license, the prospective airman is ready to start flying, first in company with his instructor, and then in solo

BEECHCRAFT D17R

A five-place biplane powered with a Wright Whirlwind engine.

WINNERS OF THE BENDIX TROPHY RACE

Frank W. Fuller, jr., of San Francisco, and his Seversky "Executive" plane with which he won the Bendix Trophy Race of 1937, and set a record from Burbank, Calif., to Bendix, N. J., in nine hours 35 minutes, an average speed of more than 255 m.p.h. The plane is powered by a Pratt & Whitney Twin Row Wasp with Hamilton Standard constant speed propeller.

flights. During the time that he is learning to fly he also is studying the Air Commerce Regulations and Air Traffic Rules.

"At the end of five hours of solo flying, he is eligible to apply for a solo pilot rating. He presents his license application to a Bureau of Air Commerce inspector, who gives him a written examination on the regulations and has him demonstrate his flying ability by making take-offs and landings and performing various flight maneuvers.

"At the end of 35 hours of solo work he may proceed with the tests for the private pilot rating. The written examination is the same as that for the amateur grade but the flight test includes maneuvers which amateur candidates are not asked to execute; and a higher degree of proficiency must be demonstrated throughout the test.

"At 50 hours the candidate may elect to apply for a limited commercial license instead of private, if his original medical examination qualified him for commercial grades. However, if more than four months have elapsed since his physical examination, he will be required to take a renewal physical. The written examination and flight test are much more comprehensive than those for the private grade. The written test covers elementary engine and plane mechanics and rigging, in addition to the subjects of the noncommercial grades. When he goes aloft for his flight test the applicant performs the same maneuvers as those specified for private pilots, but he has to meet much higher standards with respect to execution of these maneuvers. A limited commercial pilot may carry passengers for hire, but is restricted in his commercial operations to the area immediately surrounding his home airport.

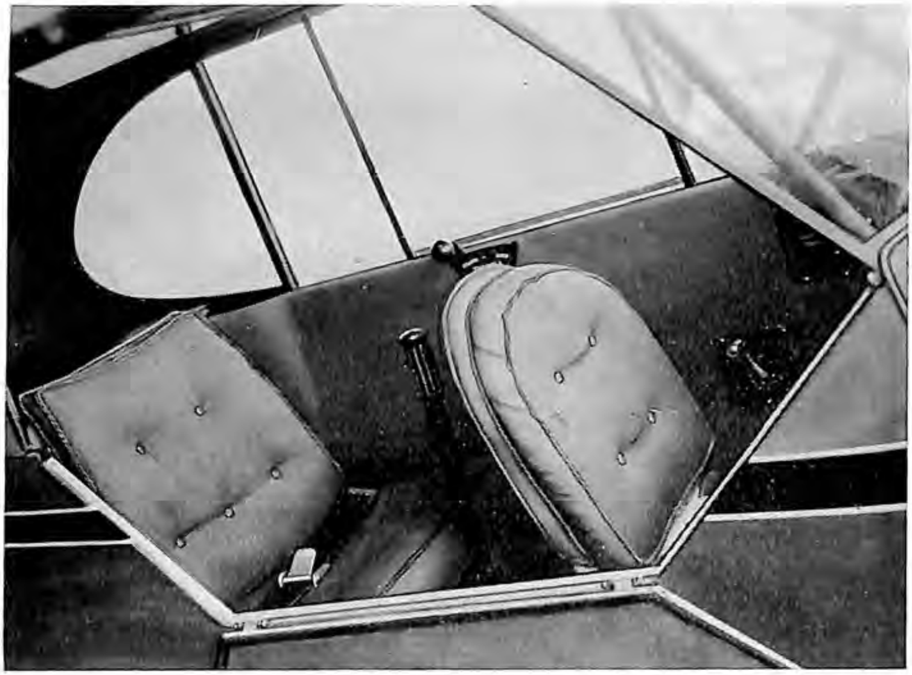
A MONOCOUPE ON EDO FLOATS

This Monocoupe is powered by a 90 h.p. Lambert engine.

COMFORT IN PRIVATE PLANES
This is the interior of the Stinson Reliant.

THE BELLANCA AIRCRUISER
It is powered by a Wright Cyclone engine.

"After 200 hours of solo flying the candidate is ready to apply for the transport grade, provided he is physically qualified. For this grade he is required to demonstrate thorough knowledge of the Air Commerce Regulations, elementary engine and plane mechanics and plane rigging, the fundamentals of meteorology and air navigation. The flight test includes cross-country flying in addition to the tests of ability given for the lower grades; and the inspector judges the entire performance by standards even higher than those for the limited



INTERIOR OF THE CUB

Improved upholstery features the new two-place Cub model of Piper Aircraft Corporation.

commercial grade. Licensed transport pilots are authorized to fly for hire in cross-country flights and to instruct students for hire, privileges which are extended to no other grade. They also are eligible to become airline first pilots, if they qualify for scheduled air transport ratings in addition to their licenses, but this requires additional training and experience.

"The candidate for a pilot license is not required to repeat a written examination that he has passed. For example, if he qualifies as an

THE REARWIN SPORTSTER

It is powered by a 70 h.p. LeBlond or a 90 h.p. Warner engine.

A PRIVATE OWNER SIKORSKY S-43

William K. Vanderbilt's air yacht is powered by two Pratt & Whitney Hornet engines.

amateur pilot, he has to pass an examination on the Air Commerce Regulations, and will not have to repeat that examination when taking his tests for a higher grade.

"Airmen who have no desire to fly professionally frequently remain in the noncommercial grades, as renewal requirements as well as original requisites are less exacting. Commercial pilots renew their licenses every six months, and take a renewal physical examination each time. Noncommercial licenses are renewable annually, with physical examinations required every two years, and the renewal can be obtained by mail.

A SPORT PLANE

The Fairchild 24 powered by a Warner engine.

"There is no minimum flying experience required for glider pilot licenses, but the applicant is given a flight test.

"Having passed the examinations and received his license, the airman is responsible for observance of the regulations, and will have to answer to an inspector if he disregards them. Licenses may be suspended or revoked, or civil penalties up to $500 assessed.

"In the event of an accident, the pilot is required to make a report to the Bureau of Air Commerce. Serious accidents are personally investigated by inspectors.

"The man who adjusts or repairs aircraft, either during flights or

THE TAYLORCRAFT DELUXE
It is powered by a Continental engine.

in the repair shop at the airport, is an airplane mechanic. A companion trade is followed by the man who similarly maintains and repairs aircraft engines, and who is designated an engine mechanic. Both are licensed by the Department of Commerce, and one man may hold both types of licenses if he has the knowledge and experience.

"The airplane mechanic starts as an apprentice, assisting experienced men in building, maintaining, or repairing aircraft. After completing a year of such work, and after passing an examination and

A WACO FOR BUSINESS USE
This Waco Model C-7 is operated by the New York News.

practical tests to the satisfaction of a Bureau of Air Commerce inspector, he receives his license.

"Two years' experience are required for the engine mechanic's license, but this may include one year on aircraft engines and one year on other types of internal-combustion engines. By presenting evidence of this experience and passing a theoretical and practical test, the candidate fulfills the license requirements.

"Parachute riggers repack parachutes, which are opened at frequent intervals and inspected to make certain that they will be in condition for use at any time. Riggers also make any repairs that may be necessary, unless the parachute is damaged to such an extent that it must be returned to the factory. Theoretical and practical tests pertaining to their trade comprise the basis of licensing, and riggers are responsible for the airworthiness of parachutes under their care."

THE RYAN S-C CABIN PLANE
It is powered by a Warner engine.

CHAPTER XI

TRAINING AND EDUCATION

Description of Instrument or "Blind" Flying Instruction—The Link Trainer—Flying Schools and Their Activities—Trade Schools—Colleges Giving Courses in Aeronautical Engineering.

SPECIAL training is necessary to fit a pilot for instrument and radio flying. When the airplane is in the clouds and there is no horizon to furnish guidance, the airman has to forget about the sensations of position and direction which would be of assistance were he flying by visual contact. These sensations can be misleading. He may feel that he is in level flight when as a matter of fact he may be descending or climbing. The instruments tell the truth, and he has to believe their indications and forget about his own feelings.

Preparing to become an instrument flier, the pilot learns to guide his airplane by using the air speed indicator, the turn and bank indicator, climb indicator, altimeter, directional gyro, and artificial horizon. He practices the use of the radio range signals, learning to identify the quadrant in which he is flying, when off course, and how to proceed to a point where he will be on course, to identify this course, proceed to the transmitter of the radio range, and find his way from there to the vicinity of the landing area, all without seeing the ground. Thus far, it is not feasible to land "blind" after completing this maneuver, as a general practice. However, blind landings have been accomplished repeatedly on an experimental basis.

To get actual experience in blind flying, the pilot practices in a hooded cockpit airplane—with a hood drawn over the top of the cockpit so that he cannot see the ground, and has to use instruments. In a cabin airplane the same thing is accomplished by enclosing one side of the pilot compartment.

Flying in the hooded cockpit plane, the pilot is accompanied by his instructor who rides in the open cockpit, or the open part of the pilot compartment. At first, the instructor may occasionally have to take over control of the airplane if the student instrument flier cannot finish his problem. After a few hours of training, when the student has learned to navigate by instruments and radio, he will be able to proceed without help from the instructor, but in practice flights he will be accompanied by a safety pilot who will be watching for other aircraft which may be in the air.

An instrument flying trainer (the Link trainer) in which the pilot can make an instrument and radio "flight," orienting himself on a

Official U. S. Army Photo

THE LINK TRAINER

Used by the U. S. Army Air Corps and by many flying schools throughout the country, this trainer is one of the newest and most successful means of teaching "blind" flying. By means of the two-way telephone, the instructor is able to send radio range signals and weather broadcasts to the pilot in the hooded cockpit. He is also provided with a set of controls which enable him to closely simulate actual flight conditions. A visual record of the flight path is made by the three-legged "crab" on the table.

simulated radio range course and finding the cone of silence over the transmitter without ever leaving the ground, is operated by the Bureau of Air Commerce and several flying schools. Army and Navy pilots and air line pilots have received instruction in the Link trainer.

In appearance the Link trainer resembles a small hooded airplane with wings, ailerons, and tail section. It rotates on a fixed base and has an angle of movement of about 50 degrees in other directions.

The flight instruments include: Air speed, turn and bank, rate of climb, directional gyro, artificial horizon, radio compass, flashing light for indicating passage over the cone of silence marker, and sensitive altimeter. Standard airplane instrument dials are used, and the instruments are operated mechanically, so that a given movement of controls will bring about the corresponding change in instrument readings that would occur in actual flight.

The trainer has no stability. A pilot operating it has to fly constantly by instruments, disregarding sensations. Since instrument

LEARNING BLIND FLYING

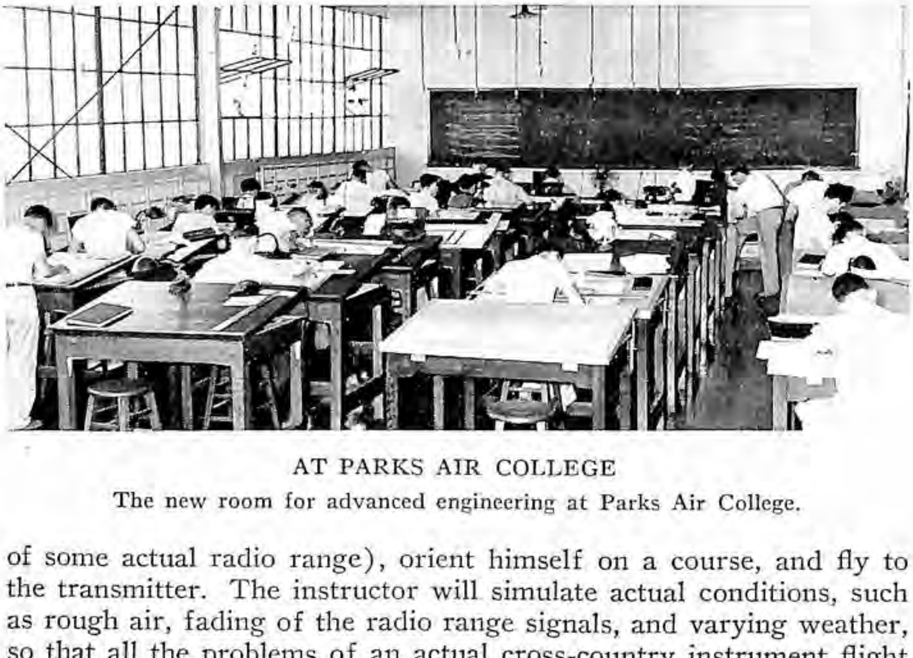
A student pilot, under the hood, prepares to go up for instrument flying instruction at the Boeing School of Aeronautics.

flying in an airplane is a mechanical procedure, the designers of the trainer believe that ground training to precede it should be on a mechanical basis.

Experience has shown that veteran instrument pilots can operate the trainer readily. However, those experienced as pilots but without a background of instrument flying have difficulty in their first trials with the trainer.

The simulated radio range signals and voice broadcasts are transmitted to the enclosed cockpit from a desk at which the instructor is seated. The instructor can transmit radio range signals and marker signals to the pilot, and can carry on two-way conversations in voice or code.

For a problem in cross-country navigation, the pilot has in the cockpit a map, or maps, showing the course he intends to "fly." After he has closed the hood, and "taken off" his instructor will manipulate the radio equipment so as to lose the pilot at a point known to the instructor but not to the pilot. It is the pilot's task to identify the radio range station whose signals are being sent him by the instructor (and which are similar to the courses and identification



AT PARKS AIR COLLEGE
The new room for advanced engineering at Parks Air College.

of some actual radio range), orient himself on a course, and fly to the transmitter. The instructor will simulate actual conditions, such as rough air, fading of the radio range signals, and varying weather, so that all the problems of an actual cross-country instrument flight will be present.

In using the two-way telephone, standard Department of Commerce procedure is followed. The instructor reads weather reports periodically, and may introduce complications, such as a brief shutdown of the radio range transmitter.

The result of the problem is given by an automatic flight recorder on the instructor's desk, consisting of a three-wheeled device (nicknamed the "Crab,") which plots the changing positions of the airplane along its imaginary course with an inked wheel. This device

FOR STUDENT PILOTS

Ryan ST training planes at the Ryan School of Aeronautics.

CURTISS-WRIGHT TECHNICAL INSTITUTE

Student body of the noted school at Grand Central Air Terminal, Glendale, Calif.

travels across the map at a given rate of speed, and every directional move is recorded on the instructor's map in ink. After the problem is finished, the pilot is asked to describe his movements from the time of take-off until landing. His idea of what happened should coincide with the record drawn on the map.

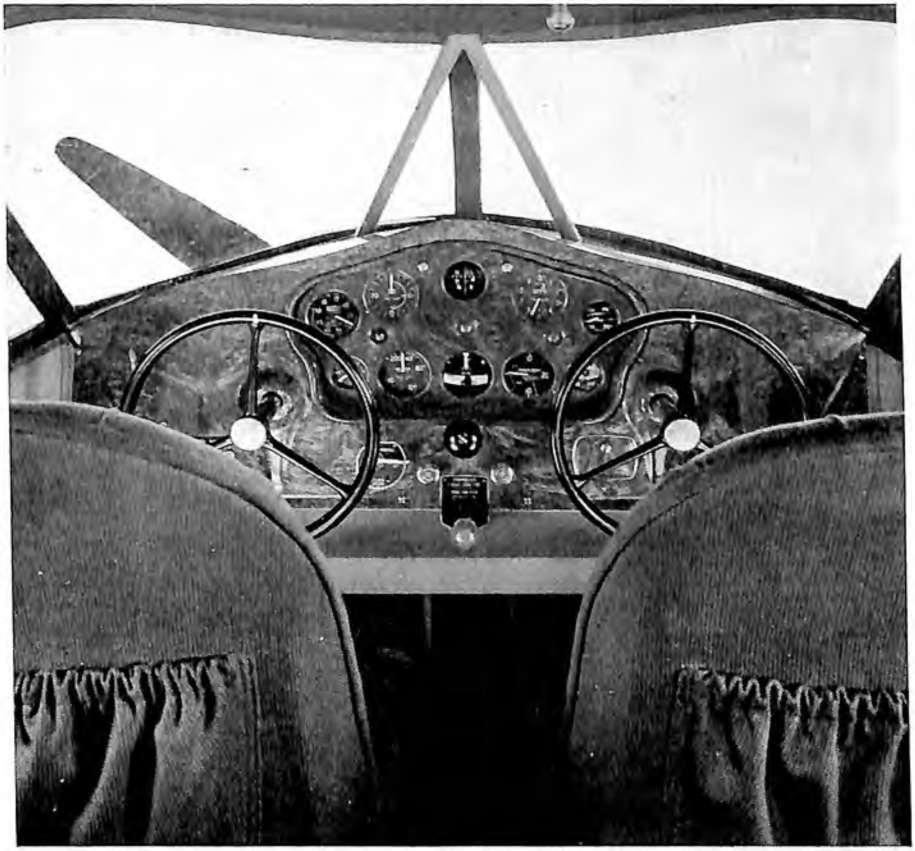
The Link trainer is actuated by varying the pressure in partial vacuum bellows, which in turn are actuated by a vacuum turbine driven by a three-fourths horsepower electric motor which is located in the base.

One advantage of learning instrument and radio flying in the

AT KANSAS STATE COLLEGE
A glider built by student club members.

trainer is that the student can proceed with perfect confidence. He knows there is no possibility of getting into trouble, and can keep his attention on the instruments and radio. Also, it is quicker because no time is lost in getting an airplane out of the hangar, warming the engines, taking off, and flying to a point on the airways system where the problem can be started. Again, the trainer is much less expensive than an airplane for such operations.

FUTURE EXPERTS
Students receiving practical instruction at the Casey Jones School of Aeronautics.



FORWARD IN THE STINSON RELIANT
Motor car comfort features the modern airplane.

The instruction of an instrument pilot also must include some actual practice in an airplane, in addition to the work in the stationary trainer, but the work on the ground materially reduces the time necessary in the air.

Air line pilots are required to demonstrate ability to navigate by instruments and radio before they are eligible to serve as first pilots on air line craft carrying passengers. When they so qualify, and meet other requirements with respect to knowledge of air line regu-

AT RENSSELAER POLYTECHNIC

Aeronautical engineering students testing wing ribs at Rensselaer Polytechnic Institute, Troy, N. Y.

lations, air navigation and meteorology, they are awarded scheduled air transport ratings which are noted on their transport pilot licenses.

There also is a nonscheduled instrument rating, for pilots who are not employed by the air lines. The non-air line pilot who wishes to engage in intentional instrument flying through or over clouds along the Federal airways is required to have that rating.

Aeronautical courses are available throughout the United States. One may take a course in aeronautical engineering, or he may choose

THE CESSNA C-37

It is powered by a 145 h.p. Warner engine and is mounted on Edo floats for seaplane use.

THE BELLANCA JUNIOR

A three-place plane with a 70 or 90 h.p. LeBlond engine.

the career of a pilot or the trade of a mechanic. Courses differ with the numerous schools.

The Boeing School of Aeronautics at Oakland Municipal Airport, Oakland, Calif., reported courses in practically every branch of the aviation industry. A total of 285 hours of flight training, including 25 hours in the Link trainer, and 2,778 hours of lecture, laboratory and shop instruction were required by the Boeing air line pilot and operations course. Other flight courses included special air line pilot, transport, limited commercial and private pilot, amateur and non-scheduled instrument rating. Training in seven ground courses qualified students for positions as airplane, engine and metal mechanics, dispatchers, meteorologists, radio operators and electricians, instrument technicians, field secretaries and managers, traffic men, and

THE WACO S-7 PRIVATE PLANE

It carries four or five persons and is powered with either a Continental or a Jacobs engine.

aeronautical, transport and flight engineers. The courses required from 12 weeks to two years. The school occupied 65,000 square feet of floor space.

The Casey Jones School of Aeronautics, Newark, N. J., specializes in training aeronautical engineers and master mechanics, with an enrollment of more than 500 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 school placed 160 graduates in jobs during 1937.

Parks Air College, East St. Louis, Ill., now offers four major courses of instruction, each requiring 96 to 108 weeks for completion. The courses specialize in preparation for entry into each of the major fields of aviation, and enrollments are accepted only for a major course. High school graduation is pre-requisite to admission. The four courses are: Professional Flight and Executive, Aviation Operations and Executive, Aviation Mechanics and Aeronautical Engineering. During the year approximately $25,000 was spent in improvements, additions and new equipment. A new dormitory was built to accommodate 24 men. Several offices for instructors were provided and classrooms enlarged. Considerable new equipment was provided for the various schools, including a Ditto machine for the reproduction of weather maps 22 x 34 inches in size, a Taft-Peirce boring fixture

THE AERONCA K

A two-place high wing plane powered by the Aeronca engine.

for the boring of link and master rods for use in the engine overhaul department, and a Link Trainer for the Professional Flight School, also a new Stinson Reliant and Fairchild 24.

The addition of new facilities increased the school's capacity to 300, and the Fall enrollment reached this capacity; in fact, 302 were entered at that time.

The school continues its policy of close cooperation with the various branches of the aviation industry. The placement of graduates in the industry continues to be satisfactory, practically all making desirable connections either before graduation, at the time of graduation or soon after.

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.

Roosevelt Aviation School at Roosevelt Field, Mineola, Long Island, N. Y. offered courses in all the grades of licensed pilot, elementary airplane and engine mechanics, master airplane and engine mechanics and combination courses in flying and mechanics.

The Safair Flying School operated by Safair, Inc., at Hangar "B", Roosevelt Field, Mineola, Long Island, New York, offered a new comprehensive Seaplane Course in addition to the regular list

THE CURTISS-WRIGHT 19-R

This is a two-place military monoplane with Wright Whirlwind engine. It can carry machine guns and bombs.

of Pilot Courses, up to and including the highest grade of Government license.

Curtiss-Wright Technical Institute of Aeronautics, at Grand Central Air Terminal, Glendale, Calif., concentrates on instructing 350 students in aeronautical mechanics and engineering. The school is operated in two divisions, engineering and mechanical. The engineering school is under the supervision of F. R. Shanley, formerly with the Bureau of Air Commerce. The mechanical division is in charge of Lewis Holmes, chief instructor, and includes five divisions—sheet metal, primary; sheet metal, advanced; engines; welding and steel fittings; and airplane maintenance and repair. Coordinating the work of the two divisions is O. D. McKenzie, registrar. The school is under the personal supervision of Major C. C. Moseley, president.

The Aeronautical University, Chicago, Ill., prepares students for all branches of the industry. A two year course in aeronautical engineering is offered which leads to the degree of Bachelor of Science in Aeronautical Engineering. Major subjects include stress analysis, airplane design, acoustics, metallurgy and propeller design.

Those who wish to qualify for their airplane and engine mechanic licenses are eligible on completion of the Licensed Mechanic course. So far, every student has successfully passed the necessary Government examinations. The Business Administrative course has been arranged to meet the needs of those who wish to prepare themselves

THE SIKORSKY S-43 AMPHIBION

It is powered by two Pratt & Whitney Hornet engines and can be operated from land or water.

for executive positions in the field of air transportation and other branches of the industry. Because of the steady demand for sheet metal workers, a Sheet Metal course has been added to the curriculum. This can be completed within fourteen weeks. Student enrollment is the largest in the history of the institution. With a capacity enrollment of 500 students indicated in the near future, the facilities of the University have been increased and new equipment acquired.

The Spartan School of Aeronautics at Tulsa, Okla., offered courses in all classes of piloting and mechanics. Flying courses required from six to 16 months, and mechanics courses required from six to 12 months. The Inter City Airlines School, at Boston, Mass., Municipal Airport, offered a wide range of pilot courses. The Grand

Central Flying School at Glendale, Calif., offered courses in all branches of flight training.

The New England Aircraft School, at Boston Airport, offers a number of courses which are designed to fit the needs and inclinations of the various types of young men who wish to enter the aircraft industry. Engineering courses are offered for students who wish to specialize in the design of aircraft. Mechanics courses for students who wish to become licensed aircraft mechanics are offered in both the day and evening school, and ground school courses are given for the benefit of those who wish to take examinations for licenses as airplane pilots.

The Stewart Technical Trade School in New York City offers five courses preparing for aviation ground work. They are the airplane and engine mechanics course requiring 1,560 hours, the aircraft sheet metal course requiring 600 hours, aircraft and Diesel engine course requiring 1,560 hours, aircraft radio course, evenings only, requiring 180 hours and leading to an operator's license, third class; and lastly, the aeronautical drafting and detail design course, days only, requiring 870 hours. The school has an enrollment of 300 students.

Universities and colleges offering engineering courses or commercial courses in aeronautics included the University of Michigan at Ann Arbor, University of Minnesota at Minneapolis, University of Utah at Salt Lake City, University of Southern California at Los Angeles, California Institute of Technology at Pasadena, Kansas State College at Manhattan, Kansas, New York University at New York, University of Florida at Gainesville, University of Cincinnati, O., University of Detroit, Mich., and the Rensselaer Polytechnic Institute at Troy, N. Y.

THE TAYLORCRAFT STANDARD

A two-place plane powered by a Continental engine.

CHAPTER XII

AIRWAYS AND AIRPORTS

Combatting Bad Weather—Facilities for Air Navigation—The Federal Airways System—Secretary Roper's Report—The Hanks Plan for Flight Strips.

AT every minute of the day and night airplanes are flying from city to city in the United States on all kinds of missions demanding the utmost in speed and assurance that they will reach their destinations safely. Night no longer is much of a handicap to the skilled pilot. Bad weather is rapidly becoming less of an obstacle. The Federal Airways System is taking care of those planes hurtling through space at terrific speeds in darkness, fog, clouds, rain or snow.

"However," states a descriptive bulletin from the Bureau of Air Commerce of the U.S. Department of Commerce in charge of the airways, "these facilities are aids to air navigation and not guarantees of safety to the users. Safety in the air lies first in the airworthiness of the aircraft, the reliability of the instruments and accessories, and in the competency of the airmen.

"Facilities provided on a Federal airway include:

"Rotating beacon lights at approximately 15-mile intervals.

"Intermediate landing fields so located, relative to airports, that established landing areas are available at intervals of approximately 50 miles.

"Radio-communications stations for weather broadcasts and emergency messages to aircraft.

"Radio range beacons for directional guidance.

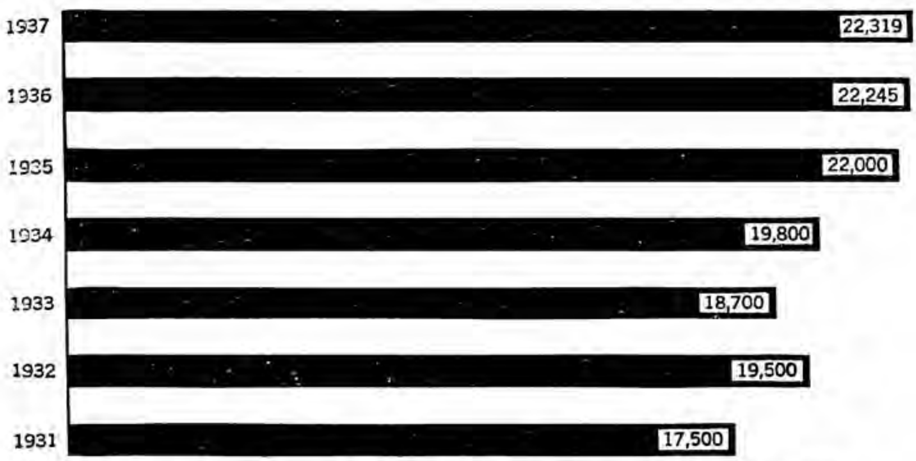
"Radio marker beacons for assistance in locating strategic points, such as intermediate landing fields, and in many cases giving directional guidance over short distances.

"Weather-reporting service, involving the use of teletypewriter circuits and point-to-point radio. The teletypewriter circuits are used not only for transmission of weather reports and forecasts but also for transmission of reports on progress of aircraft enroute along the airways.

"How these aids to air navigation operate to keep air traffic flowing smoothly and safely is best explained by tracing the course of an airplane over an airway section. A night scene has been chosen for this purpose, because lighting equipment then is in operation.

"As the pilot takes off from an airport, which for purposes of identification will be called 'Airville,' amid the lights that flood the field, for a point, say, 200 miles away, a code message (for brevity) goes out over a teletypewriter circuit operated by the Bureau of Air Commerce, telling this story:

"Airplane bearing Department of Commerce license no. NC-1, with Pilot Smith at the controls, departed from Airville at 12 o'clock, midnight, for Airboro.



MILES OF LIGHTED AIRWAYS IN THE UNITED STATES

"As that message is typed on a teletypewriter machine, it is automatically reproduced on receiving machines at communications stations along the airway to be followed by Pilot Smith. The purpose of this operation, known as position reporting, is to enable all points along the airway to check the position and progress of the plane.

"As the pilot rises into the air to establish his desired altitude and course for the flight, he is greeted in the distance by a flash of clear light. To him it is a flash from a Department of Commerce beacon light. To persons on the ground that light is a rotating searchlight with a beam projecting out into the darkness, at an angle of 1½ degrees above the horizon and turning six times per minute. The pilot in the plane, however, observes the flash only and does not see the beam until he is close to it. As the light continues to revolve and is obscured to the pilot's eye, a red light, known as a course light and located on the same structure, is seen to flash a dot-dash code signal. That signal indicates that the beacon light is the first beacon on the 100-mile stretch of the airway which he is now flying. Just as soon as the red code signals discontinue, the white flash of the revolving beacon light again appears. This operation continues from sundown to sunup.

"On some of the airways the beacon lights are double-ended, with a lens at each end. With these installations the course lights are elim-

AN E. A. L. DOUGLAS DC-3

One of the Eastern Air Lines Wright Cyclone-powered "Great Silver Fleet" at Shushan Airport, New Orleans.

inated. One of the beams is clear, the other red, and the beacon is rotating at six times a minute, giving six clear and six red flashes.

"Looking ahead, the pilot can see more faintly the flash of the second beacon along the airway, but he may look to more aids for his night air navigation than the lights. Whether or not the night is clear (and in the event it is not, he probably would be unable to see more than one beacon ahead), the pilot throws a switch which places his radio receiving set in operation.

"Wearing earphones, he listens to the signals from the radiobeacon which is designed to keep him on his course. The beacon transmitter at the airport which he has just left is sending out a series of signals composed of two code letters—A, represented by dot dash, and N, represented by dash dot. If the pilot is a little off his course to one side, the A signals will predominate in signal strength. If he is a little off to the other, he will hear the N signals more distinctly. But if he is exactly on his course, the signals will merge into one long dash. Therefore, without even glancing at the beacon lights ahead, or if poor visibility obscures them altogether, he may follow a true course by flying his plane so that at all times the long dash predominates in his earphones. Each group of 12 signals is followed by the identification signal of the station to which he has been listening.

"All communications stations along the course are on the lookout

BEECHCRAFT E17B
A five-place biplane with a 285 h.p. Jacobs engine.

for the plane which took off from 'Airville' at midnight. All stations out along the airway received this information soon after the plane left the ground. The operator at the first station knows that it will take the plane about 20 minutes to cover the distance from "Airville" to his station, so he is on the alert for it. As the sound of an engine approaches, the operator goes out into the night. The pilot gives some unmistakable signal that he is the one in which the operator is interested, such as flashing his navigation lights on and off; closing and opening his throttle; or, if the plane is equipped with two-way radio, he merely radiotelephones that his is the plane in which the operator is interested. The operator then returns to his teletypewriter and writes out a code message which tells this story:

"Plane bearing Department of Commerce license no. NC-1, with Pilot Smith at the controls, passed over this station at 12:20 a. m. and proceeded in a westerly direction.

"This information is received automatically at the point of departure of the plane, at the points yet to be flown over, and at the point of destination.

"About 100 miles away from his point of departure the pilot reaches

A WALL STREET LANDING

A Grumman amphibion on the turntable ramp at the Wall Street marine air terminal, New York.

the limit of the radio range beacon that he has been following. He then tunes his receiver to the frequency of the station located about 100 miles due ahead on the course and continues as before until his point of destination has been reached.

"But still this is not all that the Department of Commerce provides for the assistance of pilots and air travelers utilizing the established airways. Assume that the plane has passed three beacon lights and on the fourth beacon there is a green auxiliary light instead of a red one. The green light tells the pilot that at this beacon there is a lighted landing field. On approaching closer, he sees a group of small lights, white and green outlining the boundary of the effective landing area. A few red lights marking obstructions surrounding the field, lie just outside the white and green lights. This is a lighted intermediate field, leased and maintained in landing condition by the Department of Commerce for use of all planes flying the airways in the event it is advisable or necessary to make landings between terminals. These

AT ROOSEVELT SCHOOL

Air view of Roosevelt Field, Mineola, Long Island, home of Roosevelt Aviation School.

fields are located at approximately 50-mile intervals, depending upon the condition of the terrain.

"Many of these intermediate fields have radio stations. In such a case, provided Pilot Smith's plane is equipped with two-way radio, upon approaching the field he will listen to its identification broadcast of dot-and-dash signals, and confirm his position on the course. Should he desire the latest weather reports from stations ahead on the route, he has only to turn on his transmitter and request them from the operator who has them available on the teletypewriter tape and will phone them up promptly.

"As he does not have any occasion to land, the pilot continues on his route, watching the beacon lights, listening to the radio range beacon, and checking his flight and engine instruments. Suddenly the radiobeacon signals cease, and are followed by a voice which brings a message announcing the station, the correct time, the ceiling above the field at which the plane will next land, whether or not it is raining, the condition of the visibility, the velocity of the wind, the temperature, the barometer reading and other information of value and assistance

THE SIKORSKY S-42B

One of the Pan American Clipper ships. It is powered by four Pratt & Whitney Hornet engines. The wheels are for drydocking the flying boat.

to the pilot flying to that airport. The broadcaster, who is a Department of Commerce employee, also gives similar information for all important points along the line of flight. The station signs off and the radiobeacon signals are resumed.

"This weather information has been collected by the teletypewriter stations of the Weather Bureau and Department of Commerce along the airways. Each teletypewriter station places on the circuit the weather conditions at this particular point. All this information is assembled at the radio broadcasting stations, and placed on the air at regular intervals.

"Continuing his flight and utilizing the Bureau of Air Commerce aids to air navigation, Pilot Smith lands at 'Airboro,' 200 miles from his point of departure. Immediately after he lands, the Department of Commerce operator at 'Airboro' goes to the teletypewriter and types out a code message conveying the following information:

"Plane No. NC-1, from 'Airville,' Pilot Smith flying, arrived at 'Airboro' at 1:50 a. m.

"This message appears on the teletypewriters at all stations of the route just flown and serves to terminate the watch.

"The airways as established by the Bureau of Air Commerce are for

A STINSON WITH EDO FLOATS
The Reliant used as a seaplane.

the use of all pilots and aircraft regardless of the nature of their activities. Unlike railroad rights-of-way, Department of Commerce airways may be flown by any number of air transport lines; and both itinerant and scheduled aircraft are at liberty to utilize the facilities that constitute the airways, which are established in the interests of safety and reliability."

At the beginning of 1938 the Federal Airways System embraced about 22,400 miles of aerial highways, and the Government was preparing to create more. There were 21,782 miles of lighted routes with beacons and other auxiliaries. There were nearly 500 miles lighted but not in operation. There were 176 miles of daylight routes.

A total of 280 intermediate fields in the system were lighted so a pilot could land at any time. The total of 1,916 beacons included 1,676 rotating beacons and 240 flashing beacons, an average of 86 beacons every thousand miles.

Nearly 1,600 experts were employed in maintaining the airways, including 103 mechanicians keeping the beacons in order. There were caretakers at 227 of the 280 intermediate fields, the others being

AN OCEAN AIR BASE

Pan American Airways Marine Base at Port Washington, Long Island. The Imperial Airways flying boat in the water was operated with a Sperry gyropilot on its pioneering flight from Southampton, England.

maintained by automatic equipment. The Government statisticians estimate that it costs about $58 a year to maintain the fields and beacons on each mile of airways.

The report of Secretary of Commerce Roper for 1937 made this comment on airport activities of the Bureau of Air Commerce:

"In the interest of developing a long-term program of airport and airway development, surveys were initiated in connection with a project for the photographing and making of prints to scale of each airport in the United States. Surveys were also started to determine existing facilities at all airports and to collect financial information concerning them. Tests were being made at major airports in different sections of the United States with a battery of four synchronized motion-picture cameras to determine exact take-off and landing distance required by various types of airplanes in different atmospheric conditions and at varying altitudes, together with the rate of climb immediately after take-off. The results of these surveys, together with recommendations of the Post Office Department, Navy Bureau of Aeronautics, Army Air Corps, private flyers, scheduled airlines, and commercial operators will form the basis for future airport planning.

"The Bureau continued its participation in the Works Progress

THE BELLANCA PACEMAKER
It is powered by a Wright Whirlwind engine.

Administration airport development and construction program. Airport projects undertaken by the Works Progress Administration require the approval of the Bureau of Air Commerce as to the technical aeronautical features of the work on completion, the aim being to secure satisfactory and safe aeronautical facilities. As of June 30, 1937, a total of 937 airport and air marking projects had been initiated, involving $93,983,426 of Federal funds.

"As a result of the air marking program sponsored by the Bureau of Air Commerce under the works program, 7,761 markers have been completed in 46 States. The Bureau has maintained constant supervision over these projects and in addition has promoted other sponsors where Works Progress Administration assistance was not available.

"Regulations governing the rating of airports were in process of preparation during the year.

"The Bureau actively participated in the establishment or improvement of seaplane facilities throughout the United States by furnishing engineering and technical advice to sponsors of these projects."

Public interest in flight strips, as part of the State highway systems, developed during the year as a result of the efforts of Col. Stedman Shumway Hanks, creator of the plan. Defining a flight strip as a place for aircraft landing or take-off, "an area not less than 200 feet wide

THE GLENN L. MARTIN PLANT

Showing the assembly of Model 139-W bombers. They are powered by Wright Cyclone engines.

and not less than 1,800 feet long, adjacent to a public highway on State-owned land and part of the highway system," Col. Hanks reported that 16 States, four Federal agencies and five interstate or national organizations were interested in the subject at the end of the year.

"The Economic Highway Planning Surveys for facilities which are now being made in 44 States include the study of sites adaptable for flight strips," said Col. Hanks, adding:

"Among the Federal, Regional, Interstate and State subdivisions, Agencies and Boards, who have encouraged the study of flight strips are: G. H. Q. Air Force, Army Air Corps, Bureau of Public Roads, Sub-committee on Commerce, U. S. Senate, New England Council, Pacific Northwest Aviation Council, Northwest Regional Planning Commission, American Association of State Highway Officials and National Association of State Aviation Officials. Authorities in the following States are actively considering this development: Utah, Idaho, Oregon, Nevada, Florida, Georgia, Indiana, New York, Missouri, Virginia, Minnesota, Wisconsin, New Jersey, Connecticut, Massachusetts and South Carolina."

SHAPING AIRCRAFT METALS

Drop hammers with terrific force press aluminum alloy sheets into proper shapes for airplane covering. This photo was taken in the plant of the Ryan Aeronautical Company.

CHAPTER XIII

STATE AVIATION ACTIVITIES

Gill Robb Wilson's Comments—Recommendations for State Aviation Improvement and Development—Development of State and Municipal Airports—WPA's Important Contribution to the Airport System—New Laws—Plans for the Future.

THE creation of new regulatory bodies, a growing interest in airports and a plea for a national aviation policy by the president of the National Association of State Aviation Officials characterized a great share of State aeronautical activities during 1937.

The general attitude of state officials toward flying might be summarized in the words of Gill Robb Wilson of New Jersey, head of the N. A. S. A. O.: "The development of aviation will dominate the history of the world for the next half century."

Speaking at the annual convention of his organization in Miami, Fla., Mr. Wilson said:

"The public welfare is vulnerable through lack of a national aviation policy. The report of the President's Aviation Commission gathers dust in the files. Budgets are inadequate to guarantee the public safety. Unhealthy conditions force our air transport systems to such fierce competition that the savor is gone from the game. Where aviation should be sounding the keynote to a fresh prosperity, it lolls in the doldrums of uncertainty and fear. Federal agencies are a house divided against itself in a struggle for prestige of control of aviation.

"Aircraft develop without the least relationship to airports. Aids to navigation are totally inadequate, especially in sparsely settled sections of the land where they are most needed. Great metropolitan areas develop their facilities without strategic rhyme or reason. Unsatisfactory airports are maintained in existence by other than sound aeronautical judgment. Procurement routine and budget red tape run far behind the immediate and imperative necessities of present traffic. Government personnel are too few to do the work they are represented as doing. No policy for airport construction has ever been inaugurated. Unnecessary regulation for private pilots discourages the entire group. Political pressure is forced upon the weather bureau, while half-paid, unqualified, part-time star gazers hope they guessed right on visibility."

His recommendations included: creation of a bureau of federal airports; granting air transport companies route certificates assuring them permanency; an increase in the budget for the Weather Bureau; representation in the Bureau of Air Commerce for the private flier; additional funds for the Bureau; ratings for aviation trade schools;

AERONCA WITH EDO FLOATS
The Aeronca-powered K as a seaplane.

invocation of laws of eminent domain for the removal of obstructions around airports; intensification of air-marking towns and cities; coordination of Red Cross and flying activities for disaster relief; construction of a new wind tunnel for the National Advisory Committee for Aeronautics, and establishment of a joint committee on aviation in Congress.

Reports from State aviation commissions indicated increased activity.

Alabama's State director of airfields, Asa Roundtree, Jr., said the Works Progress Administration placed in operation 28 projects on ten airports in 13 towns. In all, more than $1,300,000 was spent on Alabama airports under WPA. Hangars were built on seven fields, together with other improvements. Administration buildings were constructed on two fields, and two of the hangars also had administrative and service units. A long range airfield development program was prepared, providing for the eventual construction or further de-

WHERE CUBS ARE BORN

Assembly line of Cub planes at the factory of the Piper Aircraft Corporation at Lockhaven, Pa.

velopment of 118 fields in 115 localities at a cost of more than $5,000,000.

Arizona, through its Corporation Commission, issued comprehensive orders governing the operation of aircraft as common carriers. These included the blanket adoption of Government air commerce regulations. In addition the commission promulgated this ruling:

"Every common carrier of passengers navigating any aircraft wholly or partially within the State of Arizona shall take and keep in force in some company authorized to do insurance business in this

State a policy or contract of insurance which shall contain the following conditions and provisions.

"Each passenger-carrying aircraft must be insured against injury to persons in an amount equal to a minimum of $5,000 for any one person, and subject to the same limit for each person, a minimum of $1,000 for each passenger seat plus $4,000 for any one accident, each policy to contain the provisions heretofore prescribed by the Commission."

Colorado, with a branch of the Air Corps technical school, took steps to transfer the name Lowry Field from the base of the State National Guard Air Corps unit to that of the school.

Connecticut's department of aeronautics reported that public acceptance of aviation forged ahead, with 572 pilots licensed, an increase of 40 per cent over 1936. The 297 student pilots and 142 private pilots

A UNITED AIR LINES SLEEPER

Passengers boarding a Douglas DC-3 plane for an overnight trip from coast-to-coast.

represented advances over the previous year of 55 and 40 per cent respectively. More aircraft were registered in the State than ever before, with 203 registrations constituting a 29 per cent increase over 1936.

"It is interesting to note," said Commissioner Charles L. Morris, "the growing interest in the inexpensive 'light airplane' field. In 1936 only 29 light airplanes were registered, whereas last year 52 were in the State."

During the year two new Connecticut airport construction projects were undertaken, calling for an expenditure of more than $900,000 at Bridgeport and $150,000 at Willimantic. Projects at New London and Meriden were concluded. The aviation ground school classes, sponsored by the department and operated by the WPA adult education program of the State Department of Education, were held in 24 towns and cities, with nine instructors teaching a total enrollment in excess of 1,200 students.

Florida's major airports were improved and expanded, and all airports were re-marked. The State's air-marking program was active, and the state road department, aviation division, planned to complete the re-marking of 430 communities in 1938. The addition of two radio stations to seven already in operation was contemplated.

Idaho developed five airports termed "forest fields," improved six

LOADING AIR EXPRESS

Feeding a shipment into the cargo maw of a United Air Lines Mainliner.

municipal fields, began a $125,000 improvement on the Pocatello airport, and started construction on the $450,000 project on Boise's new airport. The airport project at Idaho Falls, started in 1936, was carried through to 70 per cent of completion. Looking toward 1938, Ira J. Taylor, commissioner of public works, said it was planned to develop three municipal fields and inaugurate an extensive, State-wide air-marking program.

Illinois, also, was concentrating on its marking program. Improvement was made on six municipal airports.

Iowa contemplated a complete revision of its air code to conform with new Federal regulations.

Maine, with an Aero Club of 575 members, witnessed some intense aviation activity during the year. The Boston-Maine Airways increased its system to Caribou, adding that 168-mile extension to the Boston-Bangor run. The line was opening airports at Houlton, Millinocket, Presque Isle and Caribou, and had installed four new beacons. A field lighting system at Auburn was completed, and installations were in progress at Waterville and Bangor.

Capt. Burtis F. Fowler, State aeronautical inspector, said, "Among the aviation activities for 1937, the most prominent was the Maine Aero Rendezvous, sponsored by the Aero Club of Maine at the State

CURTISS HAWK TYPE IV

This is a single-seat fighter powered by a 745 h.p. Wright Cyclone engine.

airport at Augusta, August 28 and 29. The last day drew an attendance of 50,000 persons."

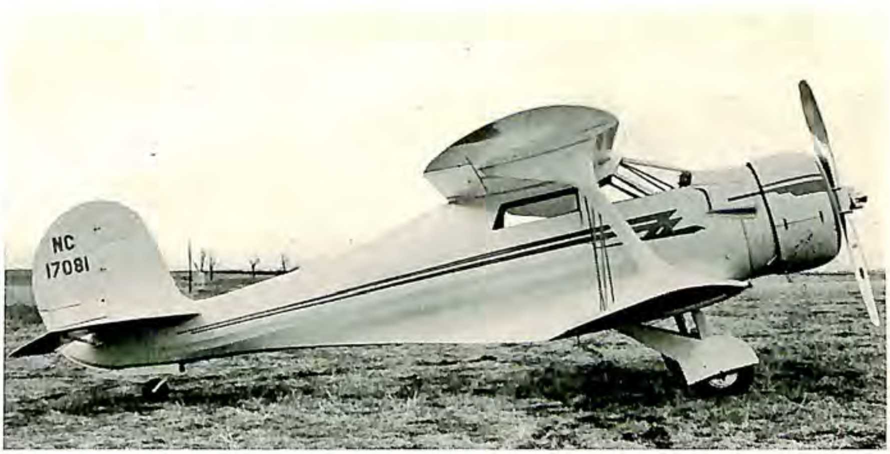
Michigan's director of aeronautics, Floyd E. Evans, reported: "A summary of the construction work on airports in Michigan completed during 1937 under the general supervision of the State Department of Aeronautics shows that 18 projects were completed on existing airports, including the black top surfacing of runways on five of the major airports and the completion of hangars at nine of them. The completion of these nine hangars together with the two hangars on entirely new fields and the 18 completed the previous year has added over 100 per cent to the hangar facilities available two years ago.

"New landing facilities were completed at eight locations, at two of which new hangars were also erected. Approximately 60 additional towns were airmarked, bringing the total marking up to above 500. During the year the State Department of Aeronautics sponsored the annual State airport conference, the sixth annual State model airplane contest, the ninth annual State air tour, published a new and up-to-date State airway map and a booklet showing in detail each of 130 landing facilities in the State."

Mississippi witnessed the gradual completion of WPA work on a score of landing fields.

Montana's 73 landing fields were materially improved, with the addition of some modern hangars and hard-surfacing of runways.

Nebraska's aeronautics commission progressed with its work of



BEECHCRAFT D17W

A five-place biplane powered with a Pratt & Whitney SC-G Wasp Junior engine.

coordinating activities of the State and the Government. Airport development was promoted and public education in air transportation was fostered.

The office of the transportation director in New Hampshire continued to extend cooperation to the WPA in improvement of airports.

Under Gill Robb Wilson, State director of aviation, New Jersey had a record of no commercial passenger fatalities for more than six years. Mr. Wilson commented: "The licensing of airports and commercial operators is the key to responsible operating procedure, and the safety established is the result of the responsible management of the operators who cooperate with our requirements."

Air-marking, removal of hazards, lighting of structures, inspection of fields, development of field locations, caring for traffic violations and vocational clinics were included in departmental work. Director Wilson noted that the outstanding trend in flight activity was the use of light aircraft by experienced pilots. He estimated that gasoline tax refunds were made on about 7,000,000 gallons of aviation fuel in 1937, sold at New Jersey airports.

Organized for the promotion and development of aviation, the New York State Aviation Association in 1937 had 2,453 members scattered among 43 chapters, Max J. Pollet, president, reported. The membership was drawn from 310 communities. Seventy-eight per cent of the members were either commercial pilots, private or student fliers, or were actively engaged in other phases of the aviation industry.

"We believe," said Mr. Pollet in an address at the N. A. S. A. O. meeting in Miami, "that private flying should be nurtured and fostered just as transport aviation has been by the Federal Government. The sound growth of aviation depends on private flying, on getting the average individual into the air, on making the airplane a common means of transportation."

LOCKHEED 12 TAKING OFF
Note that the wheels are being retracted.

The association embarked on an air-marking program in cooperation with the Department of Commerce. At the end of 1937 more than 100 signs had been erected and a full program outlined for 1938. Arrangements were made with a fuel company to make available 87-octane gasoline at even the smallest airports in the State, as a help not only to the private flier but to the transport and military services as well.

Ohio's Bureau of Aeronautics during 1937 had a wide variety of activities, chief of which was assistance in planning and developing airports by the WPA. A check on unlicensed flying was maintained, and airport and emergency landing field maps were published. Another of the Bureau's functions was the maintenance of up-to-date data and photographic records of landing facilities in Ohio. For 1938 the Bureau planned to encourage the passage of national, State and local legislation beneficial to private flying, at the same time sponsoring the re-air-marking of the entire State.

The duty of enforcing Oklahoma's aircraft laws passed to the State Department of Public Safety, of which J. M. Gentry is commissioner. Pilots and airplanes were registered, and efforts were made to obtain adherence to the law. To hold accidents to a minimum, the Department announced it meant to permit only persons holding valid State and Government licenses to operate and to see that all machines not properly licensed remained on the ground.

KEITH-RIDER MONOPLANE

Earl Ortman and his Pratt & Whitney Twin Wasp Junior-powered racer. They won second place in both the Bendix and the Thompson trophy races in 1937.

Rhode Island's airport facilities expanded notably in 1937. Willard M. Fletcher, chief of the division of State airports, said the State expected to complete its $350,000 hangar at the Warwick State airport, begun in 1937, this year. The Westerly and Block Island State airports were to be completed in 1938. Locations already have been chosen for three more State fields, at Narragansett, Newport and Woonsocket. Completion of the Warwick hangar will make available to the private owner first-class storage facilities at from $10 to $15 a month. Gasoline will be sold at a 2-cent mark-up, with no State tax.

Utah in 1937 created an aeronautics commission and adopted a law which incorporated a uniform aeronautical code. One of the most forward-looking of State laws, the statute provided for the initiation of condemnation proceedings by a political sub-division if that proved to be necessary for the acquisition of land for airports. The Act also provided:

"Where necessary, in order to provide unobstructed air space for the landing and taking off of aircraft utilizing airports and landing fields acquired or maintained under the provisions of this Act, the counties, municipalities, and other sub-divisions of this State are granted authority to acquire such air rights over private property as are necessary to insure safe approaches to the landing areas of said airports and landing fields. Such air rights may be acquired by grant, purchase, lease, or condemnation in the same manner as is provided in section 3 of this Act for the acquisition of the airport or landing field itself or the expansion thereof."

THE STEARMAN-HAMMOND Y

It is powered by a 150 h.p. Menasco engine, and carries two persons.

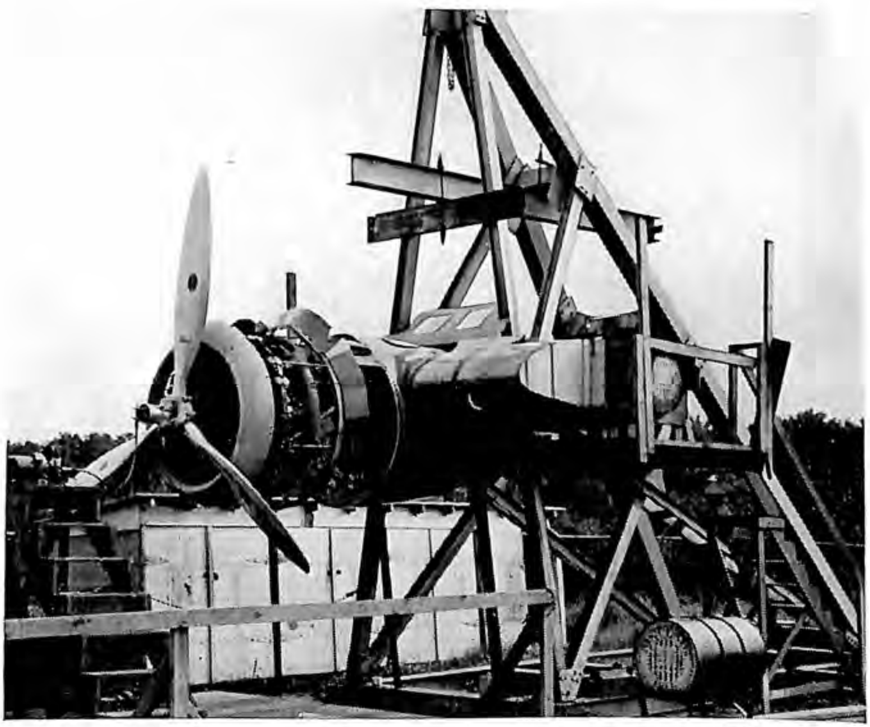
A comprehensive set of rules for the governing of flying was adopted. The commission gave $12,100 to Salt Lake City to meet a contribution to a WPA project, necessary to finish an airport project costing more than $1,250,000, and $14,000 for the purchase of snow removal and maintenance equipment for the same airport. As an added indication of the vigor with which the new commission attacked its new duties, J. E. Garn, director, reported that its promotional activities were expected to bring an airplane factory to the State. It was planned to instruct students at the factory and to establish other schools as soon as possible.

"We feel," said Mr. Garn, "that we can give a pilot flying instructions in nearly all air and altitude conditions that would be encountered from flying from a field at an altitude of 2,500 feet near St.

George, Utah, where the climate is similar to Los Angeles in winter, to fields which are 7,600 feet high and over mountains as high as 13,000 feet, at which points all kinds of air currents, updrafts and downdrafts are found."

Vermont reported that the number of pilots and student pilots increased from 93 to 167.

Wyoming also created a State aviation body, known as its aviation commission. The Governor named J. Kirk Baldwin director. The commission was charged specifically with encouraging the development of aviation, with special reference to private flying.



TESTING ENGINE INSTALLATION

This mock-up of a Glenn L. Martin flying boat nacelle and wing section was set up at the Martin plant to test the Wright Cyclone engine installations before final installation in the finished boat.

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.*
Aeronautical Corp. of America..............	LC	2	614	Warner	1	90	150	1680	285	123	108
Aeronautical Corp. of America..............	LCS	2	614	Warner	1	90	150	1852	192	116	100
Aeronautical Corp. of America..............	K	2	634	Aeronca E-113-C	1	40	146	1040	216	93	85
Aeronautical Corp. of America..............	KS	2	634	Aeronca E-113-C	1	40	146	1130	190	85	75
Aeronautical Corp. of America..............	KC	2	655	Continental A-40-4 Continental A-40-5	1 1	40	146	1060	214	93	85
Aircraft Mechanics Inc...	D-1	2	439	Continental A-40	1	37	155	962	170	80	73
Aircraft Mechanics Inc...	D-2	2	449	Szekely S-R-3-0	1	45	165	982	173	90	77
Arrow Aircraft Corp.....	F	2	601	Arrow V-8 F	1	82	180	1675	198	100	95
Arrow Aircraft Corp.....	G	2	Pend.	Arrow V-8 G	1	90	180	1750	198	120	110
Aviation Manufacturing Corp., Vultee Aircraft Division..............	V-11GB	3	Mil.	Wright Cyclone GR-1820-G2	1	1000	384	11,437	5346	215	183
Aviation Manufacturing Corp., Vultee Aircraft Division..............	V-11GB	3	Mil.	Wright Cyclone GR-1820-G2	1	1000	384	9501	3325	227	203
Aviation Manufacturing Corp., Vultee Aircraft Division..............	V-11GB	3	Mil.	Wright Cyclone GR-1820-G2	1	875	384	11,437	5346	220	183
Aviation Manufacturing Corp., Vultee Aircraft Division..............	V-11GB	3	Mil.	Wright Cyclone GR-1820-G2	1	875	384	9501	3325	231	204
Barkley - Grow Aircraft Corp................	T8P-1	8	662	Pratt & Whitney Wasp Jr.	2	800	354	8250	2500	225	195
Beech Aircraft Corp......	E17L	5	641	Jacobs	1	225	296.5	3350	883	......	166
Beech Aircraft Corp......	E17B	5	641	Jacobs	1	285	296.5	3350	804	......	177
Beech Aircraft Corp......	D17R	5	638	Wright	1	450	296.5	4200	1147	......	202
Beech Aircraft Corp......	D17S	5	649	Pratt & Whitney	1	450	296.5	4200	1147	......	202
Beech Aircraft Corp......	SE17B	5	641	Jacobs	1	285	296.5	3700	771	......	148
Beech Aircraft Corp......	SD17S	5	649	Pratt & Whitney	1	450	296.5	4600	1064	......	170
Beech Aircraft Corp......	SD17R	5	Pend.	Wright	1	450	296.5	4600	1064	......	170

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.*
Beech Aircraft Corp......	18A	8-9	630	Wright	2	640	347	6700	1579	......	195
Beech Aircraft Corp......	18B	8-9	656	Jacobs	2	570	347	6700	1640	......	192
Beech Aircraft Corp......	S18A	8-11	630	Wright	2	640	347	7170	1624	......	174
Beech Aircraft Corp......	S18B	8-11	656	Jacobs	2	570	347	7170	1727	......	168
Bell Aircraft Corp.......	BG-1 Dive-Bomber	2	Mil.	Wright Model R-1820-F56 9-cylinder	1	755	353.8	6641	......	206	......
Bell Aircraft Corp.......	BG-1 Scout	2	Mil.	Wright Model R-1820-F56 9-cylinder	1	755	353.8	5619	......	210	......
Bellanca Aircraft Corp...	66-70	2-15	563	Wright or P. & W.	1	700-750	660	11,000	4021	170	155
Bellanca Aircraft Corp...	31-50	6	565	P & W Wasp II	1	550	311	5600	1050	190	175
Bellanca Aircraft Corp...	31-42	6-8	578	Wright Whirlwind 420	1	420	311	5600	2000	170	155
Bellanca Aircraft Corp...	28-90	2	......	P & W Twin Wasp	1	950	280	7100	1900	280	250
Bellanca Aircraft Corp...	28-92	2	......	1 Ranger, 2 Menascos	3	920	282	10,000	4500	285	250
Bellanca Aircraft Corp...	14-9	3	Pend.	LeBlond 90 H.P.	1	90	140	1650	582	137	120
Boeing Aircraft Co.......	314	80	Pend.	Wright 2-row Cyclone	4	6000	......	82,500	......	200	......
Boeing Aircraft Co.......	307	37	Pend.	Wright G-102 Cyclone	4	4400	......	42,000 (approx)	......	241	......
Boeing Aircraft Co.......	299(B17)	variable	Mil.	Wright G Cyclone	4	4000	......	20 tons (approx)	......	......	......
Boeing Aircraft Co.......	XB-15	variable	Mil.	Pratt & Whitney Twin Wasp	4	4000	......	More than 30 tons	......	......	......
Boeing Aircraft Co.......	247-D	13	558	Pratt & Whitney Wasp	2	1100	836	13,650	2582	202	189
Boeing Aircraft Co.......	281	1	Mil.	Pratt & Whitney Wasp	1	500	150	3380	1026	235	210
Brewster Aeronautical Corp..................	XSBA-1	2	Mil.	Wright Cyclone	1	850	259	5734	1278	......	......
Cessna Aircraft Co., Inc..	Airmaster	4	622	Warner	1	145	181	2350	574	162	143
Curtiss-Wright Corp., St. Louis Airplane Div......	CT32 Condor Cargo	variable	Mil.	Wright Cyclone GR-1820-F52	2	1520	1208	18,500	4170	181	161
Curtiss-Wright Corp., St. Louis Airplane Div......	19R	2	Mil.	Wright Whirlwind R-975-E3	1	420	174	3200	......	212.5	194
Curtiss-Wright Corp., St. Louis Airplane Div......	A19R	2	629	Wright Whirlwind R-975-E3	1	420	174	3200	......	212.5	194
Curtiss-Wright Corp., Curtiss Aeroplane Div.	SCC-1	2	Mil.	Pratt & Whitney Wasp	1	550	342	5126	......	165	......
Curtiss Aeroplane Div.	Hawk 75	1	Mil.	Wright Cyclone GR 1820G-3	1	840	236	6418	......	280	240
Curtiss Aeroplane Div.	Hawk III	1	Mil.	Wright Cyclone R-1820-F53	1	750	262	4317	......	240	202.9
Curtiss Aeroplane Div.	P-36A	1	Mil.	Pratt & Whitney Twin-row Wasp	1	1100	......	......	......	......	......
Curtiss Aeroplane Div.	YP-37	1	Mil.	Allison	1	1000	......	......	......	......	......
Curtiss Aeroplane Div.	SBC-3	2	Mil.	Pratt & Whitney Twin-row Wasp	1	......	......	......	......	......	......

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.*
Curtiss Aeroplane Div.	Y1A-18	2	Mil.	Wright Cyclone	2	1860	......	......	......	......	......
Douglas Aircraft Co., Inc.	DC-3	24	618	Wright Cyclone SGR 1820 G 102	2	2200	987	24,400	....	216	191
Douglas Aircraft Co., Inc.	DST	17-31	607	Wright Cyclone SGR 1820 G 102	2	2200	987	24,400	....	216	191
Douglas Aircraft Co., Inc.	DC-2	16-20	540	Wright Cyclone 1820-F3	2	1420	939	18,560	3400	212	186
Douglas Aircraft Co., Inc.	DF	36	Pend.	Wright Cyclone GR-1820-G2	2	1700	1295	28,500	6755	167	150
Fairchild Aircraft Corp...	24-J	4	663	Warner	1	145	174	2550	706	138	125
Fairchild Aircraft Corp...	24-K	4	667	Ranger	1	165	174	2550	622	147	134
Fairchild Aircraft Corp...	45	5	603	Wright Whirlwind R-760-E2	1	320	248	4000	771	169	165
Fleetwings, Inc..........	F5	4	Pend.	Jacobs	1	289	235	3520	880	150	133
Grumman Aircraft Engineering Corp........	FF-1	2	Mil.	Wright F-52	1	775	310	4650	1550	220	200
Grumman Aircraft Engineering Corp........	JF-2	2-4	Mil.	Wright F-52	1	775	409	5760	1650	180	162
Grumman Aircraft Engineering Corp........	F2F-1	1	Mil.	Pratt & Whitney R-1535	1	650	230	3790	1160	240	216
Grumman Aircraft Engineering Corp........	J2F-1	2-4	Mil.	Wright F-52	1	725	409	6100	1650	180	162
Grumman Aircraft Engineering Corp........	F3F-1	1	Mil.	Pratt & Whitney R-1535	1	650	260	4100	1221	240	216
Grumman Aircraft Engineering Corp........	G-21A	8	654	Pratt & Whitney R-985	2	800	375	8000	2525	201	190
Howard Aircraft Corp....	DGA-8	4	612	Wright Whirlwind R-760-E2	1	320	185.52	3800	695	185	187
Howard Aircraft Corp....	DGA-9	4	645	Jacobs L-5	1	285	185.52	3600	867	168	168
Howard Aircraft Corp....	DGA-11	4	Pend.	Pratt & Whitney Wasp Junior SB	1	400	210.00	4100	845	196	208
Lockheed Aircraft Corp...	Electra 10 A	12	551	Pratt & Whitney Wasp Junior SB	2	900	458.3	10,100	......	210	195
Lockheed Aircraft Corp...	Electra 10 B	12	584	Wright Whirlwind	2	900	458.3	10,000	......	200	186
Lockheed Aircraft Corp...	12 A	8	616	Pratt & Whitney Wasp Junior SB	2	900	352	8400	......	226	213
Lockheed Aircraft Corp...	12 B	8	652	Wright Whirlwind	2	900	352	8400	......	220	210
Lockheed Aircraft Corp...	Electra 10 E	12	590	Pratt & Whitney Wasp S3H1	2	1100	458.3	10,500	......	215	205
Lockheed Aircraft Corp...	14 H	14	657	Pratt & Whitney Hornet S1EG	2	1700	551	17,500	......	246	227
Lockheed Aircraft Corp...	14 F	14	666	Wright Cyclone GR1820F62	2	1800	551	17,500	......	245	230
Luscombe Airplane Corp..	Phantom	2	552	Warner Super Scarab	1	145	143	1950	235	165	140
Luscombe Airplane Corp..	Ninety	2	Pend.	Warner Sacrab Jr.	1	90	140	1725	295	136	120
Luscombe Airplane Corp..	Fifty	2	Pend.	Continental A-50	1	50	140	1130	235	103	94
The Glenn L. Martin Co..	139-W	4	Mil.	Wright Cyclone	2	1700	682	14,675	5264	235	200

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.*
The Glenn L. Martin Co..	166	4	Mil.	Wright Cyclone	2	1700	682	15,394	5302	250	205
The Glenn L. Martin Co..	166	4	Mil.	Pratt & Whitney Wasp	2	2100	682	15,894	5302	255	205
The Glenn L. Martin Co..	130	52	585	Pratt & Whitney Wasp	4	3320	2170	52,000	26,389	180	130
The Glenn L. Martin Co..	156-C	53	Pend.	Wright Cyclone	4	3400	2300	63,000	31,708	182	140
The Glenn L. Martin Co..	157-F	53	Pend.	Pratt & Whitney	4	4200	2300	70,000	36,644	203	145
Monocoupe Corp........	90A	2	306	Monocoupe-Lambert R266	1	90	132.3	1610	286	130	110
Monocoupe Corp........	110 Special	2	327	Warner Super Scarab	1	145	94	1630	218	285	155
Monocoupe Corp........	Monocoach Model H	4-5	Exp.	Monocoupe-Lambert R266	2	180	231.2	3220	710	150	130
North American Aviation, Inc..............	BT9B	2	Mil.	Wright Whirlwind R-975-E3	1	400	248	4470	......	170	146
North American Aviation, Inc..............	BT9C	2	Mil.	Wright Whirlwind R-975-E3	1	400	248	4575	......	170	146
North American Aviation, Inc..............	O47A	3	Mil.	Wright Cyclone 1820-R49	1	840	349.7	7650	......	......	......
North American Aviation, Inc..............	BC	2	Mil.	Pratt & Whitney S3H1	1	550	255.76	4998	......	......	......
North American Aviation, Inc..............	NJ-1	2	Mil.	Pratt & Whitney R-1340-08	1	500	248	4710	......	195	170
North American Aviation, Inc..............	NA-16-1A	2	Mil.	Pratt & Whitney S3H1	1	550	256	5156	......	210	190
North American Aviation, Inc..............	NA-16-4	2	Mil.	Wright Whirlwind R-975-E3	1	420	248.26	4295	......	175	163
North American Aviation, Inc..............	NA-16-2A	2	Mil.	Pratt & Whitney S6H1	1	500	248.26	4771	......	202	190
North American Aviation, Inc..............	NA-16-3	2	Mil.	Wright Cyclone G3	1	840	274	6800	......	238	204
Northrop Division, Douglas Aircraft Co....	A-17	2	Mil.	Pratt & Whitney R-1535	1	750	363	7000	1425	209	195
Northrop Division, Douglas Aircraft Co....	A-17A	2	Mil.	Pratt & Whitney R-1535-13	1	750	363	7550	1219	216	204
Northrop Division, Douglas Aircraft Co....	8-A	2	Mil.	P & W Twin Wasp Jr. S1A5-G	1	750	363	8200	1600	218	186
				Wright Cyclone R-1820-G2	1	850	363	8170	1600	222	204
Northrop Division, Douglas Aircraft Co....	8A-1	2	Mil.	Bristol "Pegasus" XII	1	875	363	7500	1575	219	180
Northrop Division, Douglas Aircraft Co....	8A-2	2	Mil.	Wright Cyclone R 1820-G3	1	840	363	7500	1425	217	188
Northrop Division, Douglas Aircraft Co....	2-L	2	Mil.	Bristol "Hercules"	1	1375	363	8315	1160	270	230
Piper Aircraft Corp......	J-2	2	595	Continental A-40-4 or A-40-5	1	40-50	178.5	1000	190	85	72
Piper Aircraft Corp......	J-3	2	660	Continental A-40-4 or A-40-5	1	40-50	178.5	1000	190	88	76
Piper Aircraft Corp......	J-2S	2	595	Continental A-40-4 or A-40-5	1	40-50	178.5	1070	190	86	73

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.
Porterfield Aircraft Corp..	90	2	611	Warner 90	1	90	142	1326	475	121	112
Porterfield Aircraft Corp..	70	2	567	LeBlond 70	1	70	142	1310	475	115	105
Porterfield Aircraft Corp..	Zephyr	2	606	Continental	1	40	168	1040	400	85	80
Rearwin Airplanes........	7000	2	574	LeBlond	1	70	166	1460	220	115	103
Rearwin Airplanes........	9000-L	2	591	LeBlond	1	90	166	1460	220	123	110
Rearwin Airplanes........	9000	2	624	Warner	1	90	166	1460	220	123	110
Rearwin Airplanes........	6000M	2	661	Menasco	1	125	143.2	1700	220	150	130
Rearwin Airplanes........	6000MS	2	Pend.	Menasco	1	150	143.2	1750	220	163	142
Sikorsky Division, United Aircraft Corp..........	S-42B	32 day 14 night	592	Pratt & Whitney Hornet	4	3000	1340	42,000	......	188	163
Sikorsky Division, United Aircraft Corp..........	S-43	18	593	Pratt & Whitney Hornet	2	1500	780.6	19,500	......	190	166
Stearman Aircraft Co.....	76D1	2	Mil.	P & W T1B Wasp Jr.	1	320	297	3336	......	150	132
Stearman Aircraft Co.....	76C3	2	Mil.	Wright R-975-E3	1	420	297	3600	......	157	134
Stearman Aircraft Co.....	73L3	2	Mil.	Lycoming R-680-C1	1	225	297	2626	......	128	109
Stearman Aircraft Co.....	PT-13	2	Mil.	Lycoming R-680-7	1	220	297	2650	......	125	107
Stearman Aircraft Co.....	NS-1	2	Mil.	Wright R-790-8	1	220	297	......	......	......	......
Stearman-Hammond Aircraft Corp............	Y-1S	2	644	Menasco	1	150	210	2250	310	125	115
Stinson Aircraft Corp....	SR9A	4	621	Lycoming R-680-4	1	225	258.5	3450	626	......	135
Stinson Aircraft Corp....	SR9B	4-5	621	Lycoming R-680-6	1	245	258.5	3700	821	......	143
Stinson Aircraft Corp....	SR9C	4-5	621	Lycoming R-680-5	1	260	258.5	3750	853	......	145
Stinson Aircraft Corp....	SR9D	4-5	625	Wright R-760-E1	1	285	258.5	4100	1022	......	156
Stinson Aircraft Corp....	SR9E	4-5	625	Wright R-760-E2	1	320	258.5	4100	1022	......	161
Stinson Aircraft Corp....	SR9F	4-5	640	P & W Wasp Jr. TB-SB	1	450	258.5	4500	902	......	178
Taylor - Young Airplane Co..................	A	2	643	Continental	1	40	169	1050	226	91	81
Chance Vought	SBU-1	2	Mil.	P & W Twin Wasp Junior	1	700	......	5318	......	......	......
Chance Vought..........	SBU-2	2	Mil.	P & W Twin Wasp Junior	1	700	......	......	......	......	......
Chance Vought..........	SB2U-1	2	Mil.	P & W Twin Wasp Junior	1	750	......	......	......	......	......
Chance Vought..........	V-142	2	Mil.	P & W Twin Wasp Junior	1	750	327	5445	......	208	172
Chance Vought..........	V-143	1	Mil.	P & W Twin Wasp Junior	1	750	187	4370	......	300	243
Chance Vought..........	V-97	2	Mil.	P & W Hornet	1	700	342	4825	......	192	159
Chance Vought..........	V-99	2	Mil.	P & W Wasp	1	550	342	4645	......	176	146
The Waco Aircraft Co....	ZVN	4	659	Jacobs L-5	1	285	246	3650	621	157	137
The Waco Aircraft Co....	ZGC	4-5	627	Jacobs L-5	1	285	246	3650	830	164	144
The Waco Aircraft Co....	EGC	4-5	639	Wright R-760-E-2	1	320	246	3800	898	174	148
The Waco Aircraft Co....	YKS	4-5	626	Jacobs L-4	1	225	244	3250	730	146	128
The Waco Aircraft Co....	ZKS	4-5	626	Jacobs L-5	1	285	244	3250	684	153	135
The Waco Aircraft Co....	UKS	4-5	648	Continental W-670-K	1	225	244	3250	705	144	124
The Waco Aircraft Co....	VKS	4-5	648	Continental W-670 M-1	1	250	244	3250	695	147	127
Waterman Arrowplane Corp.................	W5A	2	Pend.	Studebaker	1	100	264	2500	230	120	105

CHAPTER XIV

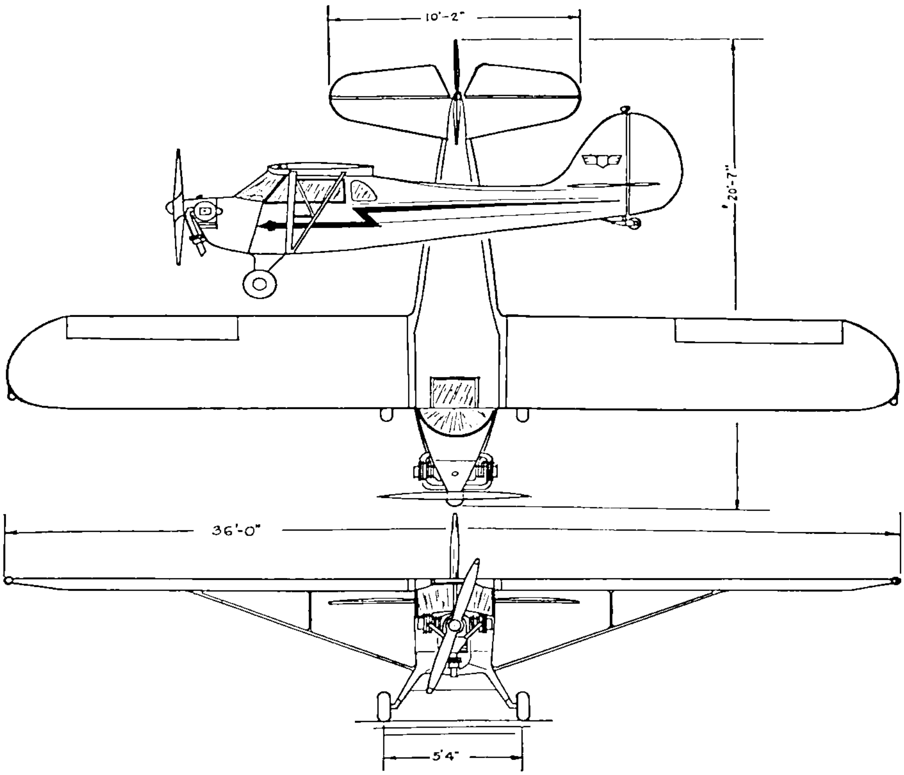
NEW THINGS IN THE AIR

Air Transport Club Cars—Flying Boats Like Ocean Liners—Supercharged Airplane Cabins—Four-Engine Machines for Land and Sea—Manufacturers of Airplanes and Their Activities—With the Builders of Aircraft Engines—Aeronautical Accessories.

AIRPLANES like club cars, flying boats like ocean liners, giant fighters that shoot with cannon, supercharged planes for sub-stratosphere work, aircraft tires as high as a motor car and a thousand and one new developments at the beginning of 1938 offered plenty of evidence that the modern miracle of aviation has not yet run its course or has, in fact, brought forth the ultimate in things for this generation of men with wings. The new planes, engines and instruments, along with all the various and remarkable scientific accessories that characterize aeronautics today represent tremendous achievements in engineering, chemistry, metallurgy and many other technical branches. The larger and faster planes, the four-motored transports in process of construction, the engines developing from a thousand to fifteen hundred horsepower, improved radio equipment for aircraft and countless other innovations mark another year in the progress of the airplane. The individual accomplishments of the manufacturers are set forth in the following pages.

Aircraft Manufacturers

Aeronautical Corporation of America, Cincinnati, O., doubled its factory floor space at Lunken Airport, increased its personnel 300 per cent, and introduced two new models, Aeronca K and Aeronca KC. Model K was a two-place side-by-side high-wing, strut-braced cabin light plane, powered by a 40 h.p. Aeronca E-113C engine. Its gross weight was 1,040 pounds with dual wheel controls, position lights, wheels with brakes and steerable tail wheel. It had a stated high speed



AERONCA K

A two-place plane for the private flier with an Aeronca E-113C engine. It is available as the model KC powered with a Continental engine.

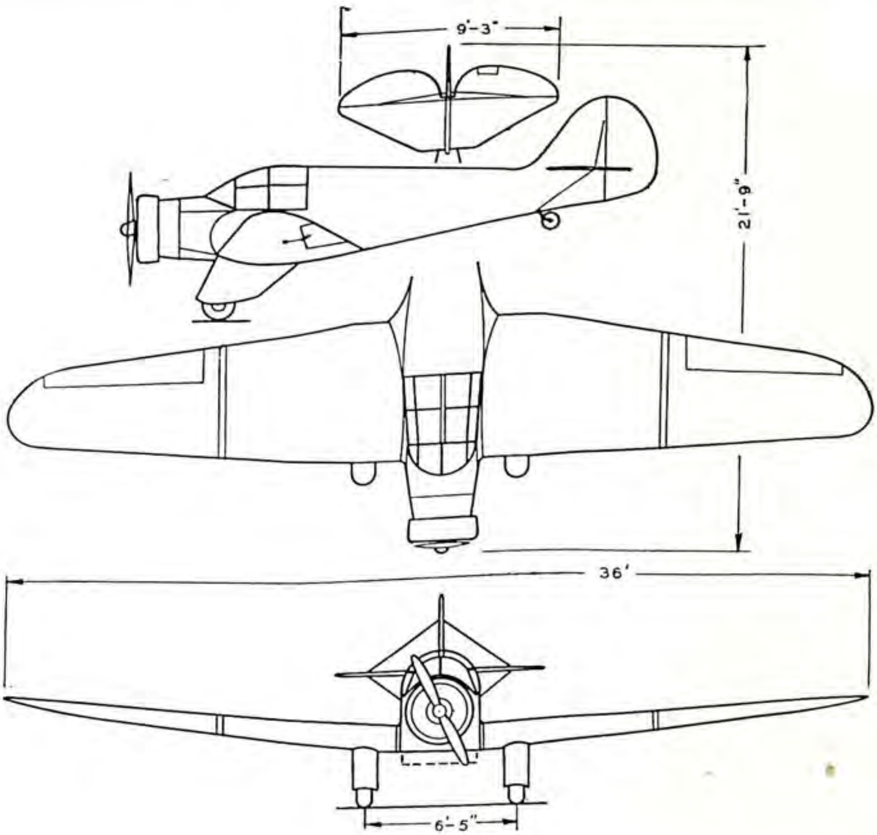
of from 88 to 93 m.p.h., cruising 80 to 85 m.p.h., landing at 35 m.p.h., range 250 miles. The Aeronca KC was powered by either of the Continental engine models A-40-4 or A-40-5, giving it a gross weight of 1,060 pounds. Aeronca LC was a cantilever low-wing two-place cabin monoplane with gross weight of 1,680 pounds, powered by a Warner Scarab Junior motor with a stated high speed of 123 m.p.h., cruising at 108 m.p.h., range 535 miles.

An Aeronca plane was flown 10,000 miles by Capt. David Llewellyn, from Peterborough, England, to Johannesburg, South Africa, in 130 hours flying time.

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.

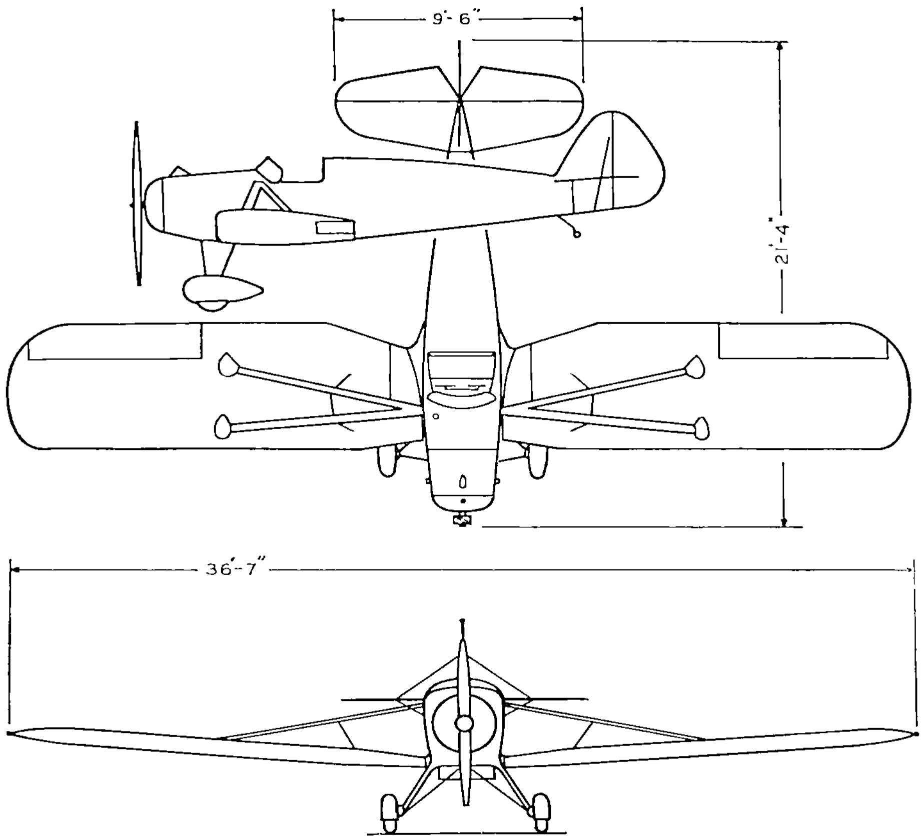
The Arrow Aircraft Corporation, Lincoln, Neb., was developing a two-seater, side-by-side light sport plane, an open or closed low-wing monoplane, 36 feet seven inches wing span, 21 feet four inches in length, stated cruising speed 110 m.p.h., powered with the 90 h.p. Arrow V-8 motor, a conversion of 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 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 high-



AERONCA LC

Available as a land or seaplane this two-place plane for the private flier is powered with a Warner Scarab Junior engine.

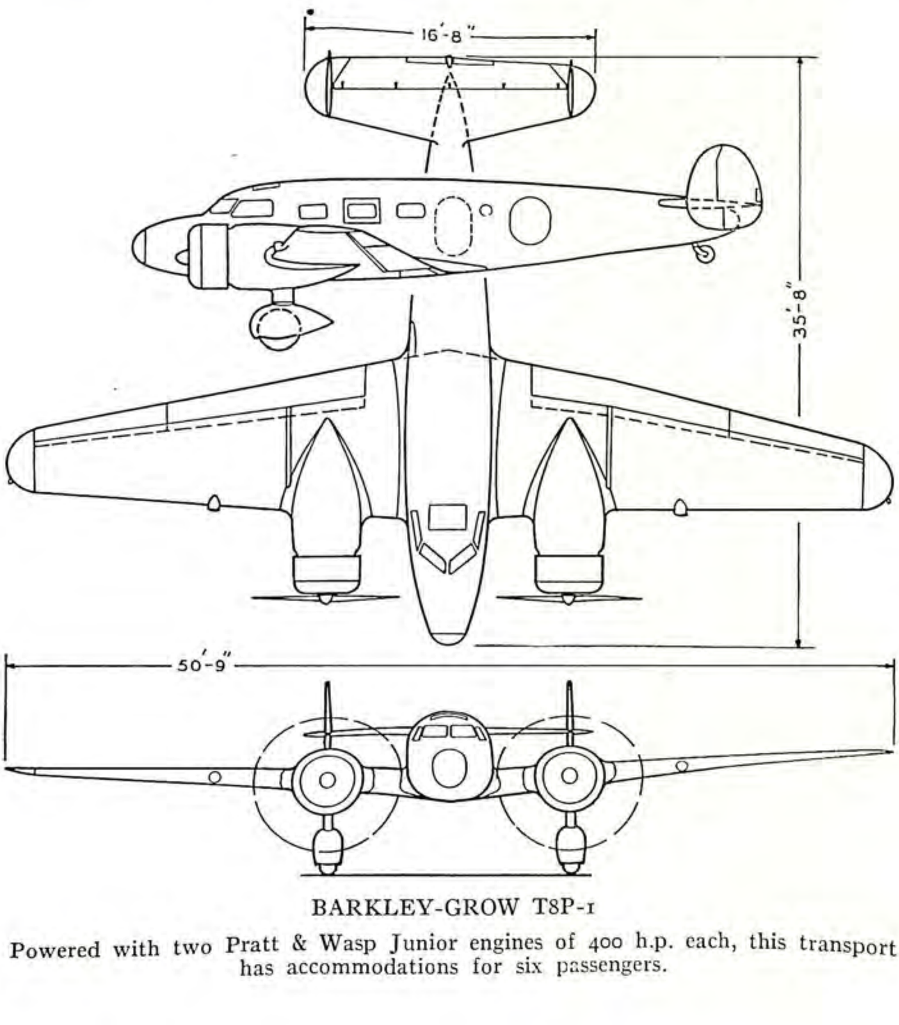


ARROW F

A two-place sport plane powered with a Ford V-8 engine.

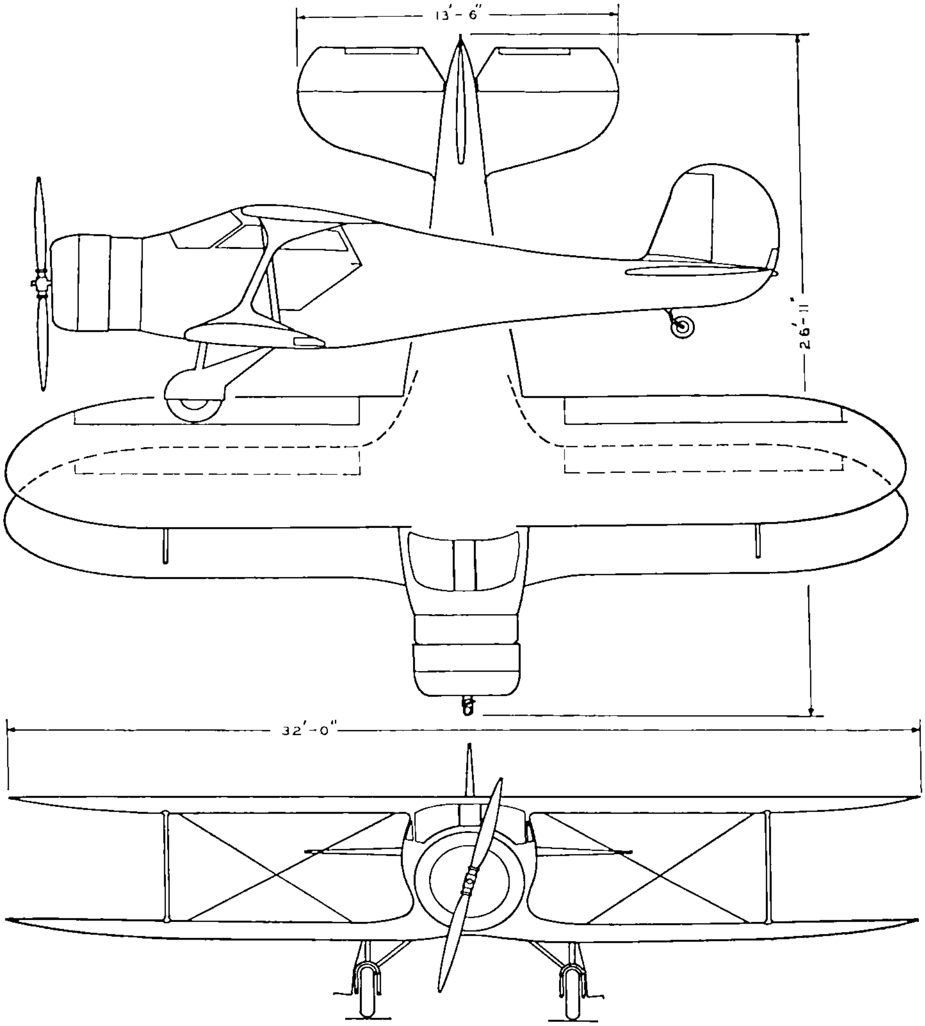
ways when not in flight. A model of that design was in use by the Bureau of Air Commerce. Experimental models of military design showed top speeds approaching 150 m.p.h., an increase of 20 per cent over the speed of fixed-wing models using the same engine horsepower.

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 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,



BARKLEY-GROW T8P-1

Powered with two Pratt & Wasp Junior engines of 400 h.p. each, this transport has accommodations for six passengers.



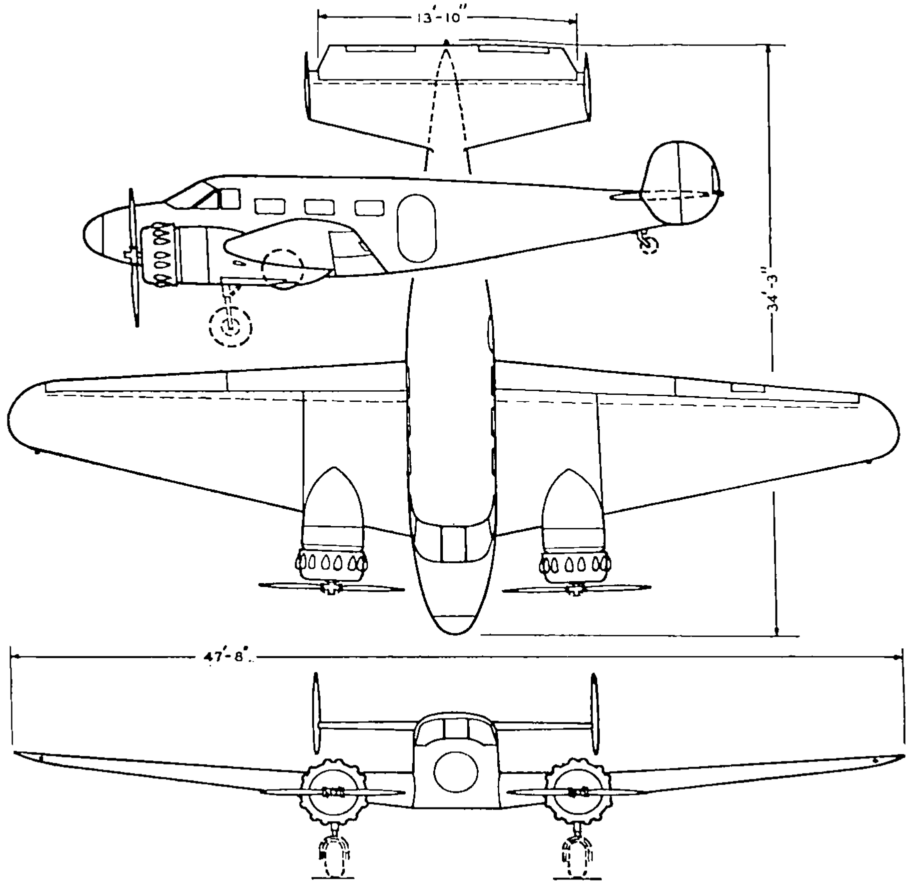
BEECHCRAFT D-17

A five-place private plane with a choice of either a Pratt & Whitney or Wright engine, with a range of horsepower from 320 to 600. The E-17 version has a strut-braced tail group and is available with either a Jacobs 225 h.p. or a 285 h.p. engine.

Kellett Autogiro Corporation and Pitcairn Autogiro Company, are described in the sections devoted to those concerns.

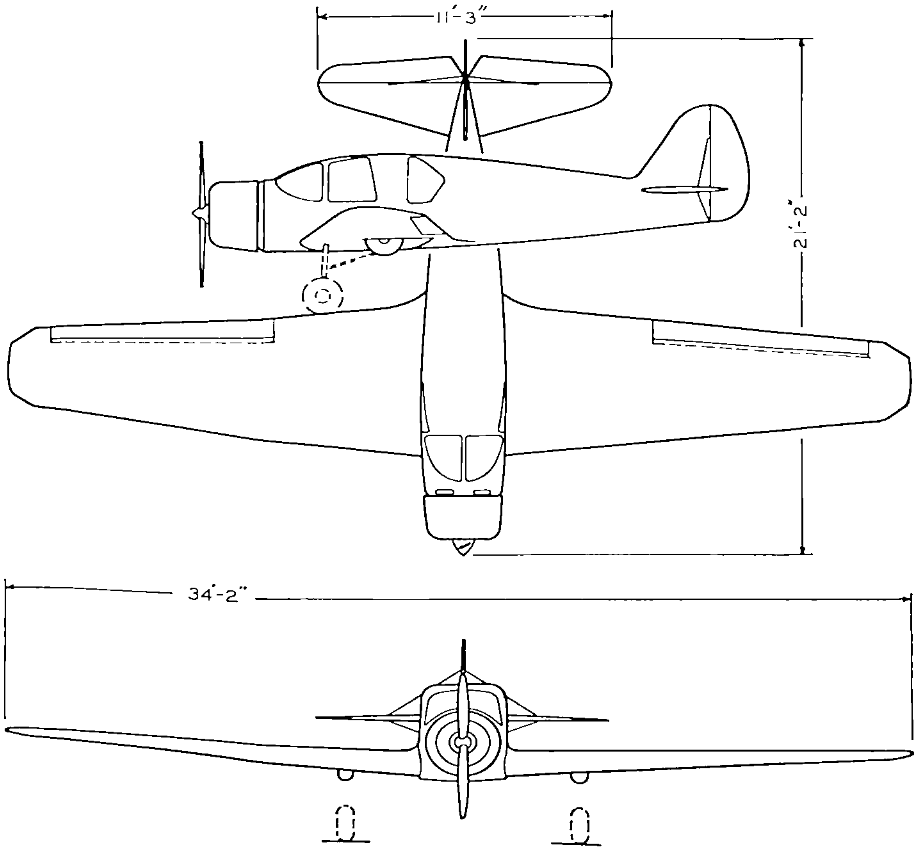
Barkley-Grow Aircraft Corporation, Detroit, Mich., produced an all metal, low-wing, twin-engine, eight-place transport, incorporating in the wing a multi-spar type of construction—a multiplicity of full spanwise members of thin sheet metal having their web sections lightened by blanked and flanged holes and their flanges made of separate pieces of heavier gauged metal.

Beech Aircraft Corporation, Wichita, Kans., had three new basic models of its Beechcraft line. The E17 series Beechcraft was a biplane, five-place, 3,350 pounds gross weight, powered by either a 225 or a 285 h.p. Jacobs engine. The D17 series was a biplane of 4,200 pounds gross weight, powered by a 320 or 450 h.p. Wright Whirlwind



BEECHCRAFT MODEL 18

This twin-engine commercial monoplane carries eight, and may be powered with either two Wright engines of 320 h.p. each or two Jacobs of 285 h.p. each.



BELLANCA JUNIOR

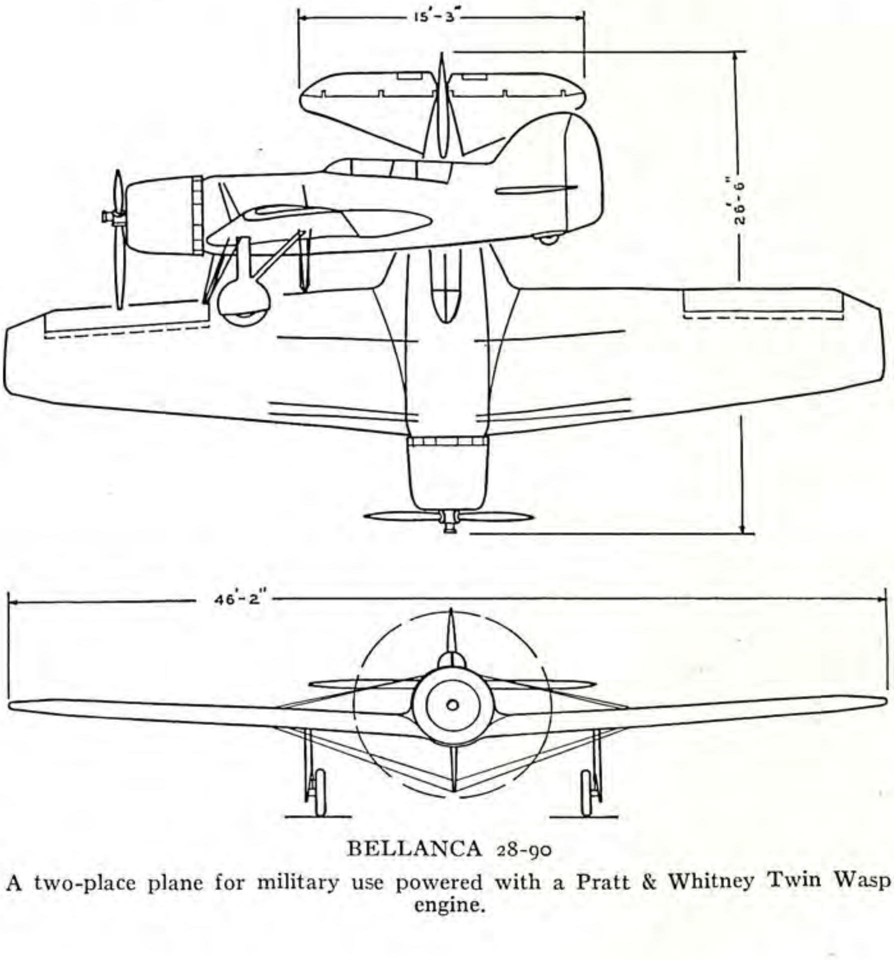
Powered with either a LeBlond 70 or 90 h.p. engine, this plane for the private flyer carries three.

or a Pratt & Whitney 450 h.p. Wasp or 600 h.p. Wasp Junior engine. Jacqueline Cochran won third place in the 1937 Bendix trophy race, flying a Wasp Junior-powered Beechcraft D17W. The third Beechcraft for 1938 was the twin-engine Model 18, with two 285 h.p. Jacobs or two 320 h.p. Wright Whirlwind engines. Several 18's were sold to foreign air lines.

As a landplane the Model 18 Beechcraft monoplane had a short run, a rapid rate of climb at approximately 1,500 feet per minute, and a stated cruising speed of 195 m.p.h. As a seaplane it had a take-off of 17 seconds from flat calm water with a full load, a climb of 1,060 ft., and a cruising speed of 174 m.p.h. During the year the gross weight of the airplane was approved for 6,700 pounds, an increase of 200 pounds in the original gross weight.

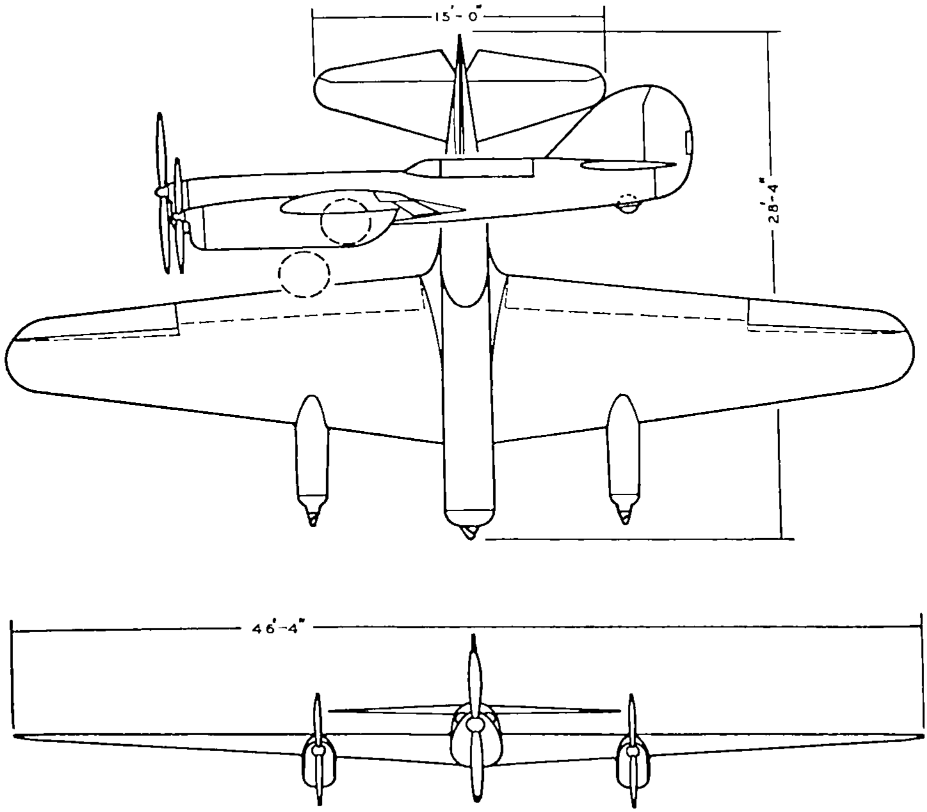
Bell Aircraft Corporation, Buffalo, N.Y., in 1937 produced its famous pusher-type, multi-seater fighter, XFM-1, for the U. S. Army Air Corps. The official War Department description of this new type military machine will be found in the Air Corps chapter. The Bell Corporation also built all the outer wing panels for the Consolidated patrol bombers produced for the Navy, and at the beginning of the year was working on confidential designs for the air services.

Bellanca Aircraft Corporation, New Castle, Del., announced its new three-place cabin monoplane, Bellanca Junior, model 14-7 pow-



BELLANCA 28-90

A two-place plane for military use powered with a Pratt & Whitney Twin Wasp engine.



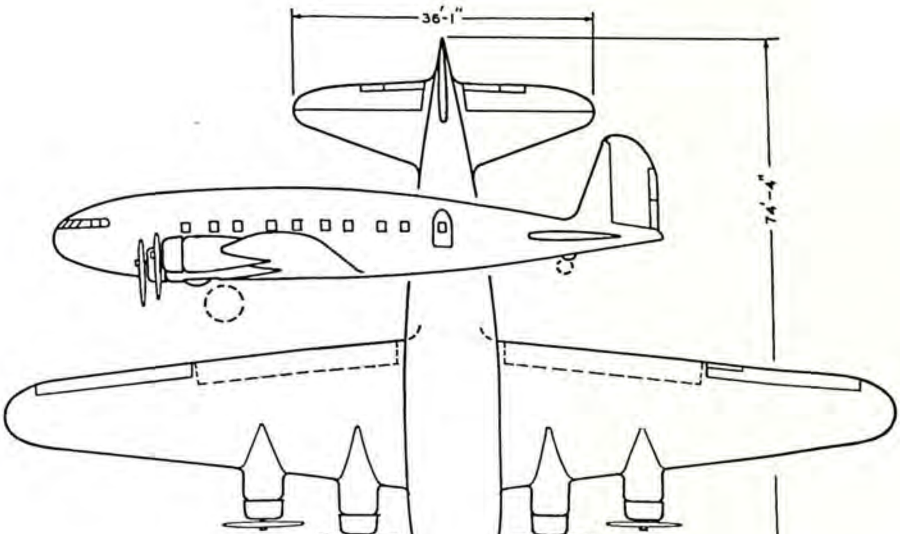
BELLANCA 28-92

This tri-motored single-seat monoplane has a Menasco engine in each wing and a Ranger engine in the nose.

ered by a 70 h.p. LeBlond engine and Model 14-9 powered by a 90 h.p. LeBlond. The plane was a low-wing monoplane, wing span 34 ft. two in., height six ft. three in., length 21 ft. three in., wing area 140.2 sq. ft., weight empty 912 lbs., payload 412 lbs., useful load 738 lbs., gross weight 1,650 lbs., and stated cruising speed 105 m.p.h. for Model 14-7, and 110 m.p.h. for Model 14-9. Bellanca produced a number of its Flash type Model 28-90, a monoplane bomber and fighter, reporting the 28-90 capable of making 270 m.p.h. with a bomb load of 2,000 pounds or when equipped with four 30-cal. fixed guns in the wings and a 30-cal. flexible gun in the rear cockpit. The company also produced its Pacemaker, Skyrocket and Aircruiser commercial models.

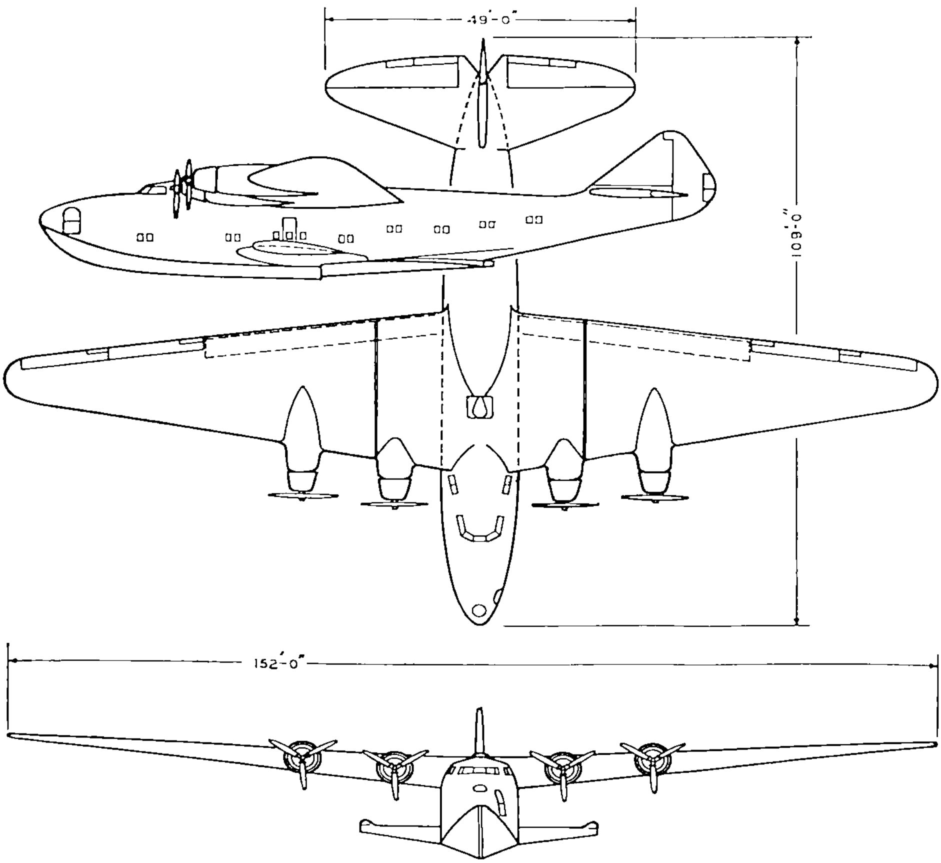
Boeing Aircraft Company of Seattle, Wash., at the beginning of 1938 was devoting its entire manufacturing facilities to the construction of large four-engine airplanes—keying its production to the slogan, "the four-engine era is here."

The planes under production included two types of four-engine bombers or "flying fortresses" for the U. S. Army Air Corps, giant Boeing 314 Clippers for Pan American Airways and four-engine land transports for Transcontinental & Western Air and Pan American, the latter being designed for sub-stratosphere operation by the use of sealed cabins and supercharging equipment.



BOEING MODEL 307

Used as a 33-passenger day plane or a 25-passenger sleeper, this transport carries a crew of four. It may be powered with either four Pratt & Whitney Twin Wasp engines of 1,200 h.p. each, or four Wright G Cyclones of 1,100 h.p. each.



BOEING CLIPPER

This Model 314 flying boat is powered with four double-row Wright Cyclone engines rated at 1,500 h.p. each. It carries 72 passengers and a crew of eight by day, and provides sleeping accommodations for 40 passengers for night flying.

Generally regarded as the fastest bombardment planes in the world, a fleet of 13 Boeing YB-17 four-engine "flying fortresses" was delivered to the Army Air Corps in 1937. In service the planes immediately began giving evidence of their remarkable performance characteristics. Routine operations included a number of non-stop cruises: one made at night from March Field, Calif., to Langley Field, Va., a distance of 2,450 miles flown with normal fuel supply in 12 hours 50 minutes; one over the 1,500-mile distance from March Field to Barksdale Field, La., at an average speed of 235 m.p.h.; and a formation flight of four of the "flying fortresses" over a 1,700-mile route which covered 15 northeastern States in 10½ daylight hours, and ended at

BELLANCA SENIOR PACEMAKER

A private owner plane powered by a Wright Whirlwind engine.

THE AERONCA KC

It is powered by a Continental engine.

Langley Field with gasoline tanks still carrying enough fuel for another three hours in the air.

Early in 1938, one of the B-17 bombers spanned the continent twice in 26 hours 28 minutes flying time, in each direction establishing a new coast-to-coast speed record for military planes. With a crew of seven, commanded by Lt. Col. Robert Olds, the plane flew non-stop from Langley Field, Va., to March Field, Calif., in 13 hours 27 minutes against a 27-mile headwind, and on the non-stop return trip covered the distance in 11 hours 1 minute. Air Corps officers termed it a "routine mission."

The Boeing YB-17 is an all metal streamlined low-wing monoplane 70 feet long, 15 feet in height and with a wing span of 105 feet. Both landing gear, equipped with air-operated wheel brakes, and tail wheel are retractible. The 20-ton plane is powered by four 1,000 h.p. Wright G Cyclone engines, and is equipped with Hamilton Standard three-bladed constant speed propellers. Defensive armament includes five machine gun emplacements, one in the nose and the other four in the streamlined "blisters" at the sides, top and bottom of the fuselage, so located as to provide overlapping zones of fire. Construction of the YB-17 is of the typical Boeing semi-monocoque type, the structure consisting of longerons, skin stiffeners, bulkheads and smooth outside skin of Alclad aluminum alloy. Following completion, eleven weeks ahead of schedule, of the first Army order for 13 of those planes, the Boeing Company was awarded contracts for an additional 26 to be designated as the B-17B. Deliveries on the new order were to begin in the summer of 1938.

Meanwhile, the Boeing Company completed the U. S. Army Air Corps XB-15 four-engine bomber, hailed as one of the greatest weight-carrying airplanes in the world. It has a wing span of approximately 150 feet, length of 90 feet, and a gross weight of more than 30 tons. The project had been under way in strict secrecy for nearly three years. Among innovations introduced by the new bomber was a complete 110-volt alternating current electrical system with generators driven not by the main engines, but by two auxiliary gasoline power plants within the plane.

The bomber has complete living accommodations for the crew, incorporated along with modern safety, navigation and comfort devices, to increase the physical endurance of the personnel and the combat efficiency of the plane for sustained operations. Power is supplied by four 1,000 h.p. Pratt & Whitney Twin Wasp engines. The XB-15, delivered in December, 1937, affords the Air Corps an opportunity of comparing three classes of bombardment planes—the comparatively small, fast, light-weight-carrying craft, the medium class exemplified by the four-engine YB-17, and now the maximum weight-carrying XB-15.

In the commercial field, Boeing's four-engine flying boats and transports are introducing many new developments. The six Boeing Model 314 flying boats or Clippers for Pan American Airways are to be the largest passenger-carrying airplanes in service anywhere in the world. First units of the six-plane fleet were nearing completion at the beginning of 1938. These transoceanic air-cruisers will carry 70 passengers in addition to a crew of 10, will have a wing span of 152 feet, a length of 109 feet, an overall height of 28 feet and a gross weight of more than 82,500 pounds.

At night, they will provide luxurious sleeping accommodations for 40 passengers. Space, moreover, is available in cargo holds for several tons of mail and air express. The 314 is a full cantilever high-wing all metal monoplane with two full decks. The upper deck contains the elaborate flight control section at the forward end, cargo space within the wing itself and crew's sleeping quarters aft. The lower or main deck includes standard passenger compartments, a lounge or dining salon, private stateroom, or "honeymoon suite," galley and dressing rooms, luxuriously fitted throughout for complete passenger comfort. Each plane contains 11½ miles of electrical wiring and 3,000 feet of piping. The control system involves 5,000 feet of control cable.

Powering the plane are four 1,500 h.p. two-row Wright Cyclone engines, any two of which are sufficient to maintain flight. Engine nacelles are accessible during flight by way of wing companionways. Although detailed performance figures have not yet been released, it has been announced that the Boeing Clipper will have a top speed of close to 200 m.p.h., cruising at 160 m.p.h., a maximum cruising range approximating 5,000 miles with reduced payload, or a normal operating range of more than 3,200 miles with 50 passengers aboard.

Construction of a fleet of new Boeing Model 307 four-engine land transports was begun during 1937—all metal, low-wing monoplanes with a wing span of 107 feet, length of 74 feet, overall height of 17 feet and a gross weight of approximately 42,000 pounds. A striking feature of the design is the completely symmetrical fuselage, circular in cross-section throughout and tapering toward the tail. There is no deviation from its smooth rounded surface even for the cockpit windows.

The initial production program, well under way at the beginning of 1938, included two planes for Pan American Airways equipped with sealed cabins and supercharging equipment for high altitude operation, and six for Transcontinental & Western Air, outfitted as standard passenger transports but so designed that the stratosphere equipment might be installed later. These planes will be powered by four 1,100 h.p. Wright series G-102 Cyclones.

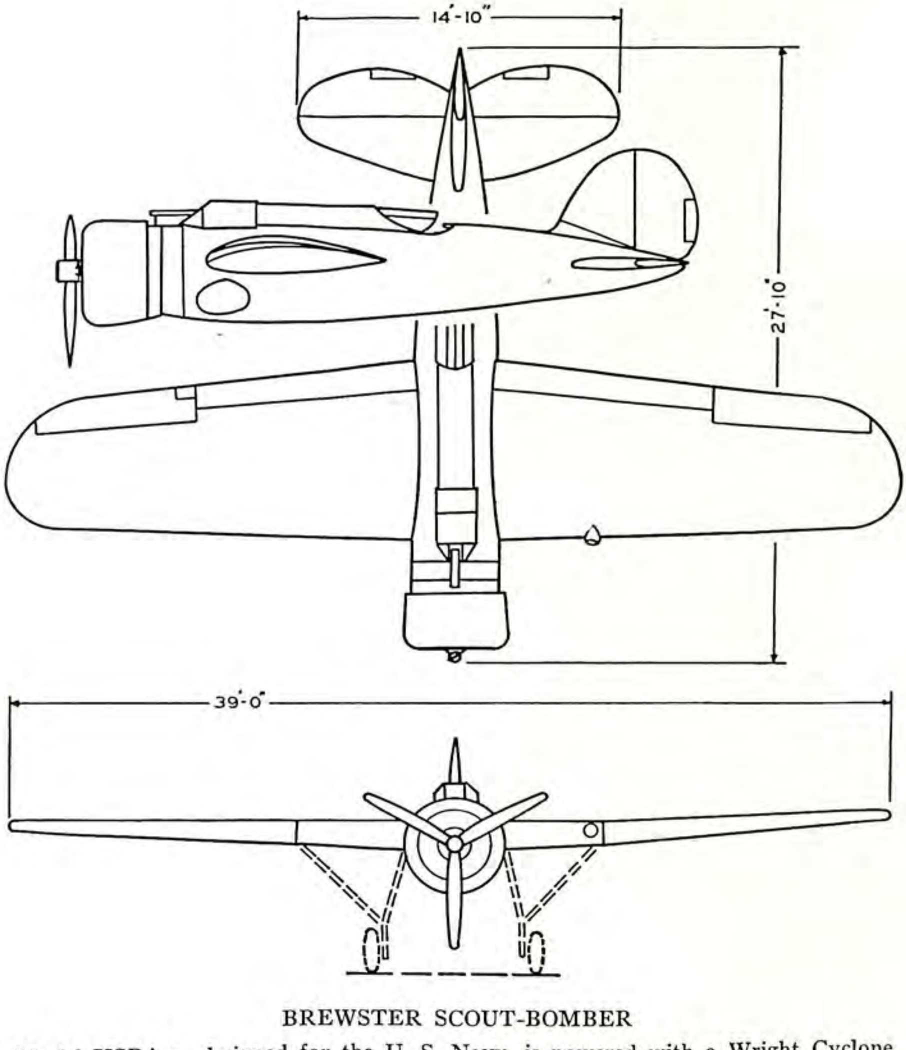
The "stratosphere type" Model 307, introducing a new phase of commercial transportation, is sealed throughout with pressure-tight skin, reinforced windows and pressure doors, all built for a design pressure of six pounds to the square inch and an operating pressure of two and one-half pounds to the square inch differential between outside and inside air. Two mechanical superchargers, each operating on only a fraction of the horsepower of one engine, will draw the air through intake valves well out on the leading edges of the wings, building up its pressure for introduction through ducts into the cabin. The equipment is designed to provide comfort conditions within the plane at an altitude of approximately 20,000 feet comparable to conditions in standard transports at the normal 8,000 to 12,000-foot level. The new upper level flying is expected to be attractive through increased speed, greater comfort and freedom from weather disturbance.

The standard Boeing Model 307 transport will carry 33 passengers plus a crew of four and 2,600 pounds of mail and cargo, or as a sleeper plane, 25 passengers and 4,000 pounds of cargo. Its stated speed is approximately 250 miles an hour with full load at an altitude of 6,000 feet, range of 1,700 miles at cruising engine power under normal conditions. Flight can be maintained on any two engines. Spacious passenger compartments, luxurious furnishings, modern sound-proofing and air conditioning are introduced to provide a high degree of passenger comfort.

A special Model 307 transport is under construction at the Boeing plant as a "flying yacht" for Captain George Whittell of San Francisco. It will have a luxurious "club style" interior with living room, dining room, master's suite, kitchenette, guest rooms, and even a shower bath. It will have a cruising range of 2,800 miles.

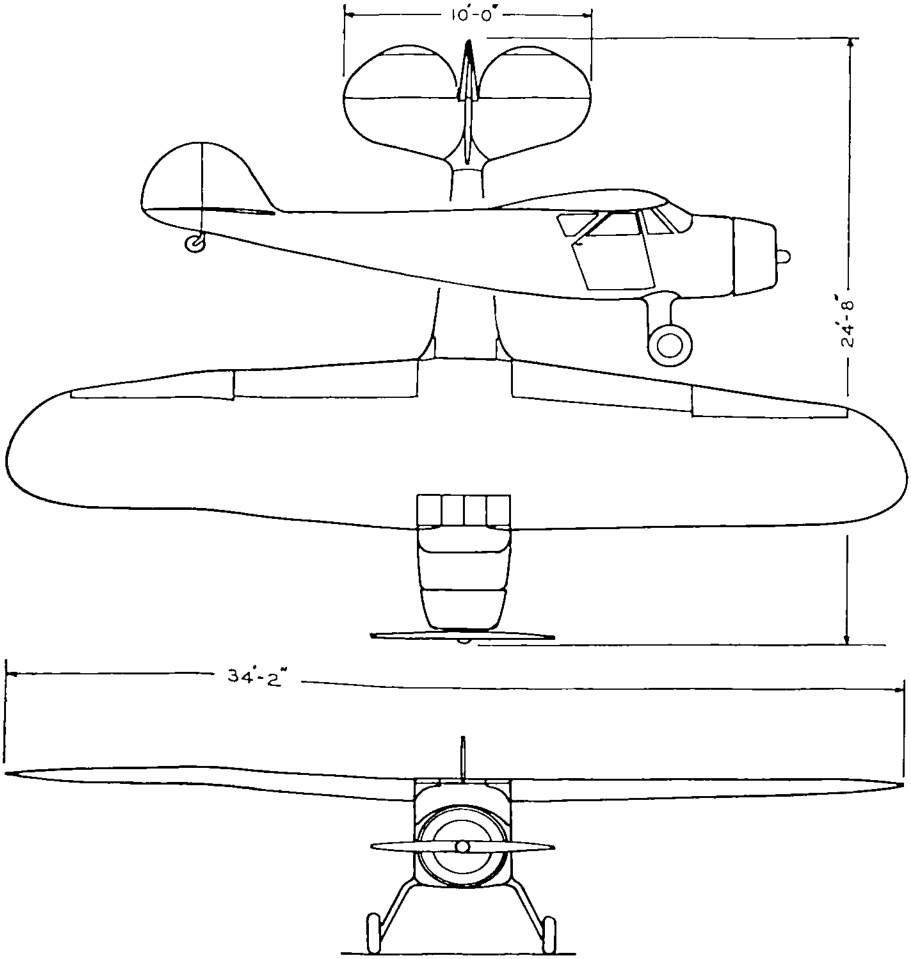
To facilitate production of its giant four-engine types, the Boeing company, late in 1937, completed a sizeable plant expansion program including an addition which more than doubled the size of the company's new Plant No. 2. The new plant unit, measuring 300 by 450 feet and providing nearly five million cubic feet of clear working space, is equipped throughout with giant monorail cranes, the largest of their type in the world.

Brewster Aeronautical Corporation, Long Island City, New York, carried on an experimental development program for the Navy, producing two models, the XSBA-1 scout dive bomber and the XF2A-1 single-seat fighter, both machines powered by Wright G Cyclone engines. The XSBA-1 had a fuselage of metal monocoque construction with cockpits for the pilot and the observer. The plane was designed to be operated from a carrier deck, equipped with a 500-pound bomb. The wings were of metal cantilever construction with watertight compartments to enable the plane to float in case of a forced landing at sea: The company also completed 77 sets of floats and braces for Navy patrol boats and 38 sets of wings and tail surfaces for utility amphibions. It was also building wings and tail surfaces for the Canadian



BREWSTER SCOUT-BOMBER

Model XSBA-1, designed for the U. S. Navy, is powered with a Wright Cyclone engine.



CESSNA AIRMASTER

A four-place plane for the private flier powered with a Warner Super Scarab engine.

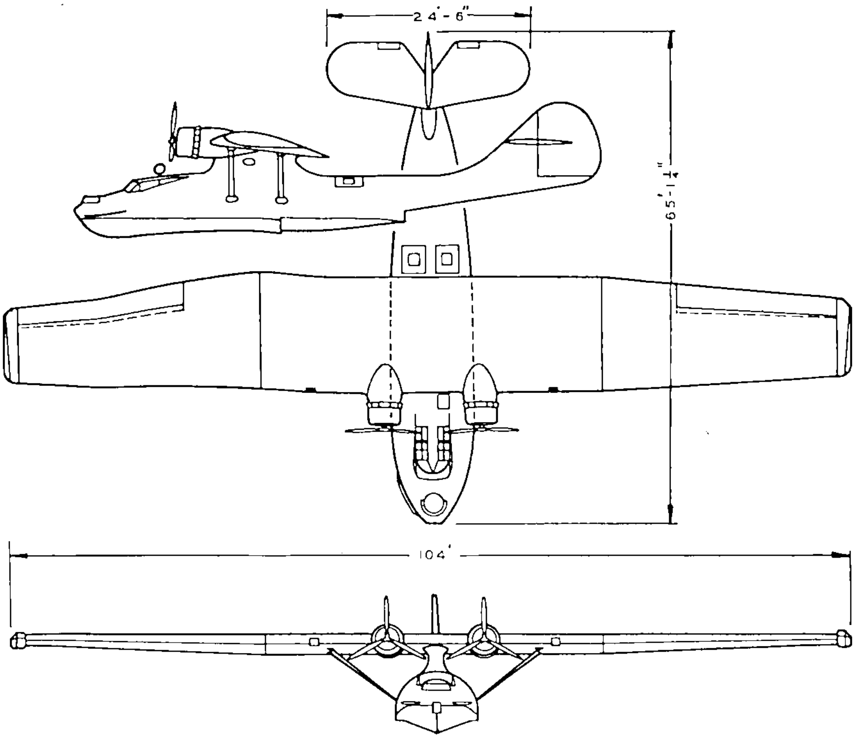
Car and Foundry Company's production of Grumman G-23 models in Canada. The company increased factory space during the year and increased employees to more than 700.

Cessna Aircraft Company, Wichita, Kans., manufactured the "Airmaster," a Warner-powered high-wing cabin monoplane 24 ft. eight in. long, wing span 34 ft. two in., gross weight 2,350 lbs., empty 1,370 lbs.

Consolidated Aircraft Corporation, San Diego, Calif., continued its extensive manufacturing program of large flying boats, completing both the PBY-1 and PBY-2 series of airplanes and making extensive progress on its third series, PBY-3. Besides this production series of airplanes, Consolidated delivered to the Navy the huge experimental plane, the XPB2Y-1, six PTY-3A's to the Argentine Government and three commercial versions of the PBY's to Russia and commercial customers—a total of 111 multi-engine boats delivered in 1937.

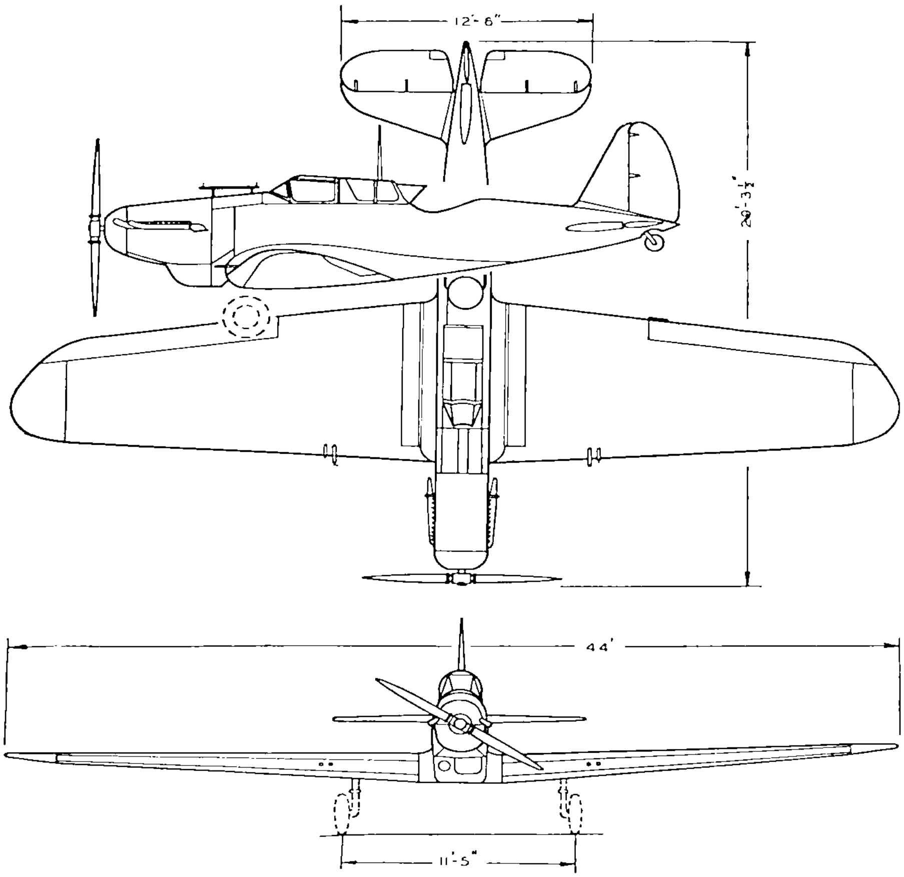
The Consolidated XPB2Y-1 was described as follows: It is a four-engine all-metal monoplane flying boat patrol bomber, its full cantilever wing mounting four Pratt & Whitney Twin Wasp engines of 1,050 h.p. each.

In order that this patrol bomber may be entirely independent of any base for an extended period of time, the hull has been protected from corrosion by latest approved finishes. Beaching gear is installed which may be removed and stored in special racks within the hull structure. All facilities for extended flight and comfort of personnel are pro-



CONSOLIDATED PBY-1

Navy six-eight-place patrol flying boat powered with two Pratt & Whitney Twin Wasps.



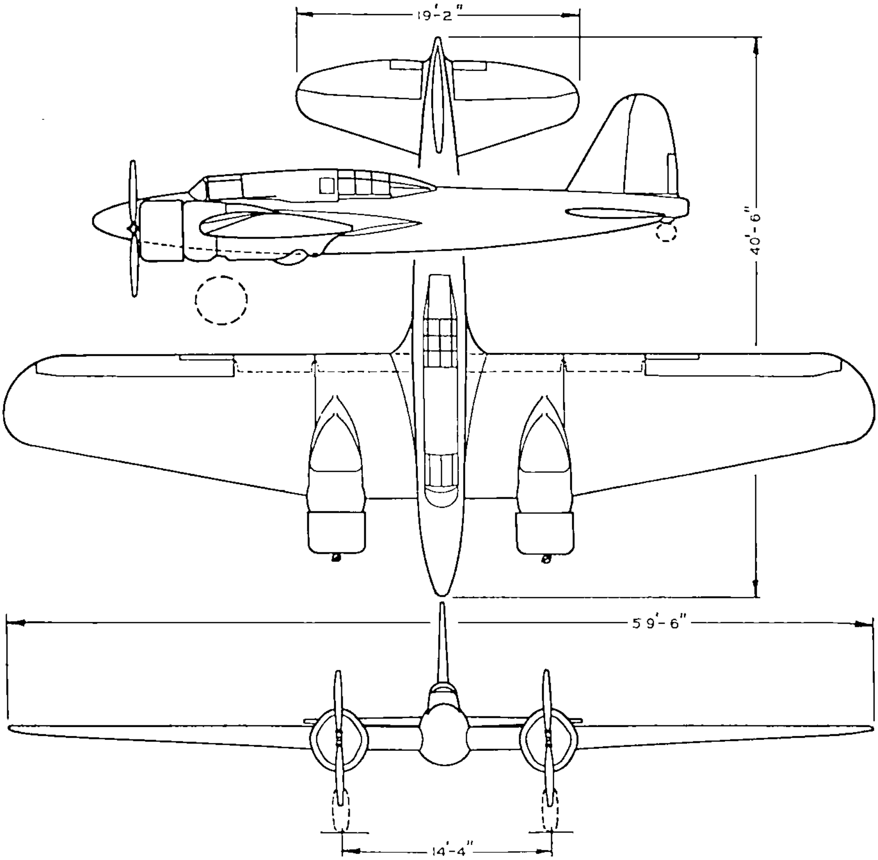
CONSOLIDATED PB2-A

A Curtiss Conqueror-powered two-place pursuit ship.

vided. These include commodious sleeping quarters, living quarters, galley complete with range and refrigerator, clothes lockers, toilet and washing facilities, heating and ventilating system, soundproofing, and even a well-equipped workshop complete with all appurtenances. For safety in the air and on the water, many novel adjuncts have been provided. All necessary navigation and engine instruments are conveniently placed and there is, of course, a complete radio installation.

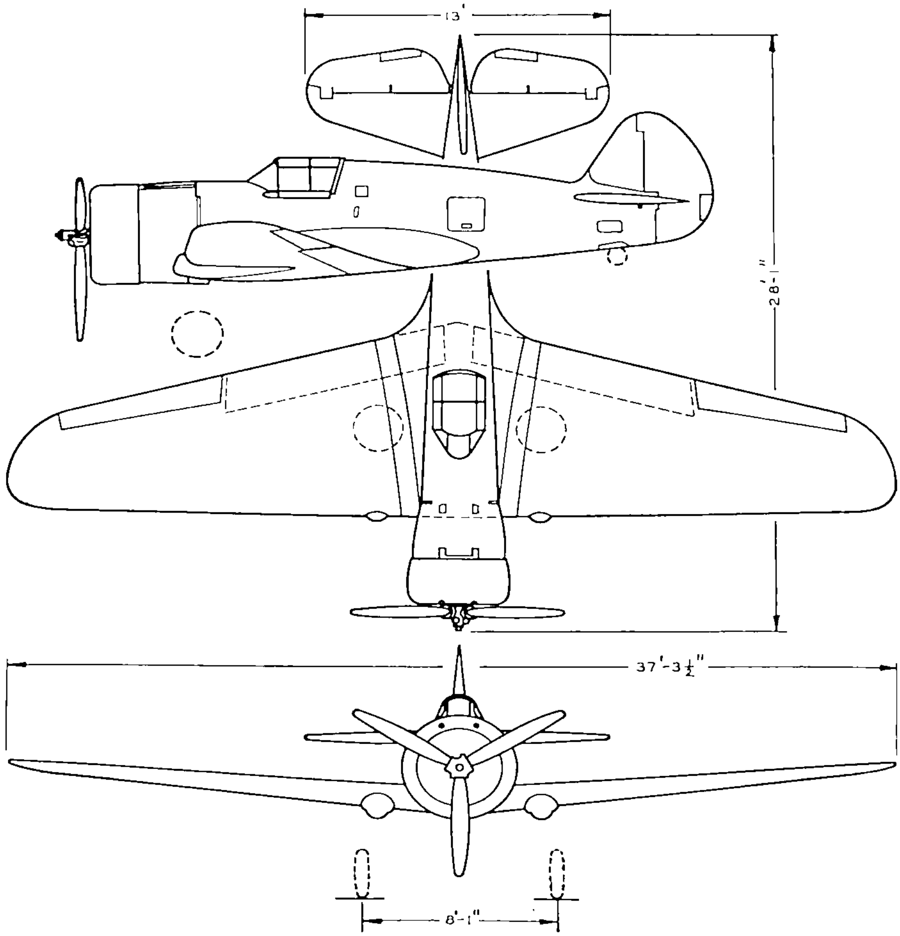
Another novel feature is the installation of retractible tip floats which, in flight, are drawn up to form the tip of the wing, thus increasing the performance of the patrol bomber materially, while, at time of landing, they are let down and form, in addition to necessary flotation for the wing tips, an additional braking effect for slow landing. A complete telephone system is installed within the boat whereby any member of the crew may contact any other member. A 110-volt alternating current electrical system is also provided, powered by auxiliary power plant motors.

Another feature is the provision of a special navigation turret aft of the wing. Here the navigator may station himself with his instruments. He has a completely unobstructed view of the sky for celestial observation. Armament details are withheld in accordance with Navy policy. However, complete and powerful protection is provided in all directions. A tremendous load of bombs may also be carried.



CURTISS ARMY ATTACK-BOMBER

This two-place model Y1A-18 is powered with two Wright Cyclones of 930 h.p. each.

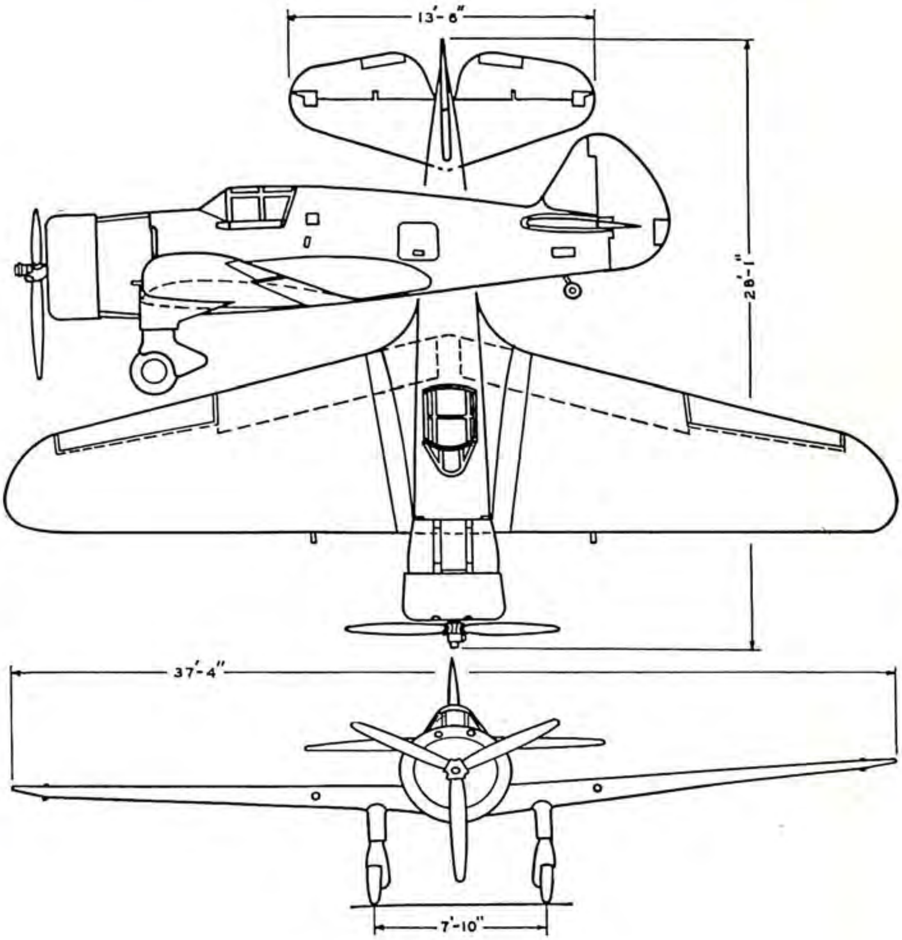


CURTISS ARMY PURSUIT Y1P-36

This one-place military plane is powered with a Twin Row Pratt & Whitney Wasp.

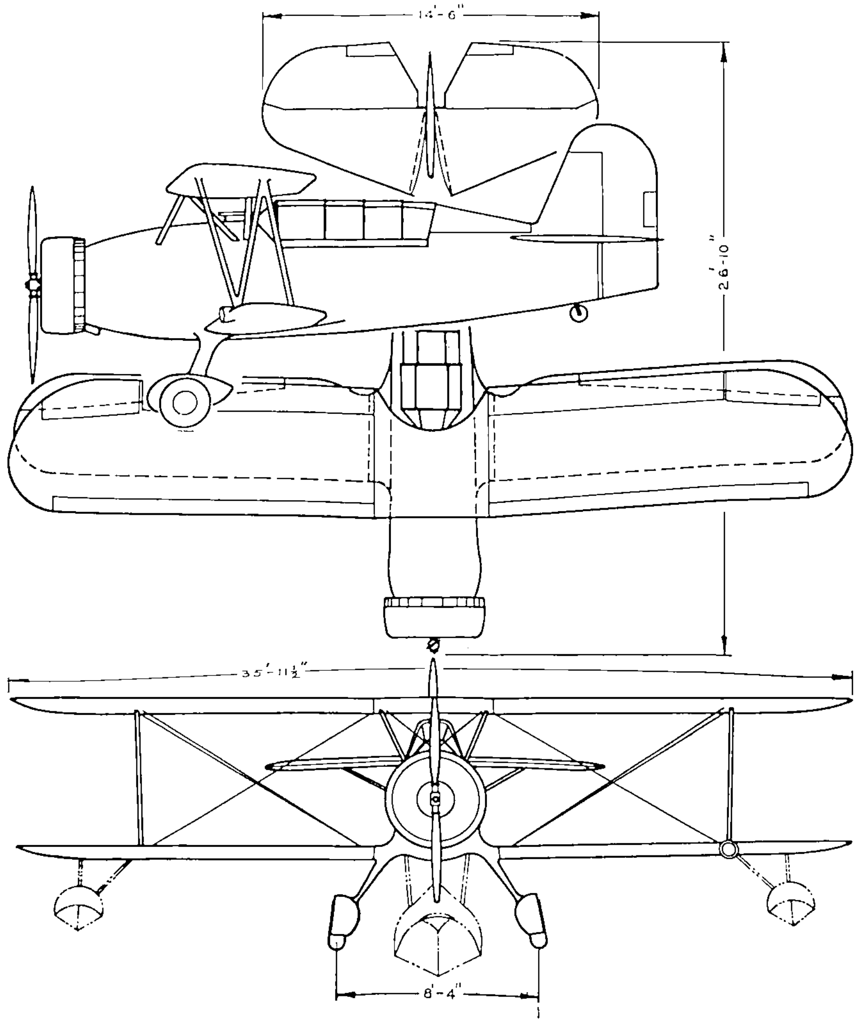
As routine transfer of Consolidated PBY airplanes from the Naval Air Station, North Island, San Diego to other bases, the Navy Department established three world's records for non-stop long distance formation flights. On January 28, 12 Consolidated PBY-1's with a crew of 80 officers and men under the command of Lieut. Comdr. William McDade, flew from San Diego Bay to Pearl Harbor, Hawaii. On April 13 a second squadron of 12 PBY airplanes under the command of Lieut. Comdr. L. A. Pope duplicated the flight to Pearl Harbor in a shorter time. On June 21, under the command of Lieut. R. W. Morris, a third squadron of 12 PBY airplanes made the third non-stop flight of the year, this time to Coco Solo, creating a new international long distance record of 3,087 miles. The PBY-1 is the only type of airplane that has made the non-stop flight between San Diego and Coco Solo in either direction.

The first commercial PBY-1 was delivered in June to Richard Archbold, research associate of the American Museum of Natural



CURTISS HAWK 75

A single-seat pursuit powered with a Wright Cyclone 840 h.p. engine.

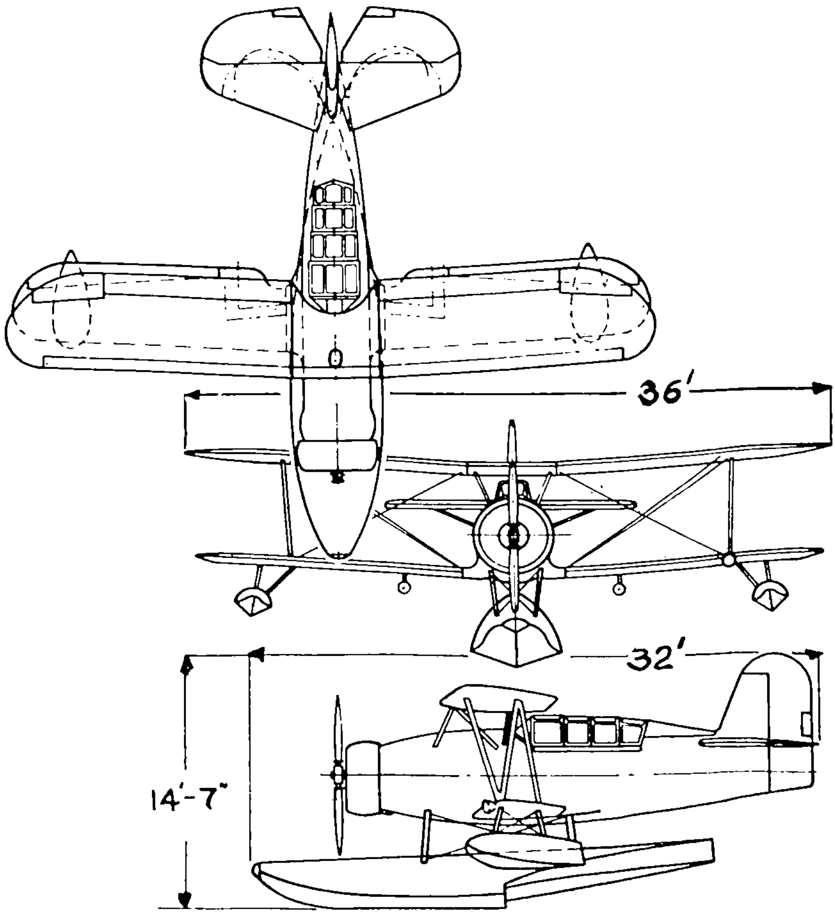


CURTISS OBSERVATION SCOUT

Model SOC-1, a two-place plane powered with a Pratt & Whitney Wasp.

History, New York. The flight of this airplane, "Guba," from San Diego Bay to New York harbor established a world record for the largest airplane and the only flying boat ever to span the United States in a single hop, the flight being completed in 17 hours 3½ minutes with sufficient reserve fuel to have continued to St. Johns, Newfoundland, or Puerto Rico in the West Indies, or to Bermuda and back to New York.

With the disappearance of Sigismund Levanevsky, the "Russian Lindbergh," and his five companions on their transpolar flight, the Russian Government purchased the "Guba," because of its 4,000-mile range, rechristened it the URSSL-2, and employed Sir Hubert Wilkins, the noted Arctic explorer, to lead an expedition with the flying boat in search of the lost fliers. Sir Hubert spent 36 days and flew over 19,000 miles in the Arctic area, vainly searching for the missing



CURTISS SEAGULL
A Pratt & Whitney Wasp-powered seaplane carrying two.

airmen. His return to New York was necessitated by the freezing over of the few suitable landing areas in that region.

With the sale of the "Guba" to the Russian Government, Mr. Archbold immediately placed an order for another ship to continue with his plans for an expedition into Dutch New Guinea. His second airplane, also the "Guba," and also licensed NC777, was delivered early in November. Mr. Archbold planned to fly to Hawaii, thence to Midway, Wake, and Guam, and finally to New Guinea, there to lead an exploratory expedition for the American Museum of Natural History.

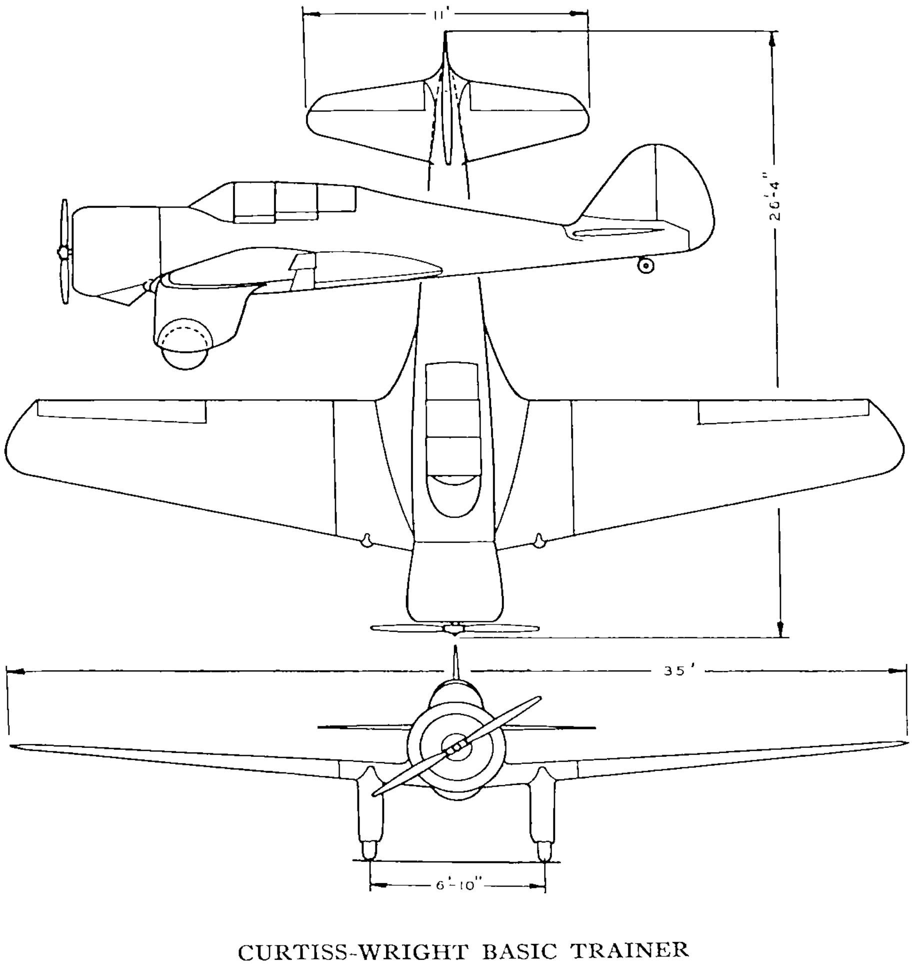
Consolidated has one of the most modern aircraft factories, erected

THE CURTISS HAWK 75

This single-seat pursuit monoplane is powered by an 840 h.p. Wright Cyclone engine. It is an all-metal plane carrying machine guns and bombs. It can perform at altitudes of more than 30,000 feet.

on a site of approximately 20 acres. The general offices and all manufacturing operations are located in the main building which is 1,000 feet long by 300 feet wide. The experimental building houses the engineering department and experimental and secret projects conducted for the U. S. Government. A woodshop is situated in the ell of the experimental building. West of the main building are the chemical and physical testing laboratories, paint storage building, acetylene generator building and tool storage warehouse. The factory, comprising 450,000 square feet of floor space, is equipped with modern processing facilities for aircraft manufacture, including heat-treating furnaces, electrolytic and anodizing equipment, dope and paint shop, wood mill, and individually motor-drawn machine tool equipment.

The Curtiss Aeroplane Division of the Curtiss-Wright Corporation at Buffalo, N. Y., at the beginning of 1938 had in production the following types and models of aircraft: single-engine, two-place Navy observation models SOC-1, 2 and 3; single-engine, two-place Navy scout-bomber SBC-3; the single aircooled engine Army pursuit



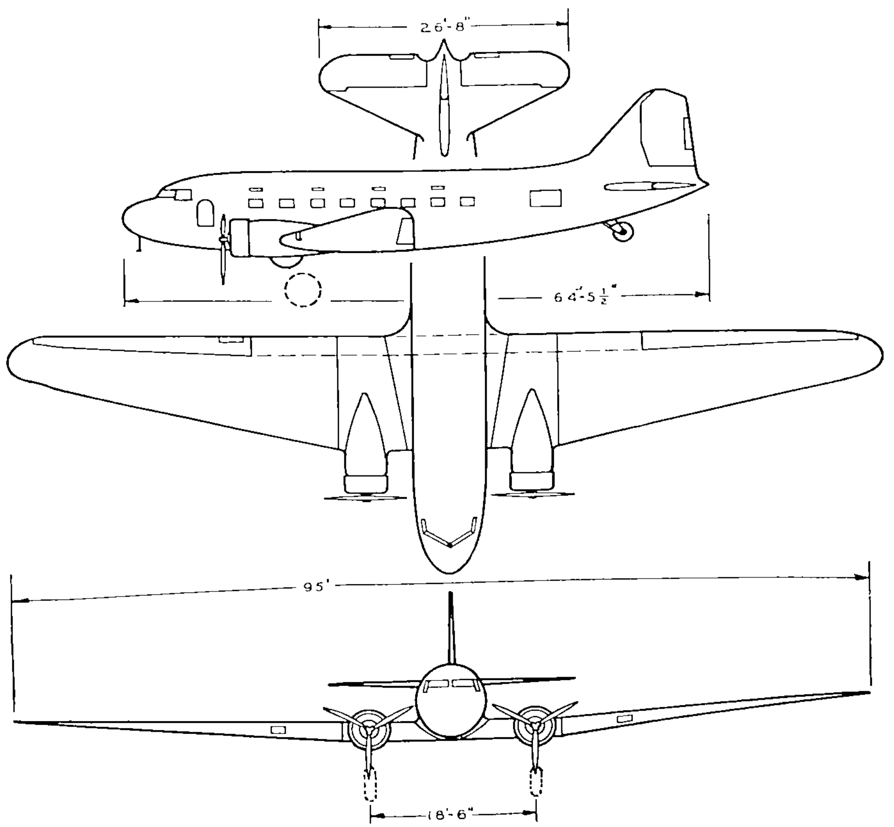
CURTISS-WRIGHT BASIC TRAINER

Wright Whirlwind-powered, this model 19-R is a two-place plane.

Y1P-36 of unusually high performance; the XP-37 single liquid-cooled engine pursuit, claimed to be the fastest military airplane in the world; and the Y1A-18, a revolutionary design in twin-engine attack planes. Besides designing and building airplanes for the Army and Navy air forces of the United States the Curtiss Aeroplane Division sold many models to foreign governments. Among the export models are: The Curtiss Seagull, two-place observation plane, developed from the SOC-1, convertible land or seaplane, powered by a 550 h.p. Pratt & Whitney Wasp engine and Curtiss propeller, carrying two machine guns and two 100-pound bombs, high speed 168 m.p.h., cruising at 137 m.p.h., range 697 miles; the Curtiss Hawk 75, single-seat fighter, with 840 h.p. Wright Cyclone engine, developed from the Y1P-36 fighter, fixed landing gear, all metal, low-wing monoplane, enclosed cockpit, capacity for four machine guns and light bombs, high speed 280 m.p.h., cruising at 240 m.p.h., range 1,210 miles and service ceiling 31,800 feet; the Curtiss Hawk Type IV single-seat pursuit biplane with 745 h.p. Wright Cyclone engine and retractible landing gear. The company reported a total of 450 military aircraft ordered and completed in 1936 and 1937, including 258 SOC observation and 83 scout-bombers for the Navy with additional Air Corps orders for Y1A-18 attack monoplanes, Y1P-36 pursuits and a new high speed experimental pursuit, besides orders from foreign air forces.

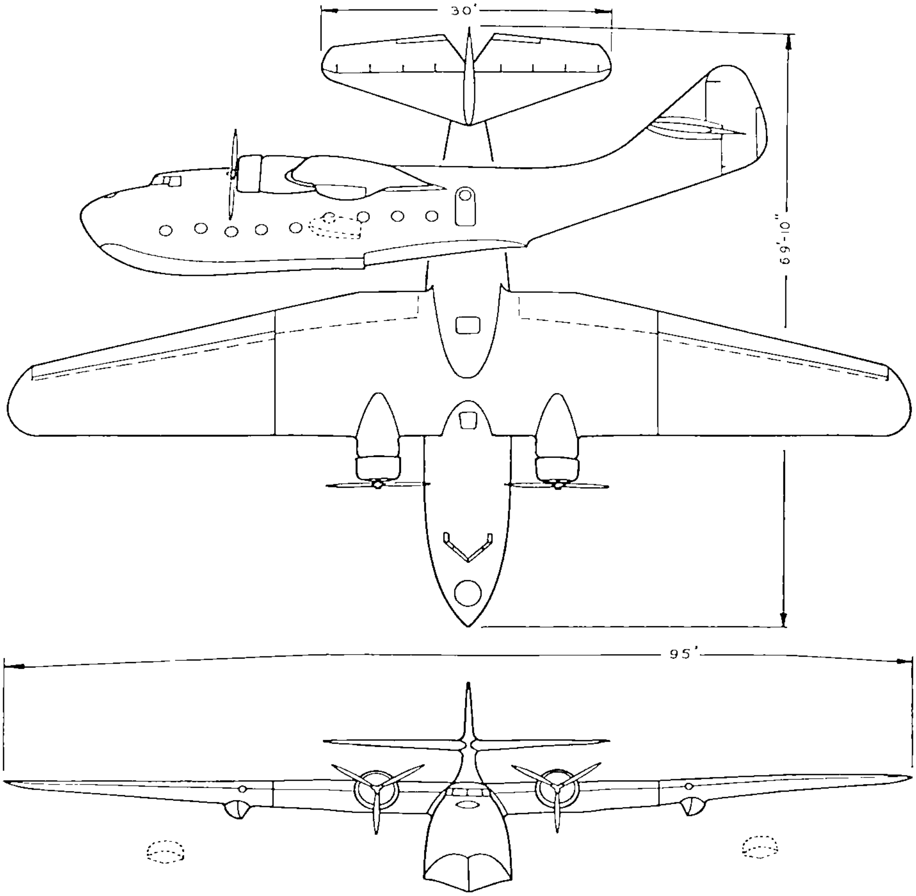
Curtiss-Wright Corporation, through its St. Louis Airplane Division, at Robertson, Mo., at the beginning of the year was completing a new twin-engine transport airplane reported to be the largest twin-motored aircraft ever developed. Details of design and construction were not released pending completion. The company also had in production several models for the export market, including several versions of Model 19 and the Condor Cargo Model CT-32. The twin-engine Condor model was a fabric covered all metal biplane with retractible landing gear, powered by two Wright Cyclone engines, useful load 6,975 pounds, stated high speed 181 m.p.h., cruising at 161 m.p.h., 715 miles range. The Curtiss-Wright Model 19 was offered in different types, as a high performance low-wing cabin commercial sport plane, commercial training plane, advanced military training plane, observation, photographic, two-place pursuit, attack or light bomber version, as a land plane, seaplane or an amphibion. As a military monoplane the Model 19-R was powered by Wright Whirlwind engines, of different power.

Douglas Aircraft Company, Inc., Santa Monica, Calif., employing 400 engineers and 4,000 others, at the beginning of 1938 had built and sold many 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



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 DF FLYING BOAT

Powered with two Wright G Cyclones, this commercial flying boat carries 32 passengers and crew of four.

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 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 length 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 beginning of 1938 Douglas had sold many DC-3 planes to United Air Lines, American Airlines, Eastern Air Lines, TWA and Royal Dutch Airlines; and several DST sleepers had been delivered to American Airlines. Another 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 and a four-engine transport for air line use, the DC-4.

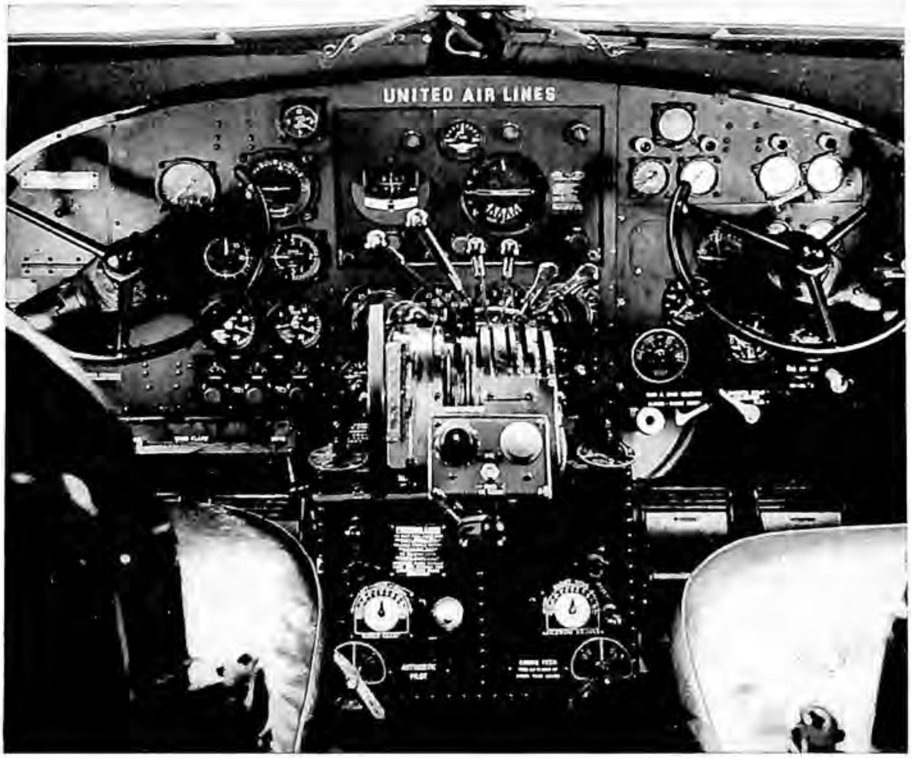
The Douglas DC-4 super air liner was rapidly nearing completion in the huge plant at the beginning of 1938. Engineered and built to the order of five air lines, the ship was a 42-passenger, four-motored monoplane, with a gross weight of 65,000 pounds—32½ tons. The latest developments in aeronautical science, and every lesson and experience gained by commercial air transport operators were incorporated in this giant of the skies. Production models of the DC-4 were to have "substratosphere cabins" in which lower-level altitude atmospheric pressures could be maintained for the comfort of the passengers, while the plane was operated at greater efficiency and with far more safety thousands of feet above the highest obstruction on the continent.

The contract for construction of the DC-4 plane was dated March 23, 1936. The five lines concerned were United Air Lines, Trans-Continental & Western Air, American Airlines, Pan American Airways and Eastern Air Lines. Cost of the DC-4 development at date of completion was approximately $1,500,000.

Separate, independent systems for supplying electricity, cooling, heating and control operations were designed and created. New materials were found and tested. A thousand-and-one details of power installations, vibration control, aerodynamic conditions and safety requirements had to be anticipated, studied and conquered by the Douglas engineers and designers. More than 500,000 engineering hours were put into construction of the DC-4 prototype plane.

The DC-4 was to carry a crew of five, in addition to 42 passengers. Its wing span was 138 ft. three in., and length 97 ft. Its height was more than 24 ft.

Its four aircooled motors totalled 5,600 h.p. for the take-off, more by 1,000 h.p. than is required by most of America's finest streamlined



THE BRIDGE OF AN AIR LINER

What the pilots work with on the Douglas DC-3 Mainliner transports of United Air Lines.

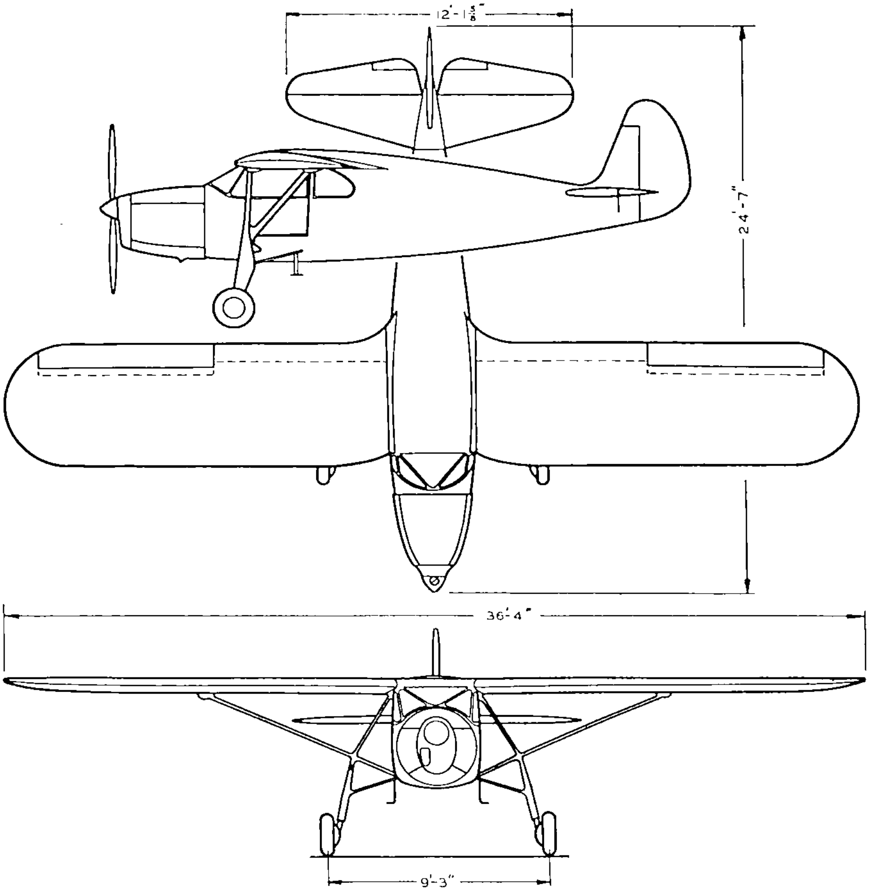
locomotives to draw a heavy train on record-breaking runs. With this abundance of power, the plane was expected to have a cruising range of 2,200 miles, a high speed at most efficient altitudes of nearly four miles a minute, and an absolute ceiling of 24,000 feet. Its gross weight was 65,000 pounds. Its useful load was 20,000 pounds, a capacity of 6,500 pounds of mail, express and baggage, besides the passengers, crew and fuel.

The most novel departure was the "tricycle" landing gear of the DC-4. This gear will permit much smoother and safer landing of aircraft of this size, as well as provide additional comfort for passengers, by taking off and landing in a horizontal position. The plane was designed to have a normal landing speed of 68½ miles an hour.

The prototype plane was to go through its initial acceptance tests with Pratt and Whitney Twin Hornet engines. Provision was made in the contract for a series of additional tests with Wright engines.

Most of the important parts of the DC-4 were built and deliberately and scientifically destroyed in the testing laboratory to prove the calculations of engineers and designers. Special machinery and fittings were designed and built at the Douglas plant to carry out the tests.

In all more than 100 major structural tests were conducted, requiring 21,000 engineering and shop hours to prove and check engineering designs and stress calculations.



FAIRCHILD MODEL 24

Ranger-powered four-place plane for the private flier. This plane is also available with a Warner Super Scarab engine.

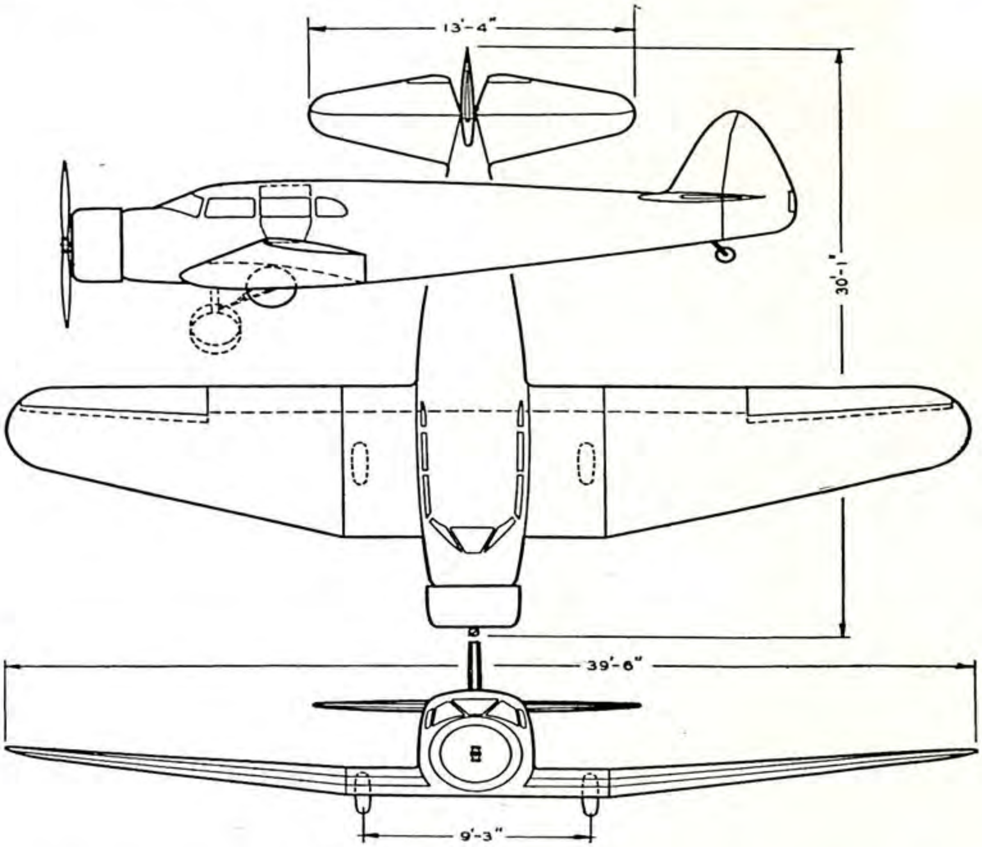
RANGER-POWERED FAIRCHILD 24

A three-place plane for private owners.

Fairchild Aircraft Corporation, Hagerstown, Md., was supplying planes to several different classes of users at the beginning of 1938. The company produced the Fairchild 24 for sportsman pilots and the Fairchild 45 for executive and private transport. The 24 model was powered with either the Ranger 165 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 four-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.

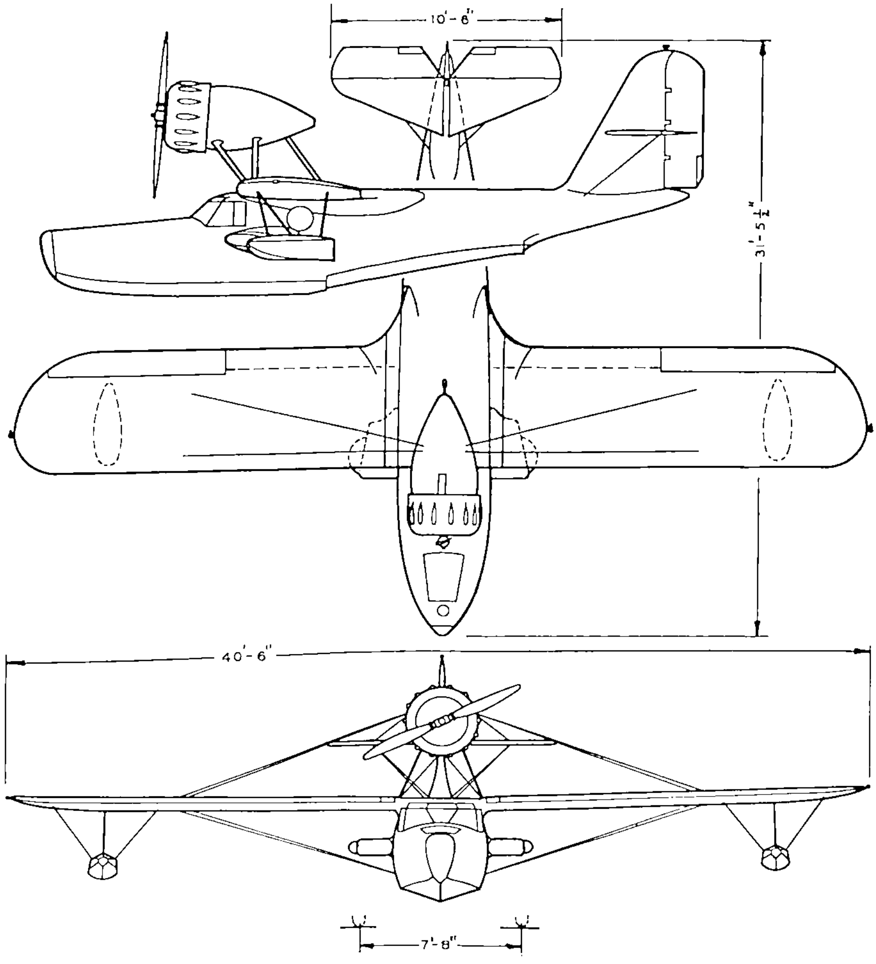
The Fairchild 24 had a fuel capacity of 40 gallons and a stated cruising range of 500 to 550 miles with full payload.

Fleetwings, Inc., Bristol, Pa., brought out a new design for its 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 F-5 had a fuel capacity of 70 gallons, giving it a stated cruising range of 550 miles at 132 m.p.h., or at most economical speeds a range of 850 miles at 10,000 feet. The Sea Bird received an Approved Type Certificate from the U. S. Bureau of Air Commerce in September, 1937. The company also produced a large number of sets of ailerons, elevators, and rudders for some of the latest Army pursuit ships manufactured by Seversky Aircraft Corporation and known as Model P-35 which were under production and being delivered to the Air Corps throughout the year. This contract extended into 1938 and will give the Army a large number of all-stainless steel, fabric-covered control surfaces. Fleetwings also designed and built a large 16-foot chord all-stainless steel wing tip for test by the Army Air Corps. That, and design projects



FAIRCHILD MODEL 45

A five-place plane for the private owner, Wright Whirlwind-powered.



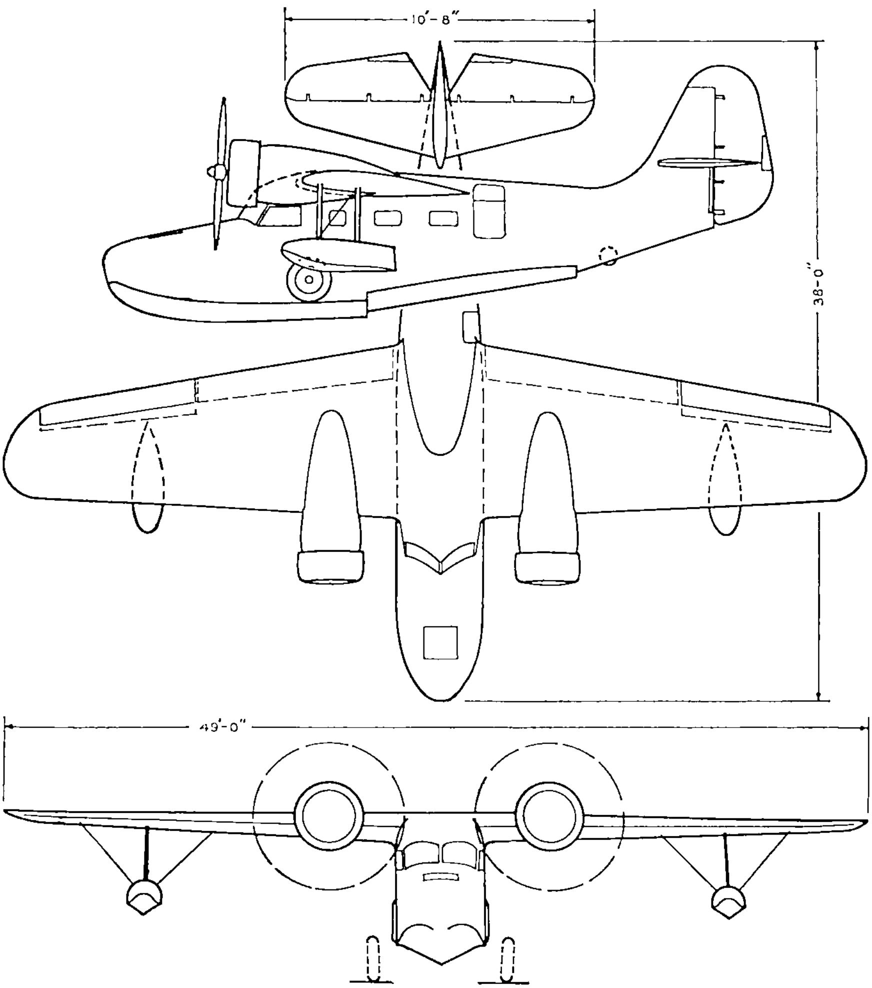
FLEETWINGS SEA BIRD

This four-passenger private amphibion is powered with a Jacobs 285 h.p. engine.

for a large Model F-20 all-stainless steel flying boat, marked the extension of stainless steel structures into what should be their most desirable field. Fleetwings now have available the design of an all-stainless steel flying boat with a wing spread of 125 feet and a gross load of 35,000 pounds.

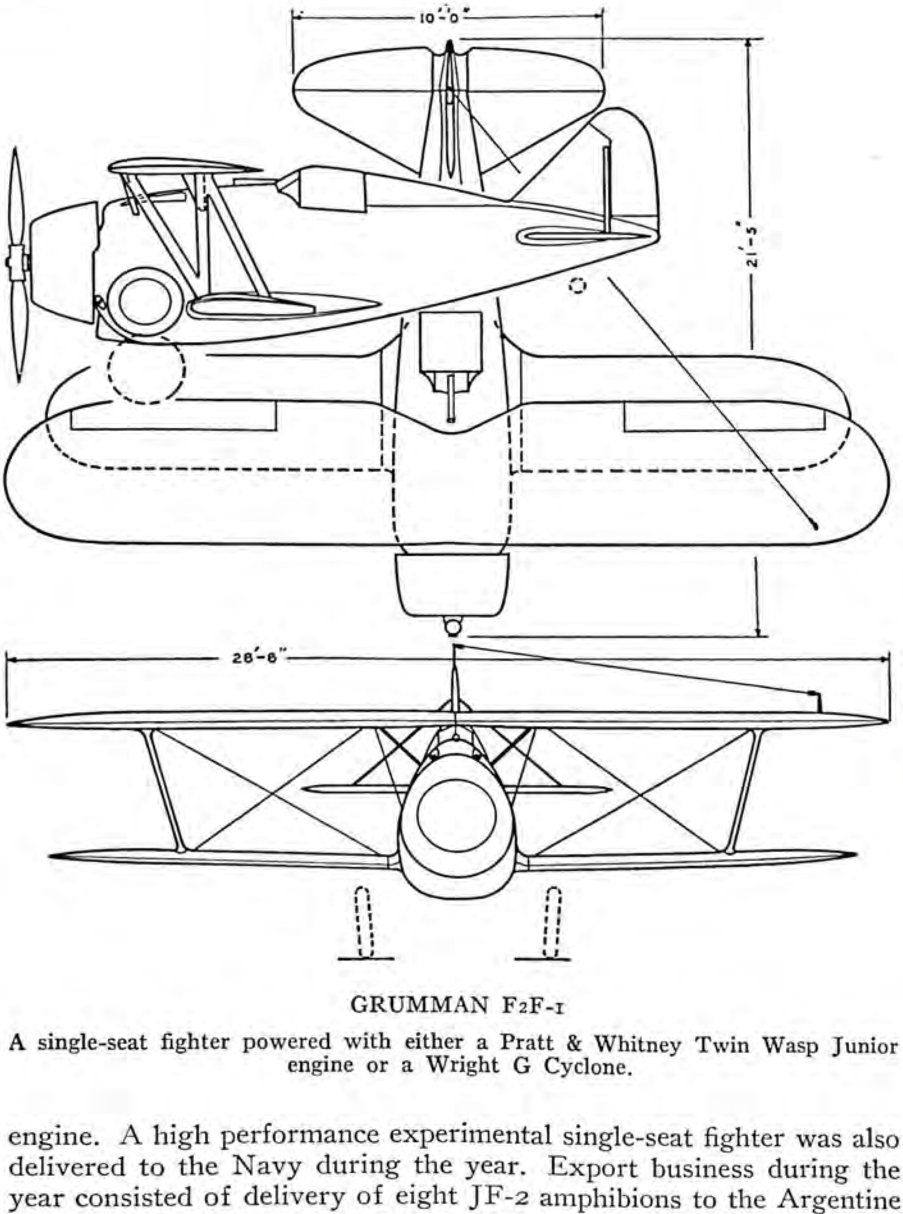
Grumman Aircraft Engineering Corporation, Bethpage, N. Y., continued building single-seat fighters and utility amphibions for the

U. S. Navy. Delivery was completed on an order for 29 J2F-1 utility amphibions, and work was started on a repeat order for 30 additional planes of the same type. A contract for 81 F3F-2 single-seat fighters for the Navy was in production. The F3F-2 airplane is similar to the F3F-1, 54 of which were delivered to the Navy in 1936, except for improved performance obtained by the use of a Wright G Cyclone



GRUMMAN G-21

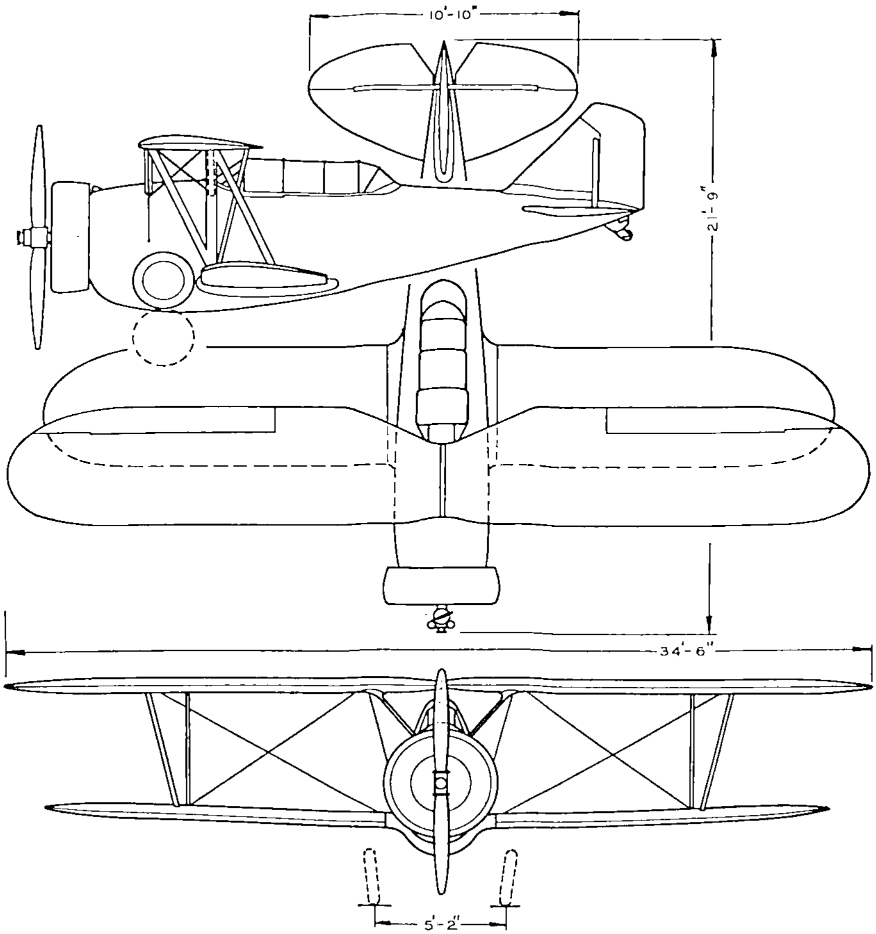
This six-eight place commercial amphibion is powered with two Pratt & Whitney Wasp Junior engines rated at 400 h.p. each.



GRUMMAN F2F-1

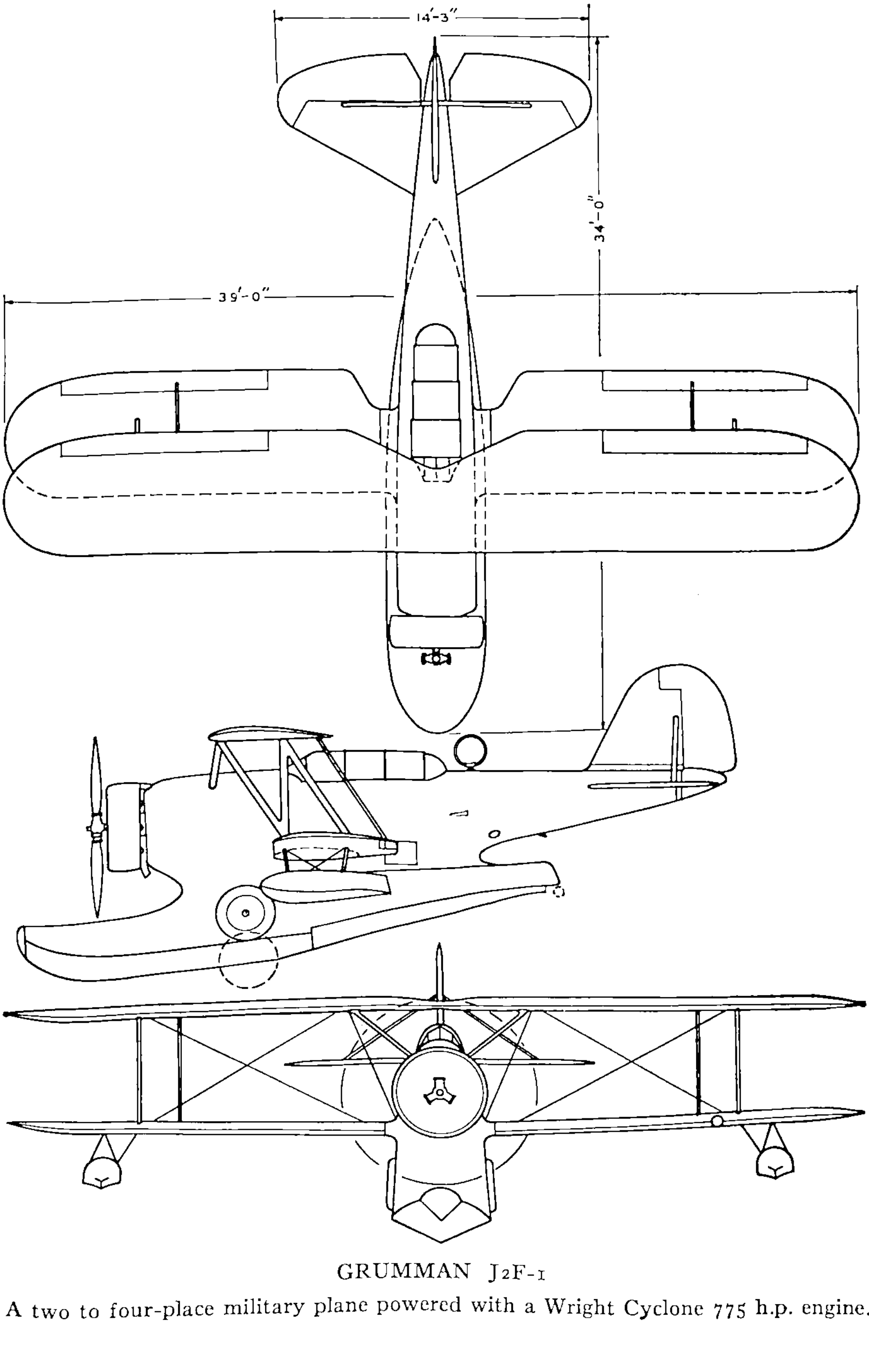
A single-seat fighter powered with either a Pratt & Whitney Twin Wasp Junior engine or a Wright G Cyclone.

engine. A high performance experimental single-seat fighter was also delivered to the Navy during the year. Export business during the year consisted of delivery of eight JF-2 amphibions to the Argentine Navy and the construction of 40 fuselages of the Grumman Scout for the Canadian Car & Foundry Company. The Grumman Scout, the J2F-1 utility amphibion, and the F2F-1 single-seat fighter were released for export. The G-21 commercial amphibion was granted Approved Type Certificate No. 654 in 1937, and 11 of these airplanes were delivered. This airplane is a twin-engine six-eight place boat type amphibion equipped with the typical Grumman landing gear that retracts completely into the side of the hull. Two Pratt & Whitney Wasp Junior 400 h.p. engines are mounted in the leading edge of the wing. The stated performance of the G-21 amphibion is: maximum speed at 5,000 feet, 205 m.p.h.; cruising speed at 9,600 feet, 193 m.p.h.; service ceiling 24,000 feet; landing speed, 60 m.p.h.; range 1,050 miles at 150 m.p.h.



GRUMMAN NAVY SCOUT

A military two-place plane, powered with a 700 h.p. Wright Cyclone.

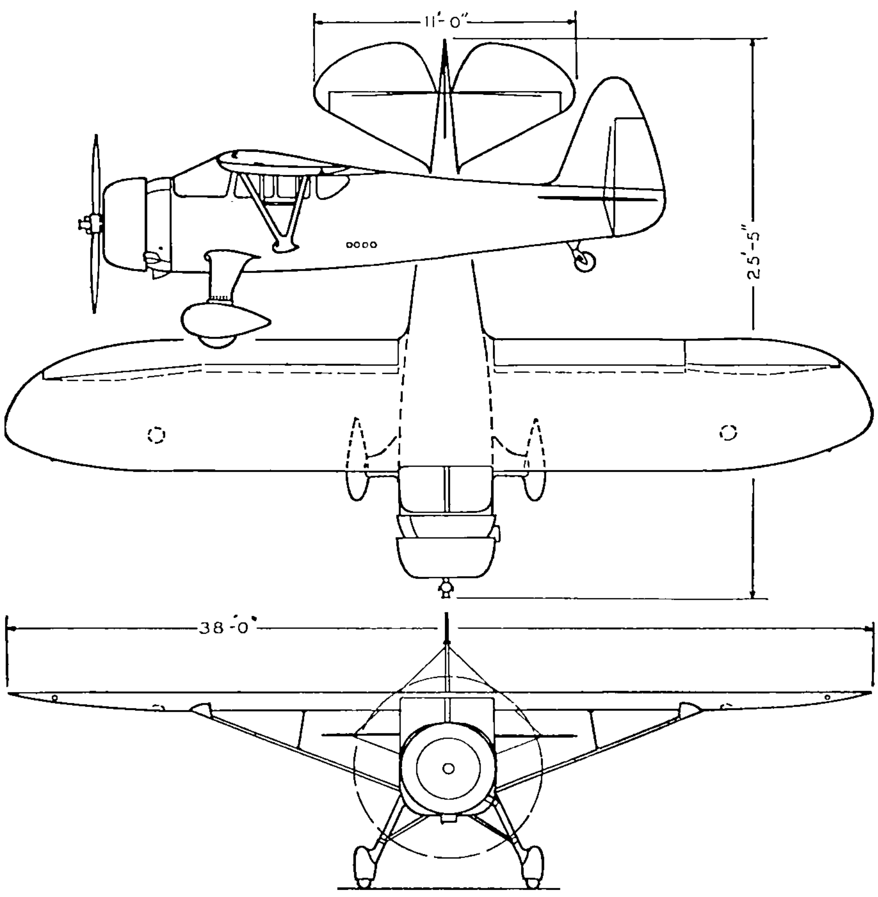


GRUMMAN J2F-1

A two to four-place military plane powered with a Wright Cyclone 775 h.p. engine.

Howard Aircraft Corporation, Chicago, Ill., produced three models of their high-wing cabin monoplane carrying four persons. The Howard DGA-11 had a 450 h.p. Pratt & Whitney Wasp Junior engine with stated cruising speed of 208 m.p.h. and range of 850 miles. The DGA-8, with a 320 h.p. Wright Whirlwind, had a stated cruising speed of 187 m.p.h. and range of 1,085 miles. The DGA-9, with a 285 h.p. Jacobs engine, had a stated cruising speed of 166 m.p.h. and range of 630 miles.

Kellett Autogiro Corporation, Philadelphia, Pa., opened 1938 with plans to complete delivery on autogiros ordered by the U. S. Army



HOWARD DGA-11

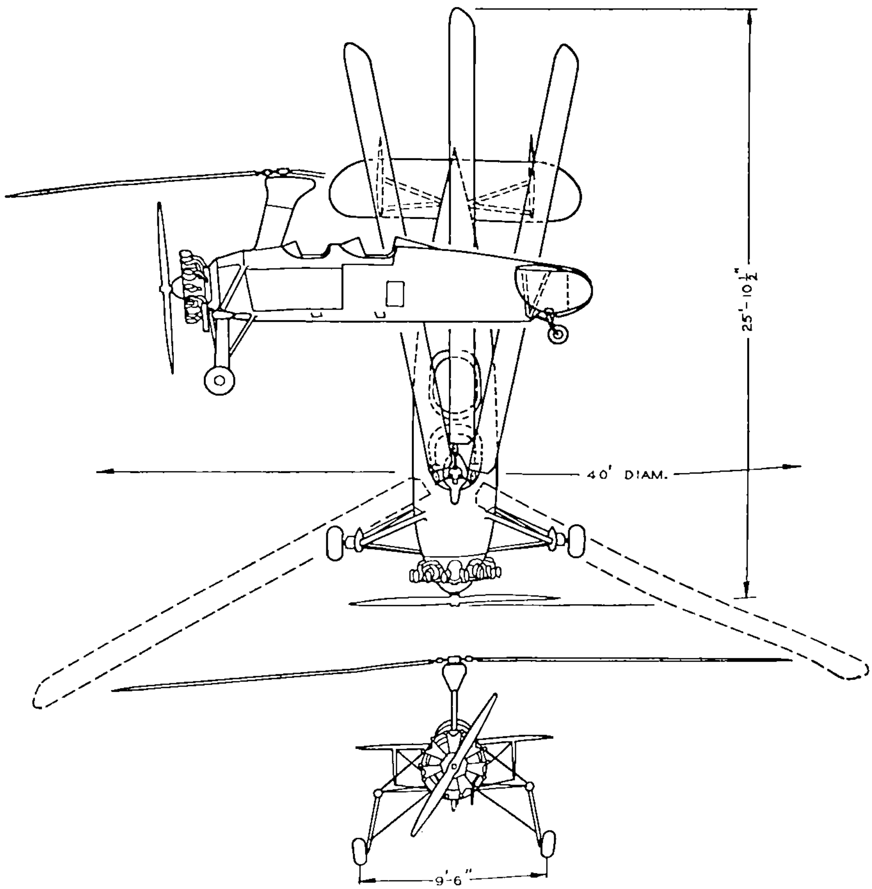
A four-place plane powered with a 450 h.p. Pratt & Whitney Wasp Junior engine.

Air Corps for military operations. These autogiros, the YG-1B, were of the direct control wingless type with improvements over the YG-1 and YG-1A models previously delivered to the Air Corps. The company has also developed the KD-1A type autogiro for inland patrol, inspection, forest fire patrol, agricultural crop dusting, air mail shuttle, and general commercial purposes.

Lockheed Aircraft Corporation, Burbank, Calif., at the beginning of 1938 reported that it had made deliveries of its models, notably the 10-passenger Electra, to Great Britain, Australia, New Zealand, New Guinea, Poland, Venezuela, Brazil, Argentina and India. During the last 12 months the company had doubled its factory floor space and had increased production facilities permitting deliveries of 10 transport planes a month. The three major models were the Electra, the

THE HOWARD DGA-11
It is powered by a 450 h.p. Wasp Junior engine.

Lockheed 12 and the 14—all twin-engine transports. The Lockheed 14 was described by the company as follows: "The Lockheed 14 provides luxurious accommodations for 11 passengers, two pilots and stewardess. At each of the 11 comfortable, reclining and swivelling chairs is a reading light, ash receptacle and push button for calling the stewardess. Large windows separated only by a narrow pillar provide the maximum possible vision for every passenger. An overhead rack extending lengthwise on each side of the cabin provides means for carrying wraps and small packages. Ample space is available for carrying baggage as well as a large cargo of mail and express. The fuselage nose compartment has a volume of 82 cubic feet, and three supplementary compartments below the cabin floor have capacities of 42, 26 and 40 cubic feet respectively. The cabin is soundproofed with Seapak, a non-hygroscopic, non-inflammable material with the highest sound absorption qualities. The cabin is also completely air-conditioned and the Seapak soundproofing further acts as an efficient heat-insulating material. Air is introduced to, and exhausted from the cabin through sound traps, so that the noise level with full open throttle is maintained lower than that of a railway sleeping coach. Cabin temperatures can be maintained at 70 degrees Fahrenheit with an outside temperature of several degrees below zero. The importance of providing a very comfortable cabin with very low sound level cannot be over-estimated with respect to its effect upon the well-being of passengers.



KELLETT KD-1

A two-place autogiro for private operations powered with Jacobs engine.

"An important innovation on the Lockheed 14 is the use of the Fowler type trailing edge wing flaps. Located on the under surface of the wing, the flaps are operated hydraulically and controlled by the pilot. This type of flap offers a great many important advantages over the conventional split-flap used extensively and very successfully in the past. The principal effect of those flaps is to increase the maximum lift coefficient without increasing the vertical sinking speed.

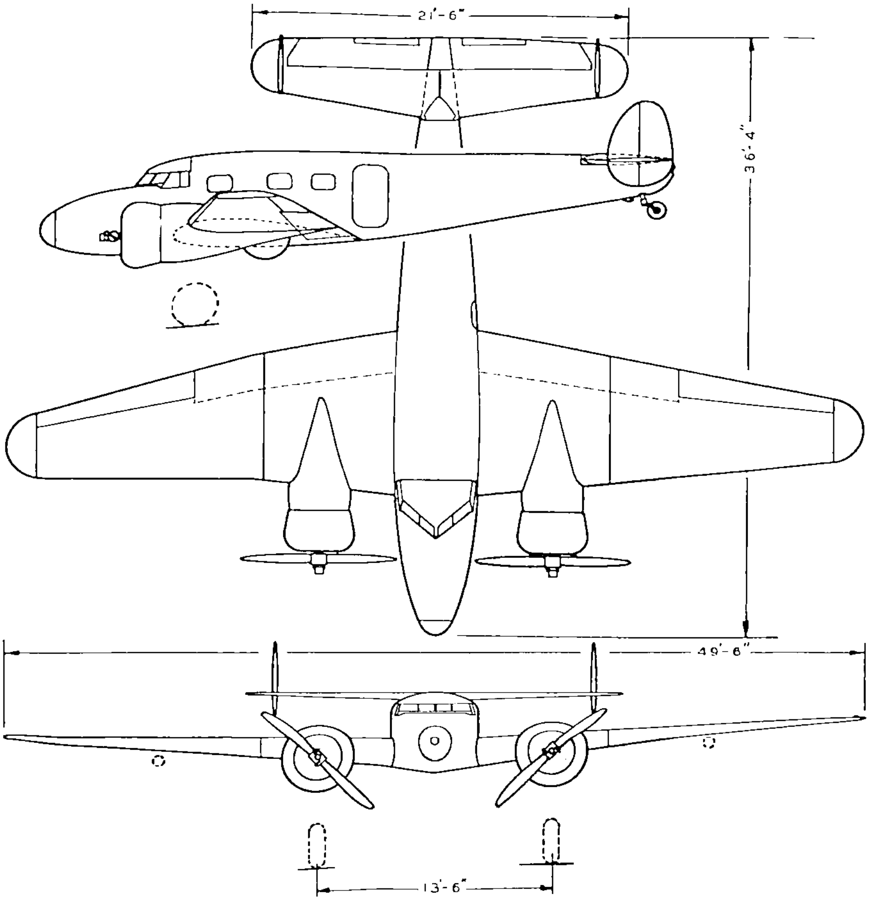
KELLETT AUTOGIRO

This is model KD-1 wingless, direct control. It is powered by a 225 h.p. Jacobs engine.

The flaps also permit shorter take-offs with steeper climb after take-off for clearance of obstacles. This increase in lift is not accompanied, as in the case of the split flap, with so large an increase in drag. This further facilitates their use for take-offs. With the Fowler flap, it is possible to carry a much larger load for a given wing area than with the split type of flap. With present day low power loadings, take-off distance, not flight, becomes the critical factor governing wing loading.

Controllable by the pilot, these flaps may be extended any desired amount up to 45 degrees inflection, and locked in place.

"The 14 is designed to accommodate any of the commercial radial engines up to 1,000 h.p., and is normally supplied with either the Pratt & Whitney Hornet S1EG or the Wright Cyclone G-3. This engine installation is the result of years of experience and research, and represents the ultimate in reliability, accessibility and ease of maintenance. The landing gear of the 14 consists of 15x16 Goodyear Air-



LOCKHEED 12

An eight-place, twin-engine transport with a choice in power plants including Wright Whirlwinds, Pratt & Whitney Wasp Juniors and Menascos.

wheels mounted on cantilever stub axles. These stub axles are rigidly supported at their inboard ends by means of semi-cantilever oleo-pneumatic shock absorbing struts having a 10-inch travel. These struts are mounted at their upper ends in welded steel plate yokes and braced against side loads by two relatively short chromo molybdenum tubes. Retraction is effected by means of a drag strut, which breaks upward in the middle and is operated by a pin-supported hydraulic cylinder. Both drag strut and hydraulic cylinder are mounted at their upper ends on the main wing spar. Ball and roller bearings are used throughout the landing gear to eliminate excessive friction and wear.

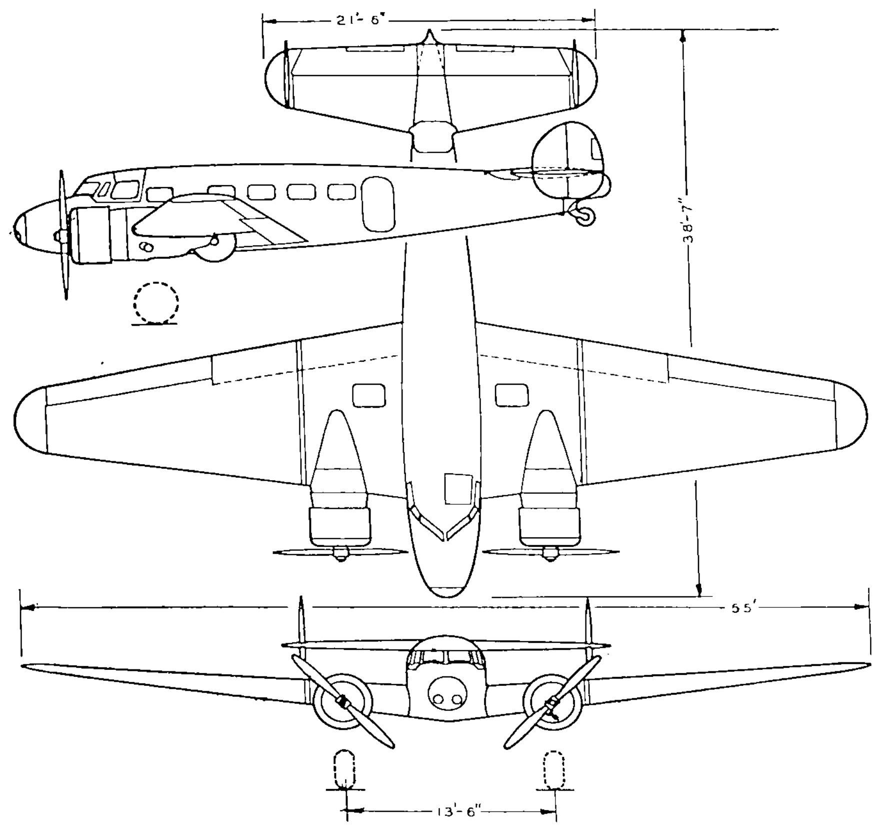
AIR BRAKES FOR AIRPLANES

The Lockheed 14 transport showing Fowler flaps, "air brakes," extended.

The gear is designed so that it will lower by its own weight. Pads are provided to receive the oleo struts in the retracted position and have sufficient strength to withstand an emergency landing with wheels fully retracted."

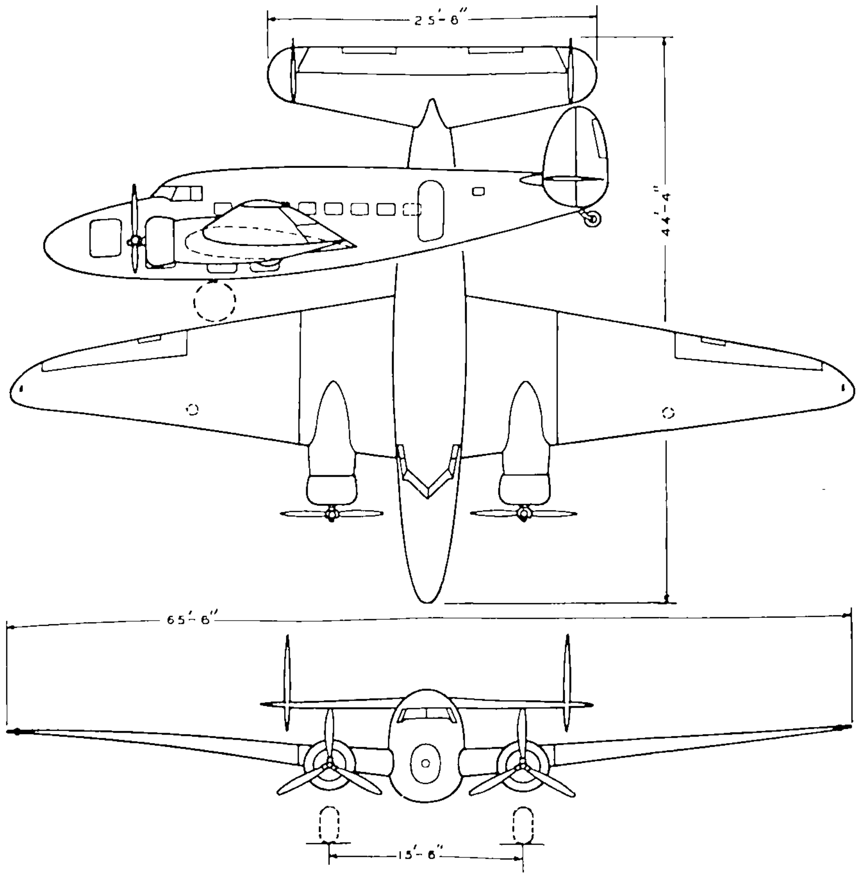
Specifications of the Lockheed 14 included: Length 44 feet 3⅞ inches; wing span 65 feet six inches; height overall 11 feet 5½ inches; wing area with ailerons and fuselage 551 square feet; fuselage, wing and tail all metal; passenger cabin 65½ inches wide, six feet three inches high and 19 feet long; landing speed 65 to 68 m.p.h. with 15,000-17,000 pounds, high speed at sea level 229 m.p.h., at 6,700 feet, 249 m.p.h., cruising speed 224 m.p.h. at 12,000 feet.

Luscombe Airplane Corporation, West Trenton, N. J., continued production on its Phantom, a two-place, high-wing cabin monoplane. This ship incorporates all metal construction, full monocoque fuselage, using fabric covering, but metal structures, on the wing and movable tail surfaces. The Phantom weighs 1,300 pounds empty, gross weight 1,950 pounds with a useful load of 650 pounds; stated high speed of 160 m.p.h. with a Warner 145 h.p. engine, service ceiling 19,000 feet and range of 650 miles, landing speed 45 m.p.h., and cruising speed of 140 m.p.h. The company produced a smaller ship similar to the Phantom in construction, a two-place high-wing all metal cabin monoplane, with a light weight of 1,100 pounds and a use-



LOCKHEED ELECTRA

A 12-place, twin-engine transport, powered with either two Pratt & Whitney Wasp engines or two Wright Whirlwinds.

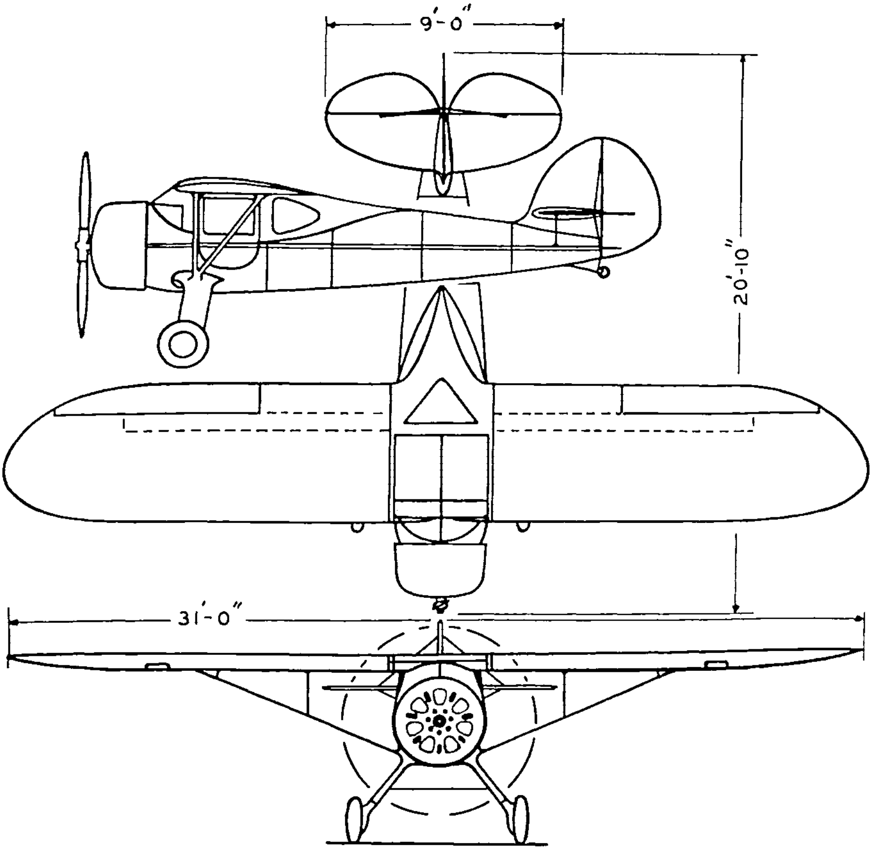


LOCKHEED 14

This 14-passenger transport is powered with either two Pratt & Whitney Hornets or two Wright Cyclone engines.

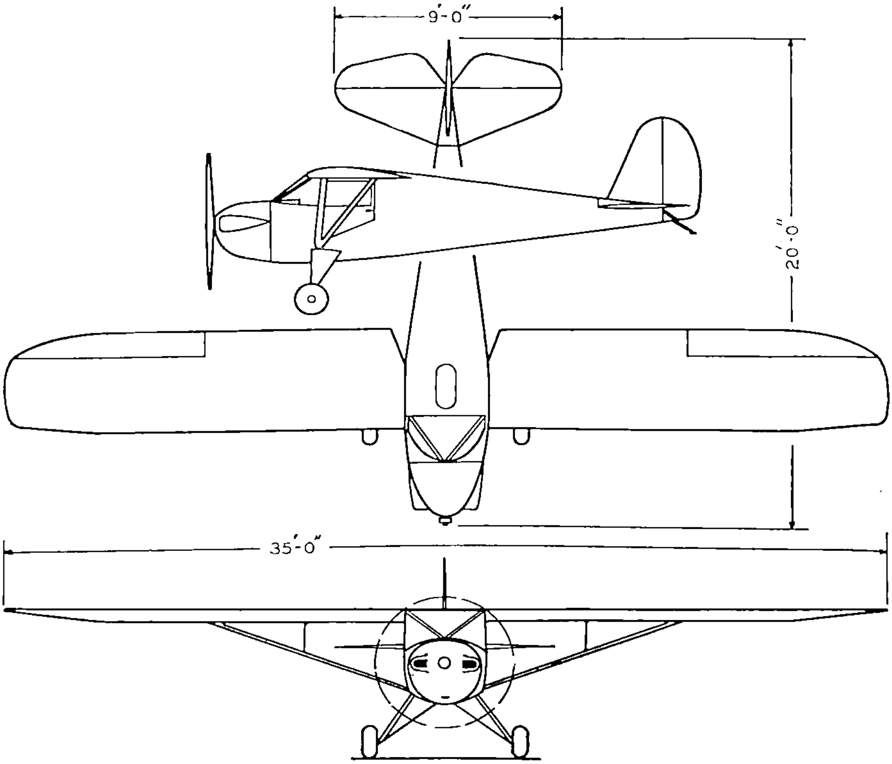
ful load of 625 pounds, stated top speed of 136 m.p.h. powered with the Warner 90 h.p. engine, and a 700 mile cruising range.

The Glenn L. Martin Company, Baltimore, Md., at the beginning of 1938 was designing giant ocean flying boats vastly larger than any under construction. The projected ships were reported to provide luxuries such as observation decks, bars and lounge rooms, and to be capable of carrying passengers, mail and express between the United States and Europe on non-stop schedules. The ability of this company to design and build any ocean craft that it might conceive was evidenced by its record, first with the three flying boats used by Pan American Airways in its fast Clipper service on the Pacific; and more recently construction of a 62,000 pound flying boat Model 156, completed late in 1937. The specifications of the Glenn L. Martin ocean transport 156 are as follows: Length, 91 feet, 10 inches; wing span, 157 feet; wing area including ailerons, 2,290 square feet; gross weight 63,000 pounds, weight empty, 29,231 pounds, disposable load 32,586 pounds, payload 10,000 pounds, including 18 passengers with sleeping accommodations, 540 pounds of baggage and 6,400 pounds of mail and express. The ship was reported to have a high speed of 190



LUSCOMBE PHANTOM

A two-place plane for the private flier powered with a Warner 145 h.p. engine.



LUSCOMBE 50

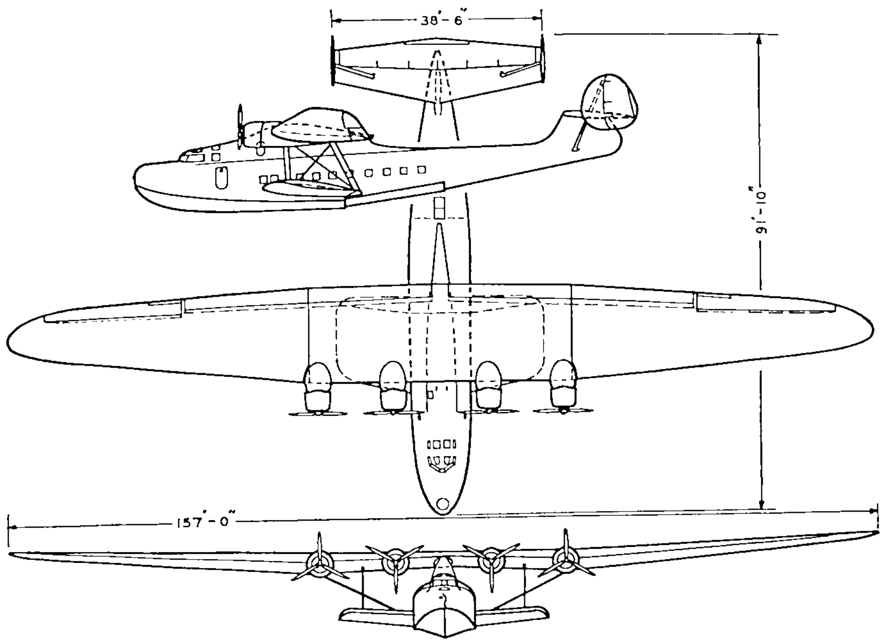
A two-place plane powered with a Continental 50 h.p. engine.

m.p.h. at 5,800 feet and an economical cruising speed of 140 to 156 m.p.h., and to be able to maintain level flight at 8,000 feet on the normal power of three of its four engines.

The Glenn L. Martin Company was also in production on foreign orders for numbers of the Martin bomber 139-W2, a twin-engine low-wing monoplane powered by two Wright Cyclone engines, with a service ceiling of 26,000 feet, high speed of 235 m.p.h. at critical altitude, normal useful load of 5,268 pounds with 2,641 pounds of armament, gross weight 14,995 pounds. The company was engaged in expanding plant facilities, including a huge assembly building 450 feet long, 300 feet wide and with 40 feet clearance under the craneways, all without posts or columns obstructing the floor area, thus permitting assembly of aircraft many times larger than the Martin-built China Clipper types. The company also had a new bomber for export—Model 166.

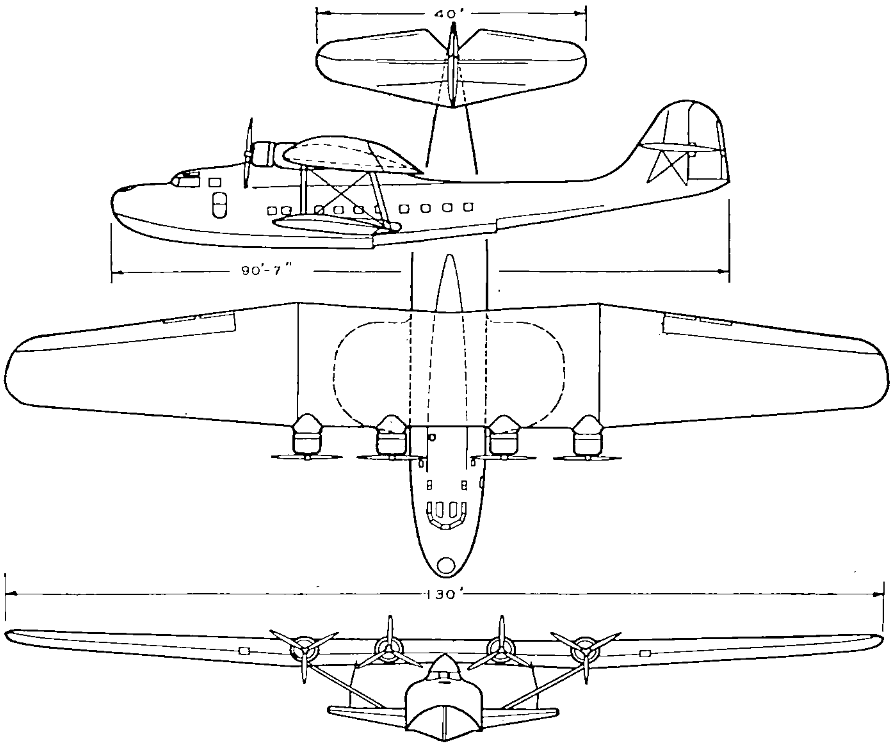
Monocoupe Corporation, Robertson, Mo., reported 1937 the best sales year in its history, with four models in production—the De Luxe Monocoupe, Monosport, Monoprep and twin-engine Monocoach. The De Luxe Monocoupe model 90A, was powered with the Lambert 90 h.p. engine and had a stated cruising speed of 110 m.p.h. 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 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 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 1938.

North American Aviation's manufacturing division at Inglewood, Calif., produced for the Army and Navy air forces a total of 248 BT-9



MARTIN 156

A Wright Cyclone-powered four-engine flying boat with sleeping accommodations for 18 passengers.



MARTIN 130

A 50-place commercial flying boat powered with four Pratt & Whitney Twin Wasps.

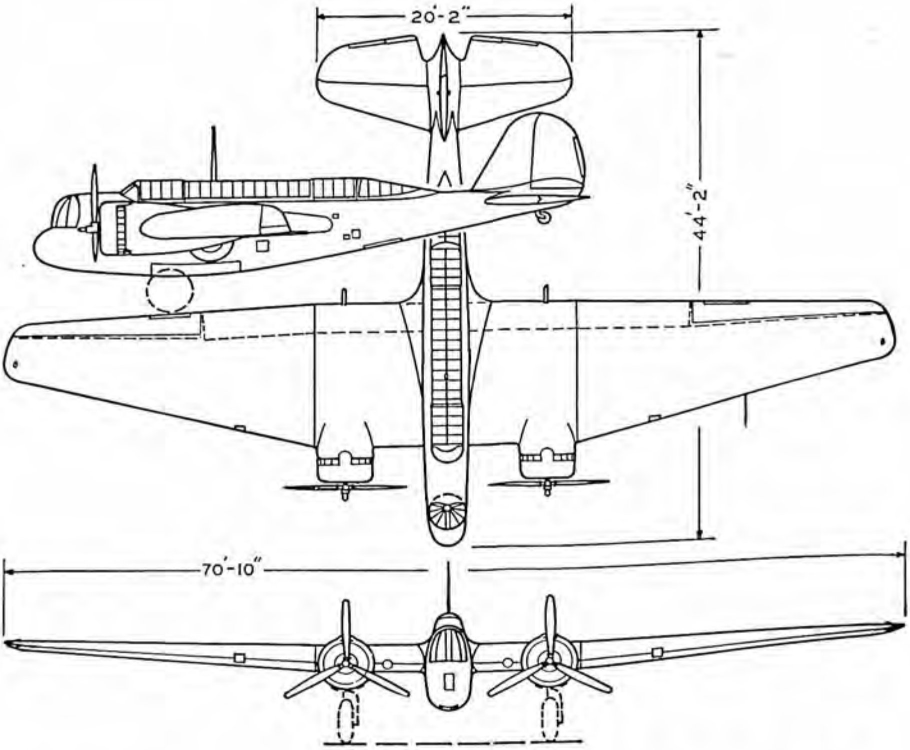
basic trainers and was in production on an order of 169 three-place observation planes, O47-A, and 200 basic combat planes for the Army Air Corps. The BT-9 was a two-seater monoplane, with enclosed tandem cockpits and was powered by a 400 h.p. Wright Whirlwind engine, high speed 171 m.p.h., service ceiling 19,250 feet. The NA-16 general purpose plane was basically the same as the BT-9, and 37 of these planes were sold to Australia, Argentina and Sweden in 1937.

License rights to build the NA-16 were sold to Sweden and Australia, Sweden building 35 and Australia building 40 for their respective air forces.

The North American O47-A is a three-place mid-wing monoplane with observer's station in the belly of the fuselage, this machine being the first of the type designed especially for the observer. The O47-A has a wing area of 349 sq. ft. It is powered by an 850 h.p. Wright

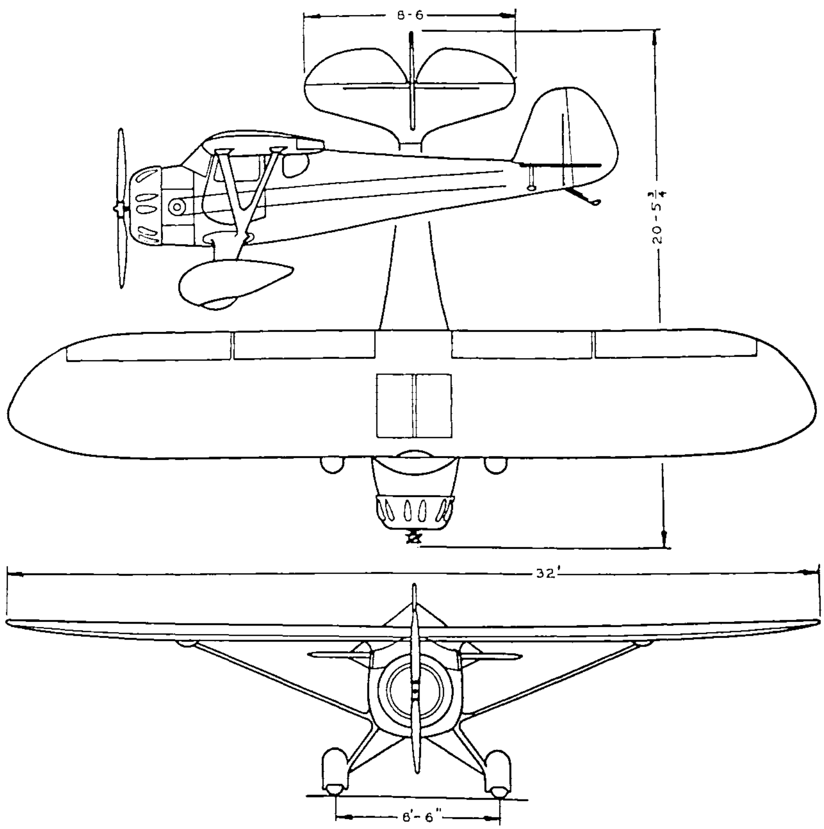
THE MONOCOACH

A four-place cabin ship powered by two 90 h.p. Lambert engines.



MARTIN 166

This bomber carries a crew of four, and may be powered with two Wright Cyclones of 850 h.p. each, or two Pratt & Whitney Wasps of 1050 h.p. each.

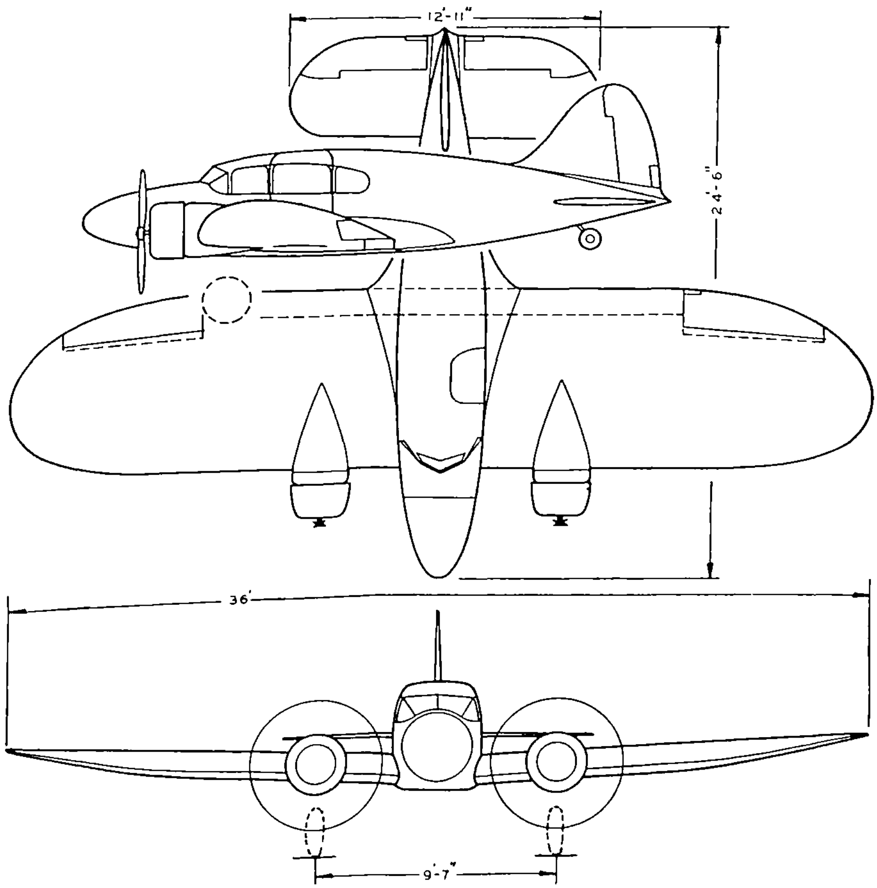


MONOCOUPE

This deluxe two-place cabin plane built by the Monocoupe Corporation is powered with a Lambert R-266, 90 h.p. engine.

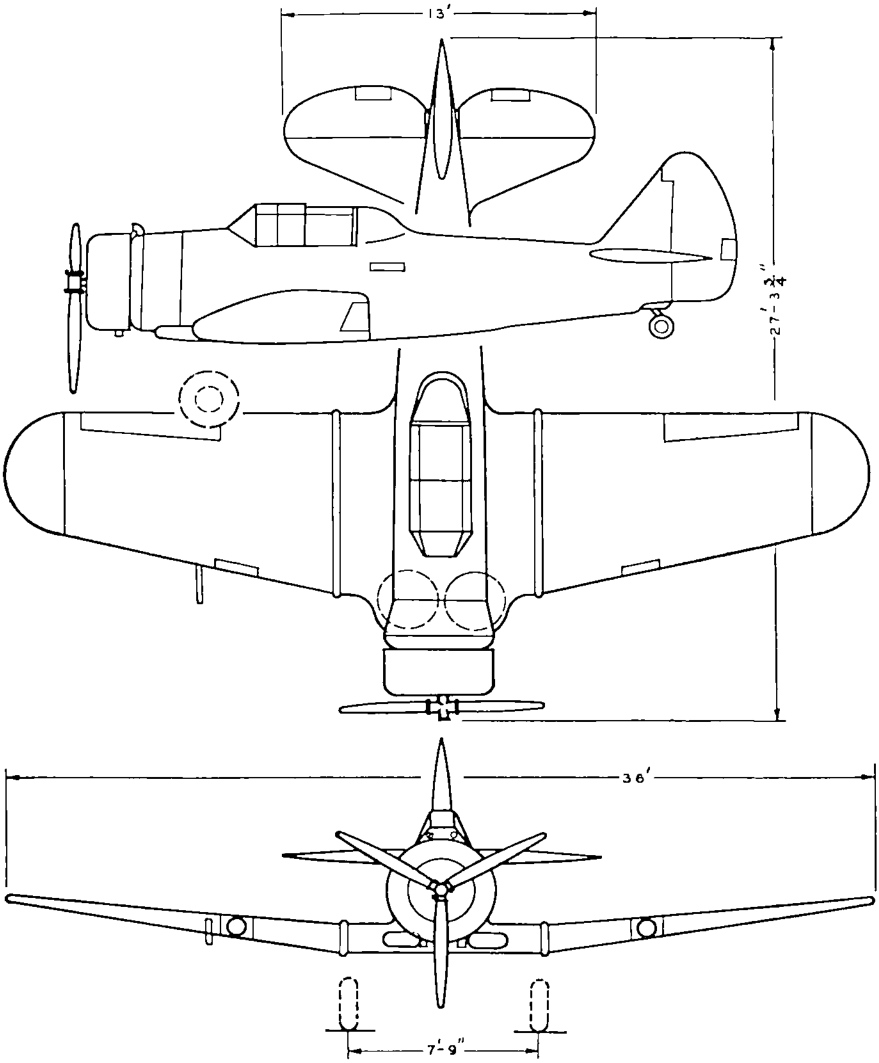
Cyclone engine. The company increased its factory floor area to 380,000 sq. ft. in 1938.

The Northrop Corporation at Inglewood, Calif., became a wholly-owned subsidiary of the Douglas Aircraft Company on August 31, 1937, and was reorganized as the Northrop Division. Northrop's schedule for 1938 included these non-confidential projects: Completion of 54 BT-1 dive bombers for the Navy, 29 A-17A attack planes for the Army, 30 8A-2 attack planes for the Argentine Government and one 8A-1 attack plane for Sweden. A total of 100 A-17A attack planes was delivered to the Army Air Corps in 1937, also the first of the BT-1 dive bombers for the Navy. An experimental model, 2-L, was delivered to the Bristol Aeroplane Company of England for use in testing a new Bristol Hercules engine. This engine had a rated horsepower of 1,375, and the 2-L was a two-place plane, with 363 sq. ft. of wing area, gross weight 8,315 pounds, payload 1,160 pounds, stated high speed 270 m.p.h. and cruising 230 m.p.h. The Northrop A-17A was a two-place monoplane with 363 sq. ft. of wing area, 7,550 pounds gross weight, 1,219 pounds payload, high speed 216 m.p.h., cruising at 204 m.p.h., powered by a Pratt & Whitney 750 h.p. Wasp engine. The 8A-2, with same wing area, was powered by a Wright



MONOCOACH

Built by the Monocoupe Corporation, this twin-engine, Lambert-powered deluxe cabin plane for the private owner carries four.

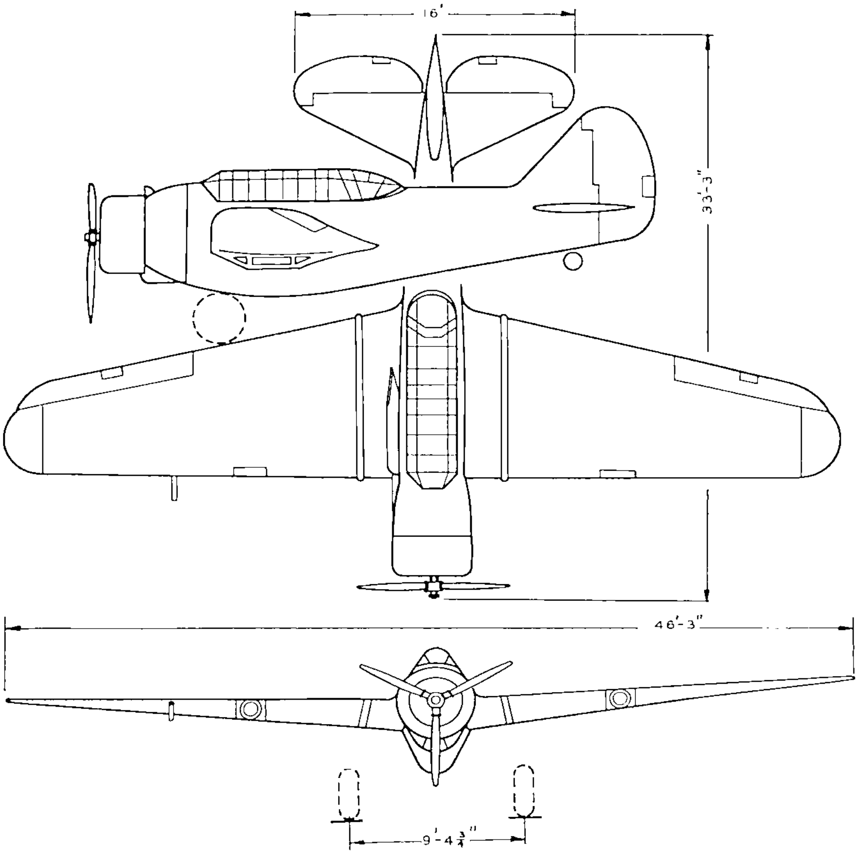


NORTH AMERICAN PURSUIT

This single-seat version of the NA-16 is powered with a Wright G Cyclone engine.

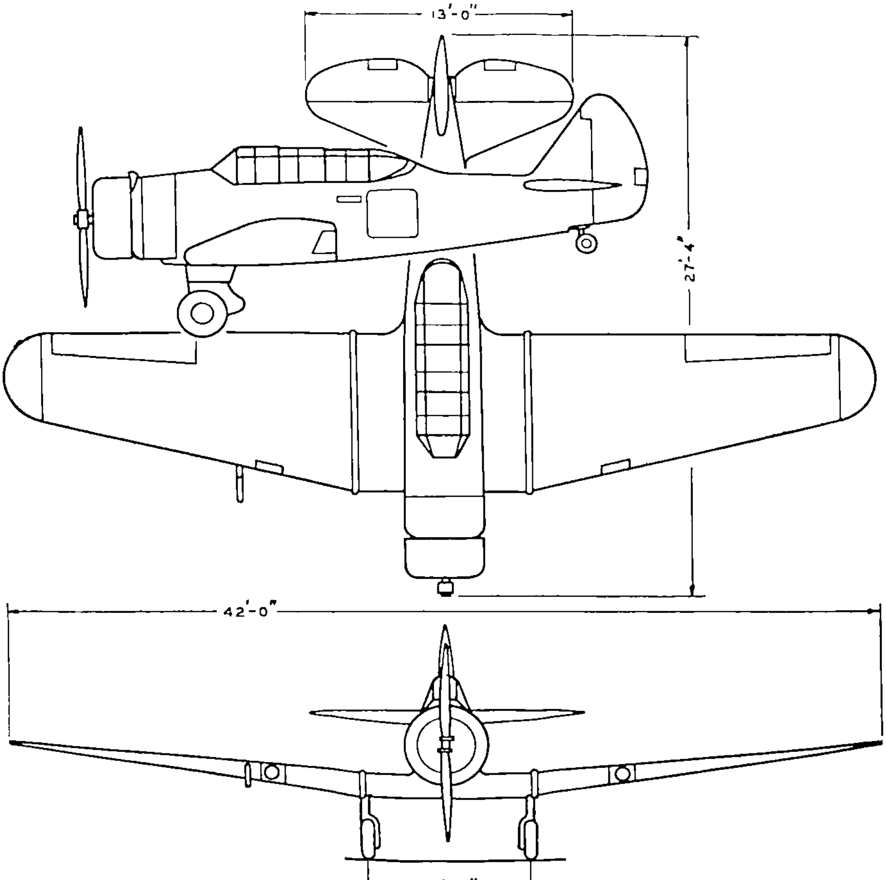
840 h.p. Cyclone engine, had a gross weight of 7,500 pounds, payload 1,425 pounds and high speed of 217 m.p.h., cruising at 188 m.p.h.

Piper Aircraft Corporation, Lock Haven, Pa., produced its Cub airplane, claiming that the development of the Cub had done much to increase interest in flying and had played a material part in the issuance of an increased number of Student Pilot permits during 1937. One of the most significant developments in the merchandizing of light airplanes was engineered by the Piper Aircraft Corporation in the introduction of a successful finance plan with interest rates comparable to those charged for the time purchase of an automobile. The Cub is a two-place tandem monoplane with conversion features making it possible to use the airplane either as a closed or open model. Designed primarily for student instruction and the private pilot, the Cub has a



NORTH AMERICAN O-47

A three-place U. S. Air Corps observation plane.

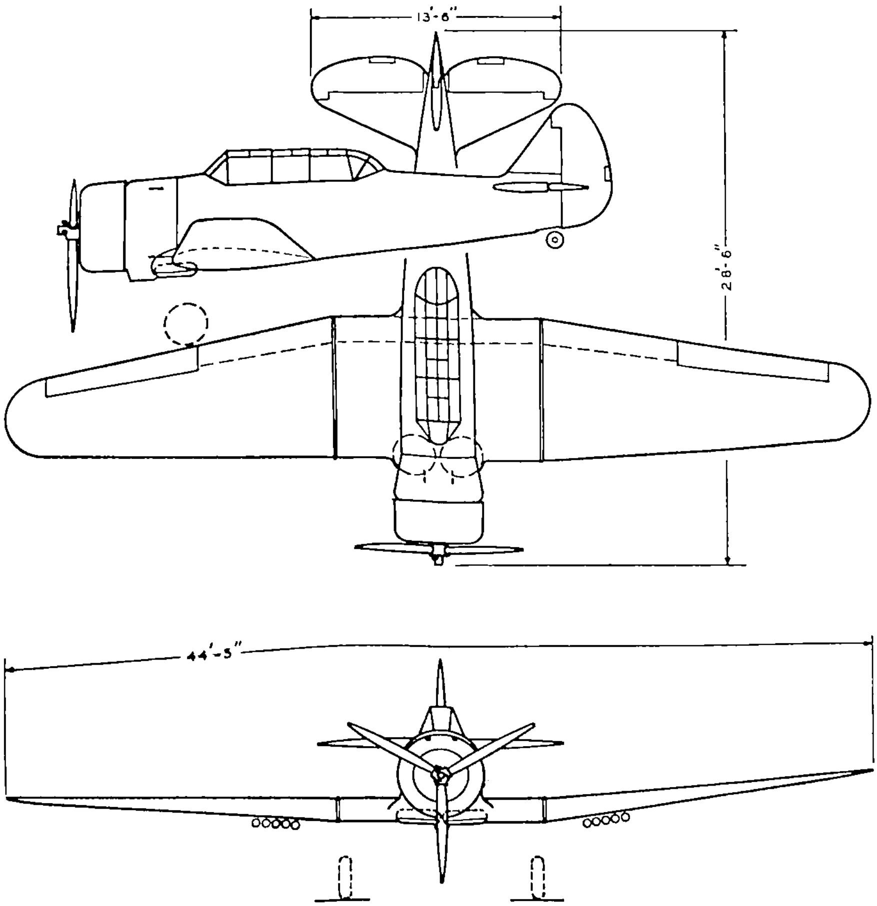


NORTH AMERICAN BT9

An Army Air Corps two-place trainer, powered with a Wright Whirlwind 400 h.p. engine.

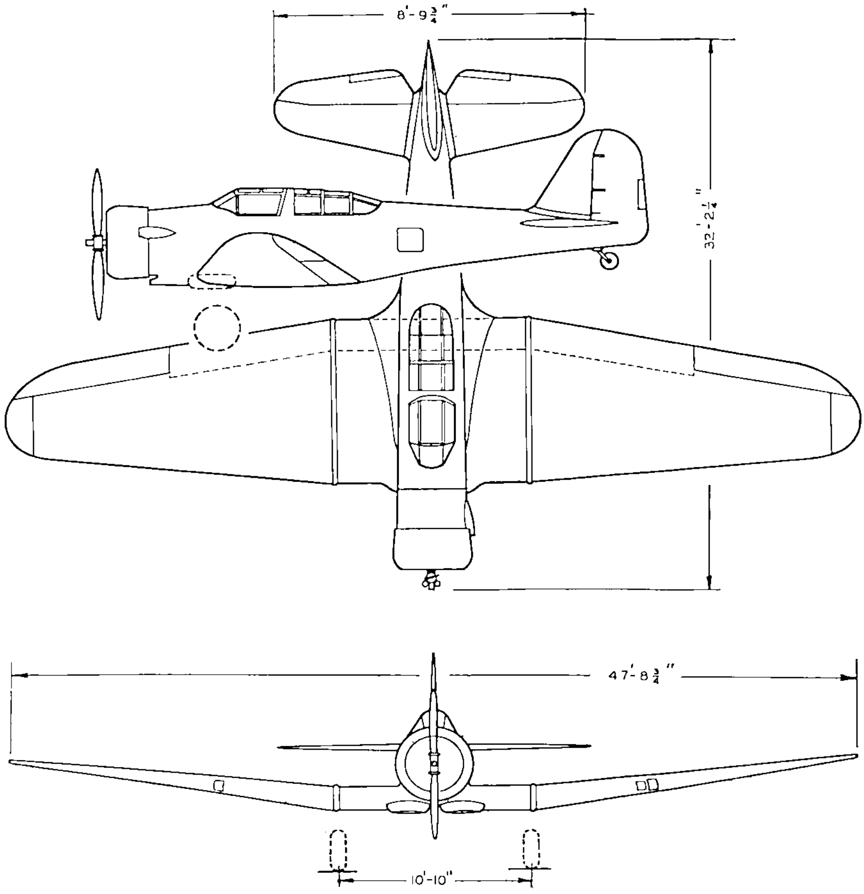
cruising speed of 72 m.p.h., top speed of 85 m.p.h. and a landing speed of less than 30 m.p.h. The ship is available with either the dual or single ignition models of the Continental 40 h.p. four-cylinder motor. The introduction of the Cub seaplane in 1937 spurred on an interest in over-water flying, with more than 30 Cub seaplanes being delivered in the spring and summer months. A thorough metallizing process recently developed prevents rust in salt water operations. Change over from wheels to floats requires no special alterations.

Foreign shipments of the Cub were leaving the new factory at Lock Haven at a rate of more than two a week. With an established agency representation in 40 foreign countries, more than 100 Cubs were in active service throughout the world. An assembly plant in Hamilton, Ontario, was preparing three Cubs a week for the Canadian market. With the largest back log of orders ever on file, the company moved into its new plant at Lock Haven, with a floor space of more than 110,000 square feet. Introduction of straight line production methods made it possible to improve efficiency of manufacture. In the fall of



NORTH AMERICAN NA-16-1G

A two-place Wright Cyclone-powered observation-attack plane.



NORTHROP A-17

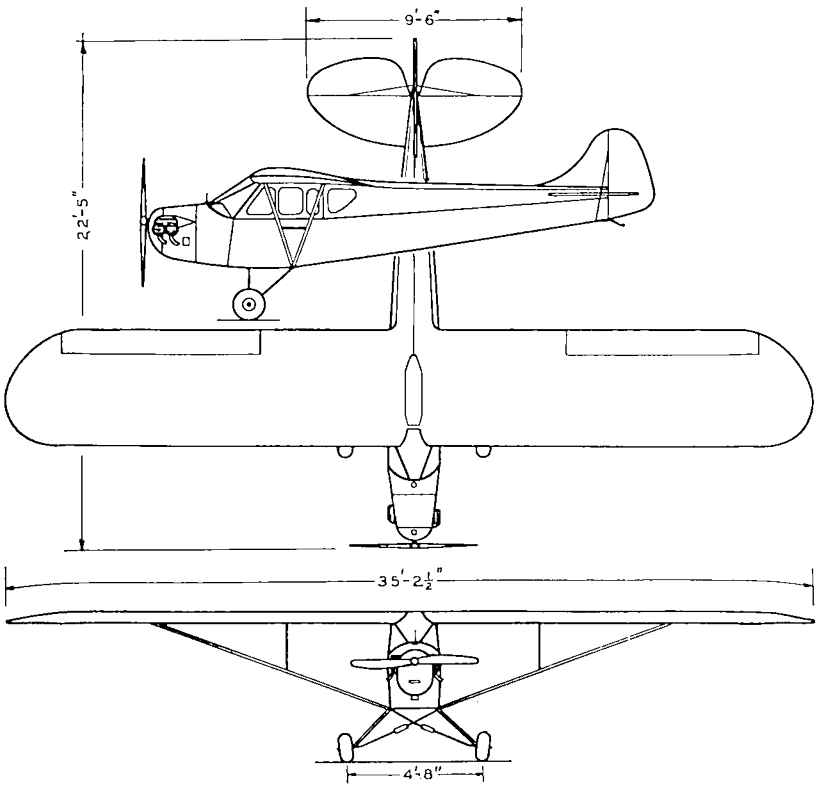
Two-place U. S. Air Corps attack plane powered with Pratt & Whitney Twin Wasp Junior 550 h.p. engine.

1937, Cubs were leaving the factory at a rate of 30 a week. Ultimate capacity is 100 a week. As rapidly as new machinery can be installed and workers trained, officials of the company state, production will be increased steadily to care for the demand.

A new model Cub, J-3, was introduced in the fall of 1937. Although bearing the same general lines of the J-2, the J-3 has many detailed improvements and refinements throughout its entire design. More comfortable seats of full width, with complete upholstery in the cabin, concealment of all control wires from the interior, general improvement of stabilizer and control mechanisms are featured in the new model.

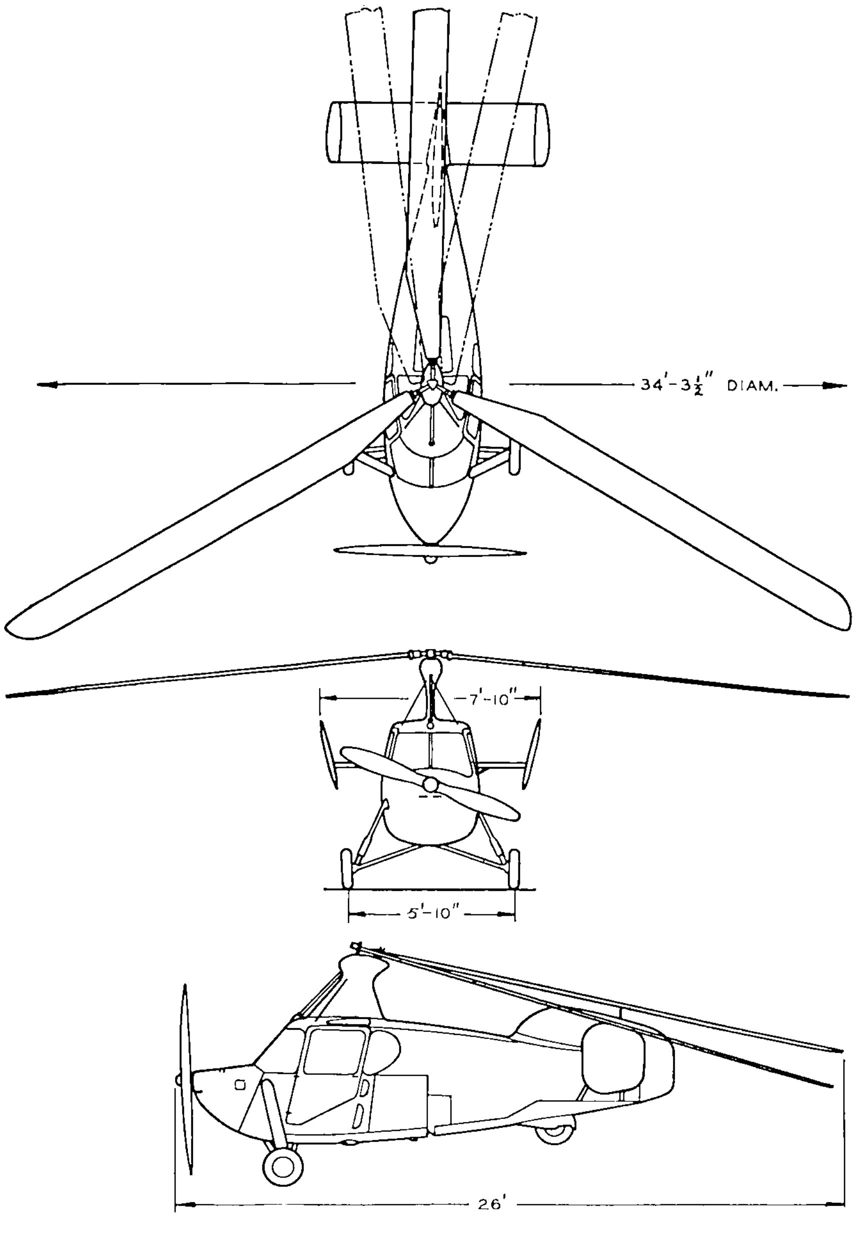
Porterfield Aircraft Corporation, Kansas City, Mo., produced three models: the Zephyr, a two-place high-wing monoplane, wing span 34 feet eight inches, length 21 feet six inches, top speed 85 m.p.h., cruising speed 75 m.p.h., range 250 miles, powered by a 40 h.p. Continental motor; the Porterfield 70, with LeBlond engine, top speed of 115 m.p.h., cruising speed 105 m.p.h., range 360 miles; the Porterfield 90 with Warner engine, top speed of 121 m.p.h., cruising at 112 m.p.h., range 336 miles.

The company reported an export business extending to 14 coun-



PIPER CUB J-2 AND J-3

A Continental-powered two-place plane for the private owner manufactured by the Piper Aircraft Corporation, Lock Haven, Pa. This model is also available as a seaplane.



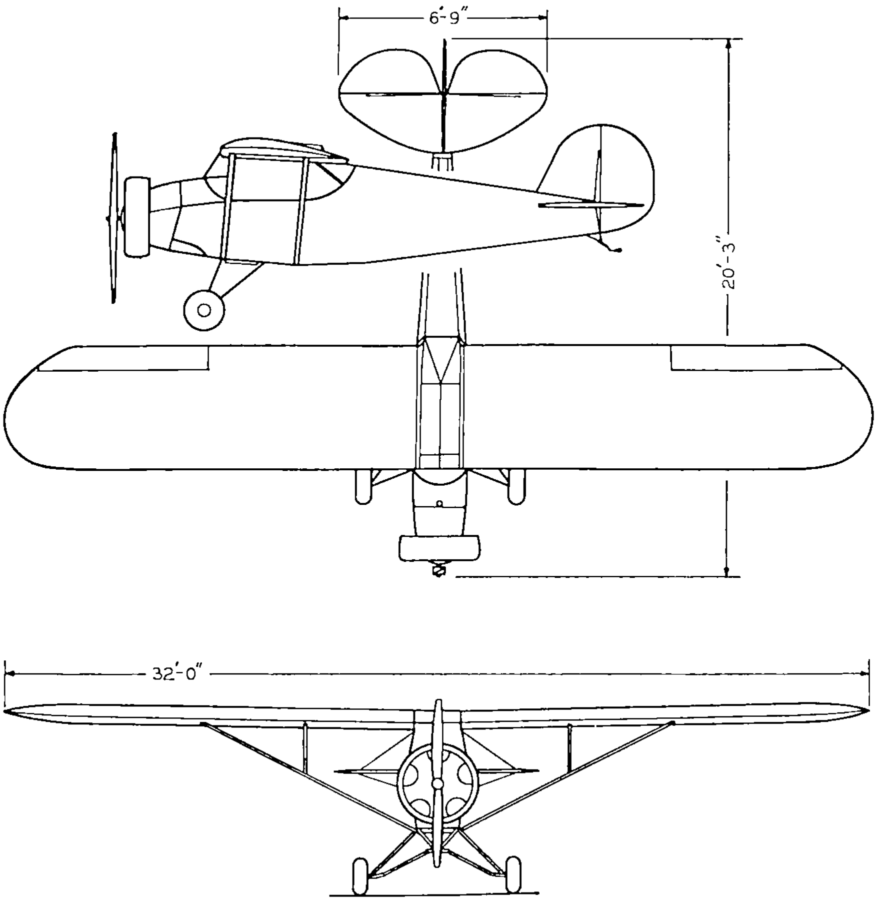
PITCAIRN ROADABLE AUTOGIRO

A two-place cabin autogiro for private operations with 90 h.p. engine.

tries and a backlog of orders promising excellent sales volume in 1938.

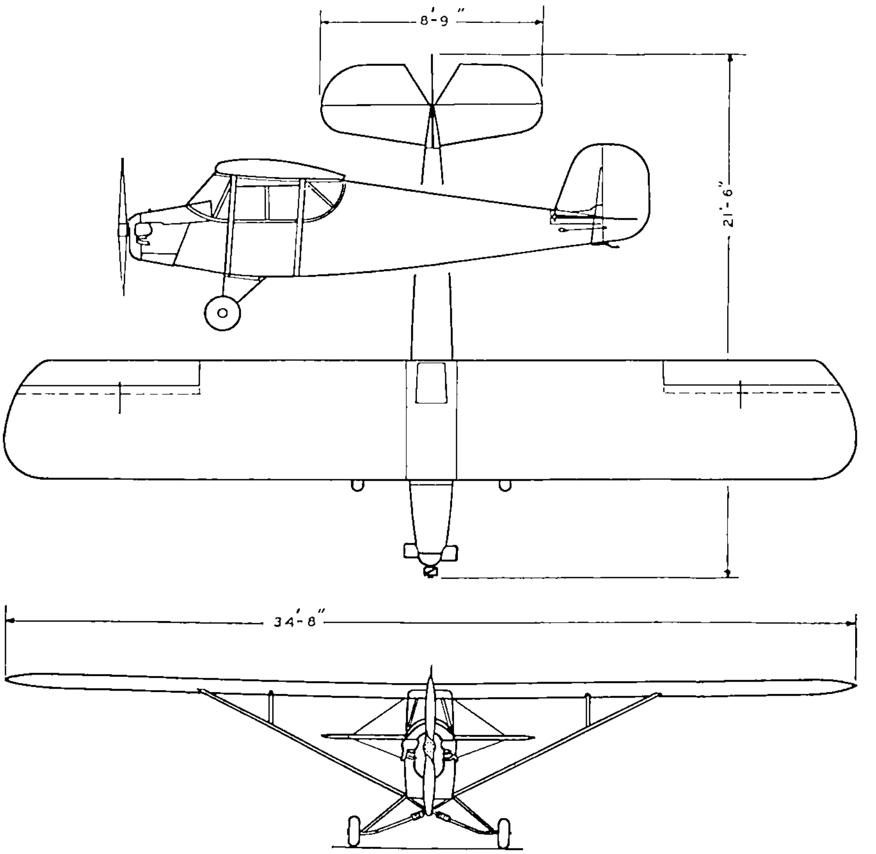
Rearwin Airplanes, Kansas City, Mo., produced the Sportster 7,000 with 70 h.p. LeBlond, the 8,500 with 85 h.p. LeBlond, or the 9,000 with 90 h.p. Warner engine. It has a wing span of 35 feet, length 22.3 feet, stated speed of 98 m.p.h., cruising range 475 miles. The Rearwin Speedster with 125 h.p. Menasco had a wing span of 32 feet and a stated speed of 130 m.p.h. cruising.

Another Speedster model was powered by a 150 h.p. supercharged Menasco engine. The company shipped planes to South Africa, Ar-



PORTERFIELD 90

A private plane for two, powered with a Warner Scarab Junior engine.



PORTERFIELD ZEPHYR

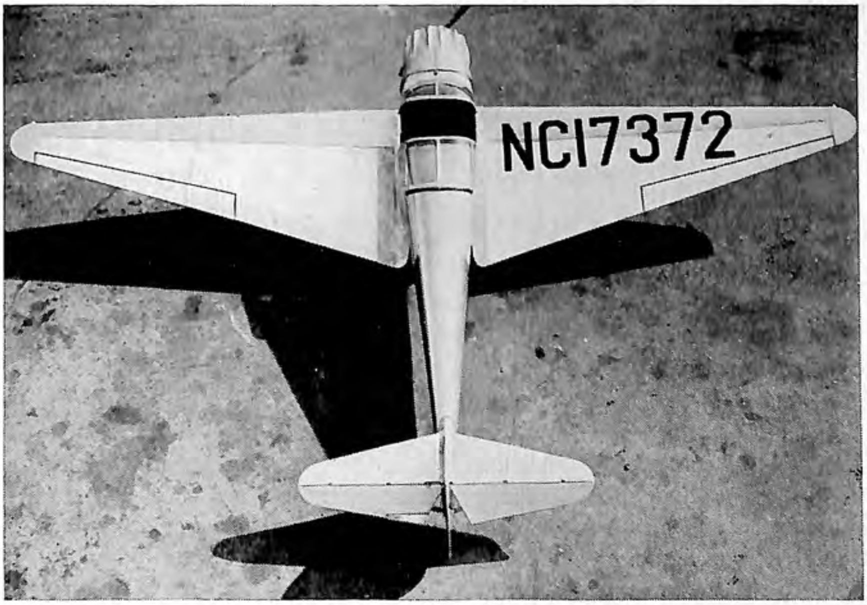
A Continental-powered two-place plane for the private flier.

gentina and Peru, and announced an increase in domestic orders.

The Ryan Aeronautical Company, San Diego, Calif., had in production three models of the metal-fuselaged Ryan sport trainer and was beginning production on a new three-place, low-wing metal cabin ship, the S-C, with either a Menasco 150 h.p. in-line supercharged engine, or a 145 h.p. radial Warner engine. Three models of the S-T sport trainer series were available, all being manufactured under Approved Type Certificates. The essential difference in these models was the horsepower of the Menasco engine, as the plane could be equipped with the Menasco 95, 125 or 150 h.p. supercharged engine. The Ryan S-T series are low-wing open cockpit sport trainers with two seats in tandem. The fuselage is of monocoque construction and

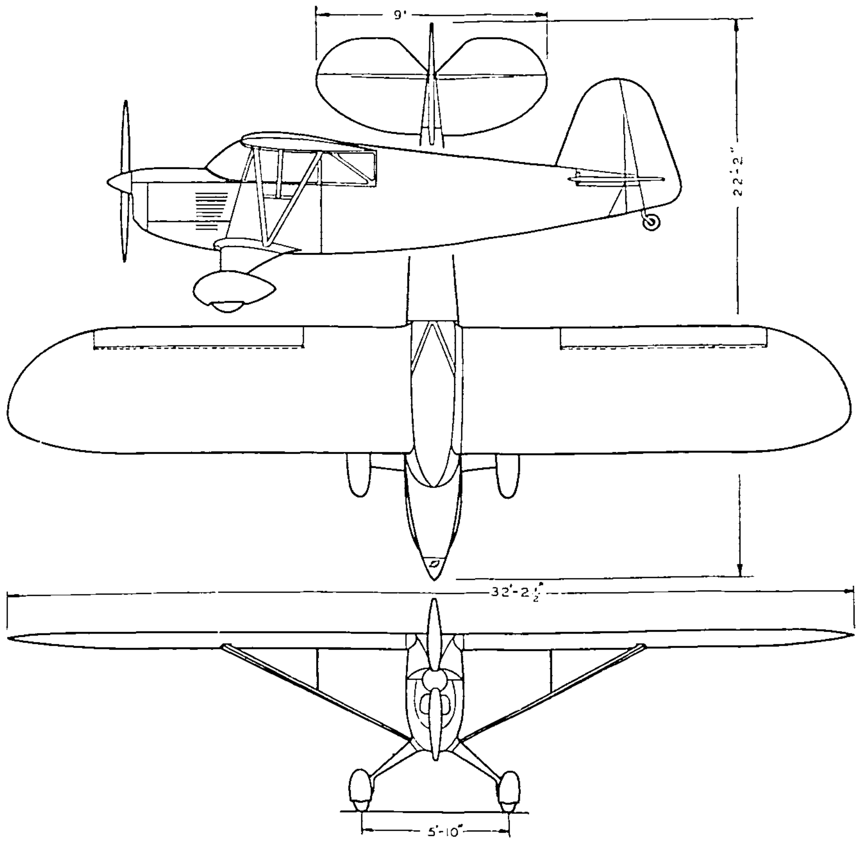
THE REARWIN SPEEDSTER

A two-place cabin monoplane powered by a 125 h.p. Menasco engine.



TOP VIEW OF THE RYAN S-C

Showing the sliding flexible glass hatch open for entrance and the sharply-tapered full cantilever metal-structured wing.

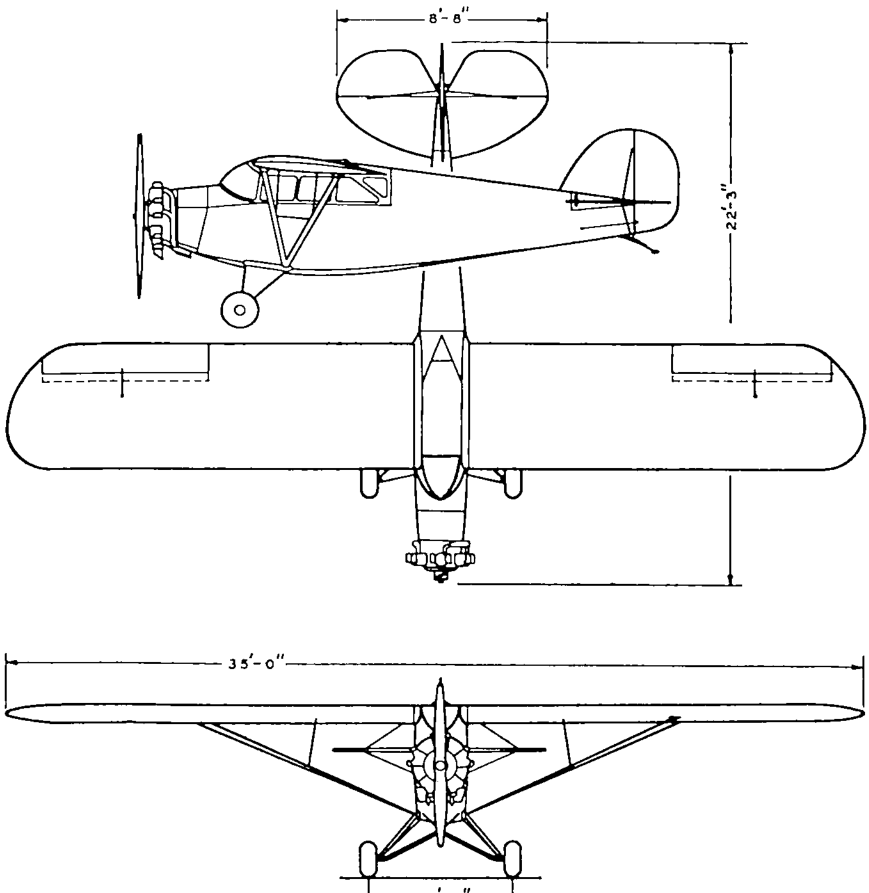


REARWIN SPEEDSTER

A two-place sport plane, Menasco-powered.

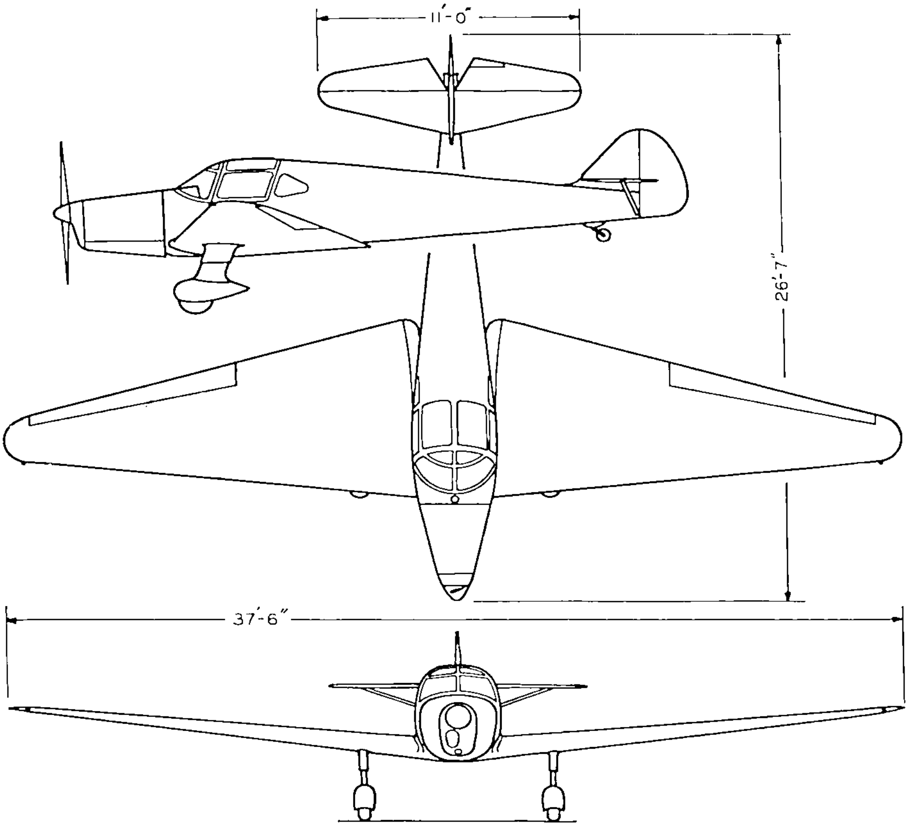
is metal throughout with 24 ST Alclad sheets over rugged rings. Wing construction features aluminum alloy ribs, steel compression members and spruce spars. Wing covering is of fabric with the leading edge sheathed in metal as far back as the front spar to preserve the true air foil. Other features of the ship are its steerable tail wheel, landing flaps, dual controls, dual brakes, and auxiliary gas tank. Control surfaces are of aluminum alloy structure with fabric covering. Trimming tabs are standard. Landing gear is of the wide treadle type with full air wheels and aluminum alloy pants. The stated high speed was 140 to 160 m.p.h., cruising speed 120 to 135 m.p.h., range 350 to 400 miles. Performance of the S-C was reported as follows: Top speed, 152 m.p.h. at 3,000 feet, cruising at 140 m.p.h., range 520 miles. Ryan planes were exported to Mexico, South Africa, Brazil, Venezuela and Australia.

Seversky Aircraft Corporation, Farmingdale, N. Y., late in 1937 was in production on an order for 85 single-seat Army Air Corps pursuit planes. The company had a contract with the Soviet Russian Government for two amphibions besides licensing construction of that type in Russia. The U. S. Navy ordered an experimental fighter for carrier



REARWIN SPORTSTER

A plane for the private flier, LeBlond or Warner powered.



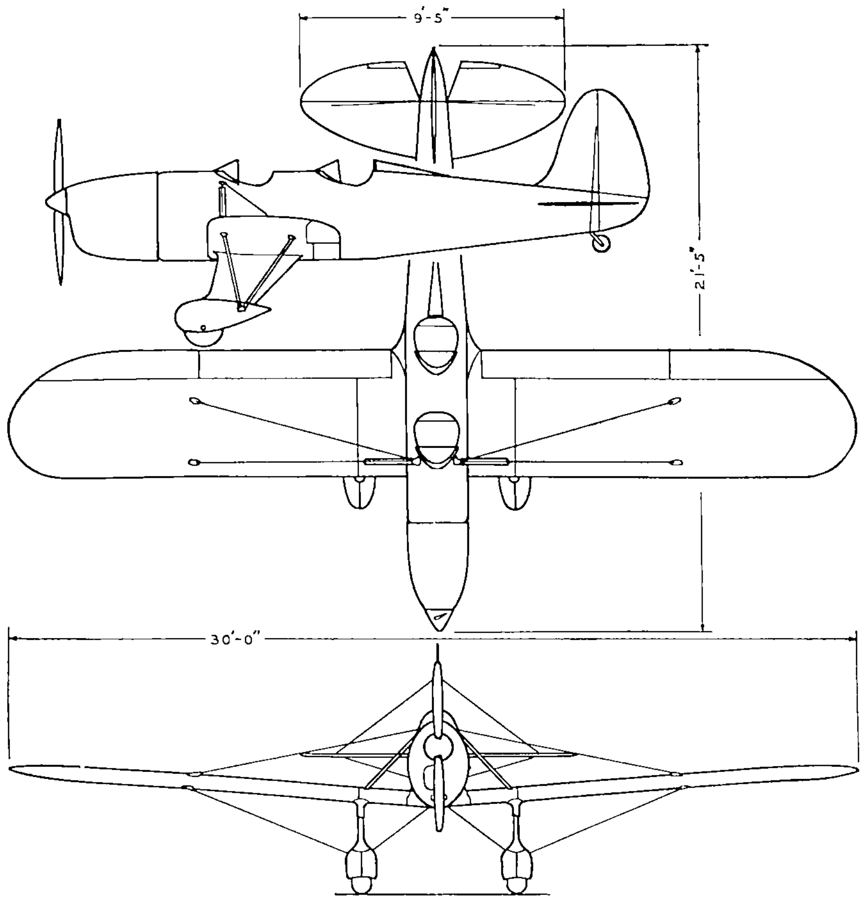
RYAN S-C

A Menasco-powered plane for the private owner that carries three. It is also available with a Warner engine.

use. Seversky also produced a two-seat convoy fighter for export, powered by a Wright Whirlwind and equipped with seven machine guns and 600 pounds of bombs. The Seversky Executive carried two passengers in a cabin behind the pilot's cockpit. In such a plane Frank W. Fuller, Jr., won the Bendix trophy race of 1937. The Executive was powered by a 1,200 h.p. Pratt & Whitney Twin Wasp engine, and had a stated top speed of 340 m.p.h. at 18,000 feet, cruising at 310 m.p.h., and range of 2,790 miles. It had a wing span of 36 feet, length 25½ feet, wing area 220 square feet, gross weight 6,753 pounds, weight empty 4,250 pounds and useful load 2,503 pounds.

Sikorsky Aircraft, Bridgeport, Conn., a division of the United Aircraft Corporation, delivered the last of an order of 10 S-42 type flying boats to Pan American Airways in June, 1937. The last ship, a Sikorsky S-42B, christened the Pan American Clipper III, carried out three round-trip survey flights over the North Atlantic during the summer of 1937. The other ships of this series remained in service in the Pacific, South American and Bermuda divisions of Pan American Airways.

Construction of S-43 amphibions was continued with both commercial and military deliveries. The S-43 was a Hornet-powered twin-engine amphibion with accommodations for 15 passengers and a crew



RYAN S-T
A two-place sport-trainer, Menasco-powered.

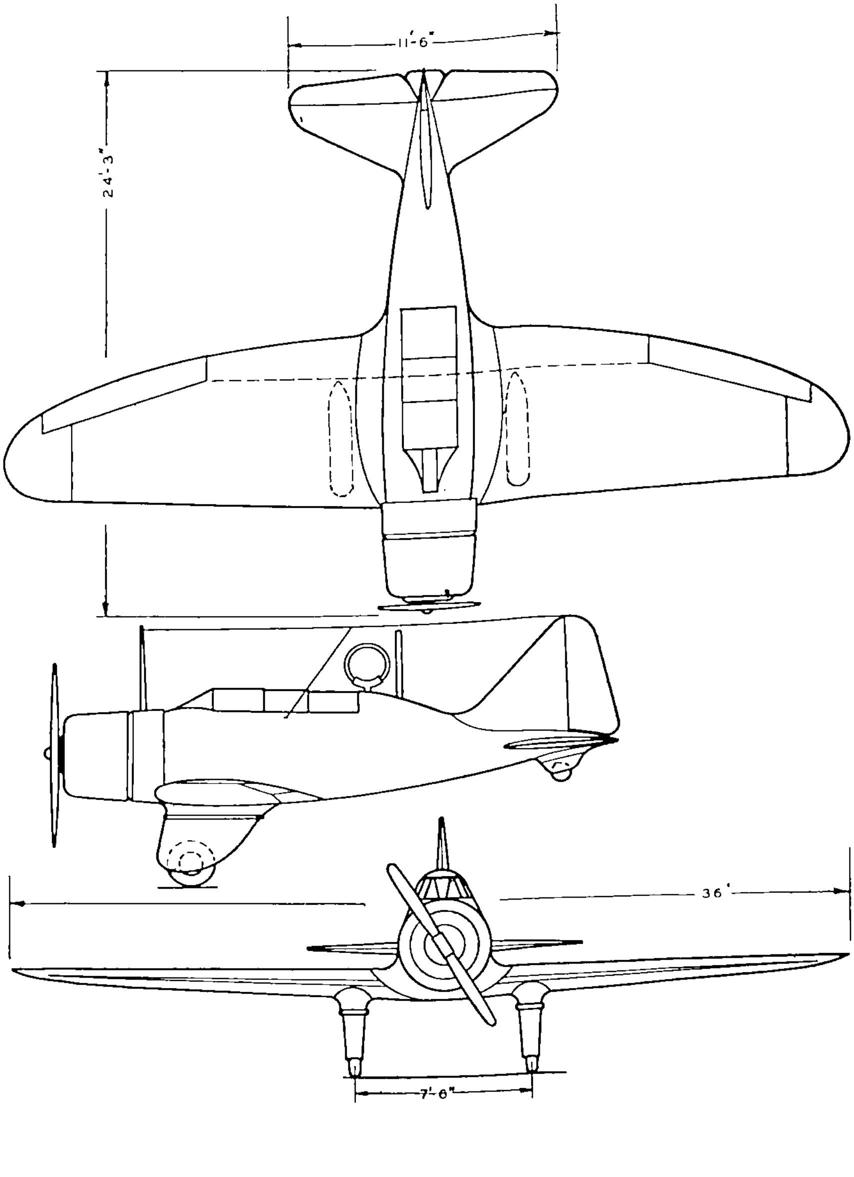
THE SEVERSKY CONVOY FIGHTER

This two-place monoplane is powered by a Wright Cyclone engine with Hamilton Standard constant speed propeller. It carries seven machine guns and 600 pounds of bombs.

Official U. S. Army Photo

AIR CORPS NORTHROP ATTACK A-17A

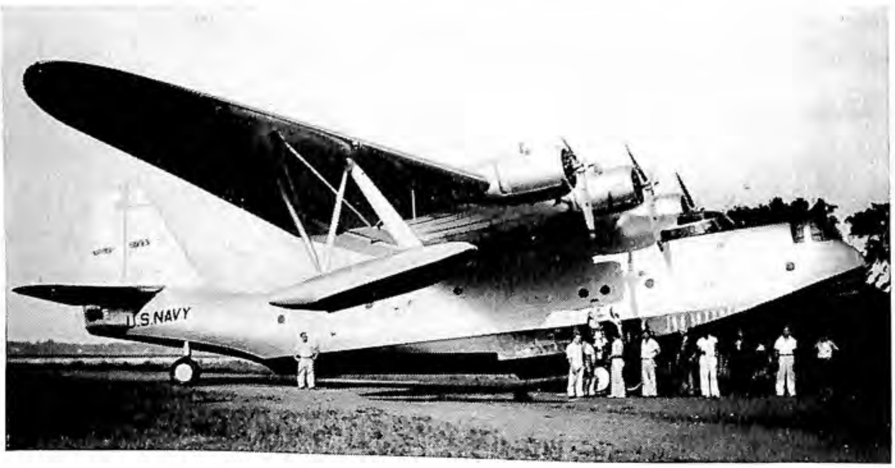
It is powered by a Pratt & Whitney Twin Wasp Junior engine.



SEVERSKY BT8

A two-place basic trainer powered by a Pratt & Whitney Wasp 450 h.p. engine.

THE PORTERFIELD ZEPHYR
It is powered by a Continental A-40 engine.



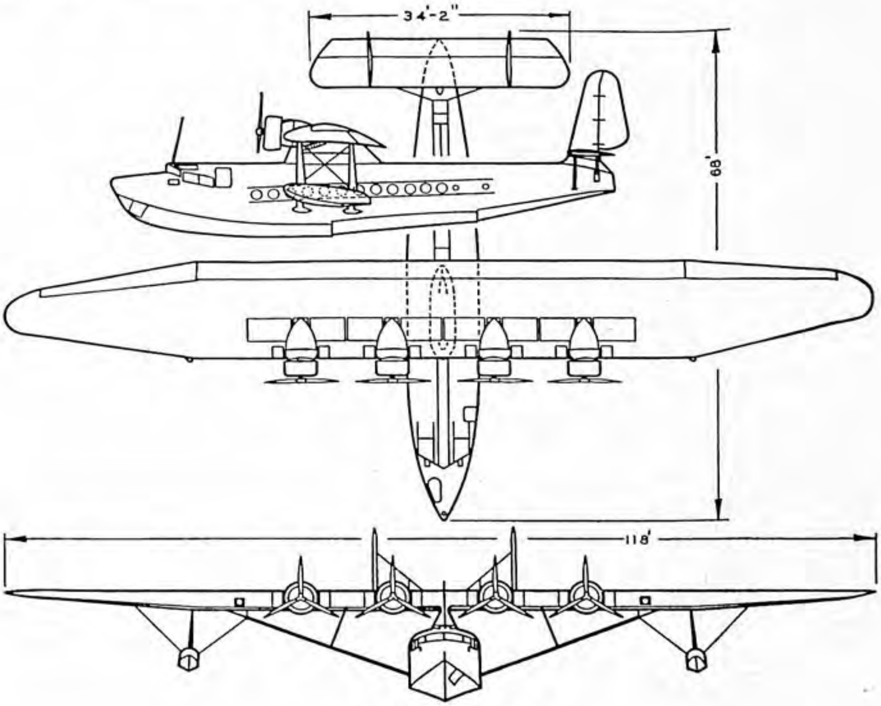
Official Photo U. S. Navy

THE SIKORSKY PBS-1

This is the PBS-1 built for the Navy by the Sikorsky Aircraft division of United Aircraft Corporation. It is powered by four Pratt & Whitney Twin Wasp engines, and is equipped with bow, rear and center gun turrets. It has a complete telephone system and an electrical system powered by an auxiliary engine. The crew can even prepare hot meals on an electric stove.

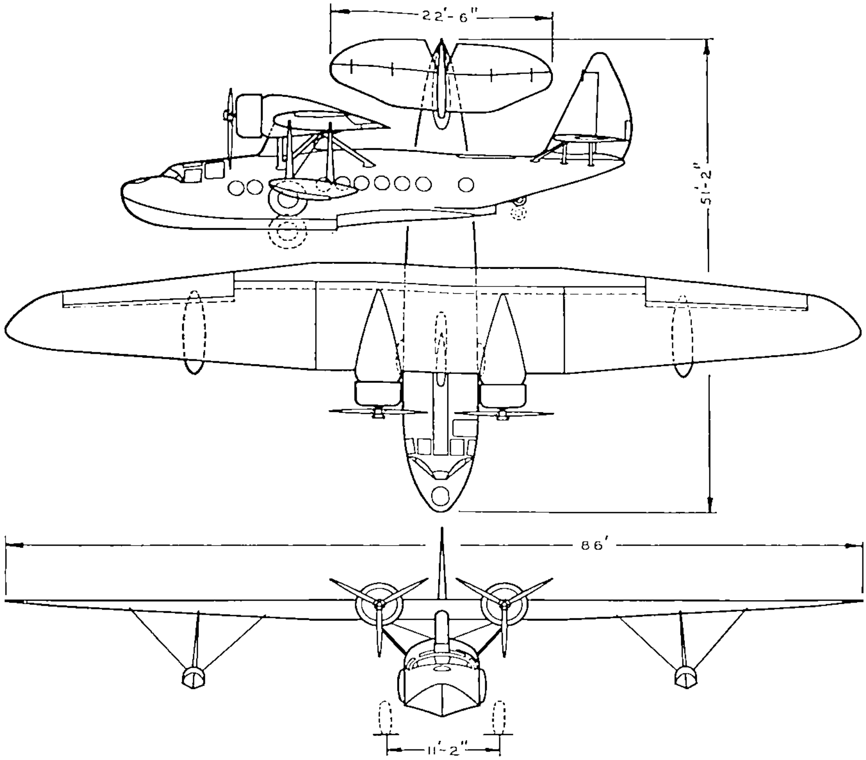
THE NEW CUB

The Piper Aircraft Corporation's Cub is powered by a 40 h.p. Continental engine.



SIKORSKY S-42B

Powered with four Pratt & Whitney Hornets, this flying boat carries 32-40 passengers.



SIKORSKY S-43

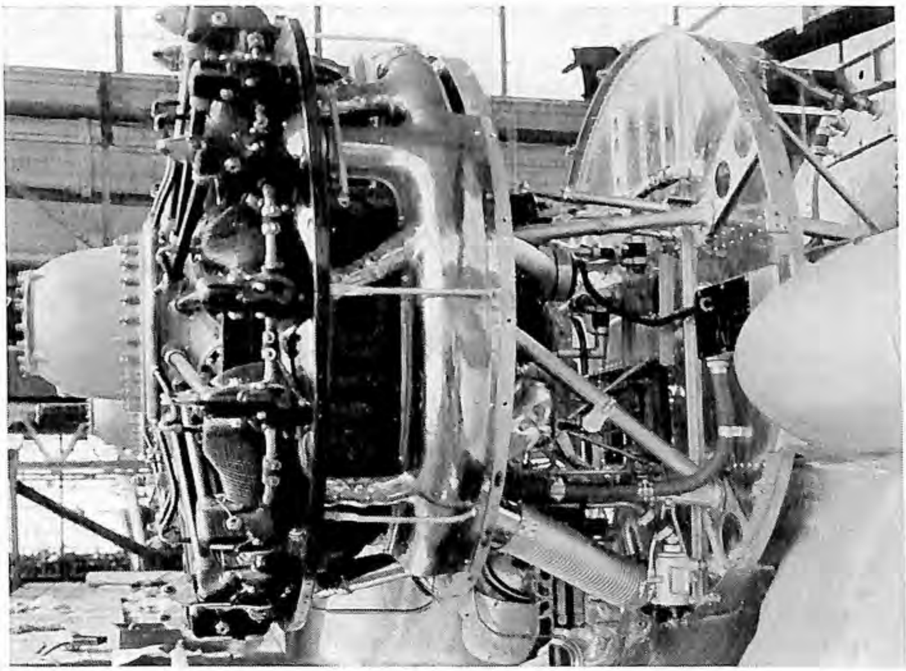
A 15-25 place commercial amphibion, powered with two Pratt & Whitney Hornets.

of three. The gross weight was 19,500 pounds and the useful load 6,750 pounds. The S-43 had a span of 86 feet; wing area 780.6 square feet; length 51 feet two inches; wing loading 25 pounds to the square foot; power loading 13 pounds per horsepower; top speed 190 m.p.h.; cruising speed 166 m.p.h.

In connection with the policy of the Navy Department to explore the value of large flying boats in national defense, the largest patrol bomber then constructed was completed at the Sikorsky factory, making its initial flight August 13, 1937. This huge flying boat, designated by the Navy as the XPBS, was reported to be one of the most powerful bombing planes in the United States, having a military load carrying capacity comparable with that of any known existing airplane. While important performance data had not been released by the Navy

STEARMAN PRIMARY TRAINER

One of the PT-13 models built for the U. S. Army Air Corps. The rear cockpit is hooded for blind flying instruction.



ENGINE INSTALLATION

Showing detail of one of the Pratt & Whitney Hornet engines set in the wing of the Sikorsky S-43.

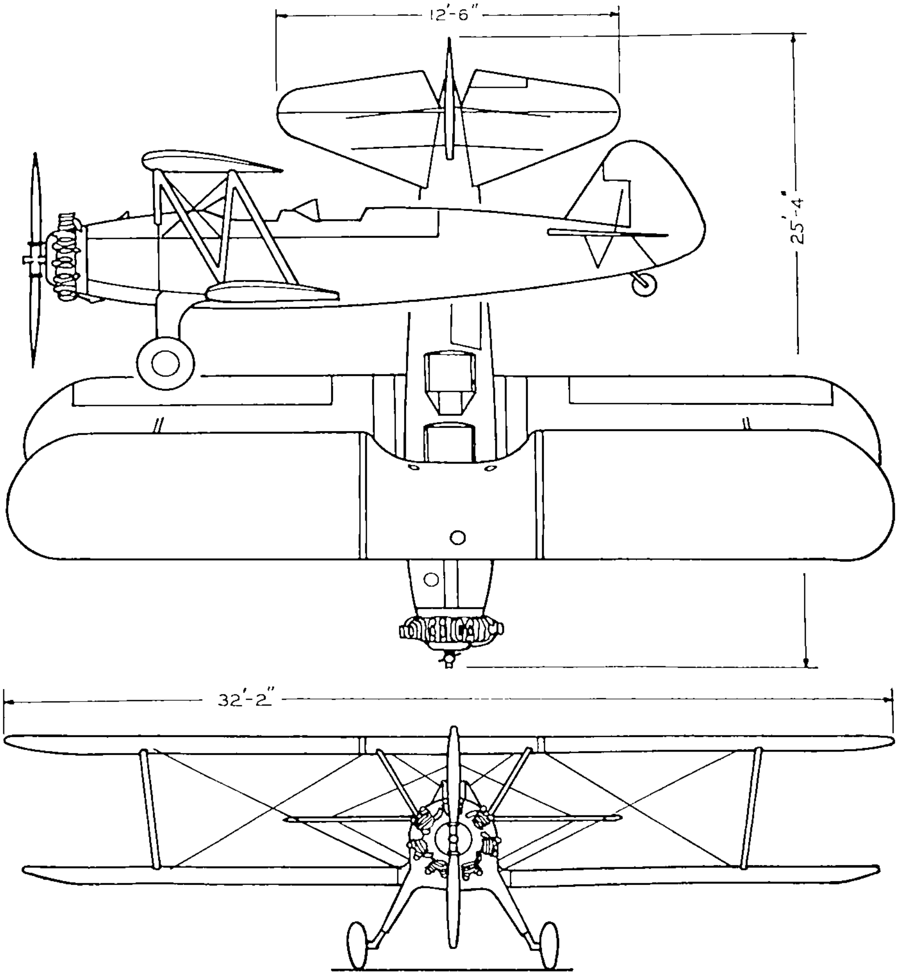
THE PORTERFIELD 70

It is powered by the LeBlond engine.

THE LUSCOMBE NINETY

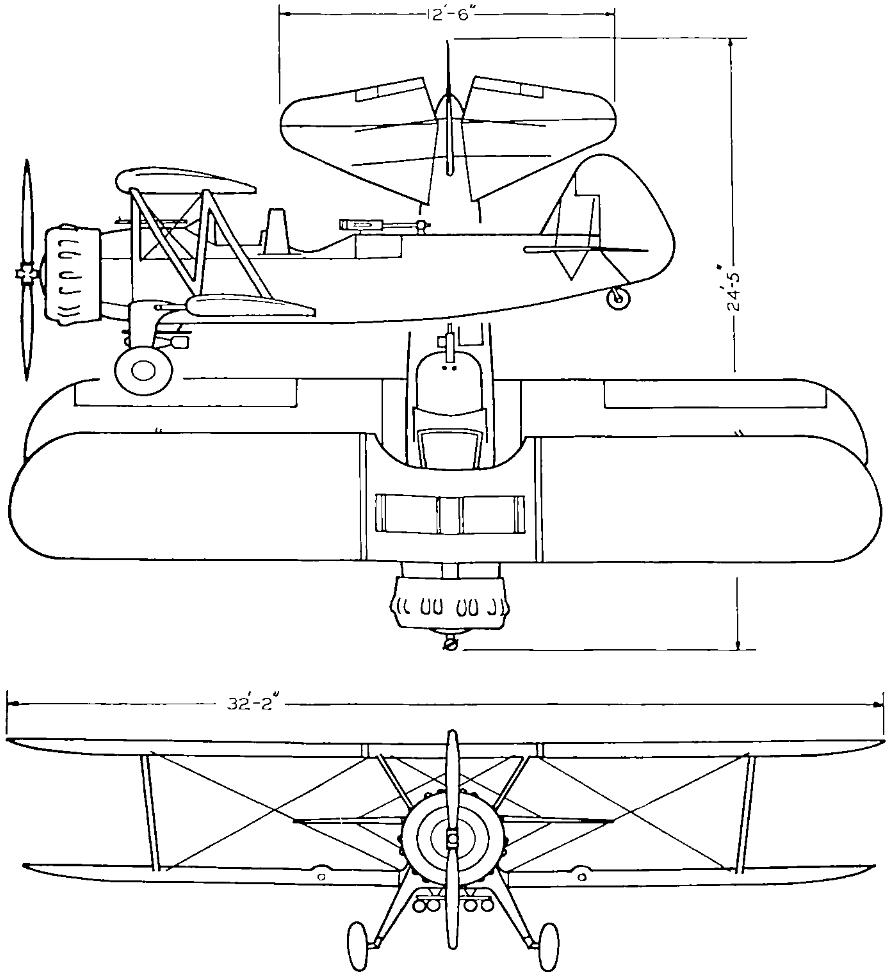
A high-wing, all metal, two-place cabin monoplane powered by a 90 h.p. Warner engine.

Department, an official Navy release states that the XPBS is a four-engine, all metal, high-wing, full cantilever monoplane flying boat of new design. It is powered by four Pratt & Whitney Twin Wasp engines of 1,050 h.p. each, and is equipped with Hamilton Standard constant speed propellers. The XPBS exceeds previous commercial Sikorsky flying boats in weight by some five to six tons, and while pre-



STEARMAN NS-1

A two-place primary trainer for the Navy powered with a Wright Whirlwind 220 h.p. engine.



STEARMAN 76D

This two-place advanced trainer is powered with a 320 h.p. Pratt & Whitney Wasp Junior engine, and is available as either a land or seaplane.

vious Sikorsky flying boat designs have employed the wing up and above the hull and used semi-cantilever strut bracing, the wing of the new Sikorsky patrol bomber is full cantilever, and flush with the top deck of the hull. Armament consists of bow, rear and center gun turrets incorporating many new features in armament design. An innovation in large flying boat equipment is provided in the XPBS with the installation of a complete 110-volt electrical system, which generates power for the electrical units such as radio and appliances in the galley.

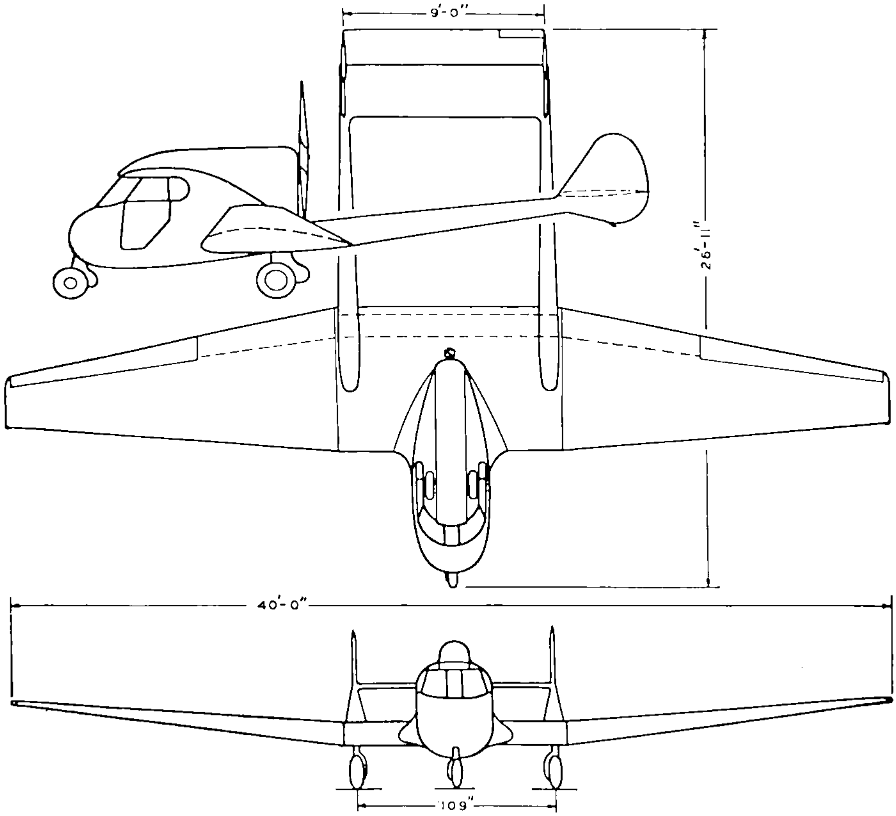
Stearman Aircraft Company, Wichita, Kans., affiliate of the Boeing Aircraft Company, throughout 1937 was producing in number its primary and advanced training planes, which are now in service in the U. S. Navy, U. S. Army Air Corps, the Argentine Naval Aviation Service, the Brazilian Army Air Corps and the Philippine Army Air Corps. The largest single order under production was a fleet of 92 Stearman PT-13A primary trainers, final deliveries of which were

THE LUSCOMBE PHANTOM

This private owner plane is powered by a 145 h.p. Warner engine.

made to the U. S. Air Corps at the beginning of 1938. These, in addition to the 26 PT-13's delivered on an earlier contract, gave the Air Corps a total of 118 Stearmans for use in primary training at Randolph Field, San Antonio, Tex.

Stearman PT-13's and PT-13A's, similar to the Stearman NS-1's in service in the Navy, are two-place biplanes with a wing spread of 32 feet two inches; height nine feet 4½ inches; length 25 feet, 7/16 inches, empty weight 1,941 pounds, useful load 709 pounds, gross weight 2,650 pounds. These primary trainers have a fuselage of welded steel frame, fabric-covered; wings of spruce spars, spruce ribs and



STEARMAN-HAMMOND Y-1

This two-place plane for the private flier is powered with a choice of two Menasco engines, rated at 125 h.p. and 150 h.p. respectively.

aluminum alloy channel drag struts, all fabric-covered; inter-plane and cabane struts of streamline aluminum alloy tubing and ailerons of riveted aluminum alloy construction, fabric-covered. Welded steel tubing construction is used in the tail group, with fixed stabilizer and with horizontal trimming provided by means of an elevator tab. Landing gear is of the full cantilever type, equipped, as is the tail wheel, with oleo shock absorbers. The plane is powered by a 220 h.p. Lycoming R-680-7 engine.

To supplement the fleet of Stearman equipment which was supplied them the previous year, four Stearman Model 73L3 primary trainers and three Model 76D1 advanced trainers were delivered in 1937 to the

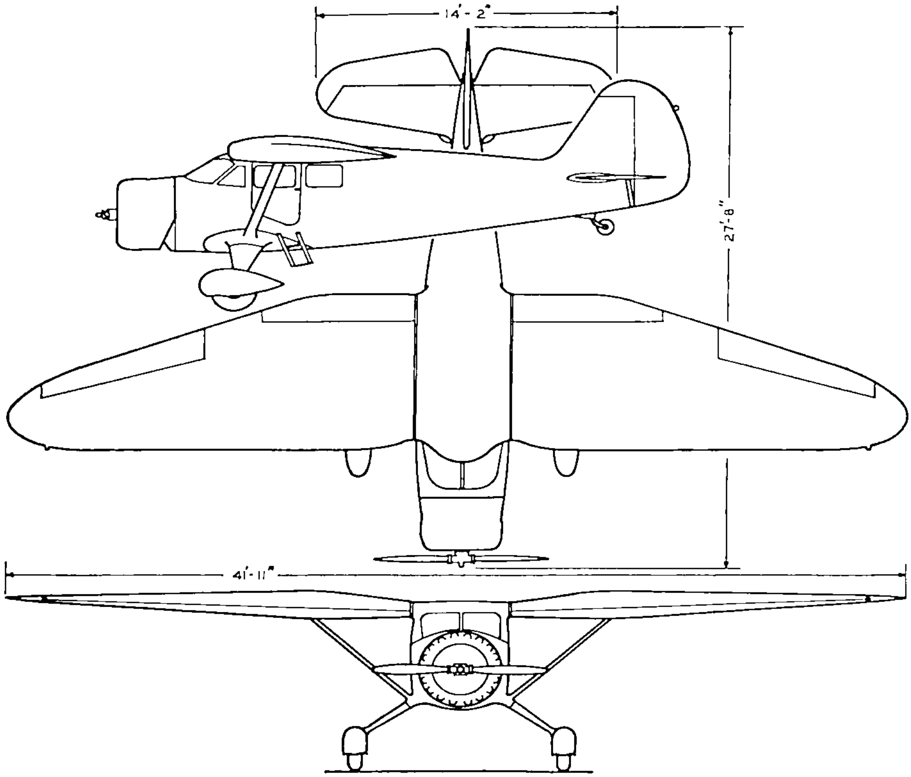
Philippine Army Air Corps. The 73L3 is powered by a 225 h.p. Lycoming R-680-C1 engine, while the 76D1 is equipped with a 320 h.p. Pratt & Whitney Wasp Junior.

The fleet of Stearman Model 76C3 advanced training and expeditionary type airplanes delivered to the Brazilian Army Air Corps, although similar in general construction to the primary trainer, has provision for the installation of both a fixed and a flexible machine gun and bombing equipment. The Brazilian planes included also alternate provision for the installation of two-way radio and aerial camera equipment. They are thus characterized by extreme visibility, being adaptable to long-range observation, aerial photography, scouting, attack bombing and advanced training. Power plant of the 76C3 is a Wright Whirlwind engine developing 420 h.p. at sea level. The wing span is 32 feet two inches, overall length 24 feet 11½ inches, height nine feet two inches, empty weight 2,495 pounds and gross weight approximately 3,652 pounds.

The Model 76D1 advanced training and expeditionary planes for the Argentine Naval Aviation Service augmented the fleet of similar planes delivered by Stearman in 1936. The Argentine Stearman, like the Philippine planes of the same type, are powered by Pratt & Whitney Wasp Junior engines. They have alternate provision for operation as land planes or as seaplanes with Edo twin floats.

All the airplanes listed above are variations of two basic Stearman training plane designs—the Stearman Model 73, including the United States Navy NS-1, U. S. Army Air Corps PT-13, and the Philippine Model 73L3, a primary trainer; and the Model 76, including 76D1 and 76C3, an advanced training and expeditionary type plane. The general performance characteristics of the Model 73, varying somewhat in accordance with the equipment employed on different models, are reported as follows: Maximum speed 123 m.p.h., cruising speed 105 m.p.h., landing speed 51 m.p.h., service ceiling 13,500 feet; absolute ceiling 15,400 feet; rate of climb at sea level 820 feet per minute; range at cruising speed 320 miles. General performance characteristics of the Model 76, also varying according to equipment installed, are: Maximum speed 153 m.p.h., cruising speed 135 m.p.h., landing speed 56 m.p.h., service ceiling 16,700 feet, absolute ceiling 18,600 feet; rate of climb at sea level 1,000 feet per minute; range at cruising speed 472 miles.

Stearman-Hammond Aircraft Corporation, South San Francisco, Calif., grew out of the Hammond Aircraft Corporation, and at the beginning of 1938 started to develop the model Y-150-S, 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



STINSON RELIANT

A five-place private owner plane available with a Lycoming, Pratt & Whitney Wasp Junior or a Wright Whirlwind engine.

the nose. With 150 h.p. Menasco C-4 engine the plane had a stated cruising speed of 118 m.p.h., landing with flaps at 45 m.p.h. The gross weight was 2,250 pounds, range 600 miles. The fuselage is a semi-monocoque structure of 24ST Alclad bulkheads, formers, stringers and covering. The engine is supported in rubber bushings to reduce vibration, noise, and fatigue in structure caused by engine forces. The location of the engine above the wing protects the propeller from ground objects and places it in efficient location relative to the wing for a pusher. Two 21½ gallon fuel tanks are located in the leading edge of the center section, easily accessible from the ground. The wing span is 40 feet and the overall length, 26 feet 10¾ inches. The wing area is 210 square feet. The all metal wing structure is provided with fabric covering. Differential tapered metal ailerons, statically balanced, provide lateral control. Split trailing edge flaps extend over 57 per cent of the 40 foot span. Flaps are controlled by the left foot pedal and hand lever. The tail surfaces are all metal full cantilever construction; the stabilizer is fixed, trim being obtained with a small trimming tab on the elevator.

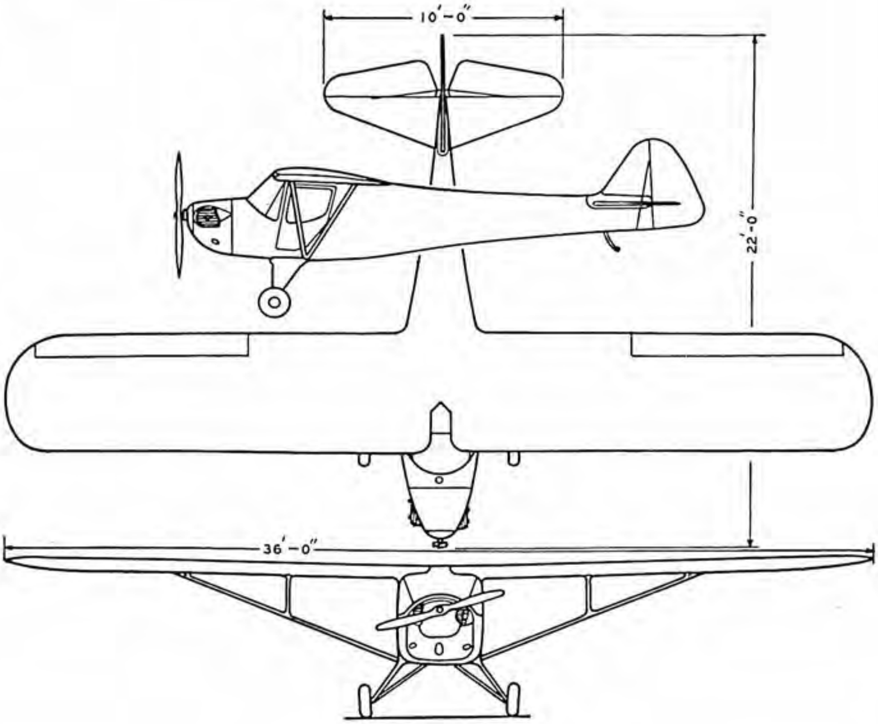
Stinson Aircraft Corporation, Wayne, Mich., a division of Aviation Manufacturing Corporation, at the beginning of 1938 was in production on four models of the Stinson Reliant single-engine high-wing, all metal cabin monoplane. Model SR9-B was powered by the 245 h.p. Lycoming R-680-D6 engine and was a five-place machine. Model SR-8B was powered by the 245 h.p. Lycoming R-680-6 motor and was a five-place machine. Model SR9-BD was powered by the same

GULF OIL'S FLEET OF STINSONS

The aviation field representatives of Gulf Oil Company use these Lycoming-powered Stinson Reliants.

Lycoming engine and was a five-place machine. Model SR9-DD, also five-place, had a 285 h.p. Wright Whirlwind engine. The last was equipped with Hamilton Standard controllable propeller. The standard equipment included full cantilever landing gear, dual controls, brakes, safety glass, and motor car width cabin. Model SR9-ED was powered by a Wright Whirlwind. Model SR9-FD was powered by a Pratt & Whitney Wasp Junior and Hamilton Standard controllable propeller.

The multi-purpose Reliant is designed especially for "out-back" and "bush" operation and for the use of the governmental air force, commercial operator or business firm when a plane must perform a number of duties if it is to be of real value. When produced for such



TAYLOR-YOUNG

A two-place Continental-powered plane for the private flier.

TAYLORCRAFT ON EDO FLOATS

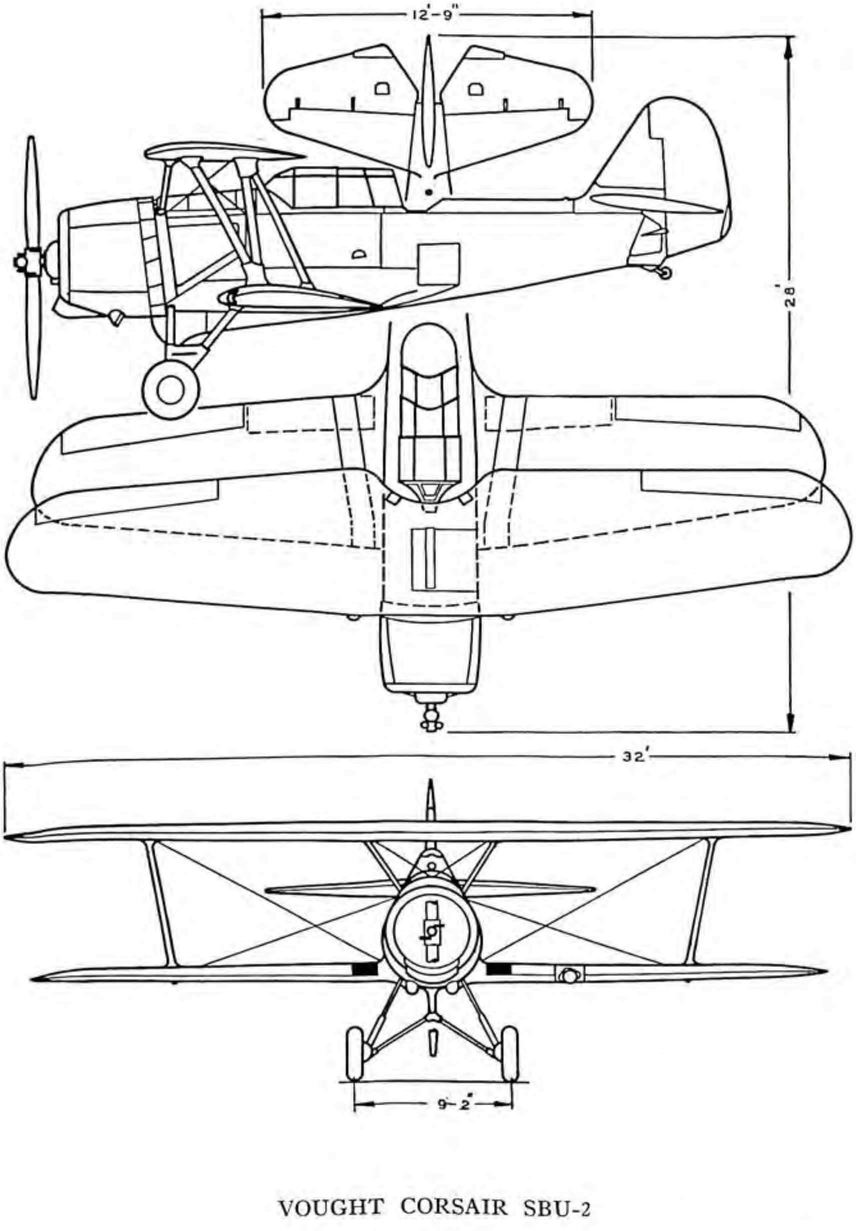
This two-place seaplane is powered by a Continental engine.

work, the Reliant is attractively decorated and comfortably appointed for the transportation of personnel or passengers and is readily convertible for the transportation of bulky cargo, supplies and equipment, or for use as an ambulance in emergency sickness or accidents. Standard equipment includes metal floor, carpet covered for passenger work, and metal side walls to window sills, resulting in a strong, durable compartment. Other Stinson multi-purpose features include additional cabin door, right hand side, for the loading and unloading of large bulky packages or stretcher and patient, special exterior steps and hand grips for refueling by means of small capacity containers where modern pump and service facilities are not available. General specifications of the Reliant, with variations due to horsepower are: Length 27 feet 11 inches, wing span 41 feet 10½ inches, height 8½ feet, wing area 258.5 square feet, weight empty 2,475 pounds, gross weight 3,700 pounds, useful load 1,225 pounds, cruising speed 143-175 m.p.h., range 615-700 miles.

Taylor-Young Airplane Company, Alliance, O., began production of its new light plane in March, 1937, turning out nine planes during that month. In September production was 65 planes. The new Taylor-Young light plane is a high-wing monoplane, two-place side-by-side cabin machine powered by a 40 h.p. Continental engine. It has a wing span of 36 feet, length 22 feet, stated high speed of 91 m.p.h., cruising at 80 m.p.h., range 230 miles.

Chance Vought Aircraft, East Hartford, Conn., a division of United Aircraft Corporation, completed 20 years as a manufacturer of military aircraft. At the beginning of 1938 the company had built and delivered more than 1,000 airplanes, principally to the U. S. Navy, although some models were produced for the governments of Argentina, Brazil, Cuba, China, Japan, Mexico, Peru, San Domingo, Siam and Great Britain. In 1937 production included the SBU-2, an improved version of the SBU-1 and an initial lot of a new model low-wing monoplane scout-bomber, the SB2U-1.

The Vought SBU-1 was a two-seat scout-bomber biplane with a 700 h.p. Pratt & Whitney Twin Wasp Junior geared engine, the new NACA "flapped" cowling, developed by United Aircraft, and a two-blade Hamilton Standard controllable pitch airscrew. It was of all metal construction, except for the covering of the wings, fuselage and movable tail surfaces, had tapered wings and was equipped with split landing flaps under the lower wings. The SBU-1 was designed to combine the duties of scouting and bombing, hitherto fulfilled by two distinct types of aircraft. The Corsair model SBU-2 was similar in areas, dimensions and engine power. The Vought Corsair V-142 was the export version of the SBU-2. It was a two-place scout and dive



VOUGHT CORSAIR SBU-2

A two-seat scout-bomber with a Pratt & Whitney Twin Wasp Junior engine.

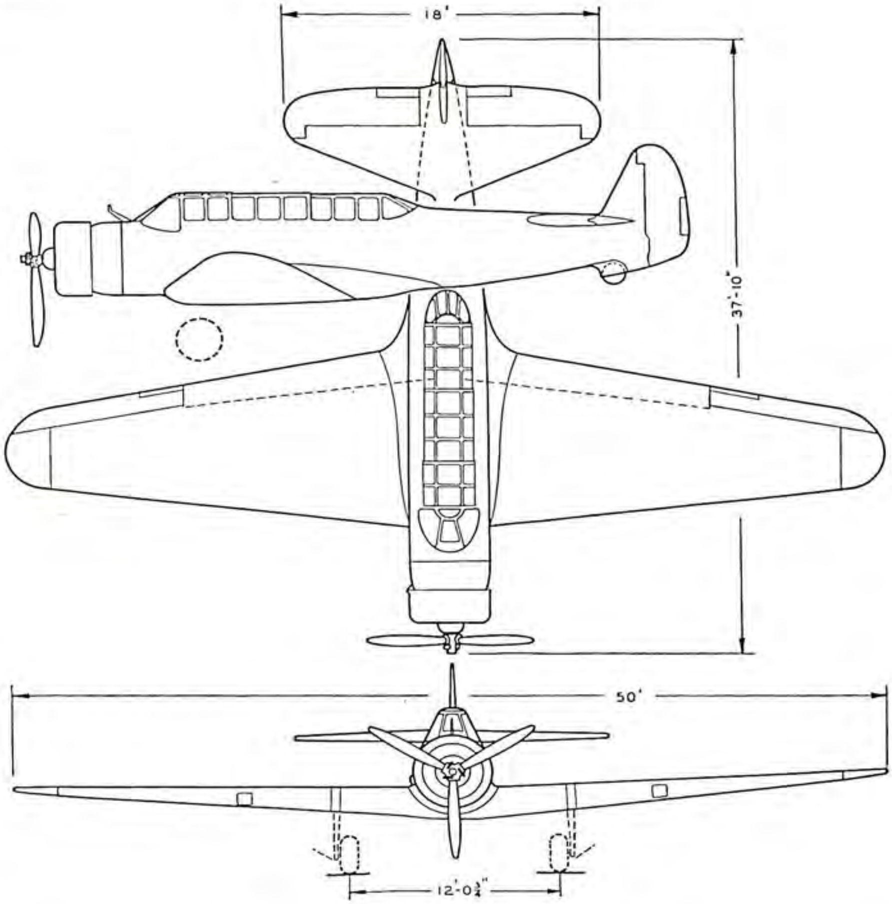
Official Photo U. S. Navy

VOUGHT SCOUT BOMBERS

U. S. Navy formation of Vought scout bombers powered by Pratt & Whitney Twin Wasp Junior engines.

bomber, powered by a Pratt & Whitney Twin Wasp Junior engine, with two machine guns, one fixed and the other flexible, length 27¾ feet, wing span 33 feet three inches, high speed 205 m.p.h. at 8,900 feet, cruising speed 169 m.p.h. on 61.5 per cent of rated power.

The Vought SB2U-1 is a low-wing scout bomber land plane powered with a 750 h.p. Pratt & Whitney Twin Wasp Junior engine and a Hamilton Standard constant speed propeller. Its structure is of metal with fabric covering on the movable tail-surfaces and on the after portions of wing and fuselage. The landing gear is retractible, each half of which is arranged to twist during retraction so that the wheels lie flat in recesses in the wing. Night flying equipment and flotation gear are provided. Fifty-four airplanes of this type were built for the U. S. Navy, and an additional order for 58 airplanes of the same basic type later was received. The Vought V-143 was a low-wing all metal single-place fighter, powered with a 750 h.p. Pratt & Whitney Twin Wasp Junior engine and a Hamilton Standard constant speed propeller. It had a stated top speed of 300 m.p.h.

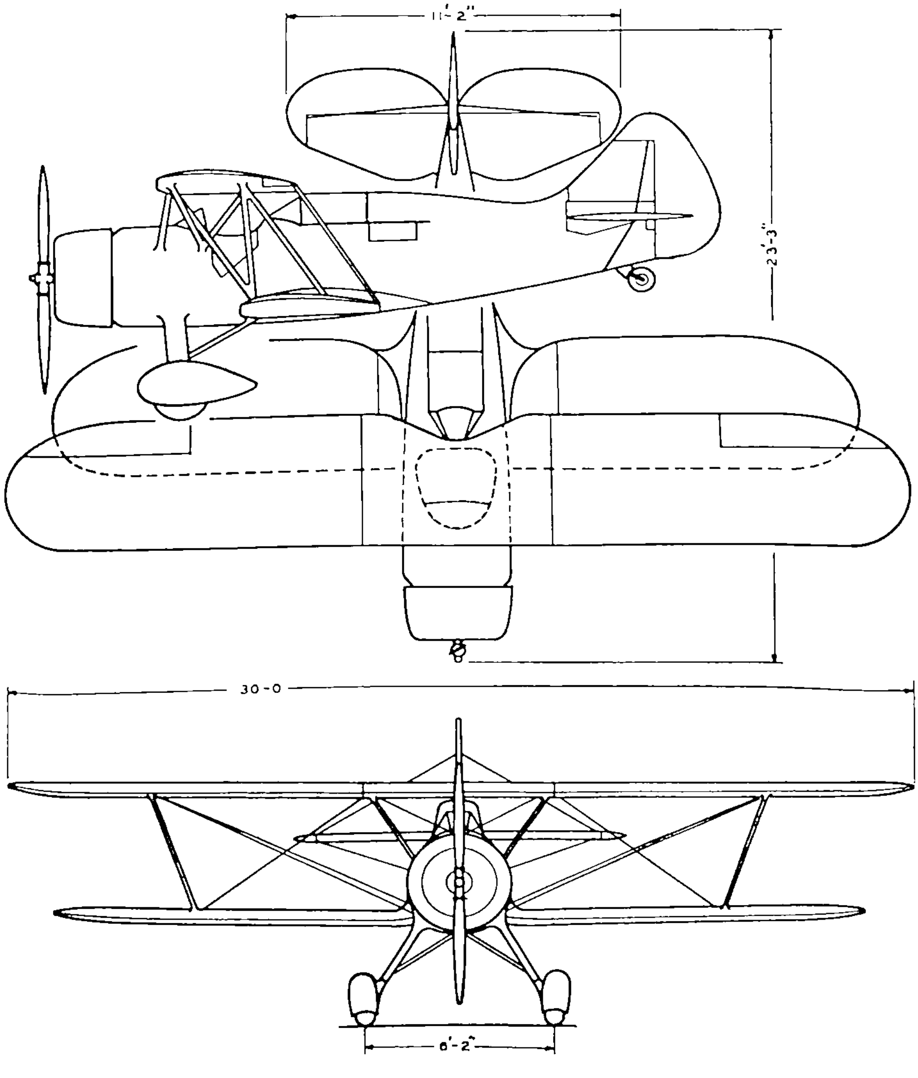


VULTEE ATTACK BOMBER V-11 GB

This three-place attack bomber is powered with a Wright Cyclone engine.

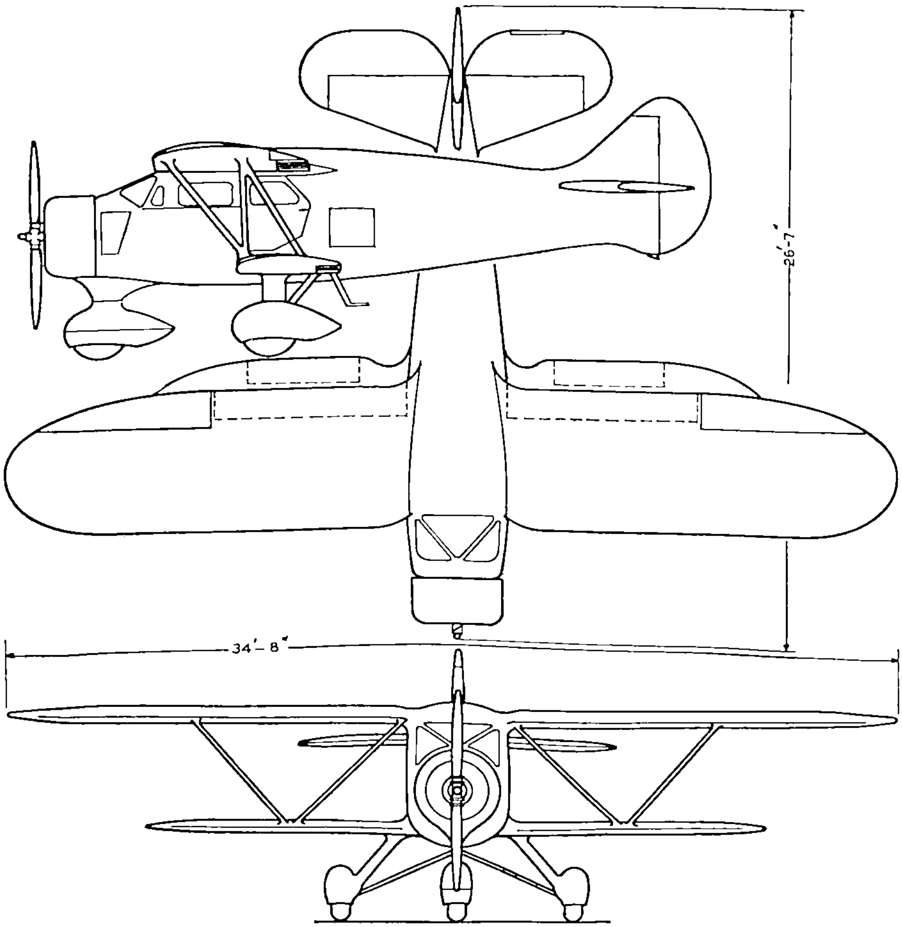
Also in production were the Vought V-97 and V-99, export models of the Vought Corsair biplane. Those two models were similar except for power plants, the V-97 using a 700 h.p. Hornet, and the V-99 a 550 h.p. Wasp.

Vultee Aircraft Division of the Aviation Manufacturing Corporation, Downey, Calif., in 1937, produced the Vultee attack bomber, V-11GB, 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



WACO F-7

As a three-place ship this private owner model is powered with a 225 h.p. Jacobs engine or a Continental engine of 225 or 230 h.p. As a two-place it is offered with a choice of Continental, Jacobs or Wright engines ranging from 240 to 285 h.p.



WACO N-7

This three-wheel model for the private flier is powered with a Jacobs L-5 engine and carries four.

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 and height 10 feet.

The V-11GB was equipped with retractible landing gear and flaps. Powered with either an 875 or 1,000 h.p. Wright Cyclone engine it had a gross weight of 9,501 to 11,437 pounds, payload from 3,325 to 5,346 pounds, and a cruising speed of from 183 to 204 m.p.h.

The Vultee plant at Downey was enlarged to 126,000 sq. ft. of factory floor space.

Waco Aircraft Company, Troy, O., produced a line of cabin biplanes for private owners and business use and supplied both cabin and closed cockpit models for both the domestic and foreign markets. A Waco EQC-6, powered by a Wright Whirlwind engine, was delivered to the U. S. Coast Guard. The Waco C-7 was a four-five place cabin plane powered by a Continental, Jacobs or Wright Whirlwind engine. The Waco F-7 was a three-place plane in the lower power bracket, a two-place in the higher power bracket, with a Continental, Jacobs or Wright engine. The Waco S-7 was a four-five place cabin ship powered by Continental or Jacobs engines.

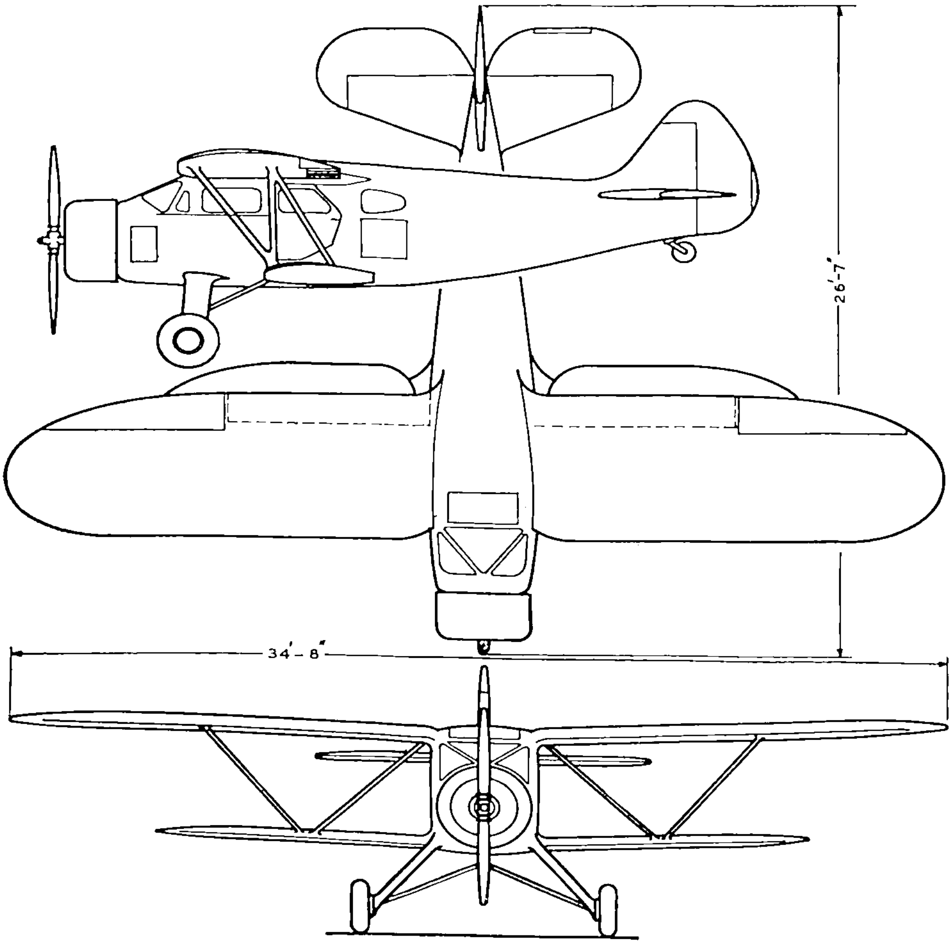
A new model for 1938 was the Waco N-7, with a three-wheel

THE THREE-WHEEL WACO N-7

Showing location of the nose wheel, with the rest of the undercarriage set well back under the wings.

landing gear, the third wheel being under the nose of the four-place cabin biplane. The company's description of the Waco N-7, which is Jacobs-powered, follows:

"Its flying characteristics are, of course, entirely conventional but its characteristics in landing, taxiing on the ground, and in take-off are unusual. The action of the pilot is perfectly natural, because when he starts to move, he is in a natural flying position on the ground and the airplane moves forward in that position until it has attained speed for take-off, when it is taken off or actually takes itself off. There is no raising or lowering of the tail to confuse the new pilot, he merely makes the perfectly natural gesture of pulling the wheel back when he is ready to ascend. The airplane is generously equipped with flaps



WACO C-7

A four-five place plane for the private owner available with Continental, Jacobs or Wright Whirlwind engine.

on both upper and lower wings. When preparing to land, the pilot approaches the edge of the landing area, closes the throttle, opens the flaps, and points the airplane to the spot on the ground where he wants to land. The flap area is sufficient to make it difficult to hold the nose far enough down to attain a glide speed of greater than 90 m.p.h. At 100 m.p.h. the flaps will close themselves. Again, as the pilot approaches the ground his action is perfectly natural. He levels off gradually and when quite close to the ground, skims it in a perfectly natural position, in other words in the same position he occupies in his automobile. At no time does he face the problem of being forced to lower the tail to kill his speed, only to find himself ballooning off the ground again. The airplane can be put on the ground at its actual stalling speed of 50-odd m.p.h. or can be put on the ground at 80 m.p.h., and held there in either case. With brakes on the rear wheels and the front wheel preventing a nose-over, it is of course possible to bring it to a very abrupt stop after it has once contacted the earth. It is immaterial to the novice whether the airplane be landed with the front wheel touching the ground first, the rear wheels touching the ground first together, or one or the other of the rear wheels touching the ground first. In any case the other two will immediately come on the ground and the airplane will remain there, the pilot and occupants sitting in it during this time in exactly the same position that they would occupy in an automobile; that is, in a natural position in relation to the ground."

Waldo D. Waterman, Santa Monica, Calif., at the beginning of 1938 was exhibiting his tailless monoplane, Arrowbile, powered by a Studebaker engine.

Builders of Aircraft Engines

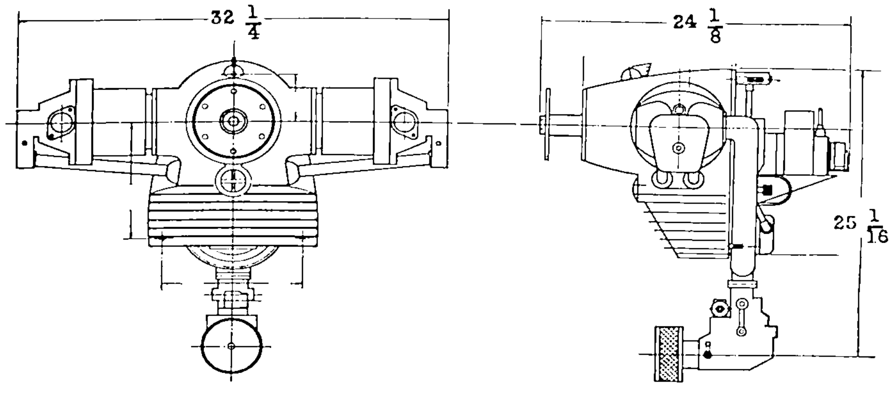
The Aeronautical Corporation of America, Cincinnati, O., reported that it had produced a record number of Aeronca engines in 1937. The Aeronca E-113C engine was a two-cylinder, horizontally opposed motor with a piston displacement of 113.5 cubic inches, bore 4.25 inches and stroke four inches, compression ratio 5:4, weight 121 pounds including magneto, carburetor and propeller hub. The official rating was increased from 36 h.p. to 40 h.p. at 2,540 r.p.m.

The Aeronca E-113-CBD engine, introduced in 1938, was equipped with dual magnetos and an automatic overhead valve gear lubricating system. It developed 45 h.p. at 2,500 r.p.m. and weighed 125 pounds.

The Allison Engineering Company, Indianapolis, Ind., a division of General Motors Corporation, continued on development work, and passed Government type test on the Ethylene Glycol cooled V-12 cylinder engine of 1,000 h.p. known as the V-1710-C6 engine.

The installation of this engine in the Curtiss XP-37 U. S. Air Corps pursuit ship indicates interesting possibilities for high speed high altitude performance.

The use of Allison V-1710 engines with special extension shaft drive for pusher installation in the Bell XFM-1 two-engine fighter also develops speculation as to the importance of the return of high powered liquid cooled engines for high performance military usage in the United States. The ready adaptation of this type of engine to the use



AERONCA E-113C

This is a two-cylinder, opposed, aircooled engine rated at 40 h.p.

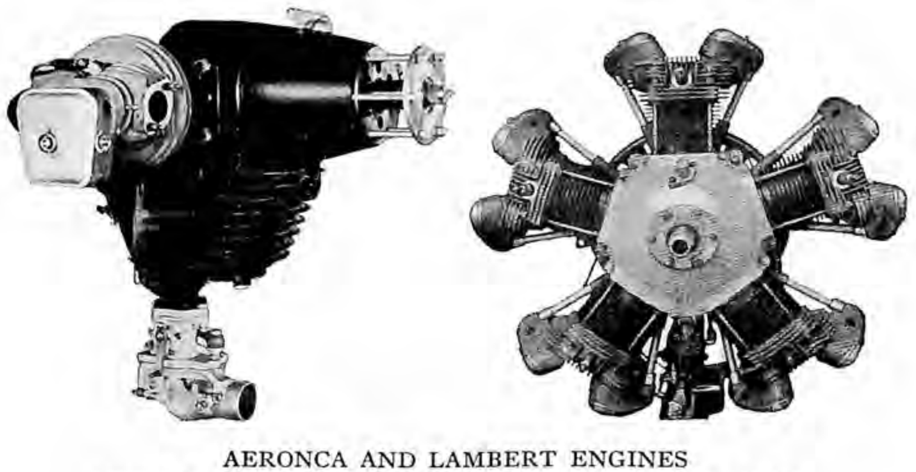
of exhaust driven turbo superchargers provides an engine with maximum sea level horsepower available to any practical altitude resulting in very high rate of climb speed, as well as high cruising economy.

The V-1760-C6 was a 12-cylinder, geared, liquid-cooled V-type engine with stated rating of 1,000 h.p. at 2,600 r.p.m., compression ratio 6:1, blower gear ratio 6.75:1, bore 5.5 inches, stroke six inches, displacement 1,710 cubic inches, length 94.47 inches, width 28.94 inches, height 40.72 inches, weight overall 1,280 pounds, weight 1.28 pounds per horsepower, fuel consumption at rated horsepower .60 pounds per brake horsepower per hour, using 87 octane fuel.

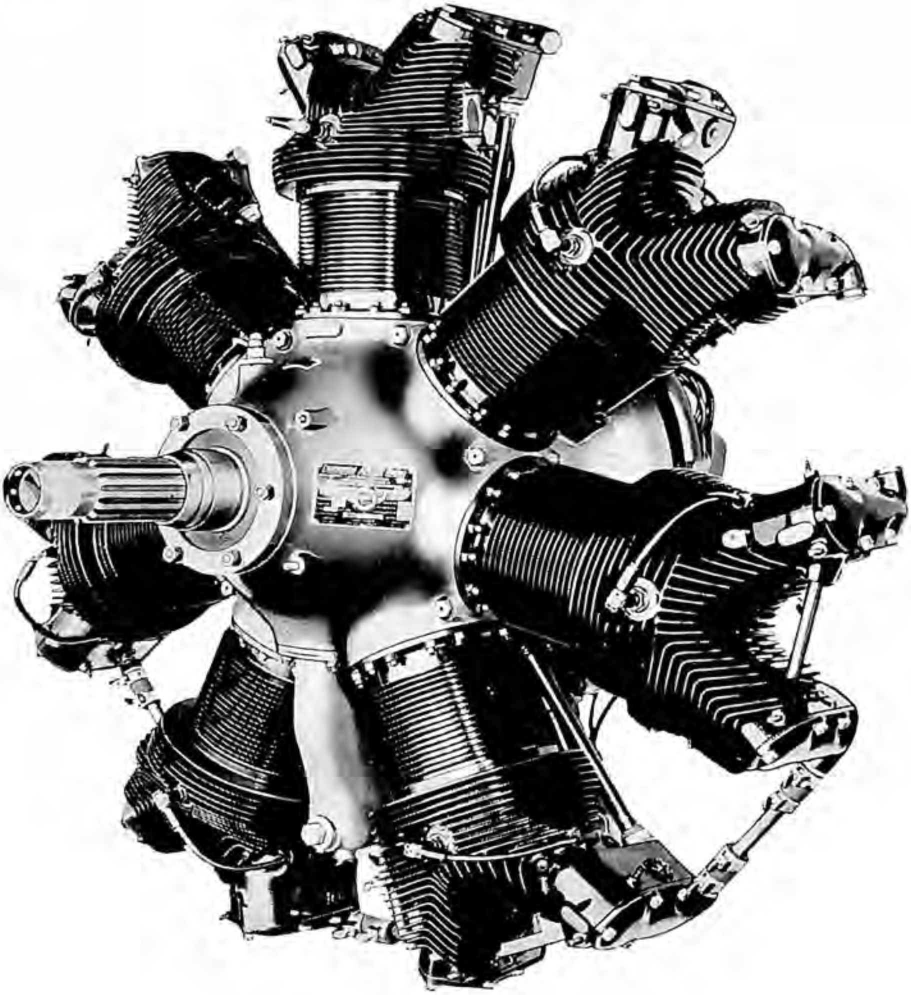
Continental Motors Corporation, Detroit, Mich., produced two models of aircraft engines. Model A-40 was produced in four series—2, 3, 4 and 5. The first two were rated 37 h.p. at 2,550 r.p.m. The latter two were rated 40 h.p. at 2,575 r.p.m. Model W-670 was a seven-cylinder radial with ratings of from 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.

A revolutionary fuel injection system and complete pressure lubrication of the valve gear were reported to be two noteworthy improvements in the W-670 Continental engine. In the new design the complete valve gear was lubricated by oil circulated under engine pressure, thereby eliminating the servicing of rocker boxes. The new fuel injection system replaced the carburetor, giving equalized fuel distribution, therefore greater economy, increased power and appreciably smoother engine performance. Another advantage claimed for the system, one particularly valuable in combat, acrobatic or stunt flying, was that the engine performed perfectly with the plane flying in any position. The manufacturer also claimed that it eliminated any possibility of icing. The fuel injection system included an engine driven injector running at half engine speed, an injector discharge nozzle in each intake pipe adjacent to the cylinder, an air throttle valve at the entrance to the engine intake manifold, controls for altitude compensation and engine speed, and a constant pressure engine-driven fuel pump. Other refinements were the increasing of the fire area of the cylinder head, a larger rocker arm bearing and a larger scavenger oil pump connected to both the nose and accessory ends of the engines. The company had under development a 50 h.p. engine.

Jacobs Aircraft Engine Company, Pottstown, Pa., continued production of its Models L-4 and L-5, seven-cylinder aircooled radial engines, with various refinements. The L-4 was rated 225 h.p. at 2,000 r.p.m., and the L-5 285 h.p. at 2,000 r.p.m., at sea level, using 73 octane aviation gasoline. The L-5 also received a rating of 300 h.p. at 2,120 r.p.m. at sea level, with 73 octane fuel, for use with controllable pitch or constant speed propellers, having a ratio at this rating of less than 1⅔ pounds per horsepower. These models carried two Scintilla battery ignition distributors and Eclipse generator as standard equipment. Both types were also supplied with two Scintilla magnetos, designated as Models L-4M and L-5M, or with one magneto and one battery distributor, designated as Models L-4MB and L-5MB. A two-piece main crankcase was used on all models, the front half being an



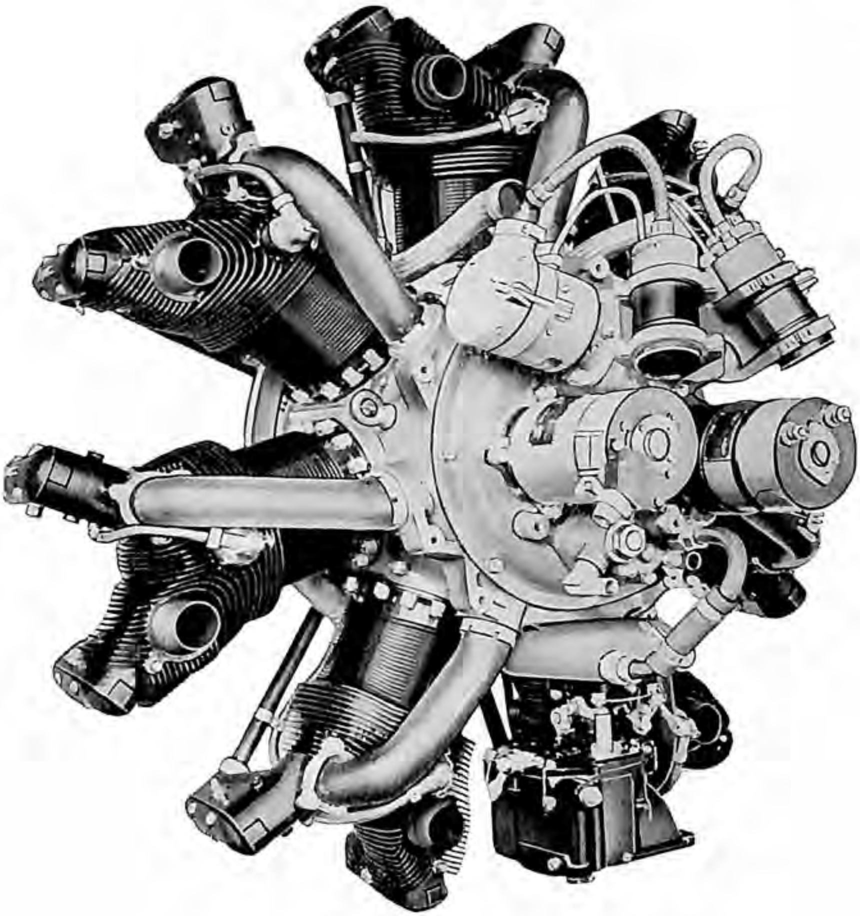
AERONCA AND LAMBERT ENGINES
Aeronca E-113C, 36 h.p. (left); Lambert R-266, 90 h.p. (right).



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.

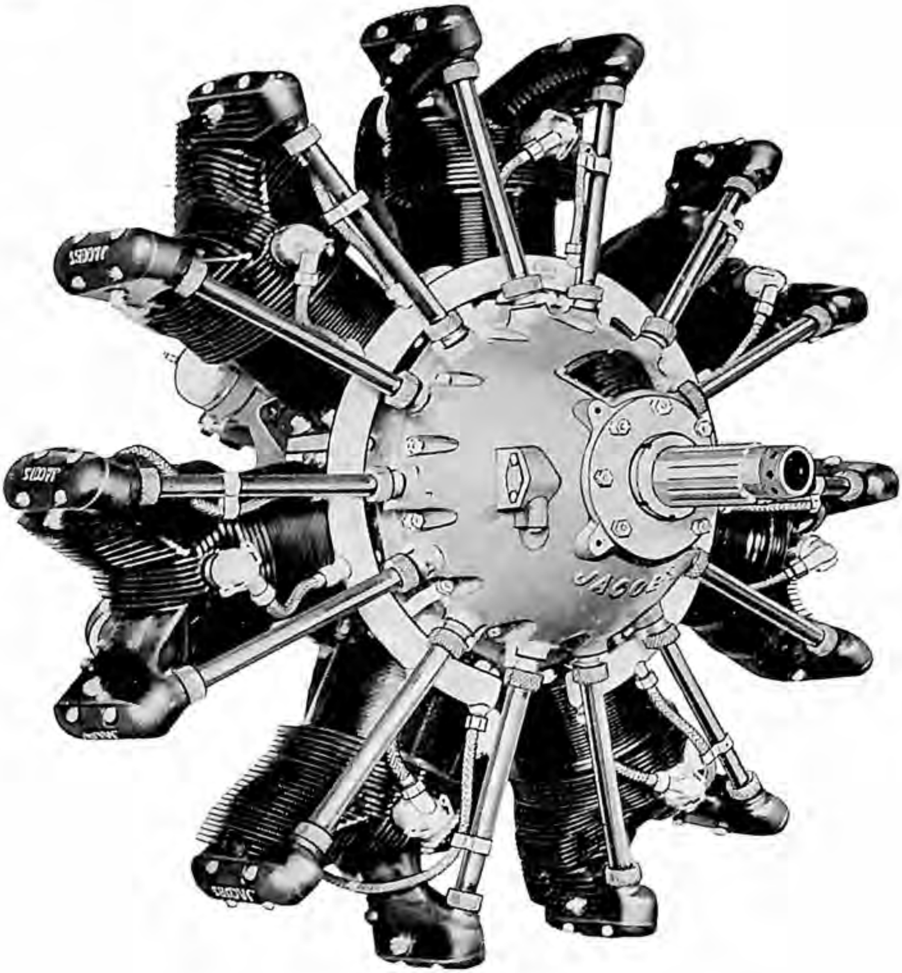
aluminum casting carrying the front main bearing, and the rear half a magnesium casting. Nose case, accessory case and intermediate bearing plates were of magnesium. All models had sodium-filled exhaust valves, forged aluminum pistons and four crankshaft bearings (two main roller bearings, and thrust and rear ball bearings). New type



THE JACOBS L-5

This seven-cylinder radial engine is rated at 285 h.p.

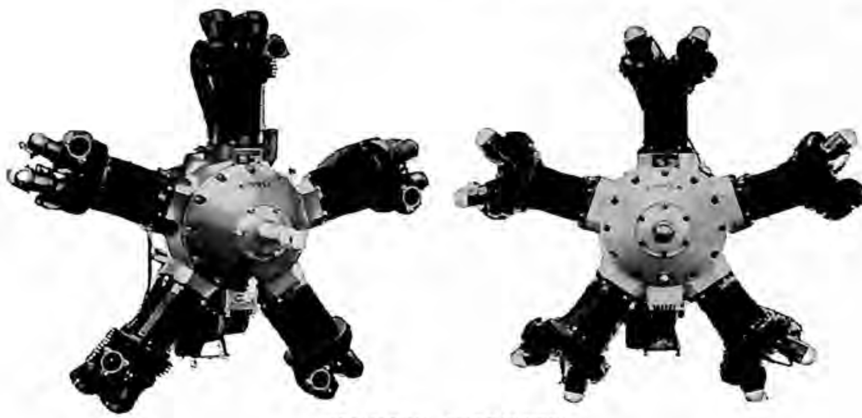
cylinder heads, with an increased number of deeper fins for cooling, were used, with completely oil tight valve gear and push rod housings. Provision was made for installation of Breeze radio shielding, Eclipse direct electric starter, and any three of the following accessories: Vacuum pump, fuel pump, hydraulic pump, constant speed propeller pitch control and machine gun synchronizers. These engines powered many of the four and five-place cabin planes sold in this country during the year, being installed in Waco, Beechcraft and Howard planes, were introduced in the new Beechcraft and Bennett low-wing twin-



THE JACOBS L-4

A seven-cylinder, radial, aircooled engine rated at 225 h.p.

engine planes, and the Fleetwings stainless steel amphibion. They also powered the Kellett direct control autogiros, built for the Army Air Corps. A substantial number of them went into service in Canada, and manufacture was begun there on the Fleet twin-engine freighter, powered with two Jacobs L-5MB's. A fleet of Jacobs-powered Wacos was purchased by the principal air line in India. Other Jacobs-powered planes were delivered abroad. The Jacobs Company announced that

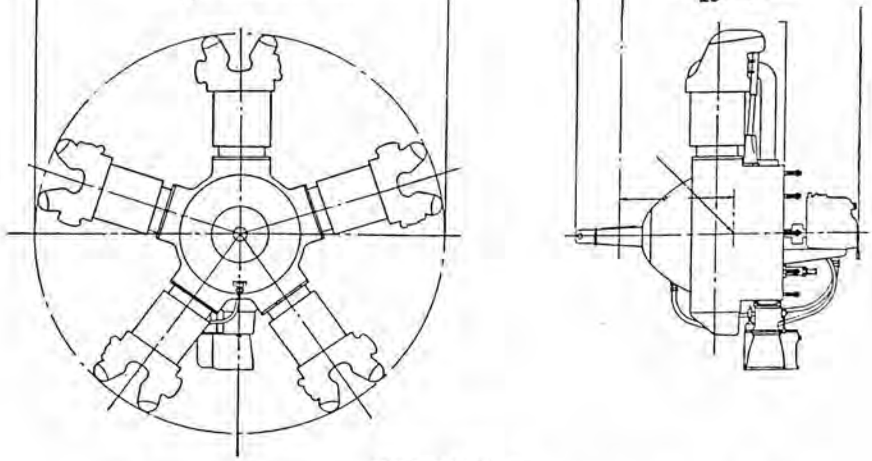


KINNER ENGINES

Kinner K-5, 100 h.p. (left); Kinner B-5, 125 h.p. (right).

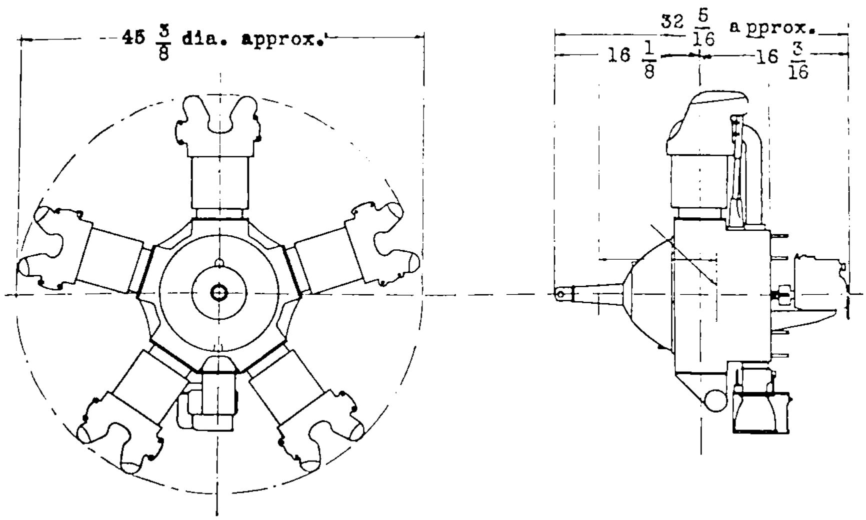
it would bring out a new series of engines in 1938, with ¼ in. more stroke and 85 cu. in. more displacement than the L-5 series.

Kinner Airplane & Motor Corporation, Ltd., Glendale, Calif., reported that it was in production on six engines, the K-5 100 h.p. at 1,810 r.p.m., weight 275 pounds; the B-5 125 h.p. at 1,925 r.p.m., weight 295 pounds; the R-5 160 h.p. at 1,850 r.p.m., weight 315 pounds; the C-5 210 h.p. at 1,900 r.p.m. weight 420 pounds; the C-7



KINNER B-5

This is a five-cylinder aircooled radial which is rated at 125 h.p.



KINNER R-5

This five-cylinder aircooled radial engine is rated at 160 h.p.

300 h.p. at 1,800 r.p.m., weight 600 pounds; and the SC-7 350 h.p. at 1,900 r.p.m. at 5,000 feet, weight 650 pounds.

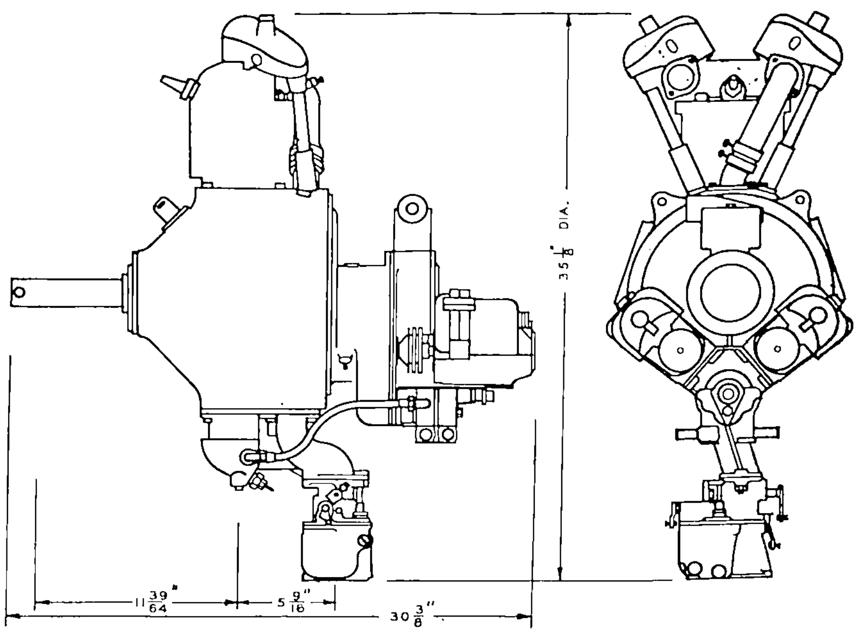
Lambert Engine & Machine Company, Moline, Ill., produced the Lambert R-266 radial aircooled engine, direct drive, 90 h.p. at 2,375 r.p.m., cruising rating 60 h.p. at 5,000 feet, compression ratio 5.55:1, bore 4.25 inches, stroke 3.75 inches, displacement 266 cubic inches, length 30 inches, diameter 34 inches, weight overall 225 pounds, 2.5 pounds per horsepower.

Lawrence Engineering & Research Corporation, Linden, N.J. continued its development work on aircraft motors.

The LeBlond engine rights were acquired by Rearwin Airplanes, and in future these engines were to be produced by Rearwin Airplanes, Engine Division, Kansas City, Mo. The company announced that it would continue to build LeBlond 70 and 90 h.p. five-cylinder radial aircooled engines. In addition it planned to build a 125 h.p. seven-cylinder radial aircooled engine.

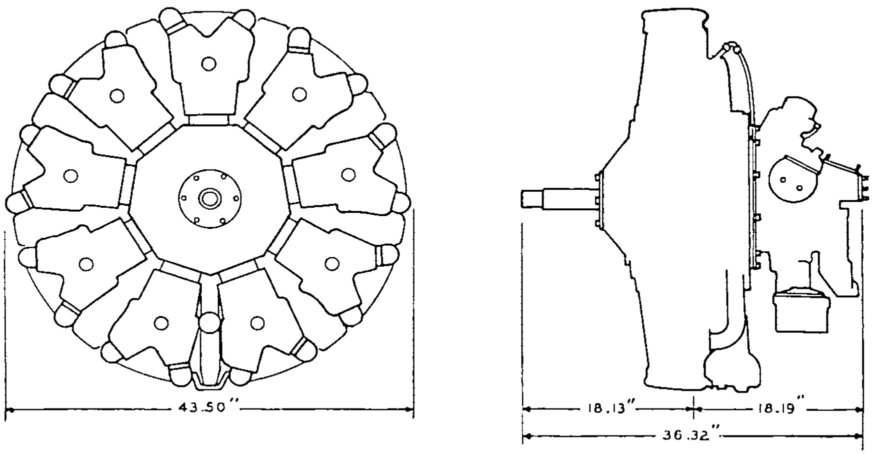
The LeBlond models in production at the beginning of the year were the 5-E-70, 5-F-90, and 7-DF-110. The 5-E-70 had ratings of 75 h.p. at 2,075 r.p.m. and 70 h.p. at 1,950 r.p.m., weight 245 pounds, 3.26 pounds per horsepower. The 5-F-90 rated 90 h.p. at 2,250 r.p.m., weight 226 pounds, 2.5 pounds per horsepower. The 7-DF-110 rated 110 h.p. at 2,150 r.p.m., weight 275 pounds, 2.31 pounds per horsepower.

Lycoming Division of Aviation Manufacturing Corporation, Williamsport, Pa., manufacturers of aircraft engines and controllable propellers, introduced a refined R-680-D series engine in 1937. Rated at 245 h.p., 260 h.p. for take-off, the Lycoming R-680-D series engine incorporated many new features and design refinements. A new feature was the automatic valve gear lubrication, which was accomplished without the addition of any moving parts. Another refinement was the greatly increased cylinder cooling fin area, a total of over 20 square inches per cubic inch displacement. Provision was made for the installation of the following accessory equipment: fuel pump, vacuum pump, generator, and constant speed propeller governor. In the military field, Lycoming R-680-5 and R-680-7 engines, were produced for use in the Stearman PT-13 and PT-13A Army primary training planes. The Model R-680-7 engine, rated at 220 h.p. also was equipped with automatic valve gear lubrication and complete accessory drive equipment. Lycoming planned to enter in 1938 the lower horsepower field with a seven-cylinder engine based on the proven design features of the Lycoming R-680-D series engine. Approved by the Department of Com-



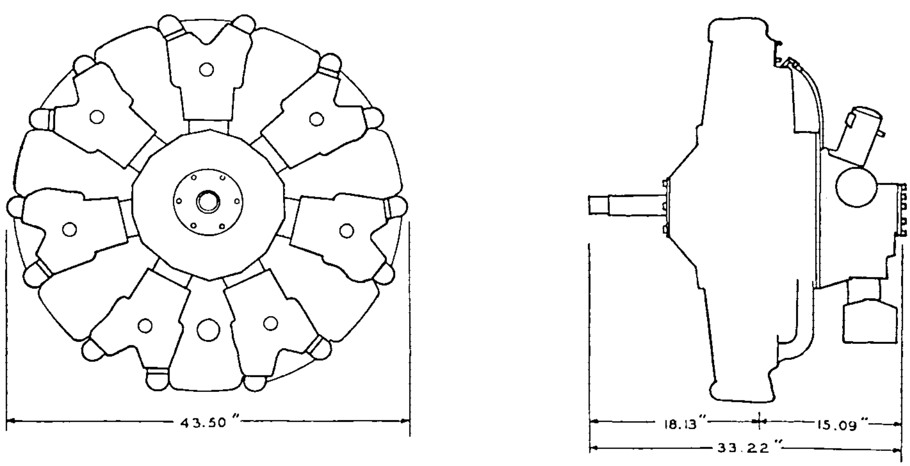
LAMBERT R-266

A five-cylinder aircooled radial engine rated at 90 h.p.



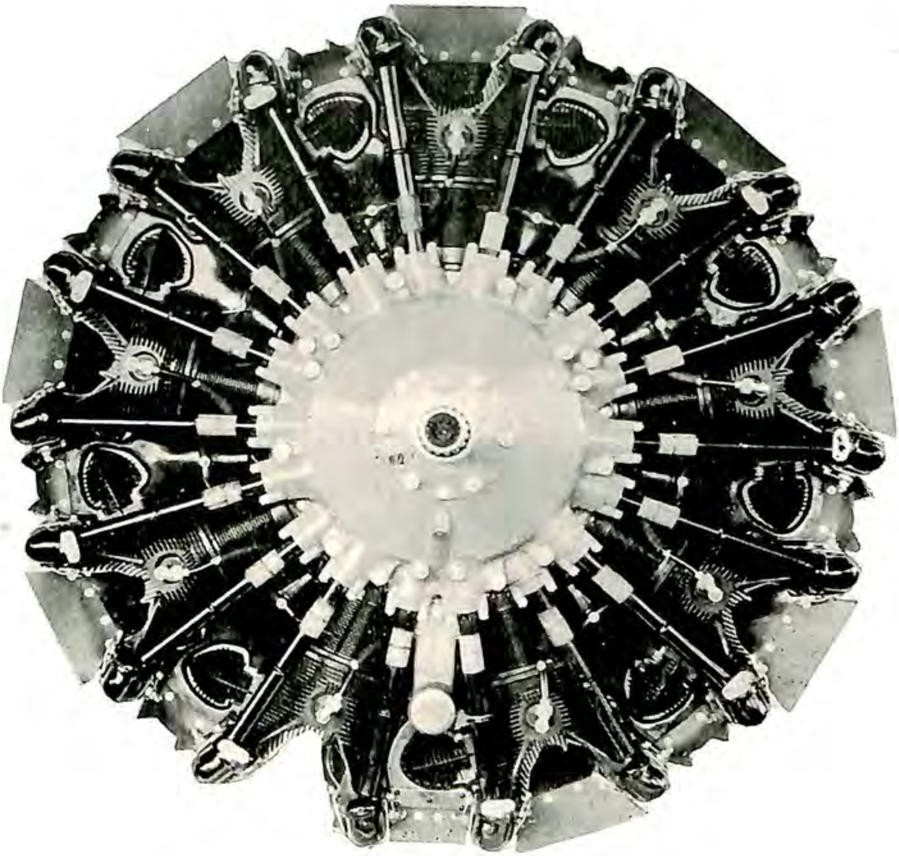
LYCOMING R-680-D

This nine-cylinder, radial, aircooled engine is rated at 245-260 h.p.



LYCOMING R-530-D

This is a seven-cylinder aircooled radial engine with normal rating of 190 h.p. and take-off rating of 210 h.p. with a compression ratio of 5.5 to 1. With a compression ratio of 6.5 to 1 it has a normal rating of 200 h.p. and a take-off rating of 220 h.p.

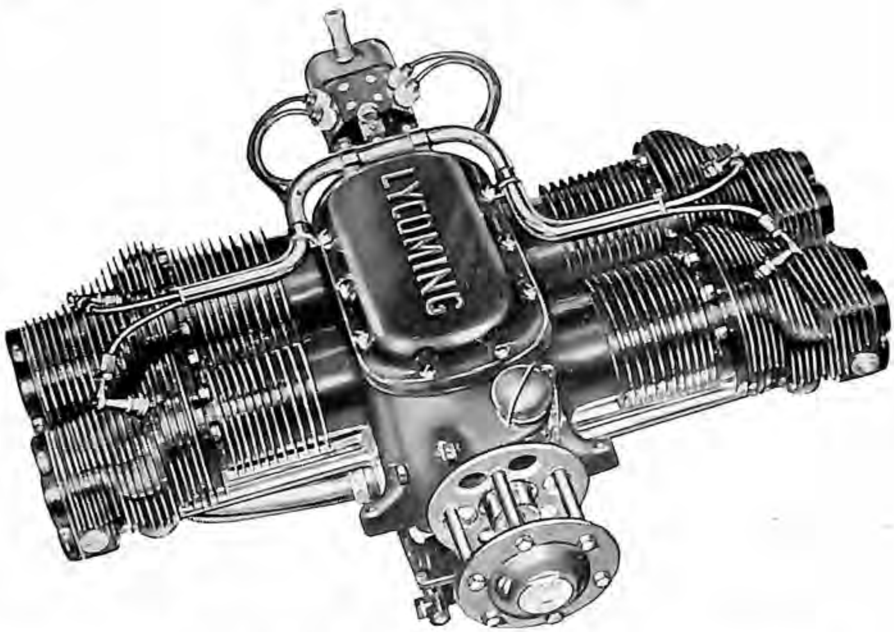


THE LYCOMING R-680-D ENGINE

This nine-cylinder model has ratings of from 245 to 260 h.p.

merce, the seven-cylinder R-530-D series engines were rated as follows: With a 5.5:1 compression ratio, the normal rating was 190 h.p. at 2,100 r.p.m. and the take-off rating was 210 h.p. at 2,300 r.p.m. With 6.5:1 compression ratio, the normal rating was 200 h.p. at 2,100 r.p.m. and the take-off rating was 220 h.p. at 2,300 r.p.m.

For light planes the Lycoming Division announced a four-cylinder, opposed engine, rated at 50 h.p. and designed for low-cost quantity production. In this engine, known as the Lycoming Model O-145, the crankcase and integral cylinders are of cast semi-steel, heat treated. Aluminum alloy cylinder heads are attached by means of studs and nuts. The top of the engine is only four inches above center-line of



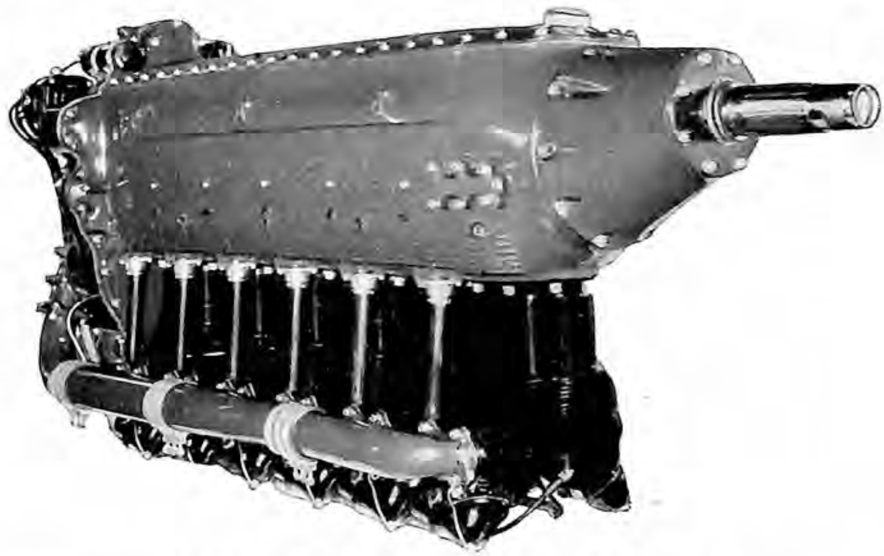
LYCOMING O-145 50 H. P. ENGINE

Front view of the new Lycoming O-145 Series, four-cylinder, opposed, 50 h.p.

thrust, and the valves are tilted downward in the cylinder, thus affording visibility. Automatic valve gear lubrication is provided to minimize maintenance attention to the valve mechanism. The propeller hub rear flange integral with the forged alloy steel crankshaft permits a No. 0 standard propeller to be readily installed and provides an overall lighter hub attachment without the usual wear.

Menasco Manufacturing Company, Los Angeles, Calif., introduced the Super-Buccaneer, its sixth current model engine. Among the six approved Menasco engines were the 95, 125, 150, 160, 200 and the 250 h.p. models. The 150, 200 and 250 h.p. models were supercharged engines. The Thompson Trophy Race of 1937 was won by a Menasco Super-Buccaneer-powered plane. Commercially, Menasco engines powered the new Ryan SC cabin plane, the Stearman-Hammond Model Y, the Rearwin Speedster and the new Swallow. The Dutch Navy used Menasco engines in its training planes. A new factory site of 2½ acres was purchased by the company thereby nearly doubling its previous plant size.

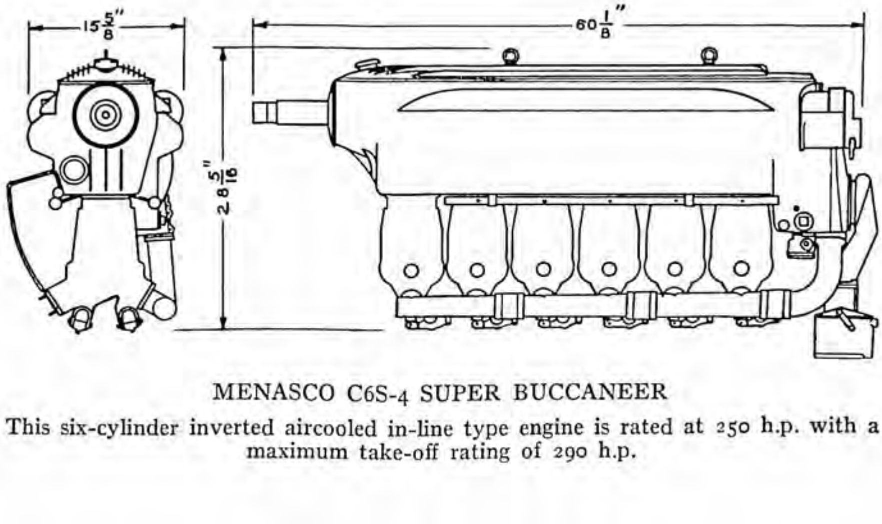
Pratt & Whitney Aircraft division of United Aircraft Corporation at East Hartford, Conn., at the beginning of 1938 had produced nearly



MENASCO C6S-4 SUPER-BUCCANEER ENGINE

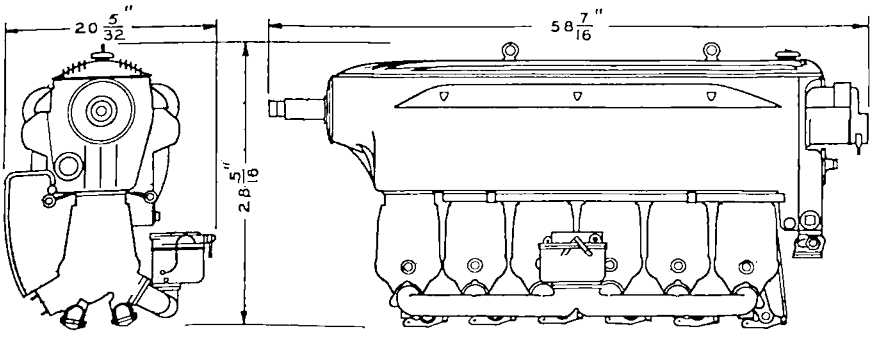
A six-clyinder inverted, in-line model supercharged and developing 290 h.p. for take-off.

13,000 engines since announcing its first engine, the Wasp 400 h.p., shortly after organizing in 1925. Late in 1937 Pratt & Whitney announced its 1,400 h.p. Twin Hornet, the latest in a line of single-row nine-cylinder engines and twin-row 14-cylinder models, including besides the new Twin Hornet, the Wasp, Hornet, Wasp Junior, Twin



MENASCO C6S-4 SUPER BUCCANEER

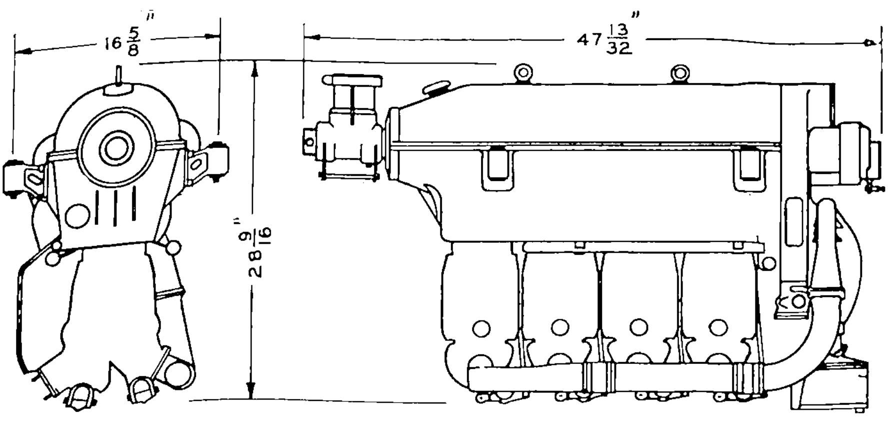
This six-cylinder inverted aircooled in-line type engine is rated at 250 h.p. with a maximum take-off rating of 290 h.p.



MENASCO B6 BUCCANEER

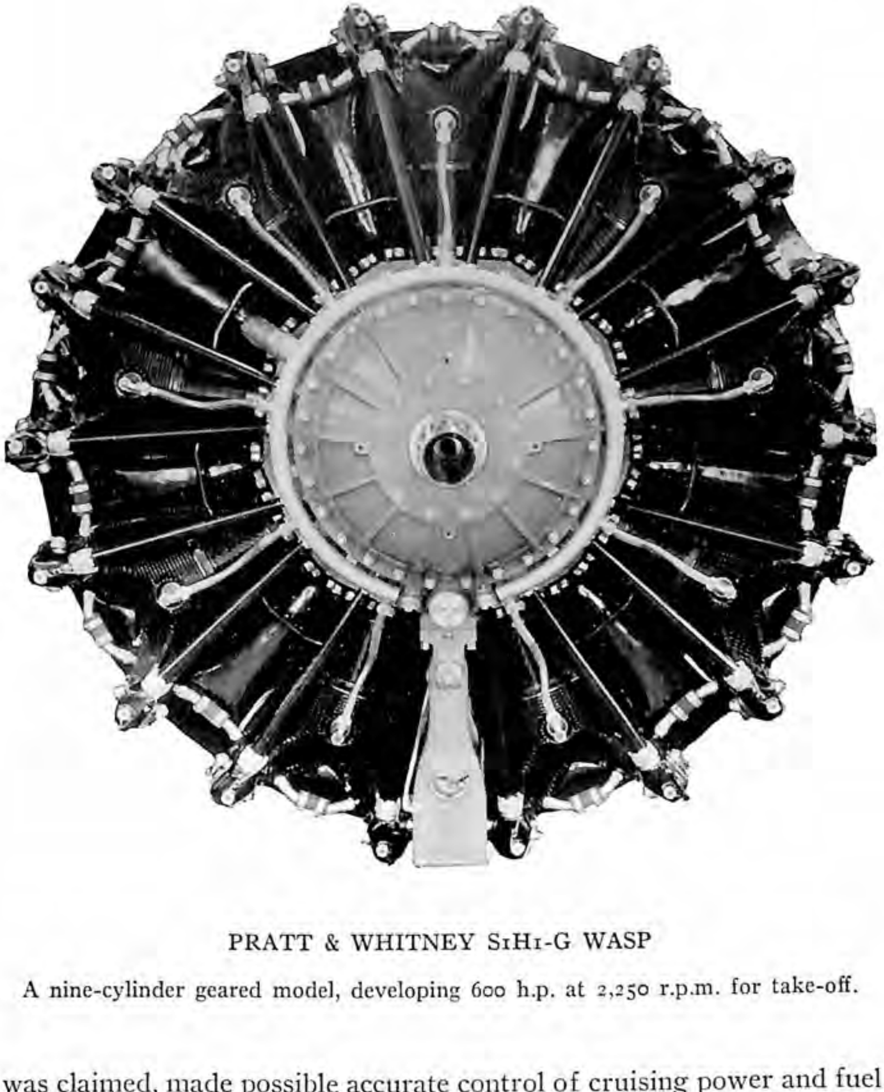
A six-cylinder inverted in-line aircooled engine developing 160 h.p.

Wasp Junior and Twin Wasp. The twin-row models powered several types of commercial and military aircraft, including the Glenn L. Martin Pacific Clipper flying boats, Army Curtiss P-36 pursuits, Consolidated Navy patrol bombers, the Douglas DC-3 Mainliners of United Air Lines, Grumman fighters, Vought scout bombers and the Sikorsky patrol bomber. The company reported that all models of its single and double-row radial aircooled types were available with the latest Pratt & Whitney design features, including automatic valve gear lubrication and automatic power and mixture control. The latter, when used in conjunction with the Hamilton Standard constant speed propeller, it



MENASCO C4S PIRATE

This is a four-cylinder inverted in-line aircooled supercharged engine rated at 150 h.p.

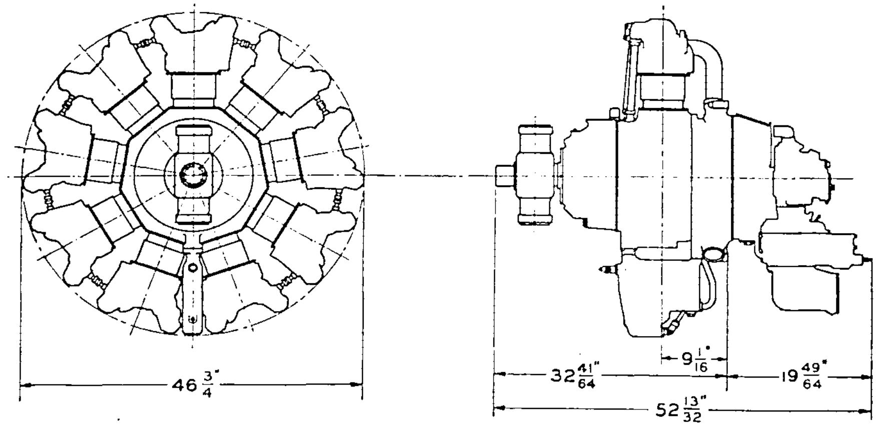


PRATT & WHITNEY S1H1-G WASP

A nine-cylinder geared model, developing 600 h.p. at 2,250 r.p.m. for take-off.

was claimed, made possible accurate control of cruising power and fuel consumption, with maximum performance, at any selected cruising height.

The Pratt & Whitney Twin Hornet was a 14-cylinder, two-row aircooled radial, displacement 2,180 cubic inches, take-off rating 1,400 h.p. at 2,500 r.p.m. with 95 octane gasoline, and 1,200 h.p. using 87 octane fuel. Normal rating was 1,150 h.p. at 2,350 r.p.m. with 95 octane fuel. This engine had successfully completed company tests equal to those of the Army and Navy, it was reported, and also had

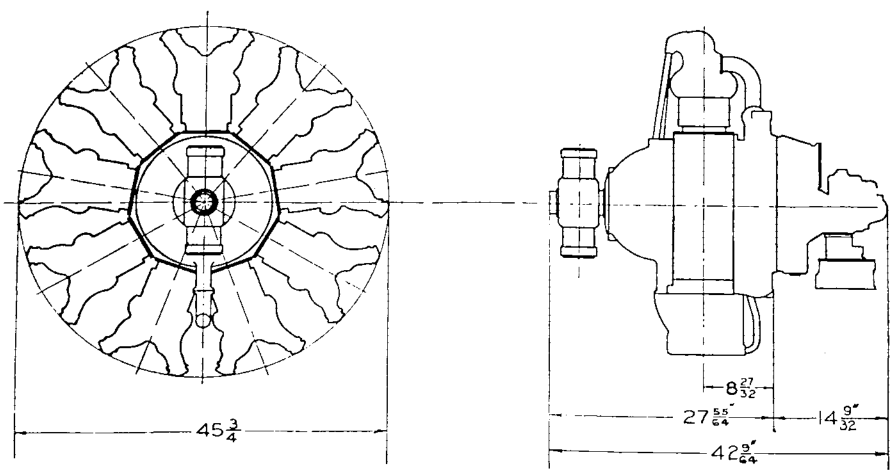


PRATT & WHITNEY WASP JUNIOR MODEL SC-G

This nine-cylinder, radial, aircooled engine is rated at 600 h.p.

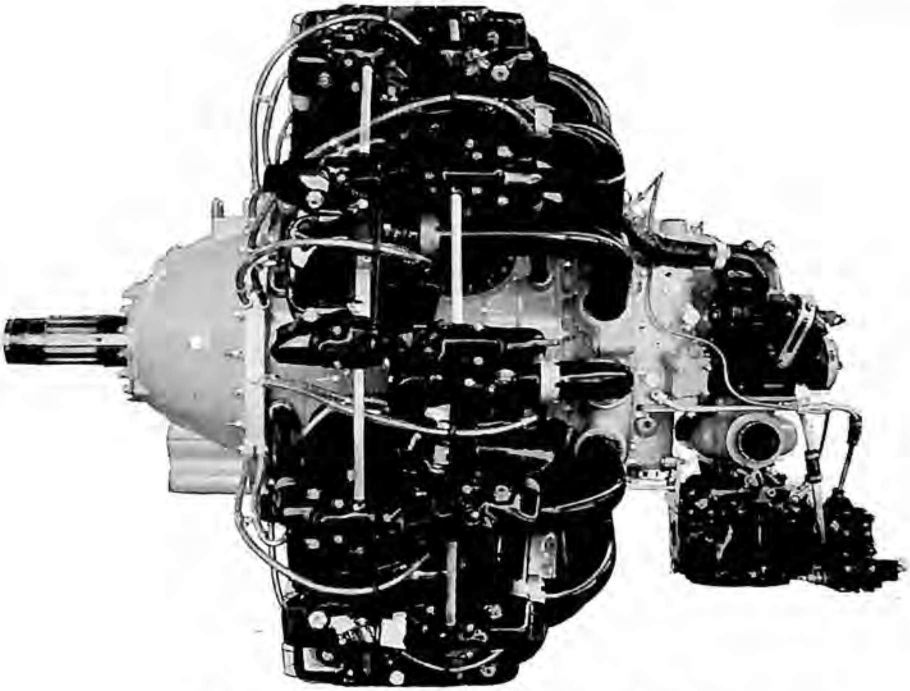
been run for long periods at take-off power on both 87 and 95 octane fuel. The company stated that it was the selected power plant for the Douglas DC-4 transport under construction for air line use.

The Pratt & Whitney Wasp Junior was a nine-cylinder radial, air-cooled engine, bore and stroke $5\frac{3}{16}$ inches, capacity 985 cubic inches. Model SB had an overall diameter of $45\frac{3}{4}$ inches, length $42\frac{1}{8}$ inches, weight dry 640 pounds, direct drive, 450 h.p. at take-off at 2,300 r.p.m. on 87 octane fuel, cruising 300 h.p. at 2,000 r.p.m. at 9,600



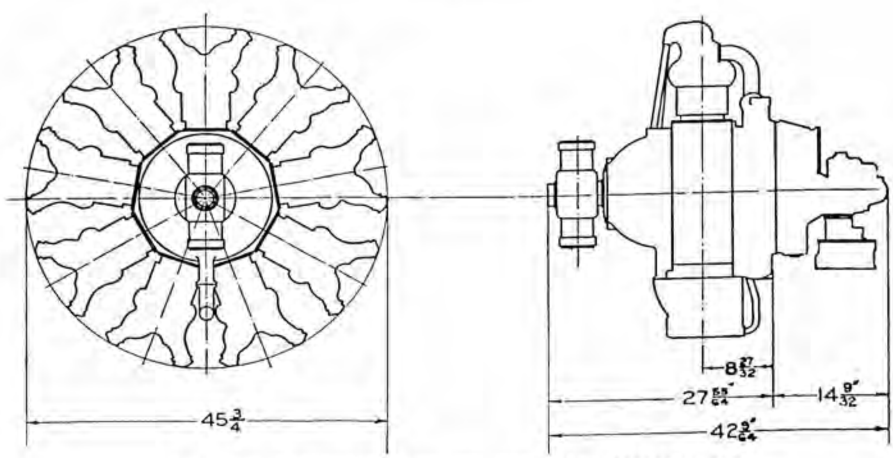
PRATT & WHITNEY WASP JUNIOR MODEL SB

A 450 h.p. nine-cylinder, radial, aircooled engine.



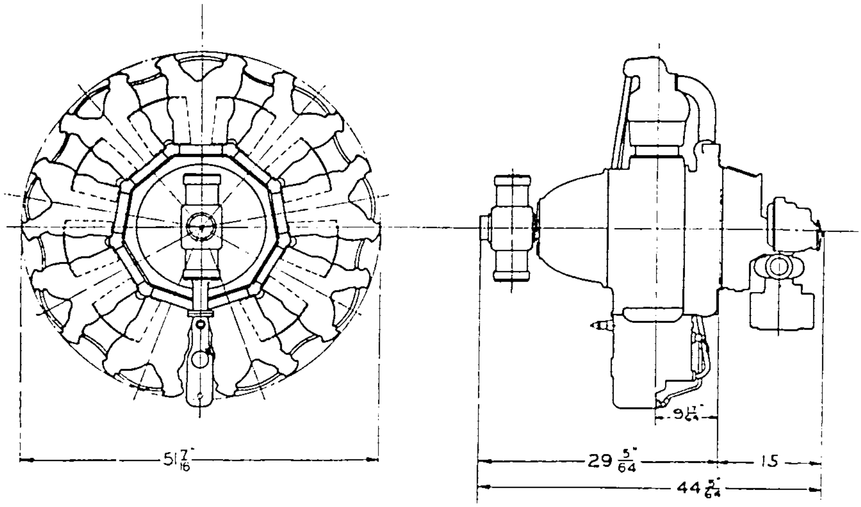
PRATT & WHITNEY TWIN WASP ENGINE

Model SB3-G, 14 cylinders in two rows, with a rating of 1,000 h.p. at 2,600 r.p.m. for take-off.



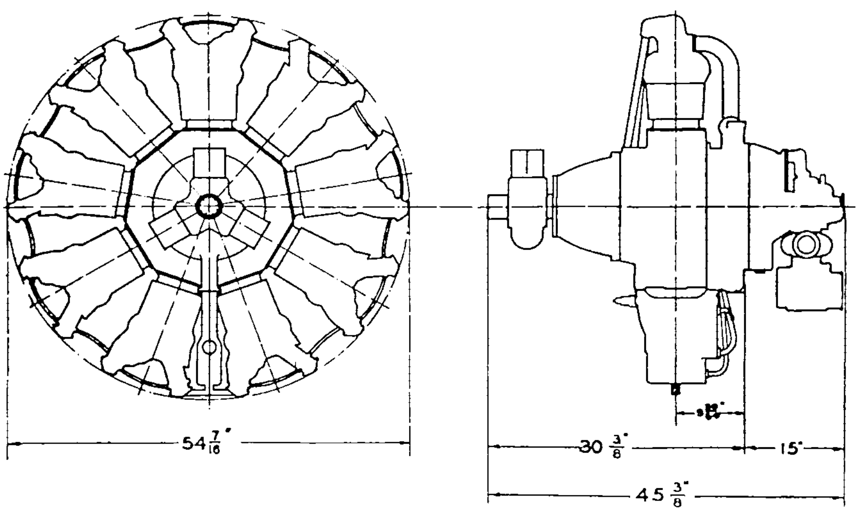
PRATT & WHITNEY WASP JUNIOR MODEL TB

A nine-cylinder, aircooled radial developing 420 h.p.



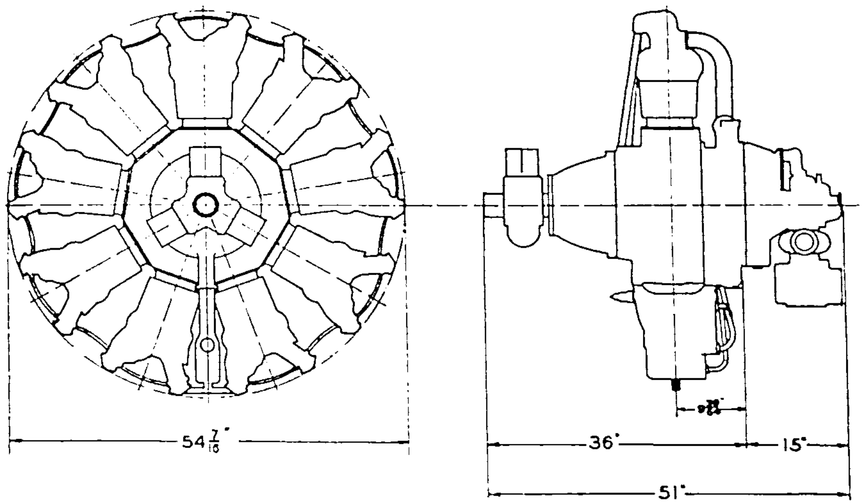
PRATT & WHITNEY WASP S3H1

A 600 h.p. nine-cylinder radial aircooled engine.



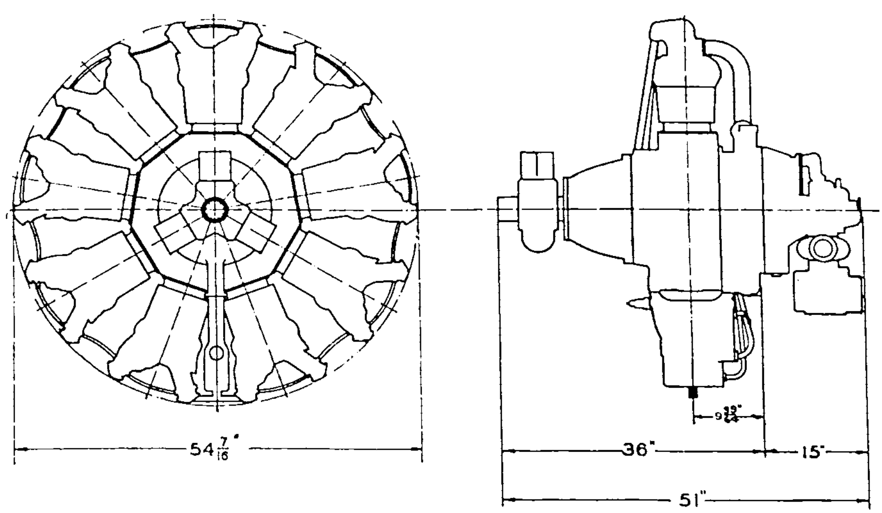
PRATT & WHITNEY HORNET S5E

A 700 h.p. nine-cylinder aircooled radial engine.



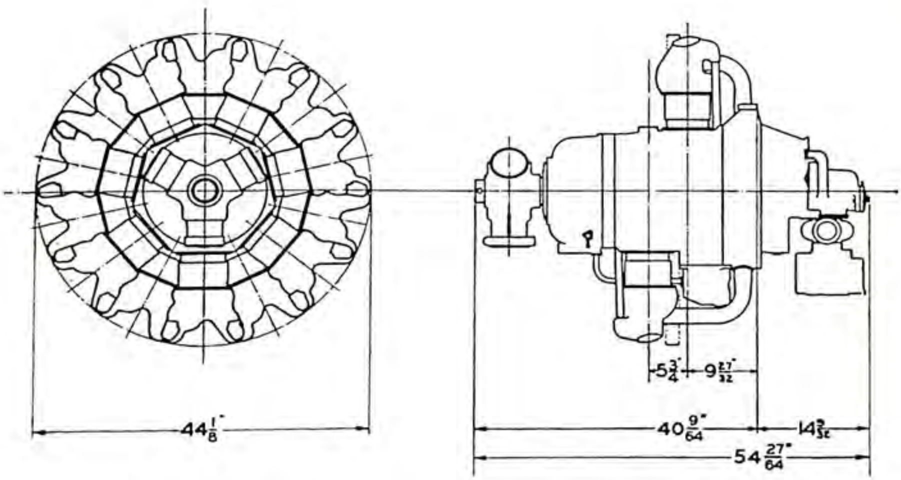
PRATT & WHITNEY HORNET S2E-G

This nine-cylinder aircooled radial engine develops 800 h.p.



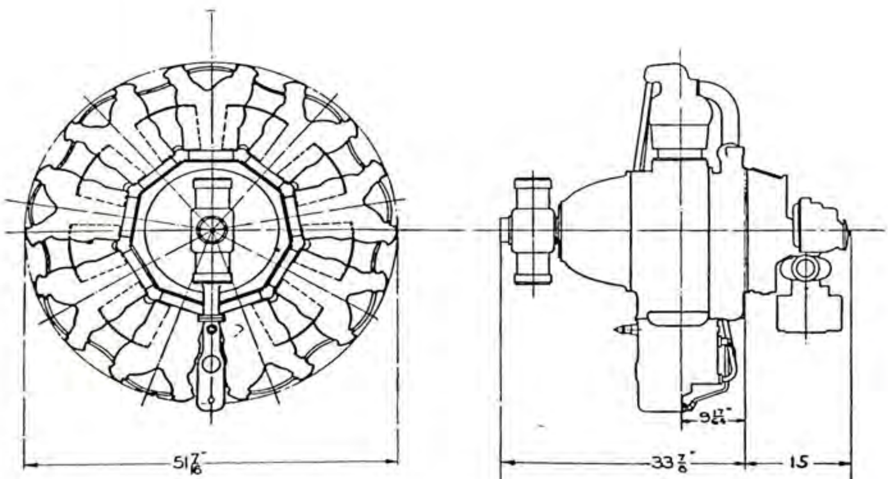
PRATT & WHITNEY HORNET S1E-G

An 875 h.p. nine-cylinder aircooled radial engine.



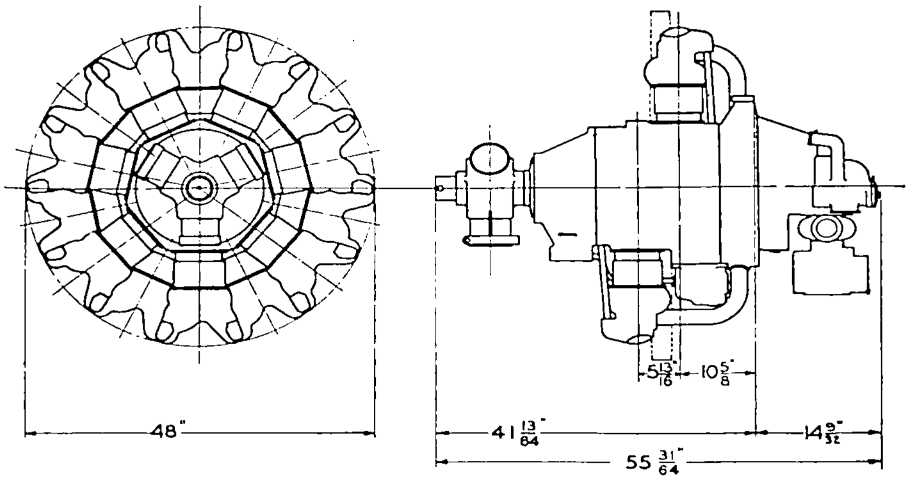
PRATT & WHITNEY TWIN WASP JUNIOR SB4-G

This is a 14-cylinder, aircooled radial engine rated at 825 h.p.



PRATT & WHITNEY WASP S1H1-G

This is a nine-cylinder, radial aircooled engine developing 600 h.p.



PRATT & WHITNEY TWIN WASP SB3-G

A 14-cylinder aircooled radial engine developing 1,000 h.p.

feet on 80 octane maximum power for continuous emergency operation 450 h.p. at 2,300 r.p.m., compression ratio 6:1, blower ratio 10:1, octane rating 87. Model SC-G has a power rating, for take-off and continuous emergency operation, of 600 h.p. at 2,850 r.p.m. on 100 octane fuel, cruising 370 h.p. at 2,400 r.p.m. at 14,500 feet, overall diameter 46¾ inches, length 52 13/32 inches, compression ratio 6.7:1, blower ratio 8.7:1, propeller drive 2:3, weight dry 864 pounds, octane value 87. Model TB had a rated power of 420 h.p. at 2,200 r.p.m., diameter 45¾ inches, length 42⅛ inches, compression ratio 6:1, blower ratio 8:1 direct drive, weight dry 640 pounds, octane value 80.

The Pratt & Whitney Wasp had a 5¾ inch bore and stroke, capacity 1,344 cubic inches, diameter 51 7/16 inches. Model S1H1-G had 600 h.p. for take-off at 2,250 r.p.m., cruising power 400 h.p. at 2,000 r.p.m. at 11,800 feet, maximum for continuous emergency operation 600 h.p. at 2,250 r.p.m., compression ratio 6:1, blower ratio 12:1, length 48⅞ inches, propeller drive 2:3, weight dry 930 pounds, octane value 87. Model S3H1 had a rated 550 h.p. at 5,000 feet, length 44 1/16 inches, weight dry 855 pounds, direct drive, compression ratio 6:1, blower ratio 10:1, octane value 80.

The Pratt & Whitney Hornet had a bore of 6⅛ inches, stroke 6⅜ inches, capacity 1,690 cubic inches and diameter 54 7/16 inches. Model S1E-G had take-off power of 875 h.p. at 2,300 r.p.m., cruising power

PRATT & WHITNEY TWIN HORNET

A 14-cylinder two-row engine with a rating of 1,400 h.p. at 2,500 r.p.m. for take-off.

525 h.p. at 2,000 r.p.m., maximum power for continuous emergency operations 800 h.p. at 2,300 r.p.m., compression ratio 6.5:1, blower ratio 12:1, propeller drive 2:3, length 51 inches, weight bare 1,015 pounds, octane value 87. Model S2E-G had take-off power of 800 h.p. at 2,300 r.p.m. cruising power 525 h.p. at 2,000 r.p.m. at 9,500 feet, maximum power for continuous emergency operations 800 h.p. at 2,300 r.p.m., compression ratio 6:1, blower ratio 10:1, propeller drive 2:3, weight dry 1064 pounds, length 51 inches, octane value 87. Model S5E had a rated power of 700 h.p. at 2,050 r.p.m. at 6,000 feet, length 45⅜ inches, compression ratio 6.5:1, blower ratio 12:1, direct drive, weight dry 975 pounds, octane value 87.

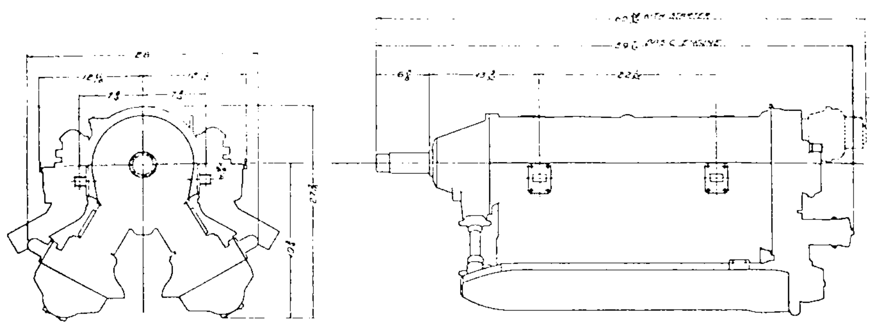
The Pratt & Whitney Twin Wasp Junior was a 14-cylinder, two-row aircooled radial. Model SB4-G had bore and stroke 5$\frac{3}{16}$ inches, capacity 1,535 cubic inches, diameter 44$\frac{1}{8}$ inches, length 53$\frac{1}{4}$ inches, weight dry (3:4 or 2:3 reduction gear) 1,087 pounds, propeller drive 2:3 or 3:4, take-off power 825 h.p. at 2,625 r.p.m., rated 750 h.p. at 2,550 r.p.m. at 9,000 feet, compression ratio 6.7:1, blower ratio 11:1, octane value 87.

The Pratt & Whitney Twin Wasp SB3-G had bore and stroke 5$\frac{1}{2}$ inches, capacity 1,830 cubic inches, diameter 48 inches, length 55$\frac{1}{2}$ inches, weight dry 1,310 pounds, take-off power 1,000 h.p. at 2,600 r.p.m., cruising 625 h.p. at 2,150 r.p.m. at 12,300 feet, maximum power for continuous emergency operation 950 h.p. at 2,550 r.p.m., compression ratio 6.7:1, drive 2:3, blower ratio 12:1, octane value 87.

Ranger Engineering Corporation, Farmingdale, N.Y., a division of the Fairchild Aviation Corporation, at the beginning of 1938 was continuing production on several models of inverted, in-line, aircooled engines. They covered a power range from 150 to 420 h.p.

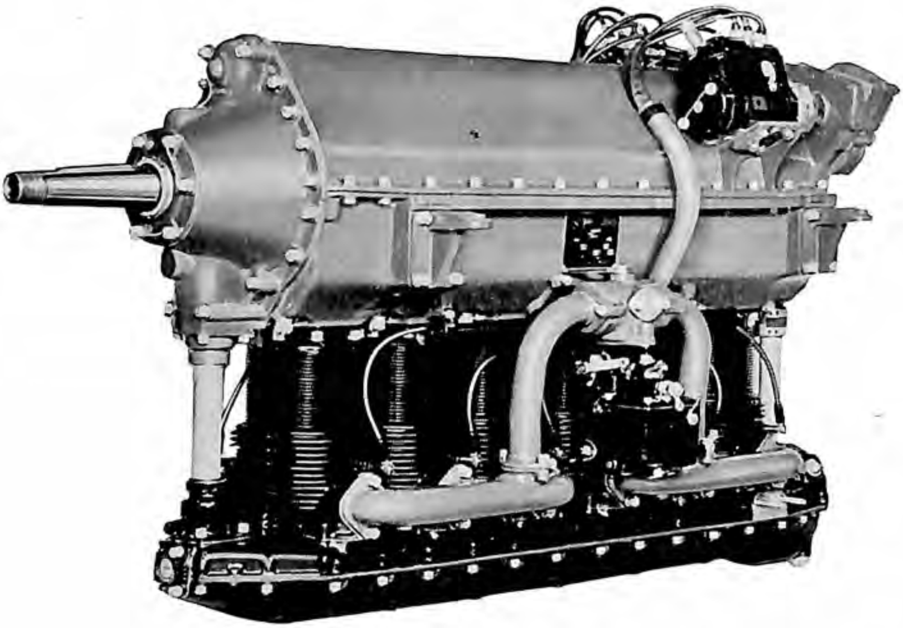
Commercial production models were the six-cylinder 6-390D-3 with a rating of 150 h.p. at 2350 r.p.m., the V-770B-4, direct-drive, unsupercharged, 12 cylinders rated 290 h.p. at 2300 r.p.m. and the SGV-770B-5 geared and supercharged. The latter was rated 420 h.p. at 2800 r.p.m. at 3000 ft. altitude with a reduction gear ratio of 3:2 and blower ratio of 8.84:1. Further development of the SGV-770 for military purposes was actively carried forward throughout the year.

Developments completed during 1937 increased the ratings of all



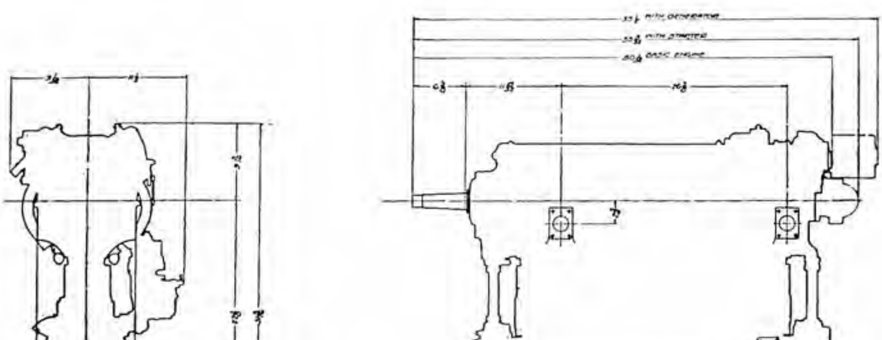
RANGER V-770B-4

This is a direct drive, unsupercharged 12-cylinder engine rated at 305 h.p. at 2,300 r.p.m.



RANGER 6-410B-1 ENGINE

A six-cylinder engine developing 165 h.p. at 2,400 r.p.m. at sea level.



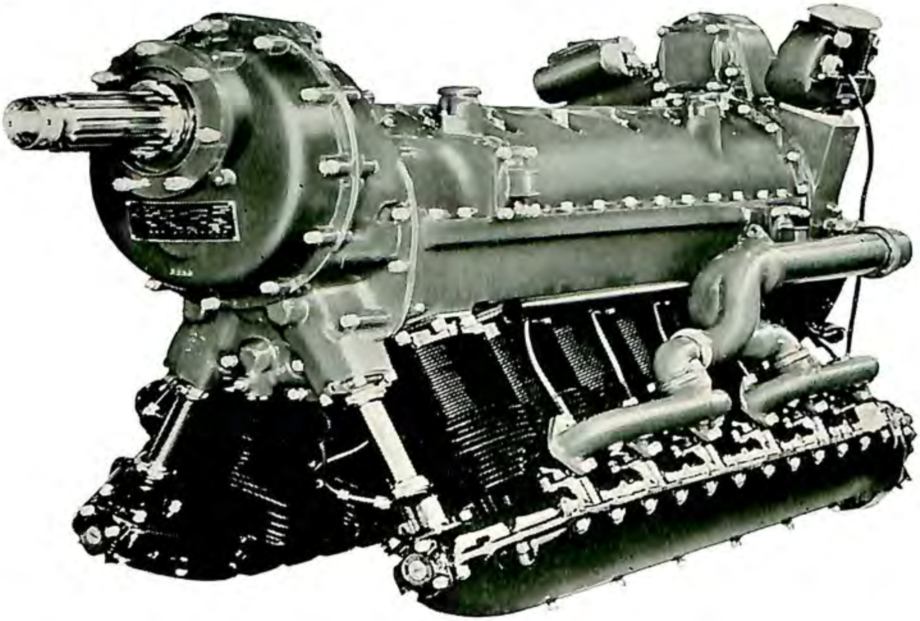
RANGER 6-390D-3

This six-cylinder aircooled inverted in-line engine is rated at 165 h.p. at 2,350 r.p.m.

Ranger commercial models. At the beginning of 1938 the company had received Approved Type Certificates, and was in production on these engines with the following ratings: Six-cylinder Model 6-410B-1, direct drive, unsupercharged, rated 165 h.p. at 2450 r.p.m. with a bare weight of 355 pounds; twelve-cylinder Model V-770B-4, direct drive, unsupercharged, rated at 305 h.p. at 2300 r.p.m. with 315 horsepower for take-off, and a bare weight of 565 pounds. Fuel specification 80 octane; twelve cylinder Model SGV-770B-5, geared and supercharged, rated at 420 h.p. at 1870 propeller r.p.m. at 3000 feet, and 450 h.p. at 2900 r.p.m. for take-off with a bare weight of 640 pounds. The reduction gear ratio was 3:2 and blower ratio 8.84:1. All models incorporated features developed by the Ranger company, such as overhead-camshaft valve gear and complete automatic lubrication. The lubrication system was arranged to eliminate all external pressure oil lines and connections, and to provide built-in centrifugal oil cleaners. The accessory drive was of a type which protected these units from destructive vibration without the use of any kind of spring-loaded drive or clutch element. On geared and supercharged engines the propeller reduction gears and blower gears were also protected from destructive vibrations and excessive loads by a design which eliminated these complications from the drive. Ranger engines were sold to Poland, Czechoslovakia, Holland, Greece, and Japan.

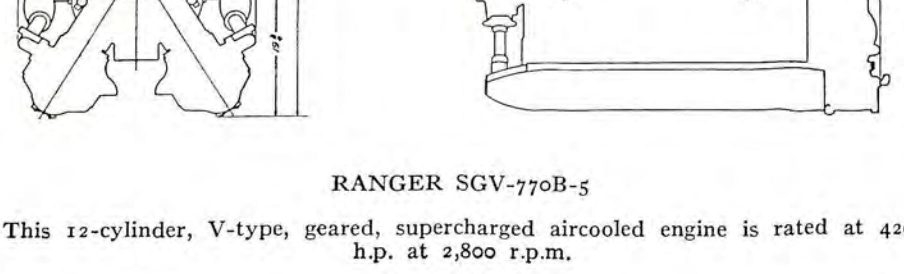
Warner Aircraft Corporation, Detroit, Mich., produced its series of three Scarab model radial aircooled engines. The Scarab Junior was a five-cylinder, direct drive motor, 90 h.p. at 2,025 r.p.m., length 28.5 inches without starter, weight 235 pounds. The Scarab was seven-cylinder, and had 125 h.p. at 2,050 r.p.m., weight 285 pounds. The seven-cylinder Super Scarab had 145 h.p. at 2,050 r.p.m., weight 305 pounds.

Wright Aeronautical Corporation, Paterson, N. J., the aircraft engine division of the Curtiss-Wright Corporation, announced that more than 2,100 of its Wright G Cyclone engines of the 1,000 h.p. type had been sold during the last 18 months. These orders were in addition to sales of about 900 Wright F-50 Cyclones, between 800 h.p. and 900 h.p. for take-off, sold in the same period. The company reported total sales of approximately 7,000 Cyclone motors since they were placed in production. The company announced that the Army Air Corps had ordered more than a thousand of the 1,000 h.p. Cyclone engines for the new Douglas twin-engine, the Boeing four-engine bombers and the new North American observation planes. American Airlines, Eastern Air Lines, Pan American Airways, Royal Dutch Airlines, Swissair and Australia National Airways were among the scheduled transport companies using 1,000 h.p. Cyclones in the Doug-



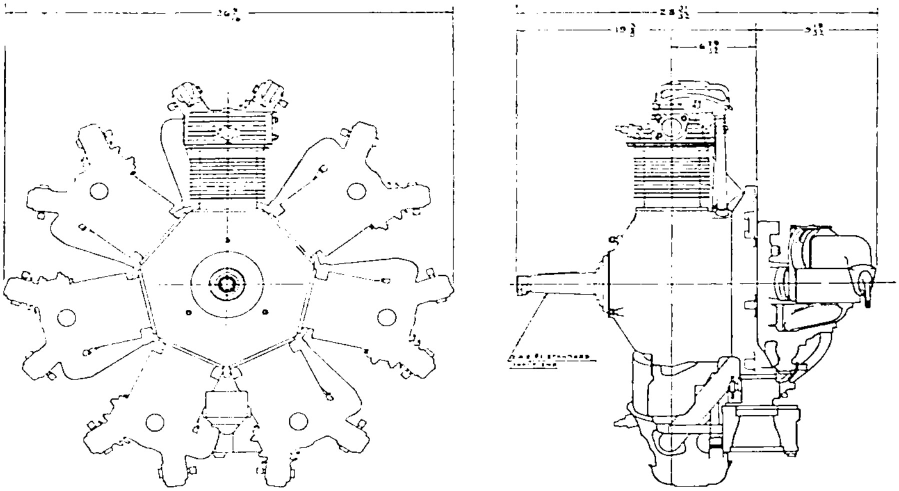
RANGER SGV-770B-5 ENGINE

A 12-cylinder engine developing 420 h.p. at 2,800 r.p.m. at 3,000 feet; 450 h.p. for take-off from sea level to 2,000 feet.



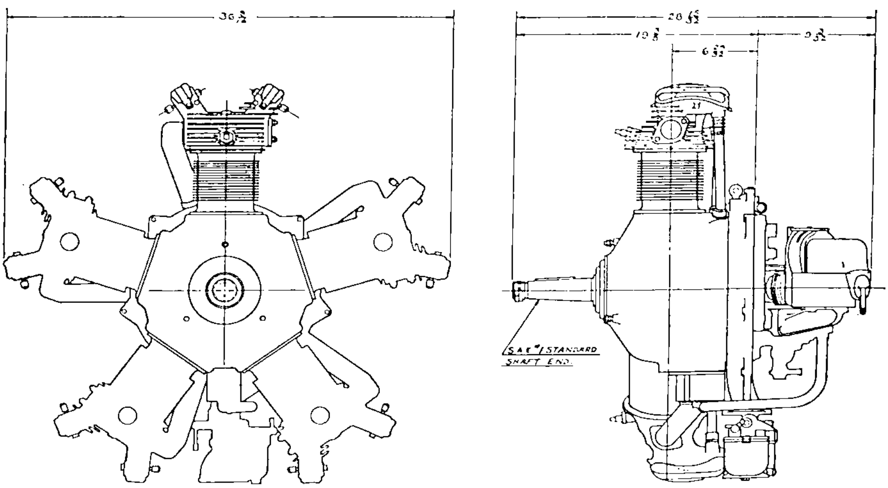
RANGER SGV-770B-5

This 12-cylinder, V-type, geared, supercharged aircooled engine is rated at 420 h.p. at 2,800 r.p.m.



WARNER SCARAB

A seven-cylinder aircooled radial engine rated at 125 h.p. at 2,050 r.p.m.



WARNER SCARAB JUNIOR

A five-cylinder aircooled radial engine rated at 90 h.p. at 2,050 r.p.m.

WARNER SUPER-SCARAB ENGINE

A seven-cylinder model developing 145 h.p.

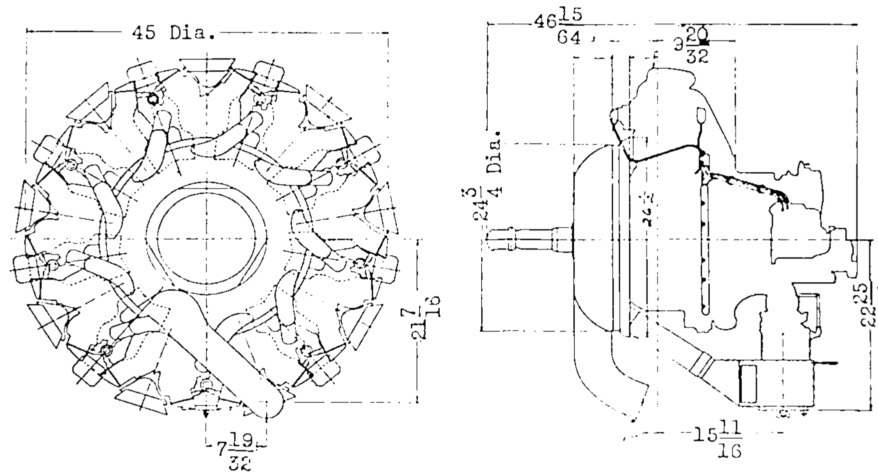
las DC-3 transports besides the 700 to 800 h.p. Cyclones in the DC-2 ships. Cyclones of 1,000 h.p. also powered more than 100 Vultee V-1A attack bombers sold to China, Turkey and Russia, while a similar number of Glenn L. Martin twin-engine bombers for export were also powered by the same engine.

The Wright Aeronautical Corporation in 1937 brought out the double-row Cyclone 14, a 14-cylinder engine of 2,600 cubic inch displacement, with an initial rating of 1,500 h.p. for take-off and 1,200

THE WRIGHT WHIRLWIND ENGINE

This seven-cylinder model has ratings of 235, 285, 320 and 350 h.p.

h.p. for sea level operations. The Army and Navy services had some of these on order, and the Pan American Airways System had ordered 25 for installation in its new four-engine ocean Clipper ships, the Boeing 314, under construction at the plant of the Boeing Aircraft Company in Seattle, Wash.



WRIGHT WHIRLWIND R-975-E

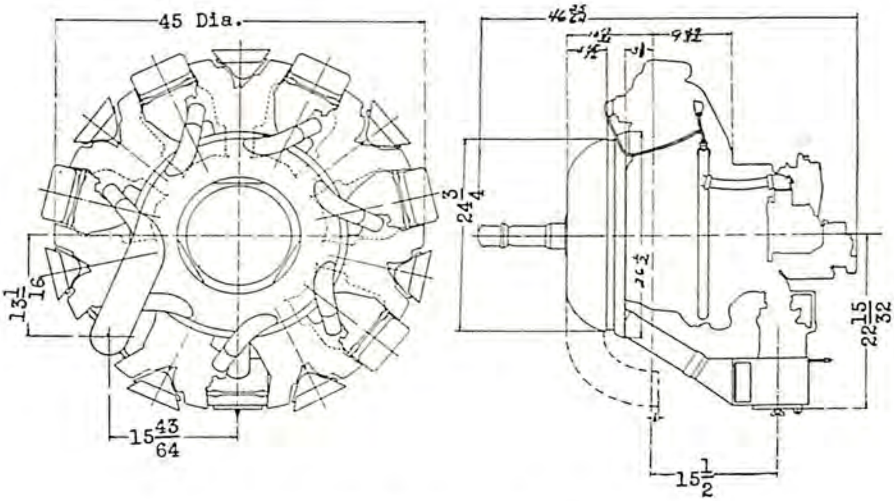
A nine-cylinder, aircooled radial engine rated at 365, 420 and 450 h.p.

Besides the new Cyclone 14, the Wright company was producing the following engines: Cyclone Series F-50, Cyclone G Series, Cyclone G-100 Series, all high-powered, nine-cylinder single-row radials of 1,823 cubic inch displacement; and the single-row Whirlwind Series of seven and nine cylinders.

The Wright Cyclone G-100 represented a development of the Cyclone G Series. Rated at 1,100 h.p. for take-off it incorporated several new design features, including a steel main crankcase, longer pistons for better cooling and a new type carburetor. The engine, complete with all accessories, weighed 1.12 pounds per horsepower. Engines of that type were chosen to power the Boeing four-engine sub-stratosphere land transports under construction for TWA and Pan American Airways, each ship to be of 21 tons gross weight.

Two models of the G-100 Series Cyclone were approved for ratings by the U. S. Department of Commerce. They were the Cyclone GR-1820-G102, 1,100 h.p. for take-off, 900 h.p. at sea level and 900 h.p. at 6,000 feet; and the Cyclone GR-1820-G103, 1,000 h.p. for take-off, 860 h.p. at sea level and 860 h.p. at 10,000 feet. Both engines were geared 16:11 and each weighed 1,275 pounds.

The Wright G Cyclone, although of the same displacement—1,820 cubic inches—as the Cyclone F and F-50 engines, included a new cylinder with a cooling fin area of 2,800 square inches against 1,000 in the other models. Improved foundry technique made possible the cast-

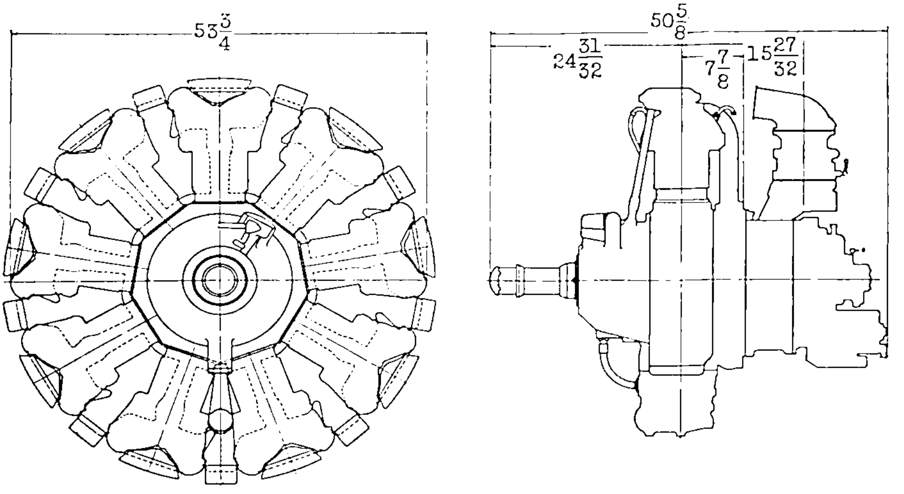


WRIGHT WHIRLWIND R-760-E

Versions of this seven-cylinder aircooled radial engine are rated at 235, 285, 320 and 350 h.p.

ing of cooling fins on the G cylinder head as closely spaced as the teeth of a comb and nearly two inches deep over the combustion chamber. The cylinder barrels were of nitralloy steel, nitrated to obtain a cylinder bore with a surface claimed to have thrice the wear resistance of ordinary heat-treated cylinder-barrels. The Wright company installed five large nitriding furnaces for that process. More accurate fuel control combined with the improved cylinder to permit a rating of 1,000 h.p. at take-off, with a weight of 1.07 pounds per horsepower and fuel consumption of .43 pounds per horsepower hour cruising, in certain models. Other features included automatic lubrication of the valve gear from a built-in system devoid of external lines or tubes, mechanism for operating two-position hydro-control and constant speed propellers, an accessory section provided with the driving mechanism for all requirements in military and civil transport services, the dynamic damper counterweight which counteracts torsional vibration at crankshaft speeds, full pressure baffling of cylinders, improved oil seals and refinements in the supercharger and induction systems to increase altitude performance.

The Wright G Cyclone was produced in three geared models and their direct drive counterparts. They were the Cyclone GR-1820-G1, 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, 1,000 h.p. for take-off, 820 h.p. at sea level,

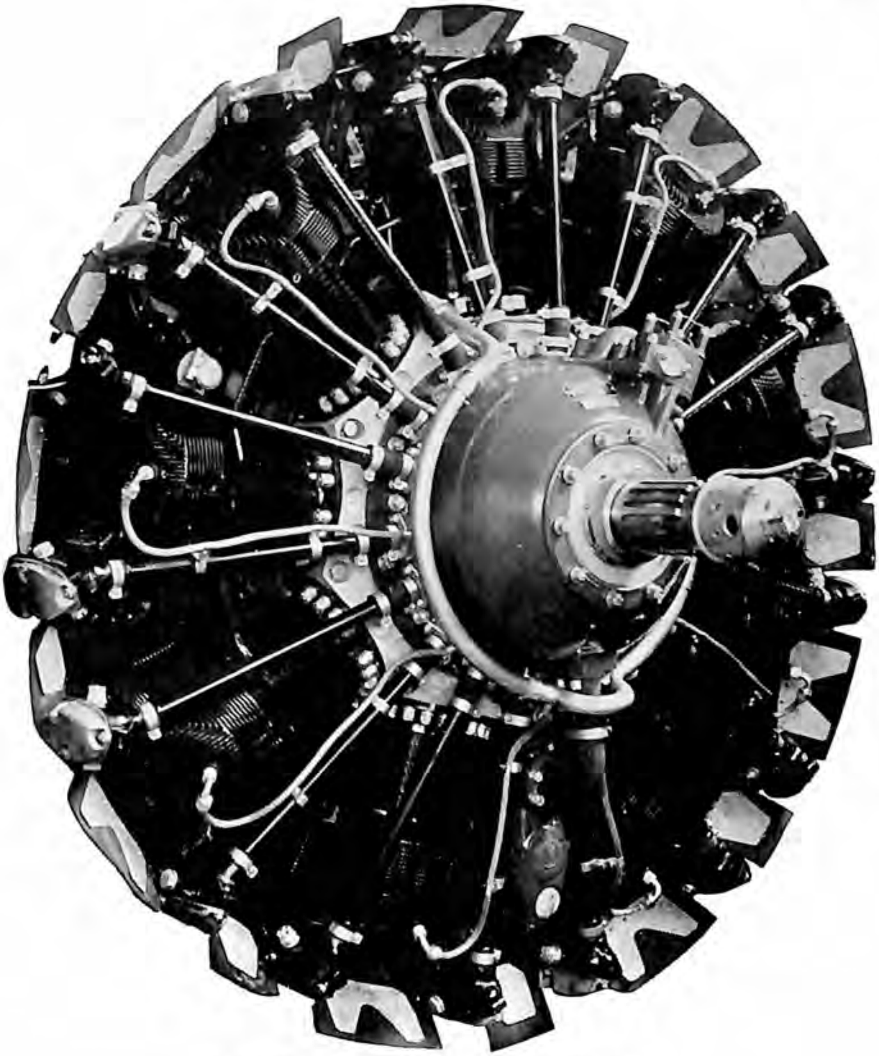


WRIGHT CYCLONE R-1820-G2 GEARED

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 5,800 feet.

and 850 h.p. at 5,800 feet; the Cyclone GR-1820-G3 rated at 875 h.p. for take-off, and 840 h.p. at 8,700 feet. The various G Cyclone models differed only with respect to the amount of supercharging applied. The G-1 had a blower gear ratio of 5.95:1; the G-2 a blower ratio of 7:1; and the G-3 a blower ratio of 8.31:1. All the G Series engines were nine-cylinder and had the following characteristics; bore, 6.125 inches, stroke 6.875 inches, compression ratio 6.45:1, diameter 54¼ inches, length 43¼ inches, dry weight (geared) 1,183 pounds (direct drive) 1,088 pounds.

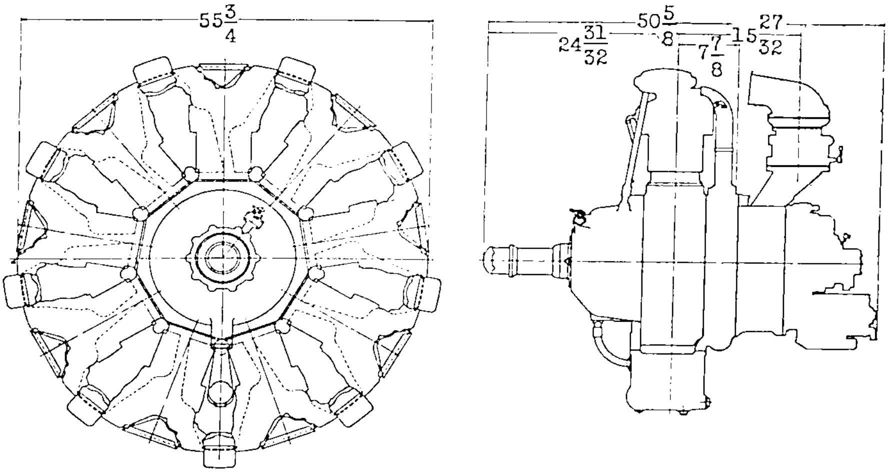
The six Boeing B-17 "flying fortress" bombers which the Army Air Corps flew to South America in February, 1938, flying the Andes at 17,000 feet or more, were powered by Wright G Cyclones equipped with two-speed superchargers developed by the Wright Aeronautical Corporation. The two-speed supercharger, it was stated, solves one of the principal problems in which large military planes require high performance for take-off at sea level and equal performance at high altitudes. The two-speed supercharger effect is produced by changing the supercharger driving gears to change the blower gear ratio, that is, the speed of the supercharger. During take-off under heavy load conditions or in flight near sea level the two-speed superchargers are fixed in the low blower ratio position providing about 1,000 h.p. for take-off. Up to a certain altitude that supercharging provides maxi-



WRIGHT G-100 CYCLONE ENGINE

Rated at 1,100 h.p. for take-off.

mum performance. After that height is reached the power begins to fall off as the air becomes thinner, when the engine is switched into high blower ratio which provides the additional supercharging required to produce sea level power at the higher levels. The shifts from low to high blower ratio is made by means of one control lever in the pilot's cockpit.



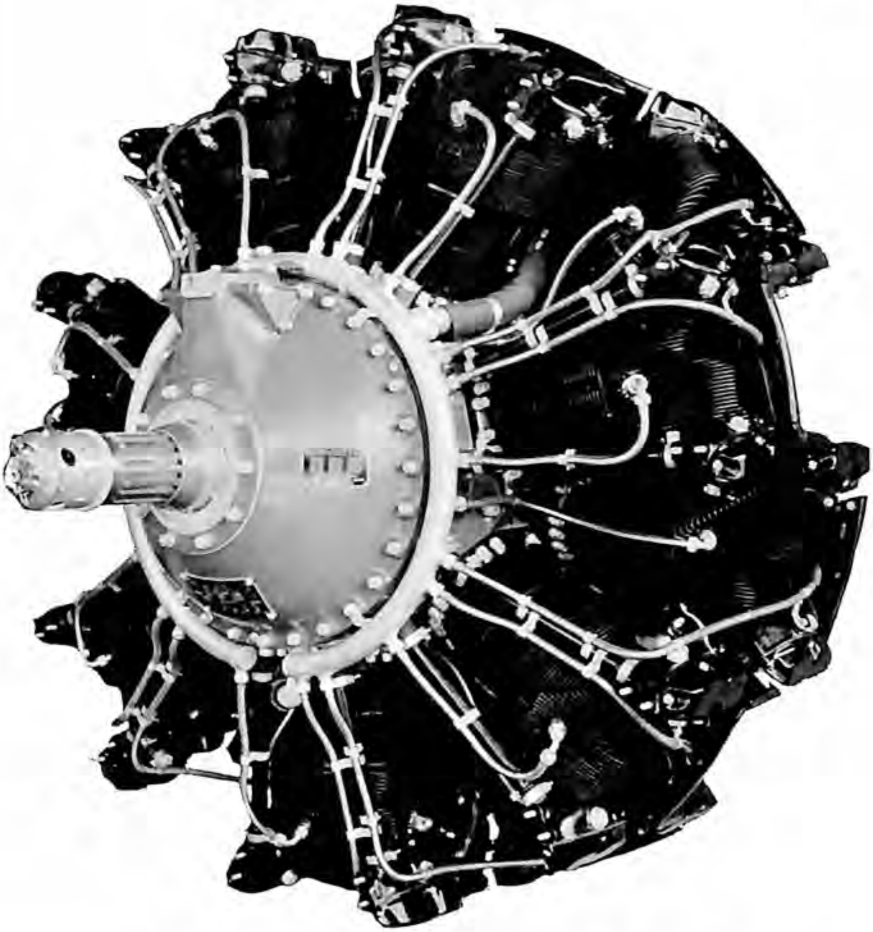
WRIGHT CYCLONE GR-1820-F52 GEARED

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.

The Wright F-50 Series Cyclone was produced in four direct drive models and their geared counterparts. These were the Cyclone R-1820-F52, 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, 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, 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, 785 h.p. for take-off, 695 h.p. at sea level, and 755 h.p. at 11,300 feet.

The models of the Wright F-50 Series were identical except for the amount of supercharging applied. All were nine-cylinder. The F-52 had a blower gear ratio of 7:1; the F-53 a blower gear ratio of 8.31:1; the F-54, a blower gear ratio of 10:1 and the F-56, a blower gear ratio of 8.83:1. Characteristics common to F-50 models were: bore 6.125 inches, stroke 6.875 inches, compression ratio 6.40:1, diameter 54⅛ inches; dry weight (geared) 1,070 pounds (direct drive) 975 pounds.

The single-row Wright Whirlwind models of seven and nine cylinders, under development for over 17 years were rated as follows: seven-cylinder 235 h.p. and 320-350 h.p.; nine-cylinder 365 h.p. and 420-450 h.p. The seven-cylinder Whirlwinds of 320-350 h.p. and the nine-cylinder Whirlwinds of 420-450 h.p. were provided with automatic valve gear lubrication, a new type of nose exhaust collector



WRIGHT DOUBLE ROW CYCLONE 14 ENGINE

Approved by Department of Commerce for a rating of 1,500 h.p. for take-off and 1,200 h.p. for normal operation at sea level.

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 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, provided greater accessibility in installations where the engine was mounted in rubber; complete radio shielding for ignition wiring, spark plugs, and magnetos.

Some of those features also were provided in the Whirlwinds of 365 h.p. The following specifications were common to all Whirlwinds, parts of which were more than 90 per cent interchangeable: bore five inches, stroke 5.5 inches, and diameter 45 inches. Weights, compressions and blower ratios vary with individual models.

The Wright Aeronautical Corporation during the latter part of 1937 completed extensions to its large factory, which brought the floor space available to approximately 800,000 square feet. Largest addition was a new four-story wing branching from one of the main buildings in which are now housed the production engineering and manufacturing offices, the personnel, standards, and time departments, and extensions of the crank-case and gear departments. To the new testing laboratory built in 1936 were added two more test cells, bringing to four the total test stands available for testing engines up to 2,500 h.p.

Manufacturers of Accessories

Aero Supply Manufacturing Company, Inc., Corry, Pa., continued to produce a full line of accessories for the industry.

Aero Spark Plug Co., Inc., New York, manufactured four types of "Universal" spark plugs for aircraft engines, including shielded and unshielded plugs for short and long reach engines.

Air Associates, Inc., Garden City, N. Y., manufactured bolts, clevis bolts and eye bolts, nuts, turnbuckles, thimbles, shackles, cowling studs and pins, rod ends and other fittings; also high pressure hydraulic hand pumps, propeller brakes, de-icer equipment, radio shielding, radio equipment, electrical equipment, wheels, safety belts, ventilators, beacons, wind cones, engine heaters and inter-communication sets. The company also acted as sales agents for many other 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 1938 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. A wider application of Alclad sheet was noted in the aircraft industry. Superior resistance to corrosion of this material has been an important factor in extending its popularity. This Company continued its program of research, development and service activities, cooperating actively with the aircraft industry, private and Government aircraft activities.

American 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 1938 it had available a full line of hydraulic brakes for all wheels produced by

BEECHCRAFT MODEL 18

A six-place twin-motored monoplane powered with Jacobs or Wright Whirlwind engines.

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, was 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 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, 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 1937 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, continued its aviation spark plug development work, and introduced new alloys to increase electrode life. The manufacturing facilities of the company were greatly expanded by the installation of new equipment and the acquisition of additional floor space. After a comprehensive study of the service problem, an illustrated booklet was published in which a standard method was detailed for the correct servicing of B. G. mica insulated aviation spark plugs. A feature of B. G. construction is the built-up center electrode in which selected alloys are used. Advantage has been taken of this construction to replace the electrode tips, at the factory, when as a result of long, hard service, excessive wear occurs which ordinarily would necessitate scrapping the complete plug.

The M-402 Electrode Forming and Adjusting Tool was developed to provide an accurate and rapid means of servicing B.G. aviation spark plugs in the field and to increase the flying time of the plugs between electrode adjustments. For forming the four-point shell electrodes of B.G. 18 m.m. spark plugs, a series of five male dies cover the complete range of these plugs used in aviation service. One male die, used in conjunction with the female die recessed in the lower end of the vertical rack of the new tool, accurately forms the shell electrodes to follow the contour of the familiar shaped center electrode tip of B.G. plugs.

After forming the shell electrodes, the plug is assembled and the individual electrodes are set to the proper clearance. This is accomplished under the pressure of a specially designed electrode adjusting foot, which is operated by a handwheel. Because of the constant clearance or gap which the new tool makes possible, electrode erosion is distributed over a large area of the electrode tip. As a result, electrode burning time is extended and the period between necessary gap adjustments is greatly increased.

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.

Boston Insulated Wire & Cable Co., Boston, Mass., manufactured a line of all sizes of electric wire for 110 volt service on aircraft, also a multi-conductor instrument cable for use on the new electrical control instruments.

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 1937; 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. The latest addition to Champion laboratory equipment was a Universal single cylinder test engine and dynamometer for determining service expectations of aviation spark plugs as developed for various types of engines.

Cities Service Company, New York, during 1937 operated a fleet of three planes, including a Douglas DC-2, a Wright-powered Beech-

THE CURTISS CONSTANT SPEED PROPELLER

Close-up of Curtiss Army P-36A pursuit monoplane powered by a Twin Row Wasp and a Curtiss constant speed propeller.

craft and a Lycoming-powered Stinson. These planes were used for sales promotion within the industry and executive transportation. The company produced an instrument designed to increase fuel economy. It was known as the Power Prover, an exhaust gas analyzer weighing approximately 10 pounds, to analyze the exhaust gases by burning them. The results of this analysis were 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 produced in 1937, in addition to Cities Service special aviation fuels and lubricants.

The Cleveland Pneumatic Tool Company, Cleveland, O., developed the "Aerol" struts. Every set of struts was especially designed for the ship on which they were to be used. The plane's weight, the length of stroke of the strut, the size of tire used, and the air pressure in the tire, were all factors which entered into the design of the metering pin regulating the size of the orifice controlling the flow of oil in the strut at the instant of landing impact. The design was such that the immediate shock of impact was taken on oil, then, in taxiing, the minor impacts were taken on air. Recent Aerol Strut designs were for the Boeing 307, the Douglas DC-4 and the Lockheed 14. The Company also introduced the Cleco Nos. 13 and 24 squeeze riveters, a type of machine which found extensive adoption in airplane manufacture. Another recent item was the Cleco sheet holder, many thousands of which were employed in temporarily securing sheets to each other and to structural members in fabrication operations involving duralumin and other metal sheets.

Curtiss Propeller Division of the Curtiss-Wright Corporation, at Buffalo, N. Y., delivered a large number of Curtiss feathering propellers to the Army Air Corps, Navy and Coast Guard as well as to domestic and foreign non-governmental customers. Repeat orders for delivery in 1938 numbered four times the total of last year's production.

The Curtiss feathering propeller, electrically operated, combines constant speed control by means of an engine driven governor with auxiliary selective type control by means of electric snap switches. This combination, while retaining all the advantages of constant speed control, such as making full power available for take-off and the automatic adaptation of propeller pitch to varying flight conditions, provides an additional safety factor in the form of an auxiliary operating system that functions independently of the control governor. The selective control system has been found useful as a means of checking the operation of the airplane power plant, because, by its use, the propeller pitch may be held fixed at any desired angle with the operating range, thus permitting a more accurate check of engine operation by removal of one variable quantity. Under certain flight conditions, fixed pitch operation is found preferable to the use of the constant speed control.

To meet the requirements of modern high performance military and commercial airplanes, the range of blade adjustment permits increasing pitch until the blades are feathered. In this position the aerodynamic forces on the blades of a propeller mounted on an inactive power plant are in balance and there is no tendency for propeller rotation due to windmilling action. The ability to feather the propeller blades is important on multi-engined airplanes because by elimination of windmilling of the propeller on an engine which, for any reason, has been switched off, much better flight characteristics on the remaining power are obtained. The removal of the excessive drag occasioned by windmilling and turbulence over the section normally in the slipstream of the inactive engine provides better climb, ceiling and cruising speed. The feathered propeller makes it possible to continue flight at a higher altitude than is possible with a windmilling propeller or to continue at the same altitude but with a lighter load on the remaining power plants.

The high range of blade adjustment is a distinct advantage on single-engine airplanes used for combat or high altitude operations because the constant speed control, working over a larger range is able to cover a larger range of altitude and more violent maneuvers. The large range permits the constant speed control to hold engine speeds during long dives, within the limits specified by the engine manufacturers. Feathering and unlimited pitch range are inherent features of the Curtiss propeller design, and do not require the use of auxiliary devices. The constant speed governor automatically controls pitch between the low pitch setting that allows full rated power of the engine to be developed on the ground and the highest flight pitch setting found necessary for the requirements of the airplane. The feathering control operates on a separate circuit and is controlled by the pilot through a separate cockpit switch.

The Dow Chemical Company, Midland, Mich., reported a greatly increased use of Dowmetal by the aircraft manufacturing industry. A full third lighter than aluminum, these magnesium base alloys, sold under the trade name of Dowmetal, have become increasingly popular with aircraft manufacturers because of their extreme lightness combined with strength, toughness and durability. During the last year many new applications of Dowmetal were made. In addition to the use of sand and mold castings, Dowmetal die castings have found increasingly wide use. To meet the increased demand The Dow Chemical Company licensed one of the largest job producers of die castings to die cast Dowmetal. Another feature of the expansion program was the opening at Bay City, Mich., of a new, large foundry to care for the increased demand for Dowmetal sand castings.

On Menasco's Super Buccaneer engines there are more than 21 Dowmetal engine parts including valve tappet guides, manifolds and supercharger impellers operating at speeds up to 40,000 r.p.m. The Ranger SGV-770 engine uses approximately 60 pounds of Dowmetal, saving 20 pounds of weight, while the use of Dowmetal in certain of the Wright Cyclone models permits the remarkably low weight per horse power ratio of 1.07 pounds. The case of the Sperry Gyropilot is entirely of Dowmetal, in addition to the case of the Sperry Gyro-Horizon.

The Eclipse Aviation Corporation, East Orange, N. J., a subsidiary of Bendix Aviation Corporation, developed several new types of accessories and improved its line of starters, generators, radio power equipment, hydraulic and air pumps, de-icer equipment and miscellaneous accessories.

During 1937 the Edo Aircraft Corporation, College Point, N. Y., continued to manufacture all-metal pontoons for the conversion of standard land planes into twin float seaplanes, and developed several new float models incorporating the latest designs and construction methods.

Interest in water flying was especially marked in the light plane class, some 40 light seaplanes having been sold during the year. Sales were made in many parts of the country where water flying was practically unknown and it was expected that this would appreciably broaden the future seaplane field. Edo continued to cooperate with the leading aircraft manufacturers in developing float gear for their new models, and made it possible for three companies who had never before offered their ships on floats to obtain seaplane A.T.C.'s. One of the most interesting new seaplanes of the year was the high speed twin-engine Beechcraft, the first fast bi-motored seaplane to be offered commercially for private and feeder line use.

Daily seaplane commuting continued to increase in the New York area, some 10 ships being regularly used for this purpose, in and out of the East River skyports. It is interesting to note, moreover, that a large majority of these ships were purchased by people who had never before owned an airplane—convincing proof of the way in which float gear tends to broaden the aircraft field.

Edo offered 10 standard float models which are stocked for prompt delivery and 13 additional custom models covering a range of floats with which almost any land plane of either American or foreign manufacture could be readily converted for seaplane use. Edo's experience in equipping 200 different types of aircraft with float gear was made available to manufacturers the world over in developing a seaplane version of their machines.

The Egyptian Lacquer Manufacturing Company, New York, continued to supply the aircraft industry with its line of clear and pigmented 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, a division of the Fairchild Aviation Corporation, moved into new and larger quarters in Jamaica, L. I., New York, in October, 1937, and now occupies an entire four-story building. This move is part of the company's program to expand manufacturing facilities to take care of increased business in the aerial camera, instrument, radio compass and sound recording lines. Floor space in the new Fairchild plant is approximately double that of the former factory. New precision machinery has been installed and a complete new finishing department added, including a modern paint shop with gas-fired baking ovens, a sandblast room and a plating room. New and up-to-date radio testing apparatus has also been installed.

Noteworthy advances during 1937 were made in the design of the Fairchild Radio Compass. A new commercial model designated as the Fairchild RC-4 was designed and quantities were sold both in the United States and in foreign countries. It features a much smaller loop antenna in a streamlined housing, a remote loop rotator, a two-band receiver of fine sensitivity and selectivity, and a compact remote control panel containing receiver tuning control, electrically operated sensitivity control, and headphone volume control. A bearing indicator, dynamotor, junction box and inter-connecting cables complete the assembly.

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. Among General Electric instruments in process of development were devices for indicating the positions of wing flaps and retractible landing gear, for indicating oil pressure, fuel pressure, oil temperature, manifold pressure, carburetor-air temperature and free air temperature.

General Tire and Rubber Company, Akron, O., produced a new smooth contour airplane tire, which, because of a rounded nose, promised improved performance in mud and snow. The tire was made in sizes from 27 to 96 inches. The company also produced a line of accessories including grommets, sheeting, sponge rubber crash pads, mountings for instruments and airplane hose.

The B. F. Goodrich Company, Akron, Ohio, developed new de-icers which were used as winter equipment on nine major transport lines and on military aircraft. While satisfactory de-icer perform-

A TIRE FOR GIANT PLANES

This Goodrich tire was built for the Douglas DC-4 air line transport.

ance was experienced during the winter of 1936-37, in some instances a number of small holes appeared in the inflation elements of some installations; and oil, always an enemy of rubber, also caused damage in some cases. It was determined that the holes were caused by electro static effects in flight and a de-icer was then developed with a prenite-graphite surface. The graphite surface afforded sufficient conductivity to dissipate the static charge; and the prenite compound used prevents oil absorption harmful to rubber.

It was found desirable, because of the advent of larger airplanes requiring substantially larger de-icers, to make minor construction changes incorporating fabric reinforcing strips to effectively prevent the growth of a tear occurring in flight. The effectiveness of these changes was demonstrated in a number of flight tests on transport planes during which de-icers were deliberately cut between the fabric reinforcements before flight. On the basis of these tests the Bureau of Air Commerce issued a letter of approval on the new construction.

During 1937 the Goodrich refrigerated wind tunnel in Akron was used for many separate test programs covering a wide variety of devices and materials considered as applicable to some phase of the ice problem.

It was found that airplanes could, under unusual conditions, collect ice formations on the leading edges of the ailerons, and research was started by an airplane manufacturer and several air lines employing the Goodrich tunnel for tests of various control surface arrangements. As a result of this comprehensive study of a new icing problem, change in the design of all movable surfaces has been made to give maximum protection against icing at vital points.

The problems arising from the icing of aircraft are many and they are made more difficult by the fact that ice forming conditions are infinitely variable. Equipment is developed and tested in as wide a range of ice-forming conditions as is practical, but there is always the possibility of a different type icing condition being encountered. Ice formations vary widely in their adhesion to the surface on which they are formed, in the texture of the ice itself and in the shape of the formation accumulated. However, with the wealth of background which has now been accumulated through the extensive use of de-icer equipment by so many operators, it is believed that coming winter seasons can be approached with a greater sense of security than ever before, because protection has been provided at all points which have previously caused trouble.

During 1937 the Goodrich Rivnut development, used originally to apply de-icers to metal wings, also found wide usage in general aircraft manufacture. In 1937 Goodrich designed and built tires for the Douglas DC-4 transport plane, the largest ever constructed for an American airplane. These tires, 65 inches in diameter with a two foot cross section, were designed to carry 15 tons each in service, contain more than 44 miles of tire cord, and are considered to be a notable contribution to the construction of large transport planes.

A new tire cord, known as Hi-Flex, was used initially in the manufacture of Goodrich airplane tires. This cord, developed after months of research, is of entirely different construction, and is designed to reduce heat generated at high speeds under heavy loads. The new cord gives unusual strength without bulk and will materially reduce operating temperatures, it is believed.

The Goodrich-Palmer airplane tire brake was introduced and installed on several air liners, including the Douglas DC-4. The brake is being made in a number of sizes from a five-inch unit for light airplanes to the 25-inch brake for the new 40 passenger transports. Several types of military aircraft are now using the new brakes and a special stainless steel installation has been developed for naval beaching gear when underwater service is necessary. The Goodrich-Palmer brake consists of a full ring of brake lining articulated to conform to the eccentricities of brake drums and expanded into position by means of an inflated rubber-like tube held in a cavity of the torque frame. Forces generated by the brake lining are translated equally to the circumferences of the torque frame through mating lugs registering in notches on the brake lining. Goodrich now manufactures more than 50 products in rubber for the aircraft industry.

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.

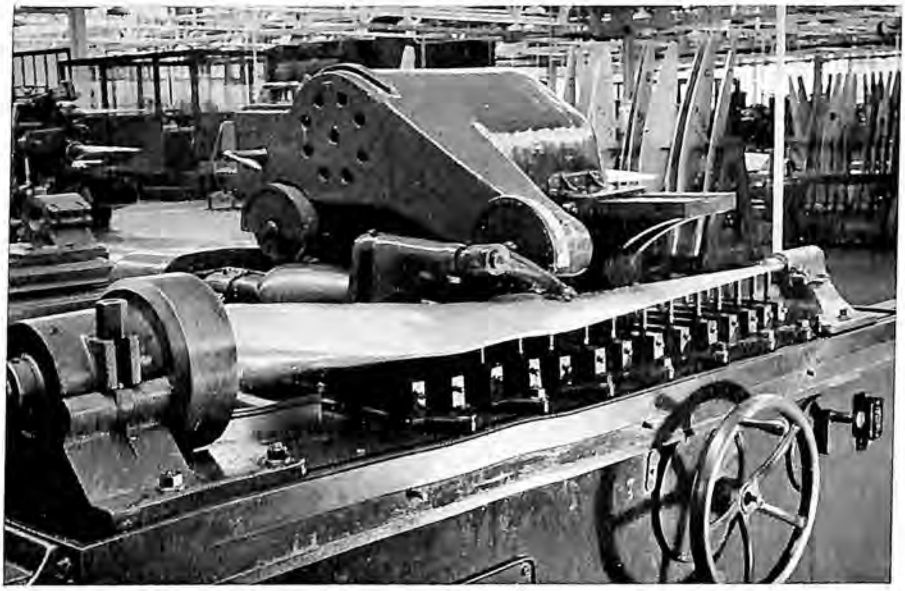
Gulf Refining Company, Inc., Pittsburgh, Pa., developed a growing market for its aviation gasoline and lubricants. Outstanding among the forward steps taken by the company was the erection of a $1,000,000 refinery at Port Arthur, Tex., for the manufacture of commercial iso-octane to be used for blending aviation gasoline of higher octane values. Realizing the importance to the future of aviation of the light plane, Major Williams and his Aviation Department worked in close cooperation with the manufacturers of the Aeronca, Cub, and Taylorcraft airplanes, and sponsored the flight of 208 of these little craft to Miami and return in December. They were from all parts of the East, Middle West, and South. Never before in the history of aviation had such a cavalcade of light planes filled the skies, and it constituted ample notice to the public of the dawn of a new era when the man-in-the-street could afford to purchase and operate his own aircraft. In the field of scheduled air line transportation, Gulf renewed its gasoline and oil contracts with Eastern Air Lines and Pennsylvania-Central Air Lines.

Hamilton Standard Propellers, East Hartford, Conn., a division of United Aircraft Corporation, produced its constant speed propeller, which was a development of the two-position controllable pitch propeller. The constant speed propeller was described as follows: Instead of being limited to two positions, 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 take-off 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



MAKING METAL PROPELLERS

A machine is profiling a blade to the proper contour in the Hamilton Standard Propeller factory.

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.

The International Flare-Signal Company, Tippecanoe City, O., continued supplying its parachute flares and signals to commercial aviation, the U. S. Government and foreign governments. This equipment, which includes both electrically and pistol operated types, affords outstanding advantages in flexibility of installation and operation, safety and dependability. There is an approved International flare especially designed to meet each classification requirement of the Department of Commerce. The International 1½-minute parachute flare generates upward of 110,000 candlepower.

The J. V. W. Corporation, Newark, N. J., is the sole distributor of the Link Trainer, a device used throughout the world for instruction in instrument and radio beam flying. The Link Trainer has been adopted as standard equipment by the U. S. Army Air Corps, Navy, Department of Commerce, the major air lines and commercial flying schools of the United States, as well as many foreign governments, including Great Britain, France and Japan.

The Link Trainer consists of a small hooded airplane mechanically operated by means of vacuum pump and a series of valves, so that the machine responds to controls in a manner similar to an airplane in the air. The cockpit is completely equipped with modern navigation instruments, and provision is made for simulating radio beams and other radio aids to navigation, controlled by the instructor. The movements of the Trainer are reproduced on a table by an automatic tracing device known as the Automatic Recorder or "Crab" which simulates the motion of the Trainer in respect to a map or a chart of the radio range stations. Improvements during the year included addition of remote control instruments on the instructor's desk, i.e., air speed, rate of climb and sensitive altimeter to facilitate the instructor's giving problems of instrument approaches and let-downs.

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, New York, reduced the weight of their lightweight steel cylinders used in airplane work. These cylinders are used with their Lux carbon dioxide fire extinguishing system installed on modern transport planes for the control of fire in the engines. These cylinders are also used in the Lux flotation gear used by the Army and Navy and many foreign countries to keep land planes afloat when forced down on water. The equipment consists of two or more rubberized fabric bags which are inflated automatically with carbon dioxide. These bags when not in use are folded up and stored in the wings or fuselage.

A further development of the Kidde Company in using lightweight carbon dioxide cylinders is the expulsion of gasoline from the fuel tanks. In an emergency landing of a land plane on water the fuel tanks are emptied quickly by producing a pressure of carbon dioxide above the gasoline, after which the empty gasoline tanks produce sufficient buoyancy to keep the plane afloat. The company also produced lightweight steel containers filled with aviators' breathing oxygen, lightweight carbon dioxide portable extinguishers for use in airplanes as well as standard airport fire equipment, including crash trucks, and life vests and life rafts inflated with carbon dioxide.

The Kollsman Instrument Company, formerly of Brooklyn, New York, outgrew their plant facilities and moved to a new plant in Elmhurst, New York. The new plant has approximately four times as much floor space as the Brooklyn plant. Many of the standard instruments were improved, notably the sensitive altimeter. An improved dial arrangement permitting easier and more accurate reading was produced. Considerable wind tunnel research work was conducted on electrically heated pitot-static tubes, resulting in better aerodynamic and thermodynamic characteristics. A new manifold pressure gage was produced, providing exceptionally accurate indication; and it is guaranteed for the life of the airplane.

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 Aviation Manufacturing Corporation, Williamsport, Pa., continued the production of various two and three blade models of the Lycoming controllable propeller, ranging from 260 to 750 horsepower, and available in diameters from eight to 13 feet. The change of blade angle in Lycoming propellers is accomplished mechanically from engine power through a series of gears, operated by the rotation of the propeller shaft. The gears are engaged and disengaged by means of an electric control. Lycoming also began

LYCOMING POWER PLANT

Showing installation of the Lycoming engine and Lycoming controllable propeller.

production of an electric propeller control integral with the engine throttle. Control of the propeller blade angle, by momentarily turning the push-pull throttle handle at any throttle setting, permits the pilot to effectively coordinate the engine r.p.m. and propeller blade angle in order to obtain maximum performance for all flight conditions. Lycoming controllable propellers are used on several high performance military aircraft, notably the Army Air Corps B-10B Martin bombers and the Navy F2F Grumman fighters.

Following extensive research and development work the Lycoming Division of Aviation Manufacturing Corporation announced the production of electrically welded hollow-steel blades in sizes for military and transport planes. The process employed in the manufacture of

AVCO blades is inherently capable of a high-quantity production. Specially designed automatic equipment is utilized to eliminate human error in welding and forming. In the various operations involved in the AVCO blade process, full advantage is taken of the most modern methods and equipment available for fabricating high alloy steels. These, and the development of several entirely new methods, constitute the improvements in manufacturing technique which permit the AVCO blade design to be based upon the endurance limit of virgin steel and permit a 25 per cent saving in blade weight. The blade is fabricated from a single homogeneous piece of seamless chrome-nickel-molybdenum steel tubing. The hollow steel construction gives the new blade greater rigidity under torsional and bending loads encountered particularly in large propellers. Due to its extremely hard surface, abrasion from rain, spray and cinders is practically eliminated.

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. A new Macwhyte development was "Hi-Fatigue" aircraft cable, designed especially for service where the highest fatigue resistance is essential.

The Merrimac Chemical Company, Boston, Mass., in 1937, 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., continued to develop and extend its many lines of precision aircraft control ball bearings, including:—single and double row types, shielded and non-shielded; completely enclosed felt seal types with removable seals; extra light ball bearing types; and ball and roller bearings for control pulleys.

Northwest Air Service, Inc., Seattle, Wash., developed a propeller pitch setter, a machine to align blades by mechanical methods rather than by manual labor, requiring only 20 minutes to do the same work that formerly took three men an hour.

Pacific Airmotive Corporation, Ltd., Burbank and San Francisco, Calif., continued to supply the market with parts and special equipment. The company enlarged its lines of equipment. During the year the engine overhaul shop was enlarged and the latest equipment installed.

Parker Appliance Company, Cleveland, O., produced seamless tubular plumbing for aircraft with Parker tube couplings. To overcome the tendency of threaded aluminum alloy parts to seize when assembled, Parker developed a number of thread compounds, thread seals and valve lubricants. The company also produced a line of fabricating tools.

Pioneer Instrument Company, Inc., Brooklyn, N. Y., a subsidiary of Bendix Aviation Corporation, reported development of new devices in addition to the production of a well-rounded list of conventional instruments for aviation. The Pioneer sensitive altimeter, with a direct reading barometric setting, was produced in various combinations of altitude scale and barometric setting to meet world-wide specifications. Another contribution was the Pioneer oxygen regulator. Through a unique valve arrangement it is possible to control the oxygen pressure to insure adequate supply and a constant flow at any given altitude. The regulator may be manually adjusted to meet the individual requirements.

While the face of the Pioneer climb indicator remains unchanged, the instrument has been completely re-designed. The new self-contained climb indicator eliminates the auxiliary vacuum tank necessary in the earlier instruments. The mechanism is thoroughly compensated for altitude and temperature changes, and a unique diffuser in place of the ordinary capillary leak reduces the error usually caused by humidity.

The Pioneer ring light now employs a new non-perishable material of high light conductivity, resulting in even illumination throughout the full range of the dial, without glare or light spillage. To promote uniform operation through a wide range of temperature, the bearings of the Pioneer turn and bank indicator have been provided with temperature compensation, to insure smooth and accurate operation at high altitudes with low temperatures. Outstanding in the complete line of aerial compasses are the Pioneer 941, which is designed to respond quickly in fast maneuvering airplanes, and the type 1161 (aperiodic), recommended for navigational purposes.

An important development of the Pioneer laboratories is the "Autosyn" system of electrical transmission. "Autosyn" is utilized in the Boeing "flying fortresses" for the purpose of remote indication of engine functions, and as position indicators for the various movable components of the aircraft. It eliminates the necessity for piping between the engine and instrument board, which automatically reduces weight and sources of trouble. "Autosyn" has been selected for the instrumentation of the giant Boeing flying boats. As a further development, "Autosyn" has been applied to a remote indicating compass which provides identical compass course indication for navigator, pilot and co-pilot. By the use of a dual system it is possible for the navigator to set the course from a remote point. Also, the master compass may be located where it is least disturbed by electrical influences.

The new Pioneer tachometer operates on the inclined weight centrifugal principle, which makes for a quiet, smooth, accurate operation without gears.

The Pyle-National Company, Chicago, Ill., produced Department of Commerce approved aircraft tail lights with both 15 and 21 candle-power lamps, and manufactured landing light reflectors for the Boeing ocean flying boats, those reflectors being the size of locomotive headlight reflectors.

RCA Manufacturing Company, Inc., Camden, N. J., a manufacturing organization of Radio Corporation of America, through its Aviation Radio Section developed a new line of aircraft radio equipment for both receiving and transmitting. A notable advancement in the art of aerial navigation was the introduction of the Model AVR-8D and E Aircraft Radiocompass. It is possible to utilize the radio signals from entertainment broadcast stations or signals from the Department of Commerce beacon stations by the aid of the radiocompass for homing purposes or by using two or more signals to obtain a fix. A visual indicator is part of this radiocompass system and headphones need not be worn.

A new and flexible series of aircraft radio receivers have been introduced, AVR-7D, E, F and G. Each model of these receivers has three bands covering the beacon-weather band, entertainment broadcast band and the aircraft communication band. They are of precision construction, although made in substantial quantities for cost consideration, and designed for remote control, enabling the receivers to be placed out of the way. The control panel with all the essential controls may be placed on the instrument board. The Model AVR-7D is the basic receiver. Model AVR-7E is similar but incorporates crystal control "lock in" on two frequencies; Model AVR-7F is similar to AVR-7D but incorporates an oscillator for the reception of CW signals; and Model AVR-7G incorporates both crystal control "lock in" and CW oscillator. Kits are available for adding a loop antenna to the above receivers, thereby making an efficient aural radiocompass. A kit to allow using these receivers on remotely located radio-beacon (Mast or "T") antenna is also available.

A new receiver (Model AVR-10-10A) weighing only 8½ pounds, completely installed and including a power supply unit, was introduced for Class I planes, thereby providing the ultra-light plane pilot with a radio receiver for airport traffic control use. These receivers are available for both six and 12-volt battery operation. Research and design are progressing satisfactorily for a small, light weight transmitter for Class I aircraft. The unit will be available during 1938.

A companion transmitter to the new AVR-7D, E, F, G receivers was also produced. The Model AVT-7B Aircraft Radio Transmitter was installed in many airplanes. This transmitter, although small in size, develops 20 watts of power, making it suitable for nearly all aircraft radio application. A novel feature of this transmitter is the availability of four frequencies, under certain conditions, with only two crystals, thus effecting an economy not available in older models of transmitter equipment. The Model AVT-12B Transmitter has been produced for those who require 50 watts of power in a conventional aircraft antenna for telephony and 90 watts for telegraphy.

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.

The Romec Pump Company, Elyria, O., produced fuel pumps, both hand-operated and power driven, vacuum pumps and hydraulic pumps for airplanes, both Government-owned and commercially operated. The company introduced an auxiliary drive gear box which takes on eight accessories in the airplane, and is operated by one drive from the engine.

Scintilla Magneto Co., Inc., a subsidiary of Bendix Aviation Corporation, supplied its Bendix-Scintilla magnetos for all classes of aircraft engines. New types of magnetos were developed and supplied for lighter aircraft engines. Battery ignition equipment was also supplied for users desiring this form of ignition. A new product, the Bendix Aviation spark plug, was developed in a wide variety of types, and supplied in quantity for many of the latest types of engines.

Shell Petroleum Corporation, St. Louis, Mo., carried out an increasing amount of research work on aviation petroleum products, and continued to increase sales and service to the Army, Navy, the air lines, manufacturers and private pilots. Grades of aviation gasoline ranging from 73 to 100 octane ratings were marketed, with special emphasis on the higher octane grades. Shell was the first company in the world to produce and offer to the industry 100 octane aviation gasoline in commercial quantities and, since then has endeavored to be first in the field for both leaded and unleaded high octane fuels. Shell's development work, in the laboratory and in the field, on aviation fuels and oils continues to look to the future, and to anticipate the operators' and manufacturers' future requirements. A fleet of aircraft was maintained for making contacts with customers and for supplementing laboratory work by actual testing of products under service conditions. To be prepared for the present tendency toward high altitude flying, plans are under way to develop fuels and lubricants especially suitable for this purpose, and to test them out in special high altitude flying equipment.

The Shell Union Group purchased a new Seversky modified pursuit airplane equipped with a 1,000 horsepower Wright G-5 Cyclone engine and a Hamilton Standard three-blade constant speed propeller. This low-wing, cantilever, all metal monoplane is to be used for a series of flight tests at various altitudes up to about 30,000 feet for the purpose of developing and improving Shell aviation fuels and aircraft lubricants.

Sinclair Refining Company, New York, is continuing its research and development work toward the improvement of aircraft engine oil

A ONE-BLADE PROPELLER

The Everel single-blade propeller on a Cessna plane.

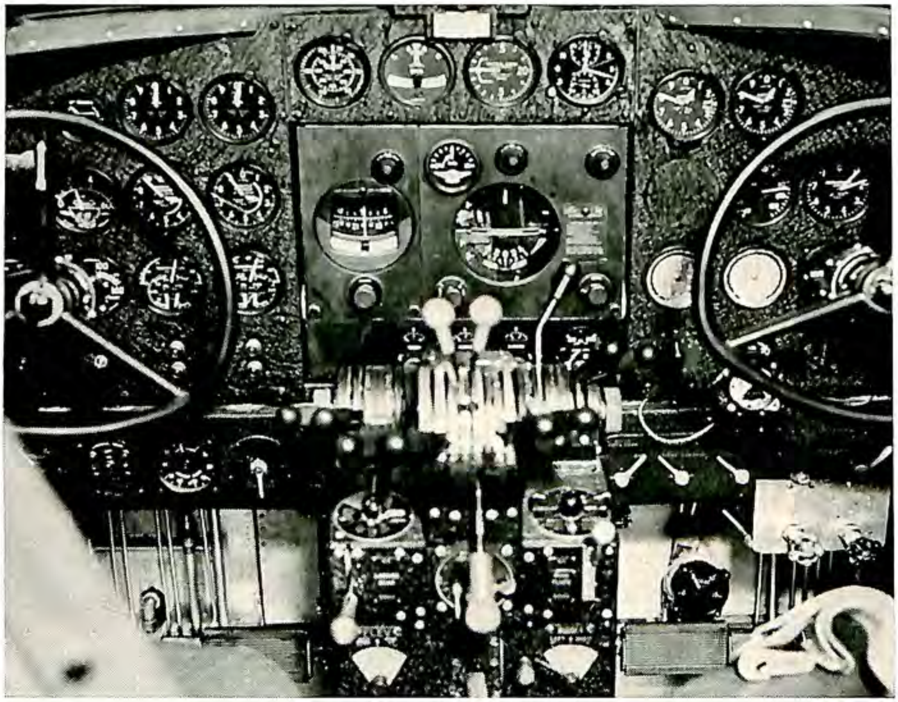
and lubricants. The present "G" series aircraft oil, Grades 100, 120 and 130, is on the approved list of engine builders, and has successfully lubricated air line fleets. Sinclair engineers and scientists, however, are making further tests toward the progressive improvement of this aircraft oil, to suit the requirements of higher output engines which will be used on Atlantic and other routes. Special lubricant, Sinclair A. F. Grease No. 3, has been developed for the lubrication of blade bushings and thrust bearings on Hamilton Standard Propellers. This lubricant has also proven its adaptibility for lubrication of Zerk Fittings on landing gear, tail wheel assemblies and other parts on Douglas and Lockheed transport ships. A new Sinclair High Temperature Grease No. 955 is also on the market and is being successfully applied on engine accessories, such as starters, generators, dynomotors, de-icer units and magnetos. Sinclair Pennsylvania Gear Oil SAE 250 is available for rocker arm lubrication on engine models requiring special treatment and where the rocker arm is not lubricated from the general oil system. Recognizing the need for extension of drain and overhaul periods in transport line operation, Sinclair engineers are cooperating with centrifuge and filter manufacturers toward the construction of a suitable unit as an attachment to the engine so that oil can be kept clean of metallic chips and other foreign particles while the engine is in flight. The Sinclair Aircraft Lubrication Index, showing recommendations for lubrication of all transport planes and models used commercially, in the Government service and in the field of private flying, has been accepted as a universal guide for efficient maintenance. This Index can be obtained, without charge, upon request. It is kept up to date by the preparation and distribution of supplements to cover new models.

SKF Industries, Inc., Philadelphia, Pa., produced aircraft bearings of a size and type for every purpose. New machines and new methods were installed, and rigid inspections enforced. Among the SKF bearings were the cylindrical roller bearings for crankshaft main support locations, and the deep groove type of ball bearing employed extensively to carry combined radial and thrust loads not only of the propeller, but of starter, rocker arm, magneto and supercharger shafts.

SKF control pulleys, equipped with either cylindrical or deep groove types of bearings, are designed to meet the important points and dimensions covered in Army-Navy Specification No. 210. Because these bearings have low friction characteristics and high radial capacity, pulleys have minimum rim wobble, are light in weight, self-contained, and very easily installed.

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, San Diego, Calif., continued manufacture of exhaust manifolds and other aircraft parts and accessories. The company devoted much time to engineering and experimentation to overcome exhaust system difficulties that have become apparent with the introduction of larger and higher-powered aircraft engines. Excessive manifold vibrations due to floating-engine mounts have been encountered, as well as higher exhaust temperatures. These difficulties have led to the search for better materials, and to the development of flexible joints in the exhaust system to eliminate stresses on manifold parts and to permit the use of long rigidly-mounted tail pipes and exhaust superchargers. The company continued to render assistance to the industry by designing and building exhaust installations for many experimental aircraft and aircraft engines. Among the manufacturers thus served were Bell, Boeing, Consolidated, Lockheed, Martin, North American, Seversky, Sikorsky, Wright Aeronautical and others. Equipment for experiments in exhaust silencers has been installed and several types tested.



SPERRY GYROPILOT INSTALLATION

Instrument panel in a Northwest Airlines Lockheed 14 showing the gyropilot installation in the center.

Sperry Gyroscope Company, Inc., Brooklyn, N. Y., reported more than 900 Sperry Gyropilots in use. In addition hundreds of gyrohorizons and directional gyros were used by pilots throughout the world. The Gyropilot was described as follows:

By assuming the burden of actually flying the plane, the Gyropilot makes it possible for the human pilots to devote their entire attention to observation, navigation, radio and engine control. With the Gyropilot at the controls, long flights can be made with a high degree of precision, even in bad weather, for the human pilots can now relax and superintend the operation of the aircraft. From the standpoint of the passengers, the Gyropilot is equally desirable. It detects the slightest departure of the aircraft from its proper course and altitude, and acts simultaneously to apply corrective movements of the controls. Thus, in rough air the aircraft is not subjected to the larger angular displacements resulting from delayed manual control, and the passengers are conscious of a sense of stability and security which otherwise would be lacking.

The Sperry Gyropilot controls the aircraft about all three of the axes of angular motion—lateral, longitudinal and directional. It is flexible in operation, permitting maneuvers under Gyropilot control to be made at the will of the human pilot. It has no clutches, motors or electric contacts. Its action, based on pneumatic and hydraulic principles, insures smooth, positive operation of the control surfaces of the aircraft. It may be adjusted simply and easily while in flight, securing the most desirable operation for any air conditions.

An ingenious adaptation of the standard Directional Gyro providing the pilot with an oriented chart which shows the various legs of the radio beacon by which he is making a blind landing, and the airport's location with respect to them, is now being tested by experts of the Safety and Planning Division of the U. S. Bureau of Air Commerce. It was invented by Horace Stark, a Pennsylvania-Central Airlines pilot, and built to the Government's order by the Sperry Company.

The chart, circular in form, is carried by a disk in a glass-covered case on top of the Directional Gyro, the main shaft of which is connected to and turns the disk; or rather, holds it stationary when the airplane is turning. A different chart, of course, must be used for each air terminal, but these are easily put in place and prevented from getting out of proper position by a foolproof fitting.

The small chart becomes a part of the Directional Gyro itself, and by being carefully balanced does not interfere with the operation of the instrument. By use of the orientator and by bringing the flight instruments and the radio compass to neutral positions, the pilot has an exact picture of the location of the radio beams, the airway and the airport's position in relation to them.

The Stanavo Specification Board, Inc., organized in 1929, now maintains its head office in San Francisco, and the Chicago office is represented by the Standard Oil Company of Indiana. Continued research and development work directed toward the progressive improvement of aviation fuels and lubricants has resulted in new 90 and

100 octane fuels being placed on the market which are the results of special refining processes which have made possible high anti-knock qualities with minimum quantity of lead. They have been supplied to the Army Air Corps for use in high speed military planes, to the Clipper ships for transoceanic flights, to engine manufacturers and air lines for special tests, and as high octane fuels for record flights and racing purposes.

The increased power made possible by these fuels, as demonstrated by service tests, has shown an increased performance of from 20 to 35 per cent. Seven grades of high octane aviation fuels were marketed by the Stanavo distributors; and included leaded and unleaded gasolines covering all kinds of aircraft operations. Five grades of Stanavo aviation oils ranging from 60 to 140 seconds Saybolt viscosity were

TRI-MOTORED BELLANCA

This is the Bellanca 28-92 long range racer. It is powered by a 420 h.p. Ranger engine in the nose and a 250 h.p. Menasco engine in the leading edge of each wing.

available to the industry, in addition to the regular line of Stanavo rocker arm greases and specialty products, including magneto oil, compass fluid, utility oil and Servo Liquid.

The Standard Oil Company of New Jersey, continued, through the Standard Oil Development Company, research for the improvement of petroleum aviation products. The work resulted in new sources for the production of 100 octane fuels, and it has added such new blending agents as isopropyl ether and hydrogenated butylene co-dimer. This latter product in commercial production in 1938 will approximately double the potential supply of 100 octane fuel. Hydro co-dimer may be recognized as adding to (2, 2, 4) trimethyl pentane an equally useful material (2, 2, 3) trimethyl pentane. Furthermore, new methods of manufacture and improvements on the old ones have tended to bring down the cost of this fuel. Hydrogenated aviation gasolines are being produced which show higher initial octane values and lead response superior to the best straight-run aviation gasolines from selected crudes. This development assures continued availability and permits increased production of high quality aviation fuels, as satisfactory crude sources of virgin aviation gasolines become depleted. Work on Diesel fuels indicates that in the coming year much greater knowledge of the desirable characteristics will result, with consequent better fuels. Safety fuels, developed by this company

LOCKHEED 14 CARGO SPACE

These four compartments aggregate 190 cubic feet for baggage, mail and express loads.

some time ago, and now available for testing in the 100 octane category, have attracted interest in the aircraft industry. A new instrument oil has been developed for automatic pilots and gyro instruments. It has a viscosity index of about 150, hence does not cause too much drag on gyro rotors at —30 degrees F., nor does it thin out too much at temperatures as high as 200 degrees F. This oil serves a multiplicity of purposes where hydraulic usage demands a minimum of change with wide ranges of temperatures.

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 1937. The company operated a fleet of three planes.

Thompson Products, Inc., Cleveland, O., produced more than 200 different parts for plane and engine builders. Among these were rollers, tappets, piston pins, studs, nuts, bolts, screws, valve keys, oil pump shafts, bearing spacers, cam followers, cam follower guides, rollers and sockets, spark plug bushings, propeller hub fronts and other parts requiring close tolerances and specialized alloy steels. In engine valve manufacture the techniques of Stelliting the seats and inserting sodium in the stems have been greatly improved. Methods for holding the dimensions and contours of the cavities of hollow-head valves, and for inspection, were also improved. The company continued its research work on valve steels and design.

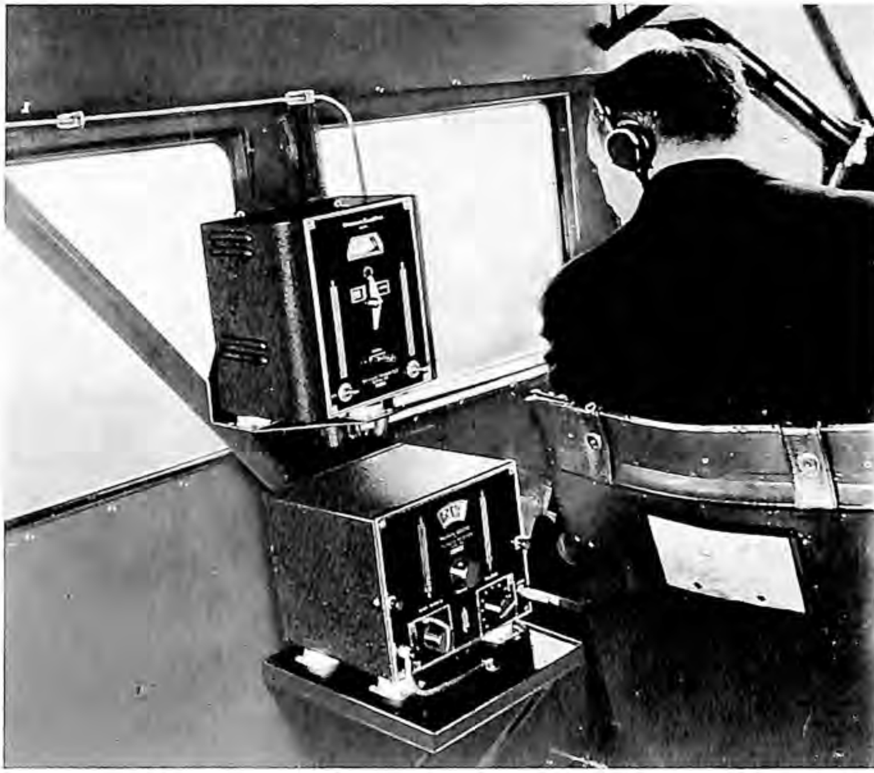
Thurston Cutting Corporation, New York, marketed its special line of Dartmouth Tex airplane fabric and other accessories.

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

THE MARTIN BOMBER

This is the Cyclone-powered Model 150 W which the Glenn L. Martin Company is producing for several foreign governments.



AIRCRAFT RADIO

This is the Western Electric 19A midget transmitter and 17A receiver, a complete two-way radio telephone system installed in a private owner plane.

magnesium or aluminum castings where corrosion is a factor. It also supplied the industry with various packing and gaskets for oil, gasoline and water application. The company also produced a new sheet packing, Vellutex, non-corrosive to alloys, light metals, steel, brass and chromium.

Western Electric Company, New York, developed a number of new items of aircraft radio equipment, including a new and simple type of shielded loop which can be rotated for direction finding service. Because of its shielded construction, it is instrumental in reducing the disturbances in radio reception caused by rain, snow and sleet static. This new loop equipment is compact and light; and can be installed with ease in any desired location aboard the ship. The slight modifications required in a receiver to employ this new device in no way affect the reliability or interchangeability of the receiver, which is of particular importance to air lines operating large fleets. The aural null direction finder enables the taking of radio bearings by rotating the loop. Rotation is accomplished by a compact control unit equipped with a 264 to 1 gear ratio and connected to the loop through a flexible shaft. The position of the loop is indicated at the control unit by a needle on a scale, permitting extremely accurate loop adjustment.

For the private flier the Western Electric Company is introducing a midget aviation radio transmitter light in weight, compact and simple in operation; providing efficiency heretofore possible only with larger, heavier and more expensive equipments. The new midget transmitter is known as the 25A, and although it weighs only 22 lbs. complete with its audio-power unit, radio frequency control unit and cables, it delivers more than 15 watts carrier power to a suitable antenna.

Arranged for multi-frequency transmission on the private flier frequencies of 3105, 3120 and 6210 kilocycles, it will also transmit on any of the 42 air line frequencies for which the plane is licensed. Shifting from one frequency to another is easily accomplished in flight; and the utmost in efficiency is constantly maintained because the antenna circuit is always tuned. A built-in relay permits the same antenna to be used for both transmitting and receiving.

NACA 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.

Aviation Chronology and Records

SUBJECT PAGE

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CHRONOLOGY FOR 1937

Jan. 4	Frank Sinclair flies from New York to New Orleans in the record time of 5 hrs., averaging 240 m.p.h. (Seversky, Wright Cyclone engine.)
Jan. 14	Herbert Schiff Memorial Trophy for the fiscal year 1936 presented to Training Squadron VN 8D5.
Jan. 19	Howard Hughes flies from Burbank, Calif., to Newark, N. J., in 7 hrs. 28 min. 25 sec., setting new transcontinental record. (Hughes Special, Pratt & Whitney Twin Wasp Junior engine.)
Jan. 21	First Annual Award for air passenger having flown the greatest number of miles awarded to André Kostalanetz who flew 126,000 miles as a passenger in 1936.
Jan. 22	Sperry Memorial Award for 1936 awarded to W. Curtiss Rockefeller of the California Institute of Technology for distinguished service to Aeronautics by the Institute of the Aeronautical Sciences.
Jan. 28	Sylvanus Albert Reed Award for 1936 presented to Professor Edward S. Taylor by the Institute of the Aeronautical Sciences for his invention of the dynamic vibration absorber.
Jan. 28-Feb. 6	National Aviation Show held in Grand Central Palace, New York City.
Jan. 28-29	Twelve U. S. Navy planes make non-stop mass flight from San Diego, Calif., to Honolulu, T.H., 2,553 miles, in 21 hrs. 43 min. (Consolidated PBY-1, 2 Pratt & Whitney Twin Wasp engines.)
Feb. 28	Howard Hughes is awarded Harmon Trophy for 1936 for his outstanding contributions to aviation.
Feb. 28	Jean Batten receives Harmon Trophy for 1936 as the outstanding woman flier.
Mar. 13	Rear Admiral William A. Moffett Memorial Trophy presented to "U.S.S. California" Aviation Unit of Observation Squadron 4 for safety in operations.
Mar. 13-21	Second Annual National Pacific Aircraft and Boat Show held at Los Angeles, Calif.
Mar. 17	Amelia Earhart and Fred Noonan fly from Oakland, Calif., to Honolulu, T. H., on the first leg of a proposed round-the-world flight. The trip was abandoned temporarily due to damage to the plane from a blown out tire on the second take-off. (Lockheed Electra, 2 Pratt & Whitney Wasp engines.)
Mar. 30	Pan American Airways completes 7,000 mile survey flight from Pago Pago to Auckland, New Zealand. (Sikorsky S-42B, 4 Pratt & Whitney Hornet engines.)
April 1	Furio Niclot sets world speed record for 100 kilometers of 321.768 m.p.h. (Breda 88, 2 Isotta-Fraschini Gnome-Rhone engines.)
April 1	Louise Thaden receives Harmon Trophy for 1936 for "the outstanding woman flier in the United States."
April 6-9	Masaaki Iinuma and Kenji Tsukakoshi, fly from Tokyo, Japan, to London, England, in 94 hrs. 18 min., setting new speed record. (Karigane monoplane, Nakijima engine.)
April 10	Furio Niclot sets world speed record for 1,000 kms. of 295.491 m.p.h. (Breda 88, 2 Isotta-Fraschini Gnome-Rhone engines.)
April 12	Henry T. (Dick) Merrill makes speed record for commercial airplanes from Newark, N. J., to Miami, Fla., of 5 hrs. 26 min. (Douglas DC-3, 2 Wright Cyclone engines.)

April 13	U. S. Navy completes non-stop mass flight of 12 planes from San Diego, Calif., to Honolulu, T. H., in 21 hrs. 25 min. (Consolidated PBY-1, 2 Pratt & Whitney Twin Wasp engines.)
April 13	Mario Stoppani, G. Divari and A. Spinelli set world altitude record for seaplanes with payload of 10,000 kgs. of 15,054.691 ft. at Monfalcone, Italy. (Cant Z 508, 3 Isotta-Fraschini Asso 11 R. C. engines.)
April 24	M. Rossi, France, sets world speed record for 5,000 kms. of 193.36 m.p.h. (Caudron Typhon, 2 Renault engines.)
April 25	Lieut. A. Erchov sets world altitude record for seaplanes with payload of 1,000 kgs. of 30,150.855 ft. at Sebastopol, U.S.S.R. (ARK-3, 2 M-25-E engines.)
April 28	Pan American Clipper arrives at Hong Kong completing first commercial flight across the Pacific.
May 1	Mario Stoppani, Ing. Antonio Maiorana, A. Spinelli, S. Forlivesi and R. T. Suriano set world speed record for seaplanes for 1,000 kms. with payload of 5,000 kgs. of 156.516 m.p.h. at Grado-Faro Ancona-Faro di Rimini temporary course. (Cant Z 508, 3 Isotta-Fraschini Asso 11 R. C. engines.)
May 1	Mario Stoppani, Ing. Antonio Maiorana, A. Spinelli, S. Forlivesi and R. T. Suriano set world speed record for seaplanes for 2,000 kms. with payload of 5,000 kgs. of 154.356 m.p.h. at Grado-Faro Ancona-Faro di Rimini temporary course. (Cant Z 508, 3 Isotta-Fraschini Asso 11 R. C. engines.)
May 1	H. L. Brook flies from Capetown, South Africa, to Croydon, London, in 4 days, 18 min., setting new speed record. (Percival Gull, Gypsy VI engine.)
May 3	H. F. Broadbent flies from Darwin, Australia, to London, England, in 6 days, 10 hrs. 55 min., setting new speed record. (DeHavilland Leopard-Moth, DeHavilland Gypsy Major engine.)
May 6	Airship Hindenburg destroyed by fire at Lakehurst, N. J., with loss of 35 lives.
May 8	Mario Pezzi sets world altitude record for airplanes of 51,361.441 ft. at Montecelio, Italy. (Caproni, Piaggio XI R. C. 72 engine.)
May 8	Mackay Trophy for most meritorious flight presented to six officers and two enlisted men of the U. S. Army Air Corps, for their flight maneuvers in 3 bombing planes from Langley Field, Va., to Allegan, Mich.
May 8	Cheney Award presented to Major Frederick D. Lynch and Staff Sergeant Joseph L. Murray for their rescue of the crew of a burning balloon at Fort Sill, Okla., on July 10, 1936.
May 9-10	Henry T. (Dick) Merrill and John Lambie fly from Floyd Bennett Field New York, to Croydon Airport, London, making a stop in Essex, in 20 hrs. 59 min. (Lockheed Electra, 2 Pratt & Whitney Twin Wasp engines.)
May 13-14	Henry T. (Dick) Merrill and John Lambie fly from Croydon Airport London to Floyd Bennett Field, New York, in 24 hrs. 22 min. 25 sec. including stop to check gas at Squantum, Mass. (Lockheed Electra, 2 Pratt & Whitney Twin Wasp engines.)
May 14	G. Baidoukoff and N. Kastanaeff set world speed record for 2,000 kms. with payload of 5,000 kgs. of 174.136 m.p.h. Moscow-Joushnaya-Basissnaya course, U.S.S.R. (Bolkhovitinoff, 4 AM-34 engines.)
May 14-21	Masaaki Iinuma and Kenji Tsukakoshi fly from London to Tokio with coronation films. (Karigane monoplane, Nakajima engine.)
May 16	Glenn L. Martin, first pilot to make a round-trip flight over water, celebrates the 25th anniversary of his flight by flying over the original route from Los Angeles, Calif., to Catalina Island and return. (Martin Clipper, 4 Pratt & Whitney Twin Wasp engines.)

May 17	Daniel Guggenheim Medal for 1937 awarded to Dr. Hugo Eckener for "notable contribution to transoceanic air transport and to international cooperation in aeronautics."
May 20	Tenth anniversary of the solo flight of Charles A. Lindbergh from New York to Paris.
May 21-July 2	Amelia Earhart and Fred Noonan fly around the world from West to East starting from San Francisco, Calif., getting as far as Lae, New Guinea. They are lost at sea on an attempt to reach Howland Island in the Pacific. (Lockheed Electra, 2 Pratt & Whitney Wasp engines.)
May 25	Imperial Airways, Ltd. completes first survey flight from Darrell's Island, Bermuda to Port Washington, N. Y. in 5 hrs. 49 min. (Short Bros. Empire Boat, 4 Bristol Jupiter engines.)
May 25	Pan American Airways completes first survey flight from Port Washington, N. Y., to Darrell's Island, Bermuda, in 4 hrs. 45 min. (Sikorsky S-42B, 4 Pratt & Whitney Hornet engines.)
May 25	Poline Ossipenko sets three women's world altitude records for seaplanes at Sebastapol, U.S.S.R. (see Official Air Records). (Canot Volant, AM-34 engine.)
May 27-28	Mario Stoppani and Carlo Tonini set world closed course distance record for seaplanes of 3,231.123 miles. (Cant Z, 3 Alfa Romeo 126 RC 34 engines.)
May 27-28	Mario Stoppani and Carlo Tonini (Italy) set nine world speed records for seaplanes. (See Official Air Records.) (Cant Z 506, 3 Alpha Romeo 126 RC 34 engines.)
May 29	Louise Thaden sets women's national (U.S.) speed record for 100 kms. of 197.958 m.p.h. at St. Louis, Mo. (Beechcraft, Wright Whirlwind engine.)
May 29	Empire Air Day celebrated at Royal Air Force Stations in England.
May 29-31	International Aerobatic competition and St. Louis Air Races held at St. Louis, Mo.
June 16	Pan American Airways and Imperial Airways inaugurate joint passenger service between Port Washington, N. Y., and Hamilton, Bermuda.
June 17-20	Pilot Valerie Chkoloff, Co-pilot Georgi Baidukoff and Navigator Alexander Beliakoff fly from Moscow, U.S.S.R., to Vancouver, Wash., completing first flight from European continent to American continent, by way of the North Pole; 5,288 miles, in 63 hrs. 17 min. (ANT-25, M-34 R engine.)
June 21-22	Twelve U. S. Navy patrol bombers fly non-stop from San Diego, Calif., to Coco Solo, C. Z., 3,292 miles, in 27 hrs. 58 min. (Consolidated PBY-1, 2 Pratt & Whitney Twin Wasp engines.)
June 24-25	Richard Archbold, his pilot, Russell Rogers, and 4 others make first transcontinental trip in a flying boat, in 17 hrs. 3½ minutes, non-stop. (Consolidated PBY-1, 2 Pratt & Whitney Twin Wasp engines.)
June 26	Eighteenth Annual Royal Air Force Display held at Hendon, England.
June 26-July 10	Soaring Society of America holds eighth annual meet at Elmira, New York.
June 30	Flight Lieut. Maurice James Adam sets world altitude record of 53,936.895 ft. at South Farnborough, England. (Bristol 138, Bristol Pegasus engine.)
July 5-6	Pan American Airways makes first west-east survey flight across the North Atlantic from Botwood, Newfoundland, to Foynes, Ireland. (Sikorsky S-42B, 4 Pratt & Whitney Twin Wasp engines.)
July 5-6	Imperial Airways makes first east-west survey flight across the North Atlantic from Foynes, Ireland, to Botwood, Newfoundland. (Short Empire Flying Boat, 4 Bristol Pegasus engines.)

July 8	Attileo Bisco and Bruno Mussolini set world speed records for 1,000 kms. with payload of 500, 1,000, and 2,000 kgs. of 263.223 m.p.h. Fiumicino-Antignano-Ansedonia course, Italy. (Savoia-Marchetti, 3 Piaggio XI engines.)
July 13-15	Col. Mikail Gromov, Comdt. Andrei Youmachev, and Ing. Sergei Daniline set world airline distance record of 6,295.662 miles from Moscow, U.S.S.R. to San Jacinto, Calif. (ANT-25, AM-34 engine.)
July 26	Jacqueline Cochran sets women's National (U. S.) speed record for 1,000 kms. of 203.895 m.p.h. (Beechcraft, Pratt & Whitney Wasp engine.)
July 28	Jacqueline Cochran sets women's National (U. S.) speed record for 100 kms. of 200.712 m.p.h. (Beechcraft, Pratt & Whitney Wasp engine.)
Aug. 6	Collier Trophy for 1936 presented to Juan T. Trippe, president of Pan American Airways, for their establishment of the transpacific airline.
Aug. 12	Sigismund Levanevsky, Nikolai Kastanayeff and Victor Levchenko, with crew of three, leave Moscow for flight over the North Pole to the United States. They did not reach their destination and rescue parties were still searching the Arctic at the end of 1937.
Aug. 20-21	Istres-Damascus-Paris Air Race won by Lieut. Comdr. Samuel E. Cupini and Capt. Amadeo Paradisi in 17 hrs. 32 min. 45 sec. (Savoia-Marchetti, 3 Alpha-Romeo engines.)
Aug. 26	Vladimir Kokkinaki and A. Briandinsky set three world speed records over a closed course in the U.S.S.R. (See Official Air Records.) (C.K.B. 26, 2M.85 engines.)
Sept. 2	Michel Alekseev sets world altitude record with payload of 1,000 kgs. of 40,187.081 feet at Moscow-Podlipki, U.S.S.R. (ANT-40, 2M.103 engines.)
Sept. 3-6	National Air Races held at Cleveland Airport, Cleveland, Ohio.
Sept. 10	Kings Cup Race won by Charles C. Gardner at 233.7 m.p.h. in England. (Percival Mew Gull, De Havilland Gypsy VI engine.)
Sept. 17-26	First Inter-American Aviation Conference held at Lima, Peru.
Sept. 19	Roscoe Turner sets national (U. S.) speed record for 100 kms. of 280.908 m.p.h. at Detroit, Mich. (Laird-Turner Racer, Pratt & Whitney Twin Wasp engine.)
Sept. 20	Air mail service opened between the United States and Paraguay.
Sept. 21	Jacqueline Cochran sets women's world and national (U. S.) speed record of 292.271 m.p.h. at Detroit, Mich. (Seversky, Pratt & Whitney 1830-B engine.)
Oct. 17	Lucien Coupet and Marcel Lebourg set world speed record for 1,000 kms. with payload of 10,000 kgs. of 162.97 m.p.h. at Istres-Grenay, France. (Farman, 4 Hispano-Suiza engines.)
Oct. 17	A. Curvale, G. Perot, P. Duclos and R. Vandequin set world speed record for 2,000 kms. with payload of 5,000 kgs. of 191.043 m.p.h., Istres-Grenay, France. (Bloch 160, 4 Hispano-Suiza engines.)
Oct. 17	A. Curvale, G. Perot, P. Duclos and R. Vandequin set world speed record for 1,000 kms. with payload of 5,000 kgs. of 196.982 m.p.h., Istres-Grenay, France. (Bloch 160, 4 Hispano-Suiza engines.)
Oct. 19-24	Jean Batten flies from Darwin, Australia, to Lympne, England, in 5 days, 18 hrs. 15 min. setting new speed record. (Percival Gull, De Havilland Gypsy VI engine.)
Oct. 25	Guillaumet, Leclaise, Comet, Neri Chapato and Le Morvan set world distance record for seaplanes of 3,586.112 miles from Port Liautey, Morocco to Maceio, Brazil. (Latecoere 521, 6 Hispano-Suiza engines.)

Nov. 1	Revised Civil Air Regulations go into effect.
Nov. 3	Mario Stoppani and Nicola di Mauro set world altitude record for seaplanes with payload of 2,000 kgs. of 29,366.737 ft. at Monfalcone, Italy. (Cant Z 506-B, 3 Alfa Romeo engines.)
Nov. 4	Frank W. Fuller, Jr. flies from Vancouver, B. C., Canada, to Agua Caliente, Mexico, in the record time of 4 hrs. 54 min. (Seversky, Pratt & Whitney Twin Wasp engine.)
Nov. 7	Mario Stoppani and Nicola di Mauro set world altitude record for seaplanes with payload of 5,000 kgs. of 24,310.973 feet at Monfalcone, Italy. (Cant Z 506-B, 3 Alfa Romeo engines.)
Nov. 11	Dr. Ing. Hermann Wurster sets world land plane speed record of 379.626 m.p.h. at Augsburg, Germany. (BF 113R, DB-12 engine.)
Nov. 14-20	Flying Officer A. E. Clouston and Mrs. Betty Kirby-Green make round-trip flight between Croydon Airport, London, and Capetown, South Africa, setting a Croydon-Capetown speed record of 1 day, 21 hrs. 2 min.; a Capetown-Croydon speed record of 2 days, 9 hrs. 23 min.; and a speed record for the round-trip of 5 days, 17 hrs. 30 min. (De Havilland Comet, 2 Gypsy VI engines.)
Nov. 21	The Luke Trophy for 1936 for excellence in machine gunnery in the Air Corps presented to the Seventy-seventh Pursuit Squadron.
Nov. 21	Colombian Trophy presented to the Third Attack Group of the G. H. Q. Air Force for best safety record in flying for the year.
Nov. 30	Adriano Bacula and Paolo d'Ambrosis set world speed record for 1,000 kms. with 2,000 kgs. payload of 275.96 m.p.h. (Savoia-Marchetti S-79, 3 Piaggio XI RC.40 engines.)
Dec. 2-5	Tenth Annual All-American Air Maneuvers held at Miami, Fla.
Dec. 3	Col. A. P. de Seversky flies from New York City to Havana, Cuba, setting a new record of 5 hrs. 3 min. 5 sec. (Seversky P-35, Pratt & Whitney 1830-9 engine.)
Dec. 3	Jacqueline Cochran flies from New York City to Miami, Fla., setting new record of 4 hrs., 12 min. 27 sec. (Seversky Executive, Pratt & Whitney 1830-9 IX P engine.)
Dec. 5	Furio Niclot sets world speed record for 100 kms. of 344.461 m.p.h. at Montecelio, Italy. (Breda 88, 2 Piaggio XI RC.40 engines.)
Dec. 8-9	Fourteen Navy patrol bombers fly from San Diego, Calif., to Coco Solo, C. Z., 3,080 mi., in 21 hrs., 55 min. (Consolidated PBY-1, 2 Pratt & Whitney Twin Wasp engines.)
Dec. 9	Furio Niclot sets three world speed records at Montecelio, Italy (see Official Air Records). (Breda 88, 2 Piaggio XI RC.40 B engines.)
Dec. 14	Herbert Schiff Memorial Trophy for the fiscal year 1937 presented to VP Squadron 7 of the "U.S.S. Wright."
Dec. 17	Thirty-fourth anniversary of the Wright brothers first flight at Kitty Hawk, N. C., celebrated in a national aviation day.
Dec. 17	Sperry Award for 1937 presented to Clarence L. Johnson of Burbank, Calif., for his work on the Lockheed 14, by the Institute of the Aeronautical Sciences.
Dec. 17	Sylvanus Albert Reed Award for 1937 presented to Eastman N. Jacobs of the National Advisory Committee for Aeronautics.
Dec. 21	Adriano Bacula and Paolo d'Ambrosis, Italy, set four world speed records. (See Official Air Records.) Savoia-Marchetti S-79, 3 Piaggio XI RC.40 engines.)

Dec. 22 Giuseppe Tesei and Lino Rosci set world speed record for 1,000 kms. with payload of 10,000 kgs. of 206.350 m.p.h. (Savoia-Marchetti S-74, 4 Alfa Romeo 126 RC 34 engines.)

Dec. 29 Pan American Airways inaugurates new transpacific service between Auckland, New Zealand, and San Francisco, Calif. (Sikorsky S-42, 4 Pratt & Whitney Hornet engines.)

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 1, 1938

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.
DISTANCE, AIRLINE..........................10,148 kilometers (6,295.662 miles)
Gromov, Youmachev and Daniline, U.S.S.R., July 13-15, 1937.
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.

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 ....10,148 kilometers (6,295.662 miles)
Col. Mikhail Gromov, Comdt. Andrei Youmachev and Ing. Sergei Daniline, U.S.S.R., ANT-25 monoplane, AM-34 860 HP engine, from Moscow, U.S.S.R. to San Jacinto, California, July 13-15, 1937.
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..............................16,440 meters (53,936.895 feet)
Flight Lieutenant Maurice James Adam, Great Britain, Bristol 138 airplane, Bristol Pegasus engine, South Farnborough, England, June 30, 1937.
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, 610.950 km.p.h. (379.626 m.p.h.)
Dr. Ing. Hermann Wurster, Germany, BF 113 R. monoplane, DB 600-950 PC 12 cylinder engine, Augsburg, November 11, 1937.
National (U.S.) Record....................Speed, 567.115 km.p.h. (352.388 m.p.h.)
Howard R. Hughes, Hughes "Special" monoplane, Pratt and Whitney Wasp Junior 1000 HP engine, Santa Ana, California, September 13, 1935.

SPEEDS FOR SPECIFIED DISTANCES WITHOUT PAY LOAD

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record.......................Speed, 554.357 km.p.h. (344.461 m.p.h.)
Furio Niclot, Italy, Breda 88 airplane, 2 Piaggio XI RC.40 1,000 HP engines, December 5, 1937.
National (U.S.) Record....................Speed, 466.563 km.p.h. (289.908 m.p.h.)
Roscoe Turner, Laird-Turner Racer monoplane, Pratt and Whitney Twin Row Wasp engine, Detroit, Michigan, September 19, 1937.

SPEED FOR 1000 KILOMETERS (621.369 MILES)

International Record........................Speed, 524.185 km.p.h. (325.713 m.p.h.)
Furio Niclot, Italy, Breda 88 airplane, 2 Piaggio XI R.C.40B. 1,000 HP engines, December 9, 1937.
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, 428.296 km.p.h. (266.130 m.p.h.)
Adriano Bacula and Paolo d'Ambrosis, Italy, Savoia Marchetti S-79, 3 Piaggio XI RC.40 1,000 HP engines, December 21, 1937.
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, 325.257 km.p.h. (202.105 m.p.h.)
Vladimir Kokkinaki and A. Briandinsky, U.S.S.R., C.K.B. 26 monoplane, 2 M.85 800 HP engines, Moscow-Sebastopol-Sverdlosk-Moscow course, August 26, 1937.
National (U.S.) Record...................Speed, 272,030 km.p.h. (169.031 m.p.h.)
D. W. Tomlinson and J. S. Bartles, 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.

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................................12,816 meters (42,047.156 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, 524.185 km.p.h. (325.713 m.p.h.)
Furio Niclot, Italy, Breda 88 airplane, 2 Piaggio XI RC.40B. 1,000 HP engines, December 9, 1937.

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, 428.296 km.p.h. (266.130 m.p.h.)
Adriano Bacula and Paolo d'Ambrosis, Italy, Savoia Marchetti S-79, 3 Piaggio XI RC.40 1,000 HP engines, December 21, 1937.

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, 325.257 km.p.h. (202.105 m.p.h.)
Vladimir Kokkinaki and A. Briandinsky, U.S.S.R., C.K.B. 26 monoplane, 2 M.85 800 HP engines, Moscow-Sebastopol-Sverdlosk-Moscow course, August 26, 1937.

National (U.S.) Record....................Speed, 272.030 km.p.h. (169.031 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 16-17, 1935.

CLASS C—WITH PAY LOAD OF 1000 KILOGRAMS (2204.622 lbs.)

ALTITUDE

International Record................................12,246 meters (40,187.081 feet)
Michel Alekseev, U.S.S.R., ANT-40 airplane, 2 M.103 12 cylinder 860 HP engines, at Moscow-Podlipki, September 2, 1937.

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, 524.185 km.p.h. (325.713 m.p.h.)
Furio Niclot, Italy, Breda 88 airplane, 2 Piaggio XI RC.40B. 1,000 HP engines, December 9, 1937.

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, 428.296 km.p.h. (266.130 m.p.h.)
Adriano Bacula and Paolo d'Ambrosis, Italy, Savoia Marchetti S-79, 3 Piaggio XI RC.40 1,000 HP engines, December 21, 1937.

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, 325.257 km.p.h. (202.105 m.p.h.)
Vladimir Kokkinaki and A. Briandinsky, U.S.S.R., C.K.B. 26 monoplane, 2 M.85 800 HP engines, Moscow-Sebastopol-Sverdlosk-Moscow course, August 26, 1937.

National (U.S.) Record....................Speed, 272.030 km.p.h. (169.031 m.p.h.)
D. W. Tomlinson and J. S. Bartles, 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.

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, 444.115 km.p.h. (275.960 m.p.h.)
Adriano Bacula and Paolo d'Ambrosis, Italy, S-79 airplane, 3 Piaggio XI RC.40 1,000 HP engines, November 30, 1937.

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, 428.296 km.p.h. (266.130 m.p.h.)
Adriano Bacula and Paolo d'Ambrosis, Italy, Savoia Marchetti S-79, 3 Piaggio XI RC.40 1,000 HP engines, December 21, 1937.

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.

CLASS C—WITH PAY LOAD OF 5000 KILOGRAMS (11,023 lbs.)

ALTITUDE

International Record.............................8,980 meters (29,461.881 feet)
Major Andrei Youmachev, U.S.S.R., ANT-6 monoplane, 4 AN-34 800 HP engines at Tchelcovo, October 28, 1936.

National (U.S.) Record..None established.

SPEED FOR 1000 KILOMETERS

International Record.....................Speed, 401.965 km.p.h. (249.769 m.p.h.)
Giovanni Lucchini and Angelo Tivegna, Italy, S.79 airplane, 3 Alfa Romeo 126 RC.34 750 HP engines, November 30, 1937.

National (U.S.) Record..None established.

SPEED FOR 2000 KILOMETERS

International Record........................Speed, 307.455 km.p.h. (191.043 m.p.h.)
A. Curvale, G. Perot, P. Duclos and R. Vandequin, France, Bloch 160 monoplane, 4 Hispano-Suiza 680 HP engines, Istres-Grenay, October 17, 1937.

National (U.S.) Record..None established.

CLASS C—WITH PAY LOAD OF 10,000 KILOGRAMS (22,046 lbs.)

ALTITUDE

International Record..............................7,032 meters (23,070.818 feet)
Michel Nioukhtikov and Michel Lipkine, U.S.S.R., Bolkhovitinov transport monoplane, 4 AM-34 860 HP engines at Tchelkovo, November 11, 1936.
National (U.S.) Record....................................None established.

SPEED FOR 1000 KILOMETERS

International Record......................Speed, 322.089 km.p.h. (206.350 m.p.h.)
Giuseppe Tesei and Lino Rosci, Italy, Savoia Marchetti S-74, 4 Alfa Romeo 126 RC 34 750 HP engines, December 22, 1937.

CLASS C—GREATEST PAY LOAD CARRIED TO AN ALTITUDE OF 2000 METERS (6,561.66 feet)

International Record............................13,000 kilograms (28,660.086 lbs.)
Michel Nioukhtikov and Michel Lipkine, U.S.S.R., Bolkhovitinov transport monoplane, 4 AM-34 860 HP engines at Tchelkovo, November 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.

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, 400.293 km.p.h. (248.730 m.p.h.)
Maurice Arnoux, pilot; Miss Lallus, passenger; France, Caudron C-450 monoplane, Renault 456 engine, September 9, 1936.
National (U.S.) Record...None established.

MULTI-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 6.5 AND 9 LITERS (397-549 CUBIC INCHES)

AIRLINE DISTANCE

International Record........................3,318.198 kilometers (2,061.703 miles)
A. Goussarov and V. Glebov, U.S.S.R., Moskalev airplane, M-11 100 HP engine of 8.577 liters, from Moscow to Krasnoyarsk, September 23, 1937.
National (U.S.) Record...None 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.

SINGLE-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 4 AND 6.5 LITERS (244-397 CUBIC INCHES)

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record......................Speed, 315.789 km.p.h. (196.222 m.p.h.)
Maurice Arnoux, France, Caudron Rafale monoplane, Renault Bengali 160 HP engine, Etampes-Chartres-Bonce course, November 13, 1937.

National (U.S.) Record...None established.

SPEED FOR 1,000 KILOMETERS (621.369 MILES)

International Record......................Speed, 302.902 km.p.h. (188.214 m.p.h.)
Maurice Arnoux, France, Caudron Rafale monoplane, Renault Bengali 160 HP engine, Etampes-Chartres-Bonce course, November 13, 1937.

National (U.S.) Record...None established.

MULTI-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 4 AND 6.5 LITERS (244-397 CUBIC INCHES)

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record......................Speed, 313.588 km.p.h. (194.854 m.p.h.)
Maurice Arnoux, pilot; Miss Lallus, passenger; France, Caudron Rafale C.660 monoplane, Renault Bengali 140 HP engine, November 14, 1937.

National (U.S.) Record...None established.

SPEED FOR 1,000 KILOMETERS (621.369 MILES)

International Record......................Speed, 302.444 km.p.h. (187.930 m.p.h.)
Maurice Arnoux, pilot; Miss Lallus, passenger; France, Caudron Rafale C.660 monoplane, Renault Bengali 140 HP engine, November 14, 1937.

National (U.S.) Record...None 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.

SINGLE-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 2 AND 4 LITERS (122-244 CUBIC INCHES)

ALTITUDE

International Record..............................6,518 meters (21,384.470 feet)
Louis Clement, France, Taupin monoplane, Regnier 90 HP engine of 3.987 liters, at Buc, November 8, 1937.

National (U.S.) Record...................................None established.

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record.....................Speed, 220.940 km.p.h. (137.285 m.p.h.)
Vladimir Simunek, Czechoslovakia, Bibi B-E.502 airplane, Walter Minor engine, Praha-Nove Benatky-Rip-Praha course, May 6, 1937.

National (U.S.) Record...................................None established.

SPEED FOR 1,000 KILOMETERS (621.369 MILES)

International Record.....................Speed, 214.174 km.p.h. (133.081 m.p.h.)
V. Zacek, Czechoslovakia, Bibi B-E.502 airplane, Walter Minor engine, Praha-Nove Benatky-Rip-Praha course, May 6, 1937.

National (U.S.) Record...................................None established.

MULTI-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 2 AND 4 LITERS (122-244 CUBIC INCHES)

ALTITUDE

International Record..............................5,603 meters (18,382.508 feet)
Capt. Jan Cervenka and Lt. Kucera, Czechoslovakia, Beta-Minor Be-50 airplane, Walter Minor 90 HP engine of 3.989 liters displacement, Praha-Kbely, November 9, 1937.

National (U.S.) Record...................................None established.

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record.......................Speed, 186.993 km.p.h. (116.192 m.p.h).
Pierre Berthomier, pilot; Rene Orbillot, passenger; France, Farman 239 monoplane, Pobjoy engine of 2.835 liters, June 20, 1937.

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, 154.532 km.p.h. (96.022 m.p.h.)
Gustave Duverne, France, Kellner-Bechereau monoplane, Train type 4A.01 engine, Villacoublay-Champseru course, June 7, 1937.
National (U.S.) Record..........................Speed, 120.406 km.p.h. (74.817 m.p.h.)
Benjamin King, Aeronca C-2 Scout monoplane, Aeronca E113A 36 HP engine, Hampton Roads, Virginia permanent course, April 26, 1936.

SPEED FOR 1,000 KILOMETERS

International Record..........................Speed, 153.157 km.p.h. (95.167 m.p.h.)
Gustave Duverne, France, Kellner-Bechereau monoplane, Train type 4A.01 engine, Villacoublay-Champseru course, June 7, 1937.
National (U.S.) Record...None established.

SINGLE-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT OF LESS THAN 2 LITERS (122 CUBIC INCHES)

AIRLINE DISTANCE

International Record..............................939.723 kilometers (583.916 miles)
Edward W. Stitt, United States, Aeronca C-2 monoplane, Aeronca engine of 1.75 liters, from Columbus, Ohio to near Booneville, Iowa, July 31, 1937.
National (U.S.) Record..Same as above.

ALTITUDE

International Record................................4,658 meters (15,282.122 feet)
Captain Jan Cervenka, Czechoslovakia, B-E.501 airplane, Walter Minor 1 engine of 1.978 liters displacement, Praha Kbely, Dec. 5, 1937.
National (U.S.) Record...None established.

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record..........................Speed, 179.229 km.p.h. (111.368 m.p.h.)
Jan Stepan, Czechoslovakia, Bibi B-E.501 airplane, Walter Minor engine, Praha-Nove Benatky-Rip-Praha course, May 6, 1937.
National (U.S.) Record...None established.

SPEED FOR 1,000 KILOMETERS (621.369 MILES)

International Record..........................Speed, 170.809 km.p.h. (106.136 m.p.h.)
Jan Cervenka, Czechoslovakia, Bibi B-E.501 airplane, Walter Minor engine, Praha-Nove Benatky-Rip-Praha course, May 6, 1937.
National (U.S.) Record...None established.

MULTI-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT OF LESS THAN 2 LITERS (122 CUBIC INCHES)

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record..........................Speed, 146.699 km.p.h. (91.154 m.p.h.)
Vaclav Fuksa, pilot; E. Franek, passenger; Czechoslovakia, Praga "Air-Baby" E.114 102 airplane, Praga B engine of 1900 cubic centimeters, July 20, 1937.
National (U.S.) Record...None established.

SPEED FOR 1,000 KILOMETERS (621.369 MILES)

International Record..........................Speed, 144.148 km.p.h. (89.569 m.p.h.)
Vaclav Fuksa, pilot; E. Franek, passenger; Czechoslovakia, Praga "Air-Baby" E.114 102 airplane, Praga B engine of 1900 cubic centimeters, July 20, 1937.
National (U.S.) Record...None established.

SEAPLANES—CLASS C2

DISTANCE, CLOSED CIRCUIT

International Record..............................5.200 kilometers (3,231.123 miles)
Mario Stoppani and Carlo Tonini, Italy, Cant Z seaplane, 3 Alfa Romeo 126 RC 34 750 HP engines, May 27-28, 1937.

National (U.S.) Record..............................2.525 kilometers (1,569 miles)
Lts. B. J. Connell and H. C. Rodd, PX-10, 2 Packard 600 HP each, San Diego, Cal., August 15-16, 1927.

AIRLINE DISTANCE

International Record..........................5,771.300 kilometers (3,586.112 miles)
Guillaumet, Leclaire, Comet, Neri Chapato and Le Morvan, crew; France, Latecoere 521 seaplane, "Lieutenant de Vaisseau Paris" 6 Hispano-Suiza 650 HP engines, from Port Liautey, Morocco to Maceio, Brazil, October 25-26, 1937.

National (U.S.) 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; Navy XP3Y-1 Seaplane, 2 Pratt and Whitney 825 HP engines, from Cristobal Harbor, C. Z. to San Francisco Bay, Alameda, California, October 14-15, 1935.

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, 322.043 km.p.h. (200.108 m.p.h.)
Mario Stoppani and Carlo Tonini, Italy, Cant Z 506 seaplane, 3 Alfa Romeo 126 RC 34 750 HP engines, May 27-28, 1937.

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, 319.778 km.p.h. (198.700 m.p.h.)
Mario Stoppani and Carlo Tonini, Italy, Cant Z 506 seaplane, 3 Alfa Romeo 126 RC 34 750 HP engines, May 27-28, 1937.

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, 308.244 km.p.h. (191.534 m.p.h.)
Mario Stoppani and Carlo Tonini, Cant Z 506 seaplane, 3 Alfa Romeo 126 RC 34 750 HP engines, May 27-28, 1937.

National (U.S.) Record..None 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, 322.043 km.p.h. (200.108 m.p.h.)
Mario Stoppani and Carlo Tonini, Italy, Cant Z. seaplane, 3 Alfa Romeo 126 RC.34 750 HP engines, May 27-28, 1937.

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, 319.778 km.p.h. (198.700 m.p.h.)
Mario Stoppani and Carlo Tonini, Italy, Cant Z. 506 seaplane, 3 Alfa Romeo 126 RC.34 750 HP engines, May 27-28, 1937.

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, 308.244 km.p.h. (191.534 m.p.h.)
Mario Stoppani and Carlo Tonini, Italy, Cant Z. 506 seaplane, 3 Alfa Romeo 126 RC.34 750 HP engines, May 27-28, 1937.

National (U.S.) Record...None established.

CLASS C2—WITH PAY LOAD OF 1000 KILOGRAMS (2204.622 lbs.)

ALTITUDE

International Record.............................10,389 meters (34,084.577 feet)
Nicola di Mauro and Mario Stoppani, Italy, Cant Z. 506 B. seaplane, 3 Alfa Romeo RC.55 700 HP engines, at Monfalcone, November 12, 1937.

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, 322.043 km.p.h. (200.108 m.p.h.)
Mario Stoppani and Carlo Tonini, Italy, Cant Z. 506 seaplane, 3 Alfa Romeo 126 RC.34 750 HP engines, May 27-28, 1937.

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, 319.778 km.p.h. (198.700 m.p.h.)
Mario Stoppani and Carlo Tonini, Italy, Cant Z. 506 seaplane, 3 Alfa Romeo 126 RC.34 750 HP engines, May 27-28, 1937.

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, 308.244 km.p.h. (191.534 m.p.h.)
Mario Stoppani and Carlo Tonini, Italy, Cant Z. 506 seaplane, 3 Alfa Romeo 126 RC.34 750 HP engines, May 27-28, 1937.

National (U.S.) Record.......................................None established.

CLASS C2—WITH PAY LOAD OF 2000 KILOGRAMS (4409.244 lbs.)

ALTITUDE

International Record...............................8,951 meters (29,366.737 feet)
Mario Stoppani and Nicola di Mauro, Italy, Cant Z 506-B seaplane, 3 Alfa Romeo 700 HP engines, at Monfalcone, November 3, 1937.

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.

CLASS C2—WITH PAY LOAD OF 5000 KILOGRAMS (11,023.11 lbs.)

ALTITUDE

International Record...............................7,410 meters (24,310.973 feet)
Mario Stoppani and Nicola di Mauro, pilots; Forlivesi, mechanic; Italy, Cant Z 506-B seaplane, 3 Alfa Romeo 700 HP engines, at Monfalcone, November 7, 1937.

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

International Record......................Speed, 251.889 km.p.h. (156.516 m.p.h.)
Mario Stoppani and Ing. Antonio Maiorana, pilots; A. Spinelli, S. Forlivesi and R. T. Suriano, crew; Italy, Cant Z 508 seaplane, 3 Isotta-Fraschini Asso 11 R.C. 836 HP engines, Grado-Faro Ancona-Faro di Rimini temporary course, May 1, 1937.

National (U.S.) Record.......................................None established.

SPEED FOR 2000 KILOMETERS

International Record......................Speed, 248.412 km.p.h. (154.356 m.p.h.)
Mario Stoppani and Ing. Antonio Maiorana, pilots; A. Spinelli, S. Forlivesi and R. T. Suriano, crew; Italy, Cant Z 508 seaplane, 3 Isotta-Fraschini Asso 11 R.C. 836 HP engines, Grado-Faro Ancona-Faro di Rimini temporary course, May 1, 1937.

National (U.S.) Record.......................................None established.

CLASS C2—WITH PAY LOAD OF 10,000 KILOGRAMS (22,046.22 lbs.)

ALTITUDE

International Record..............................4,863 meters (15,954.691 feet)
Mario Stoppani, pilot; G. Divari and A. Spinelli, passengers; Italy, Cant Z 508 seaplane, 3 Isotta-Fraschini Asso 11 R.C. 40 836 HP engines, Monfalcone, Apr. 13, 1937.
National (U.S.) Record....................................None established.

CLASS C2—GREATEST PAY LOAD CARRIED TO AN ALTITUDE OF 2000 METERS (6,561.660 feet)

International Record.........................Weight, 10,000 kgs. (22,046.220 lbs.)
Mario Stoppani, pilot; G. Divari and A. Spinelli, passengers; Italy, Cant Z 508 seaplane, 3 Isotta-Fraschini Asso 11 R.C. 40 836 HP engines, Monfalcone, Apr. 13, 1937.
National (U.S.) Record...........................Weight, 7,533 kgs. (16,608 lbs.)
Boris Sergievsky, Sikorsky S-42 seaplane, 4 Pratt & Whitney Hornet 650 HP engines, Bridgeport, Connecticut, April 26, 1934.

LIGHT SEAPLANES—CLASS C2—FIRST CATEGORY

MULTI-SEATERS WEIGHT EMPTY LESS THAN 680 KGS. (1,499.128 LBS.)

AIRLINE DISTANCE

International Record..............................1,297.100 kms. (805.979 miles)
J. V. Pissmenys, pilot; V. P. Kousnetzoff, passenger; U.S.S.R., monoplane seaplane, M11 100 HP engine, from Kiev to Batoum, May 23, 1937.
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, 210 km.p.h. (130.488 m.p.h.)
Stefanovsky and Nikitine, U.S.S.R., monoplane seaplane, Renault 140 HP engine, Touchino-Moskva, October 2, 1937.
National (U.S.) Record..None established.

LIGHT SEAPLANES—CLASS C2—SECOND CATEGORY

SINGLE-SEATERS WEIGHT EMPTY LESS THAN 570 KGS. (1,256.622 LBS.)

AIRLINE DISTANCE

International Record..................................1,174 kms. (729.984 miles)
Nicolas Fedosseev, U.S.S.R., UT-1 monoplane seaplane, M-11 150 HP engine, from Moscow to Ufa-Belaya, October 21, 1937.
National (U.S.) Record.............................355.988 kms. (221.20 miles)
Benjamin King, 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.

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, 218 km.p.h. (135.459 m.p.h.)
J. Pointkovsky, U.S.S.R., UT-1 monoplane seaplane, M-11 150 HP engine, Touchino-Moskva, October 2, 1937.
National (U.S.) Record..None 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.

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.

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.

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, 337.079 km.p.h. (209.451 m.p.h.)
Major A. P. de Seversky, United States, Seversky Amphibion, Wright Cyclone 1000 HP engine, at Miami, Florida, December 19, 1936.
National (U.S.) Record..Same as above.

SPEED FOR 1000 KILOMETERS (621.369 MILES) WITHOUT PAY LOAD

International Record......................Speed, 257.138 km.p.h. (159.778 m.p.h.)
Giuseppe Burei and Enrico Rossaldi, pilots; Gino Velati, passenger; Italy, Macchi C.94 amphibian, 2 Wright Cyclone 750 HP engines, Rovine Ansedonia-Faro Fiumicino-Antignano temporary course, May 9, 1937.
National (U.S.) Record.....................Speed, 160.854 km.p.h. (99.950 m.p.h.)
Harry Richman and George Daufkirch, Sikorsky S-39 amphibian, Pratt and Whitney 300 HP engine, Miami, Florida, February 10, 1935.

SPEED FOR 2000 KILOMETERS (1242.739 MILES) WITHOUT PAY LOAD

International Record......................Speed, 248.967 km.p.h. (154.701 m.p.h.)
Giuseppe Burei and Enrico Rossaldi, pilots; Gino Velati, passenger; Italy, Macchi C.94 amphibian, 2 Wright Cyclone 750 HP engines, Rovine Ansedonia-Faro Fiumicino-Antignano temporary course, May 6, 1937.
National (U.S.) Record.....................................None 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 (621.369 MILES)

International Record......................Speed, 257.138 km.p.h. (159.778 m.p.h.)
Giuseppe Burei and Enrico Rossaldi, pilots; Gino Velati, passenger; Italy, Macchi C.94 amphibian, 2 Wright Cyclone 750 HP engines, Rovine Ansedonia-Faro Fiumicino-Antignano temporary course, May 9, 1937.
National (U.S.) Record.....................................None established.

CLASS C3—WITH PAY LOAD OF 1000 KILOGRAMS (2204.622 lbs.)

ALTITUDE

International Record.............................6,432 meters (21,102.318 feet)
Giuseppe Burei and Enrico Rossaldi. Italy, Macchi C.94 amphibian, 2 Wright Cyclone 750 HP engines, Varese, April 15, 1937.
National (U.S.) Record.............................5,982 meters (19,625.925 feet)
Boris Sergievsky, Sikorsky S-43, 2 P & W 750 HP Hornet engines, Stratford, Connecticut, April 25, 1936.

SPEED FOR 1000 KILOMETERS (621.369 MILES)

International Record......................Speed, 257.138 km.p.h. (159.778 m.p.h.)
Giuseppe Burei and Enrico Rossaldi, pilots; Gino Velati, passenger; Italy, Macchi C.94 amphibian, 2 Wright Cyclone 750 HP engines, Rovine Ansedonia-Faro Fiumicino-Antignano temporary course, May 9, 1937.
National (U.S.) Record.....................................None 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.

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.

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.

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.

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.
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.

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........................1,715.800 kilometers (1,065.649 miles)
Ernest Demuyter and Pierre Hoffmans, Belgium, from Warsaw, Poland to Miedlesza, U.S.S.R., Sept. 1, 1936.

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.............................9,374 meters (30,754.529 feet)
Josef Emmer, Austria, "OE-Marek Emmer II" balloon, Vienna-Lac Nuesiedl, Sept. 25, 1937.

National (U.S.) Record....................................None 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........................1,715.800 kilometers (1,065.649 miles)
Ernest Demuyter and Pierre Hoffmans, Belgium, from Warsaw, Poland to Miedlesza, U.S.S.R., Sept. 1, 1936.

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.............................9,374 meters (30,754.529 feet)
Josef Emmer, Austria, "OE-Marek Emmer II" balloon, Vienna-Lac de Nuesiedl, Sept. 25, 1937.

National (U.S.) Record.............................8,690 meters (28,508.413 feet)
Capt. Hawthorne C. Gray, Scott Field, Belleville, Illinois, March 9, 1927.

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........................1,715.800 kilometers (1,065.649 miles)
Ernest Demuyter and Pierre Hoffmans, Belgium, from Warsaw, Poland to Miedlesza, U.S.S.R., Sept. 1, 1936.

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.............................10,853 meters (32,811.132 feet)
Z. J. Burzynski, Poland, at Legjonowo, March 29, 1936.

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

AIRLINE DISTANCE

International Record..................................652.256 kms. (405.292 miles)
Victor Rastorgoeff, U.S.S.R., GN-7 glider, from Moscow to the vicinity of Iarygenskaya, May 27, 1937.
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.

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 hour, 20 mins., 49 seconds.
Ewald Rohlfs, Germany, FW 61.VI. helicopter of Prof. Henrich Focke, Siemens Sh 14a. 160 HP engine, Bremen airport, June 25, 1937.
National (U.S.) Record..None established.

AIRLINE DISTANCE

International Record..............................108.974 kilometers (67.713 miles)
Melle. Hanna Reitsch, Germany, FW 61, V 2, helicopter, from Stendal airport to Tempelhof airport, October 25, 1937.
National (U.S.) Record..None established.

DISTANCE, CLOSED CIRCUIT

International Record............................80.604 kilometers (50.085 miles)
Ewald Rohlfs, Germany, FW 61.VI. helicopter of Prof. Henrich Focke, Siemens Sh 14a. 160 HP engine, Bremen airport, June 26, 1937.
National (U.S.) Record......................................None established.

ALTITUDE

International Record................................2,439 meters (8,001.952 feet)
Ewald Rohlfs, Germany, FW 61.VI. helicopter of Prof. Henrich Focke, Siemens Sh 14a. 160 HP engine, Bremen airport, June 25, 1937.
National (U.S.) Record......................................None established.

SPEED FOR 20 KILOMETERS

International Record........................Speed, 122.553 km.p.h. (76.151 m.p.h.)
Ewald Rohlfs, Germany, FW 61.VI. helicopter of Prof. Henrich Focke, Siemens Sh 14a. 160 HP engine, June 26, 1937.
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, 470.365 km.p.h. (292.271 m.p.h.)
Jacqueline Cochran, United States, Seversky low wing monoplane, Pratt & Whitney 1830-B 850 HP engine, Detroit, Michigan, September 21, 1937.
National (U.S.) Record..Same as above.

SPEED FOR 100 KILOMETERS (62.137 MILES)

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, 323.015 km.p.h. (200.712 m.p.h.)
Jacqueline Cochran, Beechcraft biplane, X-17081, Pratt and Whitney Wasp 600 HP engine, July 28, 1937.

SPEED FOR 1000 KILOMETERS (621.369 MILES)

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....................Speed, 328.139 km.p.h. (203.895 m.p.h.)
Jacqueline Cochran, Beechcraft biplane, X-17081, Pratt and Whitney Wasp 600 HP engine, July 26, 1937.

LIGHT AIRPLANES—CLASS C—FIRST CATEGORY

MULTI-SEATERS WEIGHT EMPTY LESS THAN 560 KGS. (1,234.576 LBS.)

AIRLINE DISTANCE

International Record.............................1,444.722 kms. (897.706 miles)
Miss V. Grisodoubova, pilot; M. Raskova, passenger; U.S.S.R., Jakovlev airplane, M-11 150 HP engine, from Moscow to Aktioubinsk, October 24, 1937.
National (U.S.) Record ....843.500 kms. (524.126 miles)
Helen MacClosky and Mrs. Monro MacClosky, monocoupe monoplane, Lambert 90 HP engine, from Chicago, Ill. to Endless Caverns, Virginia, June 25, 1936.

ALTITUDE
International Record..............................6,518 meters (21,384.470 feet)
Irene Vishnevskaya, pilot; Katherine Mednikova, passenger; U.S.S.R., N-9 monoplane, M-11 150 HP engine, at Moscow-Touchino, July 4, 1937.
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, 283.241 km.p.h. (175.997 m.p.h.)
Madame Charnaux, pilot; Mlle. Mahe, passenger; France, Caudron Rafale monoplane, Renault Bengali 140 HP engine, Villesauvage-La Marmogne, May 8, 1937.
National (U.S.) Record.....................Speed, 268.169 km.p.h. (166.632 m.p.h.)
Miss Helen MacClosky, Monocoupe monoplane, Warner Super Scarab 145 HP engine, at Miami, Florida, January 15, 1935.

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.

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, 218.18 km.p.h. (135.570 m.p.h.)
Miss V. Grisodoubova, U.S.S.R., UT-1 monoplane, M-11 150 HP engine, Moscow-Touchino, October 7, 1937.
National (U.S.) Record....................Speed, 198.347 km.p.h. (123.247 m.p.h.)
Annette Gipson, Monocoupe monoplane, Lambert 90 HP engine, Newark, New Jersey, July 30, 1936.

SINGLE-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 4 AND 6.5 LITERS (244-397 CUBIC INCHES)

SPEED FOR 100 KILOMETERS (62.137 MILES)
International Record........................Speed, 285.261 km.p.h. (177.253 m.p.h.)
Madame M. Charnaux, France, Caudron Rafale monoplane, Renault Bengali 140 HP engine, Villesauvage-La Marmogne course, May 8, 1937.
National (U.S.) Record..None established.

SPEED FOR 1,000 KILOMETERS (621.369 MILES)
International Record........................Speed, 263.991 km.p.h. (164.036 m.p.h.)
Madame M. Charnaux, France, Caudron Rafale monoplane, Renault engine of 6.33 liters cylinder displacement, Villesauvage course, September 8, 1937.
National (U.S.) Record..None established.

MULTI-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 4 AND 6.5 LITERS (244-397 CUBIC INCHES)

SPEED FOR 100 KILOMETERS (62.137 MILES)
International Record......................Speed, 283.241 km.p.h. (175.997 m.p.h.)
Madame Charnaux, pilot; Mlle. Mahe, passenger; France, Caudron Rafale monoplane, Renault Bengali 140 HP engine, Villesauvage-La Marmogne course, May 8, 1937.
National (U.S.) Record..None established.

SPEED FOR 1,000 KILOMETERS (621.369 MILES)
International Record........................Speed, 268.740 km.p.h. (166.987 m.p.h.)
Mrs. M. Charnaux, pilot; Miss G. Lallus, passenger; France, Caudron Rafale C-530 monoplane, Renault Bengali 140 HP engine of 6.33 liters displacement, Villesauvage-La Marmogne course, October 16, 1937.
National (U.S.) Record..None established.

LIGHT AIRPLANES—CLASS C—THIRD CATEGORY

SINGLE-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 2 AND 4 LITERS (122-244 CUBIC INCHES)

ALTITUDE
International Record................................6,241 meters (20,475.679 feet)
Mrs. Claire Roman, France, Taupin monoplane, Regnier 90 HP engine, at Buc, November 5, 1937.
National (U.S.) Record..None established.

MULTI-SEATERS WEIGHT EMPTY LESS THAN 280 KGS. (617.288 LBS.)

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.

MULTI-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 2 AND 4 LITERS (122-244 CUBIC INCHES)

ALTITUDE
International Record................................5,343 meters (17,529.491 feet)
Mrs. Claire Roman, pilot; Miss Lucas-Naudin, passenger, France, Taupin monoplane, Regnier 90 HP engine of 3.987 liters, at Buc, November 10, 1937.
National (U.S.) Record..None established.

LIGHT AIRPLANES—CLASS C—FOURTH CATEGORY

SINGLE-SEATERS WEIGHT EMPTY LESS THAN 200 KGS. (440.920 LBS.)

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.

SINGLE-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT OF LESS THAN 2 LITERS (122 CUBIC INCHES)

ALTITUDE
International Record................................2,801 meters (9,189.614 feet)
Mrs. Claire Roman, France, Peyret Taupin airplane, Polymecanique 38 HP engine of 1.57 liters, at Buc, October 21, 1937.
National (U.S.) Record..None established.

SPEED FOR 100 KILOMETERS (62.137 MILES)
International Record........................Speed, 143.130 km.p.h. (88.937 m.p.h.)
Miss Marie Doubkova, Czechoslovakia, Praga-Baby airplane, Praga B. 39 HP engine of 1.9 liters, at Praha-Kbely airport, November 29, 1937.
National (U.S.) Record..None established.

MULTI-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT OF LESS THAN 2 LITERS (122 CUBIC INCHES)

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record........................Speed, 143.850 km.p.h. (89.384 m.p.h.)
Miss Marie Doubkova, pilot; Miss Svobodova, passenger; Czechoslovakia, Praga-Baby airplane, Praga B. 39 HP engine of 1.9 liters, at Praha-Kbely airport, November 29, 1937.

National (U.S.) Record....................................None established.

SEAPLANES—CLASS C2

ALTITUDE

International Record..............................8,864 meters (29,081.304 feet)
Poline Ossipenko, U.S.S.R., "canot volant" monoplane seaplane, A.M.34 750 HP engine, at Sebastopol, May 25, 1937.

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.

CLASS C2—WITH PAY LOAD OF 500 KILOGRAMS (1102.311 LBS.)

ALTITUDE

International Record..............................7,605 meters (24,950.735 feet)
Poline Ossipenko, U.S.S.R., "canot volant" monoplane seaplane, AM-34 750 HP engine, at Sebastopol, May 25, 1937.

National (U.S.) Record....................................None established.

CLASS C2—WITH PAY LOAD OF 1000 KILOGRAMS (2204.622 LBS.)

ALTITUDE

International Record..............................7,009 meters (22,995.359 feet)
Poline Ossipenko, U.S.S.R., "canot volant" monoplane seaplane, AM-34 750 HP engine, at Sebastopol, May 25, 1937.

National (U.S.) Record....................................None established.

LIGHT SEAPLANES—CLASS C2—FIRST CATEGORY

MULTI-SEATERS WEIGHT EMPTY LESS THAN 680 KGS. (1,499.128 LBS.)

ALTITUDE

International Record..............................3,267 meters (10,718.482 feet)
Miss V. Grisodoubova, pilot; K. Slobogensko, passenger; U.S.S.R., UT-2 seaplane, Renault 140 HP engine, at Moscow, October 15, 1937.

National (U.S.) Record..........................1,850 meters (6,069.542 feet)
Crystal Mowry and Alice Bender, Kittyhawk seaplane, Kinner 125 HP engine, Miami, Florida, December 12, 1936.

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record..........................Speed, 200 km.p.h. (124.274 m.p.h.)
Miss V. Grisodoubova and Miss K. Slobogensko, U.S.S.R., UT-2 Yakavlev seaplane, Renault 140 HP engine, Moscow-Touchino, October 9, 1937.

National (U.S.) Record......................Speed, 127.361 km.p.h. (79.138 m.p.h.)
Miss Crystal Mowry, pilot; Miss Edith McCann, passenger; Kittyhawk seaplane, Kinner 125 HP engine, Miami, Florida, December 9, 1936.

LIGHT SEAPLANES—CLASS C2—SECOND CATEGORY

SINGLE-SEATERS WEIGHT EMPTY LESS THAN 570 KGS. (1,256.622 LBS.)

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 100 KILOMETERS (62.137 MILES)

International Record........................Speed 190.88 km.p.h. (118.607 m.p.h.)
Miss V. Grisodoubova, U.S.S.R., monoplane seaplane, M-11 150 HP engine, at Moscow, October 9, 1937.

National (U.S.) Record....................Speed, 107.299 km.p.h. (66.672 m.p.h.)
Margaret Bain Tanner, Aeronca seaplane, Aeronca E113A 36 HP engine, Hampton, Virginia, August 8, 1936

LIGHT SEAPLANES—CLASS C2—THIRD CATEGORY

MULTI-SEATERS WEIGHT EMPTY LESS THAN 350 KGS. (7771.610 LBS.)

ALTITUDE

International Record...............................1,777 meters (5,830.041 feet)
Miss Crystal Mowry, pilot; Miss Lillian Bishop, passenger; United States, Aeronca seaplane, Aeronca 36 HP engine, Miami, Florida, December 10, 1936.

National (U.S.) Record..Same as above.

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record........................Speed 111.063 km.p.h. (69.011 m.p.h.)
Miss Crystal Mowry, pilot; Miss Edith McCann, passenger; United States, Aeronca seaplane, Aeronca 36 HP engine, Miami, Florida, December 10, 1936.

National (U.S.) Record..Same as above.

GLIDERS—CLASS D

(Single-Place)

DURATION WITH RETURN TO POINT OF DEPARTURE

International Record..24 hrs., 14 min.
Miss Wanda Modlibowska, Poland, "Komar" glider at Bezmiechowa, May 13-14, 1937.

National (U.S.) Record....................................None established.

AIRLINE DISTANCE

International Record..............................349 kilometers (216.858 miles)
Hanna Reitsch, Germany, Reiher D-11-95 Glider, from the Wasserkuppe to Hamburg-Fuhlsbuttel airport, July 4, 1937.

National (U.S.) Record....................................None established.

HELICOPTERS—CLASS G

AIRLINE DISTANCE

International Record...........................108.974 kilometers (67.713 miles)
Miss Hanna Reitsch, Germany, FW. 61, V 2, helicopter, from Stendal airport to Tempelhof airport, October 25, 1937.

National (U.S.) Record....................................None established.

Flying Facts and Figures

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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 Pound-Miles*
1926	13	...	4,318,087	5,782	(1)	3,555	(4)
1927	19	128	5,870,489	8,679	(1)	45,859	....
1928	36	325	10,673,450	49,713	(1)	216,644	....
1929	39[2]	525	25,141,499	173,405	(1)	257,443	....
1930	43[2]	600	36,945,203	417,505	103,747,249	468,571	....
1931	41[2]	590	47,385,987	522,345	119,968,577	1,151,348	6,280,409,884
1932	34[2]	564	50,932,967	540,681	146,552,587	1,600,821	5,402,249,740
1933	29[2]	504	54,642,545	568,940	198,800,079	2,452,812	5,135,897,406
1934[3]	25[2]	518	48,786,551	561,370	225,267,559	3,449,675	4,922,822,780
1935[3]	27	459	63,540,233	860,761	360,569,431	5,511,737	8,265,416,188
1936[3]	33	380	73,303,836	1,147,969	491,774,053	8,350,010	11,482,872,622
1937[3]	20	390	76,996,163	1,267,580	549,628,407	8,914,067	13,396,460,117

[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.
[4] Air mail pound-miles have been computed by the Post Office Department commencing with January 1931; and are not available for periods prior to that date.

Monthly Air Transport Operations

Air Lines of the United States[1]

(Corrected tables compiled by U. S. Bureau of Air Commerce)

1935	*Miles Flown*	*Passengers*	*Passenger Miles*	*Mail Pound-Miles*	*Express Pounds*
January........	3,903,009	37,364	17,281,851	508,804,263	291,483
February.......	4,024,541	45,464	20,200,851	528,397,869	290,200
March.........	4,833,353	66,815	29,083,098	643,043,623	393,099
April..........	4,873,508	71,270	30,606,397	632,506,692	378,645
May..........	5,421,473	73,805	30,700,768	669,748,719	404,185
June..........	5,673,244	82,531	34,075,881	677,231,008	462,501
July..........	6,290,606	94,888	37,789,828	728,509,715	470,034
August........	6,403,280	99,274	39,576,336	761,384,770	537,950
September......	5,909,328	85,753	35,575,638	732,874,751	568,276
October........	5,952,435	79,694	32,580,871	807,459,824	618,828
November......	4,915,268	59,365	24,707,065	717,264,459	520,003
December......	5,169,188	64,448	27,480,947	858,099,895	575,033
Total......	63,540,233	860,761	360,569,431	8,265,416,188	5,511,737
1936					
January........	4,945,909	53,615	22,572,842	761,833,426	443,278
February.......	4,672,635	52,796	22,073,983	745,844,095	447,962
March.........	5,627,723	84,019	36,929,866	902,748,876	669,785
April..........	5,632,339	82,116	34,755,907	885,274,141	578,582
May..........	6,251,010	105,260	43,707,618	920,628,971	598,969
June..........	6,393,459	105,906	43,861,408	940,827,992	809,499
July..........	6,853,976	120,549	48,403,255	1,055,014,828	721,525
August........	6,867,100	116,257	47,895,432	1,051,115,146	674,173
September......	6,560,539	111,269	48,148,898	998,893,813	784,804
October........	6,746,223	112,689	49,306,143	1,060,488,440	920,792
November......	6,490,739	106,759	48,399,910	984,287,593	872,901
December......	6,262,184	96,734	45,088,782	1,166,914,401	827,740
Total......	73,303,836	1,147,969	491,744,053	11,482,872,622	8,350,010
1937					
January........	5,077,771	60,706	27,258,306	907,002,712	681,938
February.......	5,431,920	75,479	32,628,509	1,003,256,476	625,404
March.........	6,279,184	93,811	41,900,750	1,174,070,037	720,979
April..........	6,292,297	90,420	39,243,545	1,097,607,786	697,613
May..........	6,728,342	110,022	47,767,555	1,104,136,925	730,052
June..........	6,711,506	122,807	52,879,779	1,129,742,717	805,412
July..........	7,123,789	133,139	56,453,733	1,124,011,779	729,840
August........	7,160,434	135,032	57,645,776	1,151,850,637	733,180
September......	7,139,978	142,638	59,820,995	1,146,860,144	886,674
October........	7,031,984	126,313	55,314,537	1,202,650,061	854,665
November......	6,269,583	93,685	40,567,675	1,121,521,232	697,177
December......	5,749,375	83,459	38,147,247	1,233,749,611	751,133
Total......	76,996,163	1,267,580	549,628,407	13,396,460,117	8,914,067

[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 1937.

Mileage and cost of service on Government-operated and contract air mail routes for the fiscal years 1918 to 1937, 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	31,147,875	[1] 8,814,065.42	.283
1936	38,699,732	[1] 12,034,903.60	.311
1937	39,958,319	[1] 12,722,286.00	.318

[1] Subject to final adjustment.

Statistical report showing the miles of service scheduled and actually flown and weight of mails dispatched (domestic lines) during the fiscal years 1926-37

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	31,147,875	10,775,248
1936	29,198	40,802,141	38,699,732	15,377,993
1937	29,622	42,051,957	39,958,319	19,553,543
Total		280,142,902	262,350,562	92,044,160

[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 1937.

Statistical report showing the pounds of domestic air mail dispatched, by months, during the fiscal years 1934-37

	1934	*1935*	*1936*	*1937*
July	644,172	682,520	1,169,737	1,616,191
August	690,177	776,173	1,224,623	1,623,239
September	643,621	736,193	1,172,265	1,559,880
October	665,458	916,416	1,293,869	1,629,711
November	631,748	823,737	1,181,678	1,511,117
December	657,203	931,425	1,317,774	1,778,912
January	643,278	820,286	1,177,753	1,410,974
February	526,903	858,299	1,167,635	1,538,470
March	198,492	1,002,269	1,396,977	1,709,916
April	241,856	1,036,796	1,355,200	1,665,250
May	389,721	1,108,315	1,444,013	1,090,041
June	544,290	1,082,819	1,476,469	1,729,830
Total	6,476,919	10,775,248	15,377,993	19,553,543

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.

U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1937.

Statistical report showing the domestic air mail pound-miles performed, by months, for the fiscal years 1934-37

	1934	*1935*	*1936*	*1937*
July	455,598,151	454,192,862	728,599,715	1,055,014,828
August	476,472,388	511,005,729	761,384,770	1,051,115,146
September	443,327,027	487,706,543	732,874,751	998,893,813
October	463,825,148	580,238,792	807,459,824	1,060,488,440
November	431,371,394	516,204,870	717,264,459	984,287,593
December	451,217,496	581,405,062	858,099,895	1,166,914,401
January	436,385,848	508,804,263	761,833,426	907,002,712
February	348,386,704	528,397,869	745,844,995	1,003,256,476
March	136,922,593	643,043,623	902,748,876	1,174,070,037
April	188,450,222	632,506,692	885,274,141	1,097,607,786
May	307,332,754	669,748,719	920,628,971	1,104,136,925
June	374,590,801	677,231,608	949,827,992	1,129,742,717
Total	4,513,880,526	6,790,486,632	9,771,841,815	12,732,530,874

U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1937.

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, 1937

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........	6,202,030	6,065,779	97.80	3,866,101,172	30.36	$2,425,920.10	19.07
11	...."....................	Seattle-San Diego.......	1,737,113	1,706,692	98.25	491,234,347	3.86	487,347.85	3.83
12	...."....................	Salt Lake City-Seattle....	1,209,345	1,196,390	98.93	245,424,632	1.93	398,776.14	3.13
	Total..................	....	9,148,497	8,968,861	98.04	4,602,850,151	36.15	3,312,044.09	26.03
4	American Airlines, Inc...........	Fort Worth-Los Angeles...	1,928,737	1,892,423	98.12	612,116,063	4.81	525,650.38	4.13
7	...."....................	Newark-Chicago.........	1,525,743	1,477,975	96.87	738,968,645	5.80	587,120.73	4.61
18	...."....................	Boston-Newark..........	453,272	415,945	91.76	73,216,020	.58	135,720.83	1.07
21	...."....................	Boston-Cleveland.........	682,973	588,494	86.17	20,280,890	.16	188,202.08	1.48
22	...."....................	Cleveland-Nashville......	703,711	661,805	94.04	53,804,057	.42	178,848.50	1.40
23	...."....................	Albany-Fort Worth.......	2,129,742	2,010,453	94.40	602,869,313	4.73	508,993.75	4.00
25	...."....................	Washington-Chicago......	983,729	854,756	86.89	73,870,867	.58	270,366.03	2.20
30	...."....................	Chicago-Fort Worth......	744,580	677,035	90.93	155,040,524	1.22	191,913.64	1.51
	Total..................	....	9,152,487	8,578,886	93.73	2,330,166,385	18.30	2,595,005.94	20.40
3	Northwest Airlines, Inc..........	Fargo-Seattle............	1,906,677	1,845,788	96.81	440,343,784	3.46	575,808.92	4.53
16	...."....................	Chicago-Pembina.........	1,240,773	1,171,787	94.44	334,123,993	2.62	351,349.08	2.76
	Total..................	....	3,147,450	3,017,575	95.87	774,467,777	6.08	927,158.00	7.29
5	North American Aviation, Inc....	Newark-New Orleans.....	1,767,408	1,615,723	91.42	305,274,115	2.40	419,345.15	3.30
6	...."....................	Newark-Miami...........	1,745,731	1,673,410	95.86	618,104,519	4.85	494,220.99	3.89
10	...."....................	Chicago-Jacksonville......	367,949	285,860	94.00	213,343,913	1.68	346,604.10	2.72
20	...."....................	New Orleans-Houston.....	245,604	229,836	93.58	17,613,943	.14	71,596.68	.56
	Total..................	....	5,126,692	4,804,829	93.72	1,154,336,490	9.07	1,331,766.92	10.47

U. S. AIR MAIL SERVICE (*Cont.*)

9	Braniff Airways, Inc.	Chicago-Dallas	994,196	945,110	95.06	281,072,801	2.21	273,305.54	2.15
15	"	Amarillo-Brownsville	870,390	805,088	92.50	114,790,605	.90	218,584.84	1.72
	Total		1,864,586	1,750,198	93.87	395,863,406	3.11	491,080.38	3.87
14	Pennsylvania-Central Airlines Corp.	Washington-Detroit	941,137	853,092	90.64	125,544,616	.98	284,231.99	2.23
32	"	Detroit-Milwaukee	348,851	326,321	93.54	11,070,237	.09	107,806.41	.85
	Total		1,289,988	1,179,413	91.43	136,614,853	1.07	392,038.40	3.08
17	Wyoming Air Service, Inc.	Cheyenne-Pueblo	280.635	261,121	93.05	21,548,727	.17	77,374.76	.61
28	"	Billings-Cheyenne	305,140	282,576	92.61	8,312,115	.07	82,846.93	.65
	Total		585,775	543,697	92.82	29,860,842	.24	160,221.69	1.26
2	Transcontinental & Western Air, Inc.	Newark-Los Angeles	5,649,452	5,463,054	96.70	2,693,912,753	21.16	1,752,164.61	13.77
8	Chicago & Southern Air Lines, Inc.	Chicago-New Orleans	1,199,223	1,105,875	92.22	77,027,008	.61	330,556.97	2.60
13	Western Air Express Corporation	Salt Lake City-San Diego	1,037,208	996,986	96.12	328,673,141	2.58	346,447.19	2.72
19	National Parks Airways, Inc.	Great Falls-Salt Lake City	678,503	638,491	94.10	33,880,205	.26	212,236.32	1.67
24	Delta Air Corporation	Charleston-Dallas	1,218,436	1,107,209	90.87	92,535,402	.73	321,965.38	2.53
26	Hanford Airlines, Inc.	Minneapolis-Tulsa	742,721	687,973	92.63	44,949,508	.35	220,117.36	1.73
27	Boston-Maine Airways, Inc.	Boston-Bangor-Burlington	424,330	361,688	85.24	6,022,004	.05	120,515.63	.95
29	Varney Air Transport, Inc.	Pueblo-El Paso	399,579	374,602	93.75	13,717,920	.11	108,864.52	.86
31	G. T. Baker	Jacksonville-St. Petersburg	184,906	177,965	96.25	13,167,996	.10	48,051.35	.38
33	Inter-Island Airways, Ltd.	Honolulu-Hilo-Lihue	202,124	201,017	99.45	3,585,024	.03	50,251.25	.39
	Total		11,736,482	11,114,860	94.70	3,308,370,070	25.98	3,511,170.58	27.60
	Grand total		42,051,957	39,958,319	95.02	12,732,530,874	100.00	[1] 12,722,286.00	100.00

[1] Subject to final adjustment.

REVIEW OF ANNUAL MILITARY AND COMMERCIAL PRODUCTION IN THE UNITED STATES

Calendar Years

Airplane Production

	Military		Commercial	
Year	*Units*	*Value*	*Units*	*Value*
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
1937	949	37,071,160	2,281	19,188,945

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
1937	1,989	14,828,850	4,095	15,290,820

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
1937	10,056,826	7,010,242	1,891,733	19,617,151

Aircraft Engine Parts

	Military	*Commercial*	*Miscellaneous*	*Total*
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
1937	3,874,463	3,810,527	1,310,947	8,995,937

MONTHLY PRODUCTION AND SALES STATISTICS

Military and Salable Commercial Aircraft

PRODUCTION

	1936				*1937*			
	Military		*Commercial*		*Military*		*Commercial*	
	Units	*Value*	*Units*	*Value*	*Units*	*Value*	*Units*	*Value*
January . . .	53	$1,143,537	38	$ 296,957	23	$1,418,057	113	$1,178,607
February . .	174	1,026,402	60	477,916	30	2,035,800	129	1,217,059
March.	68	1,159,957	91	692,084	50	2,193,919	159	1,004,045
April.	50	1,224,523	133	1,602,704	51	2,230,592	153	1,881,830
May.	67	1,791,709	159	1,041,141	44	2,084,059	274	2,083,772
June.	84	2,184,390	182	1,319,063	63	2,427,980	270	1,772,307
July.	77	1,716,970	197	1,019,337	78	3,483,955	261	1,053,735
August. . . .	36	536,768	167	882,284	106	4,106,675	313	2,065,181
September .	48	1,038,690	137	1,123,411	94	3,435,249	245	1,309,885
October. . . .	84	1,639,994	160	1,173,154	106	4,350,012	164	1,472,916
November .	79	2,023,440	124	1,220,672	130	4,234,407	74	637,199
December. .	94	2,341,438	111	1,530,512	174	5,069,495	126	1,951,509
Total. . . .	1,141†	$27,836,199†	1,559	$12,379,835	949	$37,071,160	2,281	$19,188,945

DELIVERIES

	1936				*1937*			
	Military		*Commercial*		*Military*		*Commercial*	
	Units	*Value*	*Units*	*Value*	*Units*	*Value*	*Units*	*Value*
January . . .	47	$1,031,139	37	$ 333,703	26	$1,446,226	103	$1,159,397
February . .	56	923,402	59	402,046	30	2,035,860	135	1,223,444
March.	68	1,182,506	87	693,856	50	2,215,368	154	1,039,421
April.	50	1,226,205	136	1,631,625	51	2,230,592	159	1,906,302
May.	67	1,791,709	156	1,036,471	44	2,094,943	256	2,047,332
June.	84	2,202,414	180	1,323,620	63	2,439,575	254	1,713,189
July.	77	1,717,571	190	1,005,387	78	3,490,909	275	1,737,396
August. . . .	37	553,357	162	934,686	105	4,093,256	277	2,032,036
September .	48	1,040,488	138	1,100,392	94	3,451,753	241	1,346,968
October. . . .	84	1,646,005	144	1,153,914	106	4,357,508	164	1,497,284
November .	84	2,120,741	117	1,223,508	130	4,240,712	101	668,425
December. .	95	2,354,998	122	1,606,318	172	4,998,826	119	1,959,456
Total. . . .	1,024†	$26,898,916†	1,528	$12,535,526	949	$37,095,528	2,238	$19,230,650

All values represent planes less engines.

† 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

	1936				*1937*			
	Military		*Commercial*		*Military*		*Commercial*	
	Units	*Value*	*Units*	*Value*	*Units*	*Value*	*Units*	*Value*
January ...	130	$ 950,667	145	$ 470,802	212	$ 1,503,953	170	$ 622,569
February ..	153	1,032,659	142	417,269	121	793,335	287	1,023,886
March.....	143	1,094,325	132	551,351	163	1,135,645	331	1,369,213
April......	117	1,751,364	232	835,717	165	1,307,095	390	1,598,639
May......	169	1,424,756	220	720,889	156	1,277,568	425	1,576,842
June......	116	950,160	255	809,236	126	1,050,050	486	1,638,126
July.......	155	1,114,615	274	676,083	123	884,925	533	1,762,733
August....	121	946,156	255	588,888	250	1,841,381	383	1,024,748
September .	194	1,584,598	183	650,923	174	1,220,905	347	721,457
October....	181	1,470,060	196	542,980	160	1,208,638	268	1,308,425
November .	162	1,076,971	191	463,773	145	1,054,368	217	1,299,229
December..	163	1,173,377	208	792,089	194	1,550,987	258	1,344,953
Total....	1,804	$14,569,708	2,433	$7,520,900	1,989	$14,828,850	4,095	$15,290,820

DELIVERIES

	1936				*1937*			
	Military		*Commercial*		*Military*		*Commercial*	
	Units	*Value*	*Units*	*Value*	*Units*	*Value*	*Units*	*Value*
January ...	130	$ 950,667	140	$ 494,409	212	$ 1,513,552	167	$ 598,781
February ..	153	1,050,306	143	439,487	121	801,872	271	950,201
March.....	143	1,098,581	185	668,420	167	1,167,323	341	1,384,371
April......	117	1,757,744	250	906,193	165	1,315,080	383	1,582,701
May......	171	1,436,086	238	747,097	157	1,285,032	408	1,529,571
June......	113	964,695	283	955,204	126	1,050,050	501	1,693,813
July.......	155	1,114,615	274	668,056	123	884,925	534	1,837,465
August....	118	939,156	263	615,704	250	1,841,381	362	1,078,266
September .	194	1,584,598	172	635,641	174	1,220,905	325	682,024
October....	175	1,458,325	184	554,640	160	1,208,638	283	1,399,636
November .	162	1,085,159	185	452,798	145	1,054,368	197	1,209,663
December..	163	1,179,521	210	807,366	194	1,550,987	248	1,297,079
Total....	1,794	$14,619,453	2,527	$7,946,015	1,994	$14,894,113	4,020	$15,243,571

PRODUCTION AND DELIVERIES OF SALABLE AIRCRAFT IN THE UNITED STATES

Commercial and Military

Type	*Places*	*Production—1936*		*Deliveries—1936*		*Production—1937*		*Deliveries—1937*	
		Units	*Value*	*Units*	*Value*	*Units*	*Value*	*Units*	*Value*
Biplanes									
Open Cockpit	1	0	....	0	....	0	....	0	....
	2	5	$ 13,563	6	$ 19,903	13	$ 79,153	12	$ 74,826
	3	1	7,734	1	3,828	1	8,107	1	8,107
	Up	0	....	0	....	0	....	0	....
Sub-total	....	6	$ 21,297	7	$ 23,731	14	$ 87,260	13	$ 82,033
Cabin Single-Engine	All	211	1,192,095	214	1,292,918	201	1,186,579	194	1,172,237
Cabin Multi-Engine	All	0	....	0	....	4	125,224	4	131,815
Total Biplanes	....	217	$ 1,213,392	221	$ 1,316,649	219	$ 1,399,063	211	$ 1,386,085
Monoplanes									
Open Cockpit	1	1	1,258	1	1,258	0	....	0	....
	2	39	105,250	32	93,815	33	92,025	24	87,055
	3	0	....	0	....	9	403,200	9	403,200
	Up	0	....	0	....	0	....	0	....
Sub-total	....	40	$ 106,508	33	$ 95,073	42	$ 495,225	33	$ 490,255
Cabin Single-Engine	1	22	$ 75,995	22	86,450	0	....	0	....
	2	888	1,143,241	860	1,134,826	1,523	1,773,372	1,506	1,874,077
	3	82	330,280	84	335,910	110	492,620	101	453,200
	4	183	700,691	180	707,199	175	971,426	175	947,819
	Up	0	....	0	....	0	....	0	....
Sub-total	....	1,175	$ 2,250,207	1,146	$ 2,264,385	1,808	$ 3,237,418	1,782	$ 3,275,096
Cabin Multi-Engine	All	93	5,795,755	94	5,822,490	183	11,494,713	184	11,516,913
Total Monoplanes	....	1,308	$ 8,152,470	1,273	$ 8,181,948	2,033	$15,227,356	1,999	$15,282,264
Seaplanes	All	10	958,705	11	991,661	8	1,074,500	7	1,073,375
Amphibions	All	23	2,045,268	23	2,045,268	21	1,488,026	21	1,488,026
Autogiros	All	1	10,000	0	....	0	....	0	....
Commercial Total	....	1,559	$12,379,835	1,528	$12,535,526	2,281	$19,188,945	2,238	$19,230,650
U. S. Military Total	....	1,141	$27,836,199	1,024	$26,898,916	949	$37,071,160	949	$37,095,528
Grand Total	....	2,700	$40,216,034	2,552	$39,434,442	3,230	$56,260,105	3,187	$56,326,178

PRODUCTION AND DELIVERIES OF AIRPLANE ENGINES IN THE UNITED STATES

Commercial and Military

Commercial	*Production—1936*		*Deliveries—1936*		*Commercial*	*Production—1937*		*Deliveries—1937*	
Horsepower	*Units*	*Value*	*Units*	*Value*	*Horsepower*	*Units*	*Value*	*Units*	*Value*
Under 75..........	804	$ 297,822	792	$ 309,586	Under 75..........	1,413	$ 464,105	1,370	$ 520,545
76–125..........	266	242,836	255	238,916	76–125..........	281	283,165	285	299,419
126–175..........	160	227,028	155	218,219	126–175..........	213	313,382	210	313,281
176–225..........	100	200,188	132	268,113	176–225..........	102	218,690	93	198,990
226–300..........	293	833,482	377	1,142,842	226–300..........	348	921,997	339	898,100
301–400..........	21	89,150	23	97,730	301–400..........	27	102,425	27	102,425
401–500..........	158	691,900	158	691,900	401–500..........	445	1,992,330	438	1,956,420
501–600..........	63	371,190	57	348,630	501–600..........	108	650,760	105	636,930
601–700..........	33	193,380	34	199,305	601–700..........	43	254,565	43	254,565
701–Up..........	535	4,373,924	544	4,430,774	701–Up..........	1,115	10,089,401	1,110	10,062,896
Totals........	2,433	$ 7,520,900	2,527	$ 7,946,015	Totals.......	4,095	$15,290,820	4,020	$15,243,571
Military					*Military*				
Horsepower					*Horsepower*				
76–125..........	0	....	0	....	76–125..........	6	$ 7,070	6	$ 7,070
126–175..........	2	$ 3,450	1	$ 1,500	126–175..........	0	....	0	....
176–225..........	23	46,300	24	49,300	176–225..........	101	229,995	101	229,995
226–300..........	147	358,365	137	379,245	226–300..........	214	573,441	214	613,162
301–400..........	55	239,800	55	239,800	301–400..........	1	3,712	2	8,174
401–500..........	136	601,610	136	601,610	401–500..........	301	1,450,412	305	1,471,492
501–600..........	99	536,311	98	527,901	501–600..........	90	469,700	90	469,700
601–700..........	40	347,500	40	347,500	601–700..........	0	....	0	....
701–Up..........	1,302	$12,436,372	1,303	12,472,597	701–Up..........	1,276	12,094,520	1,276	12,094,520
Totals.......	1,804	$14,569,708	1,794	$14,619,453	Totals.......	1,989	$14,828,850	1,994	$14,894,113
GRAND TOTAL ..	4,237	$22,090,608	4,321	$22,565,468	GRAND TOTAL ..	6,084	$30,119,670	6,014	$30,137,684

PROGRESS OF CIVIL AERONAUTICS IN THE UNITED STATES

Compiled by U. S. Bureau of Air Commerce

All statistics as of Dec. 31 each year

	1935	*1936*	*1937*
Firms engaged in the industry	1,500	1,600	
Scheduled air-line operations			
Airplanes:			
In service and reserve:			
Domestic[1]	356	272	282
Foreign[1]	103	108	104
Total	459	380	386
Value of[2]	$12,465,000	$15,200,000	$19,500,000
Airways (domestic and foreign[1]):			
Services in operation	109	110	108
Express mileage	60,377	61,458	63,656
Mail mileage	51,428	51,740	57,480
Passenger mileage	52,387	61,458	63,656
Total mileage:			
Domestic[1]	28,267	28,874	31,084
Foreign extensions[1]	32,184	32,658	32,572
Total	60,451	61,532	63,656
Accidents (domestic and foreign[1]):			
Number of accidents	62	70	50
Miles flown per accident	1,024,843	1,047,198	1,539,923
Number of fatal accidents	8	10	6
Miles flown per fatal accident	7,942,529	7,330,384	12,832,694
Number of pilot fatalities	8	9	5
Miles flown per pilot fatality	7,942,529	8,144,871	15,399,233
Number of co-pilot fatalities	4	7	6
Number of crew fatalities (other than pilot and co-pilot)	2	5	4
Number of passenger fatalities	15	46	51
Passenger miles flown per passenger fatality	24,037,962	10,690,088	10,777,028
Total fatalities[3]	29	67	66
Express and freight carried (pounds):			
Domestic[1]	3,822,397	6,958,777	7,127,369
Foreign[1]	1,689,340	1,391,233	1,786,698
Total	5,511,737	8,350,010	8,914,067
Express, ton-miles (domestic[1])	1,089,802	1,860,809	2,156,070
Fuel (consumed) (domestic and foreign[1]):			
Gasoline.....gallons	33,260,609	37,057,069	41,424,384
Oil.....do	879,775	871,663	844,570
Mail:			
Carried by contractors:			
Domestic[1].....pounds	13,276,023	17,706,159	20,112,829
Foreign[1].....do	503,585	617,853	700,000 est.
Total	13,779,608	18,324,012	20,812,829 est.
Ton-miles of mail (domestic[1])	4,132,708	5,741,436	6,000,000 est.
Income to contractors:			
Domestic[1]	$10,662,554	$12,433,931	....
Foreign[1]	6,603,340	7,290,558	....
Total	$17,265,894	$19,724,489	....

See end of table for footnotes.

	1935	1936	1937
Scheduled air-line operations—Continued			
Miles of mail airways (domestic and foreign[1])	51,428	51,740	57,480
Miles flown:			
Daily average (domestic and foreign[1])	174,084	201,017	210,948
Mail (domestic and foreign[1])	39,077,189	44,027,794	....
Domestic routes	55,380,353	63,777,226	66,071,507
Foreign routes	8,159,880	9,526,610	10,924,656
Total	63,540,233	73,303,836	76,996,163
Operators, number of:			
Domestic[1]	23	21	17
Foreign[1]	7	7	7
Total	[4] 27	[4] 25	[4] 21
Passenger-miles flown (1 passenger carried 1 mile):			
Domestic[1]	313,905,508	435,740,253	476,603,165
Foreign	46,663,923	56,003,800	73,025,242
Total	360,569,431	491,744,053	549,628,407
Passengers carried:			
Domestic[1]	746,946	1,020,931	1,102,707
Foreign[1]	113,815	127,038	164,873
Total	860,761	1,147,969	1,267,580
Passenger-seat-miles flown (domestic[1])	572,546,530	680,708,230	828,188,184
Passenger-seat-miles, percentage used (domestic[1])	54.83	64.01	57.55
Passenger fare, average per mile (domestic[1])	$0.057	$0.057	$0.056
Personnel employed (domestic and foreign[1]):			
Mechanics and ground crew	2,613	2,864	3,258
Pilots	652	690	749
Copilots	335	543	598
Hostesses and stewards	212	390	420
Other hangar and field personnel	1,515	1,764	2,349
Operation and office personnel	3,006	3,721	4,172
Total	8,333	9,972	11,546
Trips, percentage completed of those started (domestic[1])	94.38	95.60	95.41
Trips, percentage started of those scheduled (domestic[1])	95.76	93.97	91.13
Trips, percentage completed of those scheduled (domestic[1])	90.38	94.05	89.51
Trips, passenger, average length (domestic[1])	420	427	427
Miscellaneous flying operations (all domestic)[1]			
Airplanes in operation (certificated and uncertificated)	8,613	8,849	10,446
Accidents:			
Number of accidents	1,517	1,698	....
Miles flown per accident	55,871	54,959	....
Number of fatal accidents	164	159	....

See end of table for footnotes.

	1935	1936	1937
Miscellaneous flying operations (all domestic)[1] Continued			
Miles flown per fatal accident	516,803	586,021	....
Pilot fatalities	134	130	....
Copilot or student fatalities	19	15	....
Passenger fatalities	100	119	....
Aircraft crew fatalities (other than pilot, copilot or student)	4	6	....
Total fatalities[3]	257	270	....
Miles flown per pilot fatality	632,505	717,849	....
Miles flown per passenger fatality	847,550	784,205	....
Fuel (consumed):			
Gasoline . . . gallons	11,104,259	10,451,496	11,500,000 est.
Oil . . . do.	334,420	316,502	335,000 est.
Miles flown	84,755,630	93,320,375	96,000,000 est.
Passengers:			
Carried for hire	1,014,957	1,215,405	1,350,000 est.
Carried for pleasure	272,418	250,653	250,000 est.
Total	1,287,375	1,466,058	1,600,000 est.
Airports and Department of Commerce Intermediate landing fields			
Airports:			
Commercial and private	552	525	492
Municipal	739	738	764
Intermediate—Department of Commerce—lighted	282	284	278
Intermediate—Department of Commerce—unlighted	9	12	5
Auxiliary—marked	630	622	602
Army, Navy, Marine Corps, National Guard, reserve and miscellaneous airports	156	161	158
Total airports in operation	2,368	2,342	2,299
Lighted, total	608	705	720
Of entry, regular	12	12	21
Of entry, temporary	43	43	34
Federal Airways System and Aids to Air Navigation			
Communication:			
Radio broadcast stations	74	80	72
Radio range beacon stations	137	146	167
Radio marker beacons	57	57	55
Weather reporting airway and airport stations—Weather Bureau and Department of Commerce operated, long line teletypewriter equipped	203	213	271
Miles of teletypewriter service	13,260	13,120	20,588
Weather Bureau—first order stations (does not include airport stations)	191	182	198
Airway lighting:			
Beacons:			
Revolving	1,657	1,677	1,717
Flashing	211	241	252
Beacons—privately owned and certified	330	410	466
Intermediate landing fields, lighted by Department of Commerce	282	284	278
Mileage lighted by Department of Commerce	22,012	22,245	22,319
Miles under construction by Department of Commerce	338	0	945

See end of table for footnotes.

	1935	1936	1937
Licenses and approvals			
Approved type certificates (issued by the Department of Commerce):			
Airplanes	593	620	658
Engines	154	168	186
Gliders	4	4	4
Parachutes	53	53	59
Propellers	535	567	658
Wheels	34	35	40
Pontoons	14	17	19
Skis	7	13	14
Flares and signals	4	4	5
Approvals (without approved type certificates):			
Airplanes	518	529	541
Engines	11	11	11
Engines—foreign (temporarily approved)	15	15	15
Gliders	2	3	7
Pontoons	32	32	32
Propellers	119	119	120
Repair stations	174	181	193
Schools	24	27	20
Skis	31	31	31
Flares	2	0	0
Wheels	2	0	0
Uncertificated aircraft (active):			
Airplanes	1,701	1,805	1,684
Gliders	387	370	320
Certificated (active):			
Airplanes	7,371	7,424	9,152
Gliders	48	31	41
Instructors, flying	85	103	91
Instructors, ground	55	48	55
Mechanics	8,432	8,738	9,314
Pilots, airplane	14,805	15,952	17,681
Pilots having scheduled air transport ratings	736	842	1,064
Pilots, glider	145	138	161
Riggers, parachute	381	393	362
Student pilot certificates issued:			
Airplane	14,572	17,675	21,770
Glider	330	209	125
Personnel employed:			
By aircraft manufacturers	[2] 18,500	23,531	....
By engine, propeller, and accessory manufacturers	[2] 5,500	7,044	....
Production and exports of aircraft			
Exports:			
Airplanes	334	515	621
Airplanes, value	$6,638,515	$11,386,896	$21,027,361
Engines	568	945	1,047
Engines, value	$2,459,317	$5,397,469	$5,944,004
Parts and accessories aircraft, value	$5,069,810	$6,060,483	$12,157,337
Parachutes and parts, value	$163,201	$298,358	$267,771
Production:			
Airplanes	1,691	3,010	[6] 3,230
Airplanes and parts, value	$27,064,339	$47,531,565	[6] $75,877,256
Engines	2,866	4,295	[6] 6,084
Engines and parts, value	[5] $12,610,285	$26,383,055	[6] $30,115,607

[1] Domestic scheduled air lines operate within the continental limits of the United States.
[2] Estimate.
[3] Does not include ground crew or third parties.
[4] In several cases the same company operates both domestic and foreign services.
[5] Value of engine parts for these years not available.
[6] Aeronautical Chamber of Commerce of America production figures.

U. S. AERONAUTIC EXPORTS

Compiled by Automotive-Aeronautics Trade Division
U. S. Bureau of Foreign and Domestic Commerce

Total Value for Calendar Years

Country of Destination	*1936 Value*	*1937 Value*
China	$ 7,185,556	$ 3,961,819
Netherlands	1,108,335	2,954,394
Russia	268,725	3,212,729
Japan	989,100	2,483,946
Brazil	550,992	1,675,092
Italy	631,270	470,131
Mexico	680,101	1,921,406
United Kingdom	461,397	1,729,271
Siam	489,441	1,154,648
Peru	460,694	847,753
Argentina	2,269,914	4,403,507
Canada	794,266	1,854,725
Netherlands Indies	1,063,509	546,859
Switzerland	35,123	27,281
Poland & Danzig	249,222	543,853
Colombia	396,424	383,792
Chile	41,200	34,565
Spain	118,871	443,085
Germany	411,252	1,026,947
France	675,546	200,894
Sweden	139,327	631,141
Cuba	59,276	67,113
Turkey	96,653	2,450,391
Rumania	127,612	704,013
Panama	175,781	126,252
Trinidad & Tobago	73,425	69,581
Hong Kong	195,544	482,581
Philippine Islands	389,111	621,830
Australia	644,587	1,392,860
Netherland West Indies	1,493	2,722
Egypt	145	11,100
Ecuador	157,088	53,099
Union of South Africa	50,294	472,410
Belgium	31,932	164,292
Guatemala	3,273	82,678
Czechoslovakia	298,989	180,891
Nicaragua	7,892	3,134
Bolivia	105,479	25,928
Honduras	145,242	193,638
Costa Rica	29,783	34,474
El Salvador	2,039	882
Yugoslavia	641,403	262,412
Portugal	14,901	80,910
Finland	57,512	47,349
Liberia	382	None
Venezuela	37,846	412,009
Norway	258,207	95,448
Haiti	1,754	989
British Malaya	250	190
British India	22,075	168,896
Iran	9,563	8,385
Other British West Indies	1,604	19,674
British East Africa	155	5,040
Dominican Republic	7,092	41,453
Latvia	2,500	5,033
Austria	64,365	51,000
British Guiana	6,121	5,592
Lithuania	9,752	7,549
British Honduras	62	1,237
Bulgaria	8,877	4,895
New Zealand	23,283	209,595
Kwantung	......	8,190
French Guiana	2,853	103,138
Saudi-Arabia	22,318	None
Gibraltar	......	None
Morocco	1,192	None
Jamaica	5,396	1,974
Barbados	33	None
French West Indies	2,493	1,129

Surinam	2,121	3,411
Greece	8,931	34,794
Uruguay	25,311	9,541
Newfoundland & Labrador	13,403	26,398
Other French Africa	251,068	56,489
Denmark	19,427	7,588
Other British South Africa	1,532	None
Aden	1,183	None
Other Asia	464	26
Iraq	373	2,476
Paraguay	294	10,378
British Oceania	139	541
Syria	65	5,683
Bermuda	1,000	17,783
Hungary	....	37
Irish Free State	....	10,480
Ceylon	....	1,275
Tunisia	....	610
Other Port. Africa	....	16,505
Azores & Madeira Islands	....	11,664
Totals	$23,143,203	$39,405,473

Airplanes, Seaplanes and Amphibions

Country of Destination	*1936* *No.*	*1936* *Value*	*1937* *No.*	*1937* *Value*
China	114	$ 3,759,520	41	$ 2,317,969
Netherlands	5	427,055	25	1,914,578
Brazil	14	204,135	46	1,008,523
Mexico	49	501,462	81	1,572,104
Siam	12	325,800	4	355,190
Japan	11	449,944	12	966,132
Switzerland	...	....	...	....
Poland & Danzig	3	162,245	6	346,920
Russia	1	117,676	10	1,419,146
Chile	3	6,422	...	....
Spain	1	80,000	8	325,000
Peru	11	285,248	9	429,283
Canada	50	345,295	62	657,664
Argentina	64	1,505,464	82	3,220,842
United Kingdom	20	91,869	25	615,505
Colombia	8	210,372	9	185,200
Cuba	1	4,000	...	....
Germany	2	15,500	2	17,700
Netherland West Indies	...	....	...	....
Turkey	...	....	20	1,750,925
Ecuador	9	149,010	1	1,103
Guatemala	...	....	8	65,999
France	10	240,265	...	....
Union of South Africa	15	28,468	20	87,467
Nicaragua	2	5,500	1	1,398
Hong Kong	1	34,568	3	184,386
Philippine Islands	13	251,529	16	337,507
Italy	1	20,000	1	10,500
Costa Rica	1	6,500	3	12,750
Yugoslavia	...	....	2	116,153
Liberia	...	....	...	....
British Malaya	...	....	...	....
Panama	5	19,500	7	21,850
British India	3	20,581	10	150,864
Egypt	...	....	2	10,103
Belgium	...	....	1	8,235
Honduras	21	74,898	23	111,300
Norway	8	191,132	11	45,897
Netherlands Indies	11	776,118	3	148,018
Barbados	...	....	...	....
Australia	21	492,156	23	913,937
Czechoslovakia	4	273,486	2	164,417
Other French Africa	2	216,660	...	....
Uruguay	2	20,310	3	5,768
New Zealand	2	15,000	6	168,820
Saudi-Arabia	1	13,937	...	....
Venezuela	1	12,895	8	302,254
Newfoundland & Labrador	2	12,000	...	....
Portugal	3	7,499	3	60,235

Trinidad & Tobago	2	6,000	1	1,137
Dominican Republic	2	2,875	1	26,100
Sweden	2	2,323	9	381,349
Morocco	1	1,176	...	....
Denmark	1	500	...	....
Finland	...	....	1	1,200
Greece	...	....	1	4,500
Lithuania	...	....	1	1,463
Rumania	...	....	7	469,880
French Guiana	...	....	1	100,000
Ceylon	...	....	1	1,250
Other Port. Africa	...	....	4	11,671
Paraguay	...	....	3	6,169
Totals	515	$11,386,893	629	$21,036,361

Aircraft Engines

Country of Destination	*1936* *No.*	*Value*	*1937* *No.*	*Value*
Italy	54	$ 457,041	17	$ 198,067
United Kingdom	34	56,251	15	45,841
China	203	1,597,111	96	720,355
Brazil	45	127,386	54	161,959
Japan	20	119,695	56	366,940
Netherlands	57	393,450	69	367,263
Argentina	85	328,668	104	526,779
Russia	11	58,308	20	226,817
Sweden	7	43,653	9	79,565
Mexico	45	114,470	62	161,714
Trinidad & Tobago	15	53,050	14	33,000
Germany	56	304,542	89	696,905
Canada	48	101,469	106	393,169
Peru	7	41,446	17	79,913
Switzerland	1	6,000	...	....
Egypt	...	....	1	900
Netherlands Indies	9	52,841	13	108,267
Colombia	7	28,867	13	54,816
Poland and Danzig	...	....	5	49,385
Hong Kong	5	17,730	...	....
Spain	2	19,554	1	4,500
Panama	22	59,501	27	26,000
Australia	16	59,447	15	90,141
Czechoslovakia	2	19,000	1	7,355
Turkey	1	1,768	16	199,448
Chile	2	10,300	1	9,000
France	28	370,500	3	40,000
Haiti	...	....	...	....
Venezuela	2	7,490	14	60,986
Cuba	9	20,750	7	14,000
Philippine Islands	8	23,092	21	111,490
Costa Rica	15	21,841	13	15,690
Union of South Africa	...	....	38	271,648
El Salvador	...	....	...	....
Guatemala	5	1,500	...	....
Other British West Indies	...	....	...	....
Honduras	20	19,148	21	32,953
Portugal	...	....	2	7,363
British Honduras	...	....	...	....
Bolivia	6	43,701	2	9,798
British Guiana	1	3,000	2	4,750
Finland	5	31,586	...	....
Morocco	...	....	...	....
Nicaragua	...	....	...	....
Latvia	...	....	1	2,800
Yugoslavia	61	627,000	...	....
Siam	12	81,710	62	484,183
Norway	7	27,664	3	3,832
Denmark	2	14,000	...	....
Austria	1	8,800	6	51,000
New Zealand	2	7,340	2	12,617
Saudi-Arabia	1	7,000	...	....
Jamaica	2	3,999	1	1,000
French West Indies	1	2,250	...	....
Uruguay	1	1,250	...	....

Newfoundland & Labrador	1	1,170	1	7,000
Dominican Republic	1	1,130	2	7,000
Belgium	...	....	10	108,562
Irish Free State	...	....	1	7,000
Rumania	...	....	6	50,289
Bermuda	...	....	1	7,000
Ecuador	...	....	1	3,352
Paraguay	...	....	1	1,881
British India	...	....	1	2,215
Kwantung	...	....	1	3,520
British East Africa	...	....	2	4,976
Other French Africa	...	....	1	9,000
	945	$5,397,469	1,047	$5,944,004

Parachutes and Parts

Country of Destination	*1936 Value*	*1937 Value*
Rumania	$120,143	$ 33,000
Argentina	72,540	22,815
Turkey	2,275	7,080
Spain	14,744	104,000
Hong Kong	2,750	....
Portugal	4,075	....
Japan	125	....
China	24,150	396
Netherlands Indies	6,534	24,349
Siam	....	....
Cuba	14	6,858
Union of South Africa	....	....
Poland and Danzig	....	....
Bulgaria	6,480	....
United Kingdom	880	2,263
Russia	1,014	441
Venezuela	1,342	....
Switzerland	175	....
Canada	3,730	10,370
Philippine Islands	....	1,075
Haiti	....	....
Brazil	19,615	16,428
Colombia	7,183	1,500
Chile	3,430	....
Mexico	2,951	....
Ecuador	1,800	....
Peru	778	34
Australia	650	....
Dominican Republic	555	550
Greece	266	30,281
Sweden	122	....
Norway	37	....
Finland	....	356
France	....	47
Latvia	....	450
Lithuania	....	4,480
Guatemala	....	350
Trinidad & Tobago	....	25
Other British West Indies	....	123
Australia	....	500
Totals	$298,358	$267,771

Aircraft Parts and Accessories (Except Tires)

Country of Destination	*1936 Value*	*1937 Value*
Russia	$ 91,727	$ 1,566,325
China	1,804,775	923,099
Japan	419,336	1,150,874
Netherlands Indies	228,016	266,225
Netherlands	287,830	672,553
Brazil	199,856	488,182
Canada	343,772	793,522
Italy	154,229	261,564
Peru	133,222	338,523
Colombia	150,002	142,276

Argentina	363,242	633,071
Siam	81,931	315,275
France	64,781	160,847
United Kingdom	312,397	1,065,662
Poland & Danzig	86,977	147,548
Sweden	93,229	170,227
Chile	21,048	25,565
Germany	91,210	312,342
Panama	96,780	78,402
Switzerland	28,948	27,281
Turkey	92,610	492,938
Philippine Islands	114,490	171,758
Australia	92,334	388,282
Mexico	61,218	187,588
Belgium	31,932	47,495
Cuba	34,512	46,255
Bolivia	61,778	16,130
Hong Kong	140,496	298,195
Spain	4,573	9,585
Union of South Africa	21,826	113,295
Honduras	51,196	49,385
El Salvador	2,039	882
Trinidad & Tobago	14,375	35,419
Finland	25,926	45,793
Czechoslovakia	6,503	9,119
Rumania	7,469	150,844
Egypt	145	97
Portugal	3,327	13,312
Norway	39,374	45,719
Guatemala	1,773	16,329
Iran	9,563	8,385
Venezuela	16,119	48,769
Yugoslavia	14,403	146,259
British East Africa	155	64
Costa Rica	1,442	6,034
Dominican Republic	2,532	7,803
Nicaragua	2,392	1,736
Ecuador	6,278	48,644
Other British West Indies	1,604	19,551
Austria	55,565	....
Latvia	2,500	1,783
Liberia	382	....
Haiti	1,754	989
Lithuania	9,752	1,606
British Guiana	3,121	842
New Zealand	943	28,158
Kwantung	....	4,670
Bulgaria	2,397	4,895
French Guiana	2,853	3,138
Saudi-Arabia	1,381	....
Jamaica	1,397	974
French West Indies	243	1,129
Surinam	2,121	3,411
British Honduras	62	1,237
Greece	8,665	13
Netherland West Indies	1,493	2,722
British India	1,494	15,817
Uruguay	3,751	3,773
British Malaya	250	190
Newfoundland & Labrador	233	19,398
Other French Africa	34,408	47,489
Denmark	4,927	7,588
Other British South Africa	1,532	....
Aden	1,183	....
Bermuda	1,000	10,783
Other Asia	464	26
Iraq	373	2,476
Paraguay	294	2,328
British Oceania	139	541
Syria	65	5,683
Barbados	33	....
Morocco	16	....
Azores & Madeira Islands	....	11,664
Hungary	....	37
Irish Free State	....	3,480
Ceylon	....	25
Tunisia	....	610
Other Port. Africa	....	4,834
Totals	$6,060,483	$12,157,337

AERONAUTICAL PURCHASES BY U. S. AIR FORCES

Fiscal Year 1937

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 1937, 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 1937

Airplanes

Type	*Factory Name*	*Quantity*
B-18	Douglas	35
Y1A-18	Curtiss	13
PT-13A	Stearman	72
Y1P-36	Curtiss	3
Y1C-36	Lockheed	3
BT9-B	North American	117
BT9-C	North American	33
O-47	North American	109
YG-1B	Kellet (Autogiro)	7
Y10A-A	Sikorsky	5
XP-37	Curtiss	1
Y1C-37	Lockheed	1
Y1B-17A	Boeing	1
B-18A	Douglas	177
BC-1	North American	85
	Total	662

Engines

Type	*Contractor*	*Quantity*
R 1820-45	Wright Aeronautical Corp.	150
R 1820-47	Wright Aeronautical Corp.	40
R 975-7	Wright Aeronautical Corp.	223
R 1820-49	Wright Aeronautical Corp.	163
R 1820-45	Wright Aeronautical Corp.	531
R 1830-13	Pratt & Whitney	5
R 985-13	Pratt & Whitney	11
R 1340-6	Pratt & Whitney	1
R 2180-5	Pratt & Whitney	12
R 1820-13	Pratt & Whitney	250
R 1340-47	Pratt & Whitney	128
R 1690-23	Pratt & Whitney	18
R 680-7	Lycoming	108
	Total	1640

Equipment deliveries to the Army Air Corps are unavailable.

NAVY PURCHASES OF AERONAUTICAL EQUIPMENT

Fiscal Year 1937

Airplanes

Type	*Factory Name*	*Quantity*
VB	Northrop bomber	54
VF	Grumman fighter	81
VPB	Consolidated patrol bomber	116
VSB	Curtiss scout bomber	83
VSB	Vought scout bomber	94
VSO	Curtiss scout observation	83
VSO	Naval Aircraft Factory	22
VN	Naval Aircraft Factory	95
VN	North American trainer	40
VJ	Lockheed utility	4
VJ	Grumman utility	15
VJR	Sikorsky utility transport	13
	Total	700

Engines

Type	*Contractor*	*Quantity*
1690	Pratt and Whitney	9
1830	Pratt and Whitney	172
1535	Pratt and Whitney	249
1535	Pratt and Whitney	56
1830	Pratt and Whitney	131
1690	Pratt and Whitney	3
1340	Pratt and Whitney	1
1340	Pratt and Whitney	108
985	Pratt and Whitney	10
1820	Wright Aeronautical Corp.	106
760	Wright Aeronautical Corp.	80
1820	Wright Aeronautical Corp.	20
	Total	945

EQUIPMENT DELIVERED TO U. S. NAVY

Fiscal Year 1937

Airplanes

Type	*Factory Name*	*Quantity*
VSB	Vought scout bomber	25
VSB	Curtiss scout bomber	1
VF	Grumman fighter	13
VJ	Grumman utility	29
VJR	Sikorsky utility transport	1
VN	Naval Aircraft Factory trainer	84
VPB	Consolidated patrol bomber	61
VSO	Curtiss scout observation	40
VTB	Douglas torpedo bomber	1
	Total	255

Engines

Type	*Contractor*	*Quantity*
760	Wright Aeronautical Corp.	12
975	Wright Aeronautical Corp.	1
1340	Pratt and Whitney	51
1535	Pratt and Whitney	145
1690	Pratt and Whitney	9
1830	Pratt and Whitney	215
	Total	433

AIRPORTS AND LANDING FIELDS

January 1, 1938

Compiled by Bureau of Air Commerce, U. S. Dept. of Commerce

State	*Municipal*	*Commercial*	*Intermediate*	*Auxiliary*	*Navy*	*Army*	*Miscellaneous Government, private, and State*	*Totals*	*Partially or fully lighted*
Alabama	10	2	7	14	0	3	1	37	11
Alaska	1	2	0	87	0	0	0	90	2
Arizona	10	5	9	19	0	1	1	44	17
Arkansas	12	1	4	8	0	0	1	26	7
California	51	41	19	46	5	4	15	181	63
Colorado	12	4	3	14	0	0	0	33	6
Connecticut	7	6	1	3	0	0	1	18	7
Delaware	1	3	0	1	0	1	0	6	3
District of Columbia	0	1	0	0	1	1	0	3	3
Florida	48	14	4	48	5	1	5	125	28
Georgia	23	3	11	21	0	1	0	59	19
Idaho	18	0	10	11	0	0	9	48	15
Illinois	13	30	6	0	0	2	3	54	26
Indiana	12	14	8	7	0	2	4	47	20
Iowa	16	6	3	6	0	0	1	32	10
Kansas	21	5	5	9	0	2	0	42	15
Kentucky	7	0	3	7	0	1	0	18	4
Louisiana	12	1	3	10	0	1	3	30	9
Maine	9	7	0	5	0	0	1	22	4
Maryland	2	8	1	1	1	3	3	19	8
Massachusetts	7	19	1	8	1	0	0	36	9
Michigan	57	12	0	16	1	3	35	124	23
Minnesota	10	3	3	14	0	1	0	31	9
Mississippi	13	0	6	12	1	0	0	32	11
Missouri	10	5	13	4	0	0	5	37	19
Montana	25	0	13	26	0	0	10	74	18
Nebraska	16	3	4	5	0	2	1	31	16
Nevada	3	3	9	6	1	0	0	22	12
New Hampshire	6	2	0	5	0	0	0	13	3
New Jersey	5	11	0	1	2	2	1	22	8
New Mexico	5	4	10	12	0	1	3	35	13
New York	28	33	4	13	0	4	7	89	27
North Carolina	12	5	3	6	0	1	0	27	9
North Dakota	18	3	5	14	0	0	1	41	9
Ohio	31	34	9	24	0	4	12	114	23
Oklahoma	19	5	7	8	0	1	0	40	22
Oregon	12	3	9	10	0	0	2	36	16
Pennsylvania	19	57	9	10	1	1	12	109	38
Rhode Island	0	2	0	3	1	0	1	7	1
South Carolina	10	3	4	7	3	0	2	29	7
South Dakota	17	2	0	4	0	0	0	23	1
Tennessee	12	1	8	5	0	0	0	26	13
Texas	54	9	24	24	0	13	1	125	50
Utah	6	1	17	2	0	0	0	26	19
Vermont	7	3	0	1	0	1	0	12	1
Virginia	10	10	8	10	2	1	2	43	17
Washington	22	7	6	6	1	3	4	49	15
West Virginia	10	5	0	8	0	0	1	24	3
Wisconsin	21	16	4	6	0	0	2	49	18
Wyoming	14	0	10	15	0	0	0	39	13
Totals	764	414	283	602	26	61	149	2,299	720

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 acilities."

(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	67,308,374(36)		+4,700,647	
	Navy	49,500,000(37)		+10,911,730	
	Air Mail	24,405,860(38)		+4,175,860	
	N.A.C.A.	1,733,850		−810,700	
	Commerce	13,238,500(39)	156,186,584	+6,388,500	+25,366,037
1938-39	*Army	73,799,532(40)		+6,491,158	
	*Navy	44,200,000(41)		−5,300,000	
	*Air Mail	26,642,275(42)		+2,236,415	
	*N.A.C.A.	1,700,000(43)		−33,850	
	*Commerce	14 000,000(44)	160,341,807	+761,500	+4,155,223

(16) Includes $135,152 deficiency appropriation.

(17) Made up as follows: Domestic, $20,000,000; Foreign, $7,000,000.

(18) Consists of $1,369,660 for "aircraft in commerce" and $8,992,640 for "air navigation facilities".

(19) Includes $7,500,000 appropriated under the National Industrial Recovery Act.

(20) Made up as follows: Domestic, $19,460,000; Foreign, $7,000,000.

(21) Consists of $1,000,000 for "aircraft in commerce" and $7,553,500 for "air navigation facilities".

(22) Includes $3,000,000 contract authorization and $7,500,000 appropriated under the Public Works Administration. Only $12,692,553 of the $23,537,769 appropriation was available for the fiscal year 1934, the balance of $10,845,216 having been impounded.

(23) Made up as follows: Domestic, $15,000,000; Foreign, $7,000,000.

(24) Consists of $1,070,570 for "aircraft in commerce" and $6,590,210 for "air navigation facilities".

(25) Includes $3,000,000 contract authorization and $325,909 for restoration of salary reduction.

(26) Includes $15,611,572 appropriated under the title of "Emergency Construction—Increase in the Navy".

(27) Made up as follows: Domestic, $12,003,291 (including salary restoration of $3,291); Foreign, $7,000,000.

(28) Consists of $676,249 for "aircraft in commerce" and $5,004.780 for "air navigation facilities".

(29) Includes $7,686,753 contract authorization; provides that $13,666,000 of the appropriation shall be used exclusively for the purchase of combat planes, their equipment and accessories.

(30) Made up as follows: Domestic, $10,700,000; Foreign, $8,000,000.

(31) Consists of $734,800 for "aircraft in commerce" and $5,175,000 for "air navigation facilities."

(32) Includes $10,669,786 contract authorization; provides that $29,322,602 shall be used exclusively for the purchase of combat planes.

(33) Includes $6,590,000 contract authorization.

(34) Made up as follows: Domestic, $12,000,000; Foreign, $8,230,000.

(35) Consists of $733,000 for "aircraft in commerce" and $882,920 for new "air navigation facilities."

(36) Includes $26,262,760 for combat planes and $19,126,894 contract authorization.

(37) Includes $27,180,000 for new aircraft of which $15,000,000 is contract authorization.

(38) Includes $14,500,000 for domestic air mail and $9,005,860 for foreign air mail.

(39) Includes $2,000,000 authority to contract, prior to July 1, 1938, for purchase, construction and installation of additional air navigation facilities.

(40) Includes $33,150,646 for combat planes and $19,126,894 contract authorization.

(41) Includes $21,258,000 for new aircraft of which $15,000,000 is for contract authorization.

(42) Includes $15,800,000 for domestic air mail and $10,842,275 for foreign air mail.

(43) Includes $200,000 for beginning of construction of a new wind tunnel.

(44) Includes $4,750,000 for establishment of air navigation facilities and $1,535,000 for aircraft.

* 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 1937.

Route	*Service Scheduled*	*Service Performed*	*Compensation*	*Percentage of Performance*
	Miles	*Miles*		
1. New York to Montreal (1 way)	104,542.0	88,970.0	$ 53,382.00	85.10
2. Seattle to Victoria	10,314.0	10,314.0	10,289.24	100.00
5. Miami to Cristobal (direct)	342,883.4	342,883.4	664,638.88	100.00
Miami to Habana	117,485.5	117,485.5	234,520.00	100.00
Habana to Belize	77,168.0	77,168.0	138,902.40	100.00
San Salvador to Cristobal	201,083.0	200,987.2	361,567.20	99.95
Port of Spain to Paramaribo	117,658.5	117,658.5	222,152.40	100.00
Barranquilla to Port of Spain	204,709.1	204,709.1	368,834.36	100.00
6. Miami to San Juan	358,075.0	358,070.2	675,208.40	99.99
San Juan to Port of Spain	139,647.7	139,647.7	264,005.60	100.00
7. Miami to Nassau (1 way)	25,756.0	25,756.0	32,195.00	100.00
8. Brownsville to Mexico City	340,180.0	340,172.5	612,309.00	99.99
Mexico City to San Salvador	170,415.0	170,415.0	306,422.40	100.00
9. Cristobal to Montevideo	918,521.4	917,440.4	1,377,017.12	99.88
10. Paramaribo to Buenos Aires	554,623.4	551,188.3	992,138.94	99.38
14. San Francisco to Manila	853,534.8	773,634.8	[1]1,555,368.74	90.64
Salaries, Barranquilla	....	....	5,258.61	....
Travel expense	....	....	460.31	....
Total	4,545,686.8	4,445,591.6	$7,874,670.60	97.80

[1] Partly estimated.

NON-MILITARY AIRCRAFT IN THE UNITED STATES

January 1, 1938

Compiled by Bureau of Air Commerce, U. S. Dept. of Commerce

State	*Certificated*	*Uncertificated*	*Total*	*Gliders*
Alabama	61	18	79	3
Arizona	56	7	63	0
Arkansas	47	16	63	1
California	1110	109	1219	37
Colorado	72	20	92	4
Connecticut	153	7	160	3
Delaware	38	0	38	5
District of Columbia	97	9	106	1
Florida	196	30	226	0
Georgia	98	39	137	0
Idaho	52	4	56	2
Illinois	604	39	643	15
Indiana	257	106	363	13
Iowa	160	15	175	2
Kansas	145	66	211	6
Kentucky	63	16	79	0
Louisiana	92	4	96	2
Maine	83	10	93	0
Maryland	110	20	130	2
Massachusetts	221	14	235	9
Michigan	433	82	515	23
Minnesota	180	66	246	6
Mississippi	97	15	112	0
Missouri	206	52	258	0
Montana	54	37	91	1
Nebraska	105	61	166	3
Nevada	26	6	32	0
New Hampshire	36	9	45	2
New Jersey	268	19	287	21
New Mexico	30	5	35	0
New York	921	37	958	31
North Carolina	125	64	189	0
North Dakota	46	26	72	0
Ohio	544	161	705	26
Oklahoma	185	41	226	2
Oregon	116	56	172	3
Pennsylvania	622	57	679	24
Rhode Island	56	5	61	0
South Carolina	47	15	62	0
South Dakota	66	6	72	2
Tennessee	101	20	121	0
Texas	422	135	557	2
Utah	31	5	36	3
Vermont	33	0	33	0
Virginia	112	25	137	3
Washington	166	22	188	9
West Virginia	76	14	90	0
Wisconsin	166	75	241	7
Wyoming	32	16	48	0
Alaska	97	1	98	0
Canada[1]	1	0	1	0
Canal Zone	0	0	0	0
Hawaiian Islands	24	2	26	0
Mexico[1]	0	0	0	0
Philippine Islands[2]	0	0	0	0
Puerto Rico	9	0	9	0
Foreign, Miscellaneous[1]	4	0	4	0
Totals	9,152	1,684	10,836[3]	273[4]

[1] Figures for these countries mean pilots and aircraft certificated or identified by the United States.

[2] Civil aircraft in the Philippines now are registered with the local government.

[3] This figure includes 36 certificated autogiros.

[4] This figure includes 47 certificated gliders and 226 uncertificated gliders.

LICENSED PILOTS IN THE UNITED STATES

January 1, 1938

Compiled by Bureau of Air Commerce, U. S. Dept. of Commerce

State	*Transport*	*Limited Commercial*	*Private*	*Amateur*	*Total*	*Glider Pilots*
Alabama	46	6	65	4	121	1
Arizona	29	4	62	0	95	0
Arkansas	49	0	37	2	88	0
California	1237	136	1855	145	3373	13
Colorado	57	12	52	9	130	0
Connecticut	87	19	158	4	268	4
Delaware	17	2	25	0	44	4
District of Columbia	116	5	120	2	243	3
Florida	275	12	214	7	508	3
Georgia	101	3	75	2	181	0
Idaho	26	5	33	6	70	0
Illinois	485	47	507	32	1071	13
Indiana	148	35	227	23	433	5
Iowa	95	18	97	7	217	0
Kansas	89	15	82	10	196	1
Kentucky	44	6	44	5	99	0
Louisiana	108	5	71	11	195	1
Maine	40	9	44	2	95	0
Maryland	70	9	106	4	189	0
Massachusetts	165	34	257	18	474	11
Michigan	287	57	370	47	761	18
Minnesota	150	34	74	8	266	1
Mississippi	34	5	45	2	86	0
Missouri	266	13	128	4	411	2
Montana	38	6	50	6	100	1
Nebraska	59	12	68	1	140	0
Nevada	10	2	13	3	28	0
New Hampshire	19	4	27	5	55	0
New Jersey	309	18	298	13	638	18
New Mexico	18	3	20	1	42	0
New York	596	102	906	57	1661	32
North Carolina	56	9	70	4	139	0
North Dakota	34	1	19	1	55	0
Ohio	329	78	460	26	893	11
Oklahoma	109	11	124	4	248	0
Oregon	77	8	104	17	206	0
Pennsylvania	300	64	576	28	968	13
Rhode Island	15	1	28	2	46	2
South Carolina	25	5	41	1	72	0
South Dakota	31	7	32	2	72	0
Tennessee	86	11	123	4	224	0
Texas	482	29	292	24	827	0
Utah	43	3	28	3	77	0
Vermont	17	6	21	1	45	0
Virginia	162	19	93	6	280	1
Washington	171	24	181	37	413	1
West Virginia	34	16	69	6	125	0
Wisconsin	102	27	98	15	242	1
Wyoming	54	0	15	3	72	0
Alaska	65	3	13	4	85	0
Canada	14	2	10	1	27	0
Canal Zone	35	0	4	0	39	0
Hawaiian Islands	63	7	31	1	102	1
Mexico	1	0	3	0	4	0
Philippine Islands	22	0	3	0	25	0
Puerto Rico	4	2	5	0	11	0
Foreign, Miscellaneous	74	0	31	1	106	0
Totals	7,475[1]	971	8,604	631	17,681[2]	161
Percentages	42.28	5.49	48.66	3.57		

[1] This figure includes 1,064 pilots who hold scheduled air transport ratings.

[2] This figure includes 494 women pilots, divided as follows: transport, 72; limited commercial, 25; private, 43; and amateur, 54.

AVIATION GASOLINE TAX SUMMARY

January 1, 1938

State	*Tax*	*Dispositions of Receipts*	*Applicable to Aircraft Fuel*	*Exemption or Refund*
Alabama	6¢	Highways	Yes	No
Arizona	5¢	Highways; R. F. C. Fund	Yes	Refund
Arkansas	6½¢	Highways; Airports	No	Exemption
California	3¢	Highways	Yes	Refund
Colorado	4¢	Highways	Yes	Refund
Connecticut	3¢	Highways	Yes	Refund
Delaware	4¢	Highways	Yes	Refund
District of Columbia	2¢	Highways	Yes	Refund
Florida	7¢	Roads; Schools	Yes	Exemption
Georgia	6¢	Roads; Schools	Yes	No
Idaho	5¢	Airfuel tax to Aeronautics Fund	Yes	No
Illinois	3¢	Highways; Schools	Yes	Refund
Indiana	4¢	Highways	Yes	Refund
Iowa	3¢	Highways	Yes	Refund
Kansas	3¢	Highways	Yes	Exemption
Kentucky	5¢	Highways	Yes	No
Louisiana	7¢	Highways; Relief; Schools; Harbor Improvement	Yes	No
Maine	4¢	Highways	Yes	Refund 3¢ per gal.
Maryland	4¢	Highways	Yes	Refund
Massachusetts	3¢	Highways; General Fund; Relief	Yes	Refund
Michigan	3¢	Highways; Aeronautics	Yes	Refund 1½¢(1)
Minnesota	4¢	Highways	Yes	Refund
Mississippi	6¢	Highways	Yes	Refund 5¢
Missouri	2¢	Highways	Yes	Refund
Montana	5¢	Highways	Yes	Refund
Nebraska	4¢	Highways; Relief	Yes	No
Nevada	4¢	Highways	Yes	Refund
New Hampshire	4¢	Highways	Yes	Refund
New Jersey	3¢	Traffic; Waterways	Yes	Refund
New Mexico	5¢	Highways	Yes	Refund
New York	4¢	Highways; General Fund	Yes	Refund
North Carolina	6¢	Highways; General Fund	Yes	Refund
North Dakota	3¢	Highways	Yes	Refund
Ohio	4¢	Highways; Schools	Yes	Refund
Oklahoma	4¢	Highways; Debt Service	Yes	Refund
Oregon	5¢	Highways; Aeronautics	Yes	(2)
Pennsylvania	4¢	Highways; Relief; Aeronautics	Yes	No
Rhode Island	3¢	Highways; General Fund Relief	Yes	Refund
South Carolina	6¢	Highways	Yes	No
South Dakota	4¢	Highways	Yes	Refund
Tennessee	7¢	Highways; General Fund except $50,000 to Airways	Yes	No
Texas	4¢	Highways; Schools	Yes	Refund
Utah	4¢	Highways	Yes	No
Vermont	4¢	Highways	Yes	No
Virginia	5¢	Highways; Bridges	Yes	Refund
Washington	5¢	Highways	Yes	Refund
West Virginia	5¢	Highways	Yes	No
Wisconsin	4¢	Highways; General Fund	Yes	Refund
Wyoming	4¢	Highways	Yes	Refund 2¢

(1) Michigan refund of 1½¢ granted only upon proof of interstate schedule.

(2) Oregon: Although the law grants refunds and exemption for fuel used for cleaning and dyeing and other commercial purposes except propelling motor vehicles upon the highways there is no express refund allowed or exemption granted with reference to airplane fuels.

COMPARATIVE TABULATION OF ACCIDENTS IN CIVIL AERONAUTICS

1934, 1935, 1936, and the First Six Months of 1937

Compiled by Bureau of Air Commerce, U. S. Department of Commerce

Mileage Flown Per Accident

	*January-June, 1934**	*July-December, 1934*	*January-June, 1935**	*July-December, 1935*	*January-June, 1936**	*July-December 1936*	*January-June 1937**
Miles flown in scheduled transport operations	21,517,658	27,268,893	28,729,128	34,811,105	33,523,075	39,780,761	36,640,152
Miles flown in miscellaneous operations including student instruction and experimental flying	36,780,157	38,821,995	40,234,185	44,521,445	41,517,085	51,803,290	45,059,950
Total	58,297,815	66,090,888	68,963,313	79,332,550	75,040,160	91,584,051	81,700,102
Accidents, all services	676	901	737	842	831	937	870
Miles flown per accident, all services	86,239	73,353	93,573	94,219	90,301	97,742	93,908
Accidents, scheduled transport operations	27	46	29	33	42	28	28
Miles flown per accident, scheduled transport operations	796,950	592,802	990,660	1,054,882	798,168	1,420,741	1,308,577
Accidents, miscellaneous operations	649	855	708	809	789	909	842
Miles flown per accident, miscellaneous operations	56,672	45,406	56,828	55,032	52,620	56,989	53,515
Fatal accidents, all services**	93	103	86	86	65	104	75
Miles flown per fatal accident in all services	626,858	641,658	801,899	922,470	1,154,464	880,610	1,089,334
Fatal accidents, scheduled transport operations**	6	4	5	3	5	5	3
Miles flown per fatal accident in scheduled operations	3,586,276	6,817,223	5,745,826	11,603,701	6,704,615	7,956,152	12,213,384
Fatal accidents, miscellaneous operations**	87	99	81	83	60	99	72
Miles flown per fatal accident, miscellaneous operations	422,760	392,141	496,718	536,403	691,951	523,266	625,833
Pilot fatalities, all services	74	84	72	70	52	87	60
Miles flown per pilot fatality, all services	787,808	786,796	957,824	1,133,322	1,443,080	1,052,690	1,361,668
Pilot fatalities, scheduled transport operations	6	4	5	3	4	5	2
Miles flown per pilot fatality, scheduled transport operations	3,586,276	6,817,223	5,745,826	11,603,701	8,380,769	7,956,152	18,320,076
Pilot fatalities, miscellaneous operations	68	80	67	67	48	82	58
Miles flown per pilot fatality, miscellaneous operations	540,885	485,275	600,510	664,499	864,939	631,747	776,896

* 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, 1934	*July-December, 1934*	*January-June, 1935*	*July-December, 1935*	*January-June, 1936*	*July-December, 1936*	*January-June, 1937*
Number of accidents involved....	27	46	29	33	42	28	28
PERSONNEL:							
Pilot:							
Error of judgment..........	14.45	4.02	12.07	3.03	9.52	8.57	6.96
Poor technique............	15.74	4.90	1.72	3.03	9.76	2.50	3.57
Disobedience of orders......	0	0	3.45	0	0	2.86	0
Carelessness or negligence...	11.67	6.95	13.79	9.09	10.12	16.07	6.25
Miscellaneous.............	0	0	0	0	0	0	0
Total pilot errors..........	41.86	15.87	31.03	15.15	29.40	30.00	16.78
Other personnel:							
Supervisory................	6.48	2.06	4.31	0	7.14	3.93	3.04
Miscellaneous.............	3.70	4.35	2.93	3.03	4.58	3.57	0
Total personnel errors........	52.04	22.28	38.27	18.18	41.07	37.50	19.82
MATERIAL:							
Power Plant:							
Fuel system...............	3.70	3.04	6.90	15.15	5.95	0	0
Cooling system............	0	0	0	0	0	0	0
Ignition system............	0	0	0	0	0	0	0
Lubrication system.........	0	4.34	0	0	0	0	0
Engine structure..........	0	2.18	0	3.03	4.76	0	0
Propellers and accessories....	7.41	2.17	3.45	6.06	0	3.57	3.57
Engine-control system......	0	2.18	0	0	0	0	0
Miscellaneous.............	0	0	3.45	0	0	0	0
Undetermined.............	.74	8.70	0	9.09	2.38	0	0
Total power-plant failures..	11.85	22.61	13.80	33.33	13.09	3.57	3.57
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.............	11.11	10.65	6.90	3.03	9.53	21.43	3.57
Wheels, tires and brakes.....	3.70	0	0	3.03	4.76	3.57	6.43
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..........	3.70	4.35	3.45	15.15	7.14	0	3.57
Miscellaneous.............	0	0	0	0	0	0	3.57
Undetermined.............	0	0	0	0	0	0	0
Total structural failures....	18.51	15.00	10.35	21.21	21.43	25.00	17.14
Handling qualities..........	0	6.52	0	0	2.38	0	0
Instruments..............	0	0	0	0	0	0	0
Total airplane failures.....	18.51	21.52	10.35	21.21	23.81	25.00	17.14
MISCELLANEOUS:							
Weather.....................	14.82	17.39	20.34	15.15	6.55	10.71	25.36
Darkness...................	0	0	0	0	0	0	0
Airport and terrain..........	.93	9.57	13.79	3.03	10.72	14.29	15.18
Other......................	1.85	6.63	0	6.06	4.76	3.57	8.21
Total miscellaneous causes..	17.60	33.59	34.13	24.24	22.03	28.57	48.75
Undetermined and doubtful.......	0	0	3.45	3.04	0	5.36	10.72
Total percentages..........	100.00	100.00	100.00	100.00	100.00	100.00	100.00

CAUSES OF ACCIDENTS
Non-Scheduled Flying

Causes	*Percentages*						
	January-June, 1934	*July-December, 1934*	*January-June, 1935*	*July-December, 1935*	*January-June, 1936*	*July-December, 1936*	*January-June, 1937*
Number of accidents involved....	640	855	708	809	789	909	842
PERSONNEL:							
Pilot:							
Error of judgment..........	8.07	6.73	8.96	7.76	10.23	9.47	8.88
Poor technique............	34.72	33.95	30.77	36.04	28.35	33.77	30.45
Disobedience of orders......	1.20	.83	.65	.69	.43	.24	.68
Carelessness or negligence...	8.28	11.35	11.51	7.20	9.37	10.80	10.37
Miscellaneous.............	.36	.29	0	.37	.23	.39	.53
Total pilot errors..........	52.72	53.15	51.89	52.06	48.61	54.67	50.91
Other personnel:							
Supervisory...............	0	.06	.07	0	0	.39	.12
Miscellaneous.............	0	.39	.28	.49	.51	.52	.30
Total personnel errors......	52.72	53.60	52.24	52.55	49.12	55.58	51.33
MATERIAL:							
Power Plant:							
Fuel system...............	5.68	5.68	5.72	4.40	4.12	4.74	5.25
Cooling system............	.31	.70	.14	.62	.38	.17	.42
Ignition system............	2.62	1.06	1.63	1.62	1.90	2.09	.95
Lubrication system.........	0	.35	.67	.12	.11	.44	0
Engine structure...........	3.41	3.33	2.93	2.60	2.73	2.31	2.26
Propellers and accessories....	.46	.94	.14	.62	1.20	.55	.47
Engine-control system......	.28	.23	.57	.37	0	0	0
Miscellaneous.............	.55	1.10	.99	.42	.13	.22	.24
Undetermined.............	2.94	4.22	3.50	5.53	5.23	4.64	4.19
Total power-plant failures..	16.25	17.73	16.29	16.30	15.80	15.16	13.78
Structural:							
Flight-control system.......	.46	.56	.42	1.24	.25	.77	1.07
Movable surfaces..........	.28	.23	.57	0	0	0	0
Stabilizing surfaces.........	0	.12	.28	.12	0	0	0
Wings, struts, and bracings..	1.10	1.80	1.56	.80	.79	1.27	.80
Undercarriage.............	4.82	4.73	4.67	7.08	4.31	5.17	5.23
Wheels, tires and brakes.....	1.54	2.48	.60	1.67	2.33	2.48	1.48
Pontoons or boats..........	0	0	0	.25	0	0	.12
Fuselage, engine mountings and fittings.............	.15	.35	.14	.06	.25	.11	.06
Tail-skid assembly..........	0	.12	0	0	.76	0	.12
Miscellaneous.............	.15	.18	.31	.25	.25	.22	.12
Undetermined.............	.15	0	0	0	0	.11	0
Total structural failures....	8.74	10.66	8.55	11.47	8.94	10.13	9.00
Handling qualities...........	1.76	.93	1.06	1.36	1.43	.76	.47
Instruments................	0	0	0	.12	.01	.11	.35
Total airplane failures.....	10.50	11.59	9.61	12.95	10.38	11.00	9.82
MISCELLANEOUS:							
Weather....................	7.67	4.80	7.89	6.29	9.07	6.58	8.03
Darkness...................	0	.28	.21	.37	.84	.74	.08
Airport and terrain..........	10.24	9.74	11.07	7.21	11.30	7.38	12.68
Other......................	2.00	2.14	2.69	3.40	3.11	3.01	4.04
Total miscellaneous causes..	19.01	16.96	21.86	17.27	24.32	17.71	24.83
Undetermined and doubtful.....	.62	.12	0	.93	.38	.55	.24
Total percentages..........	100.00	100.00	100.00	100.00	100.00	100.00	100.00

INJURIES CLASSIFIED

July-December, 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......	220	5	1	1	22	29	5	0	2	18	25
Student instruction....	401	28	18	31	230	307	5	2	7	47	61
Experimental..	21	2	3	2	7	14	0	0	0	0	0
Commercial....	466	23	6	15	158	202	0	0	0	2	2
Pleasure.......	730	29	22	42	315	408	2	1	0	4	7
Total.....	1,838	87	50	91	732	960	12	3	9	71	95

Kind of Flying	*Total Persons Involved*	*Passengers*					*Aircraft Crew*				
		Fatal	*Severe*	*Minor*	*No Injury*	*Total*	*Fatal*	*Severe*	*Minor*	*No Injury*	*Total*
Schedule......	220	19	0	8	123	150	3	0	1	12	16
Student instruction....	401	14	5	2	8	29	0	0	0	4	4
Experimental..	21	0	0	1	0	1	5	0	0	1	6
Commercial....	466	30	7	21	203	261	1	0	0	0	1
Pleasure.......	730	34	10	28	242	314	0	0	0	1	1
Total.....	1,838	97	22	60	576	755	9	0	1	18	28

January-June, 1937

Kind of Flying	*Total Persons Involved*	*Pilots*					*Co-Pilots or Students*				
		Fatal	*Severe*	*Minor*	*No Injury*	*Total*	*Fatal*	*Severe*	*Minor*	*No Injury*	*Total*
Schedule......	282	2	1	0	25	28	3	0	0	22	25
Student instruction....	418	31	26	31	244	332	4	4	6	42	56
Experimental..	20	1	1	1	10	13	0	0	0	1	1
Commercial....	347	4	0	12	138	154	0	0	0	2	2
Pleasure.......	629	22	20	31	284	357	0	0	1	10	11
Total.....	1,696	60	48	75	701	884	7	4	7	77	95

Kind of Flying	*Total Persons Involved*	*Passengers*					*Aircraft Crew*				
		Fatal	*Severe*	*Minor*	*No Injury*	*Total*	*Fatal*	*Severe*	*Minor*	*No Injury*	*Total*
Schedule......	282	22	7	1	174	204	2	1	0	22	25
Student instruction....	418	11	7	4	8	30	0	0	0	0	0
Experimental..	20	0	0	0	3	3	0	0	1	2	3
Commercial....	347	8	3	17	161	189	0	0	0	2	2
Pleasure.......	629	25	9	20	207	261	0	0	0	0	0
Total.....	1,696	66	26	42	553	687	2	1	1	26	30

Aeronautical Directory

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Paul Campbell, Minnesota

Graduate Board

Kenneth E. Benson, Chm., Akron
J. B. Hartranft, Jr., Pennsylvania
W. D. Strohmeier, Amherst
Mary Kimball Holland, Smith

Advisory Council

William R. Enyart, Chm.
Charles L. Morris
Wm. Barclay Harding
J. D. Akerman
Leslie A. Walker
B. S. Meickle

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc.

29 West 39th Street, New York

Aeronautic Officials for 1938

President.......C. W. Spicer
Vice President.......F. W. Caldwell
(Representing Aircraft Engineering)
Vice President.......R. N. DuBois
(Representing Aircraft Engine Engineering)
Vice President.......Carl Behn
(Representing Diesel Engine Engineering)
Secretary and General Manager.......John A. C. Warner

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F. W. Caldwell, Vice President
R. N. DuBois, Vice President
Carl Behn, Vice President
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W. C. Keys, Councilor
J. L. Stewart, Councilor
W. J. Davidson, Councilor
L. J. Grunder, Councilor
B. J. Lemon, Councilor
David Beecroft, Treasurer
R. R. Teetor, Past President (1936)
H. T. Woolson, Past President (1937)

Aeronautic Committees

Aircraft Committee.......F. W. Caldwell, Chairman
Aircraft Engine Committee.......R. N. DuBois, Chairman
Standards Committee
    Aircraft Division.......J. F. Hardecker, Chairman
    Aircraft Engine Division.......Arthur Nutt, Chairman
Research Committee
    Aircraft Engine Lubricants Committee.......C. H. Baxley, Chairman

THE SOARING SOCIETY OF AMERICA, Inc.

Pensacola, Fla.

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Secretary.......Arthur L. Lawrence
Treasurer.......Genevieve Eaton
General Manager.......Lewin B. Barringer
Chairman Contest Committee.......Dr. Karl O. Lange

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Aeronautic Division, Executive Committee

Chairman.......Alexander Klemin
Secretary.......Jerome Lederer

C. H. Dolan
R. M. Mock
R. V. Morse
B. M. Woods

BUREAU OF FOREIGN AND DOMESTIC COMMERCE
U. S. DEPARTMENT OF COMMERCE

Washington, D. C.

Daniel C. Roper, Secretary of Commerce
Ernest G. Draper, Asst. Secy. of Commerce
Alexander V. Dye, Director, Bureau of Foreign & Domestic Commerce

Automotive-Aeronautics Trade Division

Acting Chief...Irving H. Taylor

Aeronautics Trade Section

C. E. Christopherson Brower V. York

Note:—The Automotive-Aeronautics Trade Division is the source of information on civil aviation developments abroad, aeronautical export markets and related data.

U. S. AIR CORPS, WAR DEPARTMENT

Washington, D. C.

Harry H. Woodring, Secretary of War

Officers on Duty in Washington

Chief of the Air Corps.......................................Major Gen. Oscar Westover
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, H. H. C. Richards.
Lieut. Colonels—Rosenham Beam, G. E. Brower, H. C. Davidson, M. F. Davis, V. B. Dixon, Ira C. Eaker, A. E. Easterbrook, William E. Farthing, M. C. Grow, Lynwood B. Jacobs, David A. Myers, R. L. Walsh, H. H. Young.
Majors—Evers Abbey, K. S. Axtater, C. Y. Banfill, R. C. W. Blessley, Norman D. Brophy, James C. Cluck, A. H. Foster, Edward V. Harbeck, Jr., James B. Jordan, Robert Kauch, Alvan C. Kincaid, David C. Lingle, M. H. McKinnon, L. W. Miller, J. A. Mollison, C. P. Prime, E. W. Raley, L. H. Smith, W. G. Smith, Wm. B. Souza, G. L. Usher, G. S. Warren.
Captains—James T. Cumberpatch, J. J. Honan, L. S. Smith, James W. Spry, Donald F. Stace.
First Lieutenant...Robert M. Losey

Materiel Division

Wright Field, Dayton, Ohio.

Brigadier General A. W. Robins, Chief of the Division

Executive and Commanding Officer.............................Col. Frank M. Kennedy
Asst. Executive and Adjutant.....................................Major A. W. Brock, jr.
Supply Officer..Major J. A. Madarasz
Chief, Engineering Section..Lt. Col. O. P. Echols
Chief, Procurement Section.....................................Lt. Col. Wm. F. Volandt
Chief, Field Service Section...Col. F. D. Lackland
Chief, Ind. Planning Section.......................................Lt. Col. H. V. Hopkins
Finance Officer...Capt. J. F. Connell
Asst. Commandant, A. C. Engineering School....................1st Lt. R. P. Swofford, jr.
Quartermaster..Major John A. Russell
Signal Officer..Lt. Col. Hugh Mitchell
Engineer Corps Representative.................................Capt. Louis J. Rumaggi
Ordnance Corps Representative.....................................Major Frank F. Reed
Navy Representative...Lt. Comdr. Robert W. Bockius
Chief, Personnel Branch...Lt. Col. Morris Berman
Chief, Aircraft Branch..Major Howard Z. Bogert
Chief, Equipment Branch..Major Fred S. Borum
Chief, Inspection Branch...Major Thos. H. Chapman
Chief, Flying Branch...Major Stanley M. Umstead

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....................E. A. Cobey, S. M. Kraus, H. C. Richardson
Commanders....................A. C. Davis, R. Davison, G. Fulton, H. R. Oster, E. M. Pace, F. W. Pennoyer, C. A. Pownall, F. B. Stump, S. J. Zeigler.
Lieutenant Commanders......F. L. Baker, R. E. Blick, Rico Botta, J. V. Carney, S. B. Cooke C. F. Cotton, G. H. DeBaun, W. S. Diehl, A. K. Doyle, J. E. Dyer, D. S. Fahrney, R. E. Farnsworth, L. M. Grant, C. L. Helber, W. D. Johnson, W. M. Lockhart, I. M. McQuiston, C. A. Nicholson, J. E. Pixton, W. L. Rees, A. O. Rule, W. D. Sample, A. R. Sandborn, L. C. Stevens, J. F. Wegforth, O. A. Weller.
Lieutenants....................E. W. Clexton, W. L. Erdman, J. F. Greenslade, R. S. Hatcher, F. M. Hughes, J. W. King, D. N. Logan, C. L. Miller, G. T. Mundorff, J. L. Pratt, W. T. Rassieur, S. B. Spangler, P. D. Stroop, T. T. Tucker, A. B. Vosseller, D. E. Wilcox.
Marine Corps Aviation........Col. R. E. Rowell; Lt. Col. F. Harris, Major B. F. Johnson, Capt. A. D. Cooley, Capt. A. W. Kreiser, Capt. W. D. Saunders, Capt. P. K. Smith.
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. J. H. Hoover
San Diego, Calif....................Capt. A. L. Bristol
Seattle, Wash....................Comdr. A. W. Radford
Pensacola, Fla....................Capt. W. F. Halsey
Pearl Harbor, T. H....................Capt. K. Whiting
Coco Solo, C. Z....................Comdr. E. L. Gunther

Marine Corps Flying Fields

Quantico, Va....................Col. R. S. Geiger
San Diego, Calif....................Lt. Col. R. S. Mitchell
St. Thomas, V. I....................Maj. C. A. Larkin

Carrier Division

Commander Aircraft, Battle Force....................Vice Admiral E. J. King
Chief of Staff....................Capt. P. N. L. Bellinger
U. S. S. SARATOGA....................Capt. J. H. Towers
U. S. S. LEXINGTON....................Capt. Leigh Noyes
U. S. S. RANGER....................Capt. J. S. McCain
U. S. S. YORKTOWN....................Capt. E. D. McWhorter
U. S. S. ENTERPRISE....................Capt. N. H. White

Naval Aircraft Factory

Philadelphia, Pa....................Comdr. W. W. Webster

Special Aviation Duty

Aide to Commander-in-Chief, U. S. Fleet............................Comdr. F. P. Sherman
Aide to Commander, Battle Force..................................Comdr. D. C. Ramsey
Aide to Commander Cruisers, Scouting Force.....................Lt. Comdr. W. M. Dillon
Aide to Commander, Scouting Force...............................Lt. Comdr. H. M. Martin
Office of Naval Operations..........Comdr. R. P. Molten, Comdr. O. B. Hardison, Lt. Comdr. D. Ketcham.
Naval Examining Board..Comdr. J. E. Ostrander
Board of Inspection and Survey..................................Lt. Comdr. R. E. Jennings
Bureau of Navigation..............Lt. Comdr. R. L. Bowman, Lt. Comdr. W. W. Smith, Lt. Comdr. J. B. Lynch, (USNR).
Bureau of Ordnance........................Lt. Comdr. M. F. Schoeffel, Lt. S. E. Burroughs
Bureau of Engineering..Lt. Frank Akers
Bureau of Medicine and Surgery...............................Comdr. J. C. Adams, (MC)
Hydrographic Office...Lt. Comdr. J. S. Michael
Aeronautical Board..Lt. Comdr. J. E. Dyer

THE NATIONAL ASSOCIATION OF STATE AVIATION OFFICIALS

Officers for 1938

President
FLOYD E. EVANS,
Michigan Director of Aeronautics

First Vice President
CHARLES L. MORRIS,
Commissioner of Aeronautics
State of Connecticut

Second Vice President
D. O. LANGSTAFF,
Director of Aviation,
State of Louisiana

Third Vice President
RAYMOND R. STAUB,
Treasurer, Board of Aeronautics
State of Oregon

Secretary-Treasurer
HOWARD C. KNOTTS,
Aviation Supervisor,
Illinois Commerce Commission

Legal Counsel
GEORGE B. LOGAN,
St. Louis, Missouri

Regional Vice Presidents

North East
WILLARD M. FLETCHER,
Chief, Division of State Airports,
Hillsgrove, Rhode Island

North Central
CHARLES S. DOYLE,
Secretary, Nebraska Aeronautic Commission,
Lincoln, Nebraska

South East
DEXTER C. MARTIN,
Director of Aeronautics
Columbia, South Carolina

South Central
J. M. GENTRY,
Secretary, State Highway Commission and
State Aircraft Officer,
Oklahoma City, Oklahoma

East Central
S. B. STEERS,
Assistant Director of Aeronautics,
Lansing, Michigan

South West
W. D. Hammond,
Chairman, Utah State Aeronautics Commission
Salt Lake City, Utah

North West
FRED B. SHERIFF,
Commissioner of Aeronautics,
Helena, Montana

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.
Fred D. Fagg, Jr., J.D., Director of Air Commerce, Department of Commerce.
Willis Ray Gregg, Sc.D., 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.
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

NATIONAL BUREAU OF STANDARDS

Connecticut Ave. and Upton St., Washington, D. C.

Director	Lyman J. Briggs
Assistant Director for Research and Testing	E. C. Crittenden
Assistant Director for Commercial Standardization	A. S. McAllister
Assistant to Director (in charge of Office)	Henry D. Hubbard
Chief of Division of:	
Electricity	E. C. Crittenden
Weights and Measures	F. S. Holbrook and H. W. Bearce
Heat and Power	H. C. Dickinson
Optics	C. A. Skinner
Chemistry	G. E. F. Lundell
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	W. H. Seaquist

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..Lieutenant C. B. Olsen
Aviation Materiel..Lieutenant G. H. Bowerman
Chief Machinist F. F. Crump
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. Comdr. F. A. Leamy
New York, New York.....................................Commander Robert Donohue
Charleston, South Carolina..............................Lieut. Comdr. W. J. Kossler
Miami, Florida...Commander C. C. von Paulsen
St. Petersburg, Florida.......................................Lieutenant W. A. Burton
Biloxi, Mississippi.......................................Lieut. Comdr. R. L. Raney
San Diego, California.......................................Lieutenant S. C. Linholm
Port Angeles, Washington..............................Lieut. Comdr. N. M. Nelson

Coast Guard Air Patrol Detachments

Cape May, New Jersey..Lieutenant R. L. Burke
El Paso, Texas..Lieutenant P. S. Lyons

Inspectors of Coast Guard Aircraft

Lieutenant W. S. Anderson
Chief Machinist W. R. Kenly
Machinist W. D. Pinkston
Lieutenant C. L. Harding
Chief Carpenter O. G. Tobiason

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. C. Young, Assistant Superintendent..................................New York, N. Y.
J. A. Cruickshank, Assistant Superintendent......................................Chicago, Ill.
B. H. Lockett, Assistant Superintendent..Atlanta, Ga.
R. E. Pollard, Assistant Superintendent.................................Fort Worth, Tex.
A. O. Willoughby, Assistant Superintendent.........................San Francisco, Calif.
J. E. Lamiell, Director, Division of International Postal Service (Foreign Air Mail)

BUREAU OF AIR COMMERCE
U. S. DEPARTMENT OF COMMERCE

Washington, D. C.

Daniel C. Roper, Secretary of Commerce

J. M. Johnson, Assistant Secretary of Commerce

Director of Air Commerce....Fred D. Fagg, Jr.
Assistant Director....Howard F. Rough
Assistant Director....Denis Mulligan
Technical Assistant....E. B. Cole
Administrative Division....John S. Collins
  Assistant Chief....E. R. Ryan
  Assistant Chief....C. M. Estep
  Budget Section....W. R. Behn
  Accounts Section....G. W. Hammond
  Mail & Files....N. E. Estep
  Personnel Section....R. L. Cox
  Procurement & Leases Section....L. W. Lawrence
  Property Section....C. J. McGinnis
    Central Depot, Ft. Worth, Texas....W. G. Edwards
Airways Engineering Division....C. I. Stanton
  Airways Engineer....T. B. Bourne
  Survey Section....H. A. Hook
  Utilities Section....A. J. LaBaie
  Construction Section....G. E. Stratton
  Radio Section....W. F. McBride
  Drafting Unit....W. T. Huntress
  Maintenance Section....A. O. Preil
    Airway District Managers and Headquarters:
      No. 1, Newark, New Jersey....D. G. Van De Water
      No. 2, Atlanta, Georgia....R. C. Copeland
      No. 3, Chicago, Illinois....Carl McCluer
      No. 4, Fort Worth, Texas....L. C. Elliott
      No. 5, Salt Lake City, Utah....C. C. Lange
      No. 6, Oakland, California....H. T. Bean
Airways Operation Division....Earl F. Ward
  Communications Section....E. Sibley
  Airport Traffic Control....F. L. Smith
  Traffic Control Section....G. A. Gilbert
    Airway Traffic Control Stations:
      Burbank, California....R. Sturtevant
      Chicago, Illinois....R. A. Eccles
      Cleveland, Ohio....H. F. Cole
      Detroit, Michigan....H. D. Copland
      Newark, New Jersey....John L. Huber
      Oakland, California....L. P. de Arce
      Pittsburgh, Pennsylvania....E. R. Mehrling
      Washington, D. C....Lee Warren
Safety & Planning Division....R. G. Gazley
  Aircraft Section....John Easton
  Airports Section....A. B. McMullen
  Air Transport Section....Rogers Humphreys
  Educational Section....
  International Section....W. T. Miller
  Power Plant Section....J. H. Geisse
  Radio Development Section....W. E. Jackson
Information & Statistics Division....
  Editorial Section....F. Brinkley
  Correspondence Section....W. B. Fulton
  Flight Information Section....John Groves
  Reference Section....L. Bedford
  Statistical Section....S. Kernan
Certificate & Inspection Division....B. M. Jacobs
  Aircraft Airworthiness Section....L. V. Kerber

Airline Inspection Section (Domestic)....J. B. Jaynes
Airline Field Offices:
Newark, New Jersey....L. S. Harding
Atlanta, Georgia....Roy Keeley
Miami, Florida....R. F. Nicholson
Pittsburgh, Pennsylvania....O. D. Murphy
Chicago, Illinois....R. I. Hazen
Seattle, Washington....A. D. Niemeyer
Cheyenne, Wyoming....F. E. Williams
Oakland, California....A. W. Smith
Kansas City, Missouri....R. W. Delany
Fort Worth, Texas....N. B. Ison
Burbank, California....J. L. Kinney
Airline Inspection Section (Foreign)....E. L. Yuravich
Airway Coordination Section....H. M. Agerter
Instrument Trainer Section....Ward Davis
Medical Section....Dr. E. S. Adams
General Inspection Section....R. S. Boutelle
Supervising Aeronautical Inspectors & Headquarters:
District No. 1, Garden City, L. I., New York....L. W. Jurden
District No. 2, Los Angeles, California....J. S. Marriott
District No. 3, Atlanta, Georgia....Wiley R. Wright
District No. 4, Detroit, Michigan....H. R. Neely
District No. 5, Chicago, Illinois....O. W. Young
District No. 6, Kansas City, Missouri....S. L. Willits
District No. 7, Dallas, Texas....J. T. Shumate
District No. 8, Oakland, California....R. D. Bedinger
District No. 9, Anchorage, Alaska....Hugh Brewster
Regulation & Enforcement Division....George W. Vest
Assistant to Chief....Samuel E. Gates
Regulation Section....
Registration Section....R. R. Reining
Enforcement Section....
Accident Section....J. W. Lankford

THE AERONAUTICAL BOARD

Navy Building, Washington, D. C.

Army

Maj. Gen. Oscar Westover....Chief of the Air Corps
Brig. Gen. H. H. Arnold....Assistant Chief of the Air Corps
Lt. Col. W. H. Walker....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 J. S. Woods....War Plans Div., Naval Operations

Secretary, Jarvis Butler

FEDERAL COMMUNICATIONS COMMISSION

Washington, D. C.

Commissioners

Frank R. McNinch, Chairman
Thad H. Brown
T. A. M. Craven
Norman S. Case
Eugene O. Sykes
George Henry Payne
Paul Walker
T. J. Slowie, Secretary

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

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.....Edwin B. Gittings
Jacksonville.....Walter J. Bennett
New Orleans.....Willard F. McDonald
San Francisco.....Edward H. Bowie

General Supervising Airway Stations

(Six-hourly Airway Forecast Centers)

Washington (Arlington, Va.).....Eugene M. Barto
Atlanta.....Glen Jefferson
Chicago.....Vincent E. Jakl
Cleveland.....Clarence G. Andrus
Fort Worth.....Henry P. Adams
Kansas City.....Leslie A. Warren
Los Angeles (Burbank).....George M. French
New York (Newark).....Wilson Reed, Jr.
Portland, Ore.....Julius C. Smith
Salt Lake City.....Harry M. Hightman
San Francisco (Oakland).....John A. Riley

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, Ore. 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. Lyle F. Watts, Regional Forester
Alaska Region	Headquarters: Juneau, Alaska B. Frank Heintzleman, Regional Forester

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION

Standing Committees of the 75th Congress, third session

Senate

Appropriations

Carter Glass	(D)	Joseph C. O'Mahoney	(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 Steiwer	(R)
Alva B. Adams	(D)	John G. Townsend, Jr.	(R)
Pat McCarran	(D)	H. Styles Bridges	(R)
John H. Overton	(D)	Frederick Hale	(R)
John H. Bankhead	(D)	Gerald P. Nye	(R)

Interstate Commerce

Burton K. Wheeler	(D)	Sherman Minton	(D)
Ellison D. Smith	(D)	A. Harry Moore	(D)
Robert F. Wagner	(D)	Harry S. Truman	(D)
Alben W. Barkley	(D)	Charles O. Andrews	(D)
Matthew M. Neely	(D)	Edwin C. Johnson	(D)
William H. Dieterich	(D)	H. H. Schwartz	(D)
Augustine Lonergan	(D)	Wallace H. White, Jr.	(R)
Fred H. Brown	(D)	James J. Davis	(R)
Homer T. Bone	(D)	Warren R. Austin	(R)
Vic Donahey	(D)	Henrik Shipstead	(FL)

Military Affairs

Morris Sheppard	(D)	H. H. Schwartz	(D)
J. Hamilton Lewis	(D)	Ernest Lundeen	(FL)
M. M. Logan	(D)	George L. Berry	(D)
Robert R. Reynolds	(D)	John E. Miller	(D)

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION
(Continued)

Military Affairs (Continued)

Elbert D. Thomas	(D)	Warren R. Austin	(R)
Sherman Minton	(D)	Gerald P. Nye	(R)
Edwin C. Johnson	(D)	H. Styles Bridges	(R)
Josh Lee	(D)	Henry Cabot Lodge, Jr.	(R)

Naval Affairs

David I. Walsh	(D)	Fred H. Brown	(D)
Millard E. Tydings	(D)	Peter G. Gerry	(D)
Ellison D. Smith	(D)	Rush D. Holt	(D)
George McGill	(D)	Charles 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)
		Ernest W. Gibson	(R)

Post Offices and Post Roads

Kenneth McKellar	(D)	Dennis Chavez	(D)
Carl Hayden	(D)	Rush D. Holt	(D)
Josiah W. Bailey	(D)	Allen J. Ellender	(D)
William J. Bulow	(D)	Ernest Lundeen	(FL)
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COLORADO:	State Aviation Commission, Verry C. Vasconcelles, Chairman, Denver
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