

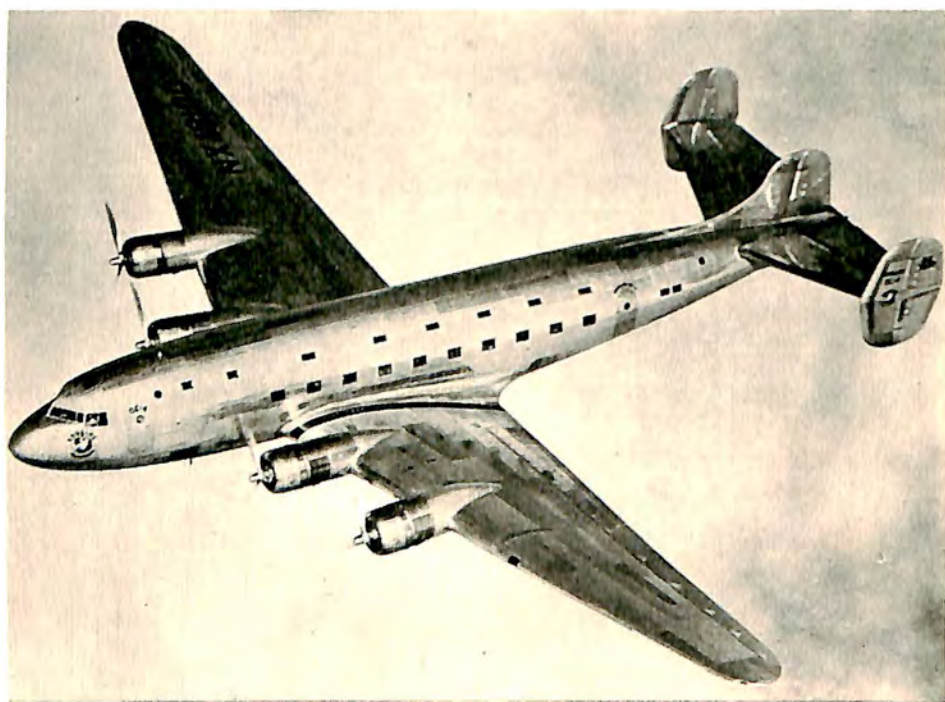
*The*  
AIRCRAFT  
YEAR BOOK

*For 1939*



90 HARRISON BRAND, JR.  
AIRCRAFT INDUSTRIES ASSOCIATION  
SHOREHAM BUILDING  
WASHINGTON 5, D. C.

AIRCRAFT YEAR BOOK FOR 1939



THE DOUGLAS DC-4 IN FLIGHT

Four Pratt & Whitney Twin Hornet engines power this giant airliner which made its demonstration flights in 1939.

*The*  
AIRCRAFT  
YEAR BOOK

*(Registered U. S. Patent Office)*

*For 1939*

TWENTY-FIRST ANNUAL EDITION

HOWARD MINGOS

Editor



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U. S. Army photo

#### NEW BOEING FLYING FORTRESS

The XB-15, the larger and more powerful of the four-engine bombers developed for the U. S. Army Air Corps. It is equipped with 1,000 h.p. Pratt & Whitney Twin Wasp engines.

## CHAPTER I

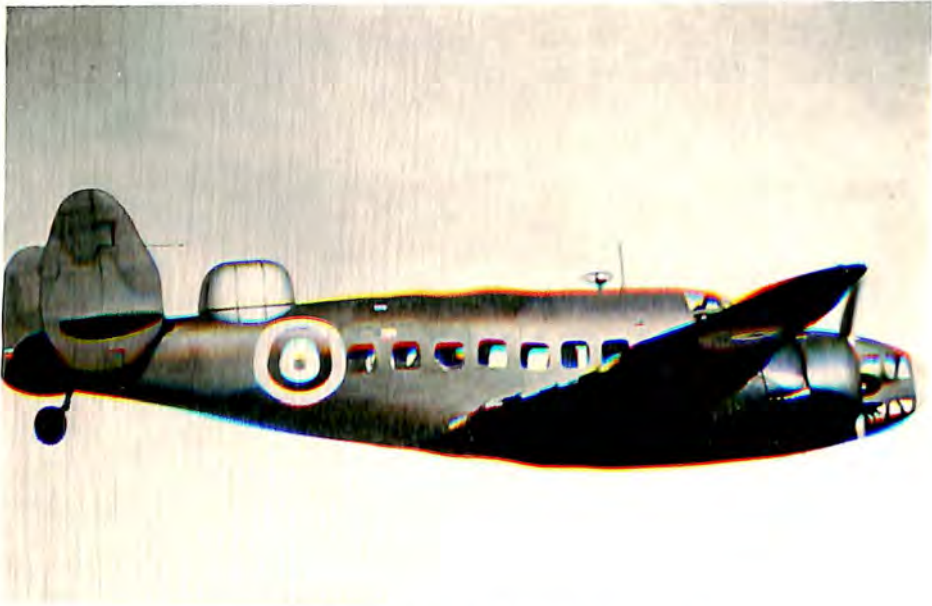
### AIR POWER IN 1938

The Munich Pact and its Results—Fear of Air Raids—Reports from Observers Abroad—German Air Power and its Influence on the World—Report of the National Advisory Committee for Aeronautics—Senator Reynolds Urges the United States to Develop "Air Power for Peace."

THE most persuasive force in international relations in 1938 was the raiding airplane. It dominated the political thoughts of the world. The threat of enemy squadrons throwing tons of explosives into defenseless cities day after day was too terrible for peaceful nations to contemplate; and their statesmen watched helplessly while aggressor nations had their way. Ethiopia, Spain and China had been proving grounds for the theory of supreme advantage to be gained by dominion in the air. Thus the Hitler Government absorbed Austria into the German Reich without physical opposition. Then in September, 1938, came the crisis over Czechoslovakia. It culminated in the conference at Munich during which the dictators of Germany and Italy blandly told the heads of the British and French Governments that Hitler must have as much of the Czechoslovakian Republic as he wanted. Again, the threat of armed force triumphed; and the world realized that Germany's vaunted air power again had won a bloodless victory. How long must such high-handed methods prevail in this civilized age? Thoughtful men everywhere asked the question. Apparently there was only one answer. Any nation desiring to preserve its liberties must be prepared to defend itself successfully; and while arming on the ground and on the sea, it must be especially prepared to defend itself in the air. That was the situation after Munich.

Edwin L. James, managing editor of the New York Times, and one of the most infallible observers of international affairs, wrote in his newspaper on September 25, 1938, that "if it be true that

Britain and France sold Czechoslovakia down the river in an effort to prevent Hitler's starting a European war, it was undoubtedly because of the existence in Germany of the world's greatest air force." Mr. James continued: "The French General Staff has no fear of the Germany Army, the British fleet has no doubt of its ability to blockade the Third Reich, but both London and Paris knew that the Nazis had an air force superior to the combined British and French air forces. That meant that there was small doubt that Goering's men could do enormous damage to the capitals of the two great European



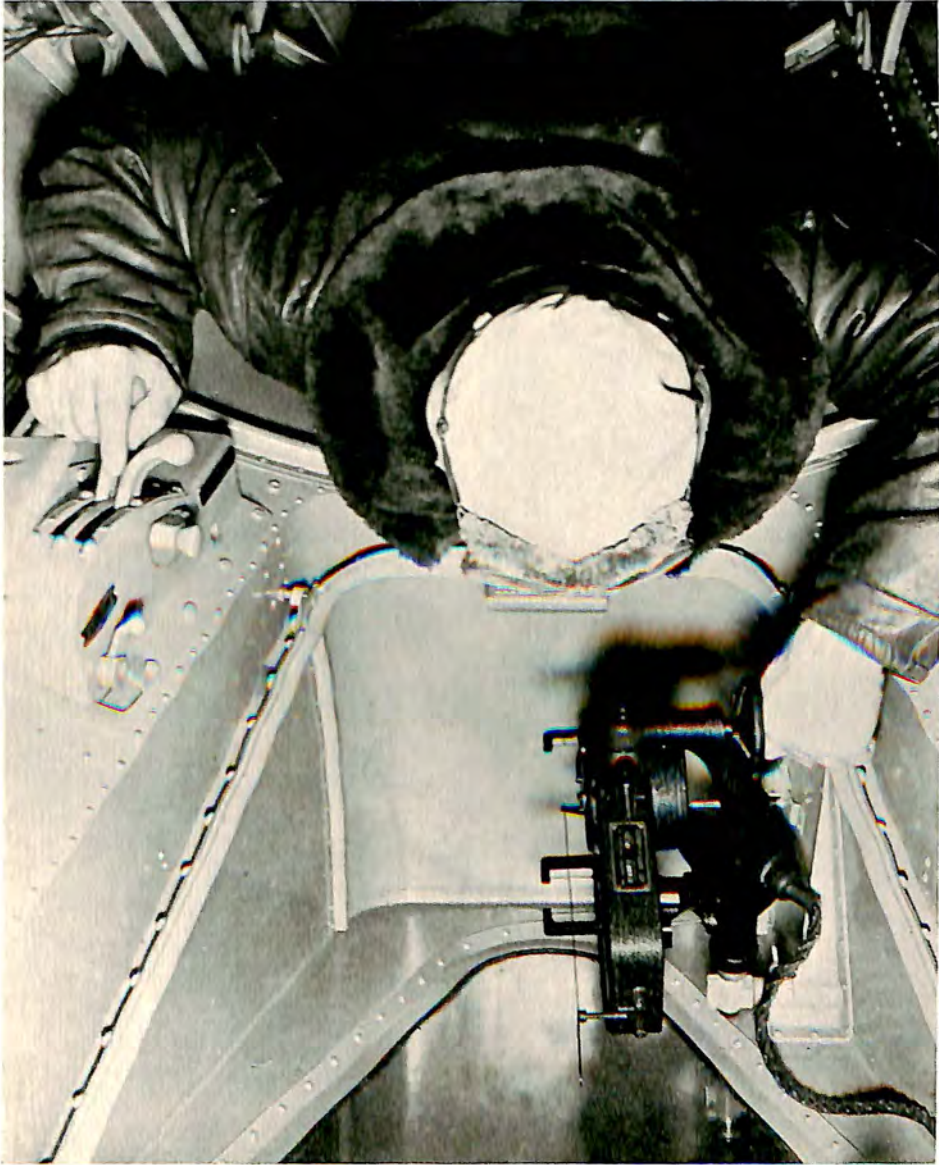
#### LOCKHEED BOMBERS FOR BRITAIN

One of the great fleet of Lockheed B-14 reconnaissance bombers which the British Air Ministry ordered from the Lockheed Aircraft Corporation in 1938. They are powered by Wright Cyclone engines.

democracies, slaughtering women and children by tens of thousands, as well as crippling the services back of the front.

"In the tense night of Sept. 13, when for hours the French believed Hitler was about to march and when for some hours it was a question of immediate French mobilization, the one dread idea in the minds of the Paris statesmen was the fate of their metropolis. At the same time, over in London, there were feverish counting and testing of the balloons with which the British plan to erect a barrage against air bombers coming from the East, while the several thousand





#### THE BOMBARDIER AT WORK

He is looking through the bomb sight mounted over the glass window in the floor of a Wright Cyclone-powered Vultee attack bomber; and is about to release an 1,100-lb. bomb on a target 10,000 feet below.

anti-aircraft batteries between London and the North Sea were put on the alert. Elaborate calculations were made calling for the evacuation of 3,000,000 people from London into surrounding territory. Both nations felt they were hopelessly weak in the air, and it was the general opinion that after three weeks of warfare Germany would have mastery in the air.

#### The German Air Force

"The next day the British Prime Minister went to Germany to see Hitler and Britain and France agreed to recommend to Czechoslo-



#### VOUGHT-SIKORSKY NAVY OBSERVATION SCOUT

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

vakia the acceptance of what they regarded as Hitler's demands. Two days before the Fuehrer had spoken of the possibility of doubling the Reich's air force.

"There are various reports of the size of Goering's air force and the Germans are supplying no details. Ten days ago the British Government said it believed Germany had 9,700 planes ready to fight. Other estimates placed the figure at 10,000. In Paris the belief holds that the German air force is 5,000 planes. In any event the latter number exceeds the number of planes which the British and the French together have in commission. It is not believed that the Ger-



U. S. Navy photo

THE NAVY CONSOLIDATED PB<sub>2</sub>Y-1

The all-metal flying boat patrol bomber with full cantilever-wing. It was produced for the U. S. Navy by the Consolidated Aircraft Corporation; and was powered by four Pratt & Whitney 1,050 h.p. Twin Wasp engines. Photo shows the flying boat taking off on the open sea near San Diego, Calif.

mans have anything like 10,000 trained pilots. But in aerial warfare replacement is the great problem and on that score the Germans were quite clearly out in front.

"It is pretty generally established that the German production is at the rate of 400 planes a month. The British production is not more than one-third of that amount, while French production is now considerably less than the British.

"The German planes are not all of the first quality, but if it be presumed that the Germans would, in the event of war, use their best planes until they had established supremacy in the air, the second-rate planes would then become of use.

"So with the issue of peace or war still in the balance, the question seems to relate to whether by a great slaughter of civilians, by a



#### NORTH AMERICANS FOR FRANCE

One of the North American NA-16 Trainers, powered by a 420 h.p. Wright Whirlwind engine, ordered by the French Air Ministry.

reign of terror without precedent, the Germans could, by trying to ruin London and Paris, force a victory in three months. Even in Germany there is grave doubt that the Reich could win a long war. There is a shortage of food. The military supplies are said not to be in good shape, except for a reserve of wheat. Germany must import her gasoline; her synthetic production is estimated to fill only 20 per cent of her needs at best. She has four months' supply of gasoline, it is said. With British sources cut off, she would have to depend on what she could get from Rumania. Mussolini has no gasoline to give Hitler.

"Could Goering's air bombs bring Britain and France to their knees in three months? Probably not. It would appear to be the best guess that if Hitler begins a war in which France and Britain join, the

ultimate result would be another defeat for Germany. But London and Paris are doubtless correct in fearing that what the Nazi bombers could do at the outset would be perhaps the most heartless and heart-breaking catastrophe our civilization has known."

#### Lindbergh's Observations

Observers who had opportunities to visit the German aviation centers late in 1918 were deeply impressed by the vast number of military planes being turned out of the factories. Notable among those who lost no time in warning of Germany's capacity for sustaining her air power by increasing numbers of planes was Colonel Charles A. Lindbergh who on several occasions stated frankly that



N. A. C. A. FREE FLIGHT TUNNEL

The 60-foot steel sphere housing the new National Advisory Committee for Aeronautics 12-foot free-flight wind tunnel at Langley Field, Va.

the German air force was not only big and powerful; it was beginning to acquire equipment superior to that existing elsewhere in Europe; and in some types better than that used by the American air forces. It was shocking news to those people in the United States who had been accustomed to acknowledging the surpassing performance of American aircraft.

It transpired, however, that Colonel Lindbergh had learned of the unlimited funds which the German Government had spent on research and development, on experimental orders with the aircraft industry and in establishing great research laboratories for further improvement of aircraft.

At the same time Great Britain, France and some of the smaller nations of Europe began placing large orders with aircraft manu-

facturers in the United States, evidence of the high regard in which such equipment was held abroad and further proof that they were hastening to build up their air forces for any emergency.

#### S. Paul Johnston's Report

S. Paul Johnston, editor of Aviation magazine, returning from a European observation trip late in 1938, published in his magazine a carefully compiled table setting forth his conclusions as to the relative positions in air power. In numbers of military planes he placed Germany and Russia at the top, Italy next, Great Britain and the United States next in line and France at the bottom of the list.

In quality Mr. Johnston ranked Germany and the United States



THE STEARMAN ATTACK BOMBER

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

at the top, Great Britain and Italy next, Russia next and France last.

In rate of production—late in 1938—the Johnston figures placed Germany first, Russia second, Great Britain and Italy third, the United States fourth and France last.

#### Report of National Advisory Committee

Of great significance, in view of the disturbed conditions abroad, was the annual report of the National Advisory Committee for Aeronautics, since 1915 the Government's great aeronautical research bureau. Important excerpts from that report are quoted here:

"The crisis in Europe in the fall of 1938 brought forcibly to world-wide attention the overshadowing influence of air power in international affairs. The realization that aircraft had been built in great numbers and developed to a point where they are capable of operating at high speeds over long distances with large bombing loads thrust upon the world a new concept of national defense. The imminent prospect of noncombatants being subject to indiscriminate attack by aircraft stirred the imaginations and fears of all peoples. The sudden and rather general appreciation of the potentialities of modern air power is the most significant event that has occurred in modern times



U. S. Navy photo

NAVY GRUMMANS F<sub>2</sub>F-1

A flight of Pratt & Whitney Twin Wasp Junior powered fighters off Hampton Roads, Va.

in connection with strengthening the desires of peoples to avoid war.

"The Committee in its annual report for 1924 discussed the increasing importance of aircraft in warfare in the light of the failure of the Limitations of Armaments Conference, held in Washington in 1921-22, to place any limitations upon the use of aircraft in warfare. The Committee at that time pointed out some of the appalling possibilities in the indiscriminate use of aircraft. These included not merely air attacks on recognized military objectives, but also attacks on civilian populations. Subsequent attempts by international confer-

ence to minimize the consequences to noncombatants have been without avail.

"The Committee, therefore, in the interests of peace and security, recommends the development by the Army and Navy of adequate and effective air arms, and the early adoption of a sound program for expanding the productive capacity of the aircraft industry and for training the necessary active and reserve personnel.

"The history of 1938 bears witness as to how a nation [Germany] in the space of a few years, by concentrating much of its scientific research and industrial resources on the development of air power, could gain, for the time being, a dominating position. The continued



NEW BENDIX AVIATION PLANT

Air view of the new factory of Bendix Aviation Corporation and its subsidiaries, Eclipse Aviation Division and Pioneer Instrument Co., at Bendix, N. J.

effectiveness of an air arm, however large, is dependent on constant progress in the new engineering science of aeronautics. The efficiency of an air force is in approximately direct proportion to the emphasis that is placed on scientific research in aeronautics, combined of course with engineering development, production, and training.

"What has happened during the past few years that has so greatly increased the relative importance of air power in the national defense programs of nations? Of first importance are the contributions of research laboratories which have so greatly extended the speed, range, and carrying capacity of aircraft. Methods of construction also have



been improved. These have included a trend toward designs of aircraft that would permit of duplicating many of the parts by the use of machinery, and thus has an approach to mass production been made. Although the designs of military aircraft of the different categories and the manufacturing methods employed in the United States have not differed widely from those in Europe, nevertheless in Europe the larger quantities manufactured have accelerated progress toward mass production methods.

"Once a nation has embarked upon a program intended to develop its air strength to maximum effectiveness, the provision of adequate laboratory research facilities and the training of skilled research personnel become of fundamental importance. The major



U. S. Army photo

#### NEW BELL PURSUIT FOR ARMY

One of the fast fighters developed for the U. S. Army Air Corps. It is the P-39, powered by a 2,000 h.p. Allison engine.

European powers at the present time are engaged on relatively large aircraft building programs which are being prosecuted under feverish pressure. Mere numbers of aircraft, however, are not in themselves sufficient for an adequate modern air force. It is of even greater importance that the aircraft be of the most effective design. The advances in aeronautical science are so rapid that assiduous attention to the subject cannot with safety be suspended for even a brief period. Where a few years ago we were pleased with speeds of around 200 miles per hour, we now seek to attain with fully loaded service airplanes speeds of 300 and 400 miles per hour. It is not only good policy from a financial consideration, but also vital from the

standpoint of national defense, that American aircraft have a performance equal or superior to that of a potential enemy. This principle necessitates serious consideration of American aeronautical research and experimental facilities.

"The President and the Congress of the United States have wisely supported what has heretofore been considered a liberal program of scientific research in aeronautics. This program for years was in advance of that of other nations, and the result was that American aircraft, civil and military, have for years had superior performance, efficiency, and safety. In the commercial field, where direct evidence



#### BREWSTER NAVY FIGHTER IN FLIGHT

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

is available, this is proved by the large number of American-built commercial airplanes used by foreign air lines.

"During the past 4 years, however, there has been increasing emphasis on aeronautical research on the part of European powers. They have greatly developed and extended their research facilities. In the rapidly advancing science of aeronautics, research problems increase in number and in difficulty with every material advance in speed, and the importance of prompt solution becomes relatively greater. The Committee's laboratories at Langley Field, Va., are working under

high pressure. The requirements of the Army, the Navy, and the Civil Aeronautics Authority for the immediate solution of pressing problems are being met. But they are met at the expense of interfering with or neglecting the more fundamental scientific long-range investigations that in the end mean much to the advancement of American aeronautics. The Committee, therefore, in October 1938, created a Special Committee on Future Research Facilities. It is expected that its recommendations will be made the subject of a special report to the Congress. In the meantime, the addition to the Committee's research facilities at Langley Field of a structures research laboratory is urgently needed, as hereinafter set forth.

"Remarkable advances continue to be made in the field of com-



U. S. Army photo

#### THE LOCKHEED TWIN-ENGINE PURSUIT

The XP-38, developed for the U. S. Army Air Corps in 1938, was powered with two Allison engines and was reputed to be one of the world's fastest planes.

mercial air transportation, and in this field the United States has for years held a recognized leadership. Although in private flying the progress has not been so rapid, the United States nevertheless has definitely excelled other nations in this field also. These gratifying conditions have been due to a combination of causes. The Civil Aeronautics Authority has provided indispensable assistance in the encouragement and regulation of civil and commercial aviation. The American aircraft industry, with its highly trained technical personnel and excellent manufacturing facilities, has been keenly alert to improve the design and quality of aircraft. The air transport lines have shown commendable initiative and efficiency in operation and

have done their utmost to eliminate accidents and the causes of accidents. The high efficiency and safety of American civil and commercial aircraft are in no small measure due to the fact that the results of the scientific investigations of the Committee are generally applicable to the design of civil and commercial aircraft as well as to military aircraft.

“Although popular attention during the past year has been largely focused on the significance of military aircraft developments, far-sighted and determined efforts are also being made by European nations to extend their commercial and political influence by establishing and extending world trade routes of the air. Service by air lines operating under the American flag to South America and across the Pacific will soon be augmented by regular trans-Atlantic service, and



NEW MARTIN ATTACK BOMBER

This is the Glenn L. Martin 167, powered by two 1,100 h.p. Pratt & Whitney Twin Wasp engines and Curtiss electric full-feathering propellers.

it is expected that there will be inaugurated during the coming year trans-Atlantic service to the Mediterranean area. The British have established a through service by air from England to the Straits Settlements, India, and Australia, with connection to Hong Kong. One significant development in Great Britain is the policy of carrying all first-class mail by airplane throughout the Empire wherever there is air service. This practice is gradually becoming general in European nations. The British, French, and Germans have made test flights preparatory to inaugurating North Atlantic air transport services. In addition, the French are preparing to establish a service across the South Atlantic. The Dutch air transport lines now extend from Holland to Australia. Japan is rapidly expanding its air lines in eastern Asia.

"In the highly competitive field of international air transportation a definite advantage will lie with that nation that has the most efficient aircraft. Continued active support of scientific laboratory research will not only pay large dividends in this field, but is absolutely essential to success.

"The use of private aircraft on a much larger scale in the United States would, of course, be desirable in that it would enlarge the productive capacity of the aircraft industry, create a reservoir of pilots constituting a distinct national asset in the event of war, and



PRODUCTION LINE AT NORTH AMERICAN

O-47 models for the U. S. Army Air Corps under construction at the plant of North American Aviation, Inc.

provide in effect a new industry in the United States with large opportunities for employment. The technical improvement of the instruments of air transportation will be reflected in lower operating costs and in increasing availability for public service. The Committee believes that civil aeronautics will in time prove as revolutionary in the lives of the people as the automobile. To achieve such a contribution to the progress of civilization will require not merely sound economic promotional impetus, such as the good-roads movement gave to the development of the automobile, but it will definitely re-

quire the earnest and serious support of scientific research and encouragement of experimental engineering development that will put into useful form the results of laboratory research."

**"Air Power for Peace"**

On February 18, 1939, Senator Robert R. Reynolds delivered an address, later printed in the Congressional Record, entitled "Air Power for Peace," because, the Senator stated, "I believe that the only way we can guarantee peace for America is to make America first in the air."



U. S. Army photo

**THE CURTISS XP-40**

This new all-metal pursuit, with Allison engine and 11-foot Curtiss constant speed propeller was produced to Air Corps specifications for an interceptor.

Senator Reynolds continued, in part:

"In the past, we have experienced national security largely by reason of the fact that broad oceans on the east and to the west separate us from the rest of the world, and we are bounded by friendly nations to the north and south of the Rio Grande. Under these conditions, to insure our national security, we had then but to build and maintain our Navy as our first line of defense, and maintain our Army as a skeleton force. With the development of aviation, with modern military planes now capable of crossing the widest expanse of ocean, this security will soon be in jeopardy, if in fact, it has not

already become a thing of the past. Our geographic isolation has been destroyed by air power, just as air power has changed the whole defense strategy of other nations.

"Air power has given aggressor nations a weapon with which to threaten death and destruction to peace loving peoples, even though separated by mountains and oceans and rimmed in with fortifications of steel and concrete.

"Air power knows no boundaries and its wings have annihilated time and distance. There is no power on earth which can stop a modern air force when once it has started on a bombardment mission. Anti-aircraft batteries and defense aviation can only minimize its effect. Superior air power in the hands of a nation committed to a



U. S. Army photo

#### THE DOUGLAS B-18 A BOMBER

It is powered by two Wright Cyclone engines as equipment for several Air Corps squadrons.

policy of armed aggression is nothing less than a highpowered rifle aimed at the heart of any nation within its range.

"We are told by our military authorities that there is only one sure protection against the threat of air power, and that is the fear of swift and sure retaliation, with all its attendant horror. No nation will launch its air force against an intended victim if it knows that its own population will be subjected to the same or a worse terror. In other words, no nation will court its own destruction.

"My friends, we in America are reluctant to even consider the possibility of directing our air power against the peoples of other nations, with whom we desire only to live in peace, and toward whom we have established the good-neighbor policy. We hope that

we will never be forced to take such an action, and yet we must prepare to do so to make sure we will never become a victim of aggression.

"Power to defend has always been the greatest power for peace in the world. Peace in America is our greatest responsibility for today and tomorrow. Our power, our wealth, and our influence in the Western Hemisphere emphasize this responsibility, and we cannot escape it. We must not only keep the peace but we must make it impossible, as nearly as it lies within our power to do so, for any nation or group of nations to bring war into this hemisphere. Air power for defense is air power for peace. Air power, and air power alone, can guarantee to keep war out of the western world."



#### THE BOEING TRANSOCEAN LINER

The Boeing 314, Pan American Airways Clipper, in a test flight. Note that one of the Cyclone engines has been stopped.



## CHAPTER II

### THE AMERICAN SCENE

The President's National Defense Message—The Industry's Ability to Double Production—Partial Production in 1938—The Manufacturers Spend Millions in Research—Progress in Air Transportation—Growth of Export Trade.

**G**ROWING concern over threats of war abroad and realization that this nation must be prepared to defend itself in any emergency was translated into official action on January 12, 1939, when the President of the United States sent a special defense message to the Congress. He requested extra defense appropriations of \$552,000,000, of which \$300,000,000 would be spent on additional airplanes for the Army Air Corps and \$21,000,000 on additional Navy planes and tests. Those requested items were in addition to the regular program appropriations which already had been included in the budget. Those parts of the President's message referring to air defense are quoted as follows:

"I repeat that 'there is new range and speed of offense.'"

"Therefore, it has become necessary for every American to restudy present defense against the possibilities of present offense against us.

"Careful examination of the most imperative present needs leads me to recommend the appropriation at this session of the Congress, with as great speed as possible, of approximately \$525,000,000, of which sum approximately \$210,000,000 would be actually spent from the treasury before the end of the fiscal year ending June 30, 1940.

"The survey indicates that of this sum approximately \$450,000,000 should be allocated for new needs of the Army, \$65,000,000 for new needs of the Navy, and \$10,000,000 for training of civilian air pilots.

"The several items will be submitted to the appropriate committees of the Congress by the departments concerned, and I need, therefore, touch only on the major divisions of the total.

"In the case of the Army, information from other nations leads us to believe that there must be a complete revision of our estimates

for aircraft. The Baker Board report of a few years ago is completely out of date. No responsible officer advocates building our air forces up to the total either of planes on hand or of productive capacity equal to the forces of certain other nations. We are thinking in the terms of necessary defenses and the conclusion is inevitable that our existing forces are so utterly inadequate that they must be immediately strengthened.

"It is proposed that \$300,000,000 be appropriated for the purchase



#### VULTEE WITH A BOMB

This Vultee attack bomber is about to take off on a flight to test an 1,100-lb. bomb in order to check the release mechanism.

of several types of airplanes for the Army. This should provide a minimum increase of 3,000 planes, but it is hoped that orders placed on such a large scale will materially reduce the unit cost and actually provide many more planes.

"Military aviation is increasing today at an unprecedented and alarming rate. Increased range, increased speed, increased capacity of airplanes abroad have changed our requirements for defensive avia-

tion. The additional planes recommended will considerably strengthen the air defenses of the continental United States, Alaska, Hawaii, Puerto Rico, and the Canal Zone. If an appropriation bill can be quickly enacted, I suggest that \$50,000,000 of the \$300,000,000 for airplanes be made immediately available, in order to correct the present lag in aircraft production due to idle plants.

"I suggest approximately \$32,000,000 for "educational orders" for the Army—in other words, to enable industry to prepare for quantity production in an emergency, of those military items which are

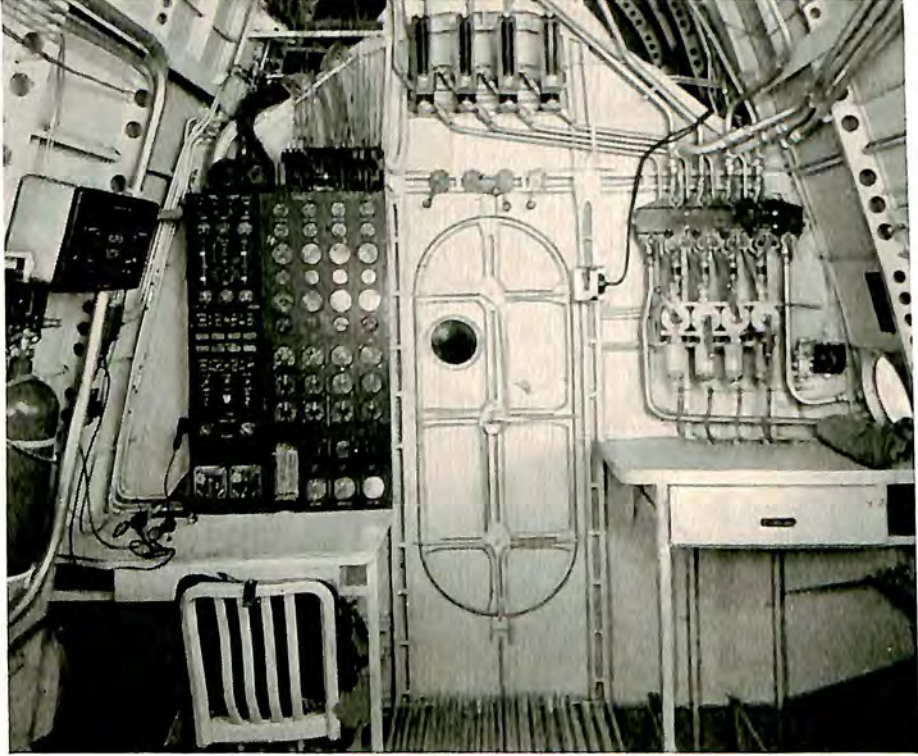


GIANT PRESS AT LOCKHEED PLANT

This hydraulic metal-forming press at the Lockheed factory in Burbank, Calif., weighs 175 tons and exerts a maximum pressure of 2,000 tons.

non-commercial in character and are so difficult of manufacture as to constitute what is known as 'bottlenecks' in the problem of procurement.

"The estimated appropriation of \$65,000,000 for the Navy should be divided into (A) \$44,000,000 for the creation of strengthening of Navy bases in both oceans in general agreement with the report of the special board which has already been submitted to the Congress.



U. S. Navy photo

#### INTERIOR OF SIKORSKY PATROL BOMBER

The mechanics compartment in the Twin Wasp-powered XPBS-1 flying dreadnought for the U. S. Navy.

(B) about \$21,000,000 for additional Navy airplanes and air material tests.

"Finally, national defense calls for the annual training of additional air pilots. This training should be primarily directed to the essential qualifications for civilian flying. In cooperation with educational institutions, it is believed that the expenditure of \$10,000,000 a year will give primary training to approximately 20,000 citizens."

## Industry Could Double Production

At the same time the Aeronautical Chamber of Commerce of America completed a thorough check-up of the industry's manufacturing facilities and productive capacity. It found that the nation's aircraft plants could more than double their current production without increasing factory space. A statement from the Chamber read as follows:

"Our survey shows that the industry can increase its military output more than twofold by hiring more labor and installing



THE BOEING 307 STRATOLINER

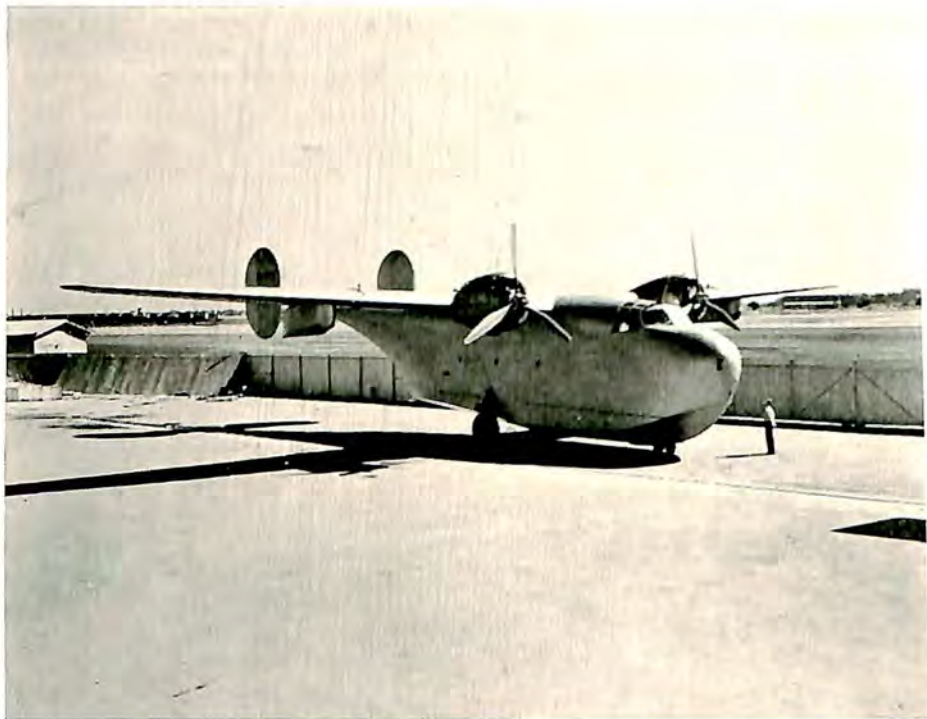
The huge plane, fully loaded, is shown climbing on the power of its two left wing 1,100 h.p. Cyclone engines, with the two right wing engines stopped and their Hamilton Standard hydromatic propellers in "full feathered" position.

machinery to prevent possible bottlenecks in production lines. In 1938 the industry's production aggregated approximately 3,675 planes of all types. Of that production there were 150 transports, 300 private and business planes, 1,425 light planes and about 1,800 military planes, including those produced for export. Yet, contrary to popular belief, the industry is nowhere near capacity production. Some of our important plants have practically no business.

"The 1938 average of 150 military planes a month was stepped

up toward the end of the year. It now averages about 200 military planes a month. If a program demanded 5,500 planes a year, the industry could meet those requirements under the following conditions.

"It is assumed that such a program would be well-coordinated, calling for heavy four-motored bombers, light twin-engine bombers, pursuit planes and both primary and advanced trainers; and further,



#### NEW CONSOLIDATED 31 FLYING BOAT

It is powered by two Wright 2,000 h.p. twin-row Cyclone engines and Hamilton Standard hydromatic full-feathering propellers; and was built by Consolidated Aircraft Corporation, San Diego, Calif.

that the orders would be for types and models which are now in service or already have passed satisfactory service tests.

"Some plants which have produced only commercial planes would be available to participate in such a military program. No important factory expansion would be necessary for either the military or commercial manufacturers, although there might be minor additions in some cases.

"Additional machinery would be necessary to eliminate certain

bottlenecks in the production line. In many instances, however, such machinery is already in storage at the plants; and it could be put in operation immediately. In some few cases the plants would have to buy new machinery.

"At the present time the industry employs about 36,000 wage-earners; and it is estimated that a 5,500 military plane program would raise that total to about 74,000 working in three shifts a day. Experience has shown that about six months would be required for training labor, and eight or nine months for tooling up and jig installation. But this does not mean that six months would be required to start production. Deliveries of most models could start immediately because they already are in production on present orders. As the plants completed their tooling operations, deliveries would increase progressively until at the end of eight or nine months full production would be reached.



U. S. Navy photo

#### NAVY SIKORSKY AMPHIBIONS

Four of the Hornet-powered S-33 ships in Navy service.

"A significant fact developed by the survey is that such a program, contemplating large numbers of planes to be completed in a given time, would be dependent on contract specifications remaining unchanged. Changes in design or engineering specifications always slow up operations; and in a large program they would seriously disrupt the production line.

"Another important item is experienced management, executive and supervisory personnel. There can be no substitute for experience in the manufacture of aircraft. In all cases where outside industries or other groups have been charged with aircraft production programs the result has been delay and waste of funds.

"If the above factors are considered in drawing up a program,

the industry as it is now constituted can provide the defense services with the 5,500 planes as shown by our survey. It also can take care of all replacement requirements, with emphasis on constant improvement through research and development, and at the same time be prepared for the vastly expanded production which would be necessary in the event of war."

#### Partial Production in 1938

Complete production and sales statistics on the airplane and engine manufacturing branches of the industry are not available, because the War Department issued orders against release of such figures after October 31, 1938. The summary for the first 10 months of the year follows:

#### January 1—October 31, 1938

	<i>Production</i>		<i>Deliveries</i>	
	<i>Units</i>	<i>Value</i>	<i>Units</i>	<i>Value</i>
Commercial airplanes .....	1,612	\$ 12,385,759	1,651	\$13,475,971
Military airplanes .....	....	42,429,049	....	42,622,058
Commercial engines .....	3,088	12,197,718	3,094	12,211,701
Military engines .....	....	15,364,969	....	15,424,517
Airplane spare parts .....	....	18,772,711	....	18,772,711
Engine spare parts .....	....	8,718,874	....	8,718,874
Total .....		\$109,869,080		\$111,225,832

The Aeronautical Chamber of Commerce of America, after considerable research, learned that an average of 36,000 employees were hired by the manufacturers of planes and engines in 1938, that their export trade gave employment to about 15,000 shop employees and that 44 cents of the average sales dollar was paid to shop labor. The remaining 56 cents, the Chamber found, was apportioned among office and other employees, management, raw materials, fabricated materials, tools, plant upkeep, repairs, sales promotion, research and development, taxes and depreciation, and profits, if any. The average shop employee in the airplane plants received an annual wage of \$1,550, comparing favorably with similar wages in other industries.

#### Millions Spent in Research

The National Advisory Committee for Aeronautics spent a total of \$6,002,480 on aeronautical research in five fiscal years, 1935-1939, inclusive.

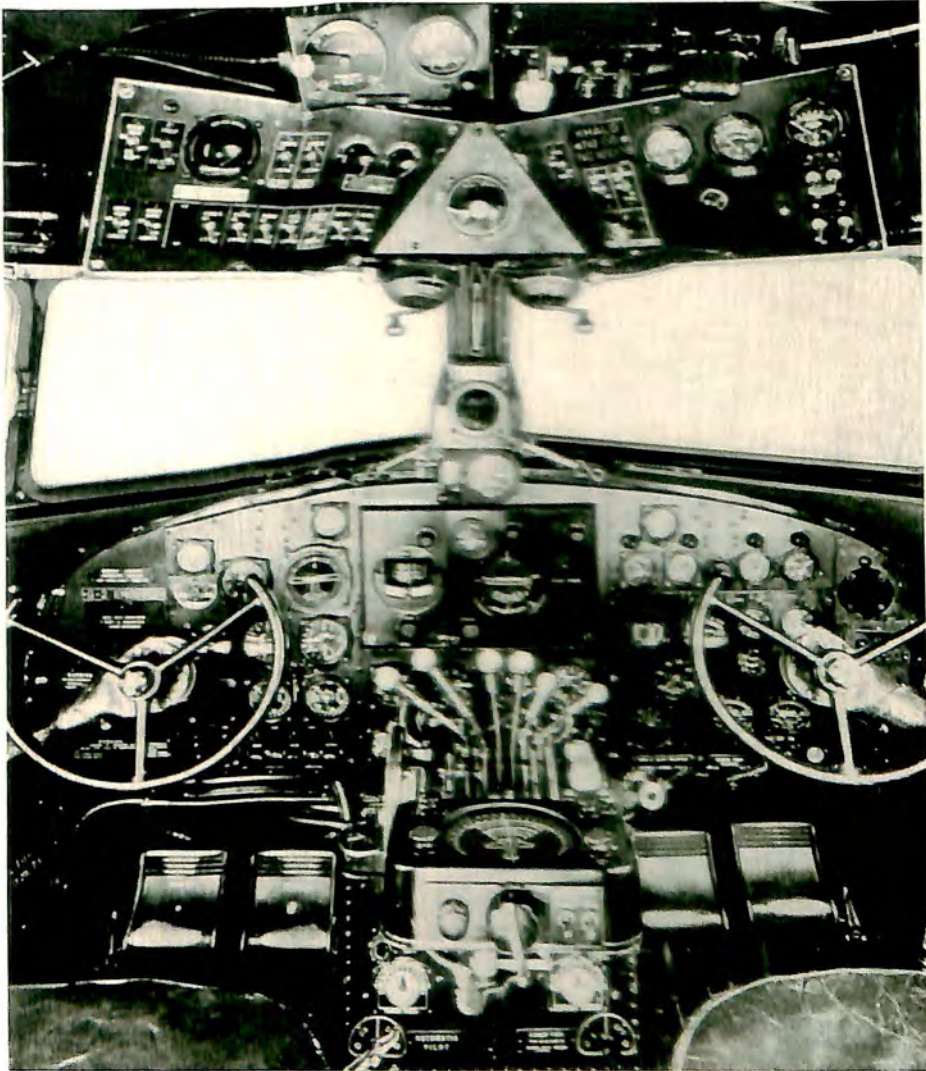
In approximately that same period of time, during the calendar years 1934-1938, inclusive, the airplane, airplane engine and propeller manufacturers of the United States spent \$44,000,000 on research and development work to improve American flying machines.



Those facts were brought out in a survey by the Aeronautical Chamber of Commerce of America.

"That research and development work actually cost the industry 63 per cent more than its net profit for the five year period," the Chamber stated early in 1939, and continued:

"Our survey included the 37 producing airplane, engine and



COCKPIT OF A DOUGLAS SLEEPER

This American Airlines transport is equipped with the new Sperry-R.C.A. automatic direction finder.

propeller manufacturers in the United States. Only five of the companies were not in business for the full period. In that time the manufacturers had gross sales of \$468,000,000. Therefore, the \$44,000,000 spent in developing new equipment represented 9.4 per cent of the industry's gross sales. The aggregate profits, after taxes, amounted to \$27,000,000, or a net of 5.8 per cent. Approximately \$12,000,000 was paid in taxes.

"As a result of the industry's heavy investment in technical development, it has continued to produce airplanes of recognized superiority throughout the world. That is evidenced by the large volume of sales abroad despite the most intense kind of competition from some foreign industries which have been aided by their own Governments with liberal subsidies and credits. Our exports amounted to \$143,000,000. That was 30.6 per cent of the total.

"The survey also revealed that commercial sales inside the United States aggregated \$107,000,000, or 22.8 per cent of the total. From that it will be seen that our combined commercial domestic and export sales amounted to \$250,000,000, or 53.4 per cent of the total. In other words, more than half the industry's business has been outside the military and naval services of the United States."

#### **Progress in Air Transportation**

The air lines of the United States, as explained in the chapter devoted to that subject, continued to make excellent progress in 1938. The domestic lines carried 1,343,427 passengers, as compared to 1,102,707 in 1937. Their express traffic increased from 7,127,369 pounds in 1937 to 7,335,967 pounds in 1938. Air mail over the domestic lines increased from 6,698,230 ton miles in 1937 to 7,422,860 ton miles in 1938. The American-owned lines operating to points abroad and in the territories carried 192,684 passengers in 1938, as compared to 187,028 in 1937.

#### **Air Transport Association's Findings**

The Air Transport Association of America late in 1938 made public significant facts about the air transportation industry. It found that in the average dollar of revenue, 61 per cent came from passenger traffic, 36 per cent from air mail and three per cent from air express. It also found that the Government was receiving back in air mail postage almost as much as it was paying the lines for flying the mails.

For every dollar of revenue, according to the Association, the lines paid out 36 cents in salaries and wages, 12 cents for fuel and oil, seven cents for materials, 15 cents for depreciation, seven cents

for insurance, six cents for advertising, four cents for rent, three cents for taxes and 10 cents for miscellaneous purposes.

The Air Transport Association of America also made a breakdown of the \$24,000,000 annual payroll. It found the average monthly pay to be \$675 for pilots, \$230 for copilots, \$115 for hostesses and stewards, \$150 for overhaul and maintenance crews, \$90 for field and hangar crews, \$240 for dispatchers, \$140 for station personnel, \$175 for meteorologists, \$140 for radio operators, \$130 for traffic personnel and \$110 for office personnel. The Association also



#### GRUMMAN ASSEMBLY LINE

Building U. S. Navy fighters at the plant of the Grumman Aircraft Engineering Corporation, Bethpage, Long Island, N. Y.

pointed out that passenger fares in 10 years had fallen from an average of 11 cents a mile to approximately half that figure in 1938.

#### Growth of Export Trade

Official reports from the Bureau of Foreign and Domestic Commerce show that "total exports of aeronautical products from the United States in 1938 amounted to \$68,209,050, an increase of 73 per cent over 1937. Asia and Oceania took 44 per cent of the dollar volume in 1938, as compared to 33 per cent the previous year. Exports to Latin America represented 19 per cent of the total. Follow-

ing is a comparative statement of total aeronautical exports for the five-year period 1933-37 and for 1938:

	1933-37	<i>Per Cent of Total</i>	1938	<i>Per Cent of Total</i>
Latin America .....	\$ 28,875,300	28	\$12,613,985	19
Europe, Africa and North America	40,362,990	39	25,553,672	37
Asia and Oceania .....	34,442,880	33	30,041,392	44
Total .....	\$103,681,170		\$68,209,050	

Fourteen countries bought our aeronautical products in excess



THE WACO D

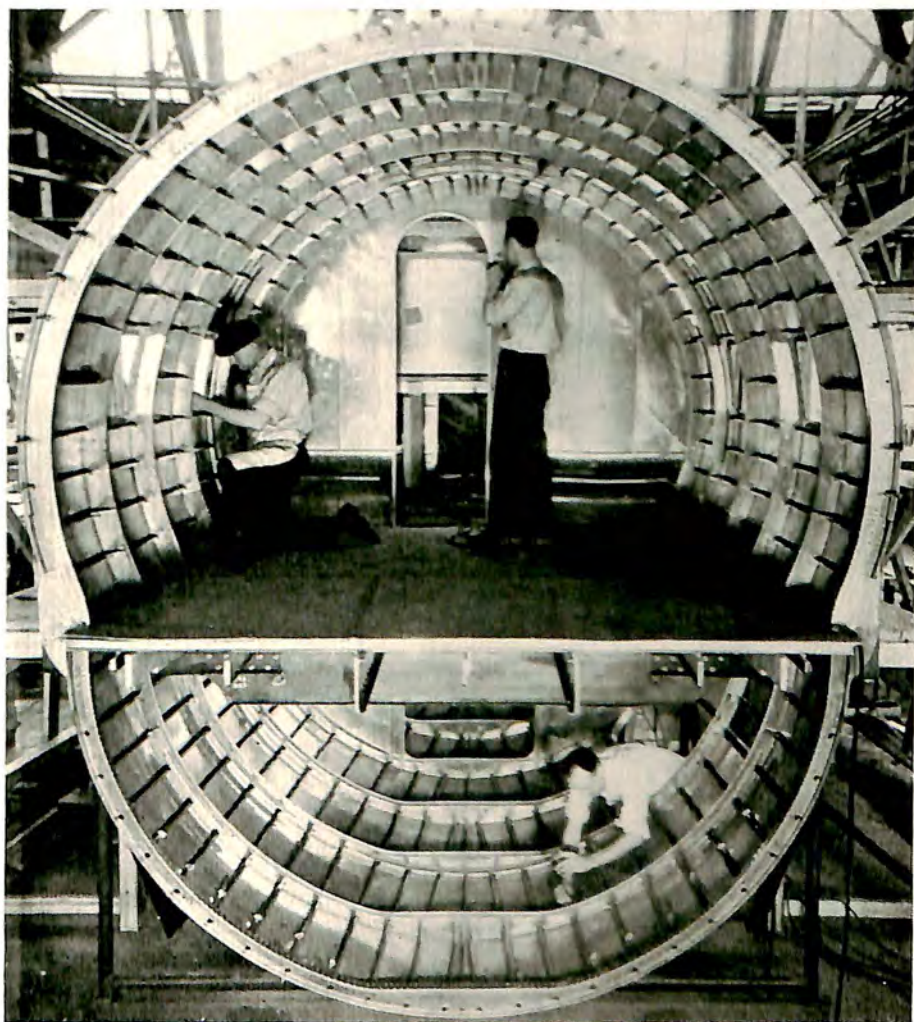
Capt. Cuadra, of the Nicaraguan Air Corps, and one of the Waco D ships delivered in 1938.

of one million dollars; Japan, Netherlands Indies, China, Argentina, Russia, United Kingdom, Canada, Netherlands, Turkey, Brazil, Mexico, Australia, Hong Kong and Sweden. Their combined purchases amounted to \$57,826,100, or 84 per cent of the total exports. Complete export tables will be found in the Appendix.

In view of the tactics employed by some European governments to wrest that trade from Americans the volume of aircraft equipment sold south of the United States was remarkable. Some of the European governments had gone to great lengths in subsidizing aircraft sales to Latin America, enabling their manufacturers to offer

bombers, military trainers, transports and light planes at prices representing only a small fraction of their cost of production. They also tried to dispose of their aircraft on a barter basis; and there were several instances where Latin American governments were invited to buy European airplanes in exchange for minerals or commodities.

In selling planes in Latin America the Europeans extended very



#### SPECIAL HOLD FOR CARGO IN CURTISS-WRIGHT CW-20

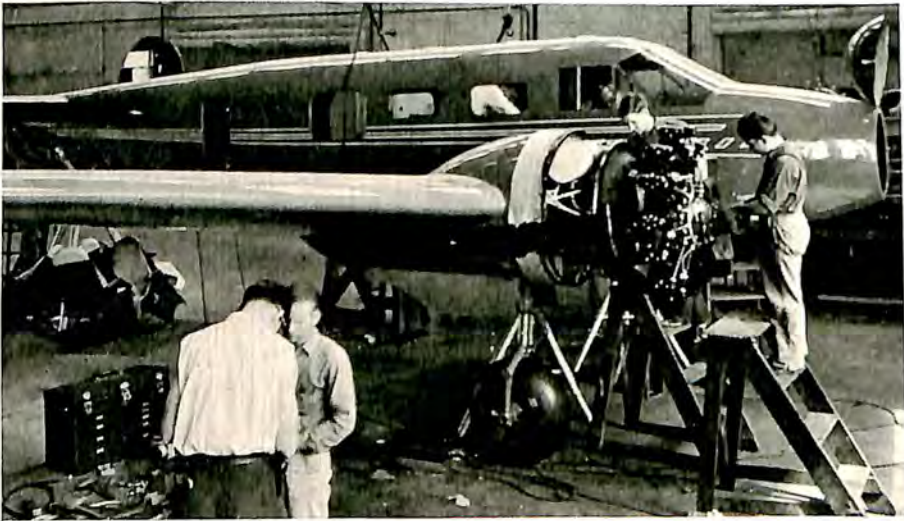
This unusual photo of the elliptical-shaped cross-section of the fuselage of the new Curtiss-Wright CW-20 transport shows the upper section which will serve as a passenger cabin, and the lower section which will accommodate mail, express and miscellaneous cargo. Marking a departure from the customary cargo bins, this compartment will be heated.

long term credits, Germany and Italy allowing five years. The European system also included interchange of official and semi-official aviation missions, including instruction groups. European instructors on several occasions were known to bar their students from flying in American equipment.

#### Air Transport Association

The Air Transport Association of America during 1938 cooperated with the Bureau of Air Commerce and the Civil Aeronautics Authority toward revision and simplification of the Civil Air Regulations.

Engineering and maintenance conferences of the Association were held at Dallas and Chicago where a combined total of 300 air line



FINAL ASSEMBLY, BEECHCRAFT 18

One of the products of the Beech Aircraft Corporation, Wichita, Kans.

engineers, maintenance superintendents, engineering representatives of aircraft manufacturers and the Army and Navy exchanged technical knowledge and laid plans for the future. Late in 1938, the Air Traffic Conference of America was formed as a division of the Association, with M. F. Redfern as executive secretary. This division functioned in a similar manner to oceanic steamship conferences in respect to agents and sales policies.

The operations committee and its sub-committees held 18 meetings last year on uniform power output for cruising speeds with engines of a particular type, weather forecasting, traffic rules and the standardization of flight forms. The Association also represented all domestic

and American-operated international air lines flying regular schedules in 1938.

#### Institute of the Aeronautical Sciences

The Institute of the Aeronautical Sciences, six years old in October, 1938, had 27 student branches in universities and colleges and five sectional branches in Philadelphia, Chicago, Los Angeles, San Francisco and Seattle. At its annual meeting in New York January

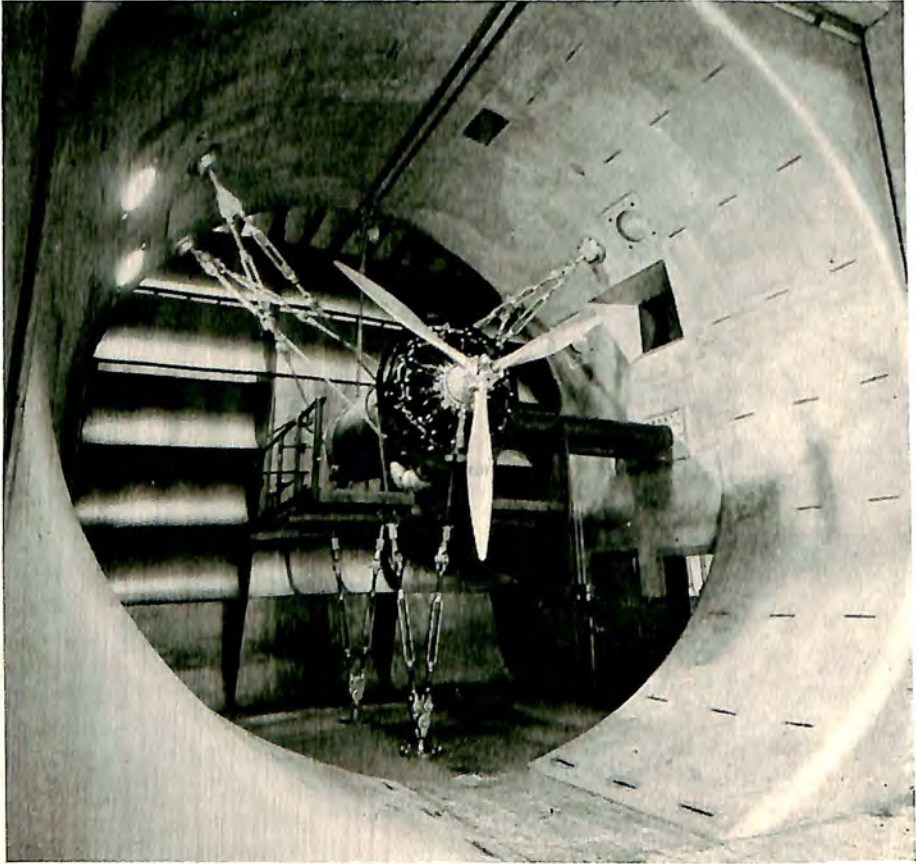


NOSE OF THE STINSON 105

The horizontally opposed 75 h.p. Continental or Lycoming engines make possible this new design. The propeller is a Sensenich, of wood, 76 inches in diameter.

25-27, 1939, the Institute held technical sessions for three days, during which 40 scientific papers were read and discussed. The following honors were conferred by the Institute on January 27, 1939: Honorary Fellowship to Dr. D. R. Pye and George J. Mead; Fellowship to Henry A. Berliner, Dr. W. G. Brombacher, C. S. Draper, Major Lester D. Gardner, Comdr. R. D. MacCart, Dr. W. Bailey Oswald, Prof. Elliott G. Reid, Elmer A. Sperry, Jr., Prof. Edward S. Taylor and Prof. John E. Younger; Honorary Membership to

Maj. Gen. H. H. Arnold, Chief of the Air Corps, War Department; Adolf Baeumker, Executive President, Lilienthal-Gesellschaft für Luftfahrtforschung; Dr. Lyman J. Briggs, Director of the National Bureau of Standards; Rear Admiral A. B. Cook, Chief of the Bureau of Aeronautics, Navy Department; Harry F. Guggenheim; Dr. George W. Lewis, Director of Research, National Advisory Com-



#### PRATT & WHITNEY'S NEW TEST CHAMBER

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

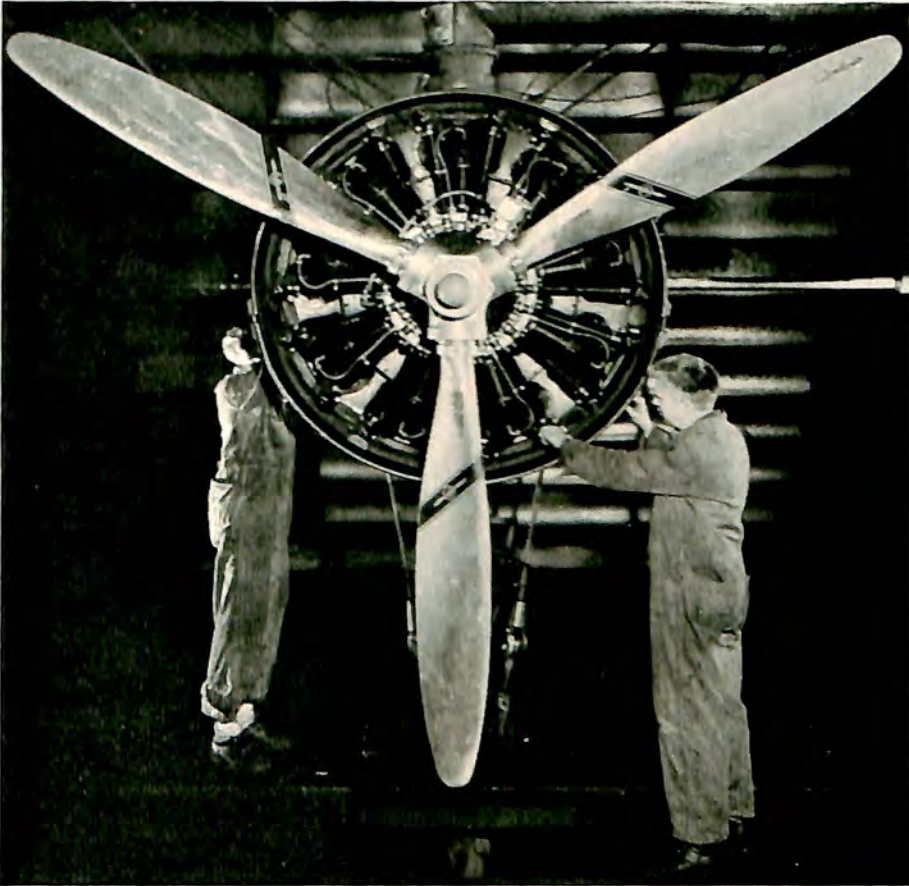
mittee for Aeronautics; Edward J. Noble, Asst. Secretary Department of Commerce; Prof. George B. Pegram, Professor of Physics, Columbia University; Comdr. F. W. Reichelderfer, Chief of the U. S. Weather Bureau, and A. H. R. Fedden, President, Royal Aeronautical Society. Seventy Foreign Fellows were also elected.

The Sylvanus Albert Reed Award for 1938 was awarded to A. V.



de Forest of the Massachusetts Institute of Technology "for the development of a method generally used by the aircraft industry for testing metals magnetically." The Lawrence Sperry Award for 1938 was awarded to Russell C. Newhouse of the Bell Telephone Laboratories "for the development and first practical application of the terrain clearance indicator."

During 1938 the Aeronautical Index compiled by the W. P. A.



#### WRIGHT AERONAUTICAL ENGINE TEST

Engineers make final adjustments on a Cyclone engine in one of the new experimental test cells at the Wright Aeronautical Corporation plant at Paterson, N. J.

under the supervision of the Institute published and distributed technical bibliographies on 28 subjects.

During the year the Institute participated in the aeronautical sessions at the Annual Meeting of the American Association for the

Advancement of Science held in Ottawa, Canada, the aeronautical sessions of the Fifth International Congress for Applied Mechanics held in Cambridge, Mass., repetition of some phases of the Fifth International Congress of Applied Mechanics, including additional aeronautical sessions in Los Angeles; the Rotary-Wing Aircraft Meetings in Philadelphia; and an air transport meeting held in Chicago.

The second Wright Brothers lecture, held under the auspices of the Institute on December 17, 1938, at Columbia University in New York, was given by Dr. Hugh L. Dryden, Chief of the Mechanics and Sound Division of the National Bureau of Standards, on the subject of "Turbulence and the Boundary Layer." On this date also, the Institute inaugurated a series of illustrated lectures to be given simultaneously at all branches once each month for 10 months of the year. The second Wright Brothers lecture was chosen as the first of this series, and was also given simultaneously with the original in New York at the 32 Branches of the Institute.

#### **The Manufacturers Aircraft Association**

The Manufacturers Aircraft Association, Inc., New York, administering the cross-license agreements relating to aircraft patents, reported that members had acquired 64 new patents in 1938; and it was estimated that more than 90 per cent of sales volume of planes manufactured in the United States were licensed under the 953 aircraft patents owned or controlled by members of the Association.

As in other years, the primary objective of the cross-license plan, namely the prevention of wasteful patent litigation within the industry, was attained, no suits for patent infringement having been filed under any of the patents coming within the operation of the cross-license agreement. The contract relationship between the Association and the United States Government, which enables the War and Navy Departments to obtain licenses on the same terms as members of the Association, was also continued throughout the year.

As a necessary adjunct to the administration of the cross-license agreement and also in order to supplement the other services rendered to members, the Association has had the foresight to acquire throughout the past 20 years, and now maintains, a private library devoted to engineering research and technical developments in the field of aeronautics. This library is acknowledged to be second to no other source of such information at present in existence, with the possible exception of the Library of Congress in Washington, which has now duplicated much of the material previously accumulated by the Association. In addition, a complete file of the aircraft patents

issued in the United States, as well as in Great Britain, France and Germany is maintained by the Association, including an independent classification and indexing system, which is not only unique from the point of view of research in the patented art, but is peculiarly adapted to the needs of the members and has resulted in a facility of great value and lasting usefulness.

During the early years, although it was recognized throughout the industry that the facilities of the Association might be utilized to advantage in connection with the development of worthwhile inventions, and to obtain the protection afforded by patents and recognition of design rights, little was actually accomplished in this direction until the formation of the Patent Research Division shortly after the adoption of the Amended Cross-License Agreement. Since that date, however, the services rendered by this Division have been



VULTEE V11-GB ATTACK BOMBER

One of a fleet built for Brazil, this Vultee is powered by a 900 h.p. Cyclone engine.

developed and expanded until it now comprises one of the most important functions of the Association. The publication of a comprehensive Digest of all current American and British aircraft patents, including abstracts of the specifications and official drawings, keeps members informed regarding patented developments in the United States and foreign countries.

The Patent Research Division also advises members of the Association insofar as practicable regarding the trend of technical development in this and other countries, with a view to minimizing infringement claims, and as a basis for the possible acquisition of patents, licenses and design rights. The facilities of the Division are also made available for use in connection with the preparation and filing of patent applications on inventions which would otherwise be the subject of abandonment by member companies but may eventu-

ally have considerable value to the membership from a defense standpoint, with the result that wasteful patent litigation has been largely avoided and advancement of the art has been encouraged by making the important technical progress available to all aircraft manufacturers in this country.

In addition to the services rendered by the Patent Research Division, as above outlined, the offices of the Association have also provided a facility for maintaining relations with non-member patent owners. Submissions of outstanding developments by all inventors in the field of aviation are given careful consideration and may be called to the attention of the membership, or kept on file so as to be readily available in case of inquiry. Some inventors feel disposed to



THE BREWSTER PLANT

Factory of the Brewster Aeronautical Corporation in Long Island City, New York.

file complete data such as blueprints, photographs, and experimental and test records in regard to their patented inventions, so as to be assured that the Association members have some indication of the real nature of constructive improvements which are offered for purchase or license. It is likewise of advantage from the same point of view that the Association be advised of terms which would be acceptable to the respective patentees. At the same time, no submission of a confidential nature is solicited or received from others than members of the Association.

A further important service rendered in connection with non-member patent owners has been the substitution of friendly arbitra-

tion proceedings for costly court litigation. A license was negotiated for the benefit of members of the Association under a group of 56 patents, owned by a foreign patentee, under which the several differences of opinion between the parties were settled satisfactorily through the use of the arbitration method which has been developed by the Association. Hence, as in the case of the elimination of patent litigation between members as a result of the operation of the cross-license agreement, the Association has also succeeded in establishing



NOSE OF THE DOUGLAS DC-4

Details of the huge four-engine transport showing mechanism of the nose wheel.

a somewhat similar situation as regards the relationship with non-member patent owners who wish to make worthwhile inventions available to the aircraft industry.

By continuing to make important technical progress available to all manufacturers, the Association has encouraged engineering development and research in this country until the premiere position now held in world leadership has been reached without interference from wasteful litigation or hardship due to any monopolistic tendency within the aircraft industry. Membership in the Association has never been restricted in any respect, no qualified applicant has ever been refused the right to acquire licenses under the terms of the agree-



#### VOUGHTS IN THE ARGENTINE

One of the Vought V-142, Twin Wasp Junior-powered planes of the Argentine Navy landing in the street near a dock in Buenos Aires.

ment, and there have never been any withdrawals from the Association except in the case of companies which either have gone out of business or have ceased the manufacture of aircraft.

There has been no price-fixing, no regulation or control of markets, nor any other restriction in regard to the sale of products. Patents of lesser consequence which might have been grouped for the purpose of controlling certain aspects of the manufacturing processes have been licensed free of charge. Inventions of a more basic character which otherwise might have been held by individual companies to dominate the industry or withheld for the purpose of preventing competition, have been made available at rates of royalty which

have permitted unlimited use by every member of the Association of all inventions coming within the operation of the agreement.

#### National Aeronautic Association

The National Aeronautic Association at its annual convention early in 1938 adopted a broad aviation program, most of which was achieved. It saw the formation of the Civil Aeronautics Authority which the Association had urged through its chapters and officials. Adequate air defense for the United States was promoted by mobilizing public opinion through the use of facts concerning foreign aviation progress and defects proved in American methods. A Federal airport survey was advocated, with the Association's platform largely incorporated in that part of the Civil Aeronautics Act.

The Association continued its policy of publicizing what it con-



#### NORTH AMERICAN ATTACK BOMBER

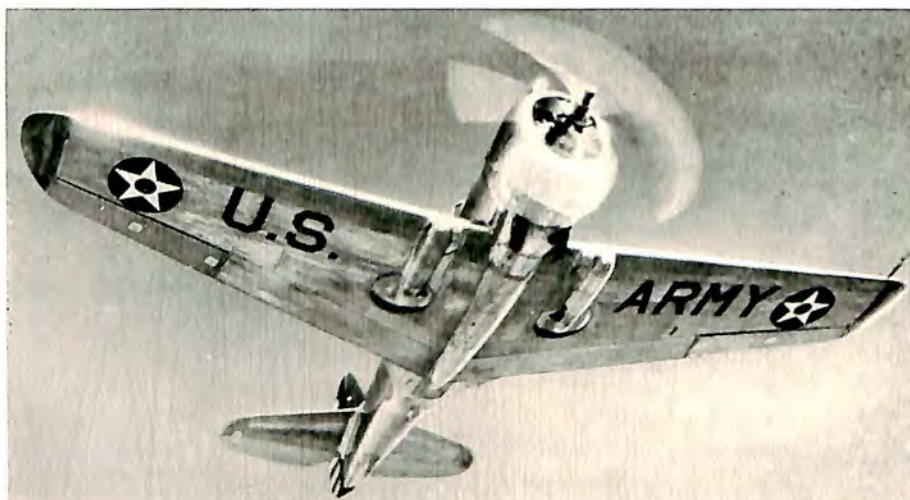
It is powered by two Wright Cyclone 1,350 h.p. engines, has a three-wheel landing gear and carries a crew of three.

sidered the inadequacy of appropriations for Federal research and experimentation in aeronautics. It opposed mandatory aviation insurance as being premature. As the American member of the Federation Aeronautique Internationale, the Association homologated all national and international record flights, and sanctioned all official flying meets and record attempts.

The National Aeronautic Association continued its work in coordinating other aviation groups, with an aviation program adopted by the First National Planning Conference encompassing 52 points presented to all participating organizations. In private flying the Association pushed toward its objectives which included a program incorporated into the Civil Aeronautics Act. The educational program for the nation's youth was carried on with the junior membership quadrupled and organization of the gas model division completed.

The military services asked the Association to recommend a limited number of outstanding aviation meets at which Army and Navy personnel could participate. The Association also worked in close cooperation with the Air Reserve Association and urged the formation of a bureau for administration of reserve operations to encourage a more effective force.

In 1938, the National Aeronautic Association had 283 senior and junior chapters located in cities throughout the country, and its membership, senior and junior, totalled 16,110.



U. S. Army photo

#### THE CURTISS P-36-A PURSUIT

One of an order of 310 which the Curtiss Aeroplane Division of the Curtiss-Wright Corporation began delivering to the U. S. Army Air Corps in 1938. It is powered by a Pratt & Whitney Twin Wasp engine.



## CHAPTER III

### THE ARMY AIR CORPS

Importance of the GHQ Air Force—Secretary Woodring's Report—Assistant Secretary Johnson's Comments—Major General Arnold Becomes Chief of the Air Corps—Strength of the Army's Air Forces—Plans for Expansion—Achievements During the Year.

**O**RDERLY expansion of the Army Air Corps to meet the demands of the changing international situation was made possible by utilizing the General Headquarters Air Force as a tried and tested framework, Secretary of War Harry H. Woodring indicated in his annual report for 1938. The year, he said, has brought further proof of the efficiency of this organization.

"I must not leave the impression that only in matters pertaining to personnel has the Army's efficiency been promoted," the Secretary reported. "There has been provided a powerful defensive arm in the form of the General Headquarters Air Force. In creating this extremely important arm, it was necessary to do more than merely procure increased numbers of airplanes. A balanced air force had to be established—balanced in personnel, ground installations, training, and supplies. In the gradual development of this air force we constantly strove to keep abreast of rapid development of aviation equipment and technique and simultaneously to provide military aircraft of unexcelled quality. Considering our initial deficiencies, it is my opinion that we have builded wisely and well in developing our General Headquarters Air Force. The efficiency attained by that force in the few short years of its history is a most noteworthy achievement. We have a substantial framework for the extension which now appears essential."

From the standpoint of our air defense, the Secretary indicated in his report, the most important lesson for the United States in connection with recent foreign developments is that they have ex-

ceeded our own efforts, not only as regards the numerical production of military aircraft, but also in technical superiority.

As a result of this development abroad, the War Department during 1938 began studies looking toward American development to keep abreast of the world trend. These studies reached a climax when President Roosevelt ordered that detailed preparations be undertaken with a view to framing a program to meet American needs. This work was well under way before the end of 1938, in anticipation of a 1939 expansion program which would greatly extend the Air Corps development begun under terms of the Baker Board report four years ago. As a result of this report, action was initiated to



#### EXPANSION OF PLANT FACILITIES

View of the Glenn L. Martin Company's plant near Baltimore, Md., with new building under construction.

attain, by June 30, 1940, a balanced Army Air Corps of 2,320 modern, serviceable airplanes, a proper complement of personnel, and to provide an adequate number of properly equipped bases from which to operate.

"In my report last year," Assistant Secretary of War Louis Johnson said in his 1938 annual report, "I pointed out that the aircraft procurement policy inaugurated in 1934, providing for the acquisition of aircraft in quantity only as a result of competitive bidding, was functioning satisfactorily and that the combat airplanes under construction as a result were in general the best and most efficient airplanes in the world. Now, however, our former technical superiority in aeronautical development is no longer clearly apparent.

Recent advances in other countries have equaled if not exceeded our efforts. We have known for some time that foreign nations far surpassed us in the number of military aircraft at their disposal but we also knew that we led the field technically. It now appears that our research and development programs must be accelerated if we are to regain our position of technical leadership.

"It appears further, and this, it seems to me, is an aspect of our defensive situation that must be faced, that our current construction program as well as our existing war-time procurement program for aircraft both fall short of providing even the minimum amount of this essential item which any realistic view of the problem will show as necessary. The same remark holds true to an even greater degree



U. S. Army photo

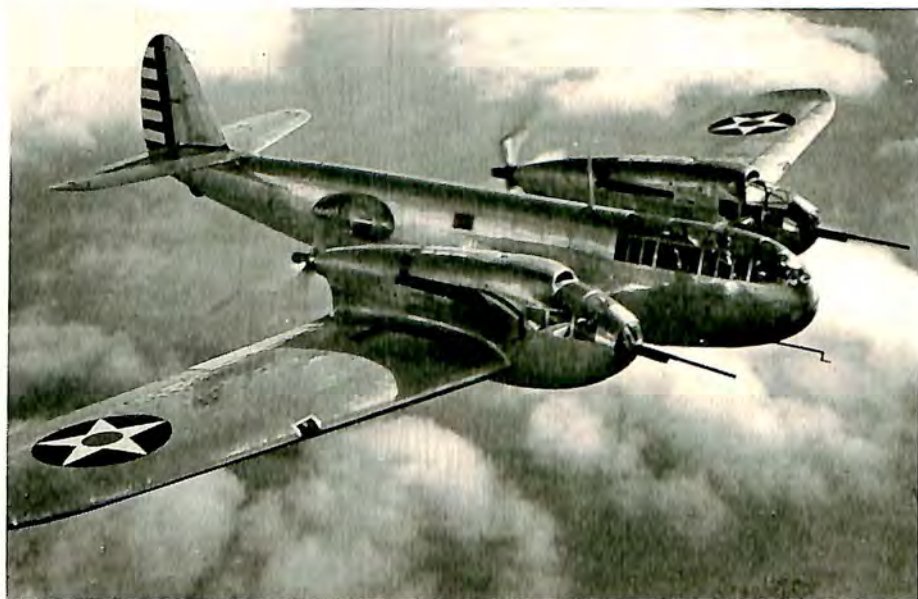
#### SEVERSKY P-35 PURSUITS

Army Air Corps flight of the Seversky pursuits which are powered by Pratt & Whitney Twin Wasp engines.

with respect to anti-aircraft material. In my opinion the people of the United States must be awakened to a realization of their weakness in the matter of defense against hostile aircraft and they must be convinced that, if adequate protection is to be provided, they must spend money for the purpose. Anyone acquainted with the facts, who considers the bombing activity which has characterized operations in Spain and China, must stand aghast at a contemplation of the havoc which a hostile bombing attack could and, in the event of war, doubtless would, wreak on our unprotected cities."

Great progress was made during 1938 toward the attainment by the Air Corps of the Baker Board objective. Funds provided in the fiscal year were expected to permit the completion of this objective.

Discussing the procurement of airplanes in connection with the Baker Board program, General Malin Craig, Chief of Staff, in his annual report, said: "The Air Corps is now being equipped with airplanes and materiel that are equal, if not superior, to any military planes in design, speed, endurance and suitability for the military use for which intended. This was convincingly demonstrated in February, 1939, by the record-breaking flight to Argentina by six United States Army bombers of the Second Bombardment Group, to participate in the inaugural ceremonies at Buenos Aires. These airplanes with normal crews, equipment, and training, gave a demonstration of



BELL AIRACUDA IN FLIGHT

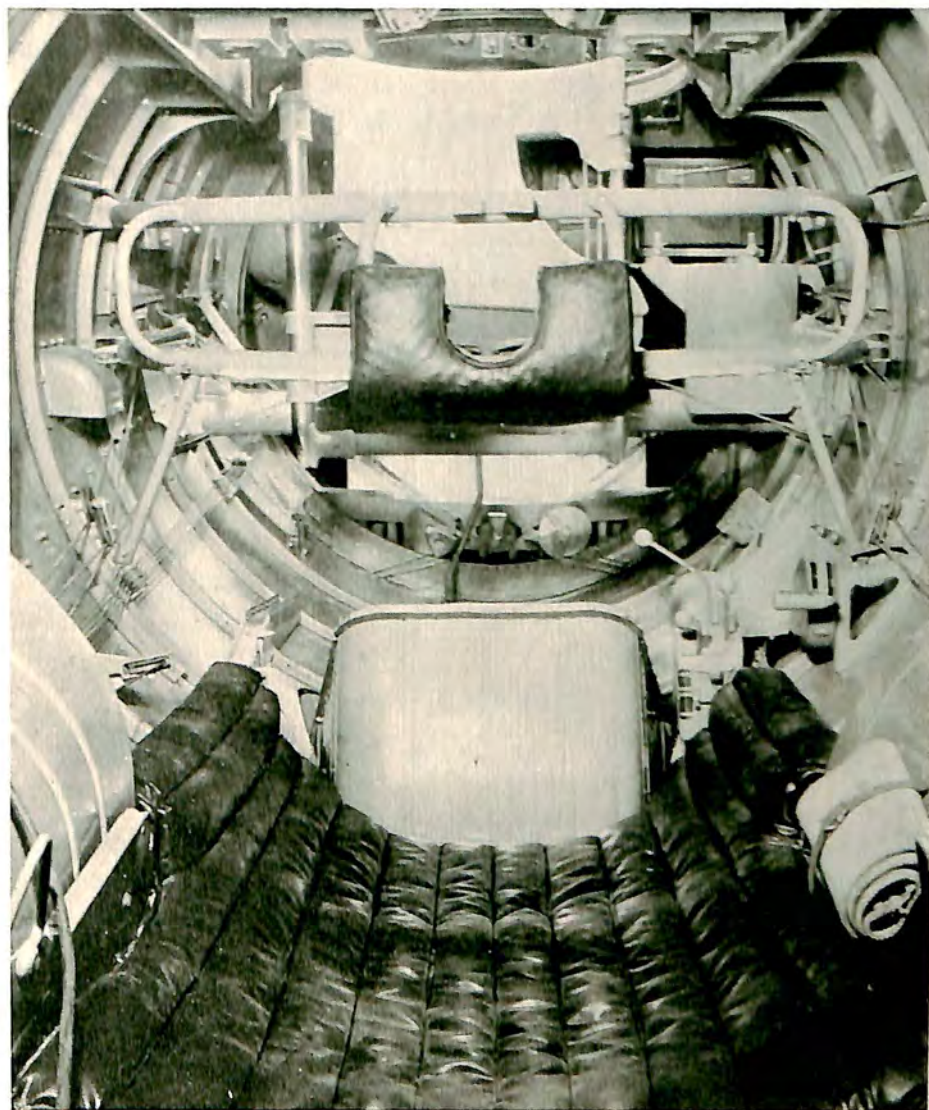
U. S. Army photo

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

speed, range and navigation accuracy unexcelled by any military planes in the world."

Just before the end of the year, leadership of the Army Air Corps, as a result of the unfortunate death of Major General Oscar Westover, passed to Major General Henry H. Arnold, a veteran of nearly 30 years of military flying service. He received his first flying instruction from the Wright brothers. General Arnold was appointed Chief of the Air Corps for a period of four years, beginning September 29, 1938, and assumed the duties of that office the following day.

On the same day, Colonel Walter G. Kilner, Chief of Staff of the General Headquarters Air Force, was appointed Assistant to the Chief of the Air Corps, with the rank of Brigadier General, for a four year period. In 1939 Colonel Barton K. Yount was also made



#### BOMBARDIER'S NEST IN A VULTEE

Looking forward from the compartment which is near the tail of a Vultee attack bomber. In action the bombardier lowers the bomb sight door (in center) and then lies face down, sighting his target through the glass window in the bottom of the door.

Assistant Chief with the rank of Brigadier-General. The oft-demonstrated ability of those officers, combined with their great popularity both in and outside the military service, made their appointment to their respective posts particularly opportune as the Air Corps was about to embark on an expansion program unparalleled in times of peace.

Following are figures from the annual report of the Secretary of War for the fiscal year 1938.

Aggregate strength of the Air Corps on June 30, 1938:

	<i>Officers</i>	<i>Enlisted Men</i>	<i>Total</i>
1 headquarters and headquarters squadron, GHQ Air Force..	30	124	154
3 wing headquarters and headquarters squadrons.....	27	229	256
2 wing headquarters.....	11	31	42
4 air base squadrons.....	27	1,034	1,061
15 base headquarters and air base squadrons.....	210	5,143	5,353
16 group headquarters.....	108	1,005	1,113
81 squadrons.....	394	9,193	9,587
Detachments (miscellaneous).....	480	2,150	2,630
Total.....	1,287	18,909	20,196

Strength of the Officers Reserve Corps, Air Corps Section, on June 30, 1938:

Colonel .....	10
Lieut. Colonel .....	43
Major .....	228
Captain .....	531
First Lieutenant .....	1,008
Second Lieutenant .....	981
Total .....	2,801

Strength of the Enlisted Reserve Corps, Air Corps Section, on June 30, 1938:

Master Sergeant .....	12
1st and Technical Sergeant .....	4
Staff Sergeant .....	11
Corporal .....	14
Private 1st Class .....	8
Private .....	339
Total .....	402

On January 5, 1939, the War Department announced the principal provisions of its estimated appropriations for the fiscal year 1940; and the Air Corps paragraphs are quoted here:

"The increase over the present strength . . . [includes] 117 second lieutenants for the Air Corps.

"Direct charges for aviation materiel and training for the Regular Army, the National Guard and the Organized Reserves amount to \$105,793,314; in the current year the amount is \$103,722,161. Considering the indirect charges such as pay, clothing, rations, housing and transportation, it is estimated that approximately \$133,000,000 goes to the support of aviation.

"The quota of 2,320 airplanes fixed by the Baker Board will be



U. S. Army photo

#### THE CURTISS YP-37

One of the new pursuit planes of the U. S. Army Air Corps delivered in 1938. It is powered by an Allison engine with Curtiss electric full-feathering propeller and General Electric supercharger.

reached with 1939 appropriations. The present program calls for the procurement of approximately 390 airplanes from appropriations for the current year and 219 are provided for in the estimates for 1940. For the purchase of airplanes for the Regular Army in fiscal year 1940, \$20,340,700 will be available. In the current year [f.y. 1939] \$33,150,646 has been provided for this purpose."

During the fiscal year 1938, rated pilots and students at Randolph Field, Texas, flew the unusual total of 105,912 hours, exceeding totals for the two preceding years by approximately 33,000 flying hours. A total of 341 students were selected for appointment as Flying Cadets to enter the July 1, 1938, Class at the Air Corps Primary Flying School, Randolph Field. This was the largest number of students ever to begin training in any class in the history of the

Air Corps Training Center. Graduation exercises for Class 38-C were held at the Air Corps Advanced Flying School on October 5, 1938. The class consisted of 64 Regular Army officers and 80 Flying Cadets and was the largest graduating class in the history of the Training Center.

The Departments of Photography and Armament were moved from the Air Corps Technical School, Chanute Field, Ill., to Lowry Field, Denver, Colo., establishing a new branch of the school and making possible future expansion to care for training of increased numbers of Air Corps mechanics and technicians in case of emergency.

The Collier Trophy for 1937 was awarded to the Army Air



U. S. Army photo

#### THE KELLETT AUTOGIRO

A two-place wingless giro plane powered by a Jacobs engine. Several machines were delivered to the Army Air Corps.

Corps for successful accomplishment in high altitude flying by the pressure cabin method. The Air Corps used a special Lockheed plane. The presentation was made to General Arnold by the President at the White House September 16, 1938. The citation accompanying the award reads:

“To the United States Army Air Corps for having designed, supervised the construction of and completely equipped the XC-35 [Lockheed] substratosphere plane, the first pressure cabin airplane to be extensively flown successfully anywhere in the world.”



Major Carl F. Greene, Captain Alfred H. Johnson and Lieut. Colonel Oliver P. Echols, Air Corps, and Dr. John E. Younger were cited as the principals in the research and development work which resulted in the award.

The Mackay Trophy was awarded to Captains Carl J. Crane and George V. Holloman, Air Corps, for their outstanding achieve-



A STEARMAN IN FLIGHT

One of the Lycoming-powered trainers in Air Corps service.

ment in successfully developing and actually demonstrating the airplane automatic landing system, the gold medals emblematic of the Trophy being presented to these officers by Secretary Woodring October 14, 1938.

The Harmon Trophy for the highest combat squadron efficiency

in the 3rd Wing, GHQ Air Force, was awarded to the 79th Pursuit Squadron, 20th Pursuit Group, at Barksdale Field, Shreveport, La.

The 19th Bombardment Group, in recognition of its record of 10,942 hours of flying, during which only one minor accident occurred, was awarded both the new Daedalian Trophy and the Colombian Trophy, a gift to the Army Air Corps by the Colombian Government. The Group in capturing these two awards flew during the preceding year more hours per airplane than any other organization in the GHQ Air Force or in the entire Air Corps.

Distinguished Flying Crosses were presented during the year to Second Lieutenant Dross Ellis, Air Reserve; Second Lieutenant Homer A. Boushey, Air Corps; First Lieutenant B. S. Kelsey, Air Corps, and Lieutenant-Colonel Robert Olds, Air Corps. The award to Colonel Olds was made in recognition of his leadership of the Buenos Aires flight; the other three for heroism displayed in con-



U. S. Army photo

ARMY SIKORSKY S-43 AMPHIBION

It is powered by two Pratt & Whitney Hornet engines.

nection with flying accidents. The Frank Luke Memorial Trophy was awarded for the second consecutive year to the 77th Pursuit Squadron, Barksdale Field, for the highest score of the year in aerial gunnery.

The increasingly high standards of training and efficiency of units of the GHQ Air Force were demonstrated in connection with exercises and maneuvers during the year.

The 2nd Wing, GHQ Air Force, concentrated in Florida during the period March 14-31 for annual field exercises, the area involved embracing central and north Florida. One of the primary objects was to test the new aircraft with which the Wing was equipped. An intensive study was made of the comparative performance of new and old aircraft at all altitudes and under all possible conditions.

During the month of March, the 5th Bombardment Group, Ha-

waiian Department, participated with the United States Navy in joint maneuvers which resulted in a considerable amount of valuable information concerning the defense of the islands.

Large-scale GHQ Air Force maneuvers were held in New England during May, the tactical mission involving the theoretical defense of the Northeastern section of the United States against attack by a coalition of European powers, while the Navy was engaged in the Pacific. Nineteen temporary air bases were utilized and 2,285 airplane hours were flown, involving 340,254 miles. Three provisional transport squadrons were utilized in transporting officers and men. Extensive tests of new portable field equipment were made. Interesting incidents of the maneuvers were the interception of the Italian liner "Rex" 750 miles at sea by a reconnaissance flight of three B-17 Flying Fortress bombers, and the "blackout" of Farmingdale, L. I., during an air raid drill.

The interception of the liner "Rex" was made after four hours



THE SEVERSKY EP-1 PURSUIT

It is powered by a 950 h.p. Pratt & Whitney Twin Wasp engine and a Hamilton Standard constant speed propeller.

of flying through line squalls and wind shifts which made navigation a difficult problem. After circling the steamer, the bombers returned to Mitchel Field on schedule, despite the adverse weather conditions. This flight was but one of a number of similar interceptions worked out during the year. The transport, "Republic", given a 20-hour start out of Honolulu on July 18, was intercepted 285 miles at sea by bombardment squadrons of the 5th Group, Luke Field. Again on September 29, the 5th Group intercepted the "Republic", 24 hours out of Honolulu, 329 miles from Oahu.

The 23rd Bombardment Squadron, Hickam Field, Hawaii, on August 11, flew a mission 550 miles to sea, at an average speed of 204 miles per hour.

Joint Anti-aircraft-Air Corps field exercises were held during October in Eastern North Carolina, with the principal bases at Fort

Bragg and vicinity. The exercise involved concentration of a major part of the Regular Army anti-aircraft artillery in the United States. Civilian aid was enlisted on a large scale in the installation of an extensive aircraft warning net extending from the Atlantic coast line to Fort Bragg. The net was found to function very efficiently in providing warning for the defense area of the approach of any hostile aircraft, permitting pursuit interception and the altering of the anti-aircraft artillery. Many missions were flown, day and night, by participating bombardment and attack units assigned to the attacking force, and by defending pursuit squadrons. Many bombardment and reconnaissance missions were flown at high altitudes.

During the disastrous flood in Southern California early in March,



VULTEE ARMY ATTACK BOMBER

One of the YA-19 all-metal attack planes built for the U. S. Army Air Corps. They are powered by Pratt & Whitney Twin Wasp engines.

Air Corps personnel aided in rescue work and performed a number of photographic and relief missions. Constant patrols were flown over the flooded sections, permitting the directing and facilitating of rescue work by means of radio communication, the dropping of food to people in marooned communities and towns, the gathering of accurate reports of conditions, and the directing of outside help. The 17th Attack Group flew 37 missions—14 to locate marooned persons; four to locate washed-out roads; eight to locate destroyed bridges; six to check the condition of dams; two to check broken power lines; two to drop food to marooned persons, and one liaison mission to Los Angeles. The 38th Reconnaissance Squadron also took an active part in the work.

Six airplanes of the 28th Bombardment Squadron, Clark Field, P. I., participated in a search for the "Hawaii Clipper," reported missing on July 28, carrying on the search for four days. Approximately 127,000 square miles were covered without mishap by planes from the 4th Composite Group.

The Lockheed XC-35 substratosphere plane was employed for an



U. S. Army photo

#### DOUGLAS BOMBERS IN FLIGHT

Wright Cyclone-powered Douglas B-18 bombers in formation.

Army Day broadcast from an altitude of 33,000 feet over New York City in April, 1938.

Flying the flags of Chile, Argentina, Peru and the United States, six Boeing flying fortress B-17 bombers under command of Lieutenant-Colonel Robert Olds, commanding the 2nd Bombardment Group, GHQ Air Force, took off from Langley Field, Va., on February 15, bound for Buenos Aires on the most notable good will flight of the

year. The next day the flight took off from Miami and, after a 1,100-mile flight to Colon, Panama, decided, in the face of somewhat unfavorable weather conditions at the equator, to continue the journey southward. For 300 miles the flight was made above an equatorial storm at an altitude of approximately 23,000 feet. The six planes landed at Lima, Peru, after a record non-stop flight of 2,695 miles in 15 hours 32 minutes.

At 11:05 p.m. on February 16, five of the bombers took off for Buenos Aires, the sixth being delayed by a mechanical difficulty. The flight landed at Buenos Aires in slightly more than 12 hours after leaving Lima, a maximum altitude of 21,000 feet being attained



U. S. Army photo

#### NORTH AMERICAN'S BC-1

The U. S. Army Air Corps received 174 of these basic combat planes, powered by Pratt & Whitney Wasps.

at one time. After correcting the difficulty, the sixth bomber re-joined the flight at Buenos Aires at 6:20 a.m., February 17.

While at Buenos Aires, the Army airmen participated in the inaugural ceremonies for the new President of the Argentine Republic. The homeward flight began on the morning of February 22, via Santiago, Chile, and Lima, Peru, where they arrived February 23. On February 25 they departed for Panama landing at Albrook Field after a nine-hour flight. The final leg of the long flight was made from Panama to Langley Field February 27, the flight landing at 5 p.m. after a trip of 10 hours and 45 minutes.

A second South American good will flight was made in August, when three Boeing flying fortress bombers led by Major Vincent J.

Meloy flew from Langley Field to Bogota, Colombia, in connection with the inauguration of the new Colombian President. The flight south was made in two stages, from Langley Field to Miami and from Miami non-stop to Bogota.

The 19th Wing, Air Corps, Panama Canal Department, under command of Brigadier General George H. Brett, with 80 officers and 70 enlisted men, in various types of airplanes, participated in an extended navigation and concentration flight from Albrook and France Fields to Guatemala City, Guatemala, in February, 1938.

On April 22, Colonel Olds and a crew of three officers and five enlisted men in a Boeing flying fortress made a record flight from the



U. S. Navy photo

#### GRUMMAN F<sub>3</sub>F-2

Powered by a Wright Cyclone 1,000 h.p. engine it is one of the most formidable fighters in the Navy and Marine Corps squadrons.

Pacific Coast to Langley Field in 10 hours and 45 minutes, bettering the previous record for a military plane by 16 minutes. The flying time from Langley Field to March Field had been 12 hours and 27 minutes, thus the previous East-West military record was exceeded by an hour.

Ten Martin B-10 airplanes of the 6th Bombardment Group, France Field, Panama Canal Zone, were flown to San Salvador, Salvador and return by way of San Jose, Costa Rica, in April.

Flying a Seversky P-35 pursuit plane, First Lieutenant Harold L. Neely, Air Corps, on July 28 crossed the United States at a speed of approximately 278 miles an hour, his total elapsed time being 11 hours and 29 minutes. Stops for refueling were made at Salt Lake City,

Omaha and Cleveland for a total time of one hour and 35 minutes, making the flying time 9 hours and 54 minutes.

A Douglas B-18 bomber made the first transcontinental non-stop flight for an aircraft of this type on August 19, from Hamilton Field, Calif., to Mitchel Field, N. Y., covering the 2,570 miles in 15 hours and 38 minutes.

Flight testing of the Boeing XB-15 "Super Flying Fortress" bomber commenced in February, 1938, at Wright Field, following a thorough inspection by Materiel Division engineers. This airplane was delivered to the 2nd Bombardment Group at Langley Field, Va., August 6.

A new Army-Navy Aeronautical Specification Unit was established at the Materiel Division for the purpose of obtaining the standardization of aeronautical specifications between the Army and the Navy. Administrative control of the unit was vested in the Chief of the Materiel Division, and executive control in the permanent working committee of the Aeronautical Board in Washington.

On October 26, Lieutenant Benjamin S. Kelsey, Air Corps, flew a new Curtiss Army Pursuit plane from Dayton, Ohio, to Buffalo, N. Y., at an average speed of 350 miles an hour, reporting a new record for an Air Corps plane.



THE GLENN L. MARTIN 162

One of the fast long range patrol flying boats under construction for the U. S. Navy. It is powered by two Wright Twin-row Cyclone engines.



## CHAPTER IV

### THE NAVY AIR FORCES

Secretary Swanson's Comments on the Progress Made—Rear Admiral Cook's Detailed Report of Activities—Need for Constant Research and Experimentation—Rear Admiral Towers Becomes Chief of the Bureau of Aeronautics.

**I**N his annual report for the fiscal year 1938 Secretary of the Navy Claude A. Swanson made these comments about the Navy's air forces:

"Naval aviation has continued its rapid strides in the development of aircraft of increased performances. The demands of the fleet constantly require broader and more inclusive roles for aircraft in the tactical organization. The importance of meeting these demands has resulted in assigning greater precedence to aircraft development than to the co-related requirements for supporting tenders and shore station facilities, until construction of the latter has lagged far behind the deliveries of aircraft, particularly patrol planes, procured under the Vinson-Trammell Act. Without these fleet auxiliaries, and with inadequate shore bases, it has been difficult to explore the possibilities in the use of these aircraft in the Fleet, and thus to form an accurate estimate of their ultimate value in national defense. With the naval expansion program in immediate prospect, active measures to increase the number of aircraft tenders and to develop adequate shore facilities are inescapable requisites to its realization."

Other excerpts from Secretary Swanson's report are of interest, as follows:

"On June 30, 1938, the Navy had 1,390 service and 115 obsolescent aircraft on hand and 642 new aircraft on order. This represents an increase of 205 aircraft over the total on hand and on order as of June 30, 1937.

"The aircraft carriers 'Saratoga,' 'Lexington,' and 'Ranger,' with their attached squadrons, operated with the Battle Force. Two new aircraft carriers were placed in commission during the fiscal

year, the 'Yorktown' on September 30, 1937, and the 'Enterprise' on May 12, 1938.

"On October 1, 1937, Aircraft Base Force, comprising the long range bombing squadrons and their tenders, was transferred to the Scouting Force, and became Aircraft Scouting Force.

"During the year the aircraft operating facilities at Reeves Field, San Pedro, and at Sitka, Alaska, were placed in commission as Fleet Air Base, San Pedro, and Fleet Air Base, Sitka, respectively.



#### VOUGHT SCOUT BOMBERS

A flight of Twin Wasp-powered Vought scout bombers, SBU-1, in U. S. Navy service.

"Special operations other than those regularly scheduled for naval aircraft, comprised the following:

"During July 1937, the Navy conducted extensive search operations in the South Pacific for Miss Amelia Earhart and her co-pilot, Mr. Fred J. Noonan, after their failure to arrive at Howland Island on their world flight. Patrol planes and ships from the Hawaiian area started the search and were later joined by the 'Lexington' and

her squadrons after a 4,000-mile run from San Pedro at high speed. The results of the search were unhappily negative.

"On November 14, 1937, seven patrol planes assisted in the search for survivors of the Greek Steamship 'Tzenny Chandris,' which steamship sank off Diamond Shoals Light. One of these patrol planes located the wreckage and a large number of survivors who were clinging to timbers and swimming in life jackets. The plane guided the Coast Guard Cutter 'Mendota' to the area where rescue operations were effected.

"Nonstop flights for the purpose of ferrying aircraft were made as follows:

"Fourteen patrol planes departed from San Diego on December 8, 1937, and arrived at Fleet Air Base, Coco Solo, Canal Zone, the following day.

"Eighteen patrol planes left San Diego on January 18, 1938, and arrived at Pearl Harbor the following day.



U. S. Navy photo

#### THE CARRIER "ENTERPRISE"

One of the U. S. Navy's new ships to increase the effectiveness of its air force.

"Aircraft from the Naval Reserve Aviation Base at Long Beach, Calif., assisted in flood rescue and relief operations in the Los Angeles area during March 1938.

"Fleet aircraft took part in coastal frontier joint air exercises and in minor air exercises of the same character on both the Atlantic and Pacific coasts.

"Naval and Marine Corps aircraft participated in the National Air Races at Cleveland, and aircraft of the Fleet Marine Force took part in the Miami All American Air Show.

"Fifty-one airplanes of the Fleet Marine Force flew from Quantico, Va., to San Juan, Puerto Rico, and return, for the purpose of participating in fleet landing exercises in that area during January and February.

"Extended flight training from tenders, using outlying bases,

was conducted by units of Aircraft Scouting Force on the Atlantic and Pacific coasts of the United States, in Alaskan waters, and in the Hawaiian and Caribbean areas."

"Since the inauguration of the aviation cadet program on July 1, 1935, sufficient time has elapsed to judge the merits of the plan as a method of meeting the shortage of pilots attendant upon expansion to Treaty Navy strength. The results have been eminently satisfactory and the aviation cadets have fitted smoothly and efficiently



U. S. Navy photo

#### U. S. MARINE CORPS GRUMMANS

They are F3F-2 Wright Cyclone-powered fighters flown by squadron Two at San Diego, Calif.

into their places in the aeronautic organization. The number of aviation cadets has increased during the year from 554 to 812, of whom 526 were at sea with the fleet on June 30, 1938."

Rear Admiral Arthur B. Cook, Chief of the Bureau of Aeronautics, gave a more detailed account of his annual report for the fiscal year 1938, as the following excerpts show.

#### Admiral Cook's Report

"Shore facilities to support the operating aircraft are being de-

veloped gradually but in no measure commensurate with the present and contemplated expansion of the Naval Aeronautic Organization. The concentration of carrier aircraft in the Norfolk area, pending the commissioning of their parent vessels, the 'Yorktown' and 'Enterprise', has focused attention on the need for greater facilities on the East Coast, which need has not previously been so evident due to the almost complete absence of the Fleet from East Coast waters during recent years. Transfer of the site for the Naval Air Station at Alameda, Calif., to the Navy Department has permitted active prosecution of the development of this acutely needed additional West Coast station. Its realization, together with expansion of existing facilities at the Naval Air Station, Seattle, Wash., will



U. S. Navy photo

#### NEW CONSOLIDATED PATROL BOMBER

This four-engine XPB<sub>2</sub>Y-1 with four Pratt & Whitney Twin Wasp engines was delivered to the Navy in 1938.

contribute materially to the relief of West Coast congestion. In similar manner, the commissioning and active development of the Fleet Air Base, San Pedro, Calif., has afforded facilities in the Long Beach-San Pedro area for the intermittent accommodation of battleship and cruiser-based aircraft. The recent commissioning of the Fleet Air Base, Sitka, Alaska, will permit the orderly extension of operations north and westward from the Puget Sound area.

"The operations of the patrol planes attached to the Aircraft Scouting Force have been seriously hampered by the lack of supporting tenders. Advanced designs of seaplanes already realized, coupled with expected further developments, will make this problem increas-

ingly important if the possibilities for these craft in support of Fleet operations are to be explored and utilized to full advantage. The meagre number, together with the obsolescent type of ships assigned to this mission, constitute a handicap which can only be removed by an orderly and rapid replacement program. This shortage will eventually be slightly alleviated by the assignment during the fiscal year 1939 of two destroyers, the 'Childs' and 'Williamson,' due for decommissioning, to duty as seaplane tenders, small. Conversion of these vessels is to be initiated in July, 1938. One large seaplane tender, the 'Curtiss,' is under construction and it is expected that an additional large seaplane tender and two small seaplane tenders will be laid down during the current year.

"Two aircraft carriers were placed in commission during the



U. S. Navy photo

#### CURTISS NAVY SCOUT BOMBER

It is the SBC-4 powered by a Wright Cyclone engine.

fiscal year, the "Yorktown" on 30 September, 1937, and the "Enterprise" on 12 May, 1938. The first aircraft operations in the "Yorktown" were conducted on 10 November, 1937. These operations were followed by a shakedown cruise to Panama and the West Indies during January and February. The first aircraft operations in the "Enterprise" were conducted on 15 June, 1938, followed by a shakedown cruise to Rio de Janeiro, Brazil. These vessels will be ready to join the Fleet by about the first of the calendar year on completion of postcommissioning navy yard work.

"Five light cruisers have been commissioned during the year. These vessels contain improved handling facilities for their complement of four aircraft.

"A continuous program of experimental projects, within financial

limitations, is being carried out to anticipate and fulfill the increased requirements for Fleet operating aircraft. The various Government, as well as commercial, agencies have been utilized to this end. As a consequence of this, the performance of naval aircraft continuously improves.

"However, it is a well known fact that improvements in the United States are accompanied and paralleled by improvements in European countries in which no restraint on expenditures of funds for military developments is evident. If the United States is not to be relegated to a comparatively inferior position in world aircraft, liberal allocation of funds must be made to permit intelligently directed experimental projects to be pursued actively. The program of the Bureau of Aeronautics envisions retention of a position ahead of other world powers, but realization of this objective necessarily is limited by appropriations allocated to the purpose.



U. S. Navy photo

#### SIKORSKY FLYING DREADNOUGHT

The four-motored patrol bomber, with Pratt & Whitney Twin Wasp engines, which Sikorsky built for the Navy.

"All naval aircraft tactical units continue to be assigned normally to the Fleet. Training, experimental and miscellaneous airplanes for administrative requirements are assigned to shore activities.

"The policy of assigning certain fleet patrol squadrons temporarily to Commandants of the Naval Districts on both coasts, for short periods, to further development of coastal defenses, continues in effect.

"Naval aircraft assigned to the Fleet participated in all Fleet problems and tactical exercises during the fiscal year 1938. The squadrons of Carrier Division Two operated from the Naval Air Station, Norfolk, pending the 'Yorktown' and 'Enterprise' joining the Fleet. Marked developments and improvements have been made in all phases of aircraft tactical training.

"Participation of the patrol squadrons in Fleet problems and exercises, together with advance base operations, involved long range flights:

"(a) by Patrol Wing One (based at San Diego) to the Pacific Northwest-Alaskan area. These flights covered the Gulf of Alaska, Kodiak, Sitka areas as well as the continental Northwest. This wing participated extensively in all Fleet exercises.

"(b) by Patrol Wing Three (based in the Canal Zone) to Guantanamo, Culebra and other Caribbean-Central American areas.

"(c) by Patrol Wing Four (based in the Pacific Northwest) to various areas along the Pacific Coast of the United States.

"(d) by Patrol Wing Five (based at Norfolk) to various areas along the Atlantic Coast of the United States as well as extensive operations in the Guantanamo-Culebra sector of the Caribbean.

"During the year, 18 planes [Consolidated flying boats] comprising Patrol Squadrons Nine and Ten made a non-stop flight from San Diego to Pearl Harbor incident to the delivery of new airplanes. Patrol Squadron Two made a similar non-stop flight from San Diego to Coco Solo.

"On July 1, 1937, Aircraft Base Force, comprising the long range Patrol Bombing Squadrons, was transferred to the Scouting Force and became Aircraft Scouting Force.

"During the year, the operating bases at Reeves Field, San Pedro, and Sitka, Alaska, were officially placed in commission. Two new patrol squadrons, VP-18 and VP-19, were organized and joined their respective wings at Pearl Harbor and Seattle.

"Aircraft One, Fleet Marine Force, flew from Quantico, Virginia, to San Juan, Puerto Rico, in January and returned in March. The flight was made for the purpose of participating in Fleet Landing Exercise No. 4, in support of the ground forces of the Fleet Marine Force. It is of note that this organization flew 52 airplanes to the maneuver area, carried out extensive oversea operations and returned without any major casualties.

"Aircraft Two, Fleet Marine Force, based at North Island, was taken aboard the "Ranger" and functioned as a group for a limited training period. This was the first time that a Marine Corps unit had operated from a carrier as a group. Two squadrons of Aircraft Two participated in Fleet Problem XIX and made excellent flying records without casualties.

"Aircraft from the Naval Reserve Base at Long Beach assisted in flood rescue and relief operations in the Los Angeles area during March, 1938.

"The policy of delivering new aircraft by air and of ferrying



some old to East Coast stations for overhaul and return was continued. This involved a total of approximately 350 trans-continental flights during the year. In addition, a large number of patrol planes were delivered to various bases.

"Lighter-than-air activities continued to be concentrated at the Naval Air Station, Lakehurst. A number of non-rigid airships were transferred from the Army and the newest of these, the TC-14, was placed in flying status. In May, delivery was made of the L-1 training non-rigid airship. The addition of these brought the total number of non-rigid airships operating to six, of which two are in an experimental status. There was a gratifying increase in the number of operating hours per airship. The operations included coastal patrol



U. S. Navy photo

#### BREWSTER FIGHTER-BOMBER

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

exercises, some in conjunction with submarines, and a demonstration of the adaptability of non-rigid airships for target practice photography. A class of six student officers was assigned to lighter-than-air training.

"Various technical improvements in airship equipment have been brought about, including an improved system of bow mooring for non-rigid airships; improved mast equipment and construction of a synthetic rubber envelope. The Durand Airship Committee has continued to function, and has sponsored useful experimental work in the fields of aerodynamics and structural analysis as applied to airships. Much of this can be applied to the moderate sized rigid airship

for training and airplane carrying as authorized in the Naval Expansion Bill.

"The training of Aviation Cadets, Naval Reserve, was continued at Pensacola during the fiscal year 1938, and is relieving the shortage of commissioned officer pilots available for duty in the Naval Aeronautic Organization. No foreign officers were under instruction in flight training at Pensacola during the year.

"Annual 14-day periods of training duty were conducted for all members of the Aviation Fleet Reserve. The large number of Fleet Reserve aviators on extended active duty for the purpose of augmenting the complement of regular naval aviators in connection with the training of aviation cadets at the Naval Air Station, Pensacola, made it possible to provide 14-day training periods for a considerable number of the volunteer aviation reserve officers who previously had been deprived of this training due to lack of funds. This training served not only to stimulate the interest of the volunteer group, but provided badly needed refresher courses.

"There are shown below the amounts of the appropriation "Aviation, Navy" for the fiscal years 1936, 1937 and 1938.

	1938	1937	1936
Navigational, Photographic, Aerological and Radio Equipment.....	\$ 750,000	\$ 700,000	\$ 498,200
Maintenance and Operation, Aircraft and Air Stations.....	18,796,000	14,408,270	11,020,450
Experiments and Development.....	4,768,000	2,500,000	2,408,000
Aircraft Construction.....	27,186,000	20,980,000	26,715,600
Total.....	\$51,500,000	\$38,588,270	\$40,732,310

"Under the subhead "Experiments and Developments," a supplemental appropriation of \$1,268,000 was made to meet unexpected increases in the cost of experimental airplanes. These supplemental appropriations have been of inestimable value in enabling the Bureau of Aeronautics to meet the emergency costs which arose under the several items mentioned.

"During the fiscal year 1938, as compared with fiscal year 1937, the total amount of hours flown increased 19.1 per cent. The total output of repairs to airplanes and engines increased 34.3 per cent, while the overhaul expenditure, including labor and material, increased 41 per cent. This increase was partly caused by an increase in cost of materials of 13 per cent over that of the preceding year, and partly due to an increase in the average size, weight, and complexity of the airplanes over that of the preceding year. Those fac-

tors of increase more than balanced savings due to a slight increase in operating intervals between overhauls and some increase in overhaul efficiency.

"Plans have been completed and authorization has been given for aircraft overhaul shops at Alameda and for additions to aircraft overhaul facilities at Norfolk and San Diego.

"Due to the knowledge gained as a result of the extensive type,



#### RYAN MILITARY TRAINER

One of the S-T-M models built for the Guatemalan air force. It is powered by a 150 h.p. Menasco engine.

accelerated service and special tests which both engines and aircraft undergo as a matter of routine, the practical limitations of engine operation affecting durability and reliability, such as speed, power, output, manifold pressure, etc., are so well known that high outputs have been achieved with safety. Considering the amount of actual operating time, serious service engine failures have been few. The personnel operating, servicing and overhauling aircraft material, as

the result of the dissemination of the information secured from the tests, have achieved a high degree of efficiency in spite of the increasing complexity of their duties.

"Power outputs both at sea level and altitude have risen consistently at a rate which compares favorably with that of previous years. The air-cooled radial has kept step in its field and is among the most powerful known on a weight and displacement basis.

"As the aerodynamic characteristics advance and physical appearance of the planes changes with increasing size, they strongly affect the trend of aeronautical engine development. In anticipation of the trend, considerable development has been made with other than the conventional radial engine types, without neglecting the latter type. Improvement has been obtained in altitude performance, general performance and reliability.

"In the installation of engines, considerable work has been done resulting in reduction of drag while still providing sufficient air flow for cooling the increasingly larger size engine cylinders and still keeping the accessory compartment at a reasonable temperature.

"The suppliers of accessories are becoming more widely distributed and the field is marked by a more vigorous tone in the attack on the problems involved. The outlook for outstanding future developments is bright.

"Among the marked changes in operating procedure is the advent of small auxiliary power plants for occasional electrical current demands.

"Special fuels and lubricants necessary for the particular service required of them are now commercially available at all large airports, as a result of the Bureau's insistence years ago on their necessity.

"Cooperation between this Bureau and other Government agencies, such as the National Advisory Committee for Aeronautics, National Bureau of Standards, and the Air Corps of the Army, through the interchange of information, has in many cases materially shortened development time and prevented useless duplication of effort and expenditure of funds. In spite of these savings, it becomes increasingly more difficult to achieve outstanding and marked progress without a considerable increase in experimental funds to keep pace with the elaborate and expensive developments of other nations.

"Development of aeronautical material on board naval vessels for the launching and arresting of aircraft, and of the necessary features on the airplanes, has shown orderly progress to meet the increasing requirements.

"Experimental airplanes have been procured almost entirely for the purpose of serving as prototypes from which satisfactory produc-

tion airplanes may be ordered in quantity, providing adequate competition among the manufacturers at the same time. A number of experimental prototypes have been contracted for during the past year to meet the needs of the Service in this respect in so far as funds were available. The increased cost of experimental airplanes makes it mandatory that appropriations for this purpose be increased in order to make it possible to continue an orderly procurement program of high performance airplanes.

"Further improvements in the procedures for calculating the loads imposed on airplanes and in methods of stress analysis have been made during the past year. These have been supplemented and substantiated by laboratory testing of airplane structures in which a study of stress distributions and the technique of strain measurements were among the primary objectives. Developments are under consideration which are expected to lead to complete stress measurements in flight.

"The rapidly increasing size and power of engines have necessitated the giving of greater attention to the subject of vibration. In consequence, intensive studies and investigations have been made, both of vibration-isolating mounting of engines and the determination of airplane vibration characteristics, with the view of setting up definite requirements and procedures to ensure that airplanes are satisfactory in this respect.

"During the past year the trials of 15 airplanes and one airship were completed, together with many miscellaneous tests involving engines, propellers, equipment, and various performance data.

"Continued progress has been made in the development of new types of instruments and improvements of existing types. Particular attention has been given to the improvement and development of navigational instruments. Repair facilities have been enlarged to provide better maintenance for instruments in service.

"The Bureau has continued its policy of exploring fully all materials which appear to have possibilities of promoting increased performance through lightness in weight consistent with satisfactory structural and maintenance considerations. New methods of fabrication designed to simplify production and concurrently improve performance of aircraft, such as spot welding, have been adopted as standard methods of construction for many parts. The use of flush riveting, because of the improved aerodynamic qualities which it imparts to exposed surfaces, is being extended. Protective coatings superior in quality to those available commercially have been developed under the Bureau's directions with a view towards simplifying maintenance problems by reducing corrosion. Cotton and acetate

base fabrics have been developed which through tests appear to be suitable for parachute use. Various metallurgical developments, including tests, are under way in an effort to develop better alloys than those now available. A series of light weight landing gear wheels have been developed and approved for service use. Electrically heated flight equipment for low temperature operations has been developed. A new design safety belt to reduce injuries to personnel incident to crash landings is being service tested.

"Very gratifying progress has been made in the application of recent aerodynamic data in the design of new naval aircraft, and in the modification of existing types, 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 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 have been very active in producing improved flying boat hull lines, better stability and control, and better aerodynamic efficiency. In particular, every effort has been made to eliminate unnecessary drag from representative airplanes in order to secure maximum performance.

"Radio equipments delivered to the Service during 1938 have shown a gratifying increase in performance, especially with regard to an increase in power output.

"Landing lights having a greater beam candlepower and increased efficiency have been procured during 1938. Improvements have also been effected in approach light systems for monoplanes. A non-glare diffusing globe has been developed for exterior lights. Navigational

running lights have been improved and a specification has been prepared which is expected to increase the efficiency of light reflectors.

Admiral Cook made the following recommendations:

"Actively pursue development of shore stations and facilities in keeping with present and in anticipation of the increased requirements of the Fleet as a consequence of naval expansion program.

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

"Develop the Naval Air Station, Alameda, California, as rapidly as possible.

"Provide new aircraft of best possible performance in sufficient numbers to (a) replace obsolescent and crash loss and (b) accelerate realization of the expansion program.



VOUGHT-SIKORSKY NAVY SCOUT SEAPLANE

Front view of the OS2U-1 seaplane with a 400 h.p. Pratt & Whitney Wasp Junior engine and Hamilton Standard constant speed propeller.

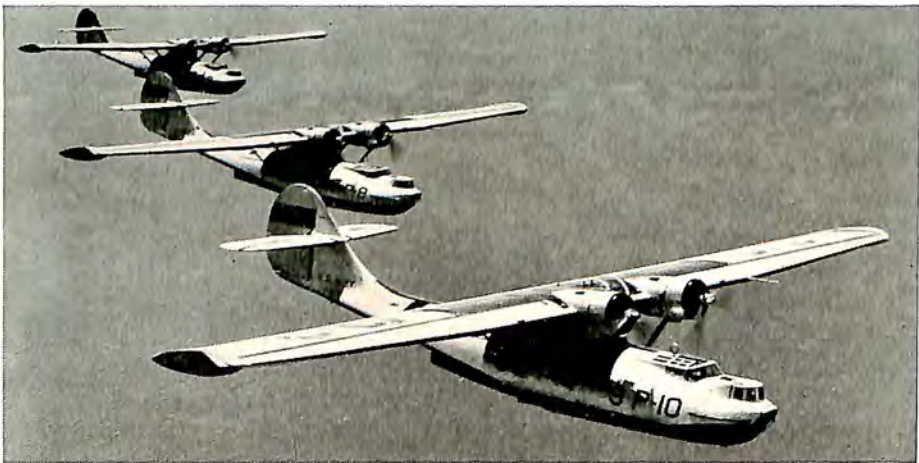
"Make every effort to obtain adequate funds for a well-considered and comprehensive experimental program to effect continued improvement in aircraft and aircraft engine reliability and performance and to forestall our falling behind foreign countries in these respects.

"Provide required increases in naval personnel to support the expansion program."

In June, 1939, Rear Admiral Cook, with an exceptionally fine record for efficiency and personal popularity, completed his tour of duty as Chief of the Bureau of Aeronautics, and became Commander of Aircraft of the Fleet Scouting Force. Captain John H. Towers, who had served as Assistant Chief of the Bureau, was appointed to succeed Rear Admiral Cook.

Rear Admiral Towers brought to his new position as Chief of the Navy air forces one of the world's pioneer aviators, skilled in all phases of service aviation and one of the most popular officers in the nation's air forces. He was born in Rome, Ga., on January 30, 1885, and received his education at the Georgia Institute of Technology and the U. S. Naval Academy. He started flying in 1911, taking his first training under Glenn H. Curtiss. During the World War he was Assistant Director of Naval Aviation, and in 1919 was placed in active charge of the Navy's flight across the Atlantic—the first in history. He captained the NC-3, one of the three flying boats that started the flight. While the NC-4 managed to get across, both the NC-2 and NC-3 were forced down on the Atlantic by engine trouble. The NC-3, however, was taxied into the Azores after a thrilling battle with high winds and rough seas. Service abroad, as attache, with the Fleet as a carrier commander and command of shore stations gave Rear Admiral Towers the varied experience that qualified him for his new command at a time when the Navy's air forces were becoming vitally important in the defense establishment.

The new Assistant Chief of the Bureau of Aeronautics was Captain M. A. Mitscher, who was a pilot of the NC-1 on the Atlantic flight and whose career during the last 20 years had paralleled that of Rear Admiral Towers.



U. S. Navy photo

NAVY CONSOLIDATED PBV'S

They are powered by Pratt & Whitney Wasp engines.



## CHAPTER V

### COAST GUARD AVIATION

Fine Record of the Flying Guardsmen—Aid to Distressed—Law Enforcement—Stations New and Old—New Equipment—Coast Guard Training—Heroic Rescues.

**T**HE motto of the U. S. Coast Guard, "Semper Paratus," or "Always Ready," was never better demonstrated than during the fiscal year 1938 when the fine record established by the aviation division of this hero-breeding arm of Uncle Sam proved once more how effective it was in saving life, warning persons and vessels of impending danger, and braving untold dangers to perform its winged tasks for humanity, law and order and commerce.

All Coast Guard aviators were regular Coast Guard officers, graduated from the Coast Guard Academy at New London, Conn., and were selected for aviation duty after serving three or more years of sea duty on Coast Guard cutters. They were then assigned to the Naval Air Station at Pensacola, Fla., where they took the regular course prescribed for Naval aviators. Coast Guard aviation pilots and other enlisted personnel were members of the regular Coast Guard establishment, selected from the general service personnel and assigned to air stations and aviation units. They also received complete Navy training as afforded at Pensacola, and were frequently assigned to other Army and Navy schools conducting courses in aviation subjects, and to engine and airplane manufacturing plants to take advantage of maintenance and repair procedure courses offered by the manufacturers. The Coast Guard took advantage of the facilities offered by the Air Corps Technical School at Chanute Field, Rantoul, Ill. The courses at Chanute Field covered aircraft sheet metal work, parachute instruction, aircraft maintenance and engine overhaul. Four officers were assigned to the school, which offered a 10-months' course.

An important part of the training of Coast Guard aviators, after their assignment to aviation units for duty, was the requirement

calling for one hour of instrument flight training, so-called "blind flying," and one hour of night flying each month. Furthermore, all aviators and aviation pilots had to complete a 10-hour syllabus of instrument flying on reporting to a station for duty, prior to assignment to regular flight duty.

Another advance in Coast Guard Aviation during 1938 was the opening of the new Air Station at Floyd Bennett Field, Brooklyn, N. Y. This station filled a great need and was admirably situated to offer proper protection to the tremendous shipping, fishing and yachting activities centered about New York. It proved to be the busiest of all Coast Guard Air Stations, and was taxed to the limit of its capacity on week-ends, responding to calls of amateur fishermen and embryo yachtsmen, in distress or out past schedule.



NEW COAST GUARD STATION

The flying Coast Guard now has these quarters at Floyd Bennett Field, New York.

Official records of the Coast Guard disclosed that in 1938 a total of 4,383 flights were made as against 3,842 in 1937, or a gain of 541 flights. Because 323 of these flights of 1938 were made at night, and many of them were out over turbulent open water, the fact that such hazardous trips increased by 69 in 1938 over 1937 indicated how well both equipment and personnel stood up under exacting conditions.

Coast Guard aviation averaged 12 flights a day throughout the entire 1938 fiscal year, and involved a total flying time of 10,131 hours, covering 934,430 miles of flying, or an increase of 153,885



HALL ALUMINUM PH-2

Built for the U. S. Coast Guard, it is equipped with two 850 h.p. Wright Cyclone engines.

miles over 1937. An area of 5,368,363 square miles of land and open sea was searched by Coast Guard planes in the performance of what is considered routine duty.

While bare statistics sometimes cannot portray all the color of dangerous tasks well done, the following tables provide ample proof of what was accomplished by the long air arm of the Coast Guard during 1938.

Persons warned of impending danger .....	2135
Vessels warned of impending danger .....	506
Passengers transported .....	3211
Persons assisted .....	212
Emergency medical cases transported .....	148
Persons transported from disabled vessels .....	21
Persons otherwise transported .....	369
Disabled vessels located .....	63
Navigational obstructions reported .....	19
Vessels identified .....	34670
Airplanes identified .....	7008
Assistance rendered to other Government departments .....	345

In addition to assistance work, the Coast Guard was also charged

with law enforcement pertaining to the protection of the customs revenue, and the prominent part played by the Aviation branch of the Coast Guard in 1938 was shown by the following statistics:—

Smuggling vessels located .....	27
Smuggling vessels seized .....	1
Contraband seized .....	17535 Gals.
Illicit distilleries located .....	607
Illicit distilleries seized .....	33
Estimated annual revenue lost to the Government due to illicit distilleries located by Coast Guard	\$55,809,408
Miscellaneous cases of law enforcement .....	16

The Aviation Division of the U. S. Coast Guard, under the direction of Captain L. T. Chalker, U.S.C.G., included eight air stations located at Salem, Mass.; New York, N. Y.; Charleston, S. C.; St.



U. S. Coast Guard photo

COAST GUARD GRUMMAN J2F-1

This Wright Cyclone-powered utility plane is operating from the cutter "Spencer" in Alaskan waters.

Petersburg, Fla.; Miami, Fla.; Biloxi, Miss.; San Diego, Calif.; and Port Angeles, Wash.; and Air Patrol Detachments situated at Cape May, N. J.; and El Paso, Texas. Seven of the larger Coast Guard cruising cutters were equipped to carry aircraft, and planes are assigned to three of these vessels; on the Cutter "Bibb" at Norfolk, Va.; the Cutter "Taney" at Honolulu, T. H.; and the Cutter "Spencer" at Cordova, Alaska. Coast Guard planes were classified as inshore patrol planes, having a cruising range of approximately 500 miles; intermediate range planes, with a range from 500 up to 1,000 miles; and long range planes which can cruise from 1,000 to 2,000 miles. In addition there were a few special service planes used primarily for training and administrative purposes.

During the fiscal year 1938, the Coast Guard accepted delivery of seven PH-2 Hall-Aluminum Aircraft Corporation flying boats and three SOC-4 Curtiss-Wright convertible land-seaplanes. The PH-2 Hall flying boats had a cruising range of 2,000 miles. Two PH-2 planes were ferried from the factory at Bristol, Pa., to the Air Stations at San Diego, Calif., and Port Angeles, Wash., the route following the East Coast seaboard down as far as Carmen, Mexico, thence overland across Mexico to Acapulco, Mexico, and up the West Coast seaboard to destinations. The journeys, approximately 4,000 and 5,500 miles, were made without incident and the planes performed in a highly efficient manner. The SOC-4 Curtiss planes were intended for duty on Coast Guard cutters, and were of the convertible observation type, so fitted as to be used with either floats, wheels, or skis.



#### COAST GUARD AMBULANCE

An injured seaman being taken aboard a Coast Guard plane for quick transportation from his ship to a hospital ashore.

As a general rule, the missing parties were located safe and sound with nothing more serious than a broken down engine in their boat or a broken down theory in their minds relative to practical navigation, but it was the duty of the Coast Guard to be sure that such was the case. There was plenty of trouble when the week-end sailors ran into the sudden squalls which have a habit of arising on Sunday afternoons, and the overturned sailing yachts and broken down power boats then put gray hairs in the heads of the Coast Guard personnel.

The strategic position, in relation to the calls for assistance originating in the highly traveled coastwise and trans-atlantic shipping lanes, cannot be too greatly stressed, and the record amassed by the New York air station in its few months of operation was a tribute to the efficiency of the Coast Guard. The design of the station was itself quite unique in that the entire station, including hangar, shops, offices, dormitories, and living quarters for the personnel, was under one roof.

The plans for the future of Coast Guard Aviation included the construction of two new air stations, one located at Elizabeth City, N. C., and the other at San Francisco, Calif. Land was being obtained for both fields.

When heroism is considered mere workaday routine, it is difficult to pick from many meritorious feats of the Coast Guard aviation units those particularly worthy of mention. But if it is kept in mind that those given here are only typical of many others, fairness will have been preserved.

On August 22, 1938, Wayne C. Taylor, Acting Secretary of the Treasury, for the President, awarded Lieut. Commander Frank A. Leamy, Boston division of the Coast Guard, the Distinguished Flying Cross "in recognition of your outstanding performance in flying an airplane of the Coast Guard a distance of approximately 60 miles from the Salem Air Station, to contact the trawler 'White Cap,' in the open sea, and removing from that vessel an officer whose left arm had been severed. The patient was then safely transported to Salem, Mass., for emergency treatment and further hospitalization. The flight was made under adverse conditions of darkness and rough seas which made landings and take-offs hazardous."

That the New England trawler fleet appreciates the splendid work of the Coast Guard's aviation unit was indicated during 1938 when the Federated Fishing Boats of America furnished two lounging rooms for the fliers in an abandoned lighthouse on the Service's air base grounds.

Henry Morgenthau, Jr., Secretary of the Treasury, acting on behalf of the President, on May 12, 1938, awarded Lieut. Carl Baker

Olsen, of the Coast Guard, the Distinguished Flying Cross in recognition of his action in flying a service plane approximately 300 miles to sea under the difficulties of darkness, storm and rough seas, to contact the Army transport "Republic," and transporting to a hospital on shore an Army officer who was critically ill.

The report of the Coast Guard to the Treasury Department, even though terse in the language of the Service, nevertheless paints a picture of daring and skill rarely matched in this official account of a rescue.

"On the afternoon of November 22, Lieut. R. L. Burke, in command of the air station at Cape May, N. J., received a message from the commander of the Norfolk Division stating that a civilian was



VOUGHT NAVY SCOUT BOMBER

The SBU-1, powered by a Pratt & Whitney geared Twin Wasp engine and a Hamilton Standard propeller.

reported slowly bleeding to death near the Ocracoke Coast Guard station from an ax wound in the knee; that the local doctor was unable to handle the case and that the nearest hospital to be reached by land and water transportation was too far away to permit saving the boy's life. The message asked if a Coast Guard plane could be made available to transport the boy to Norfolk.

"Darkness was fast approaching and the weather was threatening and hazy. To answer the call meant a 250-mile night flight with a blind, dangerous landing after darkness in the swampy shallow log-strewn waters adjacent to Ocracoke Island below Cape Hatteras, N. C. Nevertheless, the serious condition of the injured man bleeding to death warranted making this altogether hazardous flight.

"In 25 minutes, Lieut. Burke took off in plane CG-129 with an emergency medical kit, and within three hours landed in the sound off Ocracoke Island, but the plane immediately ran aground in the darkness on a mud flat among fish stakes about one half mile offshore from the Coast Guard station. Men from the Station soon rowed out to the plane, which was worked loose nearly at once, but in taxiing toward shore, it grounded again.

"When refloated, the plane was taxied into deep water, although still surrounded by fish stakes, mud flats and unlighted buoys. Armstead T. O'Neill, aged 18, was brought aboard the plane from a row-boat, having been injured seven hours before while chopping wood, severing an artery in his left leg below the knee. He was bleeding profusely when brought aboard the plane. The plane took off amid fish stakes in the darkness and within one hour of flight the patient was placed in a waiting ambulance at the Naval Air Station, Hampton Roads, Va. In all, the plane traveled 425 miles in darkness and under adverse weather conditions."

Thus does the aerial arm of the Coast Guard, night and day, fly its appointed rounds, aiding its brother Guardsmen in land stations and afloat, to perpetuate the traditions of the service which is, in truth, "Always Ready."



U. S. Navy photo

#### BREWSTER NAVY FIGHTER

The F2A-1, powered by a Wright Cyclone engine and built by the Brewster Aeronautical Corporation at Long Island City, New York.



## CHAPTER VI

### FEDERAL GOVERNMENT ACTIVITIES

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

**A**MONG the many departments and bureaus of the Federal Government engaged in aeronautical activities, the following have made interesting reports for 1938.

#### Civil Aeronautics Authority

During the first half of 1938, governmental regulation and promotion of civil aeronautics in the United States was continued under the Bureau of Air Commerce of the Department of Commerce. On August 22, the personnel and property of the bureau were transferred to the newly created Civil Aeronautics Authority, and that body took over the Government's regulatory and promotional duties as regards civil aeronautics. This change was made by the Civil Aeronautics Act of 1938, passed in the closing days of the 75th Congress and signed by President Roosevelt on June 23, 1938. The Act created the Civil Aeronautics Authority, the office of Administrator of the Authority and the Air Safety Board.

Under the terms of the Act, the Authority, composed of five members, is vested with the legislative functions, such as the issuance of certificates of convenience and necessity, the fixing of rates, and the regulation of business practices, and with judicial functions. The members are appointed by the President, with the advice and consent of the Senate, for six-year terms. Two of the members are desig-

nated annually by the President as chairman and vice chairman of the Authority. The independence of members is protected by the Act which provides that they may be removed from office by the President only for inefficiency, neglect of duty, or malfeasance in office. The Authority is required to make an annual report of its work to Congress and to transmit recommendations for additional legislation on such occasions, or more frequently if necessary.

In the Administrator of the Civil Aeronautics Authority are vested the executive functions, including the construction, operation, and maintenance of the Federal Airways, the enforcement of the air traffic rules, the conduct of development and planning work, the promotion of air commerce, and similar activities. The Administrator, named without term by the President with the advice and consent of the Senate, is independent of the Authority, and can be removed by the President whenever he fails to perform the executive functions assigned to him.

The Air Safety Board has three members, also appointed by the President for six-year terms. The Board annually elects one of its members as chairman and is charged with the responsibility of investigating accidents in air commerce and reporting the causes thereof, and of assisting the Authority in studying matters relating to air safety and making such recommendations to it as will tend to increase safety in aviation.

The Authority is vested with certain quasi-judicial functions in that it passes on certain actions of the Administrator and the Air Safety Board, and conducts hearings relative to the provisions of the Civil Aeronautics Act. In performing these judicial functions, the Authority is afforded, through the Air Safety Board and the Administrator's office with its various divisions, a background of all available and competent experience upon which it may measure the merits of every proposal before it, and the merits of every objection that might be raised.

The prestige of every action of the Authority is well marked by the provisions for appeal to the courts contained in the Act. Its findings of fact, if supported by substantial evidence, are not reversible by the Circuit Court of Appeals or the U. S. Court of Appeals for the District of Columbia, as would be an administrative order.

Earnestly sought by the aviation industry, which went to Congress and asked for a tribunal before which it could settle its problems and an agency through which its relations with the Government might flow in a single stream, and strongly recommended by the President, the Civil Aeronautics Act was the culmination of long-continued efforts by members of Congress, the Administration, the

industry itself, and private citizens interested in the future of aviation. Its passage was hailed as giving a new organic charter to civil aeronautics in the United States, framed in the light of existing conditions as well as with an eye to the future.

Until the enactment of the Civil Aeronautics Act, Federal regulation of civil aviation was limited. The Bureau of Air Commerce of the Department of Commerce regulated aeronautics from a safety standpoint, issuing certificates of competency to qualified aircraft and



REAR VIEW OF BELL AIRACUDA

Showing position of the three-bladed propellers in one of the new multi-engine fighters for the Air Corps.

airmen, and established, operated and maintained the aids to air navigation of the Federal Airways System. It also carried on research and development work in aircraft, engines, accessories, and navigational aids. It was charged, under the Air Commerce Act of 1926, which delegated these responsibilities to the Department of Commerce, with the further duty of fostering air commerce.

Economic regulation of aeronautics, in the sense that such regulations as rate-fixing and service requirements are imposed upon rail-

roads and motor carriers, was to a large extent non-existent. Insofar as it did exist, this type of regulation was merely incidental to awarding air mail contracts in protection of the Government's interest in the carrying of mails.

Two Government agencies participated in this limited economic regulation under the old laws. The Post Office Department awarded contracts for the carriage of air mail, and the Interstate Commerce Commission fixed the rates (up to a certain maximum allowable by law) to be paid for such carriage. No provision was made for the regulation of passenger and express tariffs, and no economic regulation of any nature was made of non-mail carriers.

Under the new Act, the Authority is given definite economic regulatory powers, somewhat similar to those exercised by the Interstate Commerce Commission over rail and motor carriers. This economic regulation was needed and asked for by the industry, in order to assure its continued healthy growth.

In order to operate an air line, the operator is required to hold an authorization issued by the Authority known as a certificate of convenience and necessity. These certificates authorize operations over certain routes and define the service to be rendered. They are granted to new air lines or to existing air lines for services over new routes only when such additional services are required by the public interest. When once granted, a certificate gives the air line a permanent right to the particular operation, subject only to revocation for a violation of the Act. Wasteful duplication of services is thereby avoided, and the assurance of permanency necessary for the sound financial foundation of any business enterprise is guaranteed.

The lines are required by the Act to charge reasonable rates for the carriage of passengers and property, and must file with the Authority, and make public, tariffs showing these rates. The Authority can change these tariffs if it finds the rates unreasonable.

Prior to the enactment of the Civil Aeronautics Act, the Post Office Department provided for air mail service by awarding contracts. Under the new Act this contract system is abolished, and the air lines will carry mail whenever they are required to do so by the Post Office Department, just as do railroads. Existing contracts are cancelled upon the issuance of a certificate of convenience and necessity to the holder. The Authority fixes the rates of compensation which the lines will receive from the Government for carrying the mails.

The Authority is empowered to supervise the business practices of air carriers, and to prevent unfair business practices and unfair competition. The new law enables the Authority to prevent such

interlocking corporate relationships in the aeronautical field as it finds to be contrary to the public interest.

Thus, under the new Act, the public will be assured of adequate transportation at reasonable rates, and the air lines will be assured of permanence of operation, freedom from undue duplication of services, and protection against unfair business practices.

In addition to economic regulation, the Act contains extensive provisions for the regulation of aviation from the safety standpoint and for the promotion of air commerce. These phases of the Authority's and the Administrator's work are a continuation of those carried



LOAD-TESTING A LOCKHEED 14

One of the most meticulous operations in aircraft construction is testing the safety factors in wing construction. The weight of each bag of sand is recorded as it is placed on the wing.

on by the former Bureau of Air Commerce, pertaining to the issuance of certificates of competency to aircraft, airmen and accessories, operation of the Federal Airways System and its air navigational aids, certification of air carrier operations, the conduct of research and development projects and the certification for the expenditure of Federal funds on airports. The functions of prescribing and enforcing the air traffic rules, maximum working hours of pilots (and in addition, maximum working hours of other airmen), and minimum standards as regards reserve supplies of fuel and similar regulations were continued.

The transition of control over civil aeronautics from the Department of Commerce to the Civil Aeronautics Authority was effected smoothly and efficiently. The development and research projects and programs of the former Bureau of Air Commerce were continued.

One of the major, if not the major, recent undertakings of the former Bureau was the comprehensive modernization program of the 22,000 mile network of the Federal Airways System. This extensive project was started during the fiscal year 1938 with funds especially appropriated for the purpose, Congress having authorized the Bureau to spend approximately \$7,000,000 on air navigational aids over a two-year period. In the furtherance of this program, it was determined, first, to bring the existing airways up to thoroughly modern standards by improvements to existing aids and installation of such additional aids as were needed to render a complete service, and second, to extend the Federal Airways System to include new routes.

The most salient feature of the program involved the conversion of existing airway radiotelephone and radio range stations to the simultaneous type of transmission. By means of this a pilot may be furnished at the same time and on the same frequency radiotelephone information and the radio range signals. The program also called for the construction of many new stations of this type.

Other features of the modernization program were the construction of new and additional radio marker beacons and of some new intermediate landing fields, installation of new teletypewriter circuits and of new drops on existing circuits to improve the communications facilities of the airway system, relocation of airway beacon lights in order to straighten certain airways, and the installation of new beacon lights.

This program was well under way when the Civil Aeronautics Authority took over the Bureau of Air Commerce, and it is rapidly being pushed to completion. When finished, toward the end of January, 1939, the Federal Airways System will have been modernized and improved with the addition of 131 simultaneous radio range and radiotelephone stations, 30 loop type ranges, 100 cone of silence markers, 21 fan type markers, 7,000 miles of teletypewriter circuits, as well as landing fields, beacon lights, and other airway aids.

The development and planning work initiated under the Bureau was continued by the Authority. Many projects dealing with a wide variety of subjects were studied. Among the more important studies were those dealing with the utilization of ultra-high frequencies in radio communications and navigational aids.

Two separate instrument or blind landing systems were developed. One of these has been constructed under contract for the Authority

and will be installed for flight testing at the Authority's test laboratory and field at Indianapolis. The other system, devised by a specialist of the Authority, is being tested by the builder, the Massachusetts Institute of Technology. Other developments were an automatic photographic instrument log and an airport orientator. These two instruments were also being tested during the Fall of 1938.

Special studies were undertaken relating to aviation medicine. A research laboratory, equipped with the latest clinical examining equipment and technical apparatus, and staffed by a supervising flight sur-



LOAD TESTS ON DOUGLAS DC-4

Lead bars are used in the manufacturer's safety tests on the huge four-engine transport.

geon, a trained physiologist, a scientific medical technologist and a clerical statistical employee, was established at Kansas City. This laboratory conducted investigations of aviation medical problems in the interest of safety.

Medical research contracts were awarded to three educational institutions for the conduct of special projects for the Authority. Dartmouth College was awarded a contract to conduct a research program to determine the percentage of subjects in which Aniseikonia

occurs, to what degree it exists, and its relation to pilot fatigue and conversely. The Harvard Fatigue Laboratory of Harvard University was awarded a contract to conduct research studies and develop methods of measurement for delineation of personality types, with particular reference to the individual's susceptibility to anoxia, emotional stability, and proximity to major and minor psychotic breakdown. The Johnson Foundation of the University of Pennsylvania was awarded a contract to research in and to develop biophysical methods of measuring vascular signs of physical strain and emotional states, and electrical methods for study of variations in properties of the nervous system in relation to fluctuations in blood chemistry. As the various research studies were completed, detailed reports were issued.

Active participation was carried on during 1938 in the making and maintaining of aeronautical agreements with foreign countries relative to the establishment of air routes, services, and navigational facilities. Participation was also carried on in matters relating to international law, principally in the work of the International Technical Committee for Aerial Legal Experts. Shortly after the Authority took office it was represented by one of its members and the former Director of the Bureau of Air Commerce at the Fourth Diplomatic Conference on Private Air Law at Brussels, Belgium. After this conference, the two representatives of the Authority travelled extensively through Europe studying European civil aeronautics in all its many phases and preparing a report thereon for the Authority.

The Civil Air Regulations, drawn up by the Bureau of Air Commerce and made a part of the Federal Code, were adopted, with a few minor changes, by the Civil Aeronautics Authority.

The routine, yet highly important duties pertaining to certification of aircraft, engines, airmen and accessories, operation of the Federal Airways System and the Airway Traffic Control, and inspection of air carriers, factories, schools and repair bases were carried on. A new grade of airman's certificate, that of "Air-traffic control-tower operator", was issued to qualified applicants. The Civil Aeronautics Act enlarged the definition of the word "airman" in such manner that various classes of persons engaged in aeronautical work not previously required to hold certificates of competency were made subject to the Act. Notably, all individuals who are directly in charge of the maintenance of aircraft and those in charge of the inspection, maintenance, overhauling or repair of aircraft engines, propellers, or appliances are now required to hold certificates. (The use of the word "appliances" in the Act brings in personnel in charge of radio and instrument repair and maintenance.) The Authority postponed



the effective date of the provisions of the Act calling for this certification until it had adequate opportunity to provide for painstaking and careful examination of such airmen.

The Civil Aeronautics Act states that no Federal funds can be spent on the construction or alteration of airports, other than for military purposes, except upon written certification and recommendation by the Administrator, after consultation with the Authority. This means, in effect, that all expenditures of PWA, WPA or other Federal funds on airport projects must be approved by the Authority. The former Bureau of Air Commerce checked such airport projects and approved them, serving in an advisory capacity to the CWA, PWA, WPA and other Federal agencies. The Administrator issued a certificate granting a blanket approval to 825 airport projects pre-



THE CLARK 46

An experimental airplane of plastic construction, powered by a Ranger engine.

viously approved by the Bureau, and in addition issued certificates for many other airport projects.

The Airport Section of the Authority prepared bulletins dealing with such subjects as "Airport Lighting", "Airport Design and Construction", and "Air Marking", and had a staff of experts to give advice on airport projects, as well as to check the proposed projects in accordance with the law.

The Act specifically required that the Authority make a field survey of the existing system of airports and present to Congress definite recommendations. This was done and the findings of the Authority are contained in the chapter on Airways and Airports.

A special unit dealing with the many problems of private flying was created by the Authority. Private flying was defined by the

Authority as including gliding, soaring, inter-collegiate, pleasure, course of business, sport, seaplane, instruction, charter and fixed base, and sales and repair activities—in short, all phases of aeronautical flying activities except scheduled air line operations.

Among the objectives set up for the new private flying unit were the segregation of records, interpretation of existing regulations, and the development of further regulations through the cooperation of private flyers' bodies and regional committees, development of utility and pleasure flying, increase of safety through better and more uniform training, study of the value of private flying to the military services and the national defense, study of possible revisions of approved type certificates for private flying ships and their maintenance requirements, and an effort to bring about uniformity between State and Federal regulations on private flying.

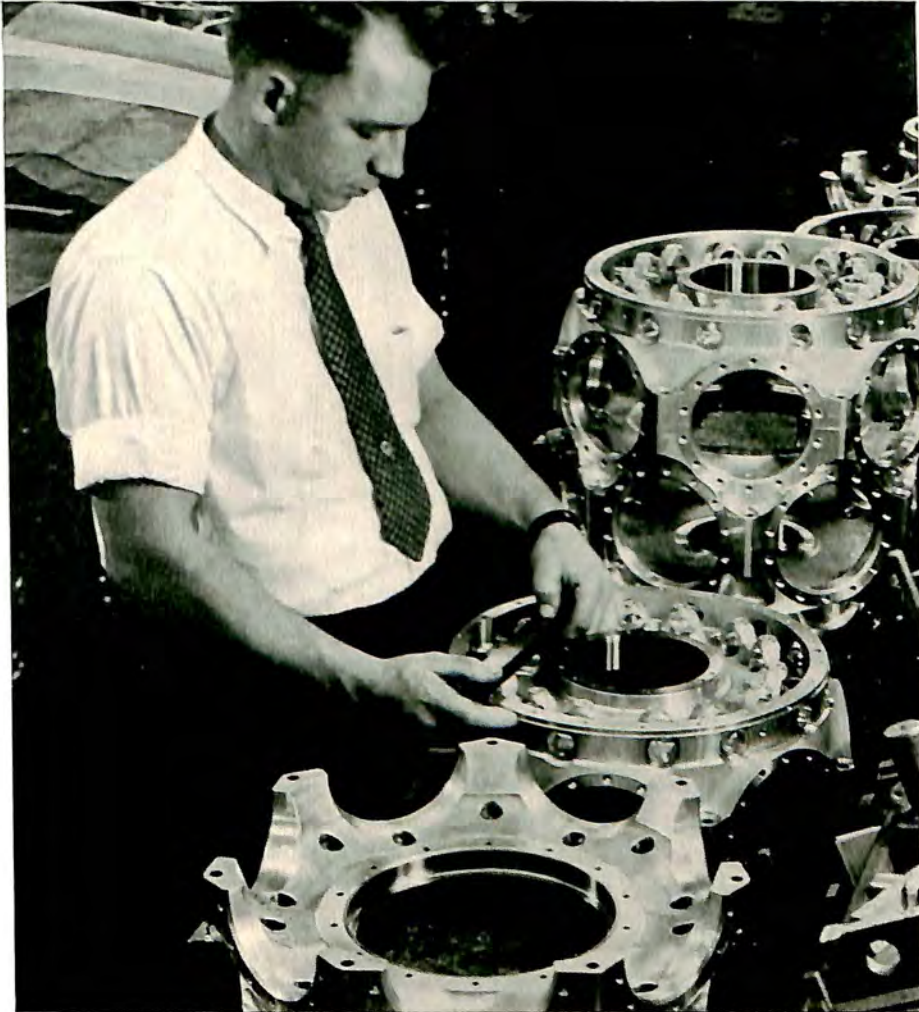
In October a meeting was held by the Authority and the Air Safety Board with members of the Air Transport Association's Operations Committee to discuss steps taken by the airlines in cooperation with the Authority to safeguard scheduled flying operations during the coming winter even beyond the conservative program enforced during the bad weather period of 1937-1938. The Air Transport Association committee informed the Safety Board and the Authority of the numerous steps already agreed upon by the air line operators in the furtherance of this safety program. One of the most important of these steps was an agreement by the three transcontinental operators—United, T W A, and American—to reduce the cruising speed of their airplanes to an even greater extent than was called for under the conservative and flexible schedules in effect during the winter 1937-1938.

The Authority announced that it had approved the purchase and installation of several radio direction finding ground stations, which will be used to supplement the existing radio beacons and other airway aids. Such direction finders play an important role in Pan American Airways' system of navigation in both Latin America and on its transpacific route, and it is intended by the Authority and the operators to determine whether they can be used as an additional aid to safe flight and as a further safeguard to air liners on the domestic airways system.

It was planned to install the direction finders at strategic points so that they could be used to take triangular cross bearings on aircraft in flight and thus provide a definite "fix" on the positions of such aircraft at times when static or other interference with radio range signals might make it difficult for their pilots to ascertain their own bearings definitely.

Air carriers were given until October 21, inclusive, to file applications for certificates of convenience and necessity with the Authority. Such certificates are required under the Act by all persons engaged in interstate commerce or in overseas or foreign commerce who act as common carriers for hire or who carry mail by aircraft.

The so-called "grandfather clause" of the Act required the



#### PRECISION GAUGE INSPECTION

With a varied assortment of precision gauges spread out on a long rack before him, an inspector carefully checks every detail of workmanship, finish and dimensions of the parts in an aircraft engine. This photo was taken in the Pratt & Whitney plant at East Hartford, Conn.

Authority to issue certificates of convenience and necessity upon application within the stated period to applicants showing proof that they, or their predecessors in interest, were air carriers continuously operating as such and rendering adequate and efficient service from May 14, 1938, until 60 days after the enactment of the law.

The Field activities of the Authority are coordinated under seven regions, each supervised by a regional supervisor. These regions are as follows:

Region No. 1—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Maryland, Delaware, Virginia, West Virginia and the District of Columbia. Regional headquarters at Newark, N. J.

Region No. 2—North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi and Tennessee. Regional headquarters at Atlanta, Ga.

Region No. 3—Ohio, Indiana, Michigan, Kentucky, Illinois, Wisconsin, Minnesota and North Dakota. Regional headquarters at Chicago, Ill.

Region No. 4—Arkansas, Louisiana, Oklahoma, New Mexico and Texas. Regional headquarters at Fort Worth, Tex.

Region No. 5—Iowa, Missouri, Kansas, Colorado, South Dakota and Nebraska. Regional headquarters at Kansas City, Mo.

Region No. 6—California, Nevada, Utah and Arizona. Regional headquarters at Santa Monica, Calif.

Region No. 7—Montana, Washington, Idaho, Oregon, Wyoming and the Territory of Alaska. Regional headquarters at Seattle, Wash.

#### **Bureau of Fisheries**

An aerial patrol of the fisheries of Alaska was again carried on by the U. S. Bureau of Fisheries of the Department of Commerce during the fiscal year 1938, with chartered airplane service being furnished by six companies on 23 days. The total flying time was 56 hours, during which the planes covered 6,246 miles.

Chartered airplane service was also used for survey and photographic work in connection with scientific investigations of the salmon which were conducted in the Bristol Bay region in western Alaska from July to October, 1938. Transportation was provided on 25 days during this period, and the total flying time was 102 hours, during which 9,200 miles were covered. Such investigations, as well as the fisheries patrol, were continued in 1939.

#### **Bureau of Foreign and Domestic Commerce**

Probably no important American manufacturing industry is more

dependent on export trade than is that group of manufacturers producing aircraft, aircraft engines and aviation instruments. For a number of years, approximately one-third of the value of the total production of this group went to export; in 1937 it was estimated at 34.2 per cent. During this first half of 1938, exports were calculated to have absorbed 51 per cent of total production. The final and all-inclusive export returns for 1938, as based on shippers' export declarations, show that the foreign sales total was \$68,209,050; 73.2 percent higher than the previous record year and representing approximately 49 per cent of the industry's total dollar volume.

It is only natural that an industry so active in foreign markets



LOAD TEST ON BEEHCRAFT 18

The entire airplane has been turned on its back and the wings loaded with sand bags to their design load capacity. At the same time the platform in the foreground carries a load of sand bags suspended from a cable which passes over a pulley and exerts an upward load on the motor mount.

should make increasing use of the facilities offered by the Automotive-Aeronautics Trade Division of the Bureau of Foreign and Domestic Commerce (Department of Commerce) to keep currently informed on developments abroad directly affecting its interests. Through the Aeronautics Trade Section of the division mentioned, the industry has the benefit of the authentic and timely aeronautical market and related information which comes in to Washington from the 33 offices of the Department of Commerce, in charge of commercial attachés and trade commissioners, located at the most strategic commercial centers abroad. This reportorial service is substantially

supplemented by data received from American diplomatic and consular offices, thus effectively affording world coverage. All this material, including that from other sources abroad, received by air mail, regular mail and cable, is expeditiously correlated and made available to the aeronautic industry through individual communications, publication in the division's periodical, "Aeronautical World News", which appears on the 15th and 30th of each month, through the bureau's 79 district and cooperative offices located in the principal cities of the United States, or in whatever other manner is considered necessary.

The year 1938 was an extremely active one for the Aeronautics Trade Section. The growth of American aeronautical exports was accomplished in the face of greatly increased competition from foreign suppliers. The competition and the form it often takes present a constantly changing array of perplexing problems to the exporters. It is these problems that are the basis of most of the increasing volume of inquiries which come to the Department of Commerce agency which has been set up by law to foster and promote the foreign and domestic trade of the United States. Whether it is the question of securing proper representation in specified markets abroad, coping with dollar exchange scarcities, foreign acceptance of American aircraft and other aeronautical equipment, duty rates, credit terms offered by foreign competitors, or merely general information on the state of development of foreign markets—on all these and many additional related subjects the Automotive-Aeronautics Trade Division can, usually from material available in Washington, render prompt service.

An important general service of the division indispensable to exporters who realize the necessity of closely following trends in their overseas markets is the export statistical statement which is contained in the "Aeronautical World News" on the 30th of each month. Here a record is given of the exports, by countries of destination, of all aeronautic products from the United States—the details include not only unit totals, where applicable, but also the value figures.

It is expected that the Automotive-Aeronautics Trade Division's 1939 program will follow the previous pattern on an intensified scale. The addition of new types of services or extension of former services will be predicted on the practical requirements, expressed through inquiries, or aeronautical exporters.

#### Division of Controls

The Office of Arms and Munitions Control, of the U. S. Department of State, was superseded January 3, 1939, by the Division of

Controls, with Joseph C. Green in charge of the newly designed bureau as he was chief of the old group.

The duties of the new division were announced by Cordell Hull, Secretary of State, as follows:

"1. To initiate the policy action of the department and to act as adviser to the Secretary of State in respect to problems arising from the international traffic in arms, ammunition, and implements of war and other munitions of war, and in respect to other controls established to prevent the involvement of the United States in war or to contribute to the national defense of the United States; to supervise the carrying out of these policies; to collaborate in the initiation of the policy action of the department; and to act as adviser to the Secretary of State in respect to other problems of American neutrality and in the supervision of the carrying out of these policies.

"2. To initiate the policy action of the Department and to act as



WACOS FOR SOUTH AMERICA

Part of the fleet of Waco Model D machines, powered by Wright Whirlwinds, delivered to Uruguay.

adviser to the Secretary of State in respect to treaties and international agreements dealing with the international traffic in arms, ammunition, and implements of war and other munitions of war; to prepare drafts of such treaties and international agreements; and to supervise the fulfillment of the international obligations of the United States under such treaties and international agreements.

"3. To perform all necessary duties in connection with the administration of the statutes providing for the preservation of American neutrality, for the control of the international traffic in arms, ammunition, and implements of war and other munitions of war, and for other controls established to prevent the involvement of the United States in war or to contribute to the national defense of the United States, in so far as the administration of these statutes is vested in the Secretary of State, and to act for and on behalf of the Secretary of State in the issuance, revocation, and amendment of

registrations, certificates, allotments, and licenses provided for by such statutes or by regulations issued thereunder.

"4. To assist, or act for and on behalf of, the Secretary of State in the performance of his duties as Chairman and Executive Officer of the National Munitions Control Board.

"5. To maintain liaison with other Departments and agencies of the Government in respect to matters within the scope of the duties of the Division.

"6. To furnish information to the Department of Justice and to assist that Department as may be required in the prosecution of violations of the treaties and statutes relating to the preservation of American neutrality, to the control of the international traffic in arms, ammunition, and implements of war and other munitions of war, and to other controls established to prevent the involvement of the United States in war or to contribute to the national defense of the United States, the administration of which is vested in the Secretary of State.

"7. To perform such other duties as may from time to time be assigned to the Division by the Secretary of State."

#### **Federal Communications Commission**

The Federal Communications Commission in 1938 continued to give expeditious consideration to requests for temporary authority to operate radio equipment when such action appeared to be justified. However, these requests were often delayed by the failure of applicant to be specific as to all matters concerning the nature of the authorization desired and the reason why immediate consideration was requested.

Growth in the aviation communication system continued. As a result of experimental work on frequencies above 30,000 kc. experimental authorizations were given for several instrument landing systems to serve commercial air transports. The operation of these systems, together with those being installed by the Civil Aeronautics Authority, will be studied with a view to the eventual standardization of instrument landing procedure. Research indicates that the transmission range of frequencies above 125 mc is adequate for airport control purposes, and that their freedom from static interference, which has been complained of on 278 kc, makes them peculiarly valuable for this purpose, inasmuch as control communication is most needed in times of bad weather.

#### **Geological Survey**

The Geological Survey of the U. S. Department of the Interior



conducted extensive operations in aerial photography as applied to mapping during the fiscal year 1938. The report of the survey follows:

"The Geological Survey, has been using aerial photography since 1919. Both multiple-lens and single-lens photographs are used, the type depending upon the character of the area to be mapped and upon the number and location of control points available for their adjustment. The graphical radial-line method is generally used in compiling maps from photographs. A line map showing all planimetric details of drainage, culture, and woodland is compiled in the office on the scale of the photographs and then reduced to the field scale and printed in light blue on plane-table sheets. The topographic survey is then completed on this planimetric map base.

During the fiscal year 1938 the Geological Survey continued the



#### VULTEES FOR TURKEY

One of the order of Vultee V11-GBT attack bombers, with 900 h.p. Wright Cyclone engine, built for the Turkish air force.

extensive use of aerial photographs in conjunction with ground surveys on topographic mapping projects, resulting by the end of the year (June 30) in the production of topographic base map (planimetric) of 16 quadrangles ( $7\frac{1}{2}$ -minute) and parts of quadrangles in Louisiana and Michigan covering a total area of 977 square miles for the two States. Line map bases (planimetric) of nine quadrangles ( $7\frac{1}{2}$ -minute) in Massachusetts and 15 quadrangles ( $7\frac{1}{2}$ -minute and 15-minute) in Missouri, covering a total area of 1,975 square miles in the two States, were compiled from aerial photographs. The compilation of planimetric maps totaled 2,952 square miles. Topographic maps of parts of two 15-minute quadrangles in Virginia and part of a special map of the Little Rockies, Montana, were constructed by

the stereophotogrammetric method, using the aerocartograph apparatus. The area covered by these was approximately 165 square miles. The Survey continued its work of mapping in the Tennessee River Basin for the Tennessee Valley Authority, using the stereophotogrammetric method with a battery of multiplex aerial projectors.

"The Geological Survey contracted for aerial photography covering 1,876 square miles and, in addition, purchased from commercial firms photographs previously taken by them, the areas covered totaling 3,342 square miles. The Army Air Corps photographed 839 square miles for the Survey. Photographs covering 389 square miles were furnished by the engineer of the First Corps Area. Photographs of scattered areas amounting to 1,000 square miles were purchased from other Federal agencies and, in addition, negatives for 5,063 square miles were borrowed from them to make prints in the Survey's laboratory for map compilation. During the year the Geological Survey obtained photographs of 12,509 square miles for mapping use. A large number of these photographs were used in the field in conjunction with ground surveys to add details of the terrain shown on individual photographs. Such use of them, when it is not practicable to construct planimetric bases, results in a saving of time to the field engineer in mapping minor features and increases their accuracy.

"The value of aerial photographs in geologic mapping has long been recognized. During the year 1938 they were used by geologists of the Geological Survey in many areas where photographs were available and in a few areas where contract flights were made for that specific purpose. In fact, the extent to which aerial photographs are used for geologic purposes by the Geological Survey is controlled principally by availability of photographs and of funds. In some areas where suitable topographic maps are available the photographs are used for geologic details. In most of the areas, however, planimetric maps based on aerial photographs will serve as a base for the published geologic map. In one area a topographic map has been constructed by the stereophotogrammetric method for geologic use.

"Executive order of December 30, 1919, creating the Board of Surveys and Maps authorized the establishment of a central information office in the Geological Survey for the purpose of collecting, classifying, and furnishing to the public information concerning all map and survey data available from the various Government agencies and elsewhere. Owing to the tremendous increase in recent years of the number of photographic projects undertaken by the Government it was decided that the map information office should be used as a clearing house for all aerial photographic data similar to

that for 'maps.' Federal agencies contemplating a photographic project request a check of the files to find out if there will be any duplication. Requests for information concerning the procurement of photographs are also handled by this office. All the work of the map information office is carried on by personnel of the Survey's section of photo-mapping.

"Aerial photography for the various Government agencies is done under specifications that cover the needs of all the services; therefore, the negatives for one project are suitable for others and an agreement is in force whereby one Government bureau can borrow the negatives of photographs taken for another bureau."

#### Hydrographic Office

The Hydrographic Office, Navy department, publishes and has on sale aviation charts covering certain areas outside the United



#### GRUMMAN AMPHIBIONS

This fleet of Grumman G-21A amphibions was delivered to the Peruvian Air Corps. Each plane is powered by two Pratt & Whitney Twin Wasp Junior engines.

States; collects and disseminates timely information, and furnishes various other aids contributing to the safe navigation of aircraft; issues periodically, free to cooperating observers, monthly pilot charts, a monthly notice to aviators and memoranda for aviators. 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 on Civil International Aviation

The Interdepartmental Committee on Civil International Aviation was organized at the request of the President of the United States on July 2, 1935 "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." The original members of the Committee were still serving in 1938. They were R. Walton Moore, Counselor of the Department of State; Stephen B. Gibbons, Assistant Secretary of the Treasury; Harlee Branch, Second Assistant Postmaster General; and John Monroe Johnson, Assistant Secretary of Commerce.

The committee held several meetings in January in connection with a conference in Washington between United States and Canadian aeronautic officials. This conference resulted in the drafting of bilateral agreements on air navigation, issuance of pilots' certificates and acceptance of certificates of airworthiness for export.

During the first half of the year, the Committee met to discuss the numerous problems arising in connection with the establishment of transatlantic and other international air services. The activities of the Committee were restricted, however, after the enactment in June of the Civil Aeronautics Act, because it was felt that nothing should be done which would interfere with the independence of action of the Civil Aeronautics Authority upon its organization. After the appointment of the members of the Authority, the Committee decided that its services were no longer necessary, because the problems which it had previously dealt with could now be handled by consultations between the Authority and the Department of State. An appropriate recommendation was therefore made to the President, who terminated the services of the Committee in October.

#### **National Advisory Committee for Aeronautics**

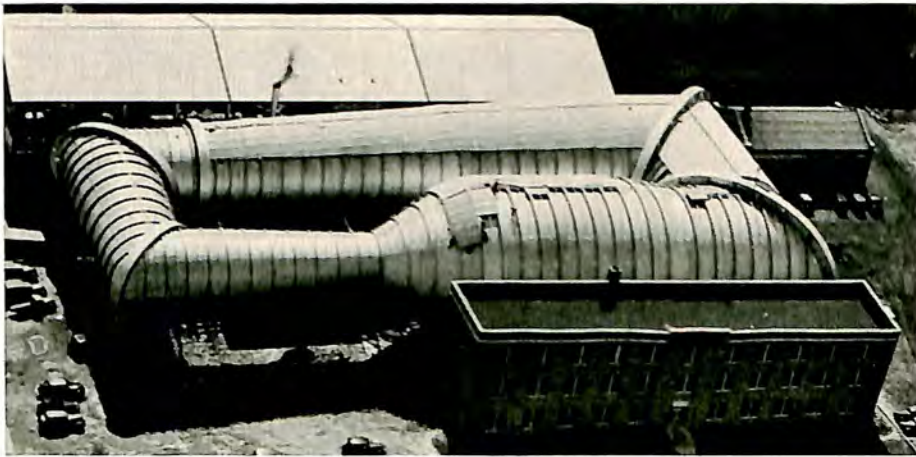
With the international race for supremacy of the air at fever pitch, superior air force is more than ever before of vital significance to the United States. Fully aware that the safety and security of the country in time of war may depend upon a decision in the air, the nation is bending strong efforts toward maintaining leadership in world aviation. With this deep interest has come the realization that the position of the United States in the air depends largely upon progress in aeronautical research.

Today the eyes of the aviation world are focused on the laboratories of the National Advisory Committee for Aeronautics at Langley Field, Va.—center of the Government's aeronautical research activities.

New wind tunnels are rising as workmen labor 24 hours a day on construction. New equipment is being installed, and old apparatus is being modernized. In the various laboratories engineers are bending to research with renewed vigor. And over all of this zealous activity the United States has dropped a shroud of secrecy, as elaborate precautions are being taken to keep hard-gained knowledge at home.

Long famed for its superlative wind tunnels, the NACA soon will have even more equipment with which to conquer new fields of aeronautical research. Of the tunnels now under construction, most impressive is the new pressure-type tunnel with a 19-foot diameter flow passage at the test section. Recently completed, a large refrigerated wind tunnel is proving invaluable in investigating problems of ice formation on aircraft.

Realizing the need for studying models of aircraft when flying unrestrained, the Committee recently developed a new form of wind tunnel known as a "free flight" tunnel. Successful experiments with a small size tunnel of this type led NACA engineers to construct one with a 12-foot diameter test section. This new tunnel is housed in



N. A. C. A. 19-FOOT PRESSURE TUNNEL

One of the new pieces of equipment at the research laboratories of the National Advisory Committee for Aeronautics at Langley Field, Va.

a gleaming sphere covered with aluminum paint that looks like a silvery celestial body which has come to earth.

So pressing has been the NACA's program for construction that the 1938 annual conference, scheduled for May, was postponed for a year.

The future holds much for aviation as is strikingly evident at the NACA laboratories. Every day engineers prove there is something new under the skies. Every day scientific facts and figures are assembled after most exacting research work, with important new data being issued frequently.

In the 7- by 10-foot wind tunnel an exhaustive study of wing flaps is underway. Already this study has led to the development of highly

effective flaps, enabling large aircraft to take off as well as to land at lower speeds, an important safety feature.

In the fields of cowling design and improved air cooling of engines, NACA scientists are convinced that possibilities for large improvements still remain. Methods of realizing these improvements are being intensely investigated both in the Committee's larger wind tunnels and in its modern power plant laboratory.

Highly significant work is being accomplished in the study of tricycle landing gear. With this new type gear, which gives unprecedented ground control of aircraft, a new era of safety has been reached. Already this gear is being used effectively on the Douglas DC-4.

During 1938, in accordance with the provisions of the Civil Aeronautics Act, President Roosevelt appointed four new members and reappointed four of the nongovernmental members of the National Advisory Committee for Aeronautics. Serving without compensation, the members form a distinguished group drawn from the ranks of science and the Government's air organizations. Those reappointed were Dr. Joseph S. Ames, Chairman; Orville Wright; Edward P. Warner; and Col. Charles A. Lindbergh. Among new members were Edward J. Noble, then Chairman, and Clinton M. Hester, Administrator of the Civil Aeronautics Authority. The two other new members were Dr. Vannevar Bush, President of the Carnegie Institution, and Dr. Jerome C. Hunsaker, of the Massachusetts Institute of Technology. Under the new law the tenure of office of non-Governmental members is limited to five years (subject to reappointment), opening the way for a periodic influx of fresh energies and viewpoints.

High honors have been conferred upon NACA engineers by the aviation world. During 1938, Richard V. Rhode became the 10th recipient of the Wright medal for aerodynamic study. His winning paper—"Gust Loads on Airplanes"—contributes new facts on the complex problem of determining the forces acting on airplanes flying in rough weather. Mr. Rhode recently designed and constructed a gust tunnel at Langley Field.

Through the years, NACA men have achieved much in aeronautical research, and the roster of award winners is lengthy. To Dr. George W. Lewis, director of NACA research, went the Guggenheim Medal; to Dr. Joseph S. Ames the Langley Medal for Aerodynamics; to Orville Wright, the Franklin Institute Medal; and to Eastman N. Jacobs, the Wright Brothers Medal. The Collier Trophy was once awarded to the Committee itself for development of the NACA cowling.

Eastman N. Jacobs, NACA staff engineer, received the Sylvanus A. Reed award for his work in the study of airfoils. His investigation of wing sections embraced several years, during which hundreds of airfoil shapes were studied. With this data, aircraft designers can predetermine the most efficient types of wings for airplanes. The Jacobs work, which was pursued in the NACA variable-density tunnel, included airfoil designs for aircraft as large as the DC-3. Now, with even much larger airplanes being designed, further airfoil research can be conducted in the 19-foot tunnel. Designed to operate at high air pressures, as in the variable-density tunnel, this new tun-



U. S. Navy photo

#### NEW GRUMMAN FIGHTER

Model F4F-2 developed for the Navy Bureau of Aeronautics is powered by a Pratt & Whitney Twin Wasp engine.

nel with its spacious test section enables engineers to study relatively large models of giant aircraft under conditions better than in a pressure type tunnel.

Today in the variable-density tunnel engineers are concentrating on investigating tapered wings and wing stalling. Already in advanced states of experimentation are stall-control flaps which have been investigated as one possible means of preventing airplanes from being stalled inadvertently and thereby falling violently out of control. There has been completed, as a result of the same study, a stall-warning indicator which warns the pilot when his airplane is approaching dangerously close to the point at which the wings lose lift.

Never content to rest on its laurels, the Committee is working to improve existing apparatus. With an eye to the future, the NACA has lengthened its seaplane testing basin to 2,900 feet. With trans-oceanic flying boats firmly established in the scheme of world trans-

portation, the "tank" fills an important need. Now scale models of flying boats are tested up to take-off speeds. The construction of hull models has advanced, and today they are similar to the large flying boats, not only in shape but even in weight distribution.

Located near Chesapeake Bay, within 100 miles of the windswept sand dunes of Kitty Hawk where the Wright Brothers made their historic flight, the NACA's laboratories hold many eye-filling wonders for visitors. There is the gigantic "full-scale" wind tunnel, where full-size aircraft are tested in a smooth stream of air flowing at 118 miles an hour. Until this type of tunnel was duplicated by foreign powers, it was the only one of its kind in the world. In the recently built high-speed tunnel, tests are made in 500-mile-per-hour winds, making possible research contributions to the development of higher speed planes.

Ever since its beginning in 1915, the NACA has thrived on the problems of flight, and by solving aviation's enigmas has won worldwide fame for the Committee's scientific experts. Not content to fill aviation's present-day research needs, the NACA tries to anticipate future problems. To analyze the present and probable needs of aviation, civil and military, the NACA has set up technical subcommittees which supervise specific fields of research. The subcommittee members are specially qualified representatives of all Federal agencies concerned with aeronautical development, as well as prominent scientists and engineers from universities and laboratories.

In the NACA annual report were the following comments about the value of research.

"Air power at the present time is a dominant factor in the strength of a nation and in enabling it to maintain its independent existence and territorial integrity. Accepted theories of warfare give a steadily increasing place to air power.

"Air power is primarily dependent not only upon numbers of airplanes, but the airplanes themselves must have performance at least equal to that of an enemy. The fact that modern military aircraft require frequent replacement by improved types brings forcibly to our attention the necessity of basing their design upon the best and most reliable data from research laboratories. New information is being obtained in the aeronautical laboratories of many nations, and unless our own laboratories keep pace, the United States cannot hope to compete with foreign nations in the development of either military or commercial aircraft.

"The relation of laboratory research to the development of efficient aircraft is being increasingly appreciated by the world powers. The



United States for a number of years has held undisputed leadership in the field of aeronautical research. At the present time that leadership is being challenged. Unless, therefore, we fully recognize the challenge and make provision for extending the Committee's research facilities and for increasing the number of its trained research personnel, the United States will definitely fall behind.

"The struggle of nations to extend their influence to other countries, is resulting in determined efforts to establish air trade routes. A few



MOCK-UP OF CURTISS-WRIGHT CW-20

The new substratosphere airliner was to be completed in 1939.

years ago, great distances were an insuperable barrier to transoceanic air transportation, but the rapid improvement of aircraft has shrunk the map of the world.

"Looking to the future, the progressive nations are making sacrifices and expending their national energies and resources for the purpose of advancing their air commerce. The United States, in extending and developing its domestic and international air commerce, is confronted with serious competition in the operation of air lines over the

Atlantic and Pacific Oceans and to South America. In this connection the importance of scientific research cannot be overemphasized, as the long distances of flight over water demand a maximum of efficiency in aircraft. The United States leads at the present time in domestic and international air commerce. It should cherish this position and bend every effort to extend further its commercial air transportation.

"The establishment of the Civil Aeronautics Authority has improved Governmental aeronautical organization. The Governmental agencies concerned with aeronautics are now organized on a sound and logical basis and function in cooperation. The aircraft manufacturing and operating industries have shown a commendable spirit of cooperation with the Government and with each other, and are alert to apply the results of the Committee's researches in a constant effort to improve the performance, efficiency, and safety of both military and civil aircraft. The Committee believes that the continuous and systematic conduct of scientific laboratory research on the basic problems of flight is the most fundamental activity of the Government in connection with the development of aeronautics. The Army, Navy, and Civil Aeronautics Authority are equally represented on the Committee. With their hearty cooperation the Committee coordinates the research needs of military, naval, and commercial aviation, and conducts the more fundamental scientific investigations in one central Government laboratory at Langley Field, Va. In this way a maximum of progress is obtained at minimum expense without overlapping or duplication.

"In the rapidly advancing science of aeronautics the technical development of aircraft is directly dependent upon scientific laboratory research. The recent great expansion of research facilities by other nations will bring to an end the period of American leadership in the technical development of aircraft unless the United States also constructs additional research facilities. This subject is being studied by a special committee which includes in its membership the heads of the Army Air Corps, the Navy Bureau of Aeronautics, and the Civil Aeronautics Authority. The recommendations of that special committee will probably become the subject of a special report to the President and the Congress.

"The Committee is grateful to the President and the Congress for the support accorded its work in the fields of basic and applied research in aeronautics. The Committee is determined to make every effort to meet its responsibilities by providing the scientific foundation for keeping America first in the technical development of both military and commercial aircraft."

## National Bureau of Standards

Airport and airway lighting—The study of the equivalent luminous intensity of rotating beacons has been continued and the results obtained thus far have been published. In cooperation with the Civil Aeronautics Authority new specifications have been prepared for two types of 24-inch airway beacons. The new designs will assure greater immunity from the effects of ice and wind, are more accessible for maintenance, and will probably be less expensive to build.

An experimental low-cost boundary light circuit has been installed at Washington Airport. This circuit has a 550-volt multiple



THE HARLOW PJC-1

It is powered by a Warner Super Scarab engine.

feed with a transformer at each boundary light unit supplying a 110-volt current to the lamp. The circuit has given no difficulty to date.

Aerodynamics—The aerodynamic investigations of boundary layer flow and of turbulence have been continued in cooperation with the National Advisory Committee for Aeronautics. A report has been published on new turbulence-measuring equipment with a. c. power supply. The transition between laminar and eddying flow in the boundary layer of an elliptic cylinder has been studied as a function of air speed and of the intensity and scale of the turbulence of the air-stream. The fluctuations of the several components of the air speed in the eddying boundary layer of a plate have been investigated. A

simple method has been developed for measuring the correlation between the velocity component perpendicular to the plate and that in the direction of mean flow. Studies have been made of the spectrum of turbulence.

Aircraft structures—The following investigations of aircraft structural problems have been made in cooperation with the Bureau of Aeronautics, Navy Department and the National Advisory Committee for Aeronautics: Strength of riveted joints in aluminum alloy; endurance of wing beams under alternating axial loads; strength of wing beams under combined loads; strength of sheet-stiffener combinations as affected by rivet spacing; performance of strain gages suitable for measuring vibrational strains; crinkling and bending strength of tubes; strength of tubing under combined loads; column strength of stiffeners; strength of flat plates under pressure; compressive properties of thin sheet material; and stresses in vibrating propellers.

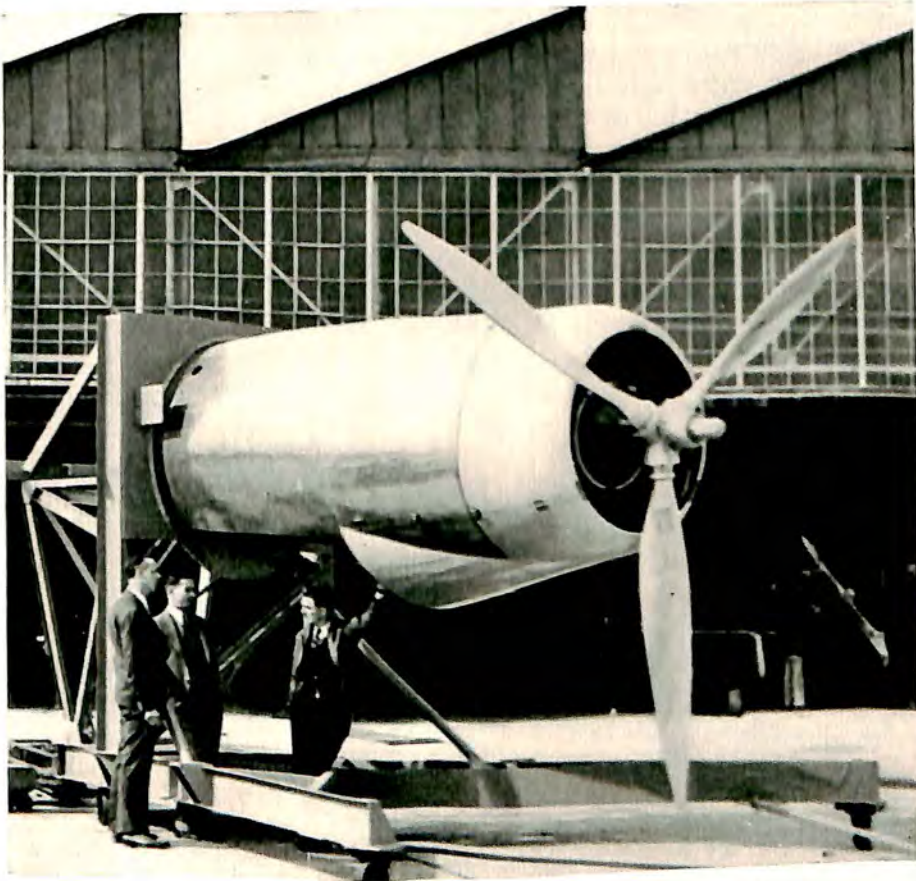
The strength and deformation of important elements of mono-coque or stiffened skin structures have been determined experimentally. Reports have been completed on the column strength of a stiffener of symmetrical section, and on the strength and deformation of sheet-stringer panels of typical design. A technique was developed for loading the sheet stiffener specimens, for measuring strains on the surface of the thin sheet, for obtaining the shape of the buckles, and for following the deformations of the stringers to failure.

Effect of corrosion on welded and riveted joints.—Supplementing a series of weathering tests of 4 years' duration, carried out under seacoastal and inland conditions, tests were begun during the year to determine the effect of atmospheric and of intermittent tide-water corrosion on riveted and welded joints. Alloys of aluminum, magnesium, and corrosion-resistant steel are included in the series.

Protection of magnesium alloys against corrosion.—The useful life of magnesium alloys, the lightest structural material available, is dependent upon the measures used to protect the surface against corrosion, especially under marine conditions. Studies along this line have been actively continued and some improvements effected in the anodic surface treatment which was developed at the Bureau of Standards a few years ago.

Chromium plating of aircraft parts.—During the last several years the Bureau has cooperated with the Bureau of Aeronautics and the Naval Aircraft Factory in a study of chromium plating and its possible applications to those parts of aircraft that are subjected to wear, or to both wear and corrosion. The properties of chromium deposited under various conditions have been studied, and a process developed

in which high current densities are used. These conditions greatly reduce the time of plating when very thick deposits of chromium are required. Fixtures especially adapted to the uniform plating of typical parts have been designed and standardized.



#### WRIGHT ENGINES "TEST FLOWN" ON THE GROUND

Each of the two Wright double-row 1,600 h.p. Cyclone engines, with which the new Curtiss-Wright "CW-20" transport is powered, were mounted on a special test rig and run up to provide a detailed study of air flow, cooling, vibration and other phases of operation preliminary to being installed in the plane. Above, one of these 1,600 h.p. Wright Cyclones, equipped with a 15-foot Curtiss Electric propeller, is shown on the special mobile test stand which may be moved so that the unit points into the wind while running.

In general, the application of chromium has proved advantageous in reducing wear on parts subjected to abrasion in service. Further studies are required to determine whether the reduction in fatigue resistance sometimes produced by the chromium coating will prevent

its application to certain parts. Where applicable, chromium may either be applied for the reclamation of used parts that have been worn in service, or for increasing the life of new parts. Among the most successful applications is that on brake drum liners.

A plant has been designed and installed at the Naval Aircraft Factory for experimental plating on a factory scale. Specifications for the plating process and the plated coating have been prepared for use by the Bureau of Aeronautics.

Elastic properties of corrosion-resistant steels.—A report summarizing the results of a fundamental study of the elastic properties of the corrosion-resistant steels, which in sheet form are coming into wide usage in aircraft construction, has been submitted to the National Advisory Committee for Aeronautics. The high strength and pseudo-elastic properties of austenitic steel, of which the commonly used "18-8" steel is an example, are obtained as a result of the very severe cold-working the material must undergo. This is not true of many of the materials commonly used in various lines of construction. Hence, the need for the study to supply this basic information.

Effect of fatigue on metals.—Three reports have been submitted to the National Advisory Committee for Aeronautics on the subject of the possible deteriorating effect on metals subjected in service to continued fatigue-stressing within the supposedly safe range. Entirely negative results were obtained by the three methods used in the work. No positive evidence was obtained on the basis of which the damage by fatigue-stressing, prior to actual failure, could be evaluated.

Failure by fatigue continues to be the predominating type of failure in many airplane parts which have failed in service and which the Bureau has been called upon to examine. In a great many cases failure can be attributed to improper design features, lack of suitable fillets, sharp corners and angles, and similar defects which, in a stressed member, serve to increase the stress locally greatly above the nominal working stress.

Plastics as structural materials for aircraft.—A survey of published information on the use of plastics in aircraft construction was made at the request of the National Advisory Committee for Aeronautics.

Various physical properties of reinforced plastics were reviewed, including density; tensile, compressive, flexural, shear, torsional, and impact strengths; moduli of elasticity; endurance limit; energy absorption; and corrosion resistance. Similar data from the literature were cited for materials which have been commonly employed for

fabricating aircraft, namely, high tensile steels, aluminum and magnesium alloys, aircraft spruce, and birch plywood.

Problems which require consideration are the choice of resin and reinforcing material, the method of combining and forming them into a suitable product, the testing of such products to determine whether they possess the requisite physical characteristics, the design of structural members to take full advantage of the properties and fabrication possibilities of plastics, and the equipment for forming the separate sections and the technique of joining these sections to produce the finished aircraft. It has been suggested that progress in the utilization of plastics in aircraft construction will be made by the gradual introduction of these materials into an otherwise ortho-



STEARMAN ARMY TRAINER

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

dox structure, and that the early stages of this development will involve the molding of such small units as fins and rudders and the fabrication of the larger units from reinforced sheets and molded sections by conventional methods of jointing. However, until more information is available on the problem of combining resin and reinforcing agent in such manner as to obtain requisite strength and stiffness, and until such products have been thoroughly tested to determine their behavior under repeated stresses, it is too early to expect any considerable progress in solving design and fabricating problems.

Coatings for airship fabrics.—Work was continued for the Bu-

reau of Aeronautics on the application of synthetic rubber-like materials as gas-impermeable coatings for airship fabrics. Considerable assistance has been rendered in the development of specifications for coated fabrics of this type and physical and chemical tests have been made on envelope fabrics for airships of the non-rigid type. The permeability of neoprene to gases, in comparison with the behavior of natural rubber, has been studied, and a report will be made available at an early date.

Non-flammable dopes for aircraft.—Despite the extensive use of metal construction in the fabrication of modern commercial and military aircraft, doped fabric continues to meet a need for a light and relatively inexpensive covering for low-stressed members and for the wings and fuselages of small airplanes. The "dope" which is applied to the fabric to make it impermeable to air and to weather-proof it consists of a film-forming material dissolved in organic solvents. Cellulose nitrate is at present commonly used as the film-forming base, but it is easily ignited and the rate of burning is very rapid. An experimental study of airplane dope formulation was, therefore, undertaken by this Bureau at the request of the Bureau of Aeronautics of the Navy Department to develop a dope, based on the comparatively non-flammable cellulose derivatives, which would compare favorably or surpass cellulose nitrate dope with respect to the action of high relative humidity on the tautness of the doped fabric.

Airplane fabrics were doped with various plastics dissolved in a variety of solvent mixtures, and the tautness of each fabric was then determined. The most important single factor involved in the initial tautening property of a dope is the solvent composition. In order to obtain a maximum tautening effect, it is necessary to formulate a dope so that a minimum of active solvent will be present during the final drying stage. The selection of this solvent is also an important factor in avoiding the formation of a film which is initially brittle or which rapidly becomes brittle upon exposure out of doors.

The highest initial-tautness values were obtained with cellulose triesters, such as cellulose triacetate and a practically completely acylated cellulose acetobutyrate. Varying the acyl or ethoxyl content of partially hydrolyzed cellulose derivatives did not have a pronounced effect on the ability of the compounds to tighten the fabric. The initial tautening property is also apparently independent of the size of the cellulose molecule, as indicated by certain flow characteristics of solutions of these materials. The tests for the majority of the cellulose esters were made with films containing 10 percent of triphenyl phosphate.

In exposure tests, the cellulose acetobutyrate and cellulose nitrate



panels behaved quite similarly, slackening somewhat when removed from the conditioning room into the sunlight, and, in general, showing a slight additional decrease in tautness in rainy weather. The cellulose acetate panels slackened during periods of rain to a greater extent than any of the other derivatives. The cellulose acetopropionate panels also showed marked slackening in rainy weather after 3 months of exposure on the roof. The ethylcellulose and benzylcellulose panels were considerably poorer in initial tautness and slackened still further upon exposure. However, the results of these exposure tests must be considered as only exploratory and preliminary to the testing of dopes formulated to develop optimum tautness, flexibility, and moisture resistance. Before dopes having these characteristics can be formulated, it will be necessary to obtain detailed information on the effect of various solvents, diluents, and plasticizers on the properties of the film-forming plastics.



TWIN TAIL SIKORSKY AMPHIBION

One of the fleet of Pratt & Whitney Hornet-powered passenger ships delivered to Inter-Island Airways in Hawaii.

Combustion of engine fuels.—A ten-inch spherical bomb, with a spark gap at its center and with indicators to measure the rapid rise in pressure during gaseous explosions, has been developed and used in cooperation with the National Advisory Committee for Aeronautics. Data already have been obtained with the fuels carbon monoxide, benzol, heptane, and octane. It is anticipated that comparative values of inherent power, economy, and flame speeds, (fundamental properties determining their suitability for use in internal-combustion engines) will result from the completed survey. Measurements are also being made to determine the individual effects of initial pressure and temperature, which operate simultaneously to influence combustion in the engine cylinder.

Octane rating of fuels.—The analysis of full-scale aircraft engine

tests has shown that current laboratory methods do not correctly rate different types of high octane aviation fuels. The Bureau will cooperate with the CFR Aviation Fuels Division in the development of an improved method of rating aviation fuels.

Vapor lock in fuel systems.—In connection with the CFR aviation vapor lock project, the Bureau is investigating the resistance to fuel flow in component parts of aircraft fuel systems as a function of rate of flow and relative amounts of liquid and vapor flowing. The object of this work is to provide the designers of fuel-feed systems with reliable data on gasoline flow under vaporizing conditions.

Stability of lubricating oils.—The laboratory work on the investigation of the stability of aircraft engine lubricating oils has been completed. A large volume of experimental data has been obtained on the changes which take place in aviation oils when heated for various periods of time with and without aeration at a number of temperatures, and this information is being prepared for publication. A satisfactory correlation has been worked out between one of the laboratory methods and aircraft engine tests under controlled conditions, as well as with service tests. Further work is under way on the relation between laboratory data, used oil analyses, and engine condition at the time of overhaul. Also, further work is being done on the effect of compounding agents on oil stability.

Wear of cylinders and pistons.—An investigation is under way concerning the effect of compounding agents in reducing cylinder wall and piston ring wear, particularly under conditions similar to those existing in high-output aviation engines. Laboratory apparatus for this work has been constructed, and some preliminary tests have been made. Tests with a full scale aviation engine on several mineral and compounded oils have been started.

Ring sticking and bearing corrosion.—Some work has been done on the development of laboratory test methods for ring sticking and bearing corrosion. On the basis of preliminary tests, operation of a liquid-cooled, single-cylinder engine with high cooling liquid temperature promises to give some information of value. Apparatus has been constructed in which oils can be acidified under controlled conditions and bearings can be operated under load to evaluate the extent of corrosion.

Explosions in gasoline dump ducts.—At the request of the Bureau of Air Commerce, explosions have been studied in tubes simulating gasoline dump ducts for aircraft. There appears to be no danger of disrupting the duct by the explosion of a gasoline air mixture in the open-end tube.

Electrical equipment and temperature surveys.—Development

work for the Bureau of Aeronautics on spark plugs, ignition cable, and spark generators has been continued. Studies of low-tension cable, and tests of auxiliary electrical equipment have also been made. Facilities have been provided for testing electric motors which operate at speeds in excess of 24,000 r.p.m. Power plant temperature surveys have been made on all new types of Navy airplanes, both on the ground and in flight. The measurements have been extended to include oil temperature and intake mixture temperature.

Engine tests.—For the information of the military services, two small experimental engines were subjected to approximate altitude tests. These engines were submitted by firms interested in the development of auxiliary power plants for use in large aircraft. In addition to the above, a series of 50-hour endurance tests were con-



THE HOWARD DGA-15PC

A private owner plane powered by a 450 h.p. Pratt & Whitney Wasp Junior engine.

ducted on the torque stand, using a 9-cylinder radial aircraft engine, for the purpose of comparing different oils and two types of oil tank.

Respiratory oxygen.—Chemical sources of respiratory oxygen have been studied and assistance has been given in the testing of apparatus for rebreathing oxygen.

Aircraft instruments.—Studies of aircraft instrument performance have been continued for the Bureau of Aeronautics, Navy Department, and the National Advisory Committee for Aeronautics. For the Bureau of Aeronautics, laboratory test methods have been developed for calibrating aerographs at various relative humidities by the use of saturated salt solutions; methods have been devised for modifying altitude mercurial barometers to permit filling in the field; and new apparatus has been designed and constructed for making

dynamic tests of accelerometers. Development of a distant-indicating fuel flow meter of the orifice type is in progress. Several super-heat meters, a stick force indicator, a maximum recording tachometer, an airspeed-acceleration recorder, and an electrical resistance thermometer have been constructed.

In cooperation with the National Advisory Committee for Aeronautics, investigations of the effect of vibration on the performance of aircraft instruments, and of the performance of corrugated diaphragms of various materials and designs are in progress. Reports were published on the performance characteristics of venturi tubes used on aircraft for operating air-driven gyroscopic instruments and on gyroscopic instruments for instrument flying.

#### Office of Education

The Office of Education, United States Department of Interior, was called upon for much additional service in aviation training during the year along with the rapid growth of the aviation industries and the consequent need of training for aviation occupations. Individuals, groups, school officials, communities and agents of various kinds have made requests for studies, conferences, information and assistance in connection with aviation education.

Considerable increases in enrollment were reported for Federally aided classes in aviation under funds provided through the Smith-Hughes and George-Deen Vocational Education Acts. About 7,000 persons are given in reports from the States in the following proportions:

All day 1,680; part-time trade extension 3,242; evening trade extension 1,653.

In part to secure current information on aviation training and in part through requests for conferences on training problems, a considerable number of mechanics training schools were visited during the year. Because of changing conditions teachers and others evidenced keen interest in securing assistance so as to maintain training to fit current needs. The schools visited covered an area sufficient in size to represent all types of public and private institutions.

The studies carried on during the year ranged from securing information on occupational training needs for specific jobs to a complete survey of aviation in all types of educational institutions throughout the United States. In a smaller study conducted through 18 aviation schools and 38 units of the aircraft industry, six questions were asked with the following results:

*Question 1:* Is specialization in aviation shop work an obstacle to individuals who might become foremen?

- Answers:* Industry Schools  
Yes—9; no—21. Yes—8; no—8.
- Question 2:* Is there difficulty in securing sufficient technically trained personnel for work on complicated modern aircraft?
- Answers:* Industry Schools  
Yes—22; no—8. Yes—14; no—3.
- Question 3:* Do you find present conditions satisfactory for the upgrading of shop employees?
- Answers:* Industry Schools  
Yes—12; no—12. Yes—8; no—7.
- Question 4:* Do you find high school graduates with from one to two years of special aviation training desirable for advancement, either as mechanics, leading men or foremen?
- Answers:* Industry Schools  
Yes—28; no—1. Yes—14; no—3.
- Question 5:* Would a school where particularly apt mechanics could be sent for a year's training in aeronautical machine work assist you in making them available for foremen's jobs?
- Answers:* Industry Schools  
Yes—25; no—3. Yes—14; no—3.
- Question 6:* Do you believe that any general training of mechanics who are particularly expert would make them suitable for advancement to foremen?
- Answers:* Industry Schools  
Yes—25; no—3. Yes—15; no—2.

At the time of going to press, the survey on aviation in education institutions was not complete, as replies were still being received. Questionnaires were sent to 1,717 colleges and universities of which number 1,023 had replied. A tabulation of reports follows:

*Courses:*

Institutions having aviation classes	109
Enrolled in aviation classes	9,837

*Flight Training:*

Institutions where flight training is available	29
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*Aviation Equipment:*

Wind tunnels	76
Engines	429
Planes	135

*Pilot Licenses Held by Faculty Members:*

Student licenses	21
Solo licenses	12
Private licenses	225

*Pilot Licenses Held by Students of the Universities:*

Student licenses	340
Solo licenses	202
Private licenses	138

*Clubs:*

Club Memberships	2,351
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About 26,000 questionnaires were sent to secondary schools of various types, the following is a digest of the 11,000 replies to date:  
Aviation Course:

Schools conducting aviation courses	130
Total enrolled in aviation courses of various types	32,837
Total enrolled in Industrial Arts Aviation Course	18,220
Total enrolled in General Aviation Courses	7,645
Total enrolled in Vocational Educational Courses	4,650
Total enrolled in Technical Aviation Courses	2,322
Total in Aviation Clubs	24,979

*Miscellaneous:*

Schools indicating use of aviation as conveyor for other subjects	1,308
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**Tennessee Valley Authority**

During 1938 the Tennessee Valley Authority operated four airplanes, a Monocoach, a Bellanca and two Stearmans. The 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 more feasibly than by surface methods.

**U. S. Coast and Geodetic Survey**

The U. S. Coast and Geodetic Survey publishes a series of 87

sectional aeronautical charts on a scale of 1:500,000 or about eight miles to the inch. These charts cover the entire United States and are for use in pilotage primarily. They include approximately 25,000 miles of lighted airways and nearly 2,500 airports. The many changes in the aids, in addition to the completion of new topographical surveys, make frequent revisions and new editions necessary, as it is the intention to maintain these charts to show existing conditions accurately for safe navigation.

To meet the needs of high speed long distance instrument flying, as distinguished from flying by reference to visible landmarks, an



FAIRCHILD 24 ON EDO FLOATS

This version is powered by a Warner engine.

additional series, known as Regional Aeronautical Charts, is in progress. This series is on a scale of 1:1,000,000, or about 16 miles to the inch. Six charts have been published of this series and others are in preparation.

A series of radio direction finding charts, designed especially for use in all forms of radio navigation, are being constructed on the scale of 1:2,000,000, or about 32 miles to the inch. Their smaller scale and wide extent make it possible to plot bearings from radio stations that would frequently be outside the limits of the local chart when

using either of the other larger scale series. Three of these charts are published already. The three remaining, required to cover the entire United States, will be published by July, 1939.

In addition to some photography along the Massachusetts coast in 1938, the nine-lens air camera was used on several experimental 1:31, 680 scale projects in cooperation with the Army Air Corps and the Soil Conservation Service. At this scale, the camera photographs a strip 17 miles wide, and 4,000 square miles are covered on a single flight, with ample overlap for plotting. A rectifying camera to facilitate mapping from its 35-inch square photographs is now under construction.

#### U. S. Forest Service

The vast timber resources administered by the United States Forest Service, besides being commercially valuable, provide watershed cover upon which hundreds of communities are dependent; they offer recreation for many millions of people, a home for much of the nation's wild life, and forage for hundreds of thousands of livestock. The job of protecting these forested areas from fire is therefore one of utmost importance. In this job the airplane has an ever-increasing place, whether it be in fields of prevention, detection, and scouting of fires or in improvement of communication and transportation facilities. In the timbered and remote regions of the national forests recent accomplishments in detection, transportation, and mapping have proved aircraft to be a powerful adjunct to ground measures for conserving the nation's forests.

Aviation aids in striking fire quickly, thereby reducing damage and fire control costs. One of its great values is in the cooperation it furnishes to lookout towers, fire guards, and other ground methods of detecting fire. The percentage of fires discovered by airplanes is low as compared with those discovered by ground lookouts, for a given spot in a forest can be observed only momentarily during a patrol flight. But air patrols are mobile and can find smoldering fires in areas that are blind to stationary men. A fire lookout may detect a forest fire 20 miles away but he cannot see through a mountain and discover the little blaze kindled by lightning on the other side, as can the airplane pilot. Airplanes are especially valuable in detection work on newly acquired national forest areas where the lookout system has not yet been fully developed, during periods when ground crews are badly hampered by haze, and following electrical storms which may cause a large number of spot fires nearly simultaneously.

In the scouting and reconnaissance of a large going fire, the



airplane is likewise significant. Circling above it and getting a more or less vertical view, the air observer can quickly determine the status of the fire, its intensity, location, extent, rate, and direction of burning; also the character of the material in which it is burning. He can determine what natural barriers to the flames's spread are present, and the most advantageous routes of approach. He gets an immediate picture of the whole situation. Information given by flying observers is of tremendous aid to fire suppression officials in allocating their men and resources in endangered sectors.

The development of a two-way radio set for communication with portable equipment on the ground has added greatly to the efficiency of scouting from the air. Formerly the aerial observer had to have messages relayed from headquarters stations, or to drop orders or



CURTISS-WRIGHT CW-22

It is a basic combat plane equipped with a 420 h.p. Wright Whirlwind engine.

messages behind the fire fighting lines tied in a little bag of sand with a streamer attached to attract the attention of the ranger on the job. Even when these messages reached their goal, there was still no way for the ranger to reply. With the new type short wave radio, two-way communication between plane and ground is possible. The observer can report his findings directly to the boss on the fire line, discuss the situation, and receive instructions.

Fires in rugged back country need men on the spot promptly to clear fire control lines. These men must have food, camp equipment, tools, and medicine. To pack in the men and supplies over rough trails difficult to traverse is often a laborious and time-consuming task. Planes contribute high speed transportation of men

and materials to spots often unreachable within time limits necessary to successful fire control by ground crews. When an airplane pilot comes zooming to a fire with an emergency load of equipment and supplies he enables the fire fighters to continue holding the flames in check until the arrival of the ground crews with adequate supplies. He brings relief when provisions run low or when medicines are needed. Transportation of supplies by air compares favorably in cost with overland transportation over rough terrain and is by far the faster method. These advantages are offset to some extent by small carrying capacity, and lack of specialization of the planes used. Air delivery may be relatively unimportant also where topography is favorable to rapid ground transportation systems, but it has proved invaluable in many of the remote back country areas of the national forest system.

More than 30 emergency landing fields have been built in a number of back country areas of western national forests in the past five years, largely by CCC workers. But there is much territory where no such emergency fields are available and there it is that emergency supplies are now being dropped from planes with the aid of parachutes. Where no good roads permit easy access to a fire, package dropping from airplanes is a great aid in equipping and supplying fire crews.

It has been found not only possible but easy to drop almost every sort of article in substantial quantities and with sufficient accuracy to be found by the waiting men below, and to do so without any loss or damage. Eggs packed in interlocking cartons, padded underneath with "bread-springs," have been dropped without a single egg being cracked. Bread has been found to be an excellent shock absorber, therefore the term, "bread-springs." As the bundles of grub or equipment, retarded somewhat by parachutes, settle down, colored streamers thereon make it easy for ground crews to spot packages that fall some distance from the target. The streamer usually floats above the brush and small trees.

The Forest Service is conducting experiments to further improve the methods of dropping supplies from airplanes. In a week's training course, forest guards in Washington and Oregon were trained to make and fold single chutes, to make up loads, and to discharge them over a target. The trainees readily learned the methods used and, on their first flights, the majority of the student droppers were making hits averaging not over 150 feet from the target. Such accuracy is important in rough country where dropped supplies might easily be lost in dense timber or on inaccessible cliffs. During the

training period approximately two hundred loads were dropped with only two or three of the chutes failing to open.

On the Summit fire in the Wallawa National Forest, late in August, 1937, a crew of about 400 men and 50 pack horses were supplied by airplane during the entire control period of this fire. Approximately 120,000 pounds of supplies and equipment were transported to the camps on the Imnaha-Snake Divide. Two planes, a six-place Travelaire cabin ship and a Bellanca six-place monoplane, made 141 flights from Enterprise, Oregon, 28 miles air line, to the fire. Items dropped with chutes included canned goods, dry foodstuffs, eggs, fresh fruits, vegetables, meats, clothing, bedrolls, tobacco, telephones, telephone wire, split insulators, telephone tools, headlights, gasoline and kerosene lanterns, radios, batteries, tool outfits, torches, back-



#### NORTH AMERICANS FOR BRITAIN

One of the hundreds of NA-16-1E two-place military planes which the British Air Ministry ordered from North American Aviation in 1938. They are powered by Pratt & Whitney 350 h.p. Wasp engines.

pack pumps, water outfits, saws, mess outfits, first aid equipment, five gallon cans of gasoline and oil, small cans of grease, hose for pumpers, cooling plates, stoves, tents, tarpaulins, grain, horse-shoeing outfits, rope and other articles. Bales of hay placed in wool sacks were dropped with chutes. The ground elevation at points of dropping was over 6,000 feet. The elevation of the planes varied from 6,200 to 7,500 feet, depending upon topography and air conditions.

Airplane delivery was almost the sole method relied on to supply crews fighting the serious forest fires which occurred in northern California in the summer of 1938. The worst of these fires occurred in remote, roadless mountain country. During the battle on

the Red Cap fire in the Klamath Forest in July, a good many tons were transported by airplane and delivered by parachute to fire fighting crews.

The possibility of dropping water, chemical retardants, or explosives upon forest fires, especially the small ones, to retard the spread of the fire until the ground crews reach it, provides another field where the airplane may be of service to foresters. The chemical phase of fire fighting is still very much in the experimental stage. Extinguishing going forest fires by sprinkling with water or chemicals released from a plane has not yet become practical because of the extreme scattering of the liquid. However, preliminary experiments indicate that one can fly over small areas even at high elevations in rough country and, with the aid of various sighting and release devices now being developed, drop water and other fire retardants on a fire with a high degree of accuracy. As a companion project, basic chemical research is being conducted by the Forest Service to determine the most effective combination of chemicals to retard fire spread. The development of chemical bombs and the use of explosive bombs to throw dirt over small fires are other fields of study.

Some progress has been made in the determination of proper sighting devices with which to place extinguishing agents on the fire, and a method of releasing various quantities of chemicals has been worked out. The problem of flying close to small fires in mountainous country presents many difficulties due to uncertain wind currents and rough air. The progress of the experiments to date indicates that continued experimentation is justified.

When the autogiro type of aircraft is developed to larger payload capacities, many obstacles in the way of treating fires from the air may be removed. These "windmill machines" perform aerial maneuvers impossible for an airplane. Landing on a "dime," taking off in 25 feet, standing almost stock still in the air, they offer unusual chances for observation. There would appear to be many advantages in the use of this hovering type of plane for chemical fire fighting from the air or for dropping fire supplies.

For several years the Forest Service has contracted for the use of privately owned airplanes, both for experimental work and for actual fire fighting. The Bureau bought its first plane in 1938. The new green-coated high wing cabin plane with Forest Service insignia has a cruising speed of 175 miles per hour with full load of 1,250 pounds. Service ceiling is 22,000 feet and flying range is over 700 miles. Wing flaps and brakes permit a landing run of 400 feet on emergency areas. The specially constructed plane is equipped with an

adjustable pitch propeller for low flying and has special sights to facilitate accurate dumping of food and fire fighting equipment by parachute from an installed cargo bin. In experimental fire control work the sights will serve to drop water and chemicals on targets to determine the effectiveness of aerial fire suppression methods on small fires.

A special feature of the Forest Service airplane is the voice amplifying equipment which is capable of transmitting verbal messages from the air to the ground. Experiments with the amplifier have indicated that voice projection is useful in directing lost persons and searching crews, guiding fire line crews to spot fires located from the airplane, broadcasting fire prevention pleas, instructing fire fighters, and giving messages in other emergencies. The voice can



THE CESSNA MODEL

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

be projected from the airplane to the ground over an average distance of one and one-half miles. The plane also carries the new two-way radio equipment for contact with Forest Service field sets at fire camps and national forest headquarters.

There are other fields besides that of fire fighting wherein airplanes are making a contribution to better management of forest land. Aerial photography helps the forest officer to plan intelligently the best uses of forest areas. Aerial photographs are now widely used in map-making. These picture maps, supplemented by other maps, give the forest officer a birdseye view of his territory and his problems. The eye of the camera furnishes him with an inventory of the physical and topographic features of an area, together with cultural improvements. He can view the country to plan re-

creational improvements, to prepare for erosion and flood control, to plot an attack on disease and insect infested areas, and in many other work projects where arduous and time-consuming field work would otherwise be required.

Timber can be surveyed to some extent from the air. The Forest Service is now making a nationwide survey of forest resources. The task of rapidly covering and making an inventory on three-fifths of a billion acres of forest land is a big one and the great help offered by aerial surveys is taken advantage of in securing needed information. Several years ago, the exploration of the huge Alaskan National Forests was carried on by airplane. This forest exploration was done by the Navy Department in cooperation with the Forest Service, the Bureau of Public Roads, and the Bureau of Biological Survey.

Aerial aids are sometimes used in making range surveys. It is possible to produce very detailed planimetric maps on a scale of two inches to the mile as low as \$7 per square mile, depending upon the amount of ground control necessary. In addition, these maps can be produced with a great saving of time. In one case, the elapsed time from the start of the flight to the completion of the map was about 15 months, and about 18 months for a finished range survey of the same area.

The range survey is carried on at the same time as the aerial survey. As soon as vertical aerial photographs are secured of an area, a set of contact prints is taken to the field whereon the range examiner outlines his grazing types and writes in the type designation and forage acre factor. He also notes on the photographs all water, classifies and marks roads and trails, locates fences, ranch buildings, and all possible located section corners. The prints are brought in at the end of the field season and the map detail shown on the set of prints is incorporated in the planimetric map. Using aerial photographs cuts the cost of range surveys about half and gives more satisfactory results. The use of the pictures in range and timber surveys is an added advantage.

Spelling further advance of mechanized science against the old romance of forest and range, unusual uses of airplanes in wild life management activities were discovered in 1938. Several game counts were made from the air, one forest ranger in Oregon, for example, using a small monoplane to take his annual deer census. Flying about 50 miles an hour at an altitude of 500 feet, he counted deer on approximately 125 miles of winter range. A relatively accurate deer count was obtained for a quarter of a mile on each side of the course. This demonstrated that in the open pine and juniper country used by

the deer in the winter, airplane observers can obtain nearly a 100 percent count in much less time than is required for a census made by parties on skis. These air surveys prove extremely valuable also in indicating when and where supplemental ground work should be done in connection with the game counts. An annual estimate of big game populations is necessary as a basis for intelligent wild life management plans and also to indicate cases of overcrowding of ranges, depletion from disease, predators, and lack of food. The airplane method of arriving at accurate game estimates is proving important in the Forest Service game management program which aims to assure continued and increasing wild life resources.

This same monoplane, operated by an experienced hunter, with a co-pilot who was also a good marksman, served as an aid in controlling predators on a sheep range. Sixteen coyotes were shot from the



WARNER-POWERED FAIRCHILD 24

air near one band of sheep and an average of five to six coyotes were bagged on each trip.

Planting of trout by airplane from altitudes of 100 and 200 feet was tried in tests conducted over Clear Lakes north of Buhl, Idaho, in 1938. In this first attempt in the United States to plant fish from the air, sponsored by the Frontier Club, 300 trout were dropped. As the plane flew over Clear Lakes, the co-pilot dumped the buckets of trout between two boat lines of forest and game officials and Frontier Club members, who examined closely the sandy bottom of the clear, shallow lake for evidences of injured or dead fingerlings. A few trout were stunned, but after a few minutes of recuperation they swam away. Ten minutes later, the 25 men in boats could find no trout injured by the plunge. The Forest Service believes this experiment may indicate new possibilities for economical stocking of streams and lakes.

The airplane has saved game animals in search of essential minerals many a long journey. In some primitive areas of the national forests, elk, deer, bighorn sheep, and mountain goats have pawed deep holes and caves in the natural salt licks. How often these animals came and how far they traveled to lick this salt is a matter of conjecture only, but the deepness of the holes indicates long and frequent trips. Airplanes have been used in some instances to aid nature by dropping the salt from the skies.

Various other incidental uses of aircraft were made by the Forest Service during the past year. Planes were used in several instances in searching for persons lost in the mountain forests. Insect damage reconnaissance has been accomplished with the aid of aircraft.

Many opportunities for cooperation between the Forest Service and the public are afforded by airplanes. Pilots of passenger carrying planes have spotted fires along their regular routes and have reported them to the Forest Service or radioed the information to their flying bases. A plan is under consideration whereby the roofs of lookout houses in the national forests may be uniformly marked to correspond with numbers on aviation maps of the United States so that any flier sighting a lookout house on a peak or a ridge may be better able to keep his bearings while crossing the national forests.

Airplane passengers who get an eagle's eye view of the country learn to appreciate some of the enormous losses caused by forest fires. They glean a broader knowledge of the resources of the country, their natural limitation, and the importance of conservation. Like aviation, the conservation movement in this country is a comparatively recent and modern development. With the winged assistance of aircraft of all kinds, conservation of the trees and the forests should have a better opportunity for a swift rise to newer heights.

#### U. S. Public Health Service

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

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



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

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

In an effort to meet this contingency, control measures, 100 percent efficient, have been instituted by the Public Health Service in



CURTISS HAWK 75-R

It is powered by a Wright Cyclone and a Curtiss constant speed propeller.

cooperation with those corporations operating aircraft between North and South America:

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

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

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

There is also under way a definite campaign to secure as far as possible by airplane "dusting" the eradication of mosquitoes and other insects, which might constitute potential vectors for the transmission of yellow fever from regions surrounding the airports of

entry located in infectible territory in the United States. Aerial photography has been employed by the Public Health Service in this connection, to get a "working" view of such regions around quarantine stations, and especially where the Public Health Service has work in progress, control of, or an interest in the surrounding territory.

During the fiscal year 1938, 4,323 airplanes carrying 53,610 passengers arrived at the 37 airports of entry in the United States from foreign countries. Of these, 1,775 planes, carrying 23,137 passengers, 6,730 of whom were aliens, were subjected to quarantine inspection. The remainder entered the country from Canada under circumstances rendering quarantine inspection unnecessary.

Number of airplanes arriving from foreign ports.....	4,323
Number of airplanes inspected by the Public Health Service .....	1,775
Number of persons arriving from foreign ports or places	53,610
Number of persons inspected by the Public Health Service .....	23,137
Number of aliens inspected by the Public Health Service	6,730
Number of aliens certified for disease.....	28

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

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

Such medical advice, radioed back free through the courtesy of certain cooperating companies to every ship requesting it, comes mainly from designated, most accessible marine hospitals and relief stations maintained by the Public Health Service on every coast, the Great Lakes, and in territorial possessions.

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

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

patient. In the last fiscal year, 148 patients were thus transported to the hospitals and relief stations maintained by the Service.

#### U. S. Weather Bureau

The program of expansion of meteorological service in aid of air navigation, which was extensive during 1937, was continued in 1938 with definite advances and arrangements made for further progress in the future. As of June 30, 1938, there were 810 stations in the Weather Bureau system, rendering meteorological reports in aid of air navigation over approximately 36,000 miles of airways in the United States, Alaska, and Hawaii.

In the latter part of 1938, the number of meteorological stations at airports with a full complement of commissioned Weather Bureau personnel rendering 24-hour service was increased from 62 to 85.



THE GLENN L. MARTIN 166 BOMBER

It is powered by Wright Cyclone engines with Curtiss electric propellers.

At the majority of the 23 additional stations, Weather Bureau personnel replaced Bureau of Air Commerce (now Civil Aeronautics Authority) personnel in connection with meteorological work. This released the latter for the pressing communication duties at important stations.

Weather reporting service was established for eight new airways, adding approximately 2,600 miles to the total for which the Weather Bureau renders service. A total of 26 "on-call" stations manned by non-commissioned airway observers were established at intermediate points along these new airways to provide additional necessary weather reporting service. These airways were: Detroit-Sault Ste. Marie; Norfolk-Washington-Buffalo; Huron-Cheyenne; Bangor-Caribou; Billings-Great Falls; Winslow-San Francisco; Dayton-Chicago and Tampa-Miami.

On August 1, 1938, the general supervising and airway forecasting work formerly conducted at Portland, Ore., was transferred to Seattle, Wash., in order to improve the service for Alaskan and northern continental flying interests. Regular 24-hour airway meteorological service was continued at Portland.

Continuing the previous year's program to modernize and increase instrumental equipment for airway stations, installation of the following equipment was undertaken:

(a) 150 improved ceiling light projectors designed to throw an intense beam far enough to permit the measurement of ceilings up to 10,000 or more feet;

(b) 90 mercurial barometers which, in many cases, replaced aneroid barometers, thus making possible a greater degree of accuracy in the determination of atmospheric pressures;

(c) 50 open-scale barographs designed to permit the measurement of pressure changes with greater precision, thus aiding in air mass analysis and forecasting;

(d) 50 wind direction indicators of an improved type, which show the direction of the wind to 16 points of the compass.

It was determined that 175 ceiling light projectors, 100 mercurial barometers, 200 open-scale barographs, and 110 improved wind-direction indicators would be required to bring the instrumental equipment at airway stations to the desired standard. Arrangements were made for these instruments to be purchased and installed.

The growth of flying activities in Alaska caused the establishment of a first-order Weather Bureau station for airway service at Anchorage, Alaska. Direct supervision of a number of intermediate airway and "on-call" stations is being conducted by the Anchorage station. Regular airway weather and pilot balloon observations are also made. Plans were formulated for considerable expansion of the Weather Bureau meteorological service to air navigation in our far-northern territory.

Pilot balloon observations, by which upper-air winds are measured, were inaugurated at three additional stations, Grand Junction, Colo., Huron, S. D., and Sacramento, Calif., bringing to 80 the total number of stations making such observations, including three in Alaska and one at San Juan, P. R. Arrangements were made for the establishment of pilot balloon observation stations at 20 additional points. Pilot balloon observations were increased to four a day at all stations in continental United States where heretofore less than that number had been made. Whereas up to 1937 pilot balloon observations had been made with 30 gram balloons, there were put into use at Las Vegas, Nevada, larger (100 gram) balloons capable of

ascending to greater heights than those now in general use. Arrangements were completed for use of the large balloons at 13 additional stations. The employment of helium instead of hydrogen gas for giving buoyancy to the balloons was investigated with a view to eliminating the danger of hydrogen explosions. Arrangements were made for the trial of helium at a limited number of stations. At Washington, D. C., a research project determined the ascensional rates of different sizes of balloons, using hydrogen and helium gas, respectively, to provide the lift.

Since 1931 Weather Bureau observations of temperature, pressure and humidity in the upper-air in this country have been made by airplanes. This method resulted in a limited height of ascent not exceeding about 16,500 feet, the necessity of cancelled flights with



U. S. Army photo

DOUGLAS-NORTHROP SA-2

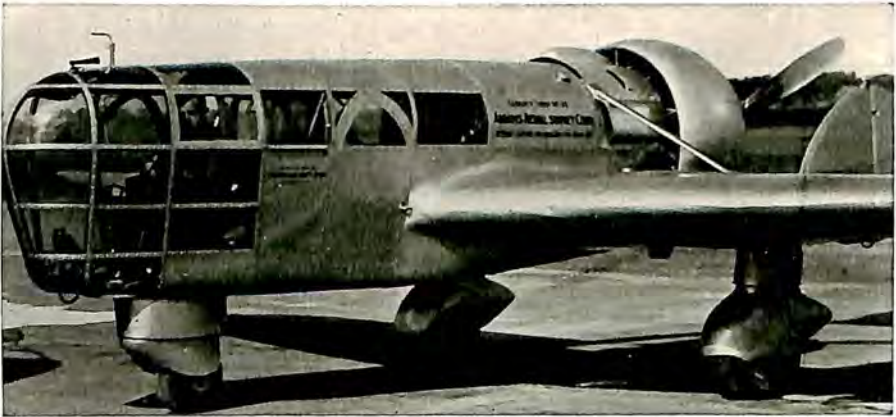
An attack bomber powered by a Wright Cyclone engine.

consequent loss of record in bad weather, as well as the hazard to pilots making these flights. In order to overcome these drawbacks, devices of about two pounds weight, known as radiometeorographs, were developed for attachment to rubber sounding balloons inflated to a six-foot diameter with hydrogen or helium gas, thus to be carried to heights of 10 to 20 miles, while automatically broadcasting to a ground recorder radio signals which depict the pressure, temperature and humidity of the air traversed.

Beginning on July 1, 1938, the airplane observations at six stations were replaced by radiometeorograph observations, using a type of instrument designed by Messrs. H. Diamond, W. S. Hinman, Jr., and F. W. Dunmore of the National Bureau of Standards, in co-operation with the Navy Department. The six stations were as fol-

lows: Sault Ste. Marie, Mich., Fargo, N. D., Omaha, Nebr., Nashville, Tenn., Oklahoma City, Okla., and Oakland, Calif. The results obtained at these stations proved valuable and showed the effectiveness of this type of upper-air sounding. On July 1, 1938 the Army Air Corps ceased making available planes and pilots for airplane weather observations at seven Army fields. However, the Air Corps proposed to begin making radiometeorograph observations at two stations.

Investigation of upper-air conditions within tropical disturbances (hurricanes) was carried out during the latter half of 1938. Seven stations were selected to be in readiness to release hydrogen or helium inflated sounding balloons carrying the necessary instruments for recording these conditions when and if a hurricane passed over



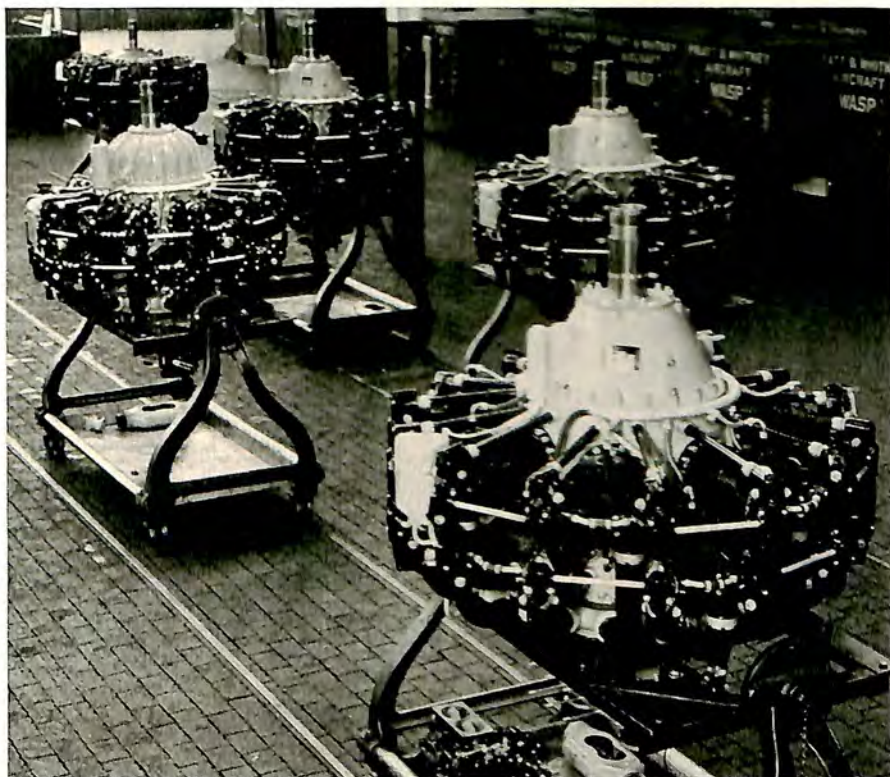
THE ABRAMS EXPLORER

An aerial photographic plane equipped with a 365 h.p. Wright Whirlwind engine.

one of the stations. These stations were Raleigh, N. C., Columbia, S. C., Macon, Ga., Montgomery, Ala., Vicksburg, Miss., Meridian, Miss., and Houston, Texas. The instrument used in this project is the Jaumotte meteorograph, weighing but two ounces and capable of making a record of barometric pressure, air temperature and humidity on a smoked glass plate about the size of two postage stamps. When the balloon bursts the fall of the meteorograph to the ground is retarded by a framework consisting of three four-foot bamboo sticks crossed at right angles. A card attached to the instrument gives instructions to the finder for the return of the device to the Weather Bureau so that its record may be deciphered and studied in connection with various other observations made on the hurricane.

Plans were made for a conference at Kansas City, Mo. in late 1938 or early 1939 for co-ordination of all phases of the Weather Bureau's meteorological service to air navigation. Such a conference was to be attended by officials of the Washington, D. C. and field offices of the Weather Bureau and the Civil Aeronautics Authority. The conference was contemplated as an effective means of exchanging views regarding problems encountered in various phases of the work of the respective organizations, and of laying plans for solution of these problems as well as for future undertakings to provide extended and improved services to aviation.

The year was marked by the death of Dr. Willis Ray Gregg, able and esteemed Chief of the Weather Bureau, who died in Chicago on September 14, 1938 after having been stricken with a heart attack while attending a conference of Civil Aeronautics Authority and air transport officials. To Dr. Gregg belonged much of the credit of the



#### PRATT & WHITNEY FINAL ASSEMBLY

A group of 14-cylinder engines in the final assembly department of the Pratt & Whitney plant at East Hartford, Conn.

development of the civil aviation meteorological service of the Weather Bureau. He had been connected with the Weather Bureau for 34 years, having joined its staff in 1904, serving first at Grand Rapids, Mich., then at Cheyenne, Wyo. and from 1907 to 1914 at the Mount Weather, Va., Observatory. In 1915, he was transferred to Washington, D. C. and placed as assistant chief of the aerological division of the bureau. He became chief of that division in 1917 and remained in this capacity until 1934, when President Roosevelt appointed him chief of the bureau.

Dr. Gregg was special meteorological advisor in 1919 to the crews of the Navy seaplanes which made a transatlantic flight, and of the British dirigible R-34. The Weather Bureau chief was a member of the National Advisory Committee for Aeronautics and chairman of its subcommittee on meteorological problems. He also belonged to the International Meteorological Organization, the International Meteorological Commission, the Guggenheim Committee on Aeronautical Meteorology, the Interdepartmental Commission on Co-ordination of Meteorological Service for Aeronautics, the American Association for the Advancement of Science, the Royal Meteorological Society, the American Geographical Union, the Washington Academy of Sciences, the Washington Philosophical Society, and was a fellow of the American Meteorological Society. Dr. Gregg was co-author of "Introductory Meteorology" and "Meteorology" and author of "Aeronautical Meteorology" and "Aerological Survey of the United States". His death came as a distinct shock to his colleagues and friends and is a decided loss to the science of meteorology.



#### SIKORSKYS IN FRENCH SERVICE

Refueling one of the four Hornet-powered S-43 amphibians operated by Aero-maritime between Dakar and Point Noire, Africa.



## CHAPTER VII

### NOTABLE FLIGHTS OF 1938

The Howard Hughes World Flight—Corrigan's "Wrong Way" Flight—Seversky's Transcontinental Record—Jones Makes Record in Aeronca—Air Corps Flight to South America—Jacqueline Cochran Sets Woman's Record—The German Flight to U.S. and Return—The British Flight from Egypt to Australia—Italy Sets Altitude Record.

**E**VER since the day he learned that the earth is round man has been using the speed with which he has been able to travel around the world as the yardstick of transportation's progress. Magellan set the fashion early in the 16th Century. His trip by sea required 1,083 days; that is, the world voyage of his ship took that long, although the Portuguese navigator died en route. About 60 years later Sir Francis Drake won lasting laurels for England by cutting 31 days off Magellan's time. Nellie Bly amazed the world by her 72 day trip in 1889, and John Henry Mears made it in 35 days in 1913.

After the World War men commenced thinking about world flights by aircraft. Possibly a thousand persons have had plans, or dreams, about flying around the earth in record time. There have been many ghastly failures, and the fact that there have been only six successful flights, including one by airship, proves that it is not as easy as it might seem to the layman. Every good flight has taken the best that could be provided. Every failure has proved the absolute need for the utmost care in preparation, the best in men and equipment. Every record flight has shown the world the magnificent advances made in flying equipment and the improved technique of using it.

#### U. S. First to Circle Globe

For six years after the war men of a dozen nations made ambitious attempts at world flights, and the record of their failures became

discouragingly long. Then the United States Army Air Corps did it in 1924. Four single-motored, specially-built Douglas biplanes took off from Seattle, Wash., on April 6, 1924. In each ship were two Army airmen, one with Major Frederick L. Martin, in command of the expedition, accompanied by his mechanic Alva Harvey, another with Capt. Lowell H. Smith, second in command, and Lieut. Leslie P. Arnold, the third with Lieut. E. H. Nelson and John Harding, Jr., and the fourth with Lieut. Leigh Wade and Henry H. Ogden. Major Martin's ship crashed in a fog in Alaska, and the flyers were not heard from for eleven days. The other three ships carried on.

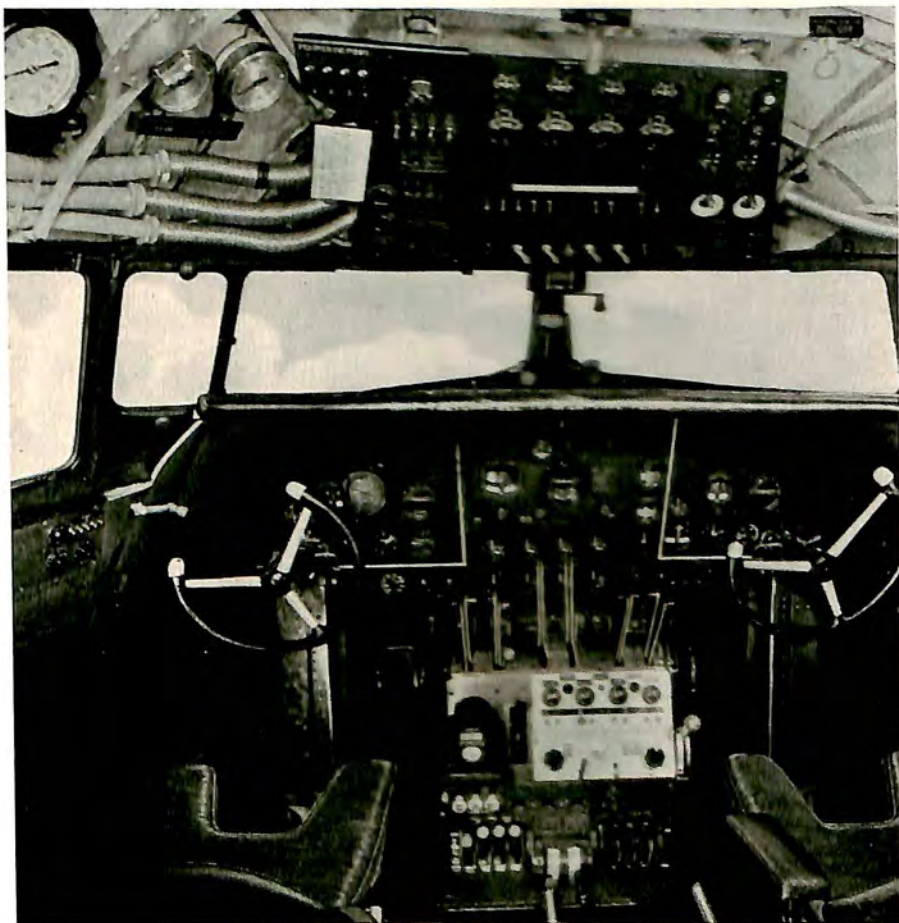
On August 3, flying between the Faroe and Orkney Islands, the oil pressure on Lieut. Wade's engine failed, and he was forced down on the water. Later, the machine was wrecked completely by the breaking of hoisting gear as it was being lifted out of the water preparatory to repairs aboard ship. The Army supplied Lieut. Wade and Ogden with a new ship, and the three crews finished their flight. During that season five other attempts, representing England, France, Italy, Argentina and Portugal, failed for various reasons. The secret of the American success was organization, preparation and the supremacy of equipment. The Douglas world cruisers were the best of their time for that purpose. They were designed to carry the necessary fuel loads and yet possess speed and climbing ability; and the builder had to reckon with the engine. The air service had elected the old wartime Liberties to do this job. They were not very efficient, possessing only 400 horsepower and countless inherent faults.

When completed the Douglas world cruisers had a wing loading of only 11.3 pounds as a seaplane and 10.2 pounds as a landplane; and they were used as both on various stages of the flight. Because of their limited range the Army projected a route which took the world cruisers up to Alaska, into Siberia, through Japan, China, and along most of the southern Asiatic coastline, to Calcutta, India, thence by the southern route over Imperial Airways through Asia Minor, across southern Europe and up to London, thence across the Atlantic by way of Iceland, Greenland and Labrador. It was more of an expedition than a speed flight, because it took 175 days. When they landed back in Seattle on Sept. 28, the planes had flown about 28,000 miles. They had been in the air 371 hours, averaging only 75 miles an hour; and they had used a total of 20 Liberty engines and a number of propellers. The planes withstood the strain much better than their power plants. The need for so many landings, of course, lengthened the route and increased the hazards of the flight; but there were other difficulties.

Bad weather, everything from snow storms to dust storms, the

almost universal lack of adequate weather reports, lack of aircraft radio equipment, the use of wooden propellers and wartime engines, equatorial heat and Arctic cold, lack of adequate service stations—these handicaps cast up obstacles too numerous to mention. But the accomplishments of this first world flight were very real and lasting.

The hospitality of other nations pioneered the development of the world fraternity of flying men. British, French and Japanese were particularly hospitable, friendly and helpful; the treatment accorded by Japan established such friendly relations between the air services of the two nations that its influence remains today a genuine instrument of friendship of the kind that Howard Hughes spoke



COCKPIT OF THE DOUGLAS DC-4

The bridge of the four-engine airliner produced in 1938.

about on his return to the United States. The flight also convinced the world that this country has an air force.

Although there were numerous attempts by Europeans, round-the-world flying lagged for several years after the Army flight, and this was due primarily to the fact that planes and engines required something more than technical improvement. Aircraft developed at an amazing pace, climaxed by Lindbergh's spectacular hop to Paris in 1927. But radio and weather reporting service were essential for fast flying around the earth. The Russians projected a world flight in 1929, and they did manage to travel from Moscow to New York. The Zeppelin airship "Graf Zeppelin" took all the honors, however, by traveling around the world in 1929, using Lakehurst, N. J., as a terminal, and stopping at Friedrichshafen, Germany, Tokyo, Japan, and Los Angeles, in the course of a trip which took the ship 19,500 miles in 21 days, 7 hours and 34 minutes. It was a real triumph in aerial navigation, and unusually spectacular, because the airship carried 61 persons, including 20 passengers, rode safely above the uncharted wastes of Siberia, nosed her defiant way through two storms and made the first aerial crossing of the Pacific.

#### Post and Gatty Better the Zeppelin

"We want to take the record away from the balloons," explained Wiley Post while he and Harold Gatty prepared to take off from Roosevelt Field in their Lockheed Vega monoplane, the "Winnie Mae," on the rainy morning of June 23, 1931. Their ship was probably the fastest craft of the kind capable of carrying a high fuel load of 540 gallons. Surely their engine was one of the best, a military type Pratt & Whitney Wasp, supercharged ten to one and increasing its horsepower from the standard 425 to 525 at 2,100 r.p.m. The ship was fairly streamlined, and there were no external struts to hold it back. Post and Gatty flew to Harbor Grace, 1,153 miles in less than seven hours.

Inadequate fueling service held them up as it did time and again. But they carried radio, and they had a Sperry Gyroscope turn and bank indicator among other new navigational instruments and Gatty was an expert navigator. He even had a new instrument making possible more accurate celestial observations at high speed. At that they were compelled to fly the Atlantic at 12,000 feet in bad weather and fog which opened only at rare intervals for Gatty to take a sight. Finally they slipped down in Wales not knowing whether they were landing there or in England, Ireland or Scotland.

Two hours later, they were off for Berlin, but they landed at Hanover by mistake. They were so tired that they forgot to refuel,

and 15 minutes after taking off, they returned to replenish their gas supply. At Berlin, their next stop, Gatty fell asleep taking a bath. On the stretch to Moscow, the weather closed in on them so they had to ride the tree tops. Only their drift indicator helped, and they were able to hit Moscow right on the nose. The Russians insisted on a nine-course dinner that night, and it held the globe girdlers up, but they had made the 8,050 miles from New York in 3 days and 19 hours.

Plain ordinary mud supplied the next obstacles to speed. The "Winnie Mae" was almost buried in it at the Blagovyeschensk airport. Plow horses and peasants pulled without avail. After fourteen hours a detachment of soldiers and an American tractor succeeded in freeing the ship. At Khabarovsk Post and Gatty spent 26 hours on a minute inspection of their ship and taking a 12-hour sleep preparatory to the dangerous flight to Nome. It proved terrible.



GLENN L. MARTIN OCEAN TRANSPORT

The four-engine flying boat purchased by Russia in 1938. It is powered by Wright Cyclones.

Rain and fog kept them from seeing a thing outside their ship for several hours. They climbed over two huge cloud banks. Mountains loomed between the clouds. They flew blind across Bering Sea and landed on the sands at Solomon Beach, 35 miles from Nome. Next morning while taking off, the "Winnie Mae" nosed over and broke the propeller. They procured a new one. Gatty, winding up, got in the way of a blade and was painfully hurt. Clear weather helped them into Fairbanks, but after that it rained so hard that the windshield leaked, and they had to poke bits of rag into the crevices to sop it up. At Edmonton, Wiley whipped the machine off a concrete highway adjoining the airport rather than risk a take-off from the

muddy field. Cleveland greeted the heroes while they refueled, and New York was the next stop. They had made a world flight in 8 days, 15 hours and 51 minutes, it was a great record, and it promised much for the future of aviation. It proved the reliability of the new engines, and although they had to land no less than 13 times on their trip, Post and Gatty knew that one day there would be planes capable of carrying such heavy fuel loads that world flying would be possible with only half that number of stops.

#### Non-Stop Pacific Flight

A few months after the Post-Gatty flight two other Americans set out to beat their record. Clyde Pangborn and Hugh Herndon, Jr., took off from Floyd Bennett Field, New York, on July 28. They had a special Bellanca monoplane, carrying 835 gallons of fuel, and their Wasp engine was similar to that which had powered the "Winnie Mae." While possessing a longer cruising range, the Bellanca was not so fast, its top speed being only 150 m.p.h. Pangborn and Herndon found bad weather over the Atlantic, lost their way, and landed in Wales. After stops at London and Berlin they were 21½ hours behind Post and Gatty, but they kept on, cutting their stay in Berlin to narrow the margin to only 13 hours.

Again they got off their course on the west side of the Ural mountains and landed, losing more time; but they pushed on to Omsk. From there to Chita they lost a few more hours, and after a muddy landing at Khabarovsk, where they damaged a wing, they had fallen behind about 27 hours, although they had come all the way from New York in 141 hours. They had to give up attempts to break the record, so turned their attention to another prize. The Tokyo Asahi had posted a prize of \$25,000 for the first to fly the Pacific non-stop between Tokyo and the United States.

Pangborn and Herndon wired the Japanese Government for permission to land on Japanese soil, but neglected to wait for a reply. They took off and flew carelessly over several forbidden areas, taking pictures innocently enough but wholly against the rules. They were the guests of the authorities for weeks. Finally, they were permitted to take-off. After leaving Samishiro Beach on October 3, they dropped their landing gear to lighten the load by 300 pounds and reduce resistance by 17 per cent, planning to come to earth on the fuselage which they had strengthened with metal strips. Forty-one hours later they came down on a dusty airport at Wenatchee, Wash., having turned back from Spokane. A snapped propeller when the machine turned up on its nose was about the only damage. The fliers landed back in New York on October 18, having finished their world

flight in 81 days, but for all that with a great record of being the first to fly non-stop by plane across the Pacific, a hop of 4,558 miles which was one of the longest in history and very close to a world record.

The most amazing thing about their flight was that they had limited servicing facilities. Their plane and engine lacked the rigid inspection now accorded all ships as a matter of course. The fact that the equipment stood up and brought them through was ample evidence of its quality, the progress made in aviation since the first world flight. Aviation experts then expressed the opinion that "the successful completion of this flight very nearly closes the pioneering chapters of spectacular aviation history." They were wrong. Machines were to be improved, engines perfected, propellers were to be revolutionized, navigational instruments were to be invented and aircraft radio was to be vastly improved in the next few years. The



U. S. Navy photo

#### CONSOLIDATED NAVY PATROL

One of the contract PB4Y flying boats, built by Consolidated and powered by Pratt & Whitney Wasps, on the ramp before launching.

thousand and one things that enter into the construction of a machine were to be so vastly improved that engineers could make radical alterations in designs, size and shape. It was to be an age of metal planes and perfected navigation, aided by fairly reliable advance meteorological data. But before that Wiley Post was to have the honor of making a solo flight around the world in the old "Winnie Mae."

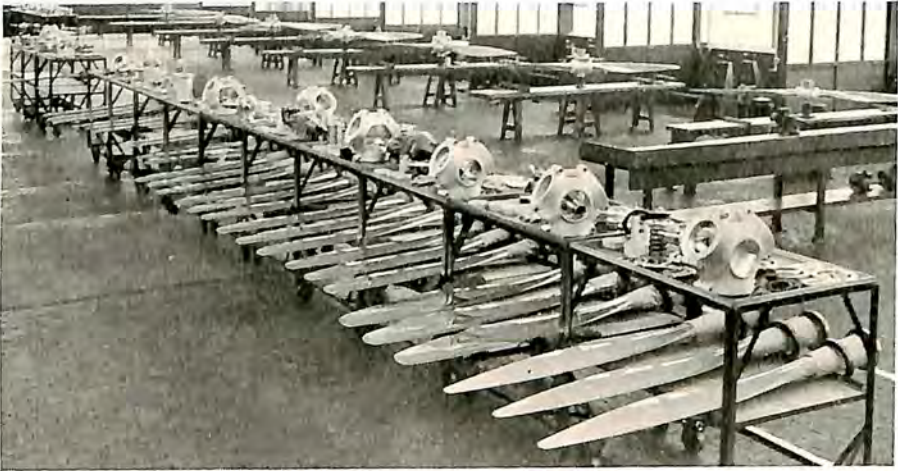
#### Post Does It Alone

Post used the same plane and the same Wasp engine which already had 846 hours before he hopped off Floyd Bennett Field on the morning of July 15, 1933. The engine had new cylinder heads and new sodium-cooled valves.

One of the new Lycoming controllable pitch propellers was an important adjunct to his equipment. He also carried directional

radio and one of the new Sperry automatic pilots, and he later admitted that the strain of flying was so great that he could not have come through in record time without its almost constant help in freeing him from the grueling task of constantly manipulating the controls.

His power plant showed improvement, and his new instruments pointed the way without deviation, so that Wiley was able to fly non-stop from New York to Berlin, 3,942 miles in less than 26 hours. "It should be called flying blind around the world," said Wiley. "There were hours when I was forced to fly blind. Most of the leg from New York to Berlin was flown in either clouds or rain."



#### HAMILTON STANDARD ASSEMBLY

Final assembly department in the Hamilton Standard propeller factory. Each truck holds complete parts for one propeller.

Over Russia, Wiley flew as high as 21,000 feet and as low as 200. Between Khabarovsk and the Alaskan coast the automatic pilot did all the work through a continuous blind stretch for seven hours. When he arrived back in New York on July 22, Wiley Post had broken his old record, having flown around the world in seven days, 18 hours and 49 minutes, a total distance of 15,596 miles at an average flying speed of 134½ miles an hour. He had made ten stops en route.

There was no reason for further stunt flights after that solo flight. It was a tight record, bearing in mind that a man must have some sleep. It remained for future airmen to concentrate on perfected



equipment and organization in order to do real pioneering. And organization, it was realized, meant better airports, better servicing facilities, better instruments, improved planes, engines and propellers and above all machines capable of carrying more than one or two persons, machines of long cruising range capable of carrying a real crew and all the paraphernalia incident to modern flying. It meant that henceforth world girdling must step up into the air transport class. And that is precisely what Howard Hughes and his companions were to do in breaking Wiley Post's record five years later. The Hughes flight was to be another glamorous mile stone in the rapid progress of American aeronautics, showing the whole world that America still retains her superiority of equipment and the supremacy of her men in the air.

#### The Howard Hughes Record Flight

There seemed to be no particular reason for duplicating or im-

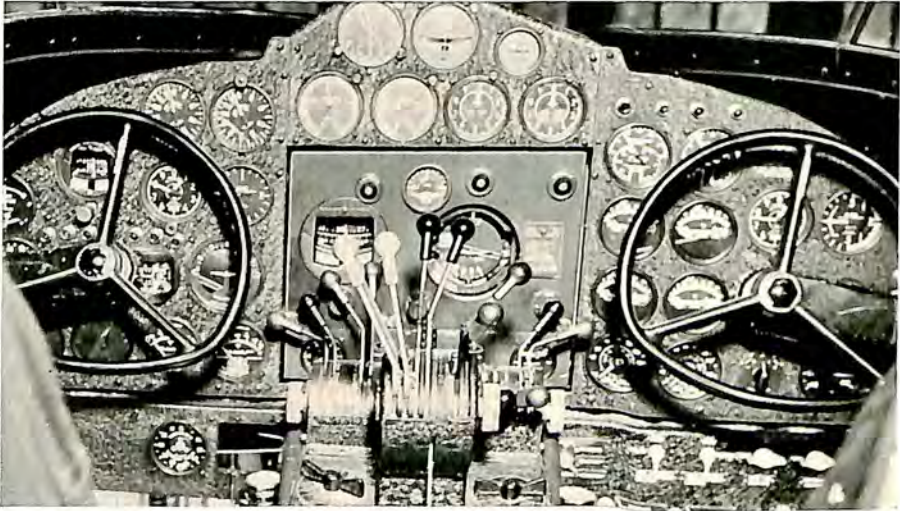


#### HUGHES WORLD FLIGHT LOCKHEED

Howard Hughes and his companions flew this Wright Cyclone-powered Lockheed 14 on their round-the-world flight in 1938.

proving the records of such famous aerial globe girdlers until 1938. Early that year, however, Howard Hughes, of a very inquiring turn of mind, decided to make a scientific world flight for a comparatively new reason. Navigational tests would be made with improved equipment. Long distance flying in any direction and for whatever purpose would receive the benefit of exhaustive checks and double checks along scientific lines.

Accompanying Hughes on this venture, which was to be classed as the outstanding aeronautical event of 1938, were Thomas Thurlow, co-navigator; Richard Stoddart, radio engineer; Eddie Lund, flight engineer, and Harry P. M. Connor, co-navigator. Their plane was a Lockheed transport powered by two Wright Cyclone engines.



#### SPERRY GYRO INSTRUMENTS

This is the instrument panel of the Lockheed 14 in which Howard Hughes made his record flight around the world. In the center is the Sperry Gyropilot control unit and to the left are the Sperry Gyro-Horizon and Directional Gyro.

After months of research, Hughes lifted the plane from Floyd Bennett field, Brooklyn, N. Y., July 10, 1938, to send it winging on its way to new records and glory enough for all its intrepid crew.

First, however, nothing was left to chance. Twenty gallons of New York City drinking water was carried so that no other water need be consumed. Special food also was loaded aboard the Lockheed to provide the utmost in nourishment. The possibility of failure was never ignored, with the food scientifically prepared and guarded against the elements so that it could be opened and eaten in the rain or a lifeboat, if such a course was necessary. Additional food stores were arranged for on the route, as well as fuel for the plane.

A special radio was built to be used in a lifeboat for broadcasting of its position if the crew had to abandon their plane. Hughes also had 250 orange-colored balloons which could be dropped out of the lifeboat at half-hour intervals so that searching planes could spot them and follow a trail to the craft as it drifted away from its originally given position. Parachutes also were hung on special racks at the main door of the plane, so that all members of the crew could get out very quickly if anything forced them to jump. Not only were the chutes ready, but the door itself could be released from its hinges and dropped out by pulling a single rod.

Hughes did not leave anything to chance. That is not his way

of doing business. He carried a little black book full of any details which might occur at any time. Most important of all, he had a complete world weather map, for the first time in the history of such extensive flights. Moreover, at the New York World's Fair headquarters, he had organized a weather reporting service. Here meteorologists constantly charted the weather, from radio reports. This vital information was immediately coordinated and radioed to Hughes. He was, therefore, in almost constant communication with his home base and was conversant with late developments as they occurred. As an example, Hughes received from his World's Fair headquarters accurate data on the weather he would encounter on the Omsk-Yakutsk leg of his trip before he landed at Omsk. This world weather reporting marked a great advance in aviation.

Such was the careful attention to detail which helped bring Hughes and his four companions home in record time. Sixteen hours and 35 minutes after thousands of persons had watched the world circling plane take off from Floyd Bennett field the Lockheed landed at Paris, having made the non-stop voyage at an average speed of 219 miles an hour. Minor repairs kept the ship on the ground for eight and one-half hours. Hughes then took off for Moscow, where he arrived seven hours and 50 minutes later.

Hughes radioed New York that on the Paris-Moscow hop he had sighted land only two or three times, flying mostly in rain, fog and clouds, with ice conditions rather serious at times. From Moscow to Omsk, in Siberia, Hughes flew at about 9,000 feet most of the way, encountering very rough and rainy weather, but managing to arrive at Omsk in seven hours. After a four-hour lay over, the gallant quintet was again in the air, heading for Yakutsk on the Lena river where they landed in about ten and one-half hours.

From Yakutsk to Fairbanks, Alaska, Hughes flew northeastward over the extreme tip of Siberia, crossing mountains 9,000 feet high, although maps recorded them at only 6,500 feet. At Fairbanks, the plane touched American soil exactly three days after leaving New York. From Fairbanks, Hughes made a fast, non-stop run to Minneapolis, in 12 hours two minutes. Only half an hour later, he was winging his way to New York again, to land at his take-off point in Brooklyn four hours and 23 minutes after leaving Minneapolis.

This spectacular world flight had been made in 91 hours at an average flying speed of 206 miles an hour and an average elapsed time speed, including the stops, of 160 miles an hour. No greater demonstration of aviation's progress could have been staged or dreamed about in 1938 than the feat accomplished by Howard

Hughes and his four companions. It proved the great advances made in aviation. It also provided future pilots, navigators, engineers, radio operators, mechanics and others with a mark at which to shoot, just as Hughes had a parade of achievement to equal or surpass.

#### Corrigan's "Wrong Way" Flight

Young Douglas Corrigan, in common with many other American youths interested in aviation, held Charles A. Lindbergh in the esteem usually reserved for idols. Corrigan had been captivated by Lindbergh's hop to Paris in 1927 and, whether he was at first conscious of it or not, began to guide his own career along channels which, one day, would see him acclaimed as another non-stop flyer



NEW CURTISS-WRIGHT 21 INTERCEPTOR

The new high-speed pursuit, designed by the St. Louis Airplane Division of the Curtiss-Wright Corporation, is equipped with an 850 h.p. Wright Cyclone engine.

of the North Atlantic. Doug Corrigan did not believe in taking many chances, either, although the relatively ancient Curtiss Robin, powered with a 175 horsepower Wright Whirlwind engine, newer than the plane, which he finally acquired after learning to fly and working as a mechanic in aircraft plants, was not regarded as the safest ship in which to traverse the Atlantic.

The Federal licensing authorities, ever alert to protect daredevils from themselves, warned Corrigan not to attempt too much with his plane. Experts frowned on its outmoded lines. But the motor was considerably newer than the plane, and the authorities finally gave in to an Irishman's winning smile and off Corrigan flew to New York. There was some sort of understanding that the care-free pilot would return to California at the end of his vacation in

the East. Early on the morning of July 17, 1938, Corrigan jumped in his plane, the door of which had to be fastened with a wire because of a defective catch, and ostensibly made preparations to take off for California from Floyd Bennett field, Brooklyn, N. Y. Airport officials assumed that was Corrigan's plan.

To the amazement of field attendants, Corrigan headed out to sea with his "old crate" and kept on going. Twenty-five hours later, he landed in Dublin, Ireland, explaining, with that same captivating grin used so effectively on the West Coast, that: "My compass must have been wrong, I must have flown in the wrong direction. I thought I was over California, but when I came down to



THE AERONCA CHIEF

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

see, there was nothing but water." That is how "Wrong Way Corrigan" got his name.

#### Seversky's Transcontinental Record

On August 29, 1938, Alexander P. de Seversky took off from Floyd Bennett field, Brooklyn, N. Y., in a plane of his own design, powered by a Pratt and Whitney Twin Wasp engine of 175 horsepower. He landed at Los Angeles 10 hours and three minutes later, establishing a new East-West non-stop transcontinental record.

#### Jones Makes Record in Aeronca

On November 30, 1938, John M. Jones, of Van Nuys, Calif., took off from Los Angeles in his 50 horsepower Aeronca "light plane" and flew non-stop to Roosevelt field, Long Island, in 30

hours and 37 minutes, covering the 2,785 miles on 123 gallons of gasoline and a quart of oil at a total cost of about \$31. His average speed was 91 miles an hour. His engine was a Continental, one of the favorite light plane motors. This pleasure jaunt by air proved to millions the remarkable possibilities the air lanes offer for a coast-to-coast trip at a rapid clip and at comparatively low cost.

#### Air Corps Flight to South America

On February 17, 1938, six Boeing "flying fortresses" bombers left Miami, Fla., on an Army Air Corps' good will flight to Buenos Aires, Argentina. Lieut. Col. Robert Olds commanded the flight of six ships which carried 49 officers and men. Sixteen hours after



U. S. Navy photo

#### NEW MARTIN NAVY PATROL PBM-1

Built by the Glenn L. Martin Company for the U. S. Navy, it is powered by Wright double row Cyclone engines with Curtiss electric full feathering propellers.

leaving Miami, they landed at Lima, Peru. The squadron reached Buenos Aires in 28 hours flying time out of Miami, having covered a total distance of 5,225 miles. Five of the six Boeings covered the 2,565 miles between Lima and Buenos Aires at an average speed of more than 200 miles an hour.

#### Jacqueline Cochran Sets Woman's Record

Jacqueline Cochran, piloting a modified Seversky pursuit ship, established a new woman's West-East transcontinental record, on September 3, 1938, when she flew from Los Angeles, Calif., to a point above Bendix Airport, N. J., in 10 hours, 12 minutes and 55 seconds. Although she did not set as fast a record as that of Frank W. Fuller, Jr., in a similar plane in the 1937 Bendix Air Race, Miss Cochran holds all honors for women in a West-East hop. As is customary when flyers compete for the Bendix Air Trophy, Miss

Cochran headed toward Cleveland, O., and the National Air Races when she took off from Los Angeles. Flying at 16,000 feet, and "smoking" oxygen to combat the thin air at such altitudes, Miss Cochran relied solely on her instruments for all but one-half hour of her fast flight. Stopping at Cleveland only long enough to refuel, she took off for Bendix and was clocked above the field before winging over to Floyd Bennett field, Brooklyn, N. Y., for a landing.

#### **The German Round-trip Atlantic Flight**

A German Focke-Wolfe Condor, a low-wing cantilever monoplane of 38,500 pounds gross weight, commanded by Captain Henke, and named the "Brandenburg," made a round-trip flight over the Atlantic between Berlin and New York August 11-15, 1938. The plane was powered with four 850 horsepower B.M.W. Pratt and Whitney Hornet engines. Because a fuel overload of 6,700 pounds was required to make the flight, without any payload, Captain Henke, a veteran transatlantic pilot, declared that the craft was not suitable for regular oceanic passenger service between Berlin and New York. The westward crossing was made in 25 hours, 56 minutes at an average speed of 158 miles an hour. Original plans called for an immediate take-off from New York on the return flight, but weather conditions and slight damage to the plane, incurred while landing, caused postponement of the return until August 15. The eastbound flight was made in the record time of 19 hours, 55 minutes, at an average speed of 207 miles an hour. This was five hours, 50 minutes, less than the record set by the late Wiley Post in 1933.

#### **British Set New Distance Record**

Three Vickers Wellesly aircraft of the Royal Air Force long-range development unit, powered with Bristol Pegasus engines, left Ismailia, Egypt, on November 5, 1938 on a flight to Australia. In a hop which lasted a total of 48 hours, five minutes, all three planes broke the existing world non-stop distance record, two by more than 856 miles, and the third by approximately 300 miles. The flight covered a total distance of 7,162 miles, of which 1,200 miles were flown in exceedingly bad weather. Clouds, rain and lightning made radio reception impossible and forced the fliers to navigate by dead reckoning. Squadron Leader Kellett commanded the flight.

#### **Italy Sets Altitude Record**

Lt. Col. Mario Pezzi, of Italy, commander of the High Altitude Department, climbed to approximately 56,017 feet on October 22, 1938, to bring the world's altitude record back to his country.

The former record had been set by Flight Lt. M. J. Adam of Great Britain. Col. Pezzi, who has established many records for Italy, took off from Guidonia airport, Italian center of technical achievement. The plane, a Caproni biplane powered with a Piaggio engine, was specially designed and built by the High Altitude Department for the flight. Combining light weight, great lift and high power, the plane and engine were fitted with all of the most advanced devices for stratosphere flying. The record flight, of one and one-half hours, was made under perfect weather conditions. It is claimed that the design of the pressure cabin of this aircraft incorporates many radical features which will have far-reaching effects on practical substratosphere flying.



#### AMERICAN AIRLINES STINSON

One of the Lycoming-powered Stinson Reliants purchased by American Airlines for instrument training and route checking.



## CHAPTER VIII

### AIR LINES OF THE UNITED STATES

Traffic and Mileage Records Show Progress in 1938—Increased Safety—Growth of Reliability—Postmaster General's Report—Air Express—Development of Feeder Lines—Non-Stop Pickup and Delivery Service—Activities of Important Air Lines.

**T**HE air lines of the United States continued to make amazing progress in 1938, as the official records of the Civil Aeronautics Authority showed at the end of the year. The lines operating in continental United States carried 1,343,427 passengers in 1938, as compared to 1,102,707 in 1937. Our American lines operating to points abroad and in the territories carried 192,684 passengers against 187,028 in 1937—a total increase of 246,376 passengers, both domestic and foreign, carried in 1938.

The number of passenger miles flown (one passenger carried one mile) showed a satisfactory increase, being 557,719,268 for domestic lines in 1938, as compared to 476,603,165 in 1937, and for the foreign and territorial operations 77,836,916 passenger miles in 1938, against 76,045,424 in 1937. The percentage of passenger seat miles used in 1938 was 58.74, as compared to 57.55 in 1937—for the domestic services.

Other statistics of the Civil Aeronautics Authority show progress in air transportation. The number of transports in operation and in reserve decreased numerically from 386 [282 domestic] in 1937 to 345 [253 domestic] in 1938; but the majority were larger transports, and all told they offered greater service because they flew more mileage and offered more seats for passengers.

The lines, combined, supplied a total of 139 services as compared to 108 in 1937. They offered 71,199 route miles for passenger service, compared to 63,656 in 1937; 63,292 mail miles, as compared to 57,480 in 1937; and 70,652 express mileage against 63,656 in 1937.

Air mail increased substantially. The domestic and territorial

lines were credited with 7,422,860 ton-miles of mail in 1938, as compared with 6,698,230 in 1937. Our foreign lines have a record of 785,025 pounds of air mail in 1938, against 714,180 pounds the previous year.

Air express also increased. The domestic lines carried 7,335,967 pounds in 1938, compared to 7,127,369 in 1937. The foreign and territorial lines flew 2,116,633 pounds as against 1,856,680 in 1937.

The 18 domestic and 8 operators of foreign and territorial services employed a total of 13,309 personnel in 1938, as compared to 11,592 in 1937. They employed 820 pilots, 605 copilots, 451 hostesses and stewards, 3,415 mechanics and ground crew personnel, 2,635 hangar and field personnel and 5,383 operations and office personnel.

The domestic lines accomplished 69,668,827 airplane miles of flying, and the foreign and territorial lines 11,389,300 miles in 1938, a total of 81,058,127 miles as compared with 77,403,365 miles in 1937.

The domestic lines completed 90.48 per cent of their scheduled trips; they started 91.37 per cent of those scheduled; and they completed 95.36 per cent of the trips that they started.

In view of increased operations the safety record of scheduled air transport showed remarkable improvement. All the lines combined—domestic, foreign and territorial—had 44 accidents, reported by the C.A.A., in 1938, as compared to 50 in 1937. They flew 1,842,230 miles per accident, as compared to 1,548,067 in 1937. They experienced eight fatal accidents, as compared to six the year before; but several were in the course of operations not involving passenger service. The number of passenger fatalities dropped to 32 in 1938, as compared to 51 in 1937. The number of passenger miles flown per passenger fatality increased to 19,861,131 in 1938, as compared to 10,836,246 in 1937.

#### The Postmaster General's Report

In his annual report for the fiscal year 1938, Postmaster-General James A. Farley made these observations:

"The rapid growth of the air-mail system continued throughout the fiscal year 1938. There were 46,112,904 miles flown by planes carrying air mail on a mileage-pay basis which exceeded by more than 15 percent the record of any previous year. At the end of the fiscal year the route miles had reached a total of 33,655 miles.

"Contracts were awarded and service started on four new routes. These routes were:

A. M. 34, Washington, D. C., to Buffalo, N. Y., Pennsylvania-Central Airlines Corporation, contractor, service started October 26, 1937.

A. M. 35, Huron, S. Dak., to Cheyenne, Wyo., Wyoming Air Service, Inc., contractor, service started April 17, 1938.

A. M. 36, Dayton, Ohio, to Chicago, Ill., Transcontinental & Western Air, Inc., contractor, service started September 1, 1937.

A. M. 37, Winslow, Ariz., to San Francisco, Calif., Transcontinental & Western Air, Inc., contractor, service started September 5, 1937.

Route A. M. 27 was extended from Bangor to Caribou, Maine, effective August 4, 1937, and from Burlington, Vt., to Montreal, Canada, effective August 10, 1937.



#### AMERICAN WINGS FOR "PEACE"

One of the history-making Lockheed transports in British Airways service used by Prime Minister Chamberlain on his appeasement trips to Germany in 1938.

Route A. M. 28 was extended from Billings to Great Falls, Mont., effective August 1, 1937.

Route A. M. 31 was extended from St. Petersburg to Miami, Fla., effective July 15, 1937.

Route A. M. 16 was extended from Pembina, N. Dak., to Winnipeg, Canada, effective March 25, 1938.

Route A. M. 14 was extended from Washington, D. C., to Norfolk, Va., effective April 7, 1938.

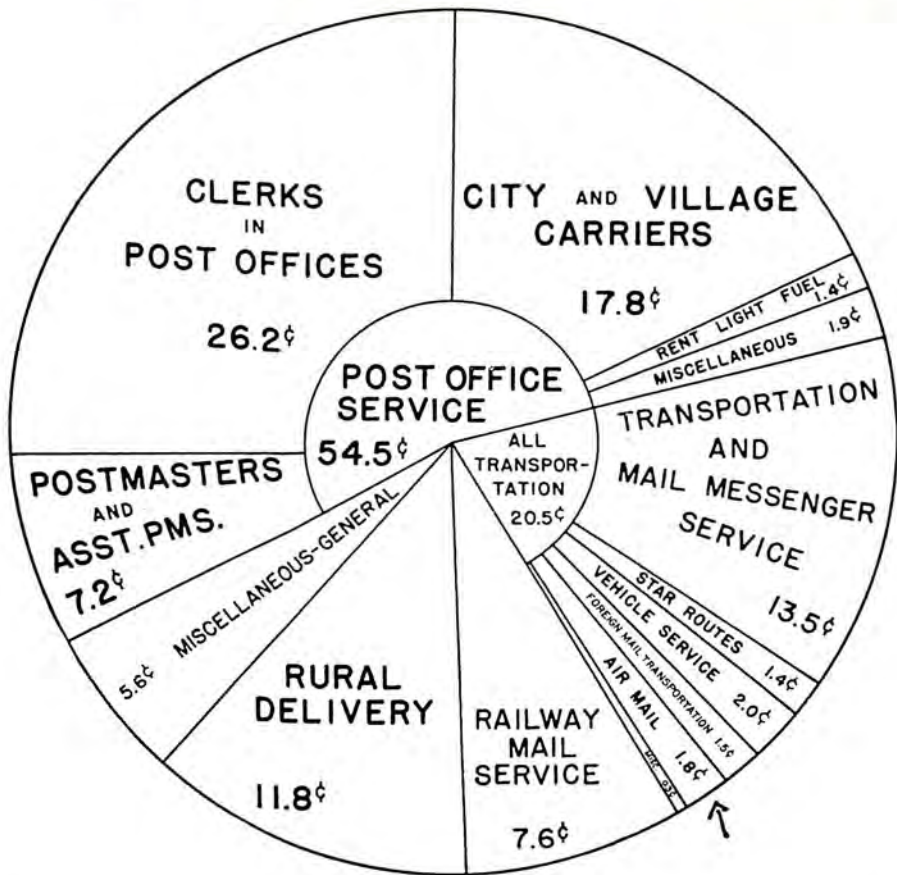
Route A. M. 3 was extended from Yakima, Wash., to Portland, Oreg., effective May 15, 1938.

Route A. M. 32 was extended from Grand Rapids, Mich., to Chicago, Ill., effective June 15, 1938.

"Twenty-three new stops, serving 26 cities, were added to the air-mail system as follows:

Wilkes-Barre, Pa., Fort Myers, Fla., Sarasota, Fla., Caribou, Maine, Presque Isle, Maine, Millinocket, Maine, Yakima, Wash., Fort Wayne, Ind., Houlton, Maine, Williamsport, Pa., Lewiston, Maine, Auburn, Maine, Walla Walla, Wash., Lewistown, Mont., Boulder City, Nev., Norfolk, Va., Huron, S. Dak., Pierre, S. Dak., Rapid City, S. Dak., Deadwood, Lead, and Spearfish, S. Dak., Watertown, S. Dak., Erie, Pa., Montreal, and Winnipeg, Canada.

"On account of airport conditions, orders were issued discontinu-



THE POSTAL DOLLAR

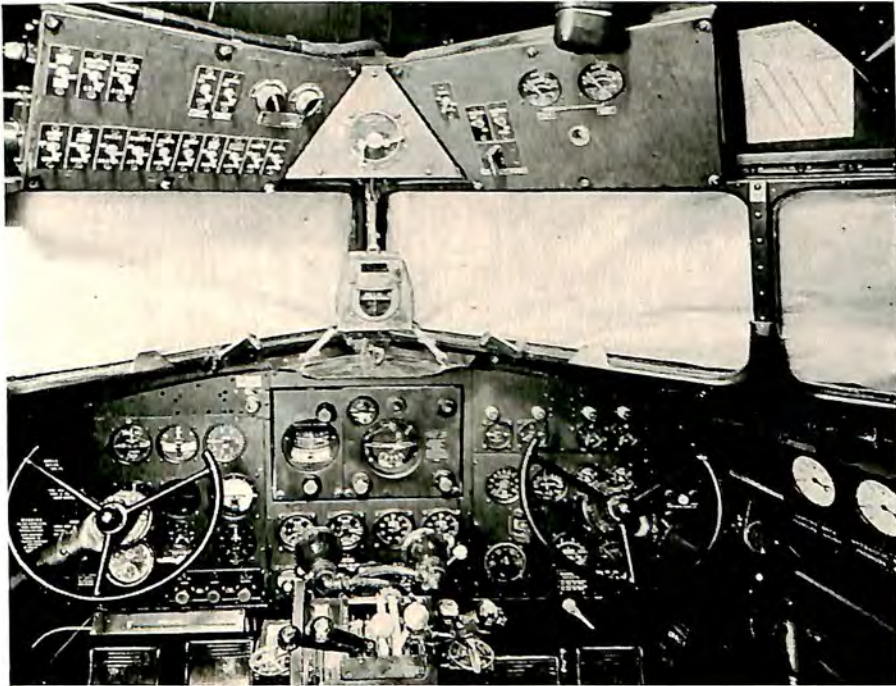
During the fiscal year 1937 only 1.8 cents of every dollar of expenditures by the U. S. Post Office Department were spent on air mail.

ing Lake Charles, La., Coffeyville, Kans., Glendive, Mont., Terre Haute, Ind., Elmira, N. Y., Dickinson, N. Dak., Florence, S. C., Charlottesville, Va., Olean, N. Y., and Pembina, N. Dak., as authorized stop points.

"Seven new routes were advertised. These routes were as follows:

Phoenix, Ariz., via Prescott and Kingman, Ariz., to Las Vegas, Nev., advertised April 5, 1938.

Detroit, Mich., via Flint, Saginaw-Bay City, and Sheboygan, Mich., to Sault Ste. Marie, Mich., advertised April 5, 1938.



COCKPIT OF K. L. M. DOUGLAS DC-3

Showing the Sperry Gyropilot control unit, in the center, and the Gyro-Horizon and Directional Gyro on a Royal Dutch Airlines transport.

Tampa, Fla., via Tallahassee, Fla., Dothan, Montgomery, Birmingham, and Florence-Sheffield-Tuscumbia, Ala., to Memphis, Tenn., and from Tallahassee, Fla., via Albany, Ga., to Atlanta, Ga., advertised April 12, 1938.

Jacksonville, Fla., via Tallahassee, Marianna, and Pensacola, Fla., Mobile, Ala., and Gulfport, Miss., to New Orleans, La., advertised April 12, 1938.

Wichita, Kans., via Hutchinson, Dodge City and Garden City,

Kans., and La Junta, Colo., to Pueblo, Colo., advertised May 21, 1938.

Bismarck, N. Dak., to Minot, N. Dak., advertised May 21, 1938.

Houston, Tex., via Corpus Christi, Tex., to Brownsville, Tex., and Houston, Tex., to San Antonio, Tex., advertised May 21, 1938.

"Air-mail contractors have continued to acquire new and improved equipment throughout the system, enabling the Department to improve schedules in many instances. The last single-motored equipment used on the domestic system was discontinued on August 1, 1937, when Hanford Airlines, Inc., supplanted Lockheed Vegas with Lockheed Electra planes on route A. M. 26. Since that date multi-motored equipment has been utilized on all domestic routes.

"The problem that was created due to the unsuitability of some airports for the use of the larger planes is rapidly being solved by local improvements and additions to airports and the opening of new and larger landing areas. Although temporary suspensions occurred at several points during the year, it was found necessary to permanently discontinue service at only three stops on account of airport conditions.

"The Department approved the following changes of names of contractors and transfers of contracts:

Varney Air Transport, Inc., name changed to Continental Air Lines, Inc., on route A. M. 29 from Denver, Colo., to El Paso, Tex., effective July 1, 1937.

G. T. Baker contract transferred to National Airlines Incorporated, on route A. M. 31, from Daytona Beach to Miami, Fla., effective Oct. 1, 1937.

North American Aviation, Inc., contract transferred to Eastern Air Lines, Inc., on routes A. M. 5, A. M. 6, A. M. 10 and A. M. 20, effective April 23, 1938.

Wyoming Air Service, Inc., name changed to Inland Air Lines, Inc., on route A. M. 35, from Huron, S. Dak., to Cheyenne, Wyo., effective July 1, 1938.

"During the fiscal year 1938, the volume of air mail transported exceeded that of any previous year by more than 11 percent as shown by tables published in the appendix. Passenger and express traffic has also continued to grow.

"A total of 14,137,360,791 air-mail pound-miles were performed during this fiscal year as compared with 12,732,530,874 pound-miles in 1937 and 9,771,841,815 pound-miles in 1936.

"May 15, 1938, was the twentieth anniversary of the inauguration of scheduled air-mail service. This event was marked by the nation-wide observance of National Air Mail Week. Postal em-

ployees, postal organizations, civic and municipal authorities, radio stations, newspapers, and citizens generally cooperated to make this one of the most successful events of its kind which has ever been conducted. Thousands of offices used special cachets to commemorate the event. There were over 1,700 special flights made on 1 day, on which planes covered more mileage than in the entire first year of operation. Forty-three women pilots were among those making special flights. It is estimated that 16,280,697 letters and 9,000 parcels were transported during the week. Events of the week clearly brought out the remarkable progress which has been made in the comparatively short space of 20 years. The short route of 218 miles from New York to Washington has grown to be a comprehensive nationwide and world-wide system of 33,655 miles in the domestic system



THE DOUGLAS DC-5

A three-wheel 16-passenger transport for light traffic on the air lines. It is powered by two 1,200 h.p. Wright Cyclones.

and 30,240 miles in the foreign system, a total of 63,895, on which planes flew last year 46,112,904 mail-pay miles."

#### Growth of Air Express

Shipments in the nationwide air express service of Railway Express Agency increased 8.8 percent in 1938 over 1937. The total for the year was 716,889 shipments.

Air shipments for the 12 months ended December 31, 1938, weighed 2,371 tons, an increase of 10.5 percent over the preceding 12 months. The average weight per shipment was 6.06 pounds, compared with 6.88 pounds the year before. In 1938 the average length of haul for air express was 867 miles, compared with 848 miles in 1937.

All-time highs in the number of air express shipments handled

in New York City during December, 1938, were set by 12 categories. Printed matter led with 11,278 shipments. Electrotypes plates were second with 4,829. Clothing came third with 4,643. Those were followed in order of percentage increases by films, photographs, bank paper, radio broadcasting records, furs, manuscripts, drawings, music and flowers.

Air express on a comparatively large scale was started September 1, 1927. It operated over four lines with a total mileage of 4,450. On its eleventh birthday, September 1, 1938, air express was being operated over 19 air lines with a total of 35,000 route miles. Regularly scheduled planes carrying express in the United States covered an average of 201,993 miles a day. During the 11-year period air express rates were reduced two-thirds. For example, a five-pound package from Boston to San Francisco cost \$15 for expressage in 1927 compared with \$4.80 at the beginning of 1939.

Speed doubled in the 11 years. Transcontinental flights in 1927 required 33 hours. Time was reduced in a decade of scientific development to 15 hours eastbound, with the prevailing winds, and 17 hours westbound, against the prevailing winds.

Frequency of plane departures and coordination of air and train services, together with higher speed and lower rates, contributed to the increased use of air express in the first 11 years. Between New York and Chicago at the beginning of 1939 there were more than 40 regularly scheduled flights daily by three major air lines. This provided the express company with a wide range of routes over which goods could be shipped. Coordination of services between planes to airport cities and trains to off-airline points extended the air-rail service to 23,000 offices of Railway Express. About 30 percent of all air express shipments either start or finish, or both start and finish, by rail. In its coordinated air-rail service Railway Express covered 213,000 miles of railroads in the United States as well as the 35,000 miles of airways. This service was handled by 57,000 employes. Night and day and holiday pick-up and delivery were expedited by 11,300 motor vehicles.

Speeding up the air express service, and at the same time relieving its customers of the necessity of carrying their shipments to the express office, Railway Express had an arrangement with Western Union whereby hurry calls to any such 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 learn by experience increase profits through speedy transportation. Clothing showed the greatest increased activity of all commodities moving in and out of New York



City in 1938 by air express. This indicated that merchants of the country are leaning upon air express to make sales that might be lost by low inventories prevailing during the period of slowed-up retail selling. Air express service was particularly welcome to news photographs and newsreel syndicates, which prior to 1927 had spent large sums of money on chartered planes in which to fly their photographic prints and reels to distant points. Now, with frequent departures of regular flights, chartered planes no longer are necessary except at points at great distances from airport cities.

Shipments of newsreels and photographs picturing the reception New York gave Douglas Corrigan, solo pilot, numbered 337 and weighed 2,517 pounds. Moving picture theaters and newspapers at distant points were supplied overnight with pictures in film and photographic form by the big distributors. Fourteen shipments weighing 74 pounds were air expressed to the West Indies and Central and



THE LOCKHEED 12

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

South America. Shipments of films and photographs out of New York in the 48 hours following the return of Howard Hughes and his four companions at Floyd Bennett field after their flight around the world numbered 766 and weighed 3,328 pounds.

Electrotype makers have been consistent users of air express. By it they have been able to blanket the country overnight with advertisements scheduled for simultaneous insertion. 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 express.

Air express has figured helpfully in epidemics following floods

and hurricanes and in the prevention and eradication of disease among men and women and animals. To prevent a shortage of bread in the Boston area due to delay in the arrival of ingredients by surface transportation following the hurricane which devastated the North Atlantic coastline on September 21, 1938, two manufacturers air expressed two and a quarter tons of yeast from Newark airport to the New England city. The National Grain Yeast corporation, of Belleville, N. J., air expressed 2,200 pounds of yeast to its Cambridge, Mass., branch, and Anheuser-Busch, Inc., 2,300 pounds to its Boston branch. Officials of both companies said that no expense was being spared to supply their New England bakery customers with enough yeast to meet the retail demand for bread.

In the four-day period from September 22 to 26 the air lines carried between New York and Boston 63,000 pounds of air express, chiefly serums, medicines and other emergency supplies. One newspaper air expressed copies of a late edition weighing 1,100 pounds.

Following the outbreak in 1938 of the most severe epidemic of sleeping sickness among livestock in years, more than 500,000 horses in the United States and Canada were immunized by a new vaccine from virus grown on chicken embryos by the Lederle Laboratories at Pearl River, N. J. So urgent was the need for the vaccine that air express was utilized to speed eggs from distant points to arrive at the laboratories on the twelfth day of incubation, and to rush the vaccine to distribution points in the affected areas. One shipment of 6,120 eggs in 34 cartons weighing 918 pounds arrived at Newark airport in the air express service from Louisville, Ky. It left Louisville in the cargo compartment of a regularly scheduled transport plane at 9:20 a.m. and arrived at Newark at 4 p.m. Spring Lake Farm, of Wyckoff, N. J., the consignee, took delivery of the eggs at the airport and rushed them by automobile to Pearl River. The eggs had been ordered from a mid-west hatchery when the Spring Lake supply which had been in incubators for 12 days was found inadequate to meet the demand of the laboratories.

Several shipments of serum for sleeping sickness among horses in Venezuela weighing more than 1,300 pounds were air-expressed in Railway Express service to Miami and by Pan American Airways clipper from Miami to Caracas.

Two thousand minnows, their insatiable appetites for mosquitoes whetted by a 968-mile flight from Savannah, Ga., by air express, went to work in the brooks and ponds of Brookline, Mass., 12 hours after they were removed from the Savannah Aquarium, and the anxiety of the residents of the city was relieved. Tests indicating that the mosquitoes along the one and one-half miles of waterfront in Brook-

line would become dangerous within two days, John Albert C. Nyhen, director of the Division of Fly and Mosquito Control of the Board of Health, telegraphed Paul H. Smith, proprietor of the Savannah Aquarium, to forward a fleet of mosquito-killing minnows by air express. Enclosed in specially prepared cans, in which, by the gentle sloshing of the water as the plane speeded through the air, oxygen was released, the tiny fish were picked up by Railway Express and loaded aboard a transport plane departing from Savannah at 12:20 a.m. At Newark airport, the fish were transferred to



#### SPERRY-RCA DIRECTION FINDER

Once tuned to the station, it points continuously to that station. The problem of 180 degrees ambiguity is eliminated, with provision made for relative, magnetic or true bearing indications throughout a full 360-degree range. Photo shows it installed in an American Airlines Douglas sleeper transport.

a Boston plane. From Boston to Brookline the shipment was rushed by Railway Express, arriving at its destination soon after noon. The fish immediately were deposited in the ponds and brooks of the city, and the threatened danger was averted.

Utilizing the coordinated rail-air-rail service of Railway Express, four southern cotton mills were saved thousands of dollars due to idleness. Receiving an order to install electric switches burned out at factories at Greenwood, S. C., the Southern Electric Service at Spartanburg, S. C., found replacements were not available at any

place nearer than Lynn, Mass. A telegram was sent to the General Electric company at Lynn to forward the switches by air express. The shipment was rail expressed from Lynn to Boston. At Boston it was transferred to a plane for Newark, where close connection was made with another plane for Spartanburg. From Spartanburg the shipment was carried in rail express to Greenwood. Within 24 hours after the burn-out the new switches were installed and the mills resumed operation. The shipment consisted of 12 boxes weighing 821 pounds.

Air express recorded another "first" on its long list of strange things carried in the service when Railway Express picked up at the Payne Furnace and Supply Company factory at Beverly Hills, Calif., three gas furnaces and set them down at Miles City, Mont., for the opening of a sales conference of the Montana-Dakota Utilities company. Delayed in the get-away by floods which paralyzed ground transportation for three or four days in the Los Angeles area, the three gas-fired floor furnaces were trucked to the Burbank airport, where, together with advertising and display material, they were placed aboard a plane for Butte. From Butte they were forwarded rail express to Miles City. Gas utility men in charge of the convention reported the furnaces arrived in record time and were installed for the opening. Total weight of the shipment was 632 pounds.

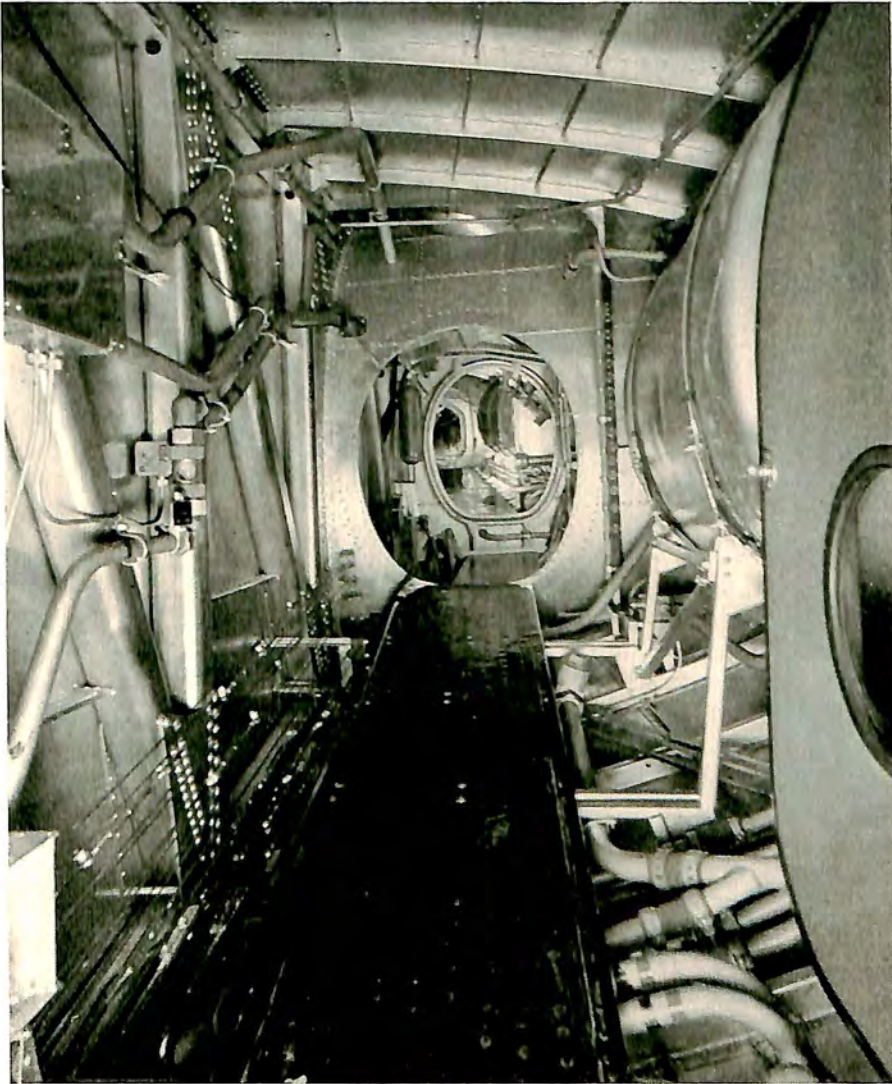
Red scale was costing millions of dollars annually to California growers of citrus fruits. Insects were air expressed from South Africa to fight the pest. Other insects were air expressed from Honolulu to South Africa to save a sugar cane crop. A New York printer air expressed overnight to a mid-western city prospectuses weighing 9,000 pounds. Extra planes were used to handle this shipment.

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.

#### **Pan American Airways**

The blue ribbon international trade route of the world is between the United States and Europe. The largest and fastest vessels ply the ship lanes between the continents; more passengers, mail and express cross the North Atlantic than any other ocean. For that reason it is the prize international air transportation route, and one which nations on both sides of the ocean are preparing to add to their international air transport networks.

In 1937 air lines of four nations—the United States, Germany, France and Great Britain—conducted survey work over Atlantic routes. In the summer of 1938, three nations made survey flights over this highly prized trade route—Great Britain, Germany and



INSIDE THE WING OF BOEING 314

Looking from the control room out into the left wing of the huge ocean transport. Through this passage the mechanics can enter the engine nacelles and make adjustments or repairs during flight.

France. The absence of Pan American Airways from the transatlantic flying program of 1938, in which Imperial Airways, Deutsche Lufthansa and Air France all had entries, illustrated that Pan American Airways was at least that much ahead of other prospective operators in preparations for this service. Pan American embarked on the transatlantic venture with nearly 10 years of international flying and more than 3,000,000 miles of actual over-ocean operation.

The three survey flights which were operated out of Port Washington, L. I., just outside of New York City, in 1937 were more than sufficient to check plans which Pan American Airways had been formulating for years. That was all that was required. Experience in flying oceans did not need to be built up. Technique did not have to be developed. All this had been done in the Caribbean and over the Pacific. So Pan American's surveys were complete. There remained only the completion of tests of the giant 41½ ton Boeing four-engine passenger flying boats which were to carry passengers, mail and express to Europe.

Progress on the big Boeing 314 flying boats slated for service on both the Atlantic and the Pacific oceans was the Pan American activity which held the spotlight throughout 1938. The work on the big Boeings and announcement of plans for a 100-passenger Clipper, which may take over the job of transoceanic air service in about three years, tended to overshadow other major achievements on the international network of the air line which reaches from Miami, Brownsville and Los Angeles through all South and Central America; which extends from San Francisco 9,000 miles across the Pacific to Hong Kong; which links the United States with Alaska and has a network of air lines through that Territory. Service already extends across the Atlantic as far as Bermuda. Pan American Airways' mileage grew to 53,166 miles of air routes in 1938 through the addition of lines across the Caribbean and Alaskan area. The millionth passenger on the system was carried during 1938. Passenger traffic increased 30 per cent; air express 45 per cent. Technical advances, particularly in communication and meteorological phases of forthcoming Atlantic service were numerous and of outstanding significance.

The launching of the first Boeing 314 at Seattle, Wash., on May 31, 1938; its initial sea runs on Puget Sound during the ensuing week; its first venture into the air on June 7, 1938; and its take-off from Baltimore as the Yankee Clipper on March 26, 1939, on a 10,000-mile inspection flight to Europe and return, brought scheduled Atlantic air operation a long step nearer reality. Under com-

mand of Captain Harold E. Gray, the huge flying boat headed for Europe with the greatest number of persons ever to take off for an Atlantic crossing in a heavier than air craft. The Clipper's main object in the survey flight to the Azores, Lisbon, Marseilles, Southampton and Foynes was to check all preparations for later scheduled operations out of these five bases. The success of the round trip



#### NOT WINGS—ONLY TAIL SURFACES

As huge as the wings of the average plane, these stabilizers and elevators for the giant Boeing 314 ocean flying boats are undergoing proof load tests.

flight proved conclusively that the well-laid advance preparations for Atlantic air service were nearly ready for use in passenger, mail, express and freight service.

In the meantime, Pan American's formal application to the Civil Aeronautics Authority for authority to institute service between the United States and Portugal, France and the British Isles was before that Federal body with hearings scheduled for the spring of 1939. Following a round trip flight across the Pacific by a sister

Boeing 314, the Authority authorized passenger service with this type craft on the Pacific. First flight with passengers was scheduled from the Treasure Island base in San Francisco Bay on March 29. Another Boeing 314, authorized by the C.A.A. for service on the Baltimore-New York-Bermuda run, was brought East from its tests on the Pacific coast to help carry an unprecedented rush of tourists to the British islands in the Atlantic.

The new super-Clipper which Boeing built for Pan American Airways was twice the size of the Sikorsky S-42's which were operated with success on the shorter runs over the Caribbean, along the east coast of South America and between New York and Bermuda. The Sikorsky planes could fly the Atlantic—one of them was used for the surveys of 1937—but they do not have the ability to fly the long distances of the Atlantic operation and still carry a profitable pay load.

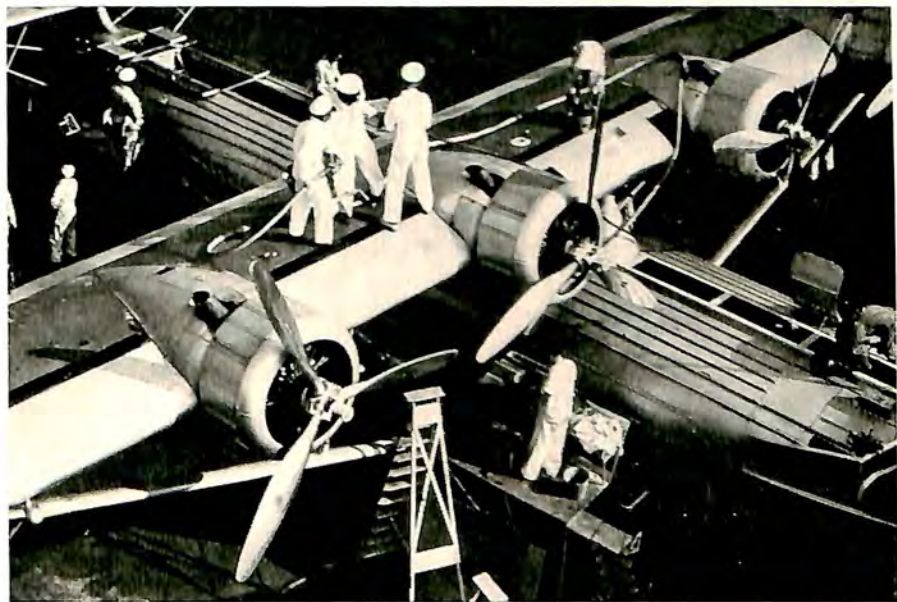
The Boeing 314 was even larger than the Martin China Clipper, which it outweighed by 15 tons. The fine performance of the Martin Clipper, which was used to inaugurate operations over the 9,000-mile air route to the Orient cannot be forgotten easily. This route included the longest overwater non-stop flight ever undertaken in scheduled air transportation, the 2,400-mile hop from San Francisco to Honolulu. The China Clipper led the way and its contribution to ocean flying was of utmost importance. But it has been limited on the long San Francisco-Honolulu run to a maximum of 12 passengers, and that was not sufficient for future operations on either of the two oceans. The Martins were to finish their careers on shorter routes, where smaller gasoline loads would enable them to carry more payload. They were to be followed by the fleet of Boeing 314 boats able to carry 50 passengers on the longest Atlantic stretches and up to 40 on the very long San Francisco to Hawaii leg to the Orient. Only two predecessor airplanes have been in a size category with the 314. They were the German Do-X and the Russian Maxim Gorky, both of which flew successfully, but neither one of which met standards for commercial operation such as those of the Boeing 314. Such requirements pertain to combined range and load carrying ability.

For a brief flight the Boeing 314 could carry and provide accommodations for 72 passengers. But the significant thing about the plane was that it could fly to Europe with 40 passengers plus 5,000 pounds of cargo, and carry these passengers in comfort and luxury. For night portions of the journey, the passengers were to sleep comfortably in roomy Pullman type berths. In the daytime they were to occupy their places in the six passenger compartments and



one private cabin suite, or stroll down to the lounge which at meal time can be converted into a dining room. As on the older Clippers, full meals would be served, with the difference that a part of the preparation of the food would be accomplished in the new Clipper's galley.

Working quarters for the flight crew were in an upper deck entirely separate from the passenger quarters; a deck which ran practically the length of the airplane, with the bridge forward, cargo space amidships, complete living quarters for the crew aft, and additional cargo space still farther aft. There was to be a crew of 10 and



#### REFUELING PAN AMERICAN SIKORSKY

Servicing one of the four-engine Hornet-powered Sikorsky clippers at the Pan American Airways terminal in Miami.

for the first time in airplane history the skipper's post was not at the controls but at a desk to the rear of the bridge. He was to handle controls during take-offs and landings, but during practically all of the cruising his time was to be devoted to the job of executive officer in charge of the operation of this ocean liner of the air.

Actually larger than the surface vessels which operated on the Atlantic not so many years ago, the huge Boeing 314 had a wing spread of 152 feet. The wing was so huge that a gangway through its leading edge let a mechanic walk to any one of the four engines

forming the power plant. Built by the Wright Aeronautical Corporation, and making their first commercial appearance on the Boeing 314, the Wright engines were rated at 1,500 horsepower each.

The world's first amphibion dry dock was constructed to put the 314 in and out of the water. Riding down the ramp on this dry dock the Clipper slipped into the water, the beaching gear was lowered and the plane moved away under its own power. Returning to the hangar after a flight, the Clipper approached the ramp, mechanics maneuvered the beaching gear under the hull, pumped up the flotation tanks until the gear was in place under the Clipper and hauled the entire craft up to the beach. But that was only one of the problems introduced by the Clipper's size. Its great length and wing span made it necessary for the engineers at all the bases where Boeings would be used to make careful and detailed plans for such simple things as bringing the plane through the hangar doors and moving it past supporting pillars. They did this by making models of their hangars and maneuvering model Clippers through the small scale doors and around wooden pegs representing the pillars of the hangar, so that they knew in advance just what they had to do with the big airplanes. And that was typical of what had been done throughout both the Pacific and Atlantic divisions of Pan American Airways in which the new planes were to operate. Six of them were ordered, with four already delivered. The Pacific Division was farther ahead in 1938 because it had been operating over its entire route to the Orient since 1935. On the Atlantic there was a twice-weekly round trip operation to Bermuda, with ground arrangements complete. During the past year the Atlantic Division had been putting final touches on ground arrangements all the way to Europe. During the last two and a half years, for example, Pan American developed a weather reporting service covering the whole North Atlantic area. As a basis for this service, it had, to begin with the reports which were regularly received from ships by the United States Weather Bureau and also others from the standard European service. But this was a foundation only, for it did not cover sufficient area. More important, it did not take into account conditions in the upper air.

The air line already had its aerological stations in the Caribbean, the reports from which were of great importance to the meteorologists working on North Atlantic weather. The line established reporting stations at Iceland and Greenland; arranged with steamship services to get reports from the ships at sea, provided special ship-board equipment for use by the crews in getting the data wanted; and entered into cooperative arrangements with Imperial Airways,

Air France and Lufthansa to exchange weather data. From these various sources Pan American Airways meteorological observers received the fundamental data from all over the Atlantic, which enabled them to make up weather forecasts for flying purposes. Meanwhile the meteorological program of the system as a whole was being advanced to keep step with progress in flying equipment. The tendency was toward operation at higher and higher altitudes. Present day airplanes operate customarily at around 10,000 feet. They were designed to cruise most economically at that altitude, which is considerably higher than was standard five years ago. In another few years the cruising altitude will go to 20,000 feet and probably still higher.

In preparation for these high altitude operations and also to augment the data on which reports and forecasts for operations were based, Pan American Airways meteorological observers got observations up to as high as 60,000 feet. The bulk of the observations were on ordinary hydrogen filled balloons, the ascensions of which were followed with theodolites to determine velocity and direction of the wind at various levels. There also were observations with meteorographs, balloons carrying small radio sets which transmitted signals connecting temperature, barometric pressure and humidity. In addition they afforded opportunities for observations of wind velocity and direction.

On the operating side Pan American Airways was preparing for high altitude flying by acquiring two airplanes designed especially for operation in the stratosphere. The airplanes were under construction for Pan American Airways by the Boeing Company and bore the designation 307S, as distinguished from the standard 307, also under construction by Boeing for operation at present normal flight altitudes over land routes. Pan American Airways had one standard 307 on order. However, the two special altitude planes were to be completed first. These planes were to have cabins which could be sealed and supercharged to an atmospheric pressure which would let passengers breathe normally when the airplane was flying four miles above the earth. The four engines likewise will be supercharged for efficient operation at altitude.

The two 307 stratosphere planes were to be operated by Pan American Airways in a grueling series of proving flights for 500 hours. After that, if it seemed desirable to do so, changes would be made in the standard 307's to convert them to high altitude planes. Original construction has been planned to make the change over possible.

High altitude operation probably will be characteristic of Pan

American's next big ocean airplane. In asking manufacturers for proposals on its 100-passenger airplanes, the air line specified that special consideration would be given to designs permitting operation at 20,000 feet altitude or higher with interior cabin pressures equivalent to 8,000 feet altitude. Pan American Airways planned to operate the new ships at cruising speeds of 200 miles an hour at sea-level, ranging up to 299 at altitude, with payload capacity of 25,000 pounds, capable of carrying that load 5,000 statute miles, and at the same time have stateroom accommodations for at least 100 passengers, dressing rooms, dining room and galley, in addition to crew accommodations for 16.

Five proposals were forwarded to Pan American for the construction of the new Clippers. Invitations had gone to the eight manufacturers who were believed to be interested in receiving them, and from this group design proposals were submitted by Boeing, Consolidated, Douglas and Sikorsky. Seversky asked for and received a copy of the letter of invitation and submitted plans for aircraft proposed for air transport operation as military or commercial equipment. The proposals were studied by Pan American Airways, but late in 1938 no decision had been reached as to what company or companies would be asked to proceed with engineering plans.

The 100-passenger planes, the stratosphere planes, the Boeing Clippers and the Atlantic preparation were all on projects for the near future. Pushing forward vigorously on all these fronts, Pan American Airways at the same time was carrying on the routine job of operating air service on 53,000 miles of international routes. On the routes of Eastern division which extended from Miami to the West Indies across the Caribbean and along the northern and eastern coasts of South America from the Canal Zone to Buenos Aires, passenger, mail and express traffic was at the highest level of the company's history—30 per cent above 1937. The division was looking forward to an increase as large, or larger, for 1939.

Steamship lines scheduled a record number of cruises to South America and Pan American Airways provided a series of air tours of South America leading off with a 46-day grand air tour through Mexico, Central America, around the southern continent and back through the West Indies to Miami. Other air tours of shorter duration and involving smaller expenditures made up a comprehensive schedule for winter tourists. All of these cruises were of the "package" type, one price covering transportation, hotels, meals and sight-seeing. The Eastern division during 1938 increased its service across the Caribbean by adding a line from Miami by way of Port au Prince to Maracaibo, Venezuela, bringing Venezuela within one day travel

time of the United States. It was the fifth air connection between the United States and South America, for two other transcaribbean routes had been established previously, one to Baranquilla, Colombia, and another direct to the Canal Zone. There were other services through Central America and by way of the West Indies.

Pan American-Grace Airways, associate company of Pan American Airways, which operated on the west coast of South America across the Andes to Buenos Aires, also was in line to profit by the big tourist season of 1938-39. All of the longer all-expense tours took passengers over Pan American-Grace routes which included the new diagonal route from La Paz, Bolivia, to the east of the Andes Mountains through Argentina to Mendoza and Buenos Aires. Pan American-Grace's newest airplanes were 21-passenger Douglas



LOCKHEEDS IN CANADA

One of the Pratt & Whitney Hornet-powered Lockheed 14 transports in the service of Trans-Canada Air Lines.

DC-3's and these were especially equipped for high altitude operation over the Chilean Andes. The new interest in Latin America extended to Mexico and Central America as well as to the nations on the southern continent and in this area air transport service was going by Pan American Airways Western division with the connection to Los Angeles by Compañia de Mexicana de Aviacion. The Western division also operated with Douglas DC-3 planes.

In the Pacific Division the regular air mail and express service to China by way of Hawaii, Midway, Wake and Guam and the Philippines enjoyed increasing popularity and it was difficult to meet the demands for passenger service to Hawaii. Two new vacation resort spots were developed by the Pacific division at Midway and Wake Islands. These tiny dots in mid-pacific, which were made into air bases by Pan American Airways, were originally intended as

merely overnight stopping points for persons enroute to the Orient. But when the air line had constructed hotels on the islands, had landscaped the ground and made the two islets habitable as quarters for the permanent ground crews, it became apparent that they need not be regarded as simply way-stations. On the contrary, they were found to be attractive spots for vacationers who wanted isolation and relaxation. With just enough activity in the form of bathing, fishing and golf as guarantees against boredom, the natural charms of Midway and Wake began to attract visitors who stayed a week, two weeks or a month.

The biggest news of the year in the Pacific division was the decision to move from the base at Alameda, Calif., to a new site on Treasure Island, where San Francisco, during 1939, was to have its Golden Gate International Exposition. Pan American Airways' dock and hangar at Treasure Island have been built on a permanent basis and after conclusion of the Fair, when the temporary buildings are removed, the whole island will be made into an air terminal. Because the Clippers do not use land runways, but make their take-offs and landings on the surface of the Bay, it was possible for the operation to take place at Treasure Island with the Clipper base as one of the major attractions of the Exposition. One end of Pan American Airways' big hangar remained open to Exposition visitors. Between this area and the working space there is a partition of glass through which people were able to watch mechanics at work on the transpacific flying boats. Another view may be had from a gallery overhanging the shop. And the regular departures and arrivals always may be witnessed by Fair visitors.

Fair visitors were expected to see departures from San Francisco for New Zealand. A route to that area in the Pacific already was surveyed by Pan American Airways and the delivery of the new Boeing 314's made available equipment for the inauguration of regular service.

A new route in another part of the air line system was the one which connected the United States with Alaska. The first section of the route was between Juneau and Fairbanks, via White Horse, Canada. This international air mail, passenger and express service, inaugurated May 3, cut travel time between Juneau and Fairbanks from five days to four and one half hours. With the inauguration August 20 of air express service between Seattle and Juneau, the final air link with the United States was complete. More than that, the United States-Alaska service provided the final connection in a network of air lines all the way from Nome, Alaska, to Buenos Aires and Argentina.

On the eastern side of the Atlantic, air service to Bermuda with the Sikorsky S-42 Bermuda Clipper was operated at near capacity during all of 1938. Bermuda has two seasons, one in the winter and another in the summer, and the Clipper proved to be a popular means of transportation for both. There were so many repeaters among passengers that Pan American adopted a commutation ticket for the run—a ticket good for 20 one-way or 10 round trips—at a reduction from the regular round trip fare.

Over the system, as a whole, Pan American Airways in 1938 carried approximately 250,000 passengers and reached the million



#### AMERICAN EXPORT AIRLINES SURVEY PLANE

The 15-ton semi-cantilever flying boat built by Consolidated Aircraft Corporation for American Export Airlines survey flights in 1939. Its cruising radius was reported to be 4,000 miles with a crew of six and a ton payload. It was developed from Consolidated's PBV-4 type and was known as Consolidated Model 28.

It was powered by two Pratt & Whitney 900 h.p. Twin Wasp engines.

mark in the total number of passengers carried since establishment of the Clipper routes. Its 53,000 miles of airways served 47 countries and colonies. The air line had a record for regularity of schedule maintained of better than 99 percent.

#### American Export Airlines

American Export Airlines, Inc., with a three year backlog of transatlantic survey work covering flying problems, weather reporting and other meteorological and navigational aids, was rapidly

moving toward the start of actual flying operations in the early spring of 1939. Flight plans reached their climax in September, 1938, when Export Airlines ordered a 15-ton semi-cantilever monoplane of the PBV-4 type from Consolidated Aircraft corporation. The ship, costing \$200,000, was the first of its type to be built for commercial service. It was reported to have a top speed of better than 200 miles an hour at 8,000 feet. With a crew of six and payload of 2,000 pounds, its cruising radius was 4,000 miles.

Transatlantic non-stop flights were to be started at New York, and it was planned to chart routes to principal European countries, North Africa and Asia Minor. The routes to be flown were to supplement the service of American Export Lines, for 20 years operators of American flag steamships to the Mediterranean and Black Sea countries. Permits for survey flights were granted by the United States, France, Germany, Italy, Greece and negotiations were being conducted with Egypt and Portugal.

Back of those preparations for transatlantic service on regular schedule is not only American Export Airlines' survey work, but extensive representation in principal ports and cities of Europe. That work included study of the problems to be met in transatlantic flying, ground and flying personnel, organization, weather routes, bases, aircraft, radio, equipment of all kinds, operating agreements and establishment of friendly relations with the authorities in the countries to be served.

The basis on which American Export planned non-stop transatlantic flying schedules with a safe, economical operations program was the coordination of flying boat and steamship operations along the approximate aerial route. Crews of Export steamships were given extensive schooling in gathering and transmitting weather reports at sea, meteorological information and other aids to navigation of aircraft. By the time the first flights were made with the new Consolidated ship in 1939, the crews were to have had two years of this highly important experience and training.

In addition to the American Export Lines fleet, ships of the Italian Line also were to be available for similar service along the route through an operating agreement between American Export Airlines and Ala Littoria, Italy's air line. The practicability of such coordination of activities was shown in the offices of the company early in October, 1938, when a weather map was constructed from reports received from 14 Export and Italian Line ships at sea, traveling over the United States-Mediterranean route. Dr. James H. Kimball, senior meteorologist of the United States Weather Bureau, plotted the map from the reports in 90 minutes. On its



completion, he said: "No transatlantic flight has ever enjoyed the benefits of such a complete weather report at so many points along the entire Atlantic route. The report was superior in all its features and is particularly adapted to practical use."

The weather map further dramatized the coordinated flying boat and steamship operations by showing that aircraft and steamships along the route could be in constant touch with the other, and be not only floating weather observatories flashing up-to-the-minute weather reports from many points across the Atlantic, but also could be mobile bases on call at any time of the day or night.

W. H. Coverdale, president of American Export Airlines, Inc., and international authority on transportation, predicted that within a very short period after regular nonstop services were established, bringing America and Europe only one day apart, there would be at least 15,000 passengers a year ready to travel the air routes; and that more than 120,000 persons could reasonably be counted on toward the end of the next 10-year period, with travel reduced to approximately half a day across the Atlantic.

The program was to start service in 1939, carrying mail. Regular flights were to be continued until new 40 to 60-passenger sleeper planes were ready for service. Specifications were submitted by Export Airlines to leading American aircraft manufacturers for the larger, faster, luxurious aircraft for non-stop scheduled Atlantic operation.

#### Airline Feeder System

The first air mail feeder conference held in the United States was addressed at Kansas City, Mo., in October, 1938, by F. W. Wiggin, assistant general manager of Airline Feeder System, Inc., of New York City. He pointed out that his company had been in business three years, two of which had been spent in experimental flight and technical research. Mr. Wiggin said, in part:

"There are two distinct types of feeder systems. One, scheduled operations carrying mail, passengers and property, and the other, pick-up and delivery systems with various types of devices. It is important that the differences in these two types of feeder systems be kept in mind. An example of the first is the system we propose to operate, the route taking the form of a figure eight. One of the pick-up and delivery types, I believe, has recently been awarded a contract in the State of Pennsylvania and another in parts of Virginia.

"First we would like to go into detail a little on the type of service we are offering. The first step must be to develop this service

so as to include cities of sufficient size to warrant a fair volume of passengers, mail and property. Although it is generally known that the operations of any airline is justified only by the carrying of mail, a certain volume of passenger and express traffic is necessary to lessen the burden to the government in subsidizing the line for the carrying of mail.

"The most important point to be kept in mind in the establishment of feeder systems is that they are primarily links in the country's air transportation system, i.e., they furnish traffic to the major air lines at any given terminal from outlying communities. In feeding traffic to the major air lines, it is more important to them to receive additional passengers than mail, as it has been the practice of the Government to pay for mail according to mileage rather than volume. It is definitely the job of the feeder systems to educate the residents of newly developed sections to become air minded. Because of this it is apparent that feeder systems will serve more passengers flying for the first time than will the trunk lines.

"During the first six months of our operation, we found that 31 percent of our traffic was connecting traffic. Our route extends from Newark, N. J., to Springfield, Mass., with intermediate stops at Bridgeport, New Haven and Hartford, Conn. In six months, we fed the major air lines a total of 32,058 passenger miles—the equivalent of \$2,000. Although the larger part of connecting traffic was given to the major lines rather than coming to us from them, the explanation of this is simple.

"We were convinced that we must sell through traffic in order to become a successful operation. Traffic personnel and station agents were instructed to dwell on a fly-all-the-way policy when selling passengers or interviewing prospective passengers. We estimate that in the first year of operation of our extended and new route, we will feed the main lines at Newark airport 2,000 passengers, or 885,000 passenger miles, or \$50,000 passenger revenue. Naturally the major lines will welcome this additional revenue and therefore they are watching the development of feeder systems with great interest. They, in turn, will reciprocate by giving feeder lines additional traffic, but they must instruct their personnel to determine the ultimate destination of the passengers, so that if they should be traveling to a point beyond the route they operate, they may be told of the feeder services available. Naturally passengers will be more enthusiastic if they are able to fly all the way to their destination.

"It is known that short runs are expensive to the major air lines, and when feeder lines become more efficient and experienced, they can render another important service to the major lines by relieving

them of the necessity of flying their heavier equipment into small fields and cutting out their short hauls of 100 to 200 miles. If feeder systems could render satisfactory service on these short runs, the overhead of the major lines and their operating costs would be reduced materially.

"It is our opinion that feeder systems should be entirely independent of trunk lines. If this were not the case the general tendency would be to route passengers all the way on one line and in so doing inconvenience the passengers. Independent feeder systems must instruct their personnel to book passengers over the trunk lines offering the best and speediest connection to their ultimate destination.

"Feeder systems should not spring up over night, and in their first few years of development should be centered around major airline terminals such as Newark, N. J., Chicago, Ill., St. Louis, Mo., Kansas City, Mo., and one or two points on the West Coast. In the Eastern section the operations should cover a radius of 200 miles of the terminal and in the middle west possibly a radius of 500 miles to allow for the increased distances between cities. We believe that the system which we are establishing, namely the figure eight system, will become a very efficient operation. Wherever possible a feeder system should serve as the rim and spokes around a hub.

"Feeder routes by nature are an adjunct to national defense and to the progressive development of our commercial life in this country. They are, in fact, frontier pioneers in a new industry of transportation, and therefore must be inaugurated and developed by Government as well as public demand. Therefore, in order to insure a sound network of feeder systems in the United States, they must keep in close contact with, and have the full cooperation of the Federal Government.

"Regarding another type of feeder service, namely, pick-up and delivery system, we firmly believe that such a development is absolutely necessary. However, we feel that it is of secondary importance to the establishment of complete feeder services, carrying passengers, as well as property and mail. Pick-up and delivery systems should be developed in territories where regular air transportation service is difficult to operate and where such devices would actually save money for the Government in transporting mail. Such services would be advisable in sections that are mountainous and that become quite inaccessible during the winter months. When fully developed these pick-up and delivery systems will become the R. F. D. of air mail transportation.

"A route which has recently been awarded mail contracts in the East calls for 26 stops. Of these only 13 have airports available.

Naturally very few passengers will be transported over this route and in order that the service can be fully determined of necessity and convenience, airports must be developed in these very small cities. This service is also limited to daylight contact flying because of single engine equipment. Pick-up and delivery routes will do much to influence cities to construct airports and airway facilities, because no sooner will they have air mail service than they will demand passenger service as well."

#### All American Aviation

All American Aviation, Inc., of Morgantown, West Va., in 1939 was to begin operations of a non-stop air mail delivery and pickup service on two routes embracing 56 cities and towns in southern Pennsylvania and West Virginia. Half the towns lacked airport facilities. All the deliveries and pickups were to be made while the planes were in flight.

An official statement by the company reads:

"The mail pickup planes are Stinson Reliants, with 260 horsepower Lycoming engines. Modifications have been made in the planes to carry the pickup and delivery equipment which is incorporated in the structure of the machine itself.

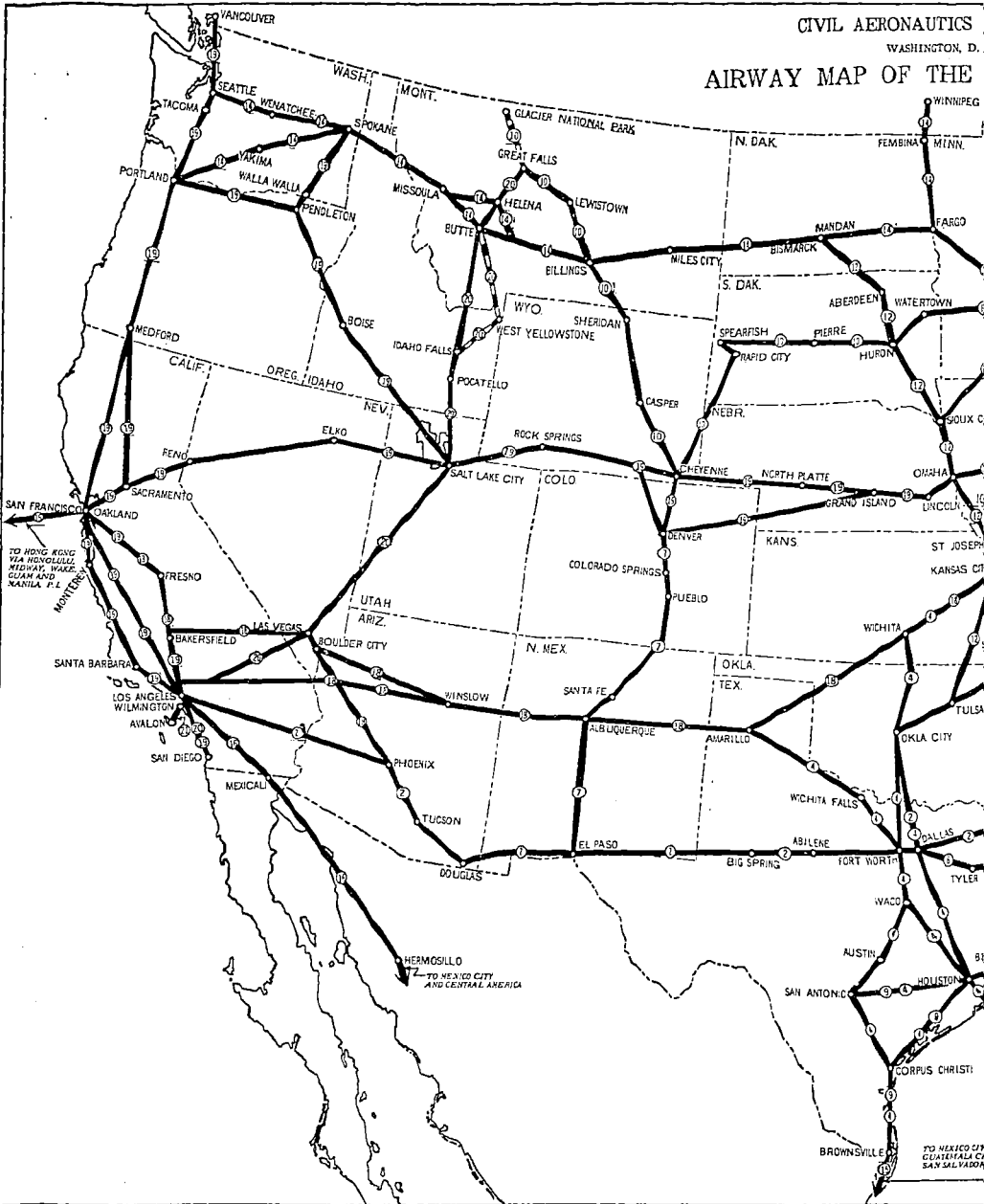
"All American Aviation Inc. is headed by Richard C. duPont, president, and Dr. Lytle S. Adams, vice president. Dr. Adams is the inventor of the pickup device. In demonstrations, the pickup planes have successfully picked up mail from ships at sea and from the roofs of buildings. Items of the most fragile sort, including electric light bulbs, bottled goods and stuffed birds, have been picked up and delivered without damage, from planes in flight.

"The airmail pickup device offers the most practical solution for providing air mail service to every community. It is directly parallel to the device on railway cars which permits the high speed train to discharge and pick up mail without stopping. The people in smaller towns are entitled to fast mail service just as much as are the people in larger cities. Obviously, it would be impossible to operate high-speed trains if the trains were obliged to stop at every town on their route to discharge and take on mail. It was the development of the railway mail pickup devices that brought first-class mail service to every city in the country.

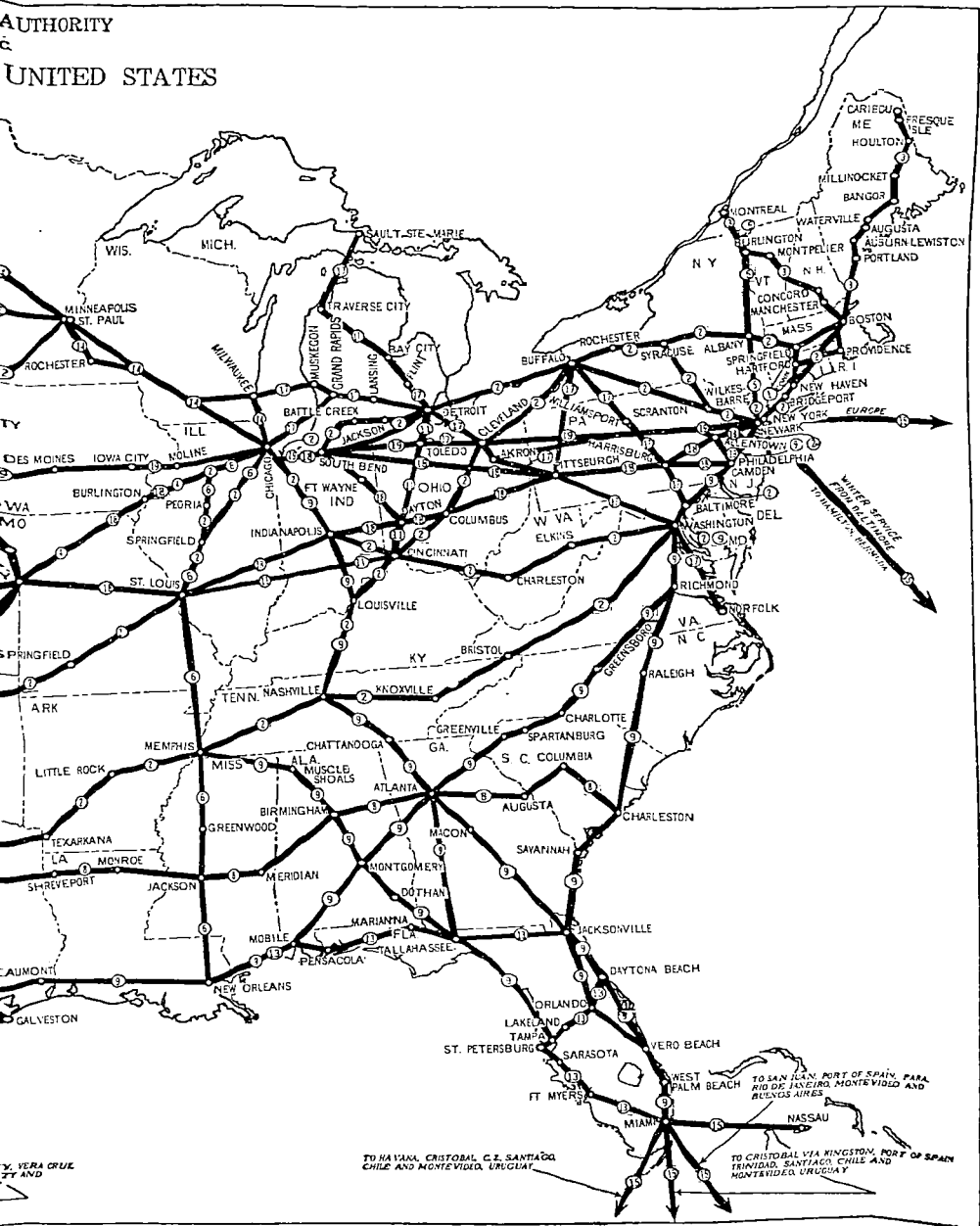
"Today only those cities equipped with costly airports receive air mail service. Our air mail pickup device makes it possible to serve all communities. On the new airmail routes, some of our pickups will be made from the centers of cities—others from hilltops.

"The Adams device is simple in operation. Mail is suspended .

CIVIL AERONAUTICS  
WASHINGTON, D.  
AIRWAY MAP OF THE



AUTHORITY  
 &  
 UNITED STATES



**SCHEDULED AIRWAYS OPERATIONS**

January 1, 1939

<i>Route No.</i>	<i>Operator</i>	<i>Routes Operated</i>	<i>Route Mileage</i>	<i>Class of Service</i>
1	Airline Feeder System, Inc.	New York to Springfield-Westfield, Mass.	127	P
2	American Airlines, Inc.	New York to Boston (direct) . . . . .	190	MPE
		New York to Boston via Hartford . . . . .	203	MPE
		New York to Boston via Providence . . . . .	221	MPE
		New York to Boston via Springfield . . . . .	206	MPE
		New York to Los Angeles via Washington, Nashville and Dallas . . . . .	2,759	MPE
		Boston to Cleveland via Albany and Buffalo . . . . .	591	MPE
		New York to Albany . . . . .	134	MPE
		New York to Chicago via Wilkes-Barre, Syracuse, Buffalo and Detroit . . . . .	821	MPE
		Detroit to Chicago via Battle Creek . . . . .	263	MPE
		Washington to Chicago via Cincinnati . . . . .	684	MPE
		Cleveland to Nashville . . . . .	469	MPE
		Chicago to Fort Worth via St. Louis and Tulsa . . . . .	934	MPE
		Boston to Bangor . . . . .	213	MPE
		Bangor to Caribou . . . . .	164	MPE
		Boston to Montreal . . . . .	261	MPE
3	Boston-Maine Airways, Inc.	Chicago to Dallas via Wichita . . . . .	929	MPE
		Dallas to Brownsville . . . . .	546	MPE
		Amarillo to Dallas . . . . .	345	MPE
4	Braniff Airways, Inc.	Dallas to Galveston . . . . .	273	MPE
		Houston to San Antonio . . . . .	191	PE
		Houston to Corpus Christi . . . . .	186	PE
5	Canadian Colonial Airways, Inc.	New York to Montreal . . . . .	332	MPE
6	Chicago & Southern Air Lines, Inc.	Chicago to New Orleans . . . . .	892	MPE
7	Continental Air Lines, Inc.	Denver to El Paso . . . . .	581	MPE
8	Delta Air Corporation	Charleston to Fort Worth via Atlanta . . . . .	1,095	MPE
		New York to Miami . . . . .	1,210	MPE
9	Eastern Air Lines, Inc.	Jacksonville to Miami via Orlando . . . . .	344	MPE
		New York to San Antonio via Atlanta, New Orleans and Houston . . . . .	1,727	MPE
		Chicago to Miami via Atlanta and Jacksonville . . . . .	1,267	MPE
		Atlanta to Tampa via Tallahassee . . . . .	434	MPE
		Tallahassee to Memphis via Birmingham . . . . .	490	MPE
		Houston to Brownsville via Corpus Christi . . . . .	319	MPE
		Cheyenne to Great Falls . . . . .	572	MPE
		Cheyenne to Huron via Spearfish . . . . .	542	MPE
		Great Falls to Glacier National Park . . . . .	113	PE
		Honolulu to Hilo . . . . .	229	MPE
10	Inland Airlines, Inc.	Honolulu to Fort Allen . . . . .	120	MPE
		Juneau to Sitka and Chichagof, Alaska . . . . .	225	PE
11	Inter-Island Airways, Inc. Marine Airways, Inc. Marquette Airlines, Inc.	St. Louis to Detroit via Cincinnati . . . . .	547	P
		Minneapolis to Kansas City via Sioux City . . . . .	488	MPE
12	Mid-Continent Airlines, Inc.	Minneapolis to Huron . . . . .	256	MPE
		Huron to Bismarck . . . . .	221	MPE
		Huron to Tulsa . . . . .	628	MPE
		Daytona Beach to Miami via St. Petersburg . . . . .	361	MPE
13	National Airlines, Inc.	Jacksonville to New Orleans . . . . .	524	MPE
		Chicago to Fargo via Milwaukee . . . . .	612	MPE
14	Northwest Airlines, Inc.	Chicago to Minneapolis via Rochester . . . . .	367	MPE
		Chicago to Fargo (direct) . . . . .	571	MPE
		Fargo to Winnipeg . . . . .	211	MPE
		Fargo to Seattle via Butte . . . . .	1,250	MPE
		Fargo to Seattle via Helena . . . . .	1,258	MPE
		Spokane to Portland via Yakima . . . . .	291	MPE
		Baltimore-Hamilton, Bermuda via Port Washington, N. Y. . . . .	947	MPE
15	Pan-American Airways, Inc.	Miami to Nassau . . . . .	188	MPE
		Miami to Havana . . . . .	226	MPE
		Miami to San Juan . . . . .	1,161	MPE

*See next column*

Route No.	Operator	Routes Operated	Route Mileage	Class of Service
		San Juan to Port of Spain.....	725	MPE
		Port of Spain to Buenos Aires.....	5,173	MPE
		Port au Prince to San Juan.....	415	PE
		Port au Prince to La Guaira via Maracaibo	888	PE
		Port au Prince to Kingston.....	455	PE
		Miami-Cristobal via Kingston.....	1,307	MPE
		Miami to Cristobal via Barranquilla.....	1,662	MPE
		Barranquilla to Port of Spain.....	944	MPE
		Maracaibo to Port of Spain.....	730	MPE
		Miami to Merida.....	717	MPE
		Brownsville to Mexico City.....	466	MPE
		Mexico City to Cristobal.....	1,765	MPE
		San Francisco to Hong Kong via Hawaii, Guam, Manila and Macao.....	8,748	MPE
		Belem, Br. to Recife.....	1,231	PE
		Recife to Porto Alegre.....	1,988	PE
		Belem to Rio Branco, Br. via Amazon River	1,685	PE
		Rio de Janeiro to Bello Horizonte.....	210	PE
		Havana to Guantanamo.....	656	PE
		Havana to Santiago via Cienfuegos.....	472	PE
		Havana to Cienfuegos.....	140	PE
		New York to Europe.....	Variable	ME
16	Pan American Airways, Inc. (Cia Mexicana de Aviacion)	Mexico City to Merida.....	736	PE
		Tampico to Mexico City via Tuxpan.....	244	PE
	Pan American Airways, Inc. (Pacific Alaska Airways, Inc.)	Juneau to Fairbanks via Whitehorse.....	660	MPE
		Fairbanks to Nome.....	528	PE
		Fairbanks to Bethel via Flat.....	531	PE
	Pan American-Grace Airways, Inc.	Cristobal, Canal Zone to Buenos Aires via Santiago, Chile.....	4,436	MPE
		Arica, Chile to Buenos Aires via LaPaz, Bolivia, and Cordoba, Argentina.....	1,640	MPE
		Arica, Chile to LaPaz, Bolivia.....	190	MPE
		Santiago, Chile to Buenos Aires via Cordoba	871	PE
17	Pennsylvania-Central Airlines Corporation	Washington to Detroit via Pittsburgh and Cleveland.....	410	MPE
		Norfolk to Washington.....	146	MPE
		Detroit to Milwaukee.....	259	MPE
		Grand Rapids to Chicago.....	131	MPE
		Washington to Buffalo via Baltimore and Harrisburg.....	318	MPE
		Washington to Buffalo via Pittsburgh.....	401	PE
18	Transcontinental & Western Air, Inc.	Detroit to Sault Ste. Marie.....	347	MPE
		New York to Los Angeles via St. Louis.....	2,533	MPE
		New York to Chicago via Pittsburgh.....	724	PE
		New York to Los Angeles via Philadelphia, Dayton, Chicago and Boulder City.....	2,675	MPE
19	United Air Lines Transport Corporation	Phoenix to San Francisco via Las Vegas.....	764	MPE
		New York to Chicago.....	719	MPE
		New York to Chicago via Philadelphia, Allentown and Akron.....	795	MPE
		Chicago to San Francisco via Denver.....	2,022	MPE
		Chicago to Salt Lake City via Cheyenne.....	1,302	MPE
		Denver to Cheyenne.....	96	MPE
		Salt Lake City to Seattle via Portland.....	816	MPE
		Portland to Spokane via Pendleton.....	341	MPE
		San Diego to Seattle via Fresno.....	1,161	MPE
		San Francisco to Seattle via Sacramento and Medford.....	712	MPE
		Los Angeles to San Francisco (direct).....	348	MPE
		Los Angeles to San Francisco via Santa Barbara and Monterey.....	366	MPE
		Seattle to Vancouver.....	123	MPE
20	Western Air Express Corporation	San Diego to Salt Lake City.....	702	MPE
		Salt Lake City to Great Falls.....	489	MPE
		Salt Lake City to Butte via Yellowstone National Park.....	404	PE
21	Wilmington-Catalina Airline, Ltd.	Wilmington to Avalon.....	31	PE





#### STINSONS FOR MAIL PICK-UP

One of the fleet of Stinson Reliants purchased by All American Aviation for non-stop air mail pick-up service between 86 towns in Pennsylvania and West Virginia. Photo shows the Reliant picking up a bag of mail. The bag, suspended between two poles, has just been caught by a grappling hook lowered from the plane.

from two posts 40 feet apart. A grappling hook is trailed 65 feet below the plane. This snatches the rope to which the mail sack is attached. A winch operated from the plane then draws the mail into the cabin. Objects weighing more than 100 pounds have been picked up by Stinson planes traveling at speeds of 120 miles an hour when the contact was made. To compensate for the terrific velocity of picking up heavy loads at high speed, a powerful shock absorbing mechanism is built into the plane."

### American Airlines

The year 1938 was one of intense activity and progress for American Airlines, Inc. As in 1937, the air line set a record for the number of revenue passengers carried in a single year by one line when it transported 358,295, representing a gain of 19.2 percent over 1937.

American Airlines operated 6,701 miles of airways ranging from Boston to Los Angeles in 1938. Its routes were between Los Angeles-Dallas, Albany-Newark-Ft. Worth (the two combining to form the air line's Southern Transcontinental Route), Newark-Boston, Newark-Chicago, Boston-Cleveland, Cleveland-Nashville, Chicago-Washington, and Chicago-Ft. Worth. Over these routes American operated 21 Douglas DC-3 "Flagships," nine "Flagship" Skysleepers, and 13 DC-2 fourteen-passenger planes. At the beginning of 1939, the air line had on order 10 new Douglas DC-3 "Flagships," five to be delivered in March, the remaining five in May. The air line also purchased three new Stinson training planes which were used in route checking and airport surveys. The new transports were bought because of the upward trend of business during the year. At the close of 1938, the air line had 1,990 employes, of which 116 were captains and 121 first officers.

During 1938, American faced an extraordinary traffic situation due to the hurricane which ravaged the Eastern seaboard. This storm, which struck in September, tied up all forms of transportation between New York, Boston, Hartford and Providence except that offered by coastwise shipping and airplanes. The ticket offices of the air line in these cities were swamped with requests for space on the "Flagships." Particularly was this true of the Boston-New York route, over which 78 flights were operated in one day at the peak of the emergency. To meet the demand all available equipment was pressed into service. In the 10-day period immediately following the storm, approximately 10,000 passengers were carried by "Flagship" between Boston and New York.

At the invitation of American Airlines, other lines cooperated in transporting food, drugs, serum, mail and persons during the emergency period. Many of the passengers were first riders and officials of the air line reported many of them have since become regular patrons.

Travel on all of American's routes was up in 1938. During the winter, passenger traffic on the southern transcontinental route to Texas, Arizona and Southern California gained appreciably. The company continued improving service on all of its routes, at the same time maintaining and emphasizing its policy of conservative operation. It improved and extended its elaborate teletype-radio com-

munications system. The company also installed full-feathering propellers, and the Sperry-RCA radio compass on its "Flagships."

Service was re-established to Springfield, Mass., linking this city to the network of 57 major cities on the air line's system from coast-to-coast. During the year American Airlines exhibited its "Flagships" in the downtown areas of three of the nation's most important cities. In Detroit, 112,751 persons viewed the ships, in Washington, 78,636, and in Chicago, 98,491.

Officials signed a lease in 1938 for hangar and office space at the new North Beach Airport in New York City. Occupying more than 300,000 square feet, the three hangar-one unit building for American Airlines comprised the largest hangar unit, in floor space, in the world. The company made plans to move its headquarters to New York as soon as the North Beach Airport was ready.

C. R. Smith, president of American Airlines, declared that in his opinion the most important steps made in air transport operation in 1938 were the following:

Decision of air lines to pay for present equipment and endeavor to operate it on a profitable basis before purchasing larger and more expensive aircraft; creation of the Civil Aeronautics Authority; increase in business by the smaller air lines at a rate higher than most of the major air lines, indicating a healthy development of air transportation on a nation-wide basis; increase in safety of air line operation; and the service rendered New England by air transport operators following the hurricane of September, 1938.

#### Boston-Maine Airways

The Boston-Maine Airways, Inc., reported that in 1938 its scheduled mileage was 2,268 miles per day made on two round trips between Boston and Montreal every morning and afternoon; and two round trips between Boston and Bangor, with an extension to Caribou, and with stops at Millinocket, Houlton and Presque Isle. Equipment consisted of Lockheed Electra planes. Passenger revenues increased 20 percent over 1937 and mail poundage gained 70 percent. Airway range stations were located at Portland, Augusta, Bangor, Concord, Burlington, Montreal, with Montpelier pending. Application was made to the Civil Aeronautics Authority for extension of the route from Boston to North Beach Airport, New York City.

#### Chicago and Southern Air Lines

Chicago and Southern Air Lines, Inc., has served the nation's transcontinental lines since 1934 when it was awarded Air Mail Con-

tract No. 8. The company was then operating as the Pacific Seaboard Air Lines with passenger service between Los Angeles and San Francisco. After receiving a mail contract the air line moved its entire equipment and personnel to the Mississippi valley, establishing its main base of operation and general offices in Memphis, Tenn. On June 3, 1934, Chicago and Southern Air Lines commenced operation of one trip daily over the 900-mile route between the Great Lakes and the Gulf Coast. On July 15, of the same year, passenger service was begun on "The Valley Level Route" from Chicago to New Orleans by way of intermediate stops at Peoria, Springfield, St. Louis, Memphis, Greenwood and Jackson. The general offices and operations headquarters moved from Memphis to St. Louis in 1935. Shortly thereafter, a second round trip schedule was added to its service and Stinson Tri-motored transports were adopted. In May of the same year, all metal twin-motored Lockheeds were placed in service. "The Valley Level Route" shares offices with TWA in the Palmer House lobby in Chicago. In St. Louis, both companies work hand in hand from their consolidated 12th and Locust street address. At Memphis, Tenn., Chicago and Southern Air Lines occupies quarters in the Peabody Hotel. At Jackson, Miss., Delta Air Lines and "The Valley Level Route" are associated in the same office. In New Orleans the company maintains its own traffic office at 216 Baronne street.

#### Continental Air Lines

The year 1938 witnessed an upturn in traffic and revenue on Continental Air Lines, Inc. The number of passengers increased 43 per cent over 1937, while passenger revenue increased 36 per cent. A lowered rate structure played an important part in causing these gains, plus increased advertising and sales effort. Continental successfully experimented with a rate structure that gave unusual advantages to the round trip passenger. It believes one-way tickets are purchased by the customer through emergency or some reason where he almost has to use the air lines, and by a person who is not interested in what the cost will be. The purchaser of a round-trip ticket is generally one who lives in Continental's own territory, knows what competing forms of transportation have to offer, and has time to compare costs as well as schedules. Therefore, the latter has to be sold his transportation. One-way fares are set on a rather high level and round-trip fares as nearly as possible to the level of "rail plus lower plus meals."

The "wife free" offer was one of the highlights of the aviation year from a human standpoint. Letting a wife ride free if she accom-

panied her revenue-paying husband definitely caused women to ride the air for the first time. A large percentage of those wives stated that they now felt much better about their husbands flying, and they could thoroughly understand why the men were anxious to have family permission for regular use of transport air lines.

Continental's Lockheed 12 planes were put into service July 1, 1937. Since then not a case of motor failure has occurred, in spite of operating over the highest average altitude route in the world. Every plane was returned to the Lockheed factory in Burbank, Calif., during June, 1938, for a complete disassembly and rebuilding. This was done purely as a precautionary matter as Continental was the first operator to use Lockheed 12's in such gruelling service as 1,310 miles per day the year around on a block-to-block schedule of 187 miles per hour.

#### Eastern Air Lines

Eastern Air Lines reported 1938 as the greatest year in its decade of operations. Highlights of the lines' expansion program during 1938 were establishment of service from Atlanta to Tampa, and from Houston to San Antonio, both in October; expansion of operations from Tampa to Memphis; and the launching of service from Houston to Brownsville in April, 1939, to connect the United States with Old Mexico, Central and South America by air through the combined facilities of Eastern Air Lines and Pan American Airways.

Prior to the inception of this expansion program, the air line system was 3,896 route miles in extent. With the expanded routes in operation, Eastern Air Lines' routes were 5,328 miles in extent. This represented a gain of 37 per cent in mileage.

In April, 1938, the air line, a division of North American Aviation, Inc., was sold to Captain E. V. Rickenbacker and his associates, Kuhn Loeb and Co., and Smith, Barney and Co. Captain Rickenbacker, who had served as general manager of the line, was elected president and general manager of the new company. In February, 1939, he issued this statement:

"January was the best January in the air lines' history due, primarily, to the operating efficiency of 93 per cent, and the fact that we were offering the greatest number of passenger seats in our history. We have purchased Douglas DC-3 twenty-one passenger planes, which are now in operation. This new equipment added, on February 15, 1939, the fifth round-trip between New York and Miami, four of which are operated with DC-3 twenty-one passenger planes, and one with DC-2 fourteen-passenger planes. The DC-3 equipment on February 15th was substituted for the DC-2 planes on

the night trip from Chicago to Miami, making the DC-2 planes available for use on the new route between Memphis, Tallahassee and Tampa.

"With this new service, the air traveler has greatly added facilities for commuting between New York, Mexico and the Central Americas. A special express schedule with the latest DC-3 planes will be operated, leaving New York in the evening, and arriving at Brownsville at approximately 8 o'clock the next morning. Direct connections there with Pan American will land the passenger in Mexico City by noon.

"The daylight semi-express schedule will be maintained between New York and San Antonio, with DC-3 equipment. The trip between New York and Atlanta remains as before, with DC-2 equipment leaving New York at 6 p.m., and arriving at Atlanta at midnight. The night run between New York and San Antonio remains, with DC-2 planes leaving Newark Airport at 11 p.m., and landing at San Antonio at 11:30 a.m. This schedule provides four round-trips a day between New York and Atlanta; three round-trips a day between New York and Houston; two round-trips a day between New York and San Antonio; and one round-trip a day between New York and Brownsville."

Florida's West Coast began receiving direct air mail, air express and air passenger service via Eastern Air Lines for the first time during 1938. The line became the artery through which air commerce flowed out of the Central and South Americas through Old Mexico and into 16 southern, middlewestern and Atlantic seaboard States. Although much of Eastern Air Lines' business was seasonal, due to the warm climates during winter months through which the line operated, there was a tendency in 1938 and early 1939 to level this traffic off on a year-round basis. As an example, every spring, summer and fall month of 1938 showed a greater volume of traffic than during the corresponding month of 1937.

At the end of 1938, 10 years and seven months after Eastern Air Lines was launched as Pitcairn Aviation, the line was serving 42 cities in 16 States, from 10,000 to 15,000 passengers were being carried per month and approximately 50,000 pounds of air express and 225,000 pounds of air mail were carried every month. The increase in business by Eastern Air Lines during the first eight months of 1938 as compared with the corresponding period in 1937 follows: revenue plane miles increased 8.1 per cent; revenue passengers carried increased 27.5 per cent; revenue passenger miles increased 23.7 per cent; mail pounds and express pounds carried increased 32.3 per cent and 8.6 per cent, respectively. One of the

busiest segments of the air line was the New York-Washington run, where regular 80-minute service was provided with 15 round trips daily.

#### Inter-Island Airways

In November, 1938, the Inter-Island Airways, Ltd., began its tenth year of scheduled airline service between the islands of the Hawaiian group, maintaining a record of no accident to any of the 130,000 passengers carried during that period. Since inception of service, the company's planes have flown over 15,800,000 passenger



#### ON EASTERN AIR LINES

One of the Douglas DC-3 Silverliners in regular service. They are powered by Wright Cyclones.

miles and have been in the air more than 27,000 hours. During 1938 two of the smaller type Sikorsky planes were rebuilt to provide a maximum of comfort and speed, supplementing, on the short runs, the three 16-passenger planes. The line's fourth Sikorsky S-43 amphibion was ordered for delivery early in 1939, which will greatly increase the service.

Operation of America's most westerly domestic United States air mail line differed from that of most mainland air lines. Although all the stops on the company's schedules were on land bases, the great

majority of the flying was done over water, 235 miles to the southeast via the islands of Lanai, Molokai, Maui and Hawaii, and 135 miles to the island of Kauai to the northwest. Hawaii's air line travelers were favored with daylight operations, ideal weather conditions, and the ever-present panorama of Oahu's white sandy beaches and rolling surf; Molokai's rugged cliffs; the summit of Maui's Haleakala rising above the clouds; and Hawaii's Hamakua coast with its pattern of sugar cane fields from the coastline to the tree ferns on the slopes of Maunaloa and Maunakea. Because the only means of travel between the islands in the Hawaiian group was by water or air, and steamer service to some islands was but twice a week, commercial aviation was of primary importance in the Territory. Emergency and charter trips were frequent. Due to Hawaii's great distance from mainland sources of supply, complete repair shops and adequate stores of supply have been maintained at John Rodgers airport in Honolulu, the home base of the company. A great deal has been done by the Territorial and Federal Governments to bring the airports of Hawaii up to mainland standards.

#### **Marquette Airlines**

On May 4, 1938, Marquette Airlines, Inc. flew its first regular schedule between St. Louis and Detroit via Cincinnati, Dayton and Toledo. This service was established with flights scheduled for only the last four days of the week, but the rapid increase in business added new schedules to operate between Cincinnati and Detroit on every day except Sunday. Each of the first six months of operation showed a substantial increase over the preceding month. Early in 1939 it was planned to increase the passenger service to two round trips daily between Cincinnati and Dayton, and to make a daily operation between Cincinnati and St. Louis. An advertising and sales campaign, and other methods of securing business were to be put into effect. It was demonstrated that Marquette Airlines, Inc. had fulfilled the need for service between the cities on its line. Its idea was to increase service and to improve air transportation along the route.

#### **Northwest Airlines, Inc.**

Plans of Northwest Airlines for 1939 included the purchase of six Douglas DC-3, twenty-one passenger planes, which would augment the fleet of Lockheed 14's and 10-A's which flew over approximately 2,500 miles of airway from Chicago, Milwaukee, Twin Cities, to Fargo, Winnipeg, Billings, Missoula, Spokane, Portland, Seattle and intermediate points. Four round trips were operated daily be-



tween Chicago and Seattle-Portland; three round trips were flown daily between Chicago and the Twin Cities; two Chicago flights made connections at Fargo, N. D., daily, with flights for Winnipeg.

Northwest Airlines in 1938 flew 5,344,802 airplane miles, representing an increase over 1937 of 19.8 per cent. Pounds of express carried jumped 19.7 per cent to a total of 277,109 in 1938. Pounds of mail increased 24.8 per cent in 1938 over the previous year, with a total of 1,857,610 pounds flown. Revenue passengers carried by the air line in 1938 were 45,926, a gain of 21.5 per cent over 1937. The 1938 payroll increased 34.2 per cent to \$1,032,864, while the number of employes gained 37.3 per cent to a total of 515.

Northwest Airlines, in 1938, had the highest load factor of any



#### AMERICAN TRANSPORTS ABROAD

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

line operating out of Chicago. Seventy-six per cent of its available seats were filled. A new stop at Madison, Wis., on the Chicago-Twin Cities route increased traffic. After 12 years of progress, Northwest Airlines transported its passengers, air mail and express at an average speed of more than 200 miles per hour from Chicago to Seattle-Portland. The schedule between Chicago and the Twin Cities was reduced to less than two hours.

Northwest Airlines planned for 1939 to launch two new middle-western runs. One would extend from Minneapolis-St. Paul to Duluth-Superior to Wausau, Wis., over to Green Bay and then down through eastern Wisconsin's Fox River valley to Milwaukee where it would connect with present Chicago-Milwaukee flights. The other

proposed route would extend southward from Rochester, Minn., on the Chicago-Twin Cities run, to Mason City, Des Moines and Ottumwa, Iowa, down to Quincy, Ill., and terminate at St. Louis where it would connect with other major air lines.

Stewardess service was begun in February, 1939, on Northwest Airlines' Douglas DC-3 twenty-one passenger planes in service on the Chicago-Minneapolis-St. Paul run.

Northwest began installation of oxygen equipment on its planes in February, 1939, after a test flight in which one of the company's planes climbed to 20,200 feet with no discomfort to passengers or crew. The oxygen equipment, developed by Dr. W. R. Lovelace, Dr. Walter M. Boothby, and Dr. A. H. Bulbulian of the Mayo Foundation, Rochester, Minn., counteracted any effect of natural oxygen at high altitudes. The apparatus weighed 40 pounds. It provided the crews with oxygen in regulated doses when they flew at 10,000 feet or more. Taken through a special mask developed by Dr. Lovelace and his associates, oxygen was easily administered to those needing or desiring it. The mask may be worn during eating, smoking or talking. To a metal pipe, running from the oxygen bottle placed in the lavatory compartment of the Northwest air liners, was attached a small rubber tube from the mask. Pilots merely "plugged in" their mask tubes when desiring the oxygen. Under pressure of 1,800 pounds, the oxygen was stepped down to two pounds in pressure by two valves, especially designed and built by NWA engineers. This was done because a human being could not take oxygen at the tremendous pressure under which it was bottled in the storage tank.

Controls for the apparatus when once set for the highest altitude the plane was expected to reach did not need to be regulated again until completion of the flight. Dr. Lovelace pointed out after the test flight that the installation of the equipment would not necessarily mean that all persons flying at high altitudes would be given oxygen. He said:

"Oxygen is necessary according to the physical requirements of the individual. Some persons require it at lower altitudes than others; still others can stand atmospheric pressure at high altitudes without any oxygen. Its installation is for the comfort of the passenger. It is easier to stand the high sub-stratosphere flying by using oxygen. And when descending, a mixture of oxygen and helium helps to equalize air pressure on one's ears. We believe this installation is very noteworthy. Northwest Airlines is the first air line to use it."

The company attracted attention to the new oxygen equipment in March, 1939, when under the auspices of the Mayo Foundation,

Rochester, Minn., a Northwest liner flew non-stop from Minneapolis to Boston in four hours and 48 minutes at an average speed of 240 miles an hour at altitudes between 15,500 and 22,500 feet. All of the crew and passengers were equipped with the special masks and declared, upon landing, that they suffered no discomfort from the high altitudes. The flight was made as a feature of the conference on physiological problems in aviation medicine sponsored by Harvard University fatigue laboratory.

#### Pennsylvania—Central Airlines

During 1938 Pennsylvania-Central Airlines continued its expansion program started with establishment of the Washington-Buffalo



SIKORSKY AMPHIBION OVER HAWAII

One of the S-43 Hornet-powered passenger planes in Inter-Island Airways service.

route in 1937. On January 31, 1938, after a hearing before the Post Office Department, permission was given to operate an off-line passenger and express service between Pittsburgh and Buffalo and between Pittsburgh and Baltimore. Permission was granted by the Post Office Department in February, 1938, for an extension of Air Mail Route 14 to Norfolk, Va. Later, permission was granted for extension of Air Mail Route 32 from Grand Rapids to Chicago. In July, 1938, an air mail, passenger and express service between Detroit and Sault Ste. Marie, via Flint, Saginaw-Bay City and Traverse City, was inaugurated. Pennsylvania-Central Airlines in early 1939 had a route mileage of 2,102 miles as compared to 715 route miles in 1934 and

127 route miles in 1927 when the original predecessor company of PCA began operations. The air line served 20 cities in eight states throughout the industrial sections of the East and Midwest in 1938. The addition of the Detroit to Sault Ste. Marie route and the Washington-Norfolk extension was of great significance for both served popular resort areas.

#### Transcontinental and Western Air

Extension of T.W.A. service, additions to its Skysleeper and Skyclub fleet, continuation of overweather research by Capt. D. W. Tomlinson, and preparations for introduction of four-engine altitude conditioned transports featured 1938 for Transcontinental and Western Air, Inc. T.W.A. flies the central and Santa Fe trail transcontinental route, serving New York, Chicago, Kansas City, Los Angeles and San Francisco and intermediate points.

T.W.A.'s traffic increased 8.32 percent in revenue passenger miles during 1938 over 1937. Extensions of service included opening a new route to Phoenix, Ariz., with intermediate stops at Kingman and Prescott. T.W.A. gave the only through service from San Francisco and northern Pacific coast cities to this winter playground area. Service to Boulder City, site of Boulder Dam, was also started, giving air travellers stopover privileges in the new Boulder Dam Recreational Area, where the Government is spending several million dollars to create a desert playground along the shores of Lake Mead. T.W.A. was the only air line to serve this area directly.

In the East, new non-stop flights were provided between New York and Chicago. Harrisburg, Pa., was given through transcontinental service for the first time. The Sky Chief, the T.W.A. crack coast to coast flight, was scheduled to St. Louis with only one stop, at Pittsburgh, on its eastern lap. Second section of this flight swung northward to Chicago to give it the benefits of deluxe transcontinental air service.

The air line's fleet of sixteen 14-passenger Skyliners, nine 21-passenger Skyclubs and eight luxury Skysleepers was augmented by two new Douglas DST Skysleepers, making a total of 40 Douglas planes covering the system. Additional rest rooms installed in equipment provided separate washing and toilet facilities for men and women.

The overweather research program, conducted in a specially built Northrup Gamma "Flying Laboratory" by Capt. Tomlinson, was continued. The data already accumulated on high altitude flying conditions was augmented by observations and records in preparation for overweather operations. The Boeing Aircraft company was

working on a 33-passenger stratoliner, to be operated at 16,000 feet, although it was to be designed to cruise at 20,000 feet when surface weather conditions were not ideal. Passenger comfort at all altitudes was reported to be insured by supercharged cabins, which will maintain lower-altitude air pressures in the passenger and crew compartment.

T.W.A. continued tests during 1938 with new ultra-high frequency radio equipment. Installed in the test ship in addition to the standard two way equipment, the ultra short-wave transmitters emit radio waves which travel only in straight lines. In tests, they were unaffected by static or weather conditions. Carried out in co-opera-



#### TWA DOUGLAS TRANSPORTS

Twelve of the Cyclone-powered Douglas DC-3 transports on the line at Newark Airport, ready for emergency service to Boston after the hurricane in 1938.

tion with the Western Electric company, tests were so successful that engineers predicted the new type equipment will be required on all airlines in the future.

T.W.A. safety first devices adopted included landing flaps, sometimes referred to as "air brakes"; de-icers for wings, tail surfaces, propellers and carburetors; Sperry Automatic pilots; flight planning; two-way radio receiving and transmitting equipment with separate power units; flight control personnel; Cambridge fuel-air ratio analyzers; accelerometers to indicate the strength of forces being applied to the airplane in turbulent air; steam heating, and the "homing" direction finder loop, which not only "leads the plane home by the nose," but serves to eliminate rain and snow static in extreme

weather conditions. For his work in the development of the directional loop, T.W.A.'s engineer, J. C. Franklin, received the National Air Board Safety Award for "contributing most to the safety of aviation during the year."

Plans for 1939 included extensive airport improvements, beginning of greatly increased schedules and starting of the National Air Youth Program jointly sponsored by Thomas Beck of Crowell Publishing company and T.W.A.

More than \$20,000,000 will be spent before completion of improvements on 10 major points of T.W.A.'s route. In San Francisco, a large, Spanish type building was to be dedicated early in 1939 as the airport administration center. T.W.A. was expected to move its facilities from Newark to North Beach on the eastern terminus of the route before Labor Day, 1939. Road development to the Allegheny Airport at Pittsburgh was to cost more than \$2,000,000. Chicago Municipal airport, central point for T.W.A., was to be enlarged to a mile square station. Other planned airport projects were reported at Kansas City, Albuquerque, Boulder City, Harrisburg and Camden.

Schedule expansions in anticipation of World Fair travel from New York's "World of Tomorrow" to the Golden Gate Exposition in San Francisco were planned to give the company its heaviest spring flying program in history. Two million seat miles were to be added March 1; and another two million May 1.

#### United Air Lines

United Air Lines' twelfth year of scheduled transport operations was marked by continued technical progress, addition to its flying equipment, expansion of ground facilities and an increase in both airplane and passenger miles flown. The following tabulation gave a direct comparison between volume of business during 1938 and 1937:

	1938	1937
Revenue airplane-miles flown. . . .	15,508,952	15,145,339
Revenue passenger-miles operated . . . . .	108,873,302	97,607,954
Mail pound-miles operated. . . . .	4,833,498,228	4,588,809,581
Express pound-miles operated. . . . .	1,509,360,023	1,548,815,053
Percentage of seat occupancy. . . . .	52.2	55.2
Number of passengers carried per airplane-mile flown. . . . .	7.02	6.44

"The year 1939 looks substantially brighter than 1938," W. A. Patterson, president of United Air Lines, declared. "Any further improvement in industry will be reflected in increased air traffic.

Naturally, the two fairs, at New York and San Francisco, will be of assistance. There are numerous problems which must be dealt with during 1939, including equipment. An intensification of the program of public education is needed."

A world's record for long distance night and day flight was established in January, 1939, when United completed its 25,000th scheduled cross-country flight over its New York-Chicago-California airway. This was equivalent to approximately 66,000,000 miles of coast-to-coast flying.

Early in 1938, to satisfy the air travelers' demands for more Mainliners, the company purchased 10 more of the DC-3 type of Mainliners to increase its fleet of those transport planes to 36. The



UNITED AIR LINES KITCHEN  
At its central commissary in Chicago.

new planes were equipped with new type 1830-C twin-row 14-cylinder Wasps for improved performance and flight characteristics. In addition, the company made installation of newly developed full feathering hydromatic Hamilton Standard propellers on its entire fleet of twin-Wasp power Douglas transports to equip them with modern power plants. Installation of these new propellers increased the efficiency of the performance of the Mainliners. These 36 planes were supplemented by 16 twin-engine Boeing 247-D type transports flying inter-city trips.

Perhaps the most impressive visual evidence of United's progress not only during 1938 but throughout its growth during the last 12

years was its new field headquarters building at Chicago Municipal Airport. In this modernistically designed two-story building was housed United Air Lines' operations executives and operating department heads, following the opening June 20 of what is said to be the largest air line office building in the country. The new building was headquarters for 150 of United's personnel, including operations, flying, communications, engineering, dispatch, and meteorology personnel, medical, passenger service, dining service, purchasing and accounting departments. Of latest type insulated construction and distinguished by a liberal use of window glass tiling, the new building encompassed 39,750 square feet of floor space. In addition to offices for operations executives and department heads, the new building housed a large staff of engineering personnel and its basement was almost entirely devoted to United Air Lines' central kitchen and commissary.

Those directing United's operations under W. A. Patterson, include R. W. "Shorty" Schroeder, vice president, who had been placed in charge of the company's safety program and was responsible for supervision of safety practices and policies and the correlation of them with the new safety board of the Civil Aeronautics Authority. Vice president in charge of operations was J. A. Herlihy, previous director of engineering for United. At one time chief engineer for another transcontinental air line and subsequently first pilot, division superintendent and assistant general superintendent for the company, Herlihy had a complete piloting, engineering and operations supervision background. Harold Crary as vice president in charge of traffic continued supervision of the company's sales, traffic and advertising practices.

The heavy volume of traffic carried over the company's New York-Chicago-Denver-Pacific Coast, and Vancouver-Seattle-Portland-San Francisco-Los Angeles-San Diego airway received several sales stimuli during 1938. Originated early in the winter by United's traffic department, the "free wives" campaign proved especially effective. Scheduling the experiment between San Francisco and Los Angeles, non-competitive points, the company tried the idea of carrying wives free with husbands who bought round-trip tickets during a limited winter month period when traffic was normally light. So successful did this prove that United and other lines established it subsequently between Chicago and New York and then coast-to-coast. Thousands of wives were thus introduced favorably to air travel. Perhaps more important than the temporary upward effect on traffic was the permanent selling job accomplished.

The most intensive air travel campaign in the history of the



company, conducted in the spring and early summer by United Air Lines, emphasized the speed and frequency of service to such important western vacation-lands as Yellowstone, Yosemite, Boulder Dam, Southern California, Sun Valley and other western points. In advertising this sales promotion, the company appealed successfully to vacation air travelers. The adoption of half-fare rates for children between the ages of two and 12 to supplement the previous policy of carrying infants up to two years of age without charge increased the use of air travel for vacation purposes.

During the year United established a new airway from Denver direct to North Platte, Nebr., to provide faster through service from Denver to Chicago-New York and the east. The company also established the first direct air service from Del Monte, Calif., to principal



UNITED AIR LINES DOUGLAS

One of the fleet of Pratt & Whitney Twin Wasp-powered Douglas DC-3 transports operated by United Air Lines.

American cities, Del Monte becoming the thirty-seventh city to be provided direct service by the air line. Shuttle plane service from Curtiss-Reynolds Airport in Glenview, Ill., in the heart of Chicago's residential North Shore districts, and the Municipal Airport, from which all scheduled flights originate, was established during the year by United to provide more convenient service to North Shore residents. The Boeing 247-D was operated from Curtiss-Reynolds Airport to connect at Municipal with east-bound departures of United Mainliners.

In its technical program and policies the line made a number of important advances during the year. Minimum flight altitudes for every mile of the company's coast-to-coast and Pacific Coast routes were established so that planes would maintain elevations at least one-half mile above the ground. United installed automatic record-

ing barographs to provide a constant record of the maintenance of prescribed flight altitudes. United was the only coast-to-coast air line to use the recording barographs. Another operations innovation was guaranteed salaries of flight officers regardless of flying. This step was taken to compensate pilots for their judgment in canceling flights during doubtful weather conditions.

During the year United completed the evolution of its dispatch to passengers to the point where veteran flight supervisors with long records as pilots were placed in charge of dispatch of key division points over the entire system. In addition, meteorologists employed with the Massachusetts Institute of Technology and the California Institute of Technology for several years completed the development of United's meteorological service to augment that of the Federal Airways System. United's technical research conducted in the communications laboratory under the supervision of director of communications, J. R. Cunningham, continued to produce important finds, including suppression of static interference on aircraft radio reception with a device installed on United's entire fleet for the 1938-39 winter season.

In collaboration with the Western Electric company and Bell Laboratories, United engineers worked on the development of an absolute altimeter to show actual elevation in flight above the ground. This device was successfully tested and demonstrated late in 1938 and was reported to provide for the first time the exact number of feet the airplane was above the ground and warn of approaching obstacles. The company also maintained a flying laboratory on which newly developed or refined devices were tested.

Recently the air lines made a nation-wide survey to determine the champion male air traveler. He was Andre Kostelanetz, the well-known orchestra leader, who traveled over 100,000 miles in 1937. In 1938, United Air Lines reported an unassuming woman who was hailed not only as champion female air traveler, but the air passenger who, in 1939, will probably match or exceed Kostelanetz's record. This champion woman air traveler is Miss Joan Wing, who had standing reservations on United Air Lines 52 weeks of the year for a flight each Tuesday afternoon from New York to Chicago via Cleveland, and each Friday afternoon from Chicago to New York. This amounted to approximately 150,000 miles a year commuting in Mainliners between New York and Cleveland and Chicago.

Jack Knight, holder of the 2,400,000 mile flight record, in 1938 retired from active flying to become director of public education for United Air Lines. He said that 20 years of flying was enough and he looked forward to a job "flying a desk." Knight estimated

that he had been flying even more since he left the job of line pilot than he did while flying on schedule. Formerly he was limited to 85 hours in the air a month, but now he is averaging over 100 hours flying per month as a passenger. Knight still retains his license. In his new work publicly representing the air line's traffic department, Knight visited every one of the 37 cities on the company's New York-Chicago-Pacific Coast and Seattle-San Diego airways.

Brooms, combs, tea, cocoa, slippers, fly swatters and soap may not spell air transportation to the average person, but they were just a few of the hundreds of articles with which every United Air Lines Mainliner was equipped. As many as 700 supply items were regularly placed on each 21-passenger Mainliner and 565 articles were stocked on each de luxe 14-passenger Skylounge type before every



#### LOCKHEED TRANSPORTS FOR POLAND

One of the Wright Cyclone-powered Lockheed 14 models delivered to Poland's air line in 1938.

flight. Because of the wide variety of articles, ranging from binoculars and electric razors to chewing gum and post cards, the various stockrooms maintained by United Air Lines on its New York-Chicago-Pacific coast and Seattle-San Diego airways were virtually general stores.

With Los Angeles isolated by disruption of all forms of surface transportation and communication due to floods, the air line played a dominant role by providing for several days the only transportation facilities between Los Angeles and San Francisco, and, with connections at Salt Lake with Western Air Express, service from Los Angeles to eastern cities. United Air Lines carried the first eyewitnesses of the flood to Chicago and New York.

"What the well-equipped air traveling baby should have" was

answered by United's passenger service department with the development of "Mainliner Baby Kits" for coast-to-coast and inter-city planes on which infants in arms were traveling. Because there had been a steady increase in the number of babies aboard scheduled services, United decided to make special provision so that youthful air travelers would have every need satisfied during trips. The special baby kit included eight cans of assorted strained vegetables, soups and fruits; Zweiback and graham crackers, warmer to heat the baby's milk, disposable diapers, special dishes for the baby's food and sterilized containers for boiled water.

The question of who traveled the air lines was answered by United Air Lines' study of 6,000 air line passengers using the company's New York-Chicago-Pacific Coast service. This survey revealed that 73 per cent of the travelers were between the ages of 30 and 50, with 37 per cent between 30 and 40, and 36 per cent between 40 and 50. Only 11 per cent were between the ages of 20 and 30, indicating the bulk of transportation was sold to business executives. Thirteen per cent of air travelers were between 50 and 60.

In answer to the question, "Do you fly on business, vacation, or emergency?", approximately 90 per cent of the passengers replied that primarily business missions prompted their use of the plane, although 17 per cent combined vacations with their business trips. In sharp contrast to five years ago, when a high percentage of travel was due to emergency missions, only 16 per cent used the airplane for emergency travel. That airplane travel was popular, once the public became acquainted with plane service, was evidenced by the fact, as revealed by United's survey, that only three per cent of the travelers do not continue flying. The check also showed that occasional flyers become, in general, regular air travelers.

Western Air Express showed an all-time record high in passenger and mail traffic during 1938. Over its border-to-border system from San Diego and Los Angeles, to Salt Lake City and Great Falls, Mont., the company operated 10,551,761 revenue passenger miles during 1938, as compared with 7,654,174 for 1937, an increase of approximately 38 per cent. Mail poundage totaled 893,920 for an increase of 26 per cent over 1937, and revenue plane miles climbed 25 per cent during 1938 to a total of 2,309,938.

Currently pending before the Civil Aeronautics Authority is the company's petition for increased air mail rates. Increased rates previously were recommended by the Interstate Commerce Commission examiners and it is hoped that the new authority will see fit to establish permanent equitable rates in accordance with Western Air's petition.

## Western Air Express

Western Air Express acquired the National Parks Airways late in 1937, and last year enjoyed the first full year of operating the system as part of its own. The route was extended from Salt Lake City and Great Falls, Mont., into Glacier National Park for the first time. Thus, Western Air offered travelers the opportunity of flight over a beautiful route, including the San Diego-Los Angeles coast



BELLANCA CARRIES A PIANO

For the first time in history of northern bush flying, a standard-sized upright piano was flown in to a remote mining camp. The 800-pound music-maker along with other heavy supplies was loaded on the new Mackenzie Air Service Bellanca Aircruiser and flown from Yellowknife, 800 miles north of Edmonton, to Gordon Lake.

line, the Boulder Dam and Lake Mead recreational area, Zion National Park and Cedar Breaks, the Great Salt Lake, Yellowstone National Park, the Grand Tetons and Glacier. From June 15 to September 15, each year, special scenic flights were operated from the Yellowstone Park airport over the entire Yellowstone area including Grand Teton National Park. During the 1938 season, West-

ern Air Express carried 1,102 passengers in and out of Yellowstone to establish a new all-time air tourist record for that area.

In 1938, the company applied for permission to extend its line into Lethbridge, Alberta, Canada. When granted, the company will be able to provide direct connections with Trans-Canada Air Lines and Alaskan service via MacKenzie Air Service and United Air Transport. The National Parks Route will be further augmented with the addition of scenic flight over the Jasper and Banff National Parks areas of Canada.

As a means of expediting its coast-to-coast service, Western Air in 1938 sought permission of the Civil Aeronautics Authority to interchange equipment with United Air Lines. Added passenger comfort were to be provided by running through sleeper schedules, previously interrupted at the Salt Lake City gateway. On the Los Angeles-Salt Lake City portion of its system, Western Air operated with Douglas DC-3 equipment, including sleeper ships and sky lounges. Boeing 247-D equipment was operated over the Salt Lake City-Great Falls and Los Angeles-San Diego portions of the route.



Fairchild Aerial Surveys Photo

#### THE NEW YORK WORLD'S FAIR

Aerial view of the exhibit area of the largest fair in history as it neared completion early in 1939.

## CHAPTER IX

### AERIAL SERVICE

A Colorful Branch of Aviation—Planes in Charter Service—Aerial Circuses Still Active—Variety of Equipment—How Flying Saves Time and Money.

**A** LONG with other branches of aviation aerial service of a private and semi-private character made real strides as a colorful means of providing quick, reasonably-priced air travel available to anyone at any time.

The great air liners departing on clockwork schedule from scores of airports throughout the country provided a steady flow of aerial transport at regular hours. Sometimes, however, in an emergency where life or death was at stake; a pleasure might be denied or realized; a business deal might hang fire or be closed successfully, it was necessary to call on the numerous operators of aircraft who specialized in any kind of an air voyage anywhere at any time.

Of the 11,159 flying machines reported in the United States by the Civil Aeronautics Authority for the fiscal year 1938, a majority of them were believed to have been engaged in aerial service operations, even though air liners and sportsmen pilots' machines were included in the grand total.

Marked gains were registered in 1938 in the licensing of aircraft, because in 1937 only 9,152 were officially certificated or licensed, while in 1938 this figure climbed 848 to an even 10,000. This increase was reflected in a corresponding drop in the number of unlicensed planes. In 1937, there were 1,684 without Federal certificates. In 1938, there were only 1,159, indicating a drop of 525.

California, just as in 1937, led the nation in number of flying machines with 1,179 to its credit. New York State was second in 1938 with 961 planes. Pennsylvania was next with 752, supplanting Ohio for third place which it held during 1937. Illinois, with 688 machines, rated fourth in 1938, with Ohio fifth with 629 and Texas sixth with 610.



#### FLEETWINGS SEABIRD IN FLIGHT

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

With strict Federal licensing of all aircraft in aerial service operations, the old days of "flying circuses" barnstorming the country still offer adventurous citizens a sky ride for several dollars. But so many means of engaging aerial travel at one's own time and convenience are available that the present system bears no nearer resemblance to its juvenile days than the stagecoach does to modern streamlined travel.

Travel bureaus engage airplanes for special jaunts as easily as engaging a lower berth in a train. Costs of special aerial service vary with the type of plane and the number of passengers, but it



#### BEECHCRAFT D17R

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





#### WACO AMBULANCE IN NORWAY

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

may be estimated from 25 cents a mile for one passenger to 60 cents a mile for seven passengers.

Most operators of aerial service specialize in the large field of non-scheduled air transportation. This means that the "sky is the limit" in any direction. Men and machines are on duty 24 hours



#### THE STINSON FAMILY

The five-place Reliant (left) is powered by various engine models by Lycoming, Pratt & Whitney and Wright Aeronautical. The three-place 105 is powered by a 75 h.p. Continental or Lycoming engine.



#### LYCOMING-POWERED AERONCA

James V. Piersol and one of the demonstrator planes operated by the Lycoming sales department.

of the day. Both personnel and equipment, carefully inspected and licensed, are as ready as the old firehorse for any call, and with more speed.

Land and seaplanes, amphibions and those equipped with skis demonstrated throughout 1938 that aerial service was a major activity. This phase of aviation, boasting such human qualities as the



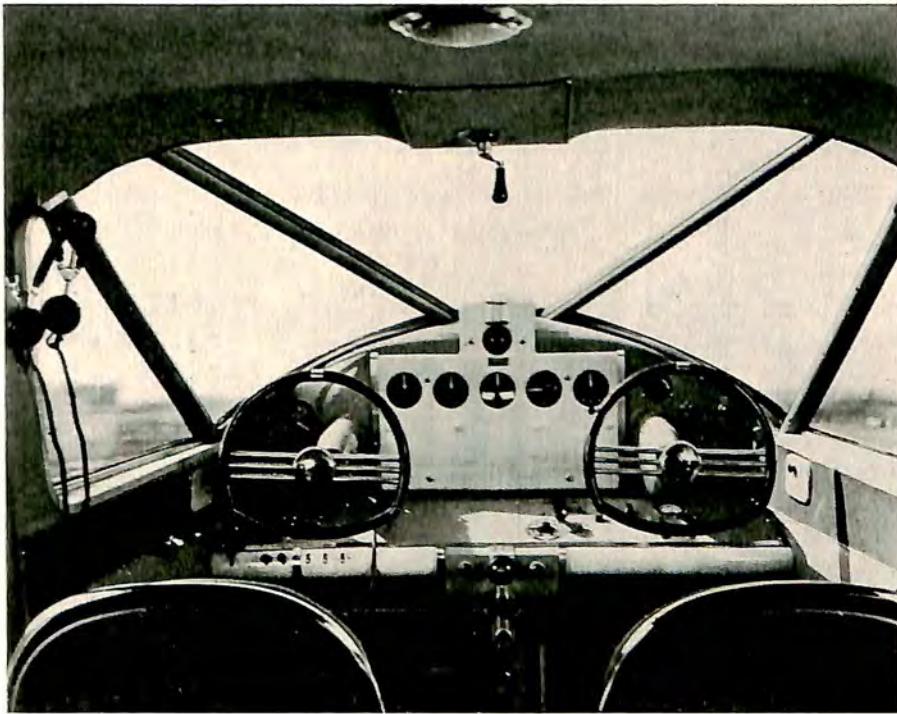
#### THE ABRAMS CONTOUR FINDER

This instrument was developed for studying and measuring the relief in aerial photographs. It weighs only 12 ounces.

saving of life, still possesses the romanticism of the older days without any loss of machine-age precision.

During the summer of 1938, an anxious mother telephoned an aerial service company on Long Island to report her son adrift somewhere on the Sound. An amphibion took off immediately, soon located the boy and his disabled craft, landed beside him, transferred him safely to the plane and towed the boat to shore.

A similar call for help urgently needed came winging eastward



STINSON RELIANT INSTRUMENT PANEL

The new arrangement showing dual controls, extent of visibility and general motor car practice in the pilot's facilities.

from Sheridan, Wyo., to Brooklyn, N. Y. A young doctor and his wife had been critically injured in an automobile accident. They could not be moved by ordinary means and the medical facilities of a small Western city naturally could not compare with those of New York City. A Brooklyn surgeon answered the call for assistance by chartering a plane. Arriving at Sheridan in late afternoon, he found he could return immediately with his patients, and gain



FAIRCHILD 24 IN FLIGHT

The engine is a Warner.

the advantage of smoother night air. Ten hours and 40 minutes from Sheridan found them all in New York. Mercy and medical skill had once more ridden the wings of an airplane.

It rained live fish on Lake Washington and Otter Lake, near Seattle, Wash., one day in 1938 when thousands of fish were dumped overboard from an airplane at 1,500 feet to discover whether propagation of mountain lakes by air was feasible. Baby fish were placed in cans attached to parachutes. When the cans struck the water, they overturned and the fish swam free. If this novel plan had not been used, Otter Lake, in the Cascade mountains, could not have



MENASCO-POWERED REARWIN

It is known as the Speedster.

been stocked, because the fry could not have been taken over a pack trail for a day.

Just as scout planes in war help artillery and tanks on the ground to find the best ways to their objectives, so planes flying high over the woods in 1938 helped timber cutters to find the easiest, and therefore most economical, ways to get their logs through to streams where they could be floated to markets. Fifteen surveyors cut off from civilization for more than a month in the snowbound fastnesses of Northern Quebec were rescued when a plane discovered their plight, dropped food to keep them alive after a diet of 14 rabbits over 36 days, and later helped in bringing them back to their base of operations. Aerial service played Sherlock Holmes in Oklahoma when two bandits, who kidnaped a bank cashier and his wife after



THE SPARTAN EXECUTIVE 7W

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

robbing the bank, were hunted down by means of planes seeking the automobile in which the escape was managed.

American business, keyed to a high tempo, probably uses aerial service to a greater degree than any other one group. A typical case was that of a New York business man who had to be in two places almost at once. Since these were Montreal and New York, the chances of success did not look too bright until aerial service was called into action. A fast plane landed the executive in Montreal in time for a morning conference and flew him back to New York for an afternoon meeting. Yes, the deal was put through, thanks to the speed and versatility of the airplane.

Advertising by means of sky-writing with smoke, trailing ban-

ners, blinking electric lights under the wings, aerial cavalcades touring a State or the Nation, or other activities in the air are being employed more and more. Crop dusting helps the farmer as aerial photography helps in more urban areas to lay out new developments, make highway traffic surveys and aid industrial companies in enlarging present facilities.

In October, 1938, the Civil Aeronautics Authority exempted non-scheduled operators of aircraft from the requirements for securing Certificates of Public Convenience and Necessity and from the requirements of certain other provisions of Title IV of the Civil Aeronautics Act of 1938, "except insofar as any specific regulation or order of the Authority may otherwise prescribe."

The exemption, which is in effect for an indefinite period, was made in order to enable the Authority to study the character of the various classes of non-scheduled operations under the general heading of aerial service.



#### A STINSON IN MANITOBA

Tom Young's Reliant which he uses to reach new lakes and trapping grounds around Moose Lake in Northern Manitoba.

## CHAPTER X

### PRIVATE FLYING

Gains in the Use of Planes for Business and Sport—More Persons Take to the Air—Increase in Pilot Licenses—Private Flying Section Established by the C.A.A.—Objectives—Adventures—John M. Jones Makes Record in Aeronca—Other Flights.

**P**RIVATE FLYING during 1938 had become so important a link in the chain of aeronautical activities in the United States that the creation of a Private Flying Unit within the U.S. Civil Aeronautics Authority was announced in late summer; the National Youth Administration began to encourage seaplane flying by creation of better landing facilities; a wide variety of aircraft was available for flying as a sport and for personal and company business; and the number of licensed pilots showed a strong gain in one year's time.

The importance of private flying during 1938 is shown in a report by the Civil Aeronautics Authority which, on August 31, 1938, stated: "10,000 airplanes operated by America's private fliers last year flew 103,000 miles and carried 1,500,000 passengers as compared to 1,102,707 passengers carried by 300 airplanes in the country's scheduled air carrier service during 66,000,000 miles of flying."

On January 1, 1939, there were 22,983 licensed pilots in the United States, as compared with 17,681 as of the first of 1938. Even glider pilots increased by 11 from 161 to 172. Of the airplane pilots, 1,159 were of air line transport grade, a special rating; 6,834 were commercial licenses; 1,005 were limited commercial; 10,676 were private; 3,005 were solo and 304 amateur.

Women continued to play an important part in the number of active airplane pilots with 675 licenses of the 22,983 belonging to women. Of this number, 73 had a commercial rating.

California again led the nation in number of licensed pilots, with 4,207 to its credit. New York, as in 1937, was in second place with



#### PORTERFIELD LIGHT PLANE

It is equipped with a 70 h.p. LeBlond engine.

2,091; Illinois third with 1,353; Pennsylvania fourth with 1,335; Ohio fifth with 1,128 and Texas sixth with 1,002.

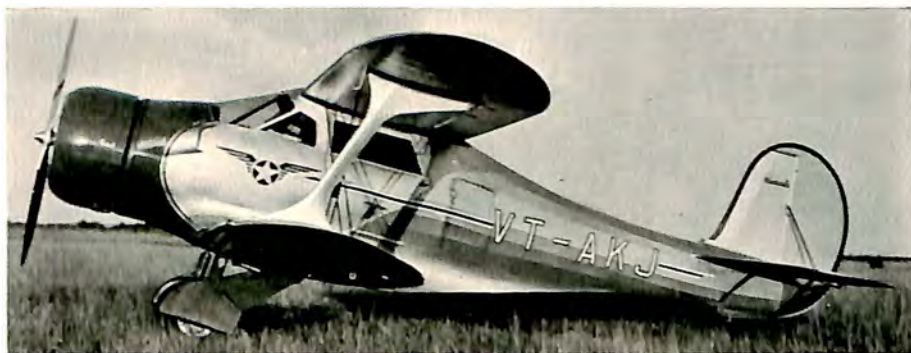
With such a steady upswing in number of licenses issued to private flyers; increased equipment ranging in price from \$1,200 to more than \$100,000, and covering all types of aircraft; gains in miles flown and passengers carried, Edward J. Noble, chairman of the Civil Aeronautics Authority, declared that, "The whole question of private flying needs immediate and special attention. The owner-pilot, the owner of a plane which he operates for his own business or pleasure, the student pilot and the charter operator, each has



#### THE TAYLORCRAFT LIGHT PLANE

Dewey Eldred and his Taylorcraft seaplane powered by a 55 h.p. Lycoming engine in which he established a non-stop record of 858 miles from New York to Daytona, Fla.





THE E17B BY BEECH

It is equipped with a 285 h.p. Jacobs engine.

problems quite dissimilar from those of the operators of large fleets in scheduled air line service."

Grove Webster, of Hackensack, N. J., was named in December, 1938, to be chief of the new Federal Private Flying Section of the Authority. His role was that of coordinator and educator rather than that of policeman. One of his important tasks was the simplification of the Authority's rules affecting private fliers and reduction of flying restrictions to a minimum consistent with safety.

In defining the scope of the new Private Flying Unit's activity, the Authority in 1938 set up the following objectives:

"1. Segregation of records: This, it is expected, can readily



WACO CHARTER IN ICELAND

One of the Jacobs-powered Wacos used in charter service in Iceland.

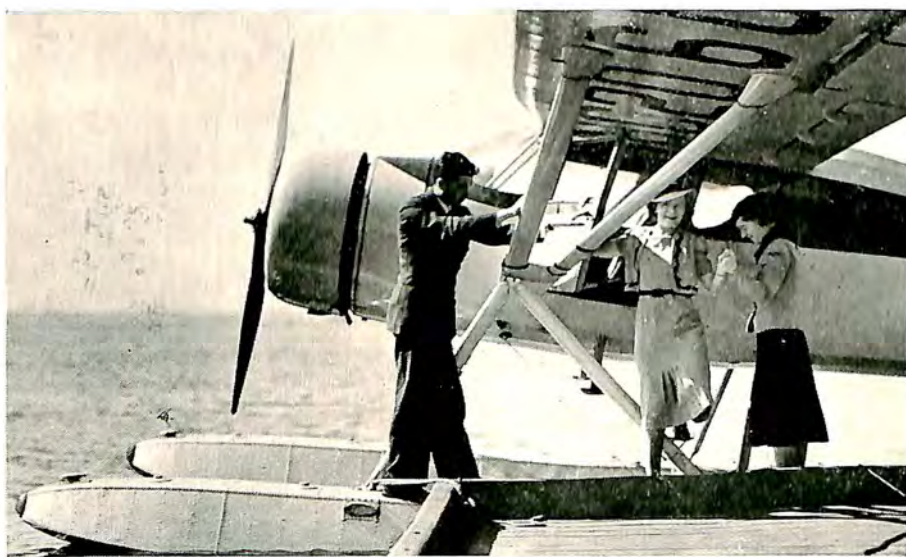


#### NEW PIPER SPORT CUB

It is powered by a choice of five engines—Continental 40 h.p. or 50 h.p., Franklin 50 h.p., Lycoming 50 h.p., or the 50 h.p. Lenape.

be accomplished by a mere change of methods of keeping figures so that, for instance, accidents caused by student pilots will not be confused with the record of charter operators and others.

“2. Interpretation of existing regulations: This is regarded as a task largely of simplification of the regulations as they apply to private flying. It will be the proposal of this unit to reduce them



#### FAIRCHILD 24 AS SEAPLANE

Detail of the machine equipped with Edo floats.

to language more easily understood by the private flyer on the one hand, and to educate the private flyer to the necessity for regulations.

"3. To develop a minimum of further regulations through co-operation with private flyers' bodies and regional committees.

"4. Development of the utility and pleasure value of private flying and its value to other industries: This will include studies of accurate costs data, use of airplanes in distribution and selling, value to such industries as oil, newspaper, mining, the effect of private flying on sports development such as fishing and hunting, its possible effect on the decentralization of business.

"5. The increase of safety through better and more uniform training: It is expected that at the earliest opportunity the unit will produce a study of present military and civilian training methods and suggestions for standing curricula and variations for individual needs. With such a standard curricula it is hoped that the requisite number of training hours may be reduced for certain classes of private flyers.



NEW STINSON 105

Showing the seating arrangement for three persons in this private-owner plane, with 75 h.p. Continental or Lycoming engine. This moderate-priced plane is the product of the Stinson Aircraft Division of Aviation Manufacturing Corporation.



#### A LYCOMING-POWERED TRIO

They are the Aeronca, Piper Cub and Taylorcraft—all powered by Lycoming 55 h.p. engines.

“6. Study of the value of private flying to the military services and the national defense: This will involve conferences with Army and Navy training authorities and possible study of foreign policies.

“7. Study of possible revision of approved type certificates for private flying ships and their maintenance requirements: This is expected to meet the complaints of numerous manufacturers that application of transport requirements to private planes unduly increases their cost.

“8. An effort to bring about uniformity between State and Federal regulations on private flying.”

These activities, it is considered by the Authority, are in line with the general policy of the Act for the encouragement and promotion of civil aeronautics as they are applied to the private flyer. It is emphasized that the success of such a program as has been



#### BELLANCA CARRIES A WING

The Mackenzie Air Service in Canada loads a Stinson Reliant wing on a Bellanca Aircruiser at Yellowknife for delivery to Cito Lake.

outlined will be sought through the fullest measure of cooperation with all groups involved in private flying, other branches of the industry, the military services, and the Authority itself.

The trend late in 1938 toward private flying, defined as gliding, soaring, inter-collegiate, pleasure, course of business, sport, seaplane, instruction, charter and fixed base, sales and repair activities, veered slightly toward the significance of such a large group in time of war. With Europe constantly seething with political unrest, military and naval authorities indicated that the army of private flyers could prove of immeasurable assistance in a time of national crisis.

The Seaplane Flying Association petitioned the Civil Aeronautics Authority late in 1938 to influence the Federal Government in con-



#### FOR LIGHT PLANE OWNERS

The new Stinson 105, a three-place high wing monoplane with slots, flaps and hydraulic brakes. It is powered by a 75 h.p. Continental or Lycoming engine.

structing, improving, developing and maintaining a national system of small seaplane bases. Investigation disclosed that there were many small communities in the United States which did not boast airports, but which were conveniently located on small rivers or lakes, from which take-offs in seaplanes were entirely feasible. An example was found in a seaplane base already operated at Charleston, West Virginia. While the terrain is mountainous, 150 students had been soloed on the Kanawha River.

Makers of seaplanes enthusiastically responded to the petition of the Seaplane Flying Association, indicating that the industry as



#### REARWIN SPORTSTER

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

well as the private flyers themselves were in hearty accord to provide better facilities for seaplane operation.

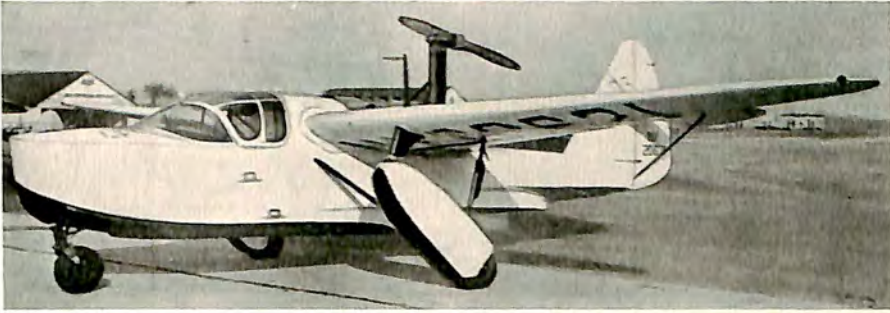
Marine aviation is steadily becoming increasingly important because its convenience and pleasure attract many persons who otherwise would not fly. Commuting to business has become a regular business among more than 25 seaplane owners in the vicinity of New York City since the establishment of a so-called "skyport" terminal for seaplanes in the East River at the foot of Wall Street.

A combination land and sea adventure in private flying was provided during 1938 when Howard Hughes, sportsman pilot, and four companions circled the globe in world-record time, only to be shoved off the front pages by the amazing feat of Douglas Corrigan, who flew from New York to Dublin, Ireland, in an ancient "crate" after



#### THE WHITE "GULL"

A private owner amphibion powered by a Ranger engine.



THE SPENCER LARSEN

One of the new models of 1938, it is powered by a 150 h.p. Menasco engine.

first completing a casual journey across the United States from Los Angeles.

But while these feats caught popular fancy, and many persons regarded all aviation either as an allied adventure or felt it was symbolized by giant multi-motored air liners carrying large, specialized crews and many passengers, John M. Jones flew non-stop from Los Angeles to New York in a plane of lower horsepower rating and cheaper operating cost per mile than popular-priced automobiles.

That the youthful Californian flew the 2,785 miles from the West to East coasts non-stop in his small Aeronca with its 50 horsepower



BELLANCA SENIOR SKYROCKET

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



#### FLEETWINGS SEABIRD

A stainless steel amphibion powered by a Jacobs engine.

Continental engine in 30 hours and 37 minutes was regarded as a remarkable feat by press, public and the aeronautical industry, but the amazing fact that the entire cost of the trip was figured by Jones to be \$24.75 was still more interesting to the average men and women who would like to try their wings.

The American press, such as the New York Times, provided such pointed comment as the following after Jones arrived :

"It was not many years ago that aviation's problem was to build planes that would span the continent non-stop. When such planes were produced, they were much too costly for general use and thus another problem was created. Today, safe, dependable planes that cost little more than automobiles and have an even lower operating



#### AERONCA PLANE AERONCA-POWERED

This version of the Aeronca Chief is equipped with a 50 h.p. Aeronca engine.



cost are being made in this country. And what is infinitely more important, they are being flown by non-professional flyers."

In the field of science, another private flyer earned rich laurels during 1938 when Richard Archbold and five companions in a Consolidated flying boat, took off from San Diego on a flight across the Pacific Ocean to Hollandia, New Guinea, to collect specimens for the American Museum of Natural History. From Honolulu, their first stop, the 14-ton flying boat flew direct to Wake Island, 2,300 miles from Hawaii, without so much as dropping in to say hello at Midway



THE PIPER CUB COUPE

This model is powered by a 60 h.p. Franklin engine.

Island, which Pan-American Airways makes as an intermediate stop. Arriving at Hollandia, one of Archbold's more outstanding feats as a private flyer was the landing and take-off from Lake Habbema, at approximately 11,000 feet altitude.

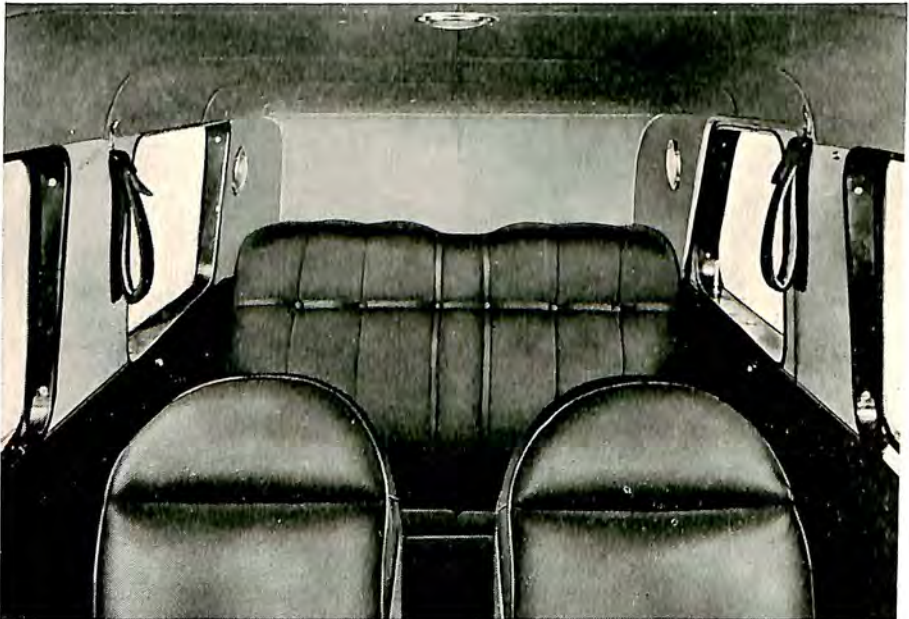
Among those 675 licenses held by women as of January 1, 1939, none has been so closely associated with meritorious feats accomplished as a private pilot than that proudly held by Jacqueline Cochran. It was only six years ago that she started to learn to fly during a six-weeks vacation from the beauty salon of a New York

department store. This was climaxed during the summer of 1938 when she won the annual Bendix Transcontinental Trophy Race from a field of nine of America's crack speed pilots.

More and more women of most classes of society are turning to aviation as a means of pleasure, sport, business or just the necessity of getting somewhere quickly and pleasantly.

Learning to fly and acquiring a license sufficiently broad to fly solo and later carry friends as a favor or anyone for hire has been made as easy as possible by the Civil Aeronautics Authority with due regard for safety and the future efficiency of the pilot. The creation of the new Private Flying Unit is expected to accomplish much toward further simplification of regulations and thereby speed up participation in aeronautics of more average type men and women.

The ninth annual national soaring contest was held at Elmira, N. Y., during June and July, 1938, with 20 gliders in the contest and 59 pilots. There were 270 take-offs during the contest, with 17 days, 10 hours and 32 minutes of soaring, in all 5,841 miles of motorless flight.



CABIN OF WACO N AND C

Interiors rivalling the best motor cars feature these Jacobs-powered models from the plant of the Waco Aircraft Company at Troy, O.

## CHAPTER XI

### AIRWAYS AND AIRPORTS

Civil Aeronautics Authority Recommends Federal Responsibility for Development of National System of Airports—\$325,000,000 Spent on All Airports to Date—2,374 Airports and Landing Fields in U.S.—Army to Conduct Tests of Metcalf-C.A.A. Blind Flying System—Sperry Working Toward Blind Flying Goal—North Beach Airport—Flight Strips—National Resources Committee—San Francisco Airports.

**A**VIATION generally is regarded as the state of being aloft, flying swiftly from one point to another. But those very take-off and landing points form an all-important link in the chain of aeronautical activities which weld a large nation together by the versatility and speed of its aircraft. A plane in the air, therefore, must have had a good place from which to take off; and must have an equally fitting place to land its cargo safely. The necessity for efficiently planned and operated airways and airports is apparent in civil aeronautics, and is of even greater importance in national defense.

The Civil Aeronautics Authority in March, 1939, submitted to Congress a report recommending that the Federal Government assume responsibility for the adequate development of a national system of airports. The official summary stated:

“Three scales of development were proposed. The first involves the expenditure of \$128,000,000 to bring to ‘a properly high standard of quality’ the airports now designated as air mail stops. The report pointed out that though 236 points were designated as air mail stops only 179 were actually receiving service on January 1, many of them being deprived of service because of the shortcomings of their airports.

“To extend adequate airport development to some 860 airports, in which would be included not only provision for future develop-

ment of the air transport system but a limited provision for private flying and pilot training, would cost, according to the estimates, about \$230,000,000.

"A completely adequate airport development program for about 3,500 airports, as compared to 2,174 existing airports and intermediate fields, [exclusive of Government and miscellaneous fields] would cost, according to the estimates, some \$435,000,000. The survey found that such a system of airports would place an airport within thirty minutes' drive of every reasonably compact population group of as many as 5,000 persons, and would furnish adequate facilities, also, to rural areas.

"For immediate expenditure the recommendations advise Congress that \$125,000,000 could be efficiently used during the next year, according to a carefully combined study and schedule."

Following a discussion of airport investment and operating expenses, the report continued:

"Any purely accounting basis is a fantastic one from which to measure the value of aviation to the people of the United States and the propriety of the expenditure that their national and local governments have made on its development. The benefits that a nation derives from a new form of communication cannot be measured in dollars. The intangible benefits are more important than the tangible ones.

"We have indicated possible ways of striking a dollar balance because the challenge to do so is often made; and we have suggested that the outcome of such a balance at present, if it were carried to an extreme of refinement in analysis, would not be unfavorable to aviation. But whether a monetary balance proves favorable or not, in this comparatively early state of aviation's development, the balance would be conclusively weighted in aviation's favor by its importance to the national defense, by the need of so large a country for the very best and fastest of transportation across the nation's entire expanse, and by the eager seizure of American people upon a new art that had its practical beginning in America, and upon the improvement of which American ingenuity and skill have striven and wrought for more than 30 years."

The direct recommendations to Congress upon that basis call for recognition that "development and maintenance of an adequate system of airports and seaplane bases should be recognized in principle as a matter of national concern" and that under certain circumstances such a system is a proper object of Federal expenditure.

The Authority asked no direct commitment at that time to any of the three scales of development outlined. "As long as Federal

money is being granted to local units for public works or work relief, the recommendations urge that a preferential proportion of such sums be allocated to airport purposes as 'rendering an important service to the localities concerned, and at the same time being of particular importance to the nation's commerce and defense.'

"When such public-works and work-relief expenditures may be terminated, the recommendations urge the continuance of airport development through annual appropriations, limited however to projects of exceptional national interest.

"It is recommended that in the case of relief-work projects on airports, the total contribution of the Federal Government for materials and equipment and non-relief supervision should be subject to increase by the provision of a special appropriation to enable the Federal Government to bear part or all of the expense now having



Fairchild Aerial Surveys photo  
NEW YORK'S NEW AIRPORT

Designed to accommodate both overland and transoceanic air traffic for the metropolis, this development at North Beach was to be completed in 1939.

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Fairchild Aerial Surveys photo

#### NEW YORK'S NEW AIRPORT

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to be borne by local sponsors. The proportion so to be assumed by the Federal Government would vary with the national importance of the project. It is recommended that the supplementary appropriation so made should also be available for contract work on projects of particular national importance and urgency which would not fit into any existing work-relief program and would have to be separately handled by contract.

"A new feature is a recommendation that wherever possible the local sponsorship be assumed by a State. In deciding upon the propriety of Federal contributions to particular projects, consideration is recommended of such factors as the support by the States of co-ordinated programs of airport development, their policies in protecting the approaches to airports, their practices in the employment of



BEECHCRAFTS FOR CANADA

One of the 18D twin-engine planes built for Prairie Airways. It is powered by two 330 h.p. Jacobs engines.

aircraft fuel taxes, and their measures to insure proper maintenance of airports and reasonable charges for service.

"Prior consideration should be given, it is recommended, to airports rendering special service to safe and efficient air transportation along the major routes of the nation and to the national defense.

"Airport buildings, it is recommended, should be eligible for special Federal aid, beyond that which would be available under normal work-relief practice, only so far as they are essential to the safe and efficient use of an otherwise qualified landing area or to the efficient conduct of Federal activities at the airport. Buildings serving only the convenience of commercial users of the airport are not recommended as eligible.

"The recommendations are likewise against direct Federal contribution to the cost of maintaining airports except that the Administrator in the Civil Aeronautics Authority may spend available



funds for the operation of airport lighting equipment and navigation aids as a part of the Federal airways system.

"The report upon which the recommendations are based runs to 80,000 words, and the preparatory survey represents 22 man-years of work on the part of the Authority's Airport Section, a special survey force and considerable help from WPA personnel. Detailed statistics of the physical and aeronautical characteristics and the financial and economic status of airports were assembled by crews traveling systematically across the country. They visited almost 90 percent of all the landing areas in the continental United



#### BOEING'S SHIPYARD FOR AIR CLIPPERS

Three of the Pan American Airways fleet of Clipper transports for ocean passenger service outside the plant of the manufacturer, the Boeing Aircraft Company, Seattle, Wash.

States, from the most important to the most obscure. Complete aerial photographs of 80 percent of all airports have been assembled. Detailed surveys of 633 airports, approximately a third of those now in existence, were completed.

"This survey, for the purposes of analysis and recommendation, for the first time separates airports into four classes. The first with runway lengths of 1,500 feet; second 2,500; third 3,500 and fourth 4,500, and makes other stipulations regarding number of runways and equipment. The survey points out that there is not a single fourth class airport at present operating in the United States, that

there are only 36 in the third class, and 178 in the second. Seven-eighths of all existing airports are either in the lowest class or not able to meet even those modest specifications.

"This classification is related to newly completed photographic measurements of the take-off and landing characteristics of airplanes, both in the transport class and in private flying. It is based on the relation of these studies to rigid requirements for safe operation."

The history of the American airport system has been one of somewhat irregular growth, according to the Civil Aeronautics Authority. The total expenditure on airports to the present time has been just over \$325,000,000. The expenditure prior to 1933



#### THE SAN FRANCISCO FAIR

Aerial view of Treasure Island in San Francisco Bay, site of the Golden Gate International Exposition of 1939. At right is the Pan American Airways terminal.

was about equally divided between municipal and private or commercial airports, with State and Federal contributions playing an almost negligible part. Since 1933, work-relief programs under the Federal Government have been responsible for most of the airport development. About \$140,000,000 of Federal funds have been spent on airports in the last six years, as contrasted with just over \$40,000,000 from all other sources combined. Private expenditure has substantially stopped, amounting to only four percent of the total for the period.

The result of investment from all sources was an increase in the total number of municipal and commercial airports from 823 at the end of 1927 to 1,185 at the end of 1929 and 1,589 at the end of 1932; and a further increase during the period of the Federal work-

relief program, to 1,833 at the end of 1938. The addition of State-owned airports and those operated by civil agencies of the Federal Government brought the total on January 1, 1939, to 1,907 civil airports in the continental United States. There were also 267 intermediate fields along airways, and 86 Army and Navy air stations.

The survey work by the Authority showed roughly an equal division of the existing civil airports between municipal and private ownership, but with a considerable number of privately-owned fields being municipally operated under some sort of agreement. About 60 percent of all the existing civil airports are under municipal operation.

A study of the facilities and equipment showed only 1,113 civil



THE BOEING STRATOLINER

The world's first commercial transport built with a supercharged cabin, the Stratoliner is designed to carry 33 passengers more than four miles a minute in the substratosphere, at altitudes up to 20,000 feet. It has a wing span of 107 feet, a length of 74 feet, and is powered by four 1,100 h.p. Wright Cyclone engines.

airports possessing hangars, only 882 with facilities for replenishing aircraft fuel supplies, approximately 230 with reasonably adequate lighting provision, and only 231 with hard-surfaced runways. The shortcomings in the last particular are especially marked.

Just over one-quarter of the total investment so far made in airports represents the value of the land that they occupy. Just over 30 percent of the total has been devoted to clearing, grading, and drainage of landing areas; 15 percent to the surfacing of runways; two percent to lighting; and 25 percent to buildings and miscellaneous purposes.

The total maintenance expense on all the airports of the United

States was somewhat over \$5,000,000 in 1937, or an average of a little under \$3,000 per airport. The average gross income for that year was about half the expense. A special study of the nine airports having the largest volume of transport operation shows an average investment for that group of \$5,700,000 per airport, with an average maintenance and operating expense in 1937 of approximately \$120,000; and an average income of approximately \$70,000. Approximately 15 percent of all the airports reporting had net operating profits for 1937. Two of the nine airports with heaviest traffic showed such profits.

The Civil Aeronautics Authority early in 1939 announced that there were 2,374 airports and landing fields in the United States



IN THE BOEING 314 CONTROL ROOM

At the left of the flight engineer is the radio officer's station, with three transmitters and three receivers.

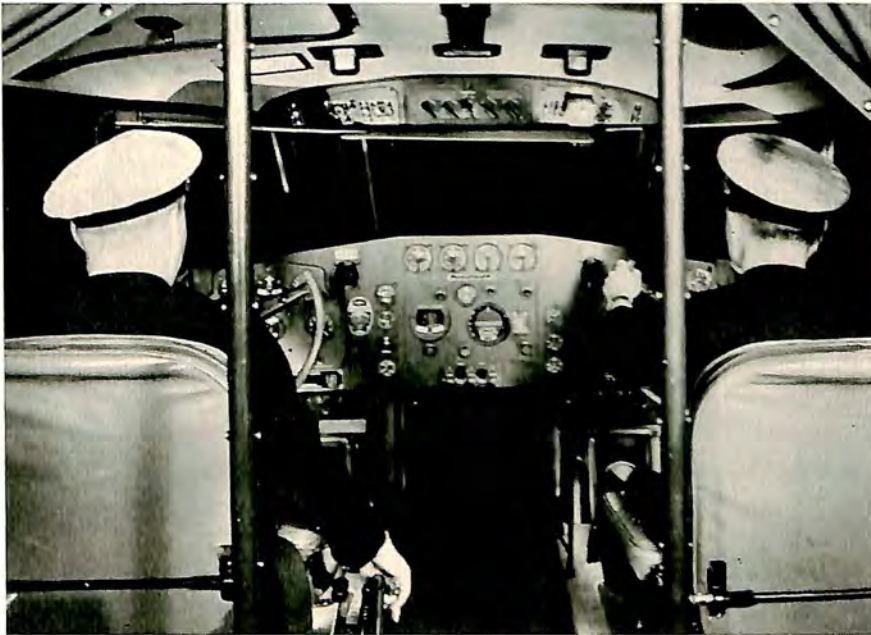
on January 1, 1939, an increase of 75 over the number at the beginning of 1938. This total includes 791 municipal and 433 commercial airports, 267 Civil Aeronautics Authority intermediate landing fields, 628 auxiliary fields, 26 Naval air stations, 60 Army airdromes, and 169 miscellaneous Government, private, and State airports and landing fields. Of these, 719 were fully or partially lighted for night use.

The following six States and the Territory of Alaska have more than 100 airports and landing fields each:

California, 177; Texas, 133; Florida, 129; Michigan, 127; Pennsylvania, 113; Ohio, 112, and Alaska, 114.

The Civil Aeronautics Authority on March 19, 1939 announced that arrangements had been concluded with the U. S. Army to conduct practical flight tests of the Metcalf-C.A.A. blind landing system at Wright Field, Dayton, Ohio. Work will be started at once and it is expected that the apparatus will be ready for commercial installation by the fall of 1939.

Of the several blind landing systems now being developed, the Metcalf-C.A.A. system has not only the advantage of simplicity in design but it operates on a frequency of 750 megacycles which is in



BRIDGE OF THE BOEING 314

The pilots of the new Pan American ocean Clipper ships have before them a Sperry Gyro-Horizon and Directional Gyro. The Sperry Gyropilot control unit is in the center.

the realm unaffected by static resulting from lightning, snow, rain or other atmospheric interference, the Authority stated. It is the only system which meets the rigid requirements of the Army Air Corps.

A single instrument on the standard instrument panel gives the pilot all the information he needs to make a safe landing. The instrument is a cathode ray tube on the flat surface of which three lighted dots indicate to the pilot whether he is on course, or, if he is not,



VULTEE TORPEDO SEAPLANE, V11-TS

A range of 1,750 miles and ability to carry a 1,600-lb. torpedo are claimed for this product of the Vultee Aircraft Division of Aviation Manufacturing Corporation. It is powered by a Pratt & Whitney 1,050 h.p. Twin Wasp engine.



THE AERONCA SCOUT

It is powered by an Aeronca 40-45 h.p. engine.

in what way his position is wrong. When the three dots line up horizontally, with the middle dot properly centered, the plane is on the glide path and in line with the runway. The artificial horizon and directional gyro (standard instruments on all transport airplanes) control the movement of the outer dots and the center dot is controlled by radio, according to the Authority.

On a day in 1938 when New York and its environs were blanketed by fog, swept by high winds and heavy rains, causing disruption of traffic in the harbor, newspapers carrying detailed accounts of the delays caused by weather casually closed their stories by stating:

"Passenger air lines in the metropolitan area were little affected



NEW FAIRCHILD M-62

A two-place low-wing monoplane powered by a Ranger engine.

by the weather. At Newark Airport, it was said that 80 percent of the passenger flights were on schedule."

When any circumstance becomes commonplace it loses most of its spot news value. The fact that in the last five years aviation has been gradually overcoming the handicaps caused by thick weather, and conducting "business as usual," is no longer classified as news. Yet because marine transportation is still groping in search of means to operate safely in fog, the fact that sea traffic was being slowed up in New York harbor was still worthy of publication.

There were several reasons why big passenger planes flew through weather that would have grounded commercial craft five or 10 years ago. For one thing, primary physical equipment was much better; planes and engines were greatly improved and meteor-



U. S. Army photo

#### NORTH AMERICAN O-47A

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



#### BEECHCRAFTS FOR INDIA

Removable mail compartment in one of the Beechcrafts built for Indian National Airways.



ological knowledge was more complete. But perhaps the most important feature was the increased use of instruments for blind flying.

With the Civil Aeronautics Authority, the military forces and private industry working together to eliminate the hazards of fog and other causes of poor visibility, great progress was confidently expected in 1939 in further perfection of existing blind flying equipment and creation of perhaps revolutionary ideas.

Joseph Lyman and F. L. Mosely, of the Sperry Gyroscope Company, Brooklyn, N. Y., prepared a scientific paper in 1938 on instrument flying and its importance in bringing aircraft safely to port in spite of poor visibility. Their opening paragraph stated:

"It is paradoxical that though the modern transport airliner can fly through nearly any type of weather with perfect safety, it can



BELLANCA AIRCRUISER

It is powered by a Wright Cyclone engine.

land only where the weather is suitable. This is a situation which we all know will not long endure and yet it is one which has defeated all attempts to remedy it through a period of 19 years. It is true that the first instrument landing occurred nine years ago, but it is equally true that no reputable air line would consider, even at the present date, actually landing a load of passengers on a completely fog-bound airport."

And yet definite progress was constantly being made. What was considered impossible a year ago was much nearer realization at the beginning of 1939. With airports and airways being improved through governmental and private enterprise, and science keeping pace with both to provide the means to bring aircraft in and take

it off in safety, the aerial highway map of the United States was expected to be expanded materially in 1939.

The importance of adequately lighted airports was being demonstrated at New York City's new North Beach land and marine terminal. The Civil Aeronautics Authority devoted special attention to the lighting problems presented at North Beach, as it was to be a focal point for commercial aviation in this country, Canada, South America and Europe. Designed exclusively for transport service, it was held to be a peak in American airport development.

North Beach, instead of illuminating the whole field with floodlights, as was insisted upon in lighting provisions established by the old Bureau of Air Commerce, will concentrate its lights on the run-



#### N. A. ATTACK DIVE BOMBER

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

ways. Boundary lights will outline the perimeter of the field and certain buildings will have low-angled floodlights trained on them. The rest of the area will be dark. Because transport flying maintains 50 percent of its schedules at night, emphasis being placed on efficient lighting of airports was expected to improve service and safety.

Twenty months' work on North Beach, up until April 15, 1939, had caused a transformation in the original 105 acres, with only three small hangers on a hill. The area has been expanded by 55 level acres on which stand six hangars of convention hall proportions, an administration building soon to be finished, two seaplane units nearing completion and several thousand feet of runway all

ready for use sometime in 1940. No. 4 runway, north-south parallel to Bowery Bay, on which seaplanes can land, is 150 feet wide and 2,000 feet long. Bisecting it at right angles are 1,500 feet of No. 3 runway. A 1,900-foot taxi strip from the far end of No. 4 and 1,000 feet of No. 2 runway intersect with No. 3 at midfield, provided facilities for light craft to take off and land early in 1939. Sixty percent of the newly developed area was reclaimed from Flushing Bay.

Colonel Stedman Shunway Hanks, creator of the plan to have



U. S. Army photo

#### THE VULTEE YA-19

One of the Twin Wasp-powered attack bombers which the U. S. Army Air Corps bought from the Vultee Aircraft division of Aviation Manufacturing Corporation.

the various States improve land owned by them, adjacent to public highways, into "flight strips" for the extension of the aircraft landing facilities of the nation, reported that progress had been made during 1938 in developing political and public interest in the idea. Col. Hanks' plan provided for a strip of land 200 feet wide and at least 1,800 feet long. Funds to develop this strip into a suit-

able landing field would come from money appropriated for the State highway departments, including Federal aid, according to Col. Hanks.

The National Resources Committee, Boston, Mass., through its chairman, Victor M. Cutter, announced in 1938 that it had continued its study of existing and potential sites for airports in a careful program covering the evaluation of such sites in view of the possible establishment of a national program of Federal and State acquisition and improvement of airports.

San Francisco is proud of the fact that when present plans nearing completion are finally culminated, the city will boast two air terminals capable of basing both land and seaplanes. Mills Field, 12 miles south of San Francisco, was acquired 10 years ago. When the Fair erected on Treasure Island, 10 minutes from both Oakland and San Francisco, is torn down on this man-made island in the Bay, one of the world's greatest airports will arise.



INSTRUMENT PANEL OF WACO N

This Jacobs-powered private plane is designed to afford the pilot plenty of vision.

## CHAPTER XII

### STATE AVIATION ACTIVITIES

State Aviation Keeps Pace with Federal Activities—Illinois and Michigan Sponsor Air Tours—Forty-four Factories in New Jersey Build Equipment—Oregon's Wooden Plane.

**S**TATES of the Union kept pace with Federal authorities during 1938 in regulatory measures controlling aviation within their borders; expansion of airways and airports; encouragement of student piloting; and other progressive steps enhancing the importance of aeronautics as an industry, a key to national defense, a major and fast transportation medium and a means of personal pleasure. That real progress was made throughout the nation, under the various State aviation commissions, is shown in the following resume by States.

A report on Alabama airport construction, as prepared by the Alabama Aviation Commission and covering the period from 1935 to 1939, showed total expenditures by the Alabama Works Progress Administration, local communities and other sponsors for the construction and improvement of airports amounted to \$2,402,129. Of this figure, \$1,076,836 was spent on municipal fields and \$1,325,293 on Army and National Guard fields and facilities.

Asa Roundtree, Jr., Director of Airfield Development for Alabama, reported that the heaviest expenditure for airport improvement was at Muscle Shoals where \$244,892 was spent for reconstruction and enlargement of the field; and construction of a stone and steel hangar and concrete apron. The next largest expenditure was at Mobile where the cost of two concrete runways, a taxi strip, extension of concrete apron and other field improvements totaled \$161,553. Birmingham was not far behind with expenditures of \$161,079 for similar improvements and rehabilitation of field lighting equipment. At the beginning of 1939, Alabama had 44 airports, an increase of more than 30 since 1933. Forty-one communities will have their airports improved or new ones created in 1939.

The Arizona Corporation Commission, through its chairman, Wilson T. Wright, reported that five air lines were carrying passengers, express and freight within the State in 1938, while another line was specializing in hauling freight and commodities used in treatment of farm products. Careful regulation of all aeronautical activities in Arizona was continued under the supervision of the Commission, with prospects bright for expansion of operations in 1939.

A highly effective method of maintaining air markings was developed in Connecticut, according to the 1938 report of Charles L. Morris, Commissioner of Aeronautics, Hartford. Every sign was inspected once each year, and repainted if necessary. The State had 290 such signs. Seven more pilot licenses were issued in 1938 over 1937, bringing the total to 579. Accidents decreased from 42 to 39.



#### WACO CUSTOM CABIN

This Wright Whirlwind-powered Waco is operated by Ohio's Civil Aeronautics Department.

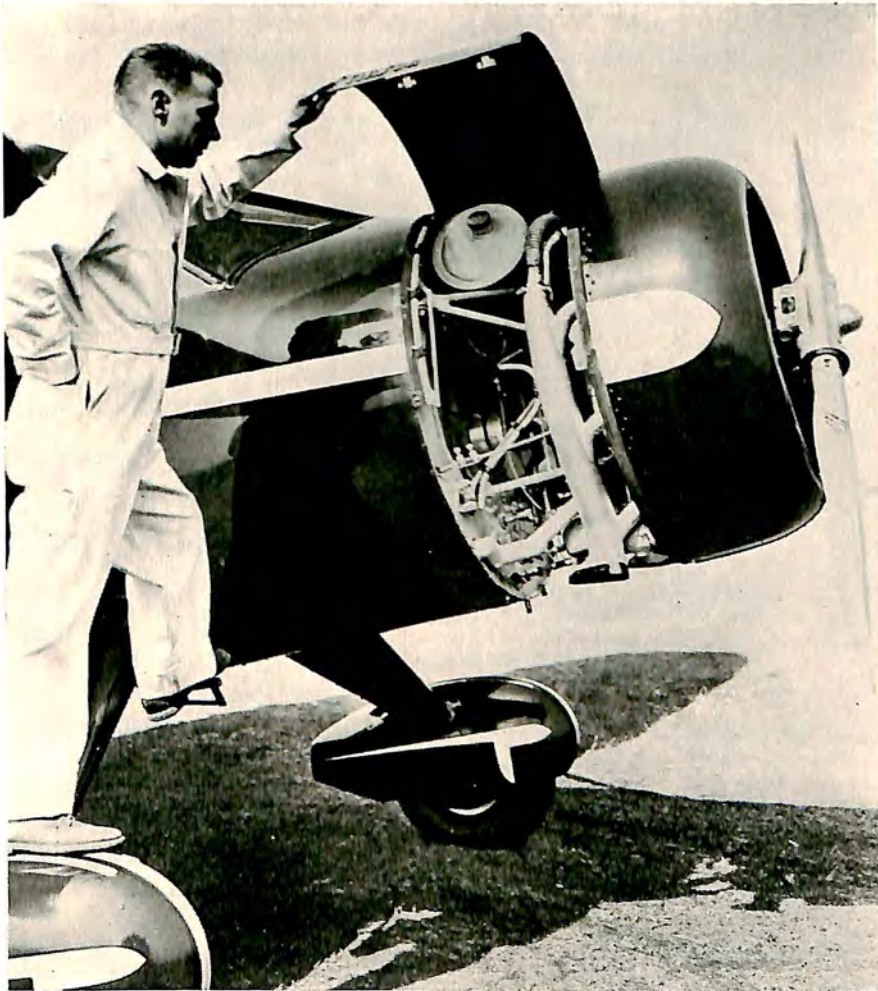
A flying scholarship was provided by Louis de Florez to one graduate of the aircraft mechanics course at the Putnam State Trade School.

Plans for 1939 included making available for aeronautical uses the unrefunded portion of the gasoline tax; use of this and other funds for development of landing areas and seaplane bases; and use of National Youth Administration facilities and labor in construction of boundary markers, wind cones, wind tees and other equipment for airports.

The Aviation Division of the State Road Department of Florida, under the direction of H. C. Whitney, accomplished an extensive air marking program in 1939 and put lighting in a number of airports, as well as keeping all of the 138 fields mowed and conditioned. In 1939

it was planned to continue the 10-year plan written in 1936, which helped materially to modernize the State's airports in its first three years. An increased appropriation was hoped for in 1939.

The Illinois Aeronautics Commission, through George C. Roberts, its secretary, stated that Chicago, Moline, Joliet and Lockport had their airport runways extended and other improvements made during 1938 through the cooperation of the Works Progress Administration.



#### LYCOMING-POWERED RELIANT

"Mechanical accessibility" is the manufacturer's claim for the new installation of this 290 h.p. Lycoming in a Stinson Reliant.

At Peoria, the city acquired the old airport and added acreage, crushed shale runways, grading and lighting equipment. This improvement was done without any assistance from the WPA.

Illinois, due to its geographical location and other reasons, played a major role in military and naval aviation. Construction of landing areas and buildings were being conducted at the Army airports at Scott Field, near Belleville, and Chanute Field, near Rantoul, during late 1938. All flying activity at the Great Lakes Naval Training Station was transferred to Curtiss Airport, near Glenview. Major improvements to hangars and offices were underway. Camp Grant, at Rockford, had its landing field improved by grading, draining and



#### NORTH AMERICAN FIGHTER

The NA-50, a single seat fighter, powered by a Wright Cyclone engine. Among foreign purchasers was the Peruvian air force.

construction of runways for the 33rd Division, National Guard unit.

During 1938, Illinois airmarking operations continued in 62 counties. Twenty planes participated in the annual Illinois Pilots' Air Tour and Efficiency Flight Contest, with nine cities on the itinerary. In 1939, the State Aeronautical Commission intended to carry on airmarking work, formulate an educational program for high schools and colleges and draft an airport zoning law.

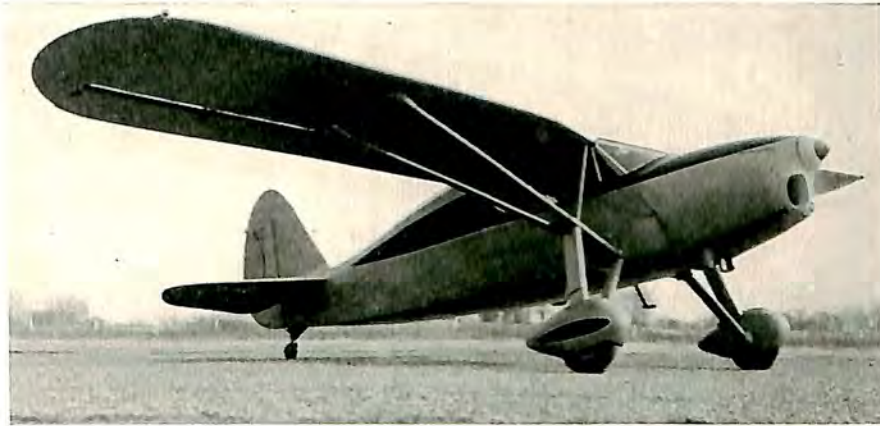
Eighteen airport projects were under construction in 1938 through Works Progress Administration activities, according to the Michigan Department of Aeronautics, Floyd E. Evans, director. Work completed consisted of finishing grading on 19 runways averaging 2,700 feet. Nine hangars were completed, all of cement block construction.



Forty towns and cities were airmarked, which nearly completed the State-wide program of marking 500 communities in the State.

Photographs were taken of more than 100 airports and landing fields. More than 1,300 exposures were made in 75 hours' flying time. Master plans for the future development of five major airports were completed. The State airport booklet showing description and location of all fields in Michigan was revised and republished.

The Annual Michigan Air Tour again was held as a light plane cruise. The State Department, in 1938, also formulated a plan of group flying known as the "Michigan Plan of Flying Clubs." Two clubs were organized during the latter part of the year and 10 or more are expected to be formed in early 1939. Wholesale priced gasoline, hangar storage rental, mechanics' services and other assistance was rendered the newly formed clubs.



THE RANGER-POWERED FAIRCHILD 24K

The Nebraska Aeronautics Commission during 1938 completed the airmarking of 179 towns and cities, according to I. V. Packard, secretary. Free ground schools in aviation were begun in a number of cities, with large groups studying aerodynamics, meteorology, navigation, theory of flight, motors, and air traffic regulations. The organization of various civic groups was begun in 1938 for the development of interest in air line feeder systems. Revision of State air traffic regulations was begun to coordinate State and Civil Aeronautics Authority rules. Plans were made for development of State-wide organizations of model builders.

In 1939, Nebraska will work for a National Guard observation squadron, and the further construction of airports.

Gill Robb Wilson, Director of Aviation for the State of New Jersey, submitted the following report of activities in 1938:

"The seventh consecutive year has passed without the loss of a single commercial passenger life in any type of flying in the State of New Jersey.

"Forty-four factories in the State are building, in whole or in part, aviation equipment. We estimate the distribution of between seven and eight million gallons of aviation fuel, and there has been a tremendous increase in flying. The licensing of airports is, we feel, the key to safety and prosperity. The light airplane is finding more and more utility and there is a noticeable increase in the use of light aircraft on pontoons.

"A number of the airports are privately owned and, of course,



THE CURTISS PLANT AT BUFFALO

The three new buildings at left were added in 1938.

cannot compete with airports available for Government assistance. We are in hopes of some solution that will develop these fields without their loss and are waiting to see the eventual disposition of the Federal Government on a national airport program.

"The young people of New Jersey are clamoring for education in the various branches of aeronautics and our public school systems are endeavoring to meet and supplement our excellent trade schools in this respect.

"We develop annually a few more meadows where flying is done close to various municipalities on the theory that, though they are not

airports they do furnish an opportunity to keep local young people satisfied and happy in their home municipalities. Aviation has a responsibility to the social consciousness of the local community and we try to bear that in mind."

The State Corporation Commission reported that New Mexico was revising its rules governing air commerce in the State.

Organized for the promotion and development of aviation, the New York State Aviation Association at the end of 1938 had 3,811 members on its mailing list. This membership was scattered among 45 chapters, Robert Aldrich, president, reported. The membership was drawn from 350 communities in the State. Seventy-five percent of the members were either commercial pilots, private or student fliers, or were actively engaged in other phases of the aviation industry.

The Association believes "that private flying should be nurtured



CURTISS-WRIGHT'S 19-R "ALL PURPOSE"

The two-place, low-wing, all-metal Curtiss-Wright, powered by Wright Whirlwind 420 h.p. engine, is produced by the St. Louis Airplane Division of the Curtiss-Wright Corporation, and may be used as an advanced military trainer.

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."

During 1938 the Association successfully opposed the passage of legislation designed to set up a regulatory aviation commission in the State. A codification of all aviation laws within the State was begun and will be continued in 1939. Cooperation of the State Department of Public Works was secured to further airmarking. The executive board cooperated with the State Planning Board in the publication of an airport manual.

During 1939 the Association planned to ask the State police to secure adequate equipment and properly qualified personnel to carry out their assignment to enforce aviation laws in the State. The Association intended to push vigorously its airmarking program. State aid will be sought for the Elmira Soaring Association in putting on its 10th annual gliding and soaring meet at Elmira, N. Y.

The year 1938 was the most significant from the standpoint of real progress that the Oregon State Board of Aeronautics had in its history, according to Dr. Paul Winning Sharp, chairman, and Allan D. Greenwood, inspector of the Board. The most outstanding achievements in the opinion of the board were the defense of State rights in the support of Oregon's aviation laws, which won national recognition during 1938; development of a wooden airplane which can be built with Oregon spruce; and completion of the first recreational airport in the State.

The State Board reported that on every major airway in Oregon



SEVERSKY CONVOY FIGHTER

It is powered by a Wright Cyclone engine.

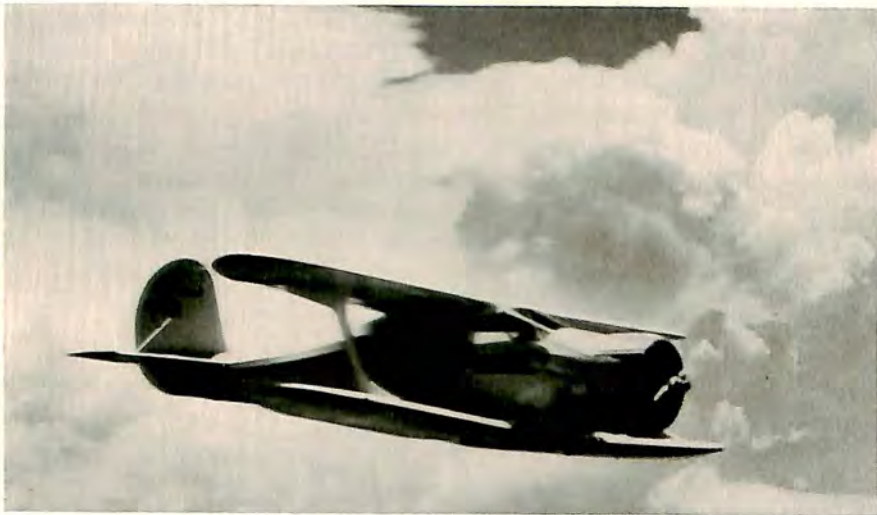
in 1938 airports had been built or improved. Expansion of the Astoria airport brought establishment of a Coast Guard flying unit.

Willard M. Fletcher, chief of the Rhode Island Division of State Airports, reported for 1938 that work was still progressing on the Westerly and Block Island airports; and that efforts were to be made in 1939 to establish air fields at Newport, Narragansett and Woonsocket to complete the proposed State system of airports. The purchase of a State plane has been recommended for general use such as photography, mapping, forest fire patrol, illegal fish trap patrol, emergency transportation and other uses. A new State hangar at the Theodore Francis Green Airport of Rhode Island has been completed.

Principal activities of the South Carolina Aeronautics Commis-

sion, as reported by E. F. Markwood, Jr., assistant director, were continuation of promotional work in airport construction and improvement of navigational aids and ground facilities; continuation of air markings and airport marking program as an independent activity; providing airport maintenance for all public airports in South Carolina, and construction of boundary markers. Plans for 1939 included the continuation of the 1938 work, plus construction and improvement of all secondary systems of airports and training fields for private flying.

Vermont, which did not take an intensive interest in aviation within its borders until the Advisory Board of Aeronautics was estab-



NEW BEECHCRAFT F17D

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

lished in 1937, today reports itself in splendid condition to assist the Federal Government in its national defense program which includes the training of pilots.

In 1935, there were only 21 licensed pilots in the State. In 1938, there were 63. Total number of aircraft in Vermont on January 1, 1939, was 34 planes, 13 of which were privately owned and not used for commercial purposes. Five fields were approved in 1937; in 1938 there were 16. There were no lakes for seaplane landings approved in 1937, but in 1938 there were 14. There were 11 established airports in the State, four of which were classed as emergency fields. There were three privately owned fields and one seaplane

base. Vermont was visited by approximately 1,100 airplanes in 1938. About 5,500 Vermonters have taken short rides aloft, which would amount to around 50,000 passenger miles flown in the State other than those persons carried by the air lines, according to R. C. Thompson, inspector-examiner of aeronautics for Vermont.

R. E. Steele, director of the Division of Aeronautics of the State of Virginia, reported that in 1938 the General Assembly created a special division of the State Corporation Commission, which brought his group into existence, and with the provision of a three cent tax on intrastate aviation gasoline, funds were set aside to maintain the new aeronautical organization. The new division expected to help in the construction of airports during 1939 and in assisting universities and colleges in preparation for the civilian training program being instituted by the Federal Government. A weekly bulletin was published by the Division of Aeronautics which proved of assistance in keeping pilots aware of all regulations.

The Aeronautics Board of West Virginia began functioning on December 1, 1938, according to Hubert H. Stark, inspector, and purchased a Stinson S.R.-9-B for inspecting airports, locating markers as to condition and location, and other survey work. The airplane also was used extensively by State executives in the transaction of their official business.



STEARMAN 76D<sub>3</sub> ADVANCED TRAINER

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

## CHAPTER XIII

### TRAINING AND EDUCATION

Contracts Awarded to 13 Schools for Training 330 Students—  
Authority Will Seek 20,000 Student Pilots After Plan is  
Given Try-Out—Importance of Link Trainer—Aeronau-  
tical Schools Progressed Rapidly in 1938.

ON February 24, 1939, the Civil Aeronautics Authority announced "the award of contracts for student pilot training at the 13 educational institutions at which 330 students are to be trained as a test for the larger program of 20,000 pilots a year which the President has recommended to Congress."

The Authority likewise announced "that 110 students have passed all physical and other requirements and are receiving or are ready to receive instruction. These are Purdue with 50 students; Georgia Tech, 30; San José State, 15; Pomona Junior College, 15."

"At Purdue university, the contract was awarded to L. I. Aratz, at \$250 per student for 50 students for the course. Five 40 and 50 h.p. Piper Cubs and three instructors will be available at the University Airport where instruction is under way.

"At the University of Michigan, the contract was awarded jointly to Ann Arbor Air Service and Michigan Aeronautical Company, at \$250 per student for 20 students. The equipment is two 40 h.p. Aeroncas and three instructors at the municipal airport.

"At New York University, the contract was awarded to Standard Aviation, Inc., at \$245 per student for 30 students. Three 40 h.p. Aeroncas and three instructors are provided at Bendix Field, Teterboro, N. J., which is a few miles across the George Washington bridge from the university campus.

"At Massachusetts Institute of Technology, the contract for 20 students was awarded to E. W. Wiggins & Co. at \$195 each. The equipment provides one 40 h.p. and two 50 h.p. Piper Cubs and three instructors at Boston airport. At North Carolina State College, the contract for 20 students was awarded to Serv-Air at \$250 each

student. The equipment provides one 40 h.p. Piper Cub and one 70 h.p. Rearwin and two instructors at Raleigh Municipal airport. At Georgia Tech, the contract for 30 students was awarded to Eastern Air College at \$200 each, the equipment to include two 40 h.p. Piper Cubs and one 50 h.p. Aeronca, with two instructors, at Candler field.

"At the University of Alabama, the contract for 30 students was awarded to Alabama Institute of Aeronautics at \$250 per student, for three 50 h.p. Piper Cubs and three instructors, operating from Tuscaloosa Municipal Airport. At North Texas Agricultural College, the contract for 30 students was awarded to Ritchie Flying Service at \$200 each, with one 50 h.p. and one 40 h.p. Piper Cub and one Fleet, with three instructors, at Meacham Field. At Pomona Junior College, the contract for 15 students was awarded to Monrovia Aircraft, Inc., at \$150 per student, including free transportation to and from the college to the airport. The equipment includes two 40 h.p. Piper Cubs, one Dart and one 40 h.p. Taylorcraft, with three instructors, at the Monrovia airport.

"At San José State College, the contract for 15 students was awarded to Norman R. Breedin at \$240, with one 50 h.p. and one 40 h.p. Piper Cub and three instructors at San José airport. At the University of Washington, the contract for 30 students was awarded to Kurtzer Flying Service at \$220, with one 40 h.p. Piper Cub, one 40 h.p. and one 50 h.p. Taylorcraft, and four instructors, at Boeing Field. At the University of Minnesota, the contract for 20 students was awarded to McInis Air Service, Inc., at \$202.71, with one 40 h.p., and one 50 h.p. Piper Cub and two instructors, at the municipal airport. The contract for training 20 students at the University of Kansas was awarded to Robertson Aircraft Corp., at \$247.50, with one Piper Cub and one Taylorcraft and five instructors."

The Authority further stated that: "The schools were chosen on the basis of pioneer work they have done in aeronautical engineering and in actual flight training of their students, as well as on their informal assurance to the Authority of their eagerness to participate in this project.

"A total of 330 students between 18 and 25 will be selected for training in the entire group of schools with \$100,000 in National Youth Administration funds allocated for the purpose by President Roosevelt when he announced the flight training program on December 27, 1938. The President included in his national defense message to Congress a request for a special appropriation of \$10,000,000 to be used by the Civil Aeronautics Authority in the training of 20,000 student pilots during the 1939-40 school year, if results ob-



tained between now and next June demonstrate the soundness of the Authority's program.

"This full-scale program would require the participation of several hundred schools and colleges in all parts of the country. Eventually, it is believed that flight training under the Authority's plan can be given not only to those actually attending schools and colleges, but through properly supervised extension courses, to qualified young men and young women in all walks of life.

"The Authority disclosed that the Army Air Corps, which has given its fullest cooperation since the plan was first conceived, because of the national defense value of the reservoir of trained fliers the



PIPER CUBS AT PURDUE

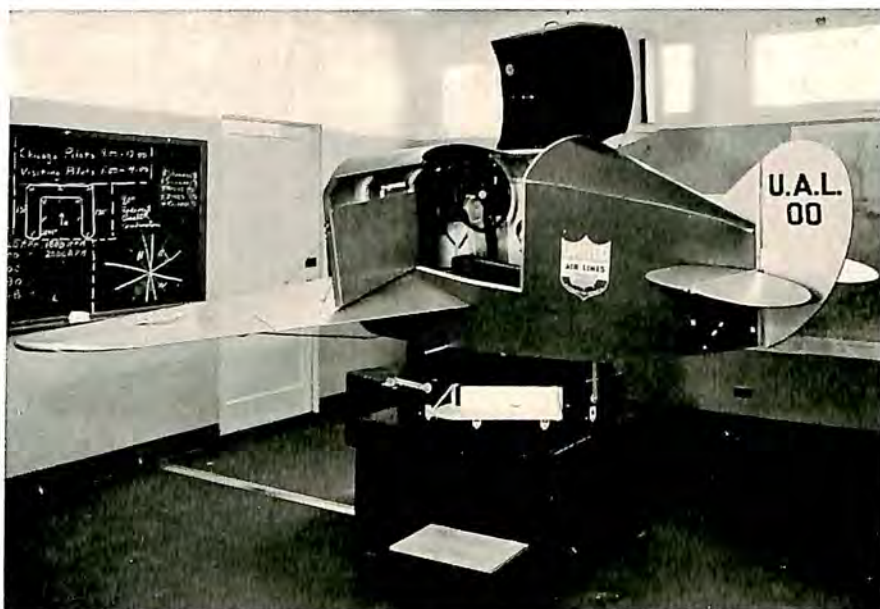
Four Piper Cubs used in the C. A. A. pilot training program at Purdue University.

Authority is attempting to create, will have its flight surgeons give free physical examinations to all students selected for training. School authorities, however, have been advised that their own physicians should conduct preliminary weeding-out examinations in order to spare the Army's flight surgeons an unnecessary burden of work. A list of physical standards to be used in eliminating all candidates who will not have a reasonable chance of meeting the Air Corps' medical requirements was forwarded to the educational institutions concerned.

"The Authority announced that participating colleges and univer-

sities which do not already offer flying training as a regular curricular or extra-curricular activity are expected to follow in general the example of institutions that have pioneered in this field by arranging with qualified flying instructors now operating on airports within easy reach of their campuses to give the necessary flight instruction with their own planes.

"As a means of insuring the whole-hearted interest of the students themselves by requiring personal financial participation, it is felt that a nominal laboratory fee should be charged those taking the course.



THE LINK TRAINER

One of the six Link instrument trainers used by United Air Lines for training purposes.

"It is the Authority's feeling that the individual schools and colleges participating in this plan should nominate the flight instructors they wish to engage, and make all necessary arrangements with them, though such instructors and their equipment, of course, must be approved by the Civil Aeronautics Authority's inspectors before they can take part in our training plan.

The Link trainer, by which student pilots or accomplished fliers learn to fly "blind" by instrument and radio control, was used extensively during 1938 when the Army Air Corps continued teaching pilots how to operate a plane from a hooded cockpit without leaving

the ground. Private schools also acquired these instrument flying trainers and planned to use them still further in 1939.

Many schools offered courses in aeronautical engineering, instruction in flying or the trade of mechanic. The courses varied, but instruction in such phases of aeronautical activity had spread rapidly throughout the country.

The Aero Industries Technical Institute, Los Angeles, Calif., completed its first year of operation in 1938. It found that the demand for recommended graduates continued to exceed the number that could be supplied by the courses in aircraft mechanics and aeronautical engineering. Stress was placed on aeronautical engineering and designing and approval was received for the school from the Civil Aeronautics Authority.

The Aeronautical University of Chicago was founded in 1929 by the Curtiss-Wright Corporation to provide definite systematic instruction, and consisted of three distinct units, the school of aeronautical



AT SPARTAN SCHOOL  
The hangars of the school.

engineering ; the school of business administration ; and the school of mechanical training and aircraftmanship. Emphasis was placed upon building character and personality equally as much as skill and efficiency. Graduates of the school of aeronautical engineering received the degree of Bachelor of Science in aeronautical engineering. The school reported an enrollment of 450 students in 1938 ; and stated that it had a record of nearly 100 per cent in placing its graduates in positions.

The Boeing School of Aeronautics, a division of United Air Lines, at the Oakland Municipal Airport, Oakland, Calif., offered a total of 14 courses, seven flying and seven non-flying courses, and training for every phase of aviation. High school graduation is the major entrance requirement. The 24-month air line pilot and engineering course includes 285 hours of flight and Link trainer instruction and 3,724 hours of lecture, laboratory and shop. Other flight courses

include the 18-month commercial pilot and operations, special air line pilot, limited commercial pilot, private pilot, and solo pilot. Instruction in the multi-engine Boeing 247-D transport assigned to the school by United Air Lines is available for big ship ratings. Seven ground courses include the 12-month air line mechanic, 18-month air line mechanic and operations, 24-month airline operations and engineering, air transport engineering, nine-month airline technician and airline meteorology courses, and 12-week aircraft sheet metal. The school's average enrollment is 200 students. A staff of 33 fully qualified instructors provides individual attention. Placement results during 1938 were satisfactory. New students came from 38 States and Australia, Canada, China, Hawaii, New Zealand, Puerto Rico, and Turkey.

The California Flyers School of Aviation at the Los Angeles



AT BOEING SCHOOL OF AERONAUTICS

The power plant shop students at work on a 14-cylinder Twin Wasp Junior.

Municipal Airport, Inglewood, completed a program of improvements and additions to its facilities in 1938. A new C-type Link trainer was added to the equipment in the instrument and radio beam flying course. Link trainer time was also added to all regular flying courses. New planes increased the school's flying squadron to 15. With the addition of the drafting course, California Flyers offered all types of aviation training, flying courses from solo to executive transport pilot, mechanics, master mechanics, instrument technicians, aircraft sheet metal and instrument flying.

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.

New York University's College of Engineering, New York City,



AT CURTISS-WRIGHT TECHNICAL INSTITUTE

Part of the sheet metal division.

introduced a course in meteorology and dispatching in the curriculum of its air transport instruction, and announced the establishment of two fellowships. One, the de la Cierva Memorial Fellowship, permitted a graduate in aeronautics or mathematical physics of an American university to undertake original research in rotary wing aircraft. As a tribute to Richard F. Hoyt and his activities in seaplane flying, his friends established the Richard F. Hoyt Memorial Seaplane Design Fellowship at the Daniel Guggenheim School of Aeronautics.

Grand Central Flying School, Grand Central Air Terminal, Glendale, Calif., launched in 1932, noted a sharp increase in 1938 in

"blind" flying instruction to meet the demands of major American and Mexican air lines that all pilots have instrument training. Howard Hughes and Douglas Corrigan completed their "blind" flying instruction at this school shortly before their history-making flights. Special training was given in 1938 in great circle course navigation; and night flying was conducted to many southern California points.

Graham Aviation company, operators of the Pittsburgh-Butler Airport, Butler, Pa., succeeded the Pypier Flying School, which operated from this airport in 1938 and which trained over 300 pilots. Graham Aviation is a Government-approved flight school and operated three 50 h.p. Franklin Cubs, two Continental Aeronca Chiefs, and one 1937 Lambert Monocoupe. They had three regular instructors, D. Norman Kite, school director; Kenneth W. Scholter, and William C. Ludington. Their ground school courses were taught by Mr. Kite and Everett E. Hart.

Casey Jones School of Aeronautics, Inc., Newark, N. J., confined its activities during 1938 largely to perfecting and rounding out its existing courses. The school continued to offer two courses, the two year course in aeronautical engineering (four years at night) and a 14 months mechanics course (28 months at night). The enrollment continues at approximately 500 students, the maximum capacity of the school. One new course dealing with the theoretical and practical use of thin metal structures was added to the engineering curriculum. New equipment includes a 4,000 r.p.m. direct connected dynamometer which takes engines up to 200 h.p., variable and controllable pitch propellers, hydraulic and electric equipment for the operation of brakes, flaps, etc., and electrical installations as used in modern transports. Among the new engines acquired by the school were a 14-cylinder Wasp Junior, three G-2 Cyclones with two stage superchargers, one F-50 Cyclone, two geared Pratt & Whitney engines, and a Holly Carburetor (Chandler Groves). The plans for 1939 contemplate even greater specialization, with particular attention devoted to training personnel for eventual positions as lead men, foremen, subforemen and crew chiefs.

The Parks Air College, East St. Louis, Ill., completed its fifth year of simulating operation of a commercial transport company by the running of an air line by its professional flight and executive students. The training period was increased from 265 hours to 300 hours for the students. The aeronautical engineering course was extended from 96 to 108 weeks, making possible more advanced work in airplane design and in stressed skin construction. The course known as master mechanics flight instruction was changed to maintenance engineering and additional work in basic subjects, such as

mathematics, physics, mechanical drawing, blueprint reading and flight engineering was added, as well as 168 additional hours in radio maintenance.

Twenty-nine members comprised the faculty with a total student enrollment of 300. Of the 122 students who entered in the fall term of 1938, 10 were Canadians. All but five graduates in the last four and one-half years were placed in aviation shortly after graduation. In the last 12 months two entire classes were placed prior to their graduation.

The Rising Sun Aircraft School, Philadelphia, Pa., specializing in airplane and engine mechanics, expanded its facilities during 1938.



AT PARKS AIR COLLEGE  
The power plants department.

It expected further enlargement in 1939. This will include construction of new buildings to house the theory classroom, welding construction and sheet metal shop, as well as the installation of new metal working equipment and new engine test stands. Special attention was given in 1938 to rotating wings. Extra-curricular activities of the students included a trip to Newark airport where they were introduced to airplane maintenance activities of major air lines. Two hundred students can now be accommodated in the day and night classes.

Roosevelt Aviation school, Roosevelt Field, Mineola, N. Y., offered 10 modern courses in every phase of aviation, including solo

pilot; commercial pilot; limited commercial; private; aircraft sheet metal; air line technician; master airplane and engine mechanic; master airplane mechanic; aircraft design and construction and combination flight-mechanic. Reporting itself as the oldest government approved school in the east, Roosevelt aviation school courses are changed constantly to meet the demands of the industry so that graduates will fit aviation's requirements when they seek employment.

More than 200 students are trained annually at the 16-year-old Ryan School of Aeronautics, Lindbergh Field, San Diego, Calif. Full time instruction is provided and includes in all flying courses full transport ground school subjects. The shortest training period for either flying or mechanical courses is three months. Solo pilot courses are discouraged by Ryan because they are considered too



AT STEWART TECHNICAL TRADE SCHOOL

Metal fabrication instruction.

short. That half of the students enroll for transport courses indicates that most of them wish to receive complete training.

The Safair Flying School, operated by Safair, Inc., at Hangar "B", Roosevelt Field, Mineola, N. Y., prepares students for all pilot courses up to and including the highest grade of license in land or seaplanes. For the 1939 season, the school has installed a complete commercial ground school at the hangar, in addition to the one operated in conjunction with New York University, in New York City. The new classrooms, shops, and facilities increases the school's capacity to accommodate 150 additional students.

The Stinson School of Aviation, Long Island City, N. Y., began in 1935 with one student, but grew so fast that it moved into larger quarters three times. The school reported that placements in the



aeronautical industry had been provided for every one of its graduates. As a student entered the school, he went into the beginning department where he learned elementary layout, bench, fitting, wood, cable and tubing work. Next he went to the wing and drafting departments and continued his training through the tool room, sheet metal, welding, fuselage covering, doping and finishing, inspection and engine departments. The school was conducted like a well-regulated airplane factory, with efforts made to dispel school-room atmosphere. Larger quarters comprising 40,000 square feet were to be used in 1939.

Aircraft courses at the Stewart Technical Trade School, New York City, were expanded during 1938 when more men than ever before in the history of the school sought admittance. Most of these were high school graduates. Greater specialization in the industry



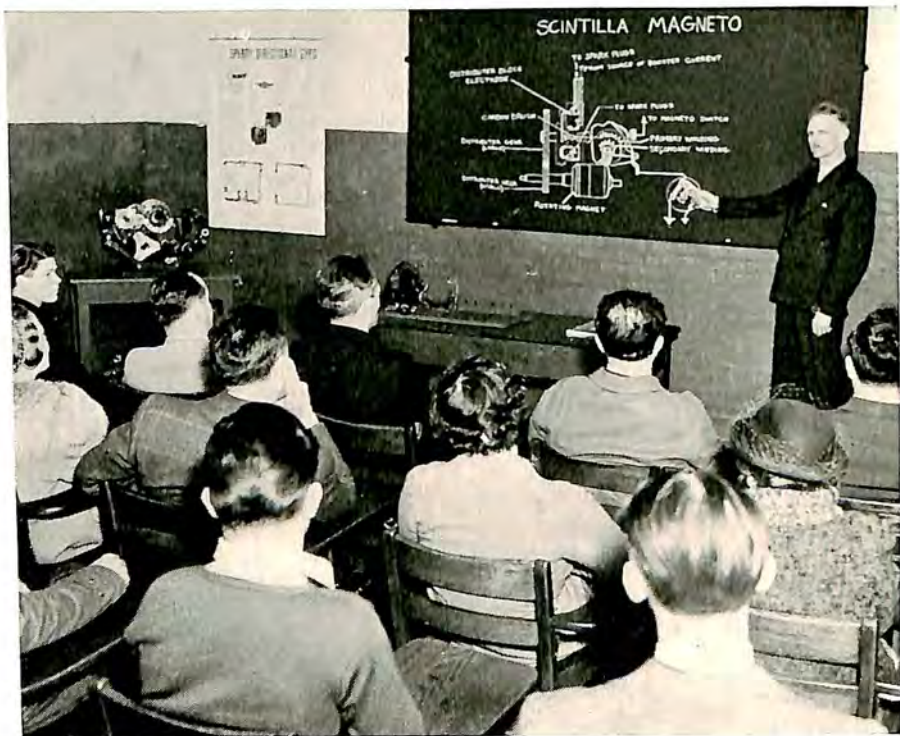
AERO INDUSTRIES TECHNICAL INSTITUTE

The main shop.

caused Stewart to institute a new series of courses designed to meet the demands of aviation. New equipment construction projects included an all metal wind tunnel of advanced design. In 1939, the school offered basic courses in aircraft and aircraft engine mechanics, aircraft radio, sheet metal, aeronautical drafting and design and aircraft and Diesel engines.

Universities and colleges offering engineering courses or commercial courses in aeronautics included the Alabama Polytechnic Institute, Auburn, Ala.; California Institute of Technology, Pasadena, Calif.; California Polytechnic School, San Luis, Calif.; State Trade School, Putnam, Conn.; Georgia School of Technology, Atlanta, Ga.; Kansas State College of Applied Agriculture and Applied Science, Manhattan, Kans.; Montana State College, Bozeman, Mont.; Newark College of Engineering, Newark, N. J.; Pennsylvania State College, State College, Pa.; Polytechnic Institute of Brooklyn, Brooklyn,

N. Y.; Purdue University, Lafayette, Ind.; Rensselaer Polytechnic Institute, Troy, N. Y.; Spartan School of Aeronautics, Tulsa, Okla.; Stanford University, Stanford University, Calif.; Tri-State College, Angola, Ind.; University of Alabama, College of Engineering, University, Ala.; University of Detroit, Detroit, Mich.; State University of Iowa, College of Engineering, Iowa City, Iowa; University of Kansas School of Engineering and Architecture, Lawrence, Kans.; University of Michigan, Ann Arbor, Mich.; Department of Aeronautical Engineering, University of Minnesota, Minneapolis, Minn.; University of New Hampshire, Durham, N. H.; University of North Carolina, Raleigh, N. C.; University of Washington, Seattle, Wash.; Worcester Polytechnic Institute, Worcester, Mass.



AT SAFAIR FLYING SCHOOL  
Classroom instruction in the Scintilla magneto.

## AIRCRAFT SPECIFICATIONS

From all official company reports received at time of going to press.

<i>Name of Manufacturer</i>	<i>Model</i>	<i>Places</i>	<i>ATC No. or Mil.</i>	<i>Make of Engine</i>	<i>No. of Engines</i>	<i>Total Rated H. P.</i>	<i>Wing Area Sq. Ft.</i>	<i>Gross Weight Lbs.</i>	<i>High Speed M. P. H.</i>	<i>Cruising Speed M. P. H.</i>	<i>Optimum Altitude</i>
Abrams Air Craft Corporation	P-2	2	Exp.	Wright R-975-E3	1	450	258	4000	215	205	.....
Aeronautical Corp. of America	50-C	2	675	Continental	1	50	169	1130	100	90	15,000
Aeronautical Corp. of America	50-F	2	688	Franklin	1	50	169	1130	92	87	14,500
Aeronautical Corp. of America	50-L	2	702	Lycoming	1	50	169	1130	92	87	14,500
Aeronautical Corp. of America	S-50-C	2	675	Continental	1	50	169	1253	90	80	12,000
Aeronautical Corp. of America	S-50-F	2	688	Franklin	1	50	169	1253	88	80	11,500
Aeronautical Corp. of America	KC	2	655	Continental	1	40	146	1060	88	80	12,000
Aeronautical Corp. of America	CF	2	Pend.	Franklin	1	40	146	1080	93	85	12,000
Beech Aircraft Corp.	E17B	5	641	Jacobs L-5	1	285	296.5	3350	.....	177	7200
Beech Aircraft Corp.	F17D	5	689	Jacobs L-6	1	330	296.5	3550	.....	180	7200
Beech Aircraft Corp.	D17R	5	638	Wright R-975E3	1	450	296.5	4200	.....	202	9700
Beech Aircraft Corp.	D17S	5	649	P & W Wasp Jr.	1	450	296.5	4200	.....	202	9700
Beech Aircraft Corp.	18-A	8-10	630	Wright R-760E2	2	700	347	7200	.....	196	10,000
Beech Aircraft Corp.	18-D	8-10	684	Jacobs L-6	2	660	347	7200	.....	196	10,000
Beech Aircraft Corp.	18-S	6-8	Pend.	P & W Wasp Jr.	2	900	347	7200	.....	225	12,000
Bell Aircraft Corp.	XFM-1	.....	Mil.	Allison	2	2000	.....	.....	.....	.....	.....
Bellanca Aircraft Corp.	31-42	6-8	578	Wright R-975-E3	1	420	311	5600	165	145	1400
Bellanca Aircraft Corp.	31-55	6	565	Pratt & Whitney Wasp II	1	550	311	5600	190	172	10,000
Bellanca Aircraft Corp.	66-76	2-16	563	Wright "Cyclone" or Pratt & Whitney Hornet	1	760	665	11,400	172	155	5800
Bellanca Aircraft Corp.	28-110	2	Mil.	Pratt & Whitney Twin Wasp	1	1100	280	8450	284	255	8000
Bellanca Aircraft Corp.	77-320	5	Mil.	2 Wright double-row Cyclones	2	3200	775	19,700	225	200	6000
Bellanca Aircraft Corp.	14-9	3	Pend.	LeBlond	1	90	140	1700	135	120	S.L.
Boeing Aircraft Corp.	314	89	704	Wright 2-row Cyclones	4	6000	2867	82,500	190	165	.....
Boeing Aircraft Corp.	307 Stratoliner	38	.....	Wright G-102 Cyclones	4	4400	1486	45,000	245	215	.....
Boeing Aircraft Corp.	B-17 Flying Fortress	Variable	Mil.	Wright G Cyclones	4	4000	.....	approx 44,000	over 250	.....	.....
Boeing Aircraft Corp.	B-15	Variable	Mil.	Pratt & Whitney Twin Wasp	4	.....	.....	.....	.....	.....	.....

Name of Manufacturer	Model	Places	ATC No. or Mil.	Make of Engine	No. of Engines	Total Rated H.P.	Wing Area Sq. Ft.	Gross Weight Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.	Optimum Altitude
Brewster Aeronautical Corp.	138	2	Mil.	Wright Cyclone G	1	950	.....	.....	.....	.....	.....
Brewster Aeronautical Corp.	XF2A-1	1	Mil.	Wright Cyclone G	1	950	.....	.....	.....	.....	.....
Brewster Aeronautical Corp.	F2A-1	1	Mil.	Wright Cyclone G	1	950	.....	.....	.....	.....	.....
Cessna Aircraft Co.	C-145	4	701	Warner	1	145	181	2350	162	151	8200
Consolidated Aircraft Corp.	XPB2Y-1	....	Mil.	Pratt & Whitney Twin Wasp	4	4200	.....	.....	.....	.....	.....
Consolidated Aircraft Corp.	PBY	6-8	Mil.	Pratt & Whitney Twin Wasp	2	2100	.....	.....	.....	.....	.....
Consolidated Aircraft Corp.	31	....	Mil.	Wright Cyclone	2	4000	.....	.....	.....	.....	.....
Culver Aircraft Corp.	Dart GK	2	674	Ken-Royce 5P	1	90	145.73	1550	135	118	.....
Culver Aircraft Corp.	Dart GW	2	674	Warner Scarab Junior	1	90	145.73	1550	135	118	.....
Culver Aircraft Corp.	Dart I	2	Pend.	Warner Super Scarab	1	145	165.00	1820	170	155	6000
Curtiss-Wright Corp.	Hawk 75	1	Mil.	Wright Cyclone GR-1820-G3	1	840	236	6418	280	240	10,700
Curtiss Aeroplane Div.	Hawk 75A	1	Mil.	Wright Cyclone GR-1820-105	1	900	236	5692	302	260	18,000
Curtiss Aeroplane Div.	P-36A	1	Mil.	P & W Twin Row Wasp	1	1100	.....	.....	Restricted	.....	.....
Curtiss Aeroplane Div.	P-37	1	Mil.	Allison Liquid Cooled	1	1000	.....	.....	Restricted	.....	.....
Curtiss Aeroplane Div.	Hawk III	1	Mil.	Wright Cyclone R-1820-F53	1	750	262	4317	240	202.9	.....
Curtiss Aeroplane Div.	XP-40	1	Mil.	Allison Liquid Cooled Super-charged	1	.....	.....	.....	Restricted	.....	.....
Curtiss Aeroplane Div.	SOC-1	2	Mil.	Pratt & Whitney Wasp	1	550	342	5126	164	123	.....
Curtiss Aeroplane Div.	SOC-4	2	Mil.	Pratt & Whitney Wasp	1	.....	.....	.....	Restricted	.....	.....
Curtiss Aeroplane Div.	SBC-3	2	Mil.	P & W Twin Row Wasp	1	.....	.....	.....	Restricted	.....	.....
Curtiss Aeroplane Div.	SBC-4	2	Mil.	Wright Cyclone	1	.....	.....	.....	Restricted	.....	.....
Curtiss Aeroplane Div.	Helldiver 77	2	Mil.	Wright Cyclone R-1820-G3	1	840	317	5710	235	197.5	9800
Curtiss Aeroplane Div.	76-D	2	Mil.	Wright Cyclone GR-1820-G3	2	1680	530	12,793	266	224	10,200
Curtiss Aeroplane Div.	Attack "Seagull"	2	Mil.	P & W Wasp	1	550	342	5126	165	130	.....
St. Louis Airplane Div.	19-R	2	Mil.	Wright Whirlwind R-975	1	420	174.3	3200	209	191	2500
St. Louis Airplane Div.	A19-R	2	629	Wright Whirlwind	1	420	174.3	3200	209	191	2500
St. Louis Airplane Div.	21	1	Mil.	Wright Cyclone R-1820-G5	1	850@	174.3	4092	304	275	7500
						6000 <sup>1</sup>					
						750@					
						15,200 <sup>1</sup>					17,000
St. Louis Airplane Div.	22	2	Pend.	Wright Whirlwind R-975	1	420	174.3	3200	215	196	2500
St. Louis Airplane Div.	20	2	Pend.	Wright R-2600	2	.....	135.3	36,000	237	200	.....
	Transport	2	Pend.								

\* With floats

Name of Manufacturer	Model	Places	ATC No. or Mil.	Make of Engine	No. of Engines	Total Rated H.P.	Wing Area Sq. Ft.	Gross Weight Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.	Optimum Altitude
Douglas Aircraft Co.											
El Segundo Div.....	DC-5	19	Pend.	Wright Cyclone	2	1700	825	19,500	223	191	5800
El Segundo Div.....	8A-3P	2	Mil.	Wright Cyclone	1	860	363	8600	228	189	11,100
El Segundo Div.....	DB-19	2	Mil.	Pratt & Whitney Twin Wasp	1	900	315	7000	251	205	12,000
El Segundo Div.....	8A-3N	2	Mil.	Pratt & Whitney Twin Wasp	1	900	363	7675	258	205	12,000
Douglas Aircraft Co.....	DC-3	14-21	618	Wright Cyclone	2	2200	987	24,000	212	190	.....
Douglas Aircraft Co.....	DC-4	42	.....	Pratt & Whitney	4	5600	2155	65,000	240	200	.....
Fairchild Aircraft Corp...	24R9										
	DeLuxe	4	706	Ranger	1	165	174	2550	.....	127	7000
Fairchild Aircraft Corp...	24R9										
	Standard	4	706	Ranger	1	165	174	2550	.....	128	7000
Fairchild Aircraft Corp...	24W9										
	DeLuxe	4	707	Warner Super Scarab	1	145	174	2550	.....	122	4000
Fairchild Aircraft Corp...	24W9										
	Standard	4	707	Warner Super Scarab	1	145	174	2550	.....	123	4000
Fairchild Aircraft Corp...	T-9	2	Mil.	Ranger	1	165-180	200	2400	146	132	7000
Fleetwings.....	Seabird										
	F-5	4	680	Jacobs L-5	1	300	235	3800	150	135	3500
Grumman Aircraft En- gineering Corp.....	FF-1	2	Mil.	Wright F-52	1	775	310	4650	220	200	.....
Grumman Aircraft En- gineering Corp.....	JF-2	2-4	Mil.	Wright F-52	1	775	409	5760	180	162	.....
Grumman Aircraft En- gineering Corp.....	F2F-1	1	Mil.	Pratt & Whitney R-1535	1	650	230	3790	240	216	.....
Grumman Aircraft En- gineering Corp.....	J2F-1	2-4	Mil.	Wright F-52	1	725	409	6100	180	162	.....
Grumman Aircraft En- gineering Corp.....	F3F-1	1	Mil.	Pratt & Whitney R-1535	1	650	260	4100	240	216	.....
Grumman Aircraft En- gineering Corp.....	G-21A	8	654	Pratt & Whitney R-985	2	800	375	8000	201	190	.....
Grumman Aircraft En- gineering Corp.....	G-37	1	Mil.	Wright Cyclone	1	750	260	4456	270	243	.....
Gwinn Aircar Co., Inc...	I	2	682	Pobjoy Niagara II	1	90	169.4	1532	120	108	10,000
Harlow Aircraft Co.....	PJC-1	2	659	Warner-Super Scarab- 145 h.p.	1	145	185	2251	170	160	5000
Harlow Aircraft Co.....	PJC-2	4	Pend.	Same as above.	1	145	185	2600	170	153	5000
Harlow Aircraft Co.....	PC-5	2	Pend.	Same as above.	1	145	185	2279	170	153	5000
Howard Aircraft Corp...	DGA- 15PC	4-5	672	Pratt & Whitney Wasp Jr.	1	450	210	4350	.....	201	9600
Howard Aircraft Corp...	DGA- 15WC	4-5	612	Wright Whirlwind	1	350	210	4100	.....	178	8500
Howard Aircraft Corp...	DGA- 15JC	4-5	645	Jacobs	1	330	210	4050	.....	175	7000
Kellett Autogiro Corp....	KD1A	2	Mil.	Jacobs	1	225	55.2*	2245	125	100	14,000

\* Rotor Blade Area.

Name of Manufacturer	Model	Places	ATC No. or Mil.	Make of Engine	No. of Engines	Total Rated H.P.	Wing Area Sq. Ft.	Gross Weight Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.	Optimum Altitude
Kellett Autogiro Corp. . .	KD1B	1	Pend.	Jacobs	1	225	55.2*	2250	127	102	14,000
Lockheed Aircraft Corp. .	Electra 10-A	12	551	Pratt & Whitney Wasp Jun- ior	2	800	458.3	10,500	202	190	9600
Lockheed Aircraft Corp. .	12-A	8	616	Pratt & Whitney Wasp Jun- ior	2	800	352	8650	225	212	9600
Lockheed Aircraft Corp. .	14-H2	14	657	Pratt & Whitney	2	1600	551	15,650	246	223	10,000
Lockheed Aircraft Corp. .	212	8	....	Pratt & Whitney Wasp Jun- ior	2	800	352	9200	216	200	9600
Luscombe Airplane Corp.	8	2	694	Continental A-50	1	50	140	1200	109	96	13,500
Luscombe Airplane Corp.	4	2	687	Warner	1	90	160	1725	136	120	15,000
Luscombe Airplane Corp.	1	2	552	Warner	1	145	143	1950	165	140	19,000
The Glenn L. Martin Co.	156-C	53	697	Wright Cyclone	4	3400	2300	63,000	182	140	10,000
The Glenn L. Martin Co.	157-F	57	....	Wright Whirlwind	4	4200	2300	70,000	203	145	10,000
The Glenn L. Martin Co.	166	4	Mil.	Wright Cyclone	2	1800	678	16,000	260	200	18,500
Monocoupe Corp. ....	90A	2	306	Monocoupe-Lambert R266	1	90	132.3	1610	130	110	.....
Monocoupe Corp. ....	110	2	....	....	....	....	....	....	....	....	....
Monocoupe Corp. ....	Special Monocoach	2	327	Warner Super Scarab	1	145	94	1630	185	155	.....
Monocoupe Corp. ....	Model H	4-5	Exp.	Monocoupe-Lambert R266	2	180	231.2	3220	150	130	.....
North American Avia- tion, Inc. ....	NA-16-E "Harvard"	2	Mil.	Pratt & Whitney Wasp	1	550	248.26	4611	205	188	8000
North American Avia- tion, Inc. ....	NA-16	2	Mil.	Wright Whirlwind	1	420	248.26	4337	172	157	1400
North American Avia- tion, Inc. ....	NA-16-1P	2	Mil.	Pratt & Whitney Wasp	1	400	248.26	4312	178	162	5000
North American Avia- tion, Inc. ....	NA-16-1	2	Mil.	Pratt & Whitney Wasp	1	550	248.26	4611	200	185	5000
North American Avia- tion, Inc. ....	NA-16-3	2	Mil.	Pratt & Whitney Wasp	1	550	256	5190	210	196	5000
North American Avia- tion, Inc. ....	NA-16-4	2	Mil.	Wright Whirlwind	1	420	248.2	4112	174	164	1400
North American Avia- tion, Inc. ....	NA-16-4	2	Mil.	Pratt & Whitney Wasp	1	400	248.2	4087	180	166	5000
North American Avia- tion, Inc. ....	NA-16-4	2	Mil.	Pratt & Whitney Wasp	1	550	246.2	4398	200	186	5000
North American Avia- tion, Inc. ....	NA-25	3	Mil.	Wright Cyclone	1	860	348.6	7595	243	217	10,500
North American Avia- tion, Inc. ....	NA-25	3	Mil.	Wright Cyclone	1	840	348.6	7533	236	210	8700
North American Avia- tion, Inc. ....	NA-44	2	Mil.	Wright Cyclone	1	775	255.76	5998	250	225	5800
North American Avia- tion, Inc. ....	NA-50	1	Mil.	Wright Cyclone	1	760	230	2389.5	270	245	8700

\* Rotor Blade Area.

Name of Manufacturer	Model	Places	ATC No. or Mil.	Make of Engine	No. of Engines	Total Rated H.P.	Wing Area Sq. Ft.	Gross Weight Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.	Optimum Altitude
North American Aviation, Inc.	NA-40	3	Mil.	Wright Cyclone	2	2700	.....	18,000	.....	.....	.....
Piper Aircraft Corp.	J-3 Cub	2	660	Continental A-40	1	40	178	1000	85	70	SL
Piper Aircraft Corp.	Cub Sport	2	691	Continental A-50	1	50	178	1100	92	83	SL
Piper Aircraft Corp.	J-3C	.....	.....	Franklin 4-AC	1	.....	.....	.....	.....	.....	.....
Piper Aircraft Corp.	J-3F50	.....	.....	Lycoming 50	1	.....	(A available	.....	as seaplane	.....	.....
Piper Aircraft Corp.	J-3L	.....	.....	Lenape Papoose	1	.....	.....	.....	.....	.....	.....
Piper Aircraft Corp.	Cub	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Piper Aircraft Corp.	Coupe J-4	2	703	Continental A-50	1	50	183	1200	96	86	SL
Piper Aircraft Corp.	Cub	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Piper Aircraft Corp.	Coupe J-4	2	.....	Franklin	1	60	183	1200	99	89	SL
Piper Aircraft Corp.	Cub	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Piper Aircraft Corp.	Coupe J-4	2	.....	Continental	1	65	183	1200	100	90	SL
Porterfield Aircraft Corp.	40	2	2-530	Continental	1	40	169	1040	85	75	.....
Porterfield Aircraft Corp.	50	2	.....	.....	1	50	169	1100	100	90	.....
Porterfield Aircraft Corp.	65	2	.....	.....	1	65	147	1310	115	105	.....
Porterfield Aircraft Corp.	75	2	.....	.....	1	75	147	1310	120	108	.....
Porterfield Aircraft Corp.	90	2	611	Warner	1	90	147	1326	135	120	.....
Rearwin Airplanes	7000	2	574	Ken-Royce Model 5-E	1	70	166	1460	115	103	.....
Rearwin Airplanes	9000-L	2	591	Ken-Royce Model 5-F	1	90	166	1460	123	110	.....
Rearwin Airplanes	9000	2	624	Warner Scarab Jr. Series 50	1	90	166	1460	123	110	.....
Rearwin Airplanes	6000M	2	661	Menasco Pirate C4	1	125	143.2	1700	150	130	.....
Rearwin Airplanes	8090	2	.....	Ken-Royce Model 5-F	1	90	161.8	1800	130	110	.....
Rearwin Airplanes	8125	2	.....	Ken-Royce Model 7-F	1	120	161.8	1800	150	125	.....
Ryan Aeronautical Co.	S-T-A	2	571	Menasco C-4	1	125	124	1600	150	127	.....
Ryan Aeronautical Co.	S-T-A Special	2	681	Menasco C-4-S	1	150	124	1600	160	135	.....
Ryan Aeronautical Co.	S-T-M	2	Mil.	Menasco C-4-S	1	150	124	1600	160	135	.....
Ryan Aeronautical Co.	S-C	3	658	Warner Super-Scarab	1	145	202	2150	150	135	.....
Seversky Aircraft Corp.	YP-43	.....	Mil.	.....	.....	.....	.....	.....	.....	.....	.....
Seversky Aircraft Corp.	XP-41	.....	Mil.	.....	.....	.....	.....	.....	.....	.....	.....
Seversky Aircraft Corp.	EP-1	1	Mil.	P & W or W. A. C.	1	1200	223	5730	320	290	15,000
Seversky Aircraft Corp.	EP-2	1	Mil.	P & W or W. A. C.	1	1200	223	5830	327	297	15,000
Seversky Aircraft Corp.	2PA	2	Mil.	P & W or W. A. C.	1	1200	223	6022	315	285	15,000
Seversky Aircraft Corp.	2PA-2	2	Mil.	P & W or W. A. C.	1	1200	223	6122	322	292	15,000
Seversky Aircraft Corp.	2PA-S	2	Mil.	P & W or W. A. C.	1	1200	250	6475	260	230	15,000
Seversky Aircraft Corp.	2PA-A	2	Mil.	W. A. C.	1	850	250	6500	225	200	15,200
Sikorsky Aircraft	S-42-B	37	592	Pratt & Whitney Hornet	4	3000	1340	42,000	188	163	15,000
Sikorsky Aircraft	S-43	18	593	Pratt & Whitney Hornet	2	1500	780.6	19,500	190	166	19,000
Sikorsky Aircraft	S-43-B	18	593	Pratt & Whitney Hornet	2	1500	780.6	20,000	190	166	19,000
Sikorsky Aircraft	XPBS-1	.....	Mil.	Pratt & Whitney Twin Wasp	4	4200	.....	.....	.....	.....	.....
Spartan Aircraft Co.	Executive 7W	5	628	P & W Wasp Jr.	1	400	250	4400	212	200	9600

Name of Manufacturer	Model	Places	ATC No. or Mil.	Make of Engine	No. of Engines	Total Rated H.P.	Wing Area Sq. Ft.	Gross Weight Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.	Optimum Altitude
Spartan Aircraft Co. . . . .	Executive 7WF	4	Mil.	P & W Wasp Jr.	1	400	250	4500	212	..... 200	5000 9600
Spartan Aircraft Co. . . . .	Zeus FBW-1	2	Mil.	P & W Wasp	1	550	256	4953	234	..... 218	5000 10,000
Spencer-Larsen Aircraft Corp. . . . .	SL-15	4	XP	Ranger 6-440C-1	1	185	197	2850	140	125	5000
Stearman Aircraft, Div. of Boeing . . . . .	S76D1	2	Mil.	Pratt & Whitney	1	320	297.4	3600	148	130	15,600
Stearman Aircraft, Div. of Boeing . . . . .	76D1	2	Mil.	Pratt & Whitney	1	320	297.4	3146.5	151	132	19,000
Stearman Aircraft, Div. of Boeing . . . . .	76D3	2	Mil.	Pratt & Whitney	1	400	297.4	3477	159	136	20,400
Stearman Aircraft, Div. of Boeing . . . . .	73L3	2	Mil.	Lycoming	1	225	297.4	2790.5	123	106	11,400
Stearman Aircraft, Div. of Boeing . . . . .	76C3	2	Mil.	Wright Whirlwind	1	420	297.4	3447.5	157	136	20,200
Stinson Aircraft Div., Aviation Mfg. Corp. . .	SR10-B	5	678	Lycoming	1	245	258.5	3875	149.5	147	4000
Stinson Aircraft Div., Aviation Mfg. Corp. . .	SR10-C	5	678	Lycoming	1	260	258.5	3875	152	150	4000
Stinson Aircraft Div., Aviation Mfg. Corp. . .	SR10-D	5	679	Wright	1	300	258.5	4150	159	155	5500
Stinson Aircraft Div., Aviation Mfg. Corp. . .	SR10-E	5	679	Wright	1	350	258.5	4150	166	157	6300
Stinson Aircraft Div., Aviation Mfg. Corp. . .	SR10-F	5	685	Pratt & Whitney Wasp	1	450	258.5	4650	186	179	9600
Stinson Aircraft Div., Aviation Mfg. Corp. . .	SR10-G	5	Pend.	Lycoming	1	290	258.5	4150	159	154	4300
Stinson Aircraft Div., Aviation Mfg. Corp. . .	SR10-J	5	Pend.	Lycoming	1	300	258.5	4150	160.5	156	5200
Stinson Aircraft Div., Aviation Mfg. Corp. . .	SR-10K	5	Pend.	Wright	1	450	258.5	4650	184	176	5500
Stinson Aircraft Div., Aviation Mfg. Corp. . .	SR-10H	5	678	Lycoming	1	280	258.5	3875	156.5	152	4500
Stinson Aircraft Div., Aviation Mfg. Corp. . .	105	3	709	Lycoming or Continental	1	75	155	1580	115	105	.....
Taylorcraft Aviation Corp. . . . .	A	2	643	Continental A40-4	1	40	167	1050	91	80	.....
Taylorcraft Aviation Corp. . . . .	BL	2	700	Lycoming 0-145	1	50	167	1100	97	88	.....
Taylorcraft Aviation Corp. . . . .	BC	2	696	Continental A-50	1	50	167	1100	97	88	.....
Taylorcraft Aviation Corp. . . . .	BF	2	699	Franklin 4AC-150	1	50	167	1100	97	88	.....



Name of Manufacturer	Model	Places	ATC No. or Mil.	Make of Engine	No. of Engines	Total Rated H.P.	Wing Area Sq. Ft.	Gross Weight Lbs.	High Speed M.P.H.	Cruising Speed M.P.H.	Optimum Altitude
Chance Vought Div., United Aircraft Corp.	SBU-1	2	Naval	Pratt & Whitney R-1535	1			Prototype of V-142	low		
Chance Vought Div., United Aircraft Corp.	SBU-2	2	Naval	Pratt & Whitney R-1535	1			Later version of SBU-1			
Chance Vought Div., United Aircraft Corp.	SB2U-1	2	Naval	Pratt & Whitney R-1535	1			Prototype of V-156	low		
Chance Vought Div., United Aircraft Corp.	SB2U-2	2	Naval	Pratt & Whitney R-1535	1			Later version of SB2U-1			
Chance Vought Div., United Aircraft Corp.	V-142	2	Mil.	Pratt & Whitney R-1535	1	750	327	5455	208	172	9000
Chance Vought Div., United Aircraft Corp.	V-143	1	Mil.	Pratt & Whitney R-1535	1	750	187	4370	300	257	11,000
Chance Vought Div., United Aircraft Corp.	V-156	2	Mil.	Pratt & Whitney R-1535	1	750	.....	6500	257	227	11,000
Vultee Div., Aviation Mfg. Corp.	Attack-Bomber V-12	3	.....	Pratt & Whitney Twin Wasp 1830 S3C3-G	1	950 at 14,300 ft.	384	Attack 10,769 Bomber 12,609	Attack 262 Bomber 240	Attack 237 Bomber 213	Attack 15,300* Bomber 15,300*
Vultee Div., Aviation Mfg. Corp.	Attack-Bomber V-11GB	3	Mil.	Wright Cyclone GR-1820- G105A	1	900 at 6,500 ft.	384	Attack 9712 Bomber 11,582	Attack 238 Bomber 220	Attack 214 Bomber 191	Attack 19,000* Bomber 19,000*
Vultee Div., Aviation Mfg. Corp.	Torpedo Seaplane V11-F8	3	Mil.	Pratt & Whitney Twin Wasp 1830 S1C-G	1	1050 at 7,500 ft.	384	Torpedo 11,135 Scout 11,600	Torpedo 197 Scout 206	Torpedo 179 Scout 188	Torpedo 7500* Scout 7500*
Vultee Div., Aviation Mfg. Corp.	Scout-Bomber V11-GB8	3	Mil.	Wright Cyclone GR-1820- G105A	1	900 at 6,500 ft.	384	Scout 10,652 Bomber 11,700	Scout 196 Bomber 189	Scout 173 Bomber 157	Scout 19,000* Bomber 19,000*
Vultee Div., Aviation Mfg. Corp.	Vultee Army YA-19	3	Mil.	Pratt & Whitney Twin Wasp	1	.....	.....	.....	230	.....	.....
Vultee Div., Aviation Mfg. Corp.	Attack-Bomber V11-GB	3	Mil.	Pratt & Whitney Twin Wasp 1830 S3C3-G	1	950 at 14,300 ft.	384	Attack 9887 Bomber 11,757	Attack 251 Bomber 230	Attack 222 Bomber 202	Attack 15,300* Bomber 15,300*
Waco	ZVN	4	677	Jacobs L-5	1	285	246	3650	156	147	6000
Waco	AVN	4	677	Jacobs L-6	1	330	246	3800	161	151	6000
Waco	ZGC	5	644	Jacobs L-5	1	285	246	3800	164	155	6000
Waco	AGC	5	644	Jacobs L-6	1	330	246	3800	171	161	6000
Waco	EGC	5	665	Wright R760E2	1	320	246	3800	171	159	7000

Note: \* (with ram)

<i>Name of Manufacturer</i>	<i>Model</i>	<i>Places</i>	<i>ATC No. or Mil.</i>	<i>Make of Engine</i>	<i>No. of Engines</i>	<i>Total Rated H.P.</i>	<i>Wing Area Sq. Ft.</i>	<i>Gross Weight Lbs.</i>	<i>High Speed M.P.H.</i>	<i>Cruising Speed M.P.H.</i>	<i>Optimum Altitude</i>
Waco.....	VKS	5	648	Cont W670M Carburetor	1	240	244	3250	145	136	6000
Waco.....	VKS	5	648	Cont W670M1 Fuel Inj.	1	250	244	3250	146	137	6000
Waco.....	ZKS	5	626	Jacobs L-5	1	285	244	3250	152	144	6000
Waco.....	JHD	2	Mil.	Wright R975E1	1	365	256.3	3800	170	155	7-8000
Waco.....	WHD	2	Mil.	Wright R975E3	1	450	256.3	3800	180	162	7-8000
Waco.....	S3HD	2	Mil.	Pratt & Whitney TB	1	420	256.3	3800	180	160	7-8000
Waco.....	S2HD	2	Mil.	Pratt & Whitney SB	1	450	256.3	3800	175	158	7-8000
Waco.....	ZPF-T	2	Mil.	Jacobs L-5	1	285	244	2650	146	127	.....
Waco.....	VPF-T	2	Mil.	Cont W670M Carburetor	1	240	244	2650	140	123	.....
Waterman Arrowplane Corp.....	Arrow- bile-6	2	Pend.	Studebaker-Waterman S-1	1	100	264	2200	120	105	.....

\* With floats.

\* Rotor blade area.

## CHAPTER XIV

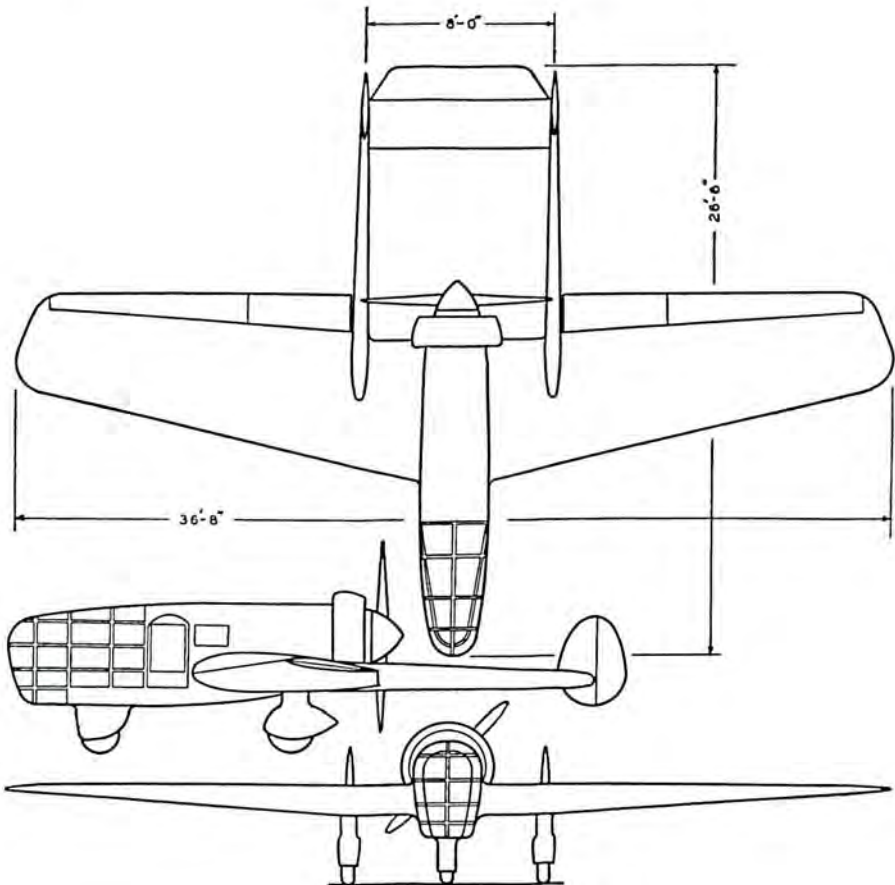
### NEW THINGS IN THE AIR

American Manufacturers Make Progress in Planes both Large and Small—Description of Aircraft—Activities of the Leading Companies—Developments in Aircraft Engines—New Instruments and Accessories.

**T**HE superiority of American aircraft, engines and accessories, for years acknowledged throughout the world, was even more convincingly demonstrated in 1938 by the actual production of giant transports, ocean flying boats, substratosphere planes, light planes and military aircraft of several types which were far in advance of flying machines turned out abroad. Elsewhere in these pages the American plane and engine manufacturers are credited with having spent forty-four million dollars on research and development during the last five years. Proof that it was money well-spent will be found in the following paragraphs which are based on special reports from the manufacturers themselves, describing their products in detail.

#### Manufacturers of Aircraft

Abrams Air Craft Corporation, Lansing, Mich., produced a new type aerial photographic plane, which the company described as follows: The "Explorer" provides perfect forward and downward visibility, with the entire front end of the gondola enclosed in glass. It is of the "pusher" type, with a 450 h.p. Wright Whirlwind engine mounted in an N.A.C.A. cowling. It is equipped with a tricycle landing gear to prevent nosing over; cross-wind landings are no hazard with this equipment. The ship is as easily steerable as an automobile and is braked as effectively. Stability and ease of control are built into the "Explorer" by placement of the engine, fuel and other heavy loads close to the center of lift, and applying the propeller thrust along the line of drag so that in rough air the plane is inherently stable. In tests the plane showed a rate of climb of 1,000 feet a minute, and a



#### THE ABRAMS EXPLORER

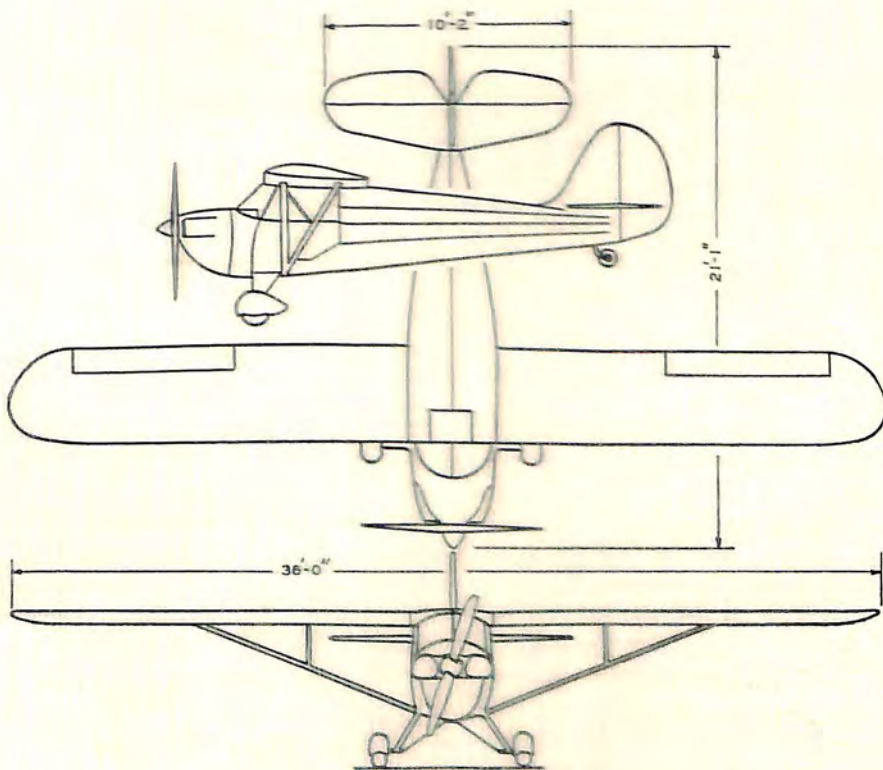
A two-place aerial photo plane with a 450 h.p. Wright Whirlwind engine.

maximum speed of well over 200 miles an hour at 10,000 feet. The plane is built for mapping in the substratosphere, and the interior of the cabin is supercharged to provide oxygen to the two-man crew at high altitudes. The camera is mounted over an opening in the floor. The fuselage is constructed of welded steel tubing. The wings are of welded steel tube monospar, with steel tube ribs, metal covered center section and fabric covered outer section.

Aeronautical Corporation of America, Cincinnati, O., produced two light two-place models, the Aeronca Scout, powered by Aeronca 40 or 45 h.p. engines or the 40 h.p. Continental engine; and the Aeronca Chief, powered by 50 h.p. Lycoming, Continental, Menasco

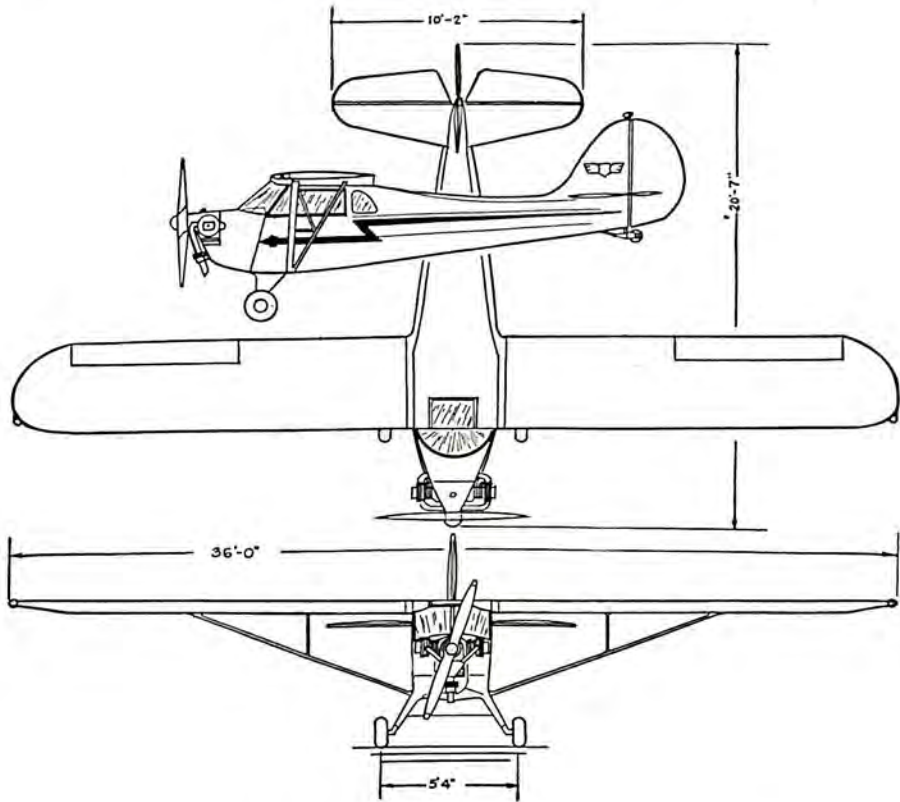
or Franklin engines. The Scout had a wing span of 36 ft., length 21 ft., weight empty 670 lbs., and a stated cruising speed of 90 m.p.h. Aeronca reported export sales in Puerto Rico, Portugal, South Africa, Hawaii, Denmark, England, Australia, France, Switzerland, Brazil, Peru and Canada. Carl Voelter won the Miami All American light plane race in an Aeronca at a speed of 109 miles an hour.

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 highways when not in flight. A model of that design was in use by the Civil Aeronautics Authority. Experimental models of military design



THE AERONCA CHIEF

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



AERONCA K

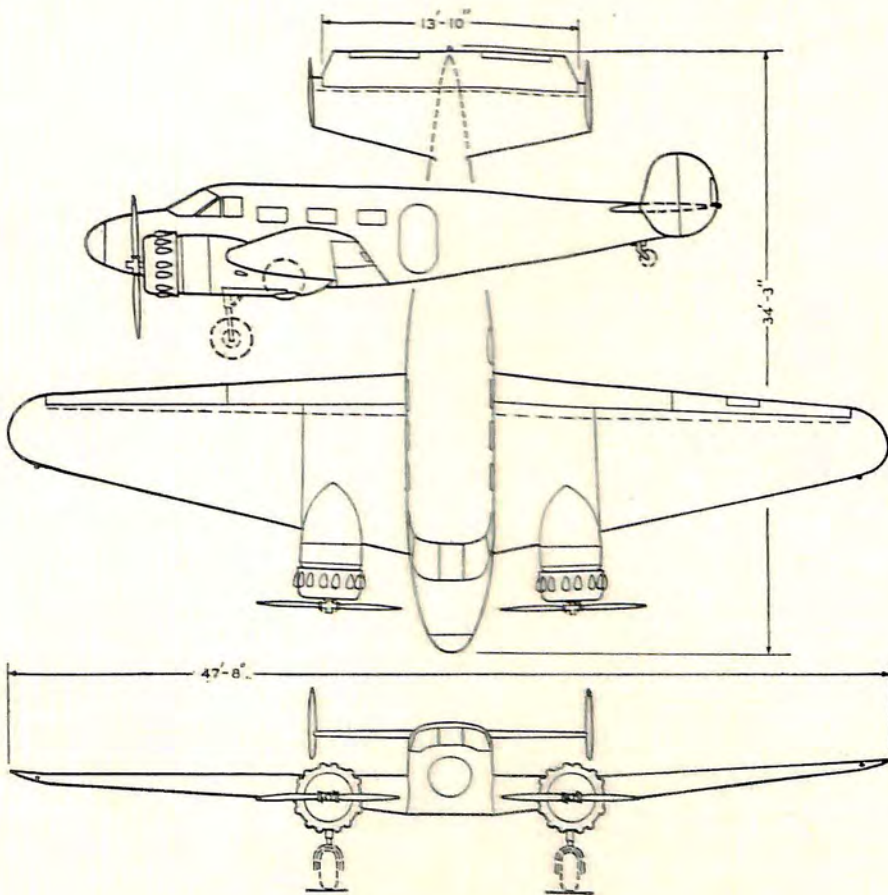
A two-place plane for the private flier with an Aeronca E-113C engine. It is available as the model KC powered with a Continental engine.

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

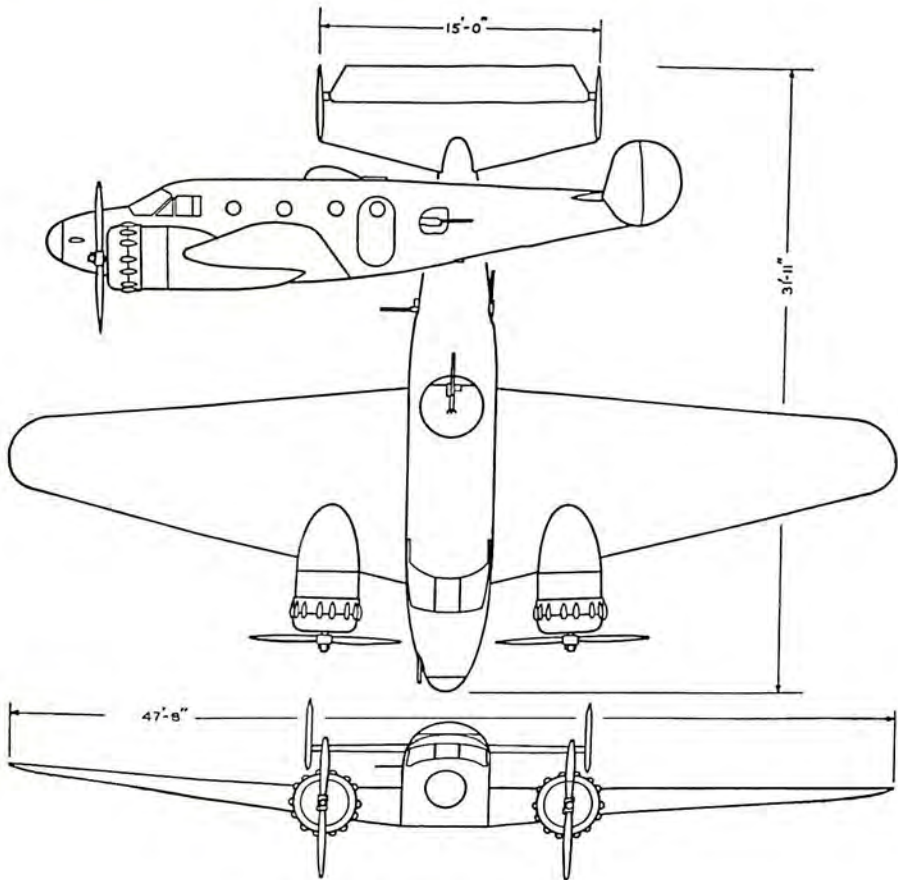
speed. He then released the starter clutch, permitting the blades to assume normal flight incidence. The excess kinetic energy represented in the excess speed of the rotor was then converted into a direct lifting force sufficient to lift the machine directly off the ground. Individual designs developed by the Company's licensees, Kellett Autogiro Corporation and Pitcairn Autogiro Company, are described in the sections devoted to those concerns.

The Beech Aircraft Corporation, Wichita, Kans., continued the manufacture of its E17 biplane series and its D17 biplane series during 1938. The E17 series comprises the E17L with the 225 h.p. Jacobs



BEECHCRAFT MODEL 18

This twin-engine commercial monoplane carries eight, and is powered with two Jacobs engines of 330 h.p. each.



THE BEECHCRAFT M-18

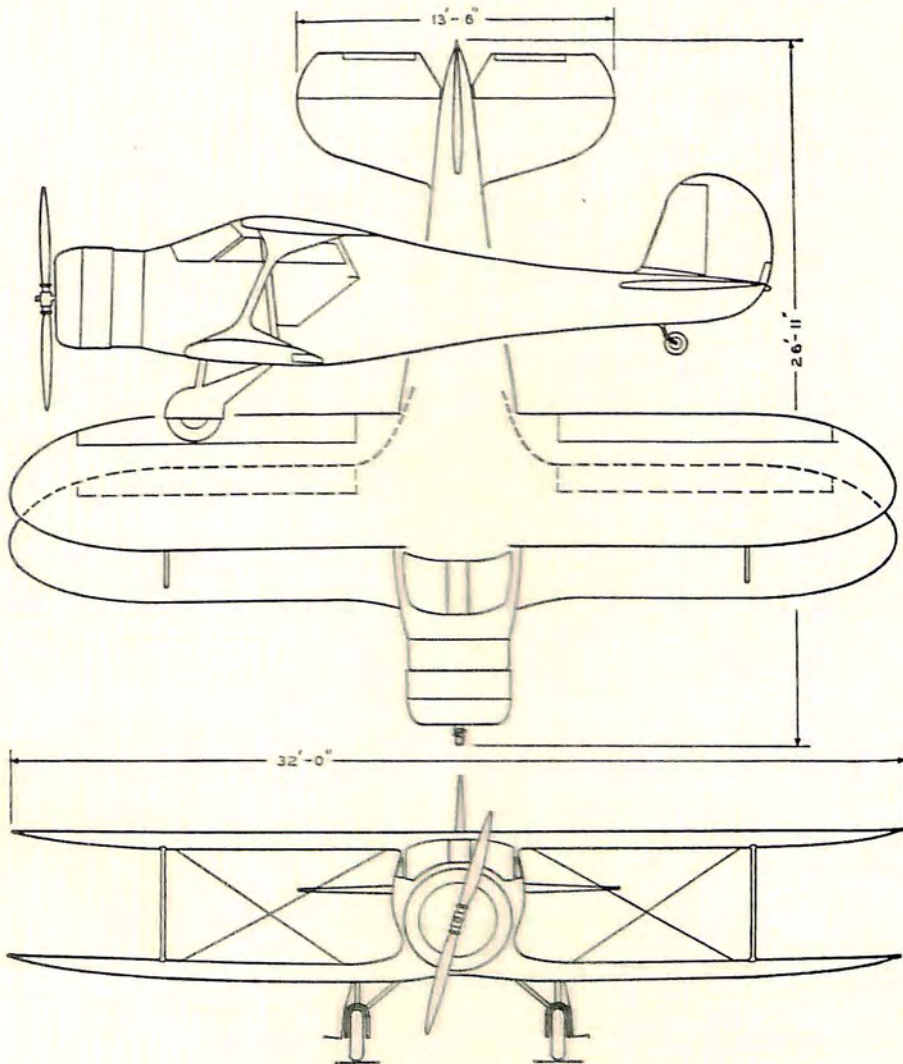
This light bomber and twin-engine trainer is powered with two 450 h.p. Pratt & Whitney Wasp Junior engines and Hamilton Standard constant speed propellers.

engine and the E17B with the 285 h.p. Jacobs engine. Both airplanes are five-place biplanes of 3,350 lbs. gross weight. The D17 series comprises the D17R and D17S Beechcraft five-place biplanes of 4,200 pounds gross weight, powered respectively with the 450 h.p. Wright Whirlwind and the 450 h.p. Pratt-Whitney Wasp Junior engines. During the year a new Beechcraft five-place biplane was introduced in the performance and weight classification between the E17 and the D17 Beechcraft biplanes. This new model, the F17D Beechcraft, is a five-place biplane similar to the others but of 3,550 pounds gross weight. It is powered with a 330 h.p. Jacobs engine.

The development and manufacture of the Beechcraft all-metal

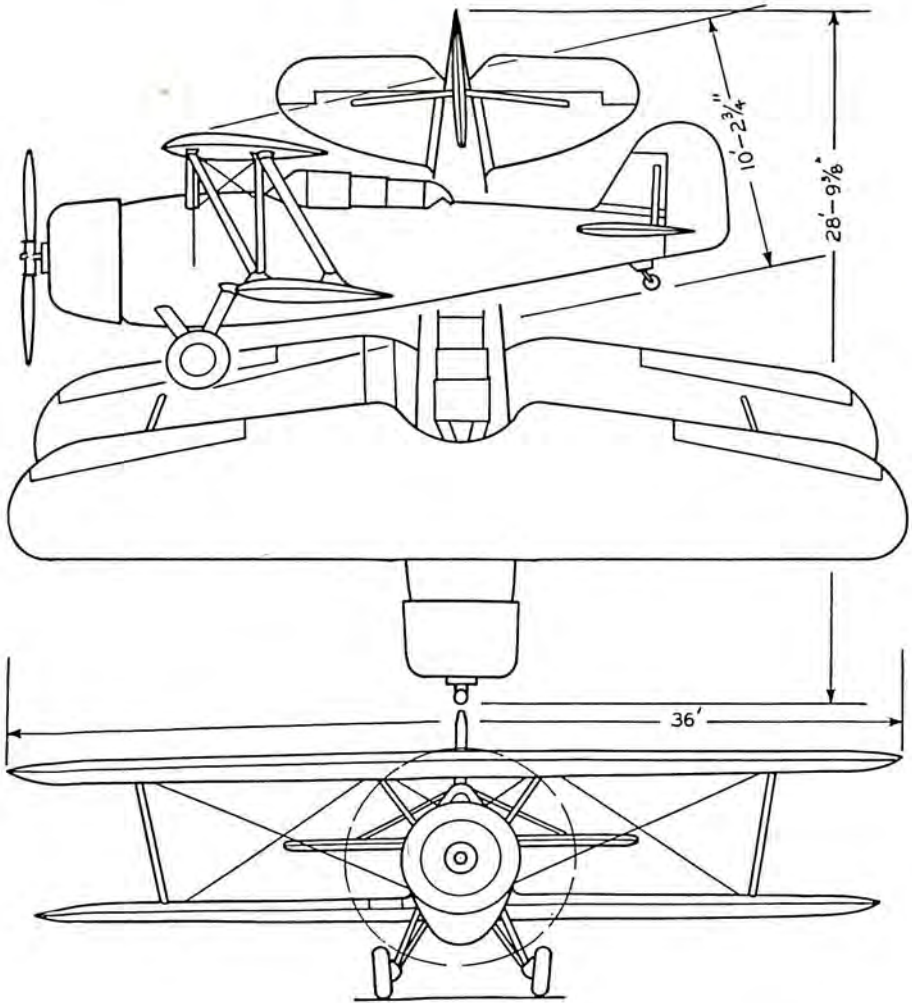


twin-engine monoplane was continued during 1938. The Civil Aeronautics Authority approved an increase of 500 pounds in the gross weight, making the new approved gross weight 7,200 pounds. This change resulted in the addition of approximately 450 pounds to the



BEECHCRAFT D-17

A five-place private plane with a choice of either a Pratt & Whitney or Wright engine both rated at 450 h.p. The E-17 version has a strut-braced tail group and is available with either a Jacobs 225 h.p. or a 285 h.p. engine, while the F-17 is offered with a 330 h.p. Jacobs.



BELL BG-1

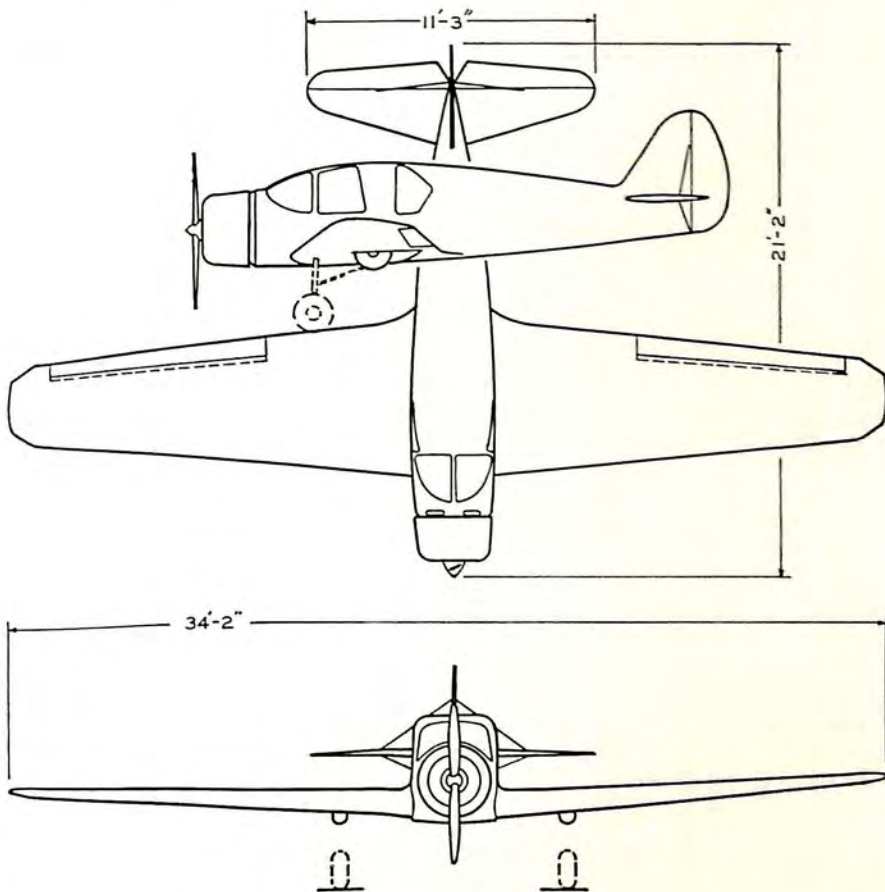
A two-place scout bomber with 755 h.p. Wright Cyclone engine.

payload. The Model 18 Beechcrafts carry L-6 Jacobs 330 h.p. engines as standard equipment. They are characterized by short take-off, high cruising speed and a short landing run. Because of their stated cruising speed of 195 miles an hour with relatively small engines, they are exceptionally efficient for long-range operation and are capable of carrying unusually large payloads over long distances.

The manufacture of the Model 18 Beechcraft seaplane was continued during the year. This airplane has a take-off time of 17 seconds

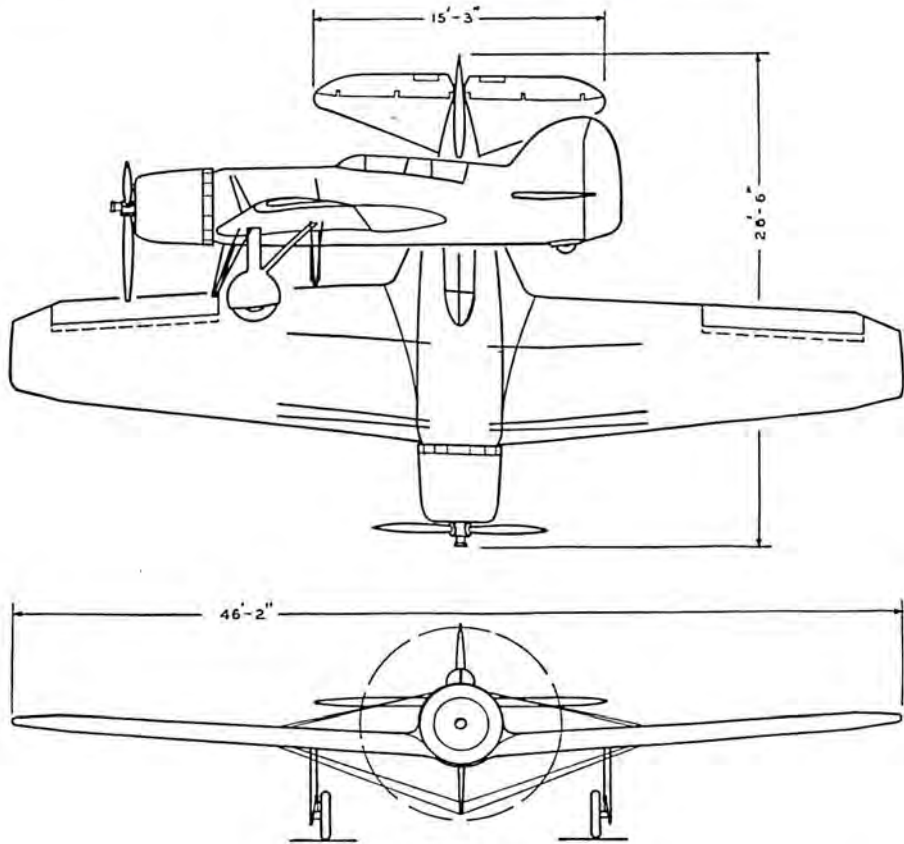
from flat, calm water with a full load, a climb of 1,060 feet per minute, and a stated cruising speed of 174 miles an hour.

A military version of the Model 18 Beechcraft was developed to use Pratt & Whitney 450 h.p. Wasp Junior engines. This model has a top speed of 230 miles an hour, a climb of 1,700 or 1,900 feet a minute, and a service ceiling between 26,000 and 29,000 feet, depending upon the load carried. It makes provision for a crew of four, 1,000 pounds of bombs, and a complete armament of six machine guns. With this loading, it has a stated range of more than 1,000 miles at a speed of 212 miles an hour. If fuel is carried for a 600-mile range, a maximum of 1,400 pounds of bombs can be carried in addition



BELLANCA JUNIOR

Powered with either a LeBlond 70 or 90 h.p. engine, this plane for the private flyer carries three.



BELLANCA 28-90B

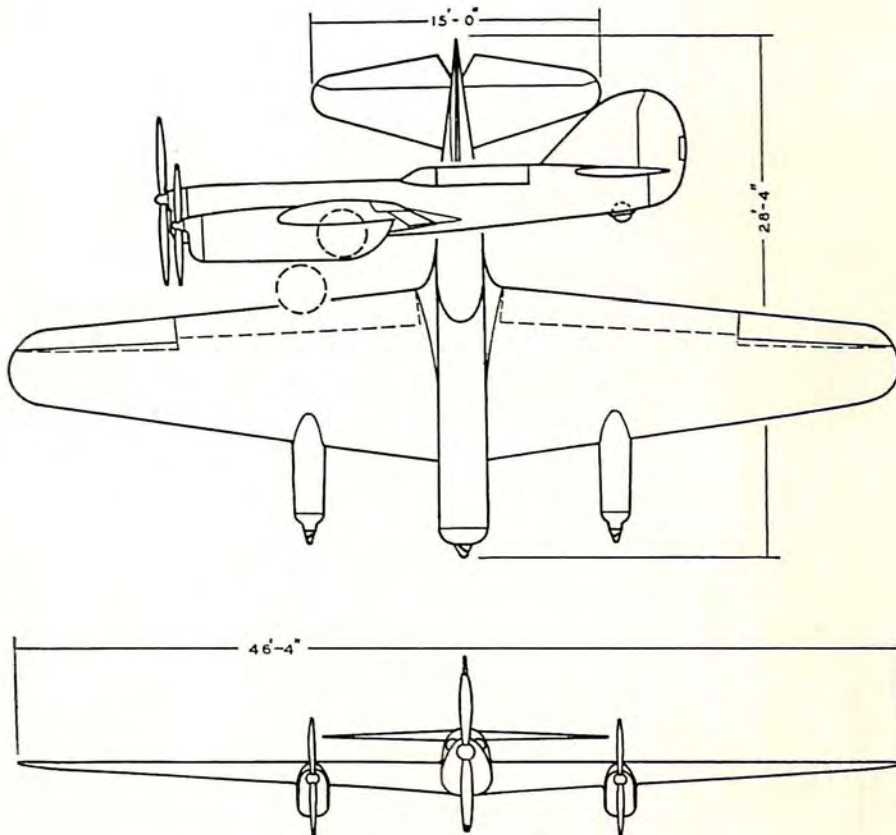
A two-place plane for military use powered with a Pratt & Whitney Twin Wasp engine.

to the crew of four and the armament of six machine guns. This unit is designed also as a photographic-observation airplane, an attack airplane or an ambulance airplane.

During the year, a considerable number of D17R Beechcraft biplanes were built and delivered to foreign countries for use as military ambulances. These airplanes carried no armament, but made provision for a stretcher patient, a pilot and a doctor or a nurse. They were provided with medical equipment for primary first aid in the air, and had fuel capacity sufficient for a cruising range of more than 1,250 miles. The first units delivered were painted white with large red crosses on the top, bottom and sides; but it was quickly found that modern warfare does not take cognizance of the usual symbols of

mercy, and for that reason later units were painted in the most modern camouflage patterns to make them as invisible as possible.

The high altitude performance of Beechcrafts made them a favorite of aerial mapping organizations, and many were sold for this purpose. A Model 18 Beechcraft was purchased for photographic mapping use and transport use by the Philippine Air Corps. This airplane was equipped with facilities for vertical mapping and oblique photography. The twin-engine unit was chosen because of the hazard of operating single-engine planes over the dense jungles of the Philippine Islands. Authorities of the Philippine Air Corps state that an idea can be gained of the difficulties of jungle travel from the fact that it required the labor of one hundred men for an entire week to



BELLANCA 28-92

This tri-motored single-seat monoplane has a Menasco engine in each wing and a Ranger engine in the nose.

hew a path four feet wide through the jungle for a distance of a quarter of a mile.

Beechcrafts were exported to many foreign countries during the year, and outstanding among the Beechcraft customers were the Controller of Civil Aviation of Canada, the Director of Civil Aeronautics of Brazil; two Model 18 Beechcrafts for Prairie Airways of Moose Jaw, Saskatchewan, and three Model E17B Beechcrafts for Indian National Airways of New Delhi, India. The E17B Beechcrafts for Indian National Airways incorporated special mail bins to carry 40 cubic feet of mail; as well as the pilot and two passengers. These mail bins were readily removable so that the airplanes could be converted into standard five-place airplanes on short notice. The exceptionally large mail loads carried in proportion to the passenger loads is due to the fact that in the British Empire all first-class mail is carried by air under the new air mail scheme.

Beechcrafts again participated in the Bendix Race in 1938, and



#### METAL STRUCTURE OF WINGS

Completing the structure of a wing flap for a Beechcraft 18.

took fourth and fifth places. The fourth place was taken by Max Constant flying Miss Jacqueline Cochran's D17W Beechcraft, and fifth place was taken by Ross Hadley flying a standard D17S Beechcraft powered by a 450 h.p. Wasp Junior engine. The Hadley Beechcraft was the only standard "NC" licensed airplane to complete the race.

Bell Aircraft Corporation, Buffalo, N. Y., at the end of the year was in production on an Air Corps order for 13 Bell Airacuda fighters, twin engine, Allison-powered, pusher-type monoplanes, described by an official War Department announcement as follows:

"The Bell fighter includes several radical departures in design not included in any military plane being supplied in quantity to any country in the World, and is a further proof of the leadership which,

up to the present time, has been maintained by American aeronautical engineers. The high speed of this airplane has not been announced by the War Department but it is believed to be sufficient to overhaul any modern bomber now in production or building.

"This new experimental plane 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 on either wing, to have a free field of fire and observation to the front, uninterrupted by engine or propeller. It also frees the gunners from having to work in the propeller blast, a handicap to gun maneuver and accuracy.

"The plane is armed with six guns, including two aircraft cannon—more powerful armament than ever before carried on a fighter. It carries a crew of 5—pilot, co-pilot-navigator, radio operator-gunner and two outboard wing gunners. The latter operate the guns located in the noses of the two engine nacelles. All members of the crew may change places without difficulty while in flight. Complete telephone inter-communication is provided between all stations.

"Gasoline is carried in the wings, thereby reducing the fire hazard. The plane has complete night-landing equipment, and all modern radio equipment is provided in order to insure the safety of the plane and its personnel. The new monoplane embodies the latest devices to increase its speed and air-worthiness. 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 its crew, which will be needed at its fighting ceiling, over thirty thousand feet.

"In addition to the main engines, which furnish power to the propellers for the propulsion of the plane, there is an auxiliary power plant, which operates 9 different motors for retracting or extending the landing gear, retracting the tail wheel, and for the operation of the landing lights for use at night, for lighting the plane throughout, and to provide power for the operation of the radio sets, and for all instruments and controls, including an automatic pilot. The provision of this auxiliary power plant reduces the load materially, which would otherwise have to be borne by the main engines of the plane and permits a much less complicated design."

On April 15, 1939, the War Department issued this statement:

"The Bell P-39 pursuit airplane has been undergoing flight tests at the Air Corps, Materiel Division, at Wright Field, Dayton, O., for the past several weeks. This fighter represents a considerable departure from its predecessor pursuit types in that it has a tricycle type landing gear. This does away with the necessity for a tail wheel, and also pro-

fects against nosing over when landing in muddy fields or when making full use of brakes in small fields, upon which landings would be made in actual warfare. The gear is retractable in flight, resulting in an exceptionally clean, low-wing monoplane. The P-39 is powered with a single Allison 12-cylinder engine rated at 1,000 h.p. The propeller is a three-blade metal constant speed type. A nose spinner comes to a smooth point, cutting down the drag appreciably. The airplane is a single-seater of all metal construction. The pilot is enclosed in a transparent canopy, which gives exceptional vision characteristics in all directions. The door resembles that of an automobile. This does away with the sliding sections of conventional type and provides for



U. S. Army photo

#### THE BELL AIRACUDA

The twin-engine pusher monoplane fighter, powered by two 1,000 h.p. Allison engines.

quicker egress in case the plane is disabled in combat. The engine is supercharged to carry this fighter to the exceptionally high altitude where air fighting now takes place. In order that the pilot may be able to fly and fight at maximum efficiency in light clothing, his cockpit is heated and he is provided with oxygen. The liquid-cooled Allison engine lends itself to exceptionally fine streamlining. Efficient landing flaps are used, reducing the landing speed so that the plane may operate out of small war-time fields."

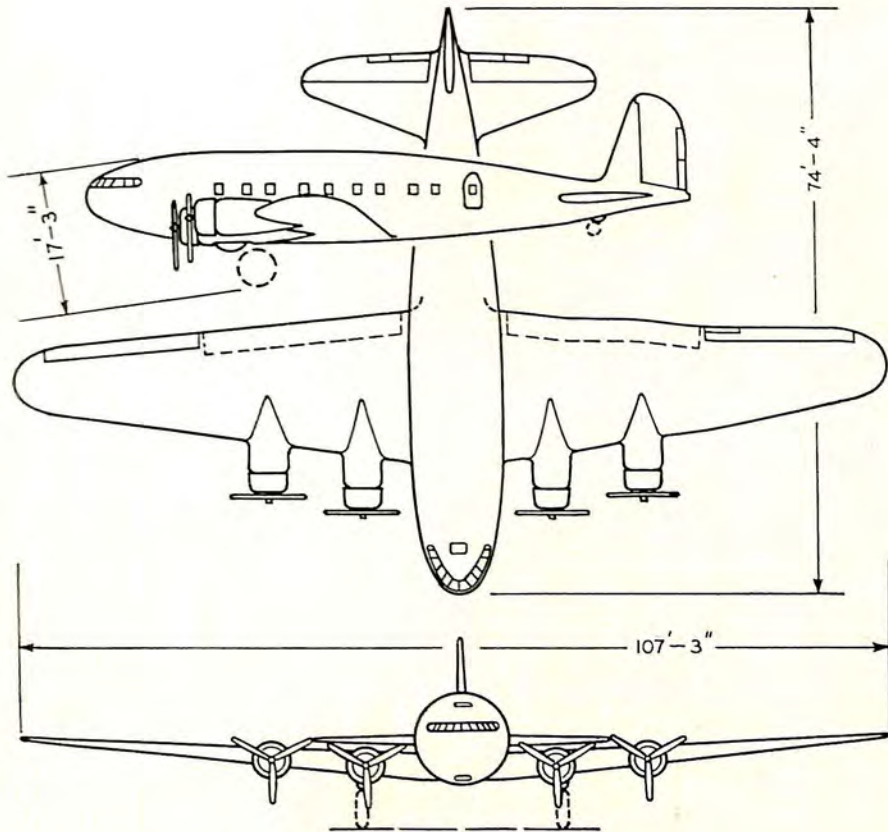
Bellanca Aircraft Corporation, New Castle, Del., continued development and sales of its current models. Model 14-7 was equipped with a 70 h.p. LeBlond engine and Model 14-9 with a 90 h.p. LeBlond. The plane was a low-wing monoplane, wing span 34 ft. two in., height six ft. three in., length 21 ft. three 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.

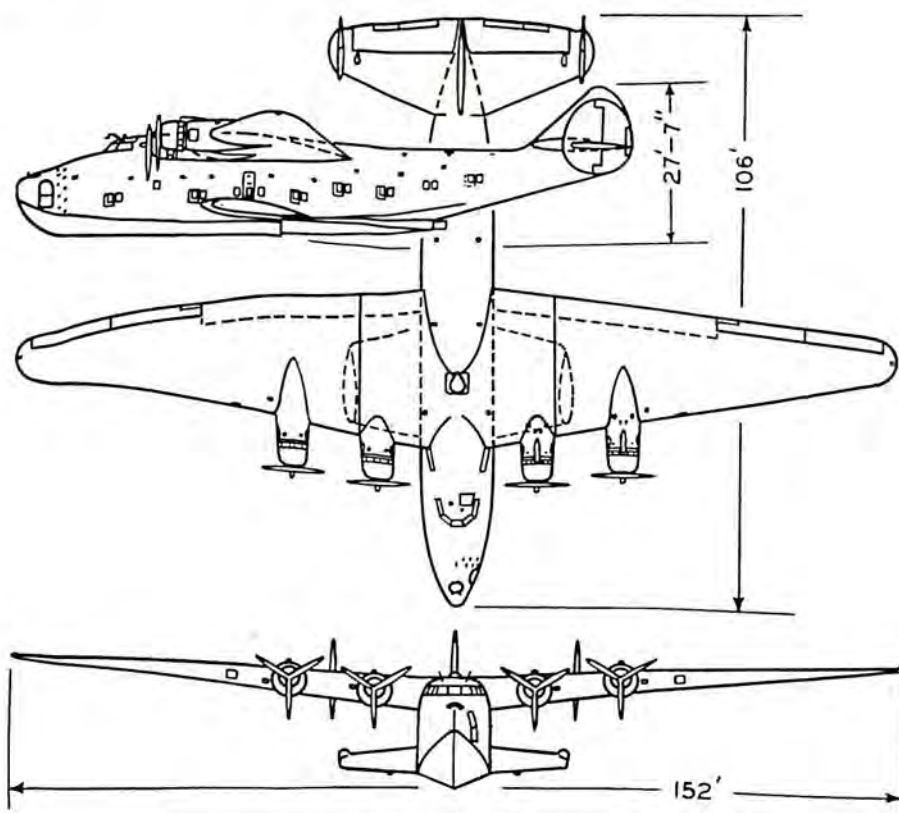
Boeing Aircraft Company, Seattle, Washington, at the beginning of 1939 was busy turning out production fleets of three types of large four-engine aircraft—Clippers, Stratoliners and military Flying Fortresses.

Highlights of the year 1938—the Company's twenty-second year in



#### THE BOEING STRATOLINER

A 33-passenger transport for substratosphere operations. It is powered by four Wright Cyclone engines.



THE BOEING 314

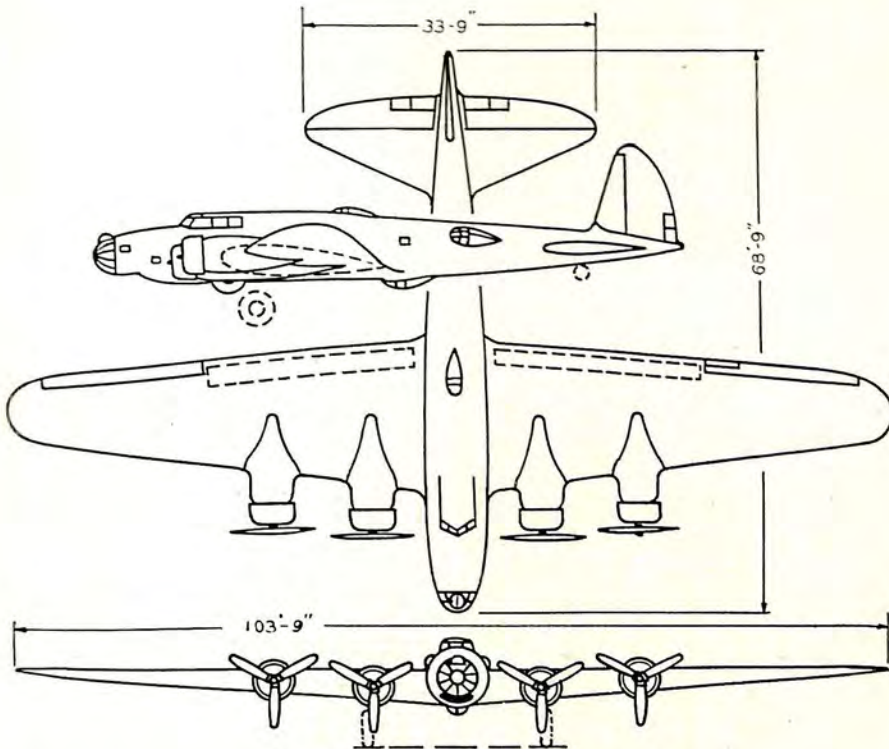
Pan American Clipper ship for ocean passenger service, powered by four 1,500 h.p. Wright Cyclone engines.

the aircraft manufacturing business—was the completion and testing of the Boeing 314 Pan American Atlantic-type Clippers, the largest aircraft yet built in America. During the summer and fall of the year the first plane of a fleet of six of these giant ocean air liners underwent its elaborate test program, described by engineers as the most rigorous and thorough-going test procedure ever laid out for a new transport airplane. Extensive flight tests were carried on at various gross weights ranging from 55,000 pounds to the maximum loaded weight of 82,500 pounds, the greatest weight ever carried aloft by any of the world's heavier-than-air craft, with the exception of the now-extinct German Dornier DO-X and the Russian Maxim-Gorky.

The Boeing 314 has day accommodations for 74 passengers and night accommodations for 40, in addition to its crew of eight. It is powered by four of the most powerful radial engines yet used in

American aircraft—1,500 h.p. two-row Wright Cyclones, giving it a total of 6,000 horsepower for take-off. Its wing span is 152 feet and its overall length is 106 feet.

But these figures alone do not fully portray the exceptional size and capabilities of the new Clipper, the first commercial airplane built to fly a sizable load of passengers and air express over the long non-stop routes of both the Atlantic and Pacific oceans. The wing span is equal to nearly half a city block. The hull, divided into two full decks connected by a spiral staircase, has an inside volume equal to that of a five-room house, including the basement. It contains 18 separate rooms. Its thermostatically controlled heating system produces approximately five times as much heat as the heating system of a modern seven-room house. Its fuel tanks hold 4,300 gallons of gasoline, or enough to drive a car two and a half times around the world. Its four engines supply twice as much power as an ordinary railway locomotive.



THE BOEING FLYING FORTRESS

Model B-17 four-engine bomber. It is powered by Wright Cyclone engines.

The Clipper's upper deck features a spacious control room measuring 12½ by 21 feet in which the six flying officers—first pilot, second pilot, navigating officer, radio officer, flight engineer and master, have their modern working quarters. Aft of the control quarters are the main cargo holds in the center section of the Clipper's big wings, and still farther aft on the upper deck are crew's living and sleeping quarters. A bow compartment carries mooring apparatus, additional crew bunks, and more cargo space, giving the plane a total cargo capacity of more than five tons of air mail and air express. The lower deck is divided into a series of commodious passenger compartments, including standard compartments accomodating 10 passengers each in the daytime and making up into upper and lower berths for six; a spacious dining and lounge salon in the center section; a de luxe compartment or bridal suite in an aft section; men's and women's dressing rooms and a completely equipped kitchen galley.

The engineering of the Clipper comprised the largest single engineering project ever undertaken by the Boeing Company. Indicating the scope of the problem, there were more than 6,000 engineering drawings and 390,000 square feet of blueprint paper used in the project; there were more than 50,000 different parts, assembled by approximately a million rivets and 15,200 bolts in each of the Clippers. The electrical system contains 11½ miles of wiring, the plumbing system involves 3,000 feet of tubing and the control system includes 5,000 feet of cable.

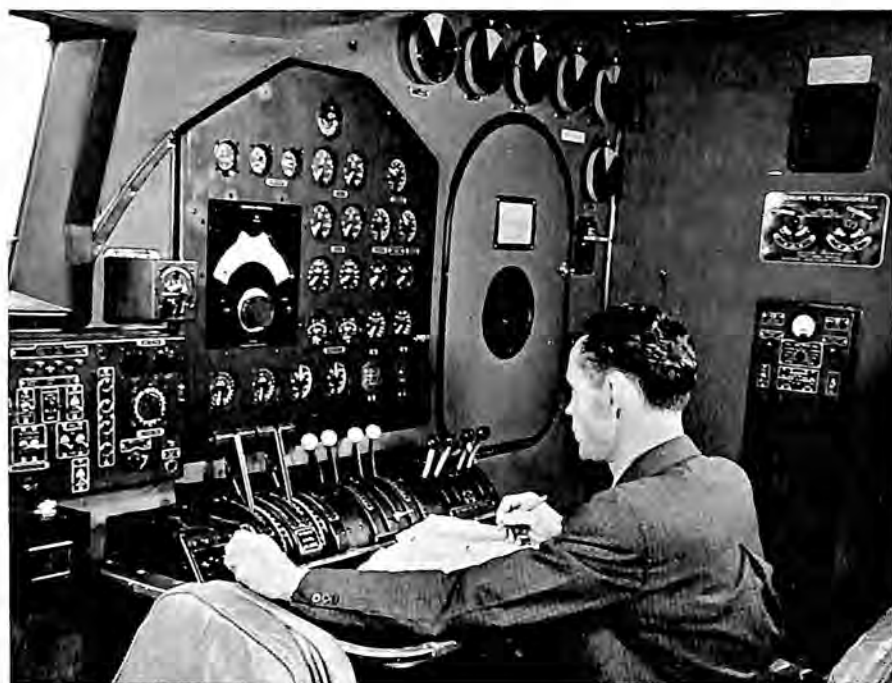
A leading feature of the Clipper, made possible by its exceptional size, is the accessibility of all four of its power plants during flight by way of catwalks through the wings leading to the large semi-monocoque engine nacelles. Flight may be maintained on any two of the four engines. The Clipper has a top speed of 190 miles per hour, a cruising speed of 165 miles an hour, and a range of 3,100 miles with 40 passengers aboard. The first of the fleet of six of these Clippers was delivered to Pan American Airways on January 27, 1939, and the second on February 10.

Smaller than the Clippers, but equally remarkable because of their interesting new sub-stratosphere features, are the Boeing 307 Stratoliners, the first of which made its initial test flight on December 31, 1938. Results of the thorough-going series of preliminary flight tests which continued through January, 1939, were described as "outstandingly successful." These four-engine overland transports introduce sealed, pressure-type cabins for comfortable flight in the sub-stratosphere.

The Boeing Stratoliner is a low-wing monoplane, with exceptionally roomy accomodations for 33 day passengers or 25 night

passengers—16 in upper and lower berths and 9 in individual reclining chairs. The plane has a wing span of 107 feet and a length of 74 feet. Its engines are four 1,100 horsepower Wright series G-102 Cyclones. It has a maximum speed of 245 miles per hour, at an altitude of 6,000 feet, a cruising speed of 215 miles per hour, a rate of climb of 1,250 feet per minute, and a service ceiling of 23,300 feet. Fully loaded, it can climb to an altitude of more than 10,000 feet with two engines on the same side completely stopped.

Striking in appearance, the Stratoliner can be likened in shape to a winged dirigible. Its fuselage has a perfectly circular cross-section from nose to tail, without even the usual deviation for cockpit windows. From the rounded nose to the pressure bulkhead just aft of



ENGINEER'S STATION ON BOEING 314

On the instrument panel are 26 instruments which, because many of them combine the functions of more than one instrument, together serve the purpose of 62 separate indicators. The large centrally-located instrument in a black panel shows temperatures at the heads and bases of the two master cylinders on each of the four Wright Cyclone engines. The controls in front are propeller feathering and propeller speed regulators, cowl flap controls, automatic manifold pressure regulators, and fuel mixture controls. To the right is a door opening on the wing passageway to the engines, and above it are hand wheels controlling fuel systems.

the women's dressing room and steward's galley in the rear of the cabin, the entire interior is sealed to withstand a differential of six pounds per square inch between inside and outside atmospheric pressure. In actual operation a pressure differential of only  $2\frac{1}{2}$  pounds per square inch will be used. This moderate supercharging will give passengers the comfort conditions of normal flight altitude when the plane is actually operating in the sub-stratosphere at altitudes of 14,000 to 20,000 feet above sea-level. Operating on this "upper level," the Stratoliner will gain the advantages of additional comfort in the smooth sub-stratosphere air, additional speed, and freedom from stormy surface weather.

The Stratoliner has two fully independent supercharging and heating installations, automatically controlled, which re-create natural low level atmospheric conditions within the sealed cabin during high altitude flight. Fresh air, drawn through the leading edge of each wing, is compressed by two engine-driven superchargers, and is then circulated throughout the cabin, after which it is discharged through an exhaust chamber below deck. Heating is accomplished by passing the air through freeze-proof condenser-type steam radiators. The air is conducted directly into the cabin ventilating system, and the individually controlled auxiliary ducts at passenger seats supply the same "conditioned" air as do the general circulation ducts.

During the early part of 1938, the Materiel Division of the U. S. Army Air Corps completed acceptance tests of the great Boeing XB-15 experimental super bomber, largest landplane in America. This mightiest of all air defense weapons has a wing span of 150 feet, a length of 90 feet, and a gross weight described as "in excess of thirty tons." It is powered by four 1,000 horsepower Pratt & Whitney twin-Wasp, engines, and has two auxiliary gasoline power plants inside the fuselage driving generators in a 110-volt alternating current electrical system. As in the case of the Boeing Clippers, all the XB-15's engines are accessible to the crew during flight. The plane's retractable landing gear includes two sets of dual wheels. Six enclosed machine gun emplacements, streamlined into the top, bottom, sides and nose of the fuselage, provide the bomber's defensive armament. Complete living and sleeping quarters for the crew are included in the plane to increase the efficiency of the flight personnel during sustained operations.

The War Department during 1938 placed with the Boeing Aircraft Company additional orders for Boeing B-17B flying fortresses, making a total of 52 of these four-engine bombers on hand or on order for the U. S. Army Air Corps. Thirteen Boeing B-17's were delivered to the Army in 1937 and the additional 39, designated as B-17B's,

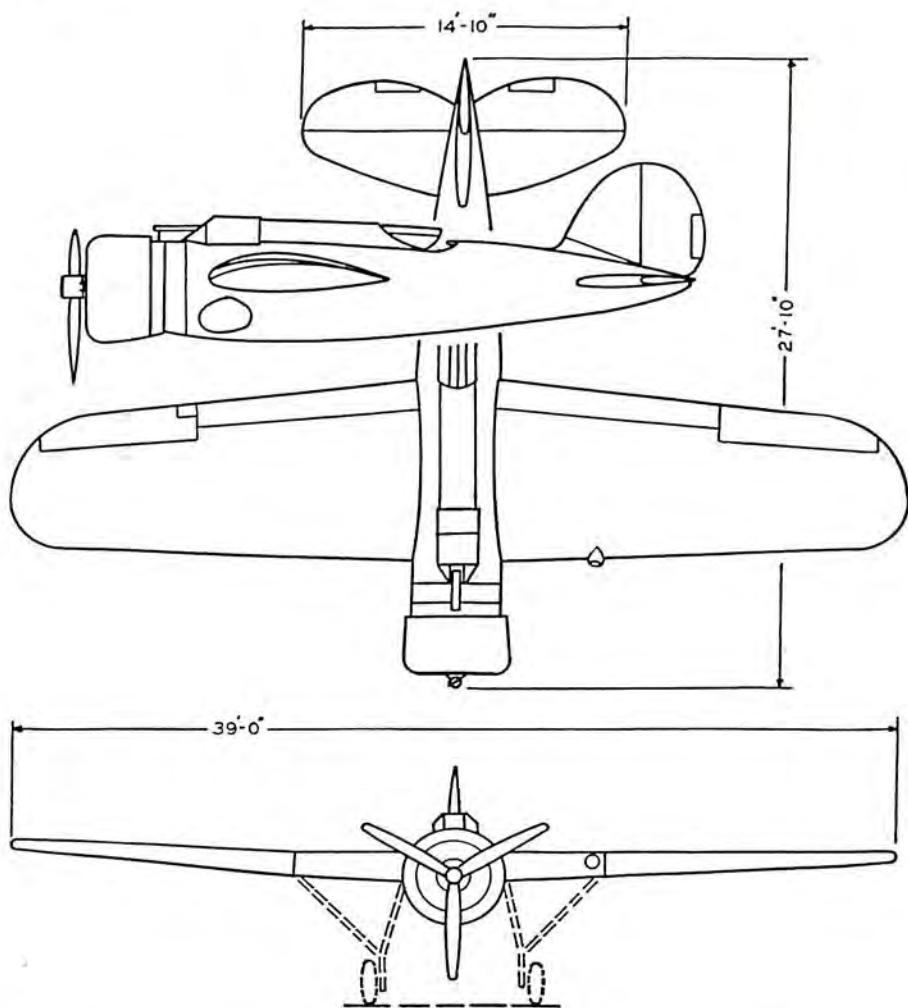
are now in production. This type, universally known as the Flying Fortress, is a 22-ton completely streamlined mid-wing monoplane with a wing span of 105 feet and a length of 70 feet. It is powered by four 1,000-horsepower Wright "G" Cyclone engines. It has a stated maximum speed of more than 250 miles an hour and a range of more than 3,000 miles.

The Army Air Corps' operations during 1938 with its fleet of 13 of these Flying Fortresses, demonstrated graphically the potentialities of the type as an efficient aerial defense weapon. Flight activities included numerous long-range and mass formation cruises. Non-stop transcontinental cruises from March Field, California, to Langley Field, Virginia, a distance of 2,317 miles, were made in as little as 10 hours and 45 minutes elapsed time, establishing new records for military planes. Most sensational of all was the Army's mass goodwill flight from Miami, Florida, to Buenos Aires, Argentina, made with six of the Flying Fortresses under the command of Lieut.-Col. Robert Olds. The distance of 5,260 miles was covered in less than a day and a half elapsed time, in but two hops, with a stop-over at Lima, Peru.

As a further development of the Flying Fortress type bomber, a new plane designated the Boeing YB-17A was completed and turned over to the Army Air Corps on January 31, 1939. It is identical in size and similar in general design to the Boeing B-17 Flying Fortresses, but is equipped with special engine superchargers for operation in the substratosphere.

The design and installation of the engine supercharging system incorporated in the new YB-17A is the product of months of research and experimentation. By means of exhaust driven blowers (or superchargers), turning at high speeds, air is fed to the engines at approximately constant sea level density, although the airplane may be at an altitude of 20,000 feet. This rarefied air is first compressed to sea-level density, then cooled by radiators, both operations being performed before it enters the carburetors. By means of these superchargers the approximate maximum power output of the engines may be maintained in spite of a decreased density of the air at high altitudes.

The Brewster Aeronautical Corporation, Long Island City, New York, produced wings and tail surfaces for the Canadian Car & Foundry Company, two place fighter and wings, tail surfaces and wing tip floats for Navy fighters, utility amphibians and long range patrol boats. In the early part of the year Brewster delivered 47 sets of wings and tail surfaces for the Canadian Car & Foundry Company Ltd. Model G-23 two place fighter, which completed the total order



#### BREWSTER SCOUT-BOMBER

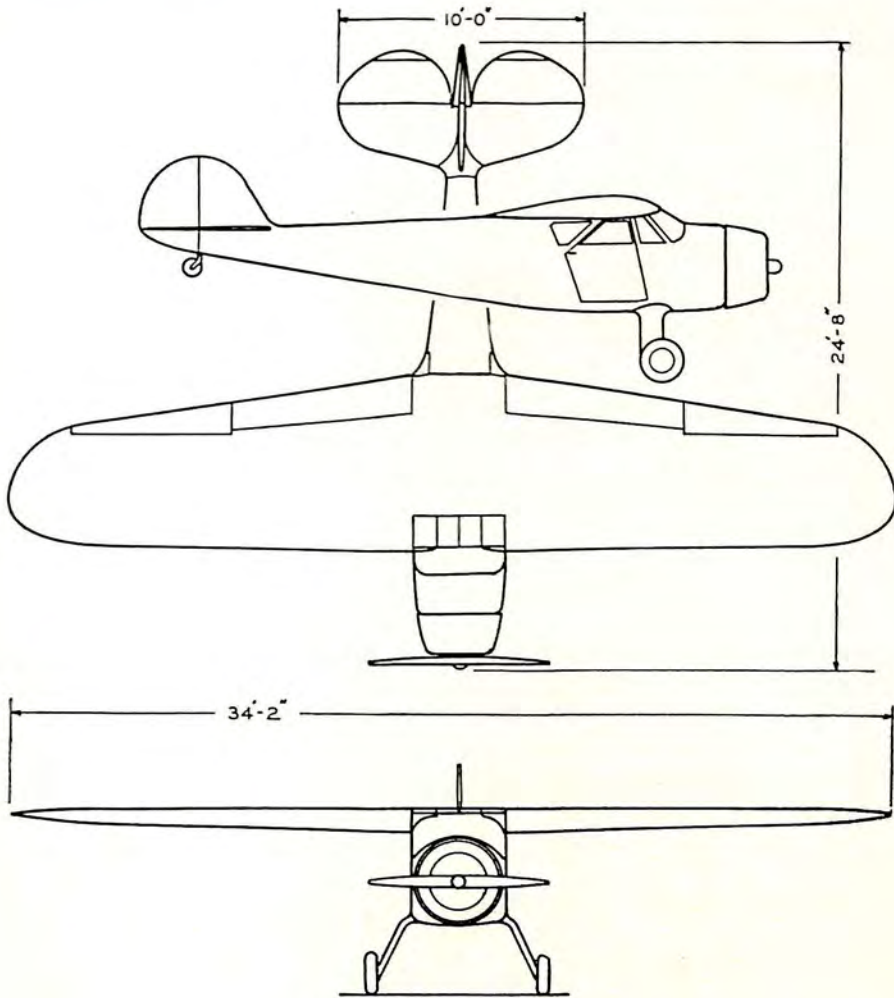
Model XSBA-1, designed for the U. S. Navy, is powered with a Wright Cyclone engine.

of 54 sets initiated in 1937. Brewster also delivered 80 sets of wings and tail surfaces for Navy fighters, 40 sets of wings, tail surfaces and wing tip pontoons for Navy utility amphibians, and in excess of 123 sets of wing tip pontoons and braces for Navy long range patrol boats.

Brewster's XSBA-1 500-lb. dive bomber was approved and accepted after undergoing Navy service tests. As a result of the out-

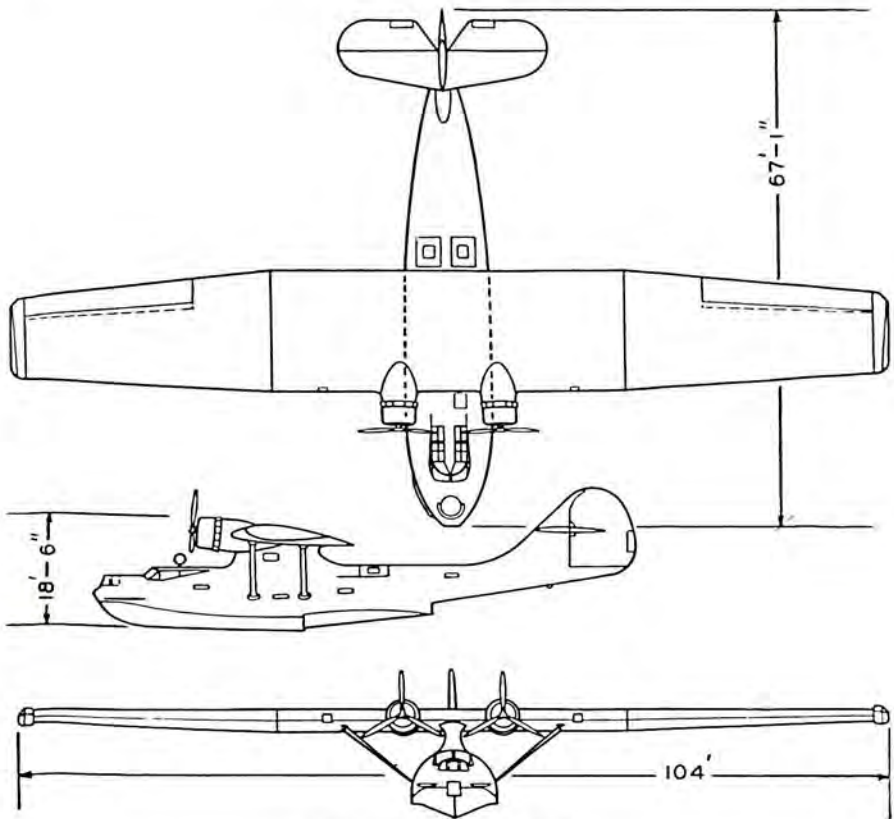


standing performance of the XSBA-1 the United States Navy is proceeding with the manufacture of a production order of these planes at the Naval Aircraft Factory in Philadelphia. The Brewster Model 138, which is the export version of the 500-lb. dive bomber, was released for export. The Brewster Model XF2A-1 won the Navy single seater fighter competition. Based on the performance of the experimental airplane Brewster received a contract for 54 F2A-1 single seater fighters, delivery beginning early in 1939.



CESSNA AIRMASTER

A four-place plane for the private flier powered with a Warner Super Scarab engine.



#### CONSOLIDATED PBV

Navy patrol flying boat, powered by Pratt & Whitney Wasps.

The steady increase in business necessitated an expansion in factory space. The company purchased a multi-story building of 170,000 square feet occupying one-half of a city block in Long Island City, with provision for expansion on the remaining land equivalent to the present available floor space. The building permits the centralization of activities.

Although now actively engaged in the airplane manufacturing field Brewster is carrying on its parts business.

Cessna Aircraft Company, Inc., Wichita, Kans., brought out a new Airmaster model, a four-place cabin monoplane with a 145 h.p. Warner engine. It had a stated top speed of 162 m.p.h., cruising at 151 m.p.h., gross weight 2,350 lbs., empty 1,380 lbs. and 34 ft. 2 in. wing span.

Consolidated Aircraft Corporation, San Diego, Calif., in May,

1938, celebrated the 15th anniversary of its founding, having produced over 2,000 airplanes. The activities of the corporation centered around the building and development of the large flying boats, with emphasis on the production of the famous record breaking PBY patrol bomber type. The PBYs, almost as quickly as delivered to the Navy, established new massed flight records. These flights, described by the Navy as "routine transfers" involved 147 PBYs and as flight crew members, 1,022 men. The non-stop flights were from San Diego to Pearl Harbor, Hawaii (2,553 miles) and from San Diego to Coco Solo in the Canal Zone (3,087 miles). The smallest group in these flights was 12 planes, and the largest was 48, making the hops concurrently. On only one occasion did any of these alight en route. On the flight of 48 to Coco Solo, three of the group, after battling adverse flying conditions for hours, descended a few miles short of their destination to take on additional fuel simply as a precautionary measure. The flights were otherwise completed without incident, thus piling up an almost incredible record of consistent long range performance: 422,283 airplane miles, or about 17 times around the globe.

The Consolidated model 28 (commercial PBY) of Richard Archbold of the American Museum of Natural History, flew from San Diego to Dutch New Guinea in three hops in June. San Diego to Hawaii (2,553 miles), Hawaii to Wake Island (2,300 miles), Wake to Hollandia, New Guinea (2,325 miles). Flying time: 51 hrs. and 4 min. Immediately setting about with the work of the expedition, this plane transported over 180 miles of practically impenetrable jungle, 110 men with tons of supplies and equipment to establish a base camp on Lake Hebbema (elevation 11,500 feet), in the interior of New Guinea. Another camp of 60 men was similarly established on the Indenberg River, with both camps set up in record time for jungle exploration work. Making possible exploration work where it is impossible for native porters to penetrate, Richard Archbold's model 28 has opened up entirely new fields. Within a short time after the establishment of the bases, several new lakes were discovered and one flight of the plane brought to light the existence of a large colony of primitive natives hithertofore unknown to white man.

Starting in May ('39) the Archbold plane was to make the return trip to San Diego, continuing on around the world the long way. Arrival in San Diego was scheduled for July. The itinerary is south to Australia, across Australia and thence across the last ocean to be traversed by air, the Indian Ocean. This portion of the return flight: Onslo, Australia W.C.; Cocos Isl.; Diego Garcia Isl.; Seychelles Isl.; and Mombassa, Kenya, Africa, is the alternate "Empire Route" long advocated in Australia, and the plane will accommodate Aus-

tralian representatives on the flights. Lake Victoria, Lagos and Dakar will be the stops in Africa. St. Thomas in the West Indies follows, then Miami, Fla.

An additional model 28 was sold to American Export Airlines for transatlantic survey work.

Supplementing the PBYS and commercial model 28s, is the four engine XPB2Y-1, claimed to be the fastest four-engine flying boat in the world upon its completion. Successfully completing its tests, it was officially turned over to the Navy on August 24th. On Navy Day this Consolidated XPB2Y-1 was flown from San Diego to Washington, D. C., entirely overland in a non-stop flight of 13 hours carrying a crew of 10. It was totally without equipment for alighting on land. The return flight was likewise overland and non-stop. The longest previous flight was one of five hours the day before departure from San Diego.

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 provided. 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.

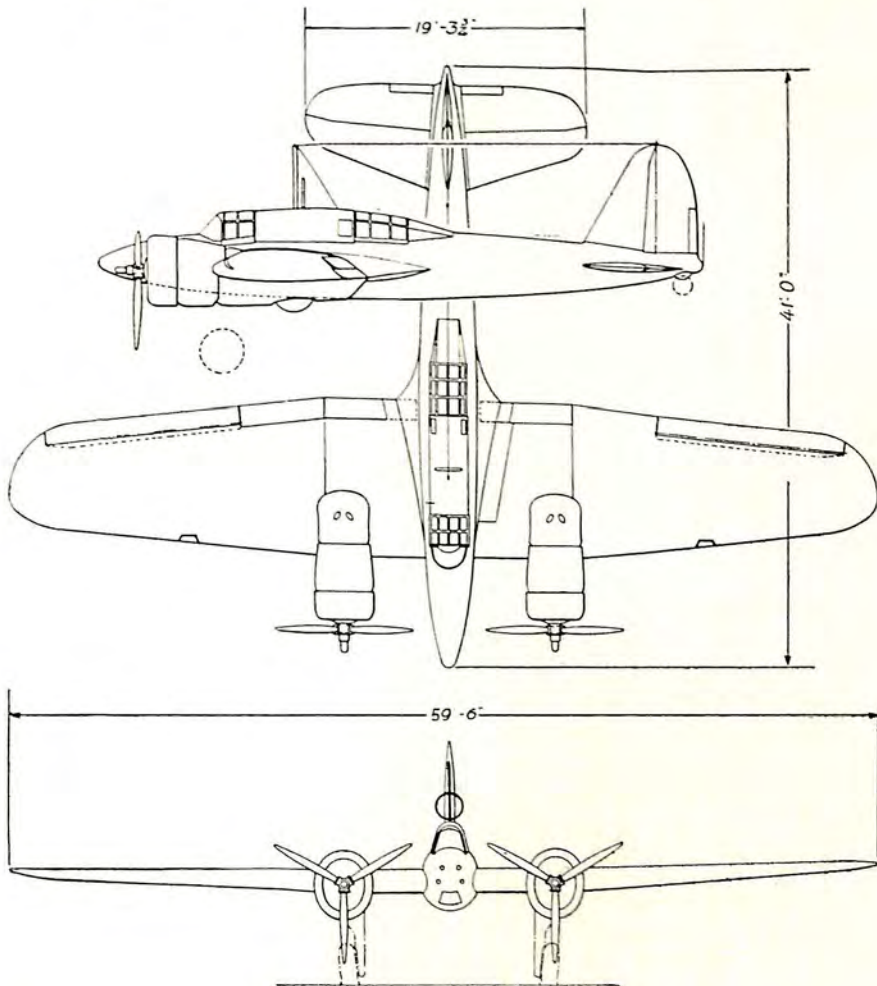
Another novel feature is the installation of retractible tip floats which, in flight, are drawn up to form the tip of the wing, thus increasing the performance of the patrol bomber materially, while, at time of landing, they are let down and form, in addition to necessary flotation for the wing tips, 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 also may be carried.

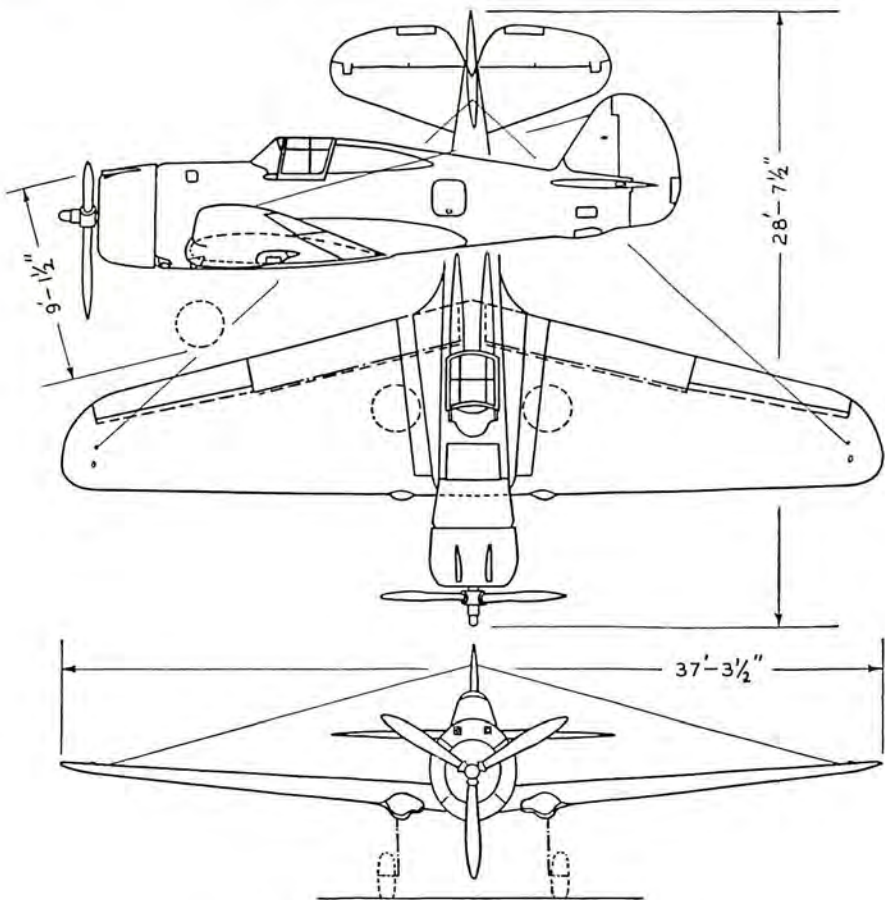
The Curtiss Aeroplane Division of the Curtiss-Wright Corporation, Buffalo, N. Y., in 1938 reached the highest peak for peacetime operation. Contracts for the United States Army, Navy and Coast Guard and the air forces of several foreign nations were filled during the period.

To handle increased business, it was found necessary to construct



THE CURTISS Y1A-18 ATTACK

It is powered by two Wright Cyclone engines.



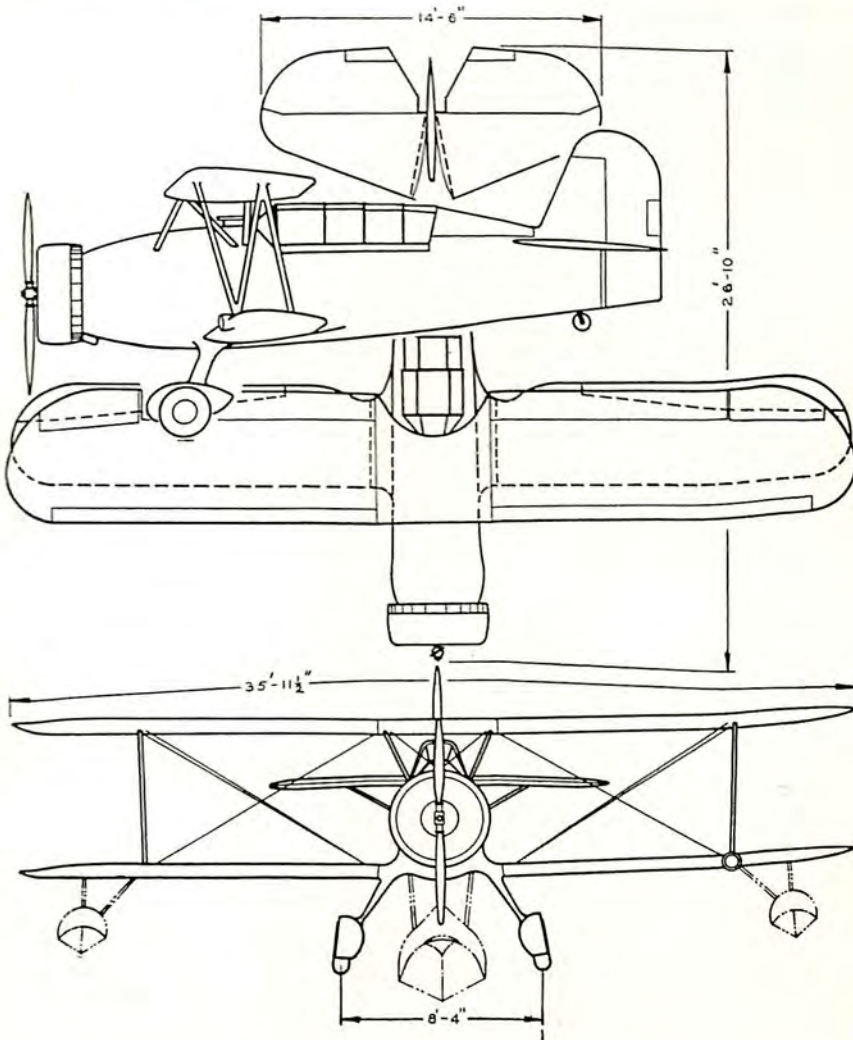
#### THE CURTISS P-36-A PURSUIT

A single-seat fighter with Pratt & Whitney Twin Wasp engine.

three additional buildings in connection with the original Curtiss Buffalo factory. These include a forge and foundry shop, in which zinc dies are formed for use on drop hammers and hydraulic presses and where exhaust stacks for all models are fabricated; a paint shop, in which is housed modern equipment. This building is completely air-conditioned and the spray booths are equipped with a water-washing process which safely removes all the over-spray and keeps the air clear and free at all times. Overhead monorail systems allow the transfer of parts easily and swiftly and prevent undue handling of units after final paint. Large spray booths were designed which are capable of handling a complete wing or fuselage and directly

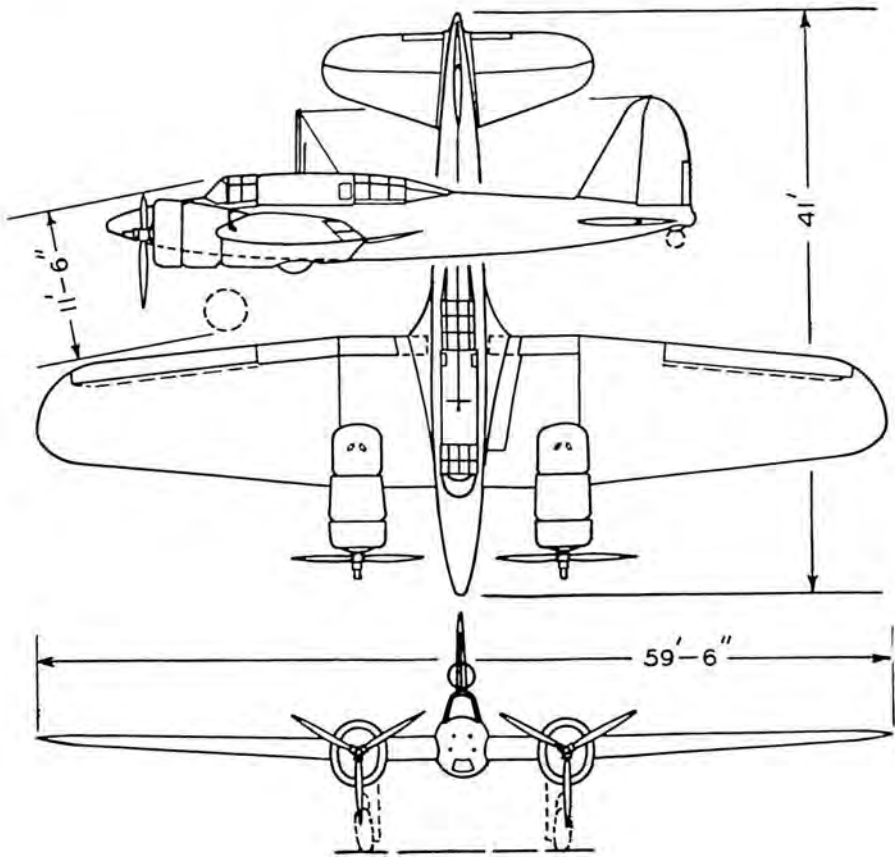
opposite the booths are a set of drying ovens into which the material may be transferred on the monorail in a minimum length of time.

The third building houses the complete assembly department. The doors at the east end open the complete width of the building to permit planes being rolled onto an asphalt ramp for engine test. Four overhead electric monorails with three-ton automatic hoist allow the movement of any unit or completed airplane to any part of the building.



CURTISS OBSERVATION SCOUT

Model SOC-4, a two-place plane powered with a Pratt & Whitney Wasp.



THE CURTISS 76D

A twin engine attack plane powered by two Wright Cyclone engines, 840 h.p. each.

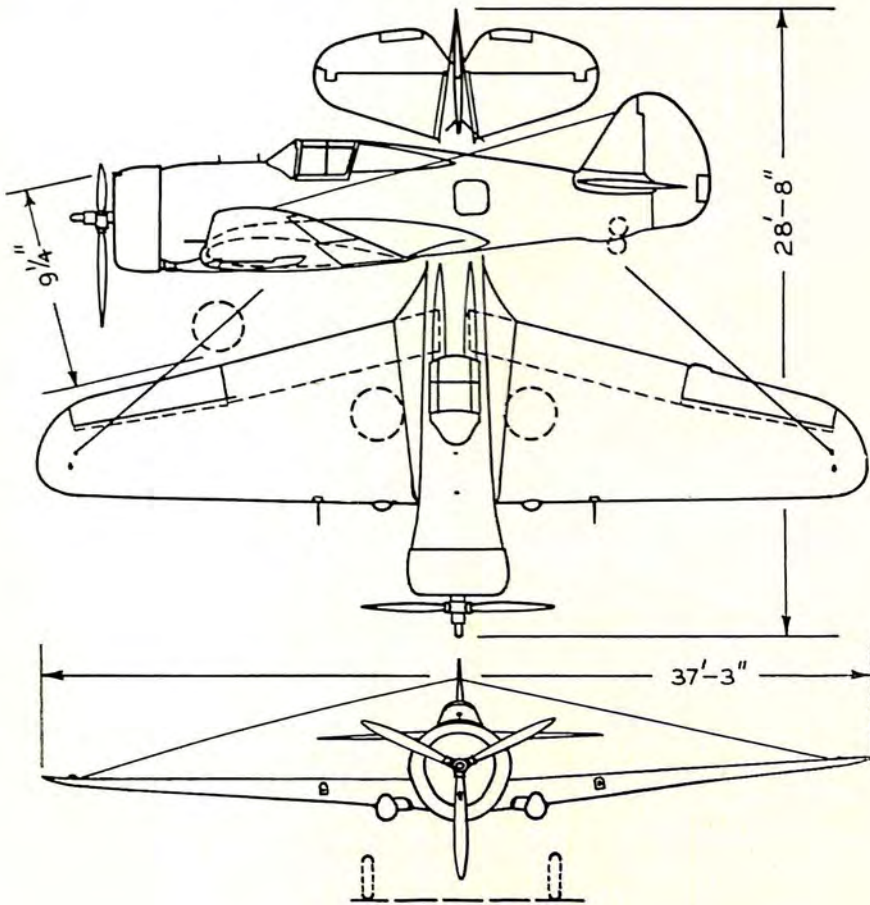
All tracks are interconnected with switches and an extension allows loading of trailers for shipment to the airport, should it be desired. The building has a clearance of twenty-five feet over the ceiling trusses, which will facilitate the construction of larger types of aircraft than Curtiss is building today.

Several new designs were developed during 1938. These include the YP-37 pursuit, the Allison-powered airplane similar to the XP-37 which had been supplied to the Air Corps in 1937; the XP-40, another Allison-powered airplane entered in the 1939 competition for pursuit aircraft; the Hawk 75-R, a low wing monoplane using a radial engine but developed with interceptor characteristics; and the SBC-4, a second production airplane of the SBC type which will supplement others



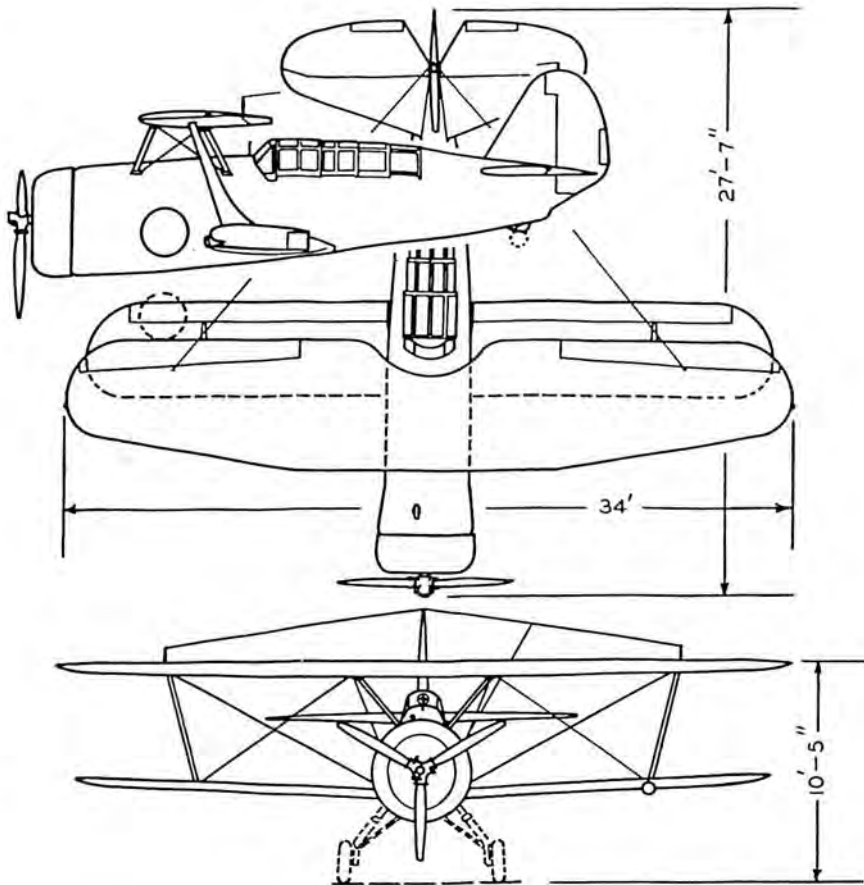
now in service. Several changes were also made in the Hawk 75 series of pursuits, but these were of such a minor nature that they were not given direct and specific classification.

At the beginning of 1939 major production included P-36A pursuits for the Air Corps and 13 YP-37 pursuits with Allison engines. A new design designated as the XP-40 was delivered to Wright Field, the Army testing base. This plane is also powered with a "V" Type liquid cooled engine and although similar in specification to the P-36 and P-37, is reputed to have considerably increased performance. Other production consists of two contracts for U. S. Navy scout



CURTISS HAWK 75A

A one-place pursuit with 900 h.p. Wright Cyclone engine.



CURTISS HELLDIVER 77

A two-place scout bomber with 840 h.p. Wright Cyclone engine.

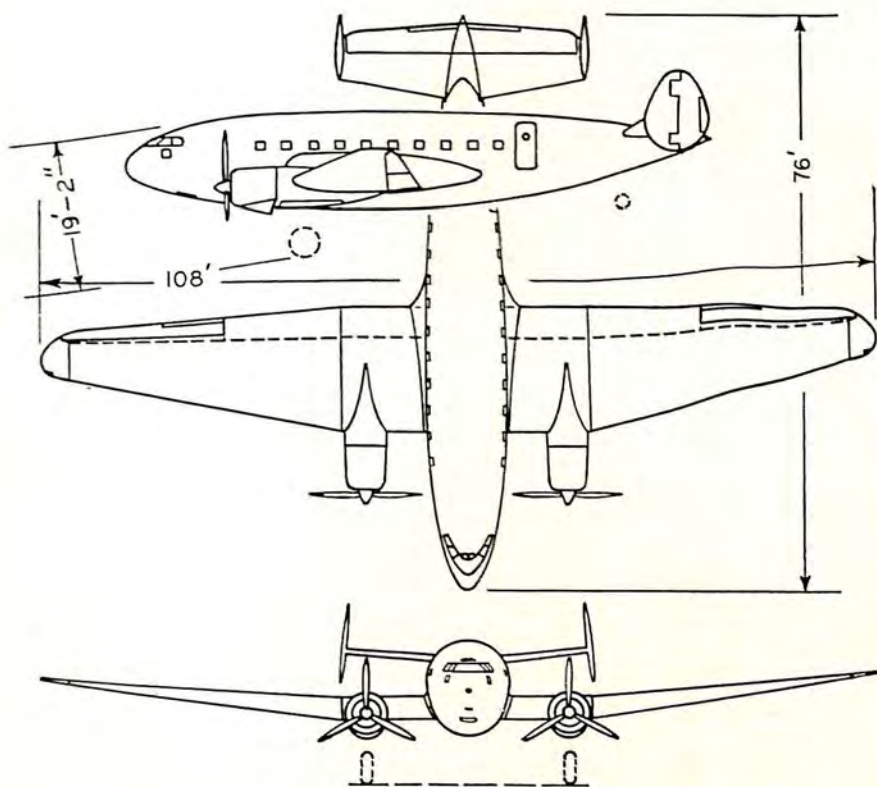
bombing airplanes, designated as the SBC-4 and a number of orders for the Hawk-75 series of aircraft. This type is a single place low-wing all-metal pursuit airplane. Other export models available were the Curtiss design 76-D, a twin-engine attack monoplane or light bomber, the Curtiss Hell Diver 77, a dive bomber for carrier use and the Curtiss Sea Gull, a two place observation plane convertible from land to seaplane operation. Several experimental models were undergoing flight tests.

The St. Louis Airplane Division of the Curtiss-Wright Corporation, St. Louis, Mo., increased plant capacity and installed new pré-

cision machine tools, a 420-ton hydraulic press and extensive jiggling for production.

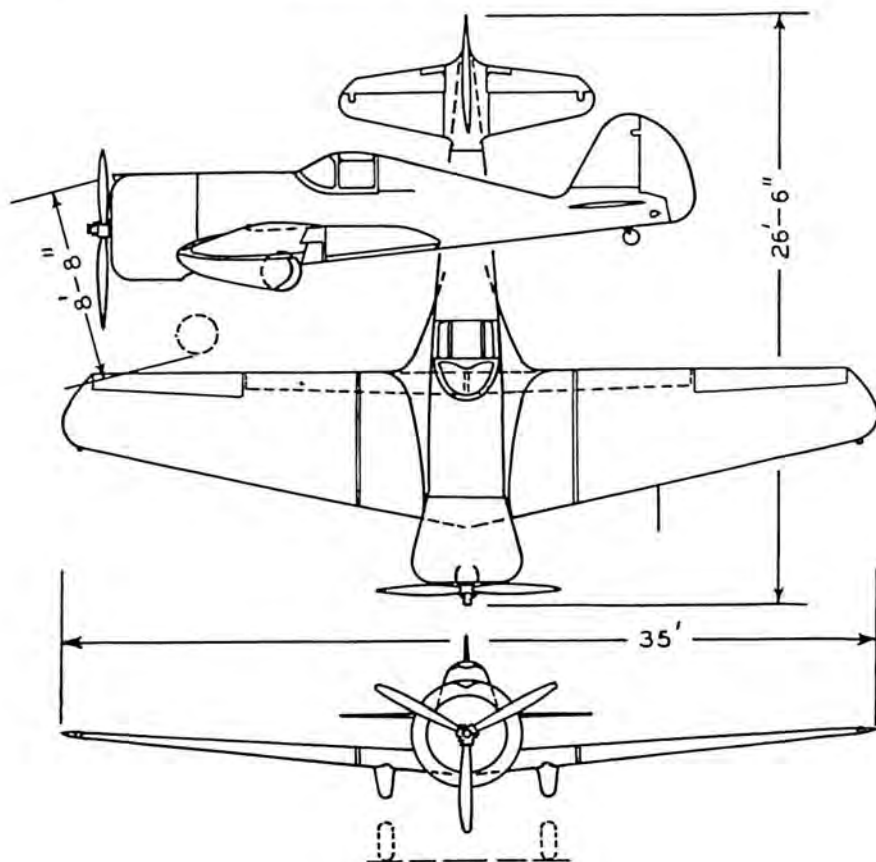
The engineering department was engaged in development of three models, two of which were completed and one nearly completed by 1939. In addition, certain undisclosed military projects were on the program. The most sizable project was the detail design and intermediate stage testing of the C-W 20 transport, for which the general design and preliminary structural and aerodynamic tests were carried out during 1937. The second major project was the C-W 21 interceptor, which was flown during the year. Also developed and completed was the C-W 22, primarily a basic combat type, but also adaptable to private sport use.

Engineering work on the Model 20 consisted partly of detail design assisted by the construction of a full-size mock-up, believed to



THE CURTISS-WRIGHT 20 TRANSPORT

A 24-34-place twin-engine transport powered with double-row Cyclone engines.



THE CURTISS WRIGHT 21

New interceptor, powered by an 850 h.p. Wright Cyclone engine.

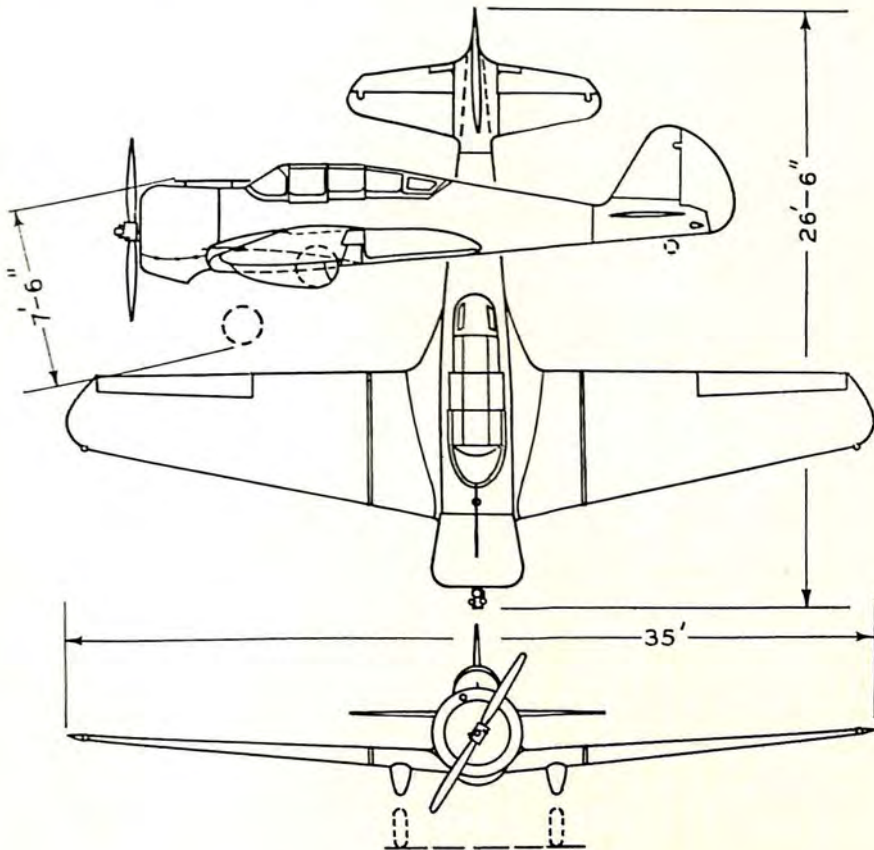
be the most complete airplane mock-up ever built; its complete interior and pilot's compartment greatly facilitated design of these details. The test program was in a secondary stage in which all specific design units were thoroughly tested; engines and control systems, retractable landing gear, the hydraulic system, and heating system were all subject to thorough operating tests preparatory to installation in the completed airplane.

Development of the C-W 21 Interceptor Fighter resulted from recognition of the need for a fast climbing, high speed military airplane as a necessary addition to present defense of large urban centers against bombing attacks. Flight tests showed a rate of climb for the airplane of 5,000 feet a minute, coupled with a stated top speed of

more than 300 m.p.h. It was claimed to be the fastest climbing airplane in the world.

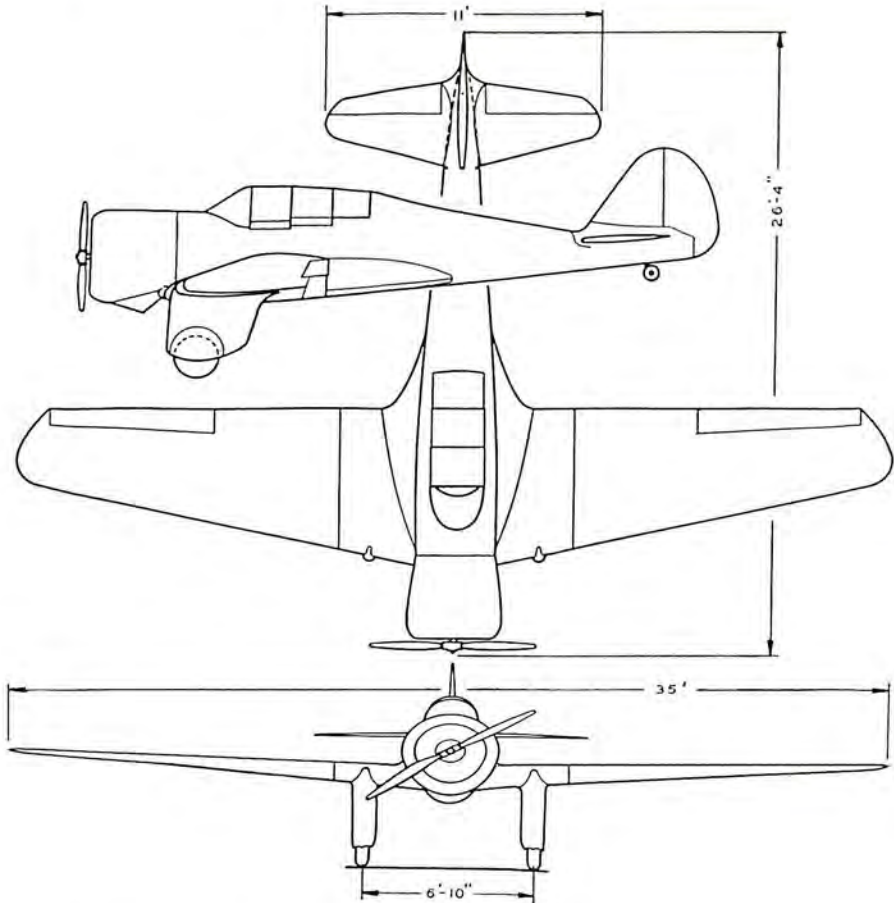
Combining certain features of the 19-R and 21, the third airplane developed by the company during the year, the C-W 22 Basic Combat, powered with a Wright Whirlwind, was said to have high performance for a ship of moderately low power. Its top speed of 217 m.p.h. at 420 h.p. was made possible by an extremely clean design which included a completely cowled retractable landing gear.

In production during the year were the 19-R All-Purpose military airplanes for the export market and tail assemblies, ailerons, flaps, exhaust manifolds, fuel and oil tanks, and engine cowls for Hawk



THE CURTISS-WRIGHT 22

A two-place basic combat plane powered by a 420 h.p. Wright Whirlwind engine.



### CURTISS-WRIGHT BASIC TRAINER

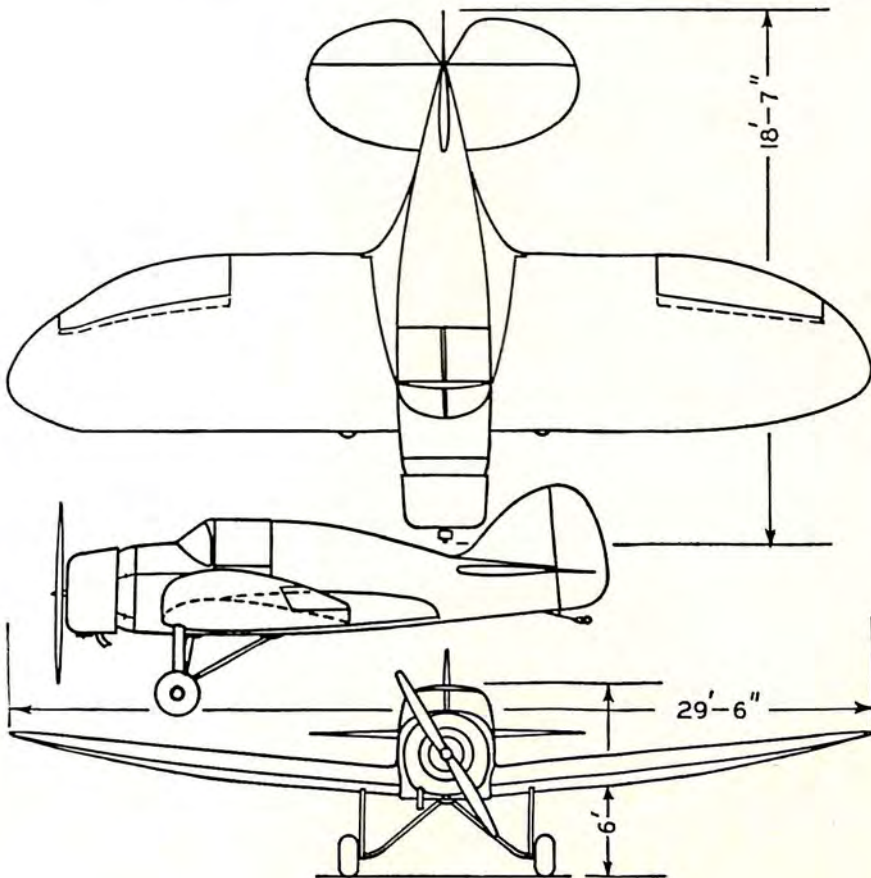
Wright Whirlwind-powered, this model 19-R is a two-place plane.

75's being assembled at the Curtiss Aeroplane Division plant in Buffalo.

The construction of the prototype C-W 20 was a major shop accomplishment, begun in February, 1938, and nearing completion at the end of the year. The ship's components were built up in permanent production jigs, all electric arc welded to eliminate the shrinkage and warpage as found in former bolted and acetylene welded jigs. To compensate for temperature contractions and expansions of parts set up in the larger jigs, bases for these jigs were mounted on adjustment jacks, and special checking stations were laid out on the jigs for

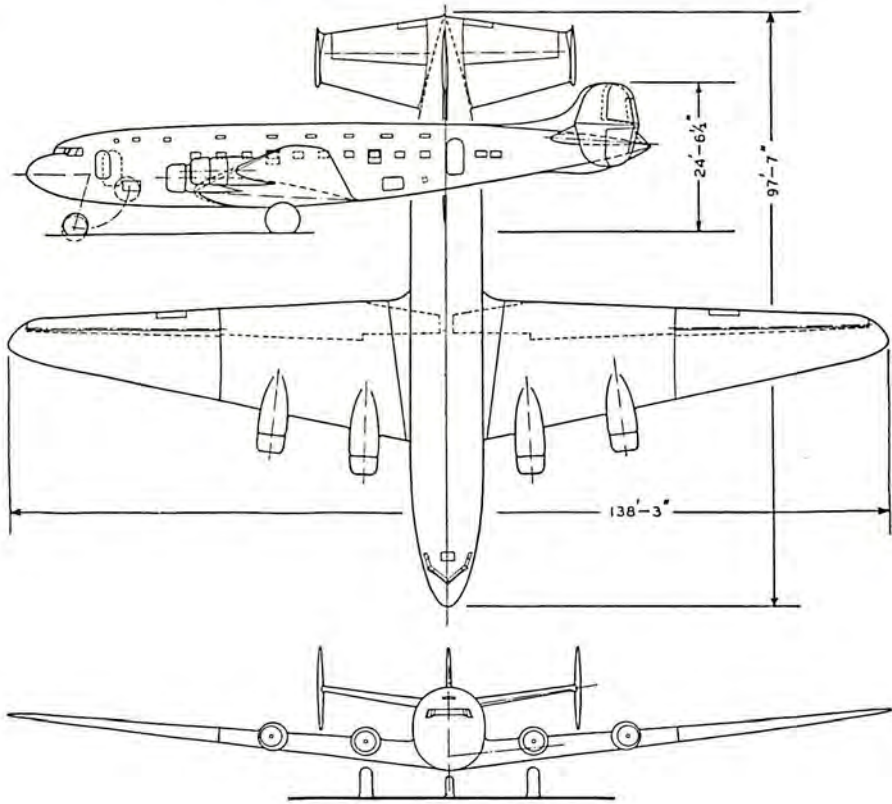
proper alignment from time to time as required. The ship was jiggled for construction in the following major assemblies: fuselage, wing center panel, tail cone and surfaces, outer panels, engine nacelles, landing gear and tail wheel assembly. Minor assembly jigs were constructed for wing flaps and other control surfaces and for fuel tanks. Permanent production jigs, rather than temporary development set-ups, were employed in order to facilitate the transition to quantity production of the transport.

The Culver Aircraft Corporation, Columbus, O., formerly the Dart Manufacturing Corporation, became active in sales and production of Dart airplanes during 1938. The Dart Model G and later



THE DART GW

A two-place plane with a Warner engine. This private owner machine is manufactured by the Culver Aircraft Corporation.



#### THE DOUGLAS DC-4

A 42-place day or 30 berth sleeper transport, powered by four 1,400 h.p. Pratt & Whitney Twin Hornet engines.

the Models GK and GW were produced, and found favorable acceptance from private flyers and fixed base operators. Parks Air College purchased one of the first Dart airplanes early in the year, and after a service test, placed an order for five Model GW Darts which were delivered and placed in service. Numerous small schools and operators also use Darts for primary and acrobatic instruction.

A standard Model G Dart was flown at the National Air Race Aerobatic Exhibitions by Leonard R. Peterson, and amazed spectators by its maneuverability and inverted flight characteristics. The facilities and factory floor space were enlarged three times during the year to accommodate increasing business.

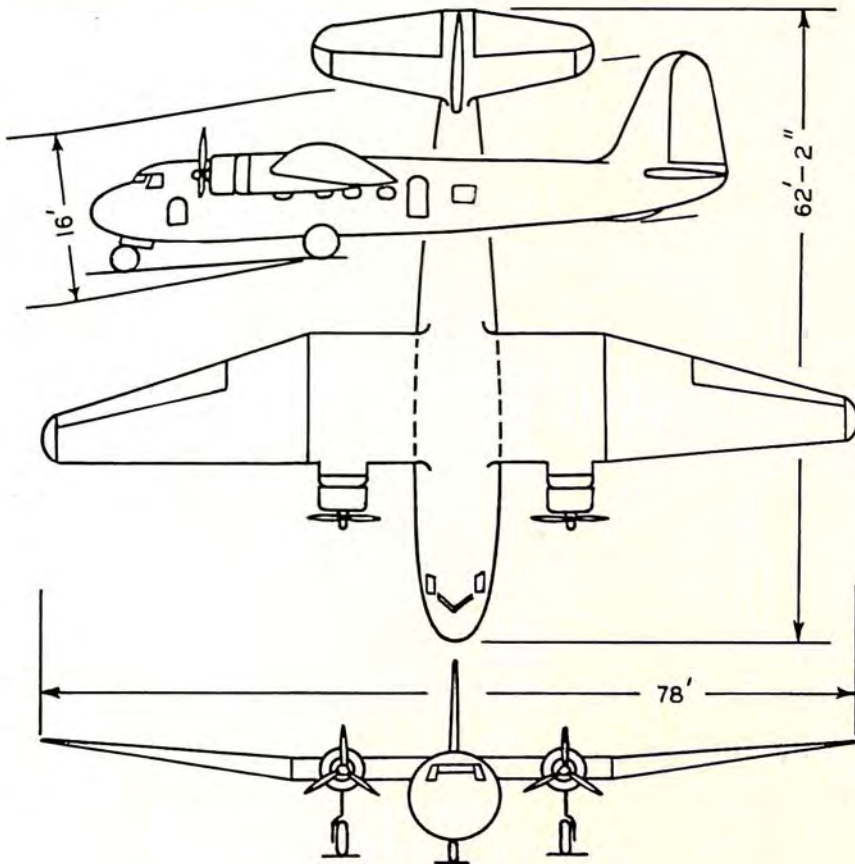
Distributors were appointed in the various distributing sections. The policies of the company remained unchanged for 1939. Experi-



mental and service testing of a higher powered airplane, the Dart Model I, is being conducted. Sales plans call for a more complete coverage of the United States, as well as for an active participation in the export trade.

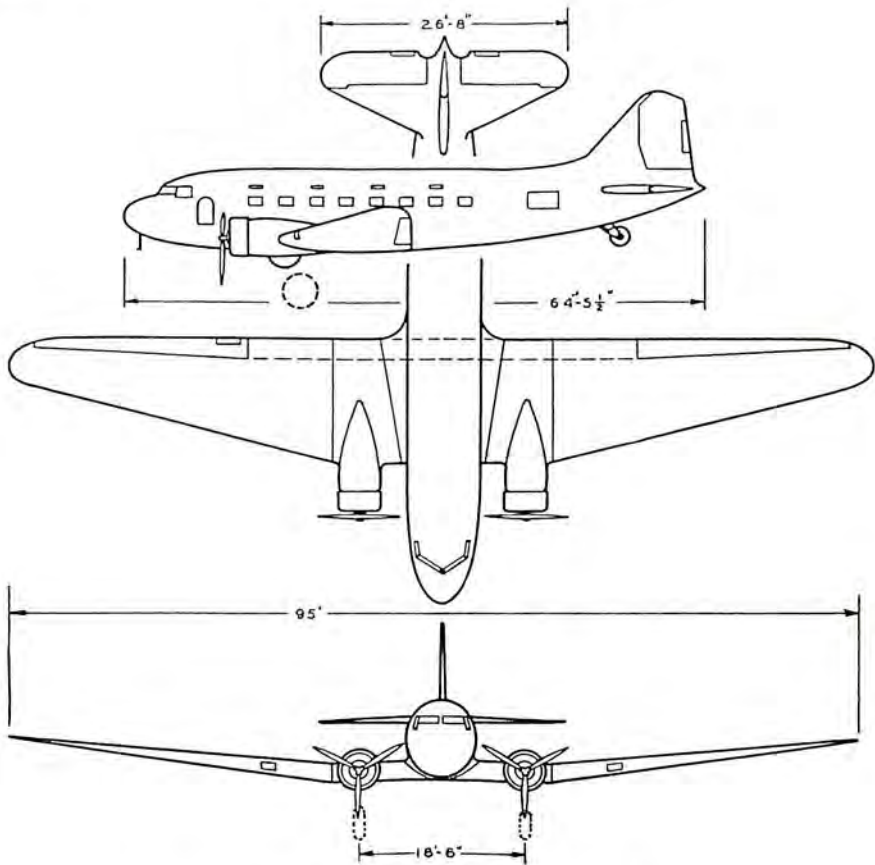
All the Model G Series of Dart airplanes are two-place, enclosed, low-wing airplanes. The variation in model designations distinguish the power plants. The plane has cantilever wings and tail surfaces, elliptically tapered wings and close coupled design. The side by side seating arrangement is standard on all models.

Douglas Aircraft Company, Inc., Santa Monica, Calif., had a backlog of nearly \$50,000,000 of well-balanced production in mid-year of 1939. With recent military orders added to those on hand, Douglas continued to stress its commercial field activities by bringing out new



THE DOUGLAS DC-5

A 16-passenger transport powered by two 1,200 h.p. Wright Cyclone engines.



#### DOUGLAS DAY-SLEEPER TRANSPORT

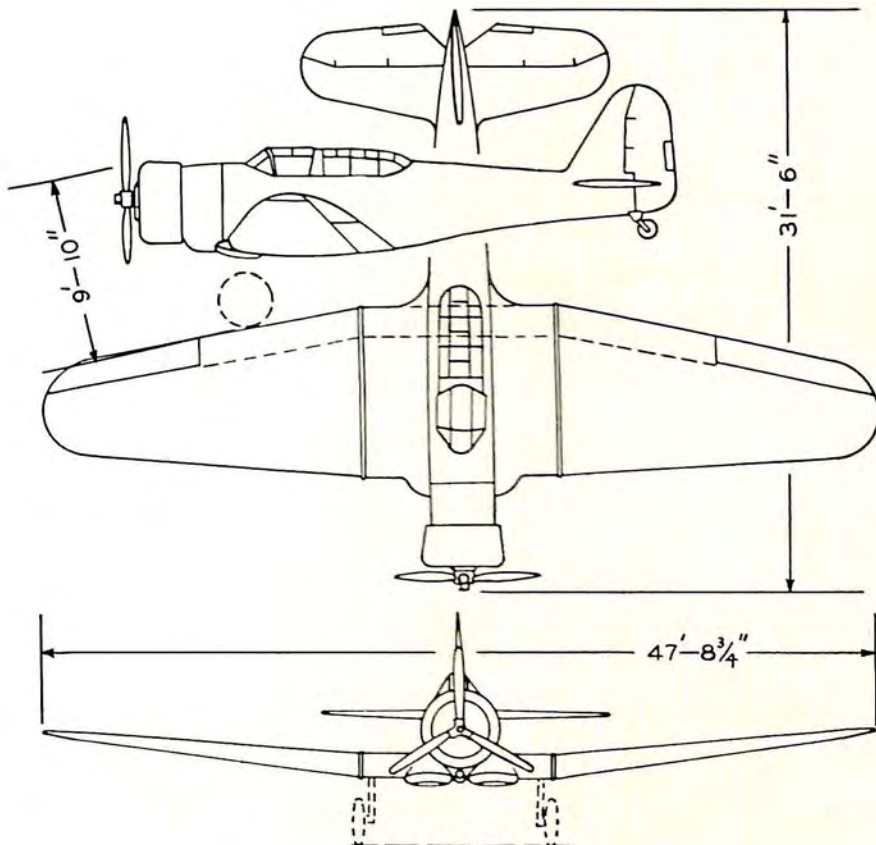
Available either as a 21-passenger day plane (DC-3) or a 14-place sleeper (DS-T) these planes are powered with two Pratt & Whitney Twin Wasps or Wright G-2 Cyclone engines.

types of planes to augment its transport models in use in the United States and on international air lines throughout the world. In addition to the current production of aircraft for the air services of the United States, the company was concentrating its efforts as the year progressed on the refinement and improvement of a medium sized bomber of the B-18 type for the Army Air Corps, and on the start of the \$15,000,000 order for an ultra-modern, high-performance, twin-engine attack bomber capable of speeds heretofore unattained in airplanes of its type.

Highlight of 1938 was completion of the DC-4, which received its approved type certificate on May 11 of that year. Immediately

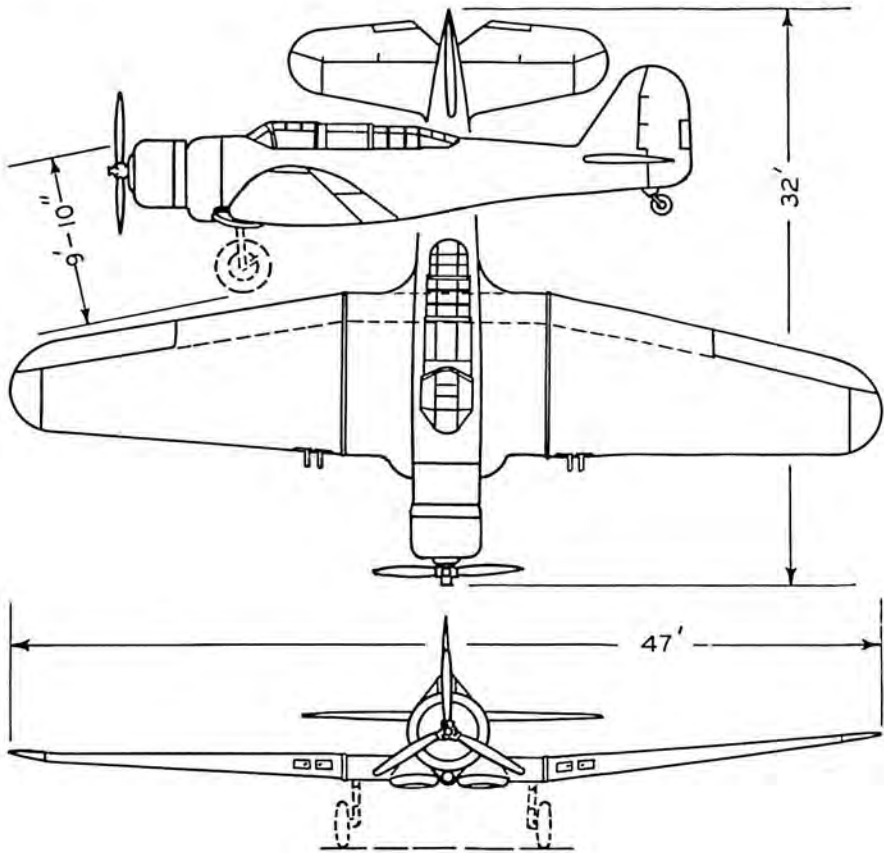
after obtaining its commercial license, the big transport made a service test flight and "good will tour" across the continent, stopping in the major cities for demonstration flights. As the result of this trip and of its remarkable performance, the DC-4 was widely acclaimed in the United States and in Europe as the outstanding development of its time.

Sharing some of the spotlight was its newer, but smaller sister, the DC-5. By the middle of June, 1939, three air lines had placed orders for twelve DC-5 airplanes, while many other air lines instituted inquiries and studies of this model's performance characteristics and its adaptability to their uses. Lines placing orders were KLM (Royal Dutch Airlines), Pennsylvania Central Airlines, and Scadta of Colombia, South America. The Dutch air line, which operates the longest



THE DOUGLAS DT-203

Powered by a Pratt & Whitney 550 h.p. engine.



DOUGLAS 8A-3P

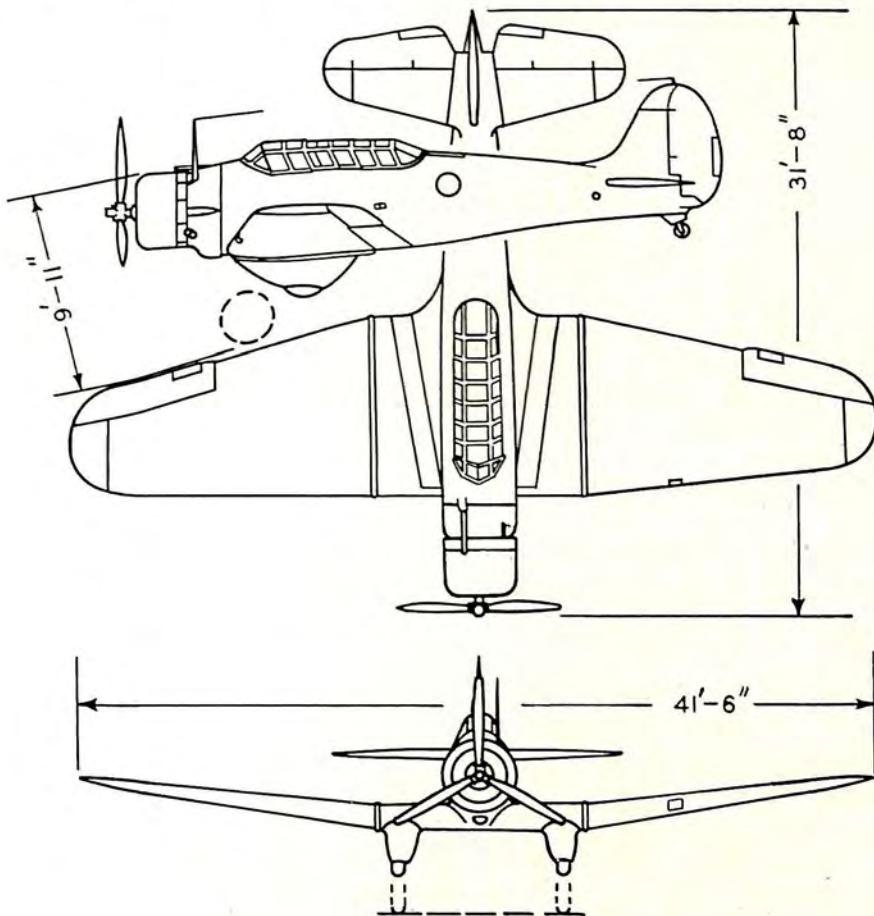
A two-place attack bomber with 860 h.p. Cyclone engine.

scheduled air route in the world from Amsterdam to Batavia and is the largest foreign user of Douglas equipment, had signed a contract for four. Pennsylvania Central Airlines' first order was for six, and the South American Line's for two.

The DC-4 is a 42-passenger (Crew-5), sleeper-transport. The production model weighs 66,500 pounds, has a wing span of 138 ft. 3 in. and an overall length of 97 ft. 7 in. As a night plane, the sleeper arrangement will accommodate 32. With its four Pratt & Whitney engines of 1,450 h. p. each, making a total of 5,800 h.p., it claims a cruising speed of 200 m.p.h. (65 per cent of power), has surpassed a top speed of 245 m.p.h., and can land at 70 m.p.h. Except for "Tri-Safety" (Douglas trademark) tricycle landing gear, which makes it

practical for present airports, tail assembly and power plants, the all-metal design and construction of the DC-4 follows closely that of the universally used DC-3. It represents the pooled experience of the Douglas Aircraft Company and five major air lines.

The DC-5 is a 16-passenger (Crew-3), high-wing transport with a gross weight of 20,000 pounds and a wing span of 78 feet. It is being presented with many different engine installations which will give it top speed between 235 and 250 m.p.h. The new transport was designed for feeder line operations, and for commercial flying over routes now only partly covered by transcontinental air lines. Its Tri-Safety landing gear and aerodynamic characteristics make the DC-5 an ideal air-



DOUGLAS DB-19

A two-place dive bomber with 750 h.p. Twin Wasp Junior engine.

plane for getting into and out of smaller fields heretofore deprived of high speed operations.

Typical Douglas production flowed from the two plants, the main plant at Santa Monica, and the El Segundo Division, under the general managership of Major Carl Cover and Edmond Doak, respectively. The commercial deliveries resulted from repeat orders of "old customers", both in the United States and Europe, and also from orders of new customers in those and other countries. In addition to the high quantity domestic military orders were those of Peru, France and the Netherlands governments. Conservative figures showed Douglas commercial transports were flying more than 350,000 miles daily over 58 countries of the world. The universal demand for the company's DC-3 models continued in 1939, during which time delivery of the 350th transport was made. In this number is represented the 139 14-passenger DC-2's and a total of 150 -2's and -3's in foreign service. Improvements and new developments incorporated in the DC-3's, together with their basic design, have been responsible for the success and continued manufacture. In addition to installing the newer Wright G-102A and G-103A engines and the Pratt & Whitney 1830-C's, the DC-3's were fitted with hydromatic full-feathering propellers.

The latest Douglas engineering improvements were new oil tanks, spherical pressure tanks for the hydraulic system, landing gear hydraulic struts, floor panels and heating system boilers, all designed to give better service. The duralumin inner cowl rings were changed to stainless steel, and a newer and more efficient fuel dump valve system was installed. There were numerous detailed changes, many of which were originated by the operating air lines. Two of the new DC-3 customers in 1939 were Canadian Colonial Airways and Northwest Airlines.

In its 1,400,000 square feet of floor space the Douglas Aircraft Company was employing more than 700 engineers and 7,100 shop and office workers, whose average monthly payroll was nearly one million dollars.

Research and engineering development continued to be among the foundation stones of Douglas policies. In the first quarter of 1939 the corporation spent as much on perfection of its product and air development of new models as it set aside for profits. In the last two years more than \$2,000,000 was spent for that purpose.

During the last ten-year period it spent approximately \$7,000,000 in developing its experimental models. These expenditures represent the total accumulated cost of thirty-one experimental airplanes. It gave the world some of its most efficient airplanes and brought to Douglas universal acclaim.

The El Segundo Division added another modern structure to its plant. The new building is 120 x 340 feet and adds 62,800 feet to the division's working space.

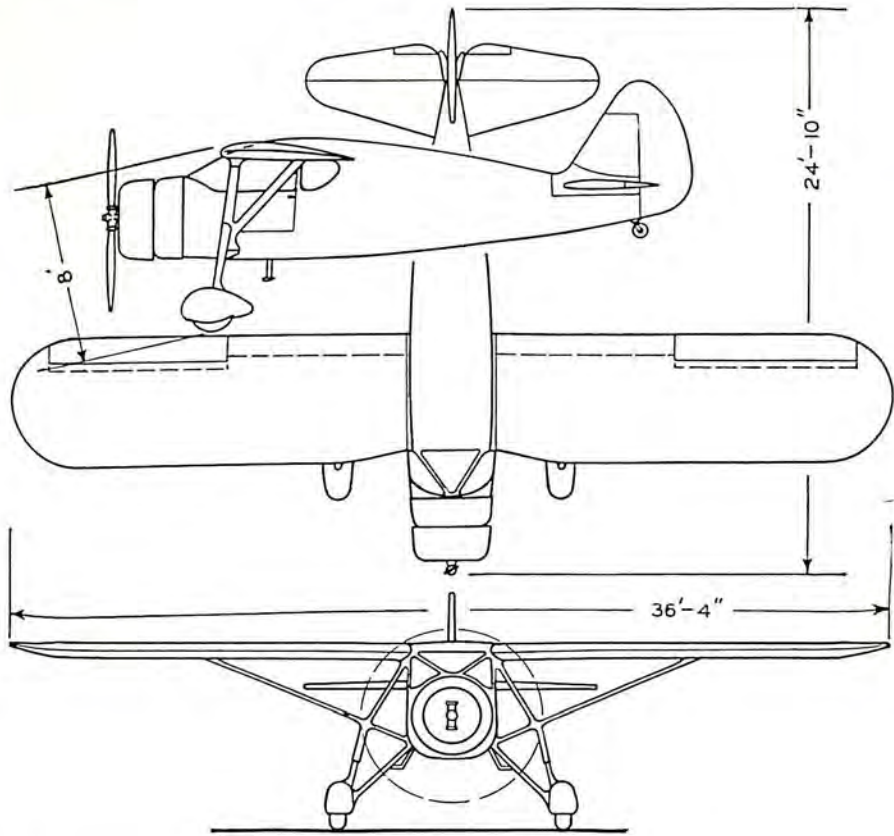
In foreign business the company opened some new fields. The order for French high-speed attack bombers was well under way by mid-summer. Three 8A-3P low-wing attack bombers, capable of a 250 m.p.h. top speed, last of an order for Peru, were flown away from the company's plant by Peruvian Air Mission officers, establishing a record of 24 hours and 45 minutes for the 4,790 miles, averaging well over 190 m.p.h., and blazing new trails in friendly commercial relations with a South American neighbor republic. Another significant flyaway delivery was that of a DC-3 for Air France, sold through the company's European agent, the Fokker Company, for use in South America over the trans-Andean route of the French line. The airplane, powered with Wright G-102 Cyclones, was flown from Santa Monica via El Paso, Brownsville, Texas; Mexico and Guatemala cities; Canal Zone; Lima, Peru, and Valpariso, Chile; to its operating terminal, Buenos Aires.

Fairchild Aircraft Corporation, Hagerstown, Md., in 1938 sold 123 Fairchild "24's". Twenty-three ships were delivered to the Bureau of Air Commerce which has since been replaced by the C. A. A. These ships are now being used by inspectors and officials of the C. A. A. An interesting sidelight in connection with the purchase of these 23 airplanes is the fact that the Fairchild Corporation was the sole bidder.

In 1938 more "24's" were exported than in any previous year. One customer alone, the Aerial Transport Company of Siam, purchased 6 Warner-powered "24's" for use in hauling air mail and express to the remote regions of the kingdom. Other export sales went to Haiti, South America, Alaska, France and South Africa.

In 1939 no changes were made which affected the ship aerodynamically. It is still a 4-place airplane with the same performance, empty and gross weights and the same handling characteristics. The 1939 improvements consist principally of changes in the landing gear oleo, tail wheel and incidental refinements. Hydraulic brakes have been substituted for the mechanical. The steerable full-swiveling tail wheel adds to the ease of ground control. A choice of Plexiglas or Safety Glass windows is optional. The instrument panel incorporates more room for radio equipment.

In addition to the continuation of the "24" production, Fairchild was developing an entirely new ship. It is known as the M 62. This is a low-wing tandem-seat Ranger-powered airplane designed according to United States Army specifications for primary training purposes. The airplane is at present in the experimental flight stages and



THE FAIRCHILD 24

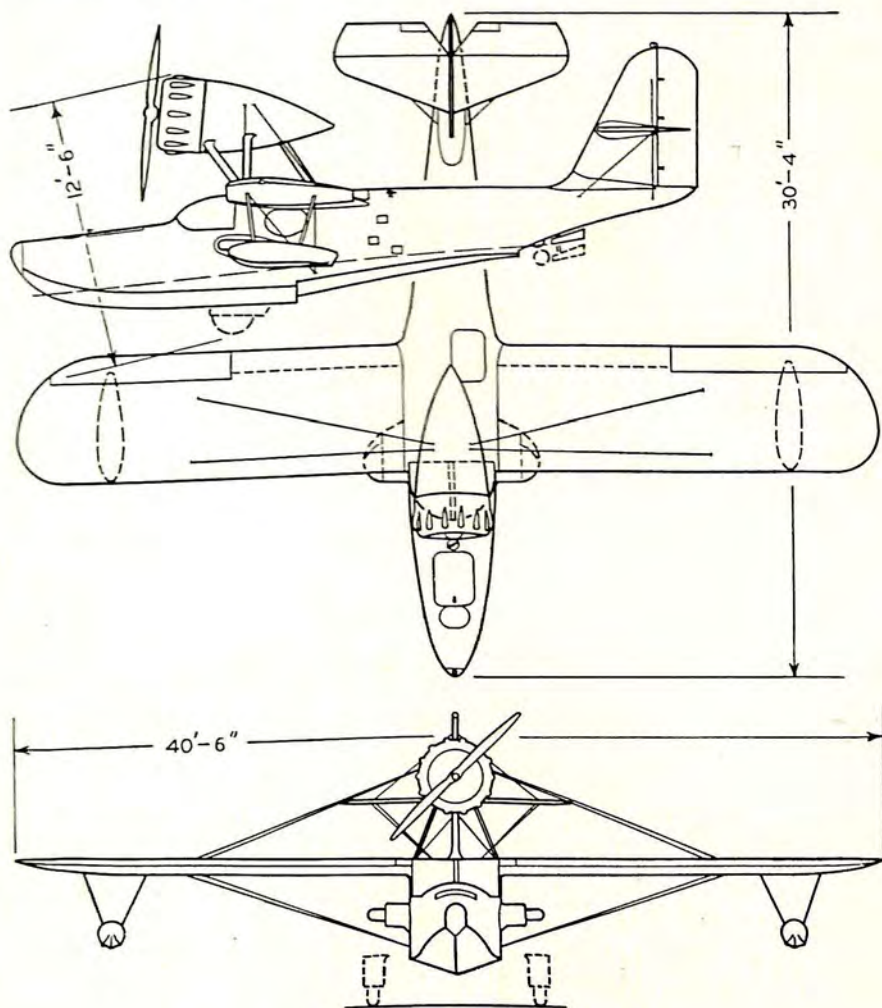
A private owner plane with Warner or Ranger engine. Above is Warner installation.

details of its performance are not yet available. It can be generally stated that the purpose of this type of trainer is to furnish something which even in the primary stages will enable the student to become accustomed to the general type of airplane, flight characteristics and technique necessary to the flying of basic trainers and advanced military airplanes which are practically all of the low-wing type.

Fleetwings, Incorporated, Bristol, Pa., has continued to add to the features of its stainless steel Sea Bird amphibion Model F5. It is now licensed to use a two-position Hamilton Standard variable-pitch propeller, and it is likewise licensed to seat four or five people. It is powered by a Jacobs engine. During the past year the ship has been demonstrated from Jamaica in the West Indies to Ottawa in Canada, and from Long Island in the East to Los Angeles on the West Coast.

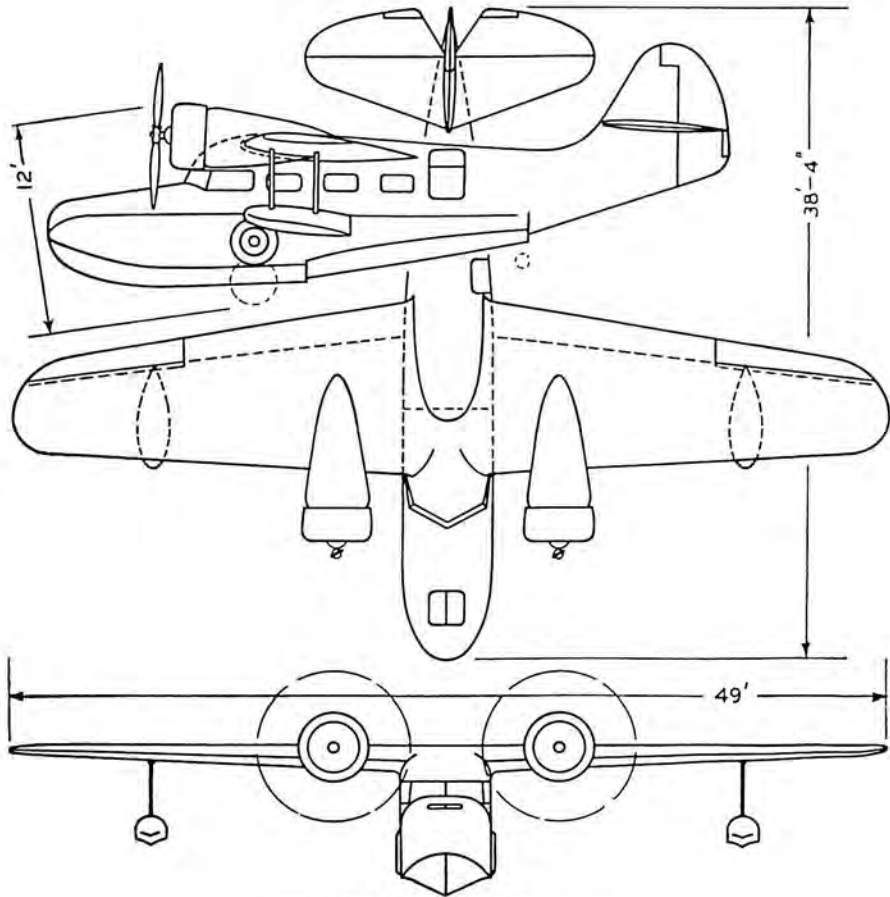


Grumman Aircraft Engineering Corporation, Bethpage, N. Y., continued building single-seat fighters and utility amphibions for the U. S. Navy. Delivery was completed on an order for 81 F3F-2 single-seater fighters and work has begun on an order for 27 additional single-seaters designated as F3F-3. The F3F-3 is similar to the F3F-2 except for improved performance achieved through design refinement. Delivery was completed on contracts for 30 J2F-2 utility amphibions for the U. S. Navy and a repeat order for 20 more has been



THE FLEETWINGS SEABIRD

It is powered by a Jacobs engine.



GRUMMAN G-21 AMPHIBION

An eight-place machine with two Pratt & Whitney Wasp Junior engines.

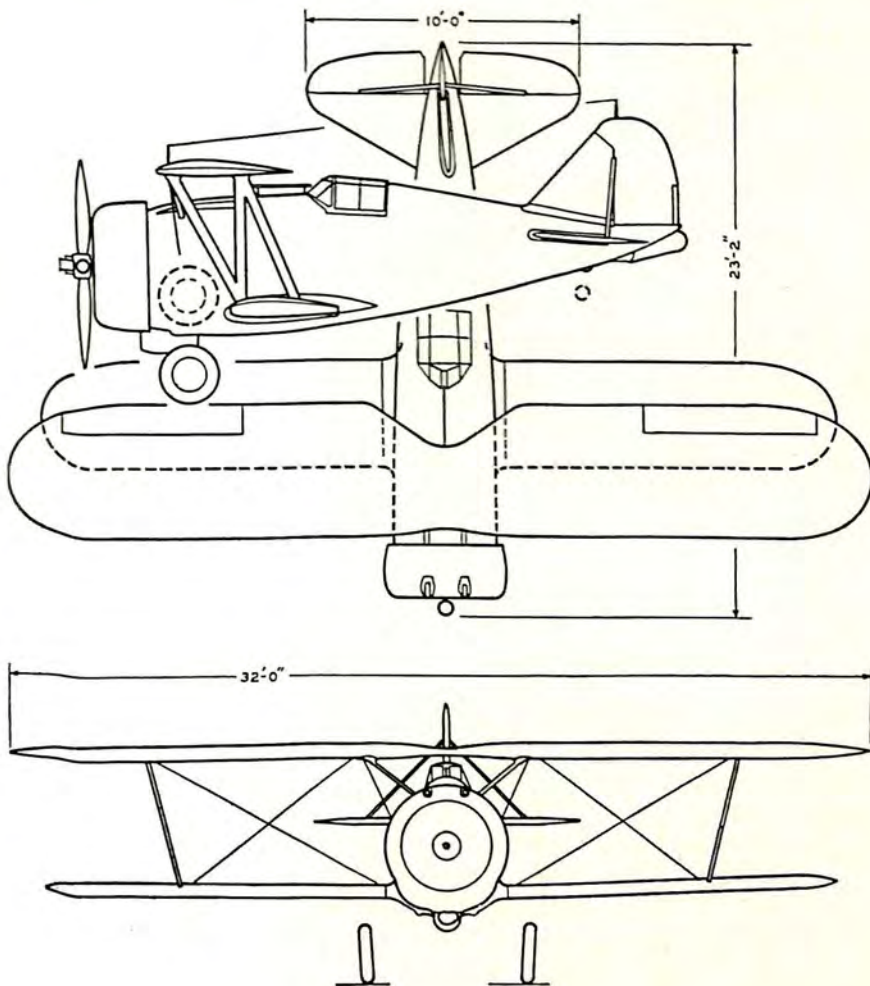
received. Nine additional commercial G-21A's were delivered, making a total of 20 now in service. A modified version of the G-21A, designated as the XJ3F-1 was delivered to the U. S. Navy. Work has begun on another version of the G-21A, designated as the OA-9, 26 of which have been ordered by the Army Air Corps. One G-32, a high performance two-seater, has been delivered to Major Al Williams, and one G-32A has been constructed to demonstrate Grumman single-seater performance. Work is now in progress on two experimental single-seaters for the U. S. Navy.

The Grumman G-37, an export version of the Navy F3F-2 single-seater, is available for export. This plane is believed to be the fastest biplane built and possesses exceptional maneuverability.

The Gwinn Aircar Company, Buffalo, N. Y., at the end of 1938 was engaged in developing a two and three-place light airplane with tricycle landing gear and the aerodynamic control features of the original Gwinn biplane aircar.

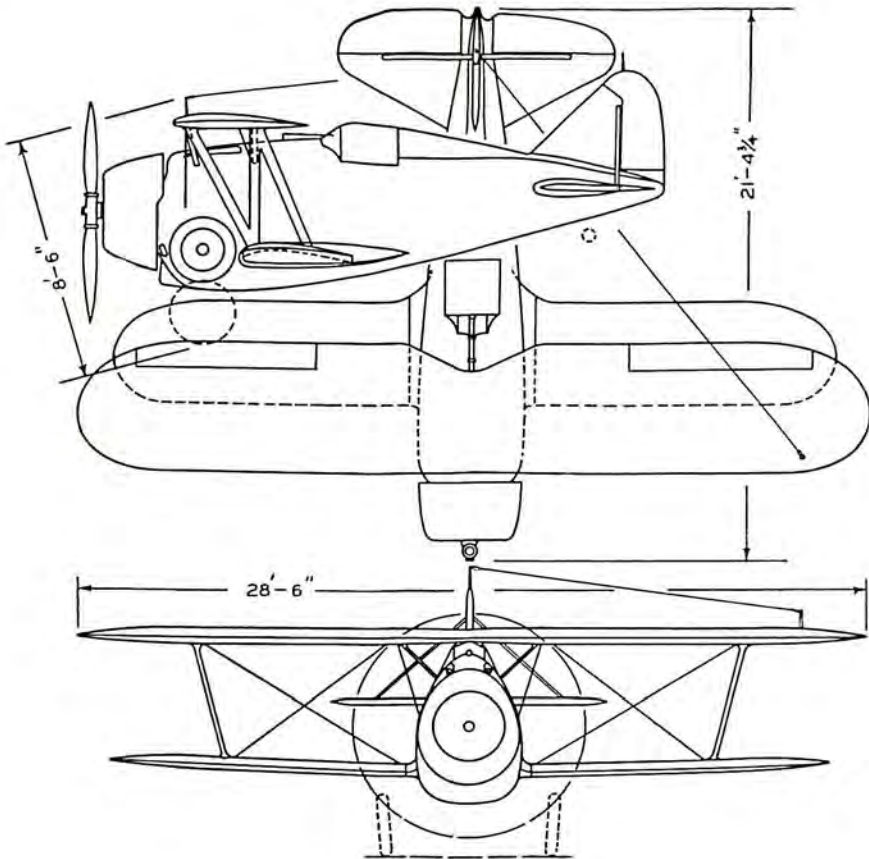
Harlow Engineering Corporation, Alhambra, Calif., produced the Harlow PJC-1, a two-place commercial monoplane powered by a 145 h.p. Warner Super Scarab engine. It had retractable landing gear.

Howard Aircraft Corporation, Chicago, Ill., produced its DGA-



GRUMMAN G-37

A single-seat fighter with a Wright Cyclone 750 h.p. engine.

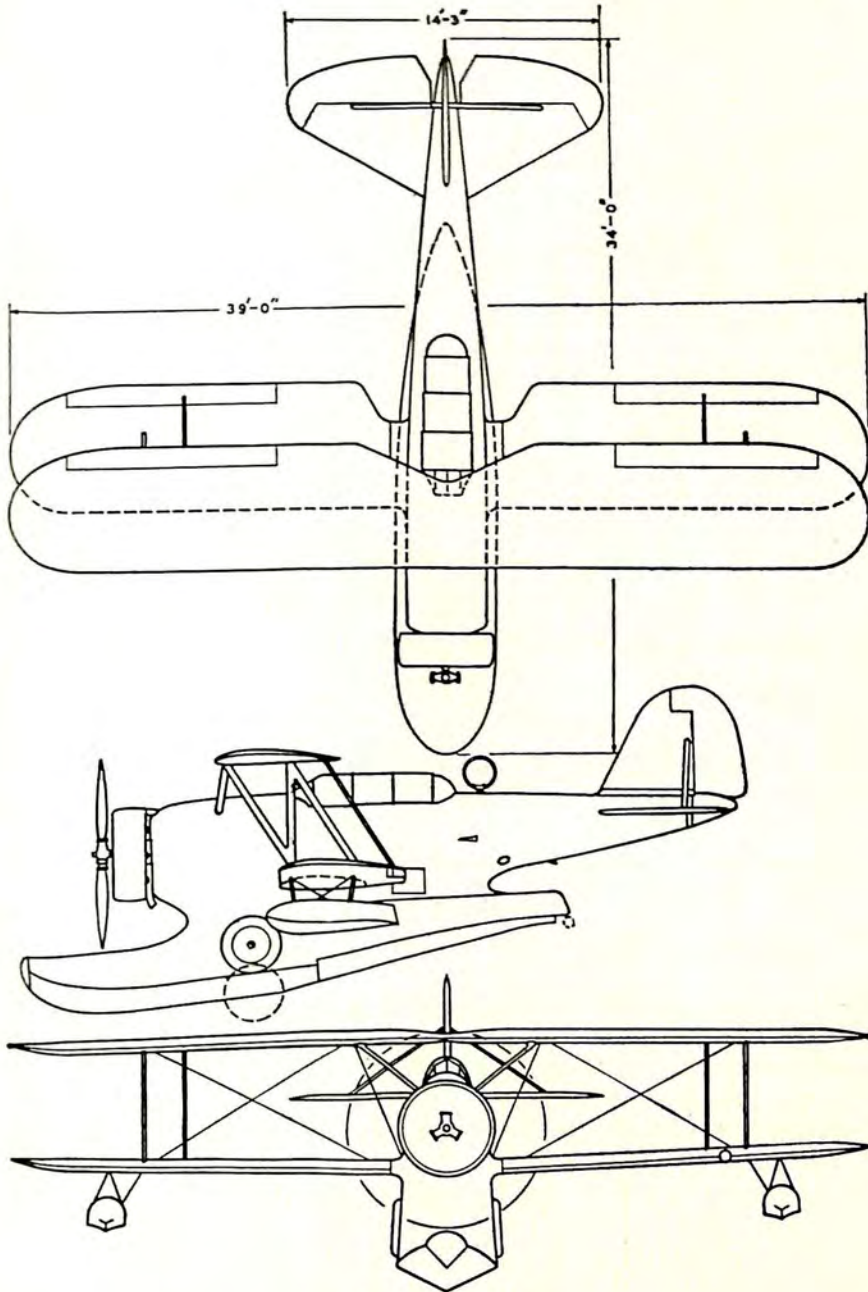


GRUMMAN F-2F-1

A one-place fighter with 650 h.p. Wasp Junior engine.

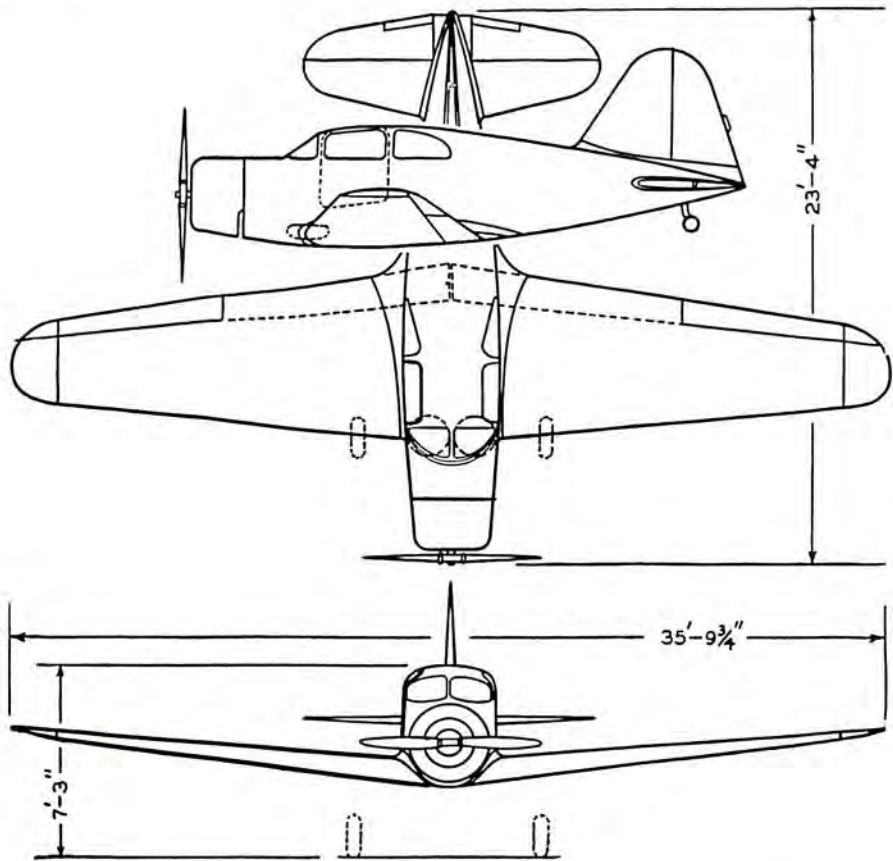
15PC and DGA-15WC models, powered by Wasp Jr. and Whirlwind engines respectively.

Kellett Autogiro Corporation, Philadelphia, Pa., anticipated many advances in the rotary-wing aircraft field during 1939. In June, 1938, Congress voted \$2,000,000 for concentrated development of giro-type flying craft, and it was believed that this program, embracing interest of a score of Federal departments and bureaus, would reach full scope during the coming months. YG-1B direct-control military autogiros constructed by Kellett were in Air Corps use. Improved military models for observation and liaison missions were in the design stage as an extensive production program got under way. During 1938, seven deliveries were made to the Air Corps.



GRUMMAN J<sub>2</sub>F-1

A two to four-place military plane powered with a Wright Cyclone 775 h.p. engine.



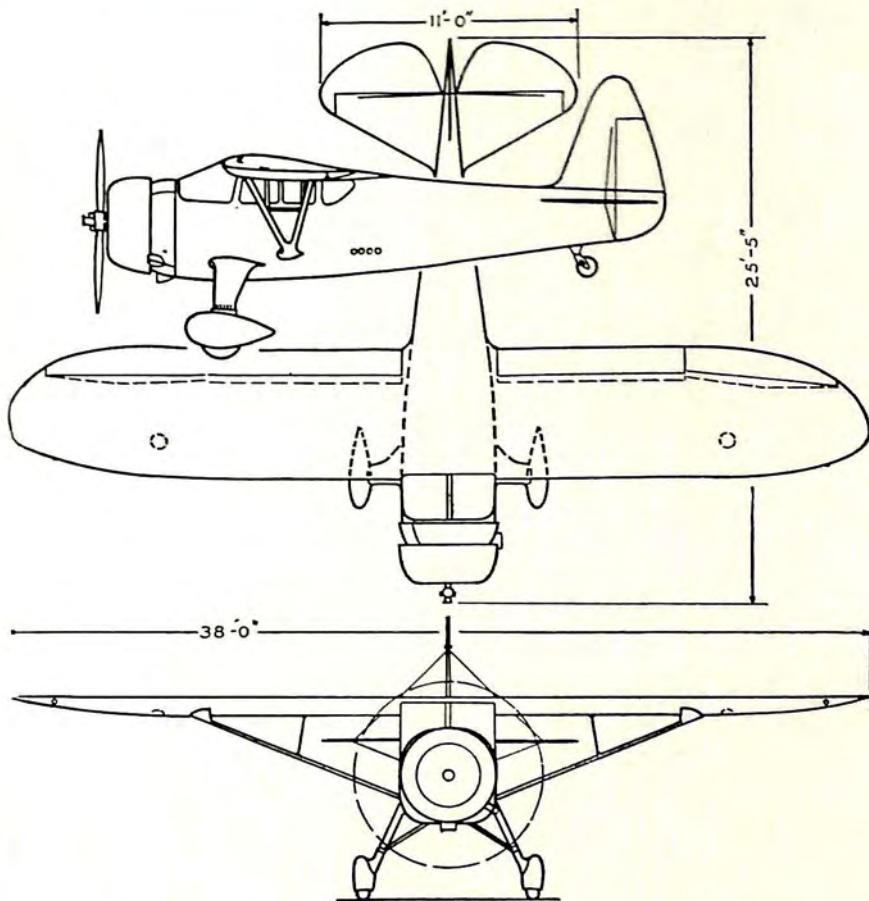
THE HARLOW PJC

A two- to four-place plane with Warner Super Scarab engine.

Design of the Kellett KD-1B commercial-express model was introduced in connection with the operation of the Philadelphia-Camden, N. J., autogiro mail shuttle line, which was to start service to and from the roof of the Philadelphia General Post Office about mid-summer. Mail will be carried from the Central Airport, at Camden, the air mail field for the Philadelphia area. The KD-1B model, one-place with a large mail or express compartment, will be offered for commercial uses in addition to the proposed extension of the mail-shuttle service to other cities. It is also suitable for feeder-express operations. It is a modification of the successful U. S. Army Air Corps' YG-1A (KD1A) type.

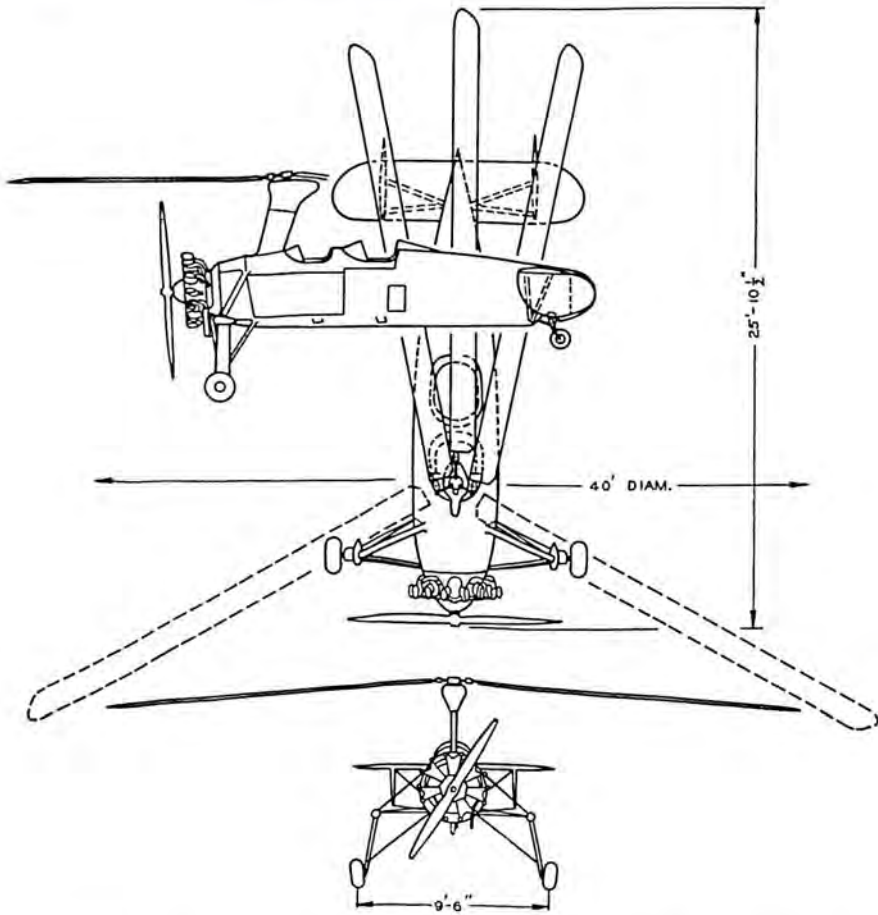
The Lockheed Aircraft Corporation, Burbank, Calif., at the end

of 1938 reported that for the previous twelve months, it had made deliveries of its commercial models, Lockheed Electra, Lockheed 12, and Lockheed 14 to air lines, private purchasers and corporations throughout the world, and had begun delivery of a fleet of high-speed reconnaissance bombing planes for the British Air Ministry. For the period ended Dec. 31, 1938, the company experienced a record sales volume of \$10,274,503, and saw its employment soar to more than 3,000. Floor area of the factory had been expanded to more than 320,000 square feet; and it was expected that early in 1939 production facilities would be keyed to a delivery schedule of at least one plane a day. This would be necessary, officials said, to complete orders on



HOWARD DGA-11

A four-place plane powered with a 450 h.p. Pratt & Whitney Wasp Junior engine.



KELLETT KD-1

A two-place autogiro for private operations powered with Jacobs engine.

the books totalling more than \$30,000,000. New types developed during 1938 included the Lockheed B-14, Lockheed 212 and the Lockheed XP-38. The latter was a twin-engine interceptor pursuit built for the U. S. Army Air Corps.

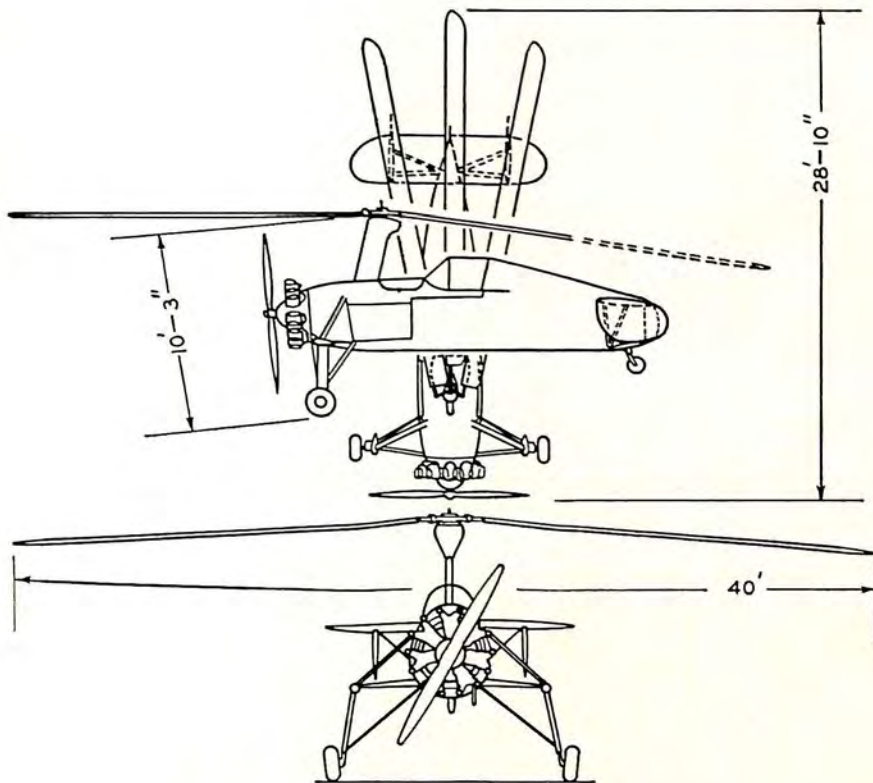
The "B-14" is a twin-engine reconnaissance bomber similar in design to the commercial Lockheed 14, but is reputed to have even greater performance and improved flying characteristics. This model was being manufactured at a record pace at the turn of the year and rapid deliveries were being made to the British Air Ministry. The "212" is an all-purpose military conversion of the 6-passenger Lock-



heed 12 commercial model. A dozen of these twin-engine, all-metal fighters were ordered by the Colonial Government of the Netherlands East Indies to be delivered early in 1939.

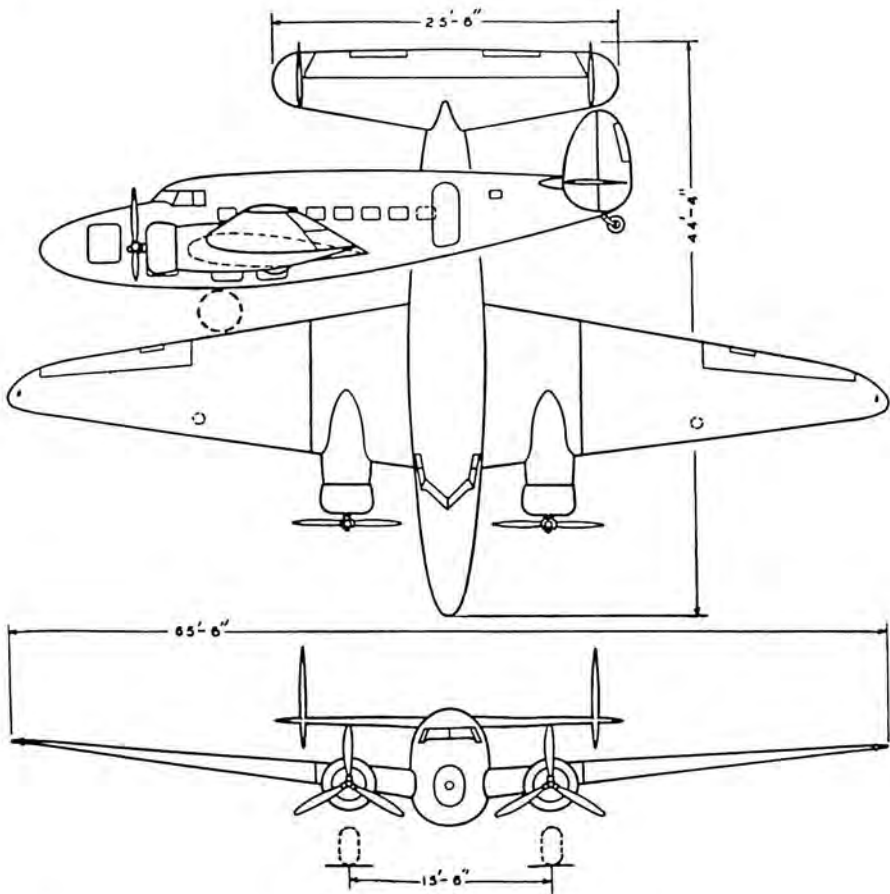
The Lockheed 14 remained the company's most popular commercial model; and deliveries of this type were made to Australia, Royal Dutch Air Lines, Royal Netherlands Indies Airways, Polish Air Lines, Trans-Canada Air Lines, "Lares" Air Line of Rumania, British Airways, and many private owners, including Howard Hughes, who flew his Lockheed 14 around the world in July in the record-breaking time of 91 hours.

The Lockheed 14 is described as an all-metal, twin-engine transport type providing luxurious accommodations for 11 passengers, two pilots and a stewardess. At each of the passenger seats is a reading light, ash receptacle and push button for calling the stewardess. Ex-



KELLETT KD-1B

It is powered by a 225 h.p. Jacobs L-4MA engine.



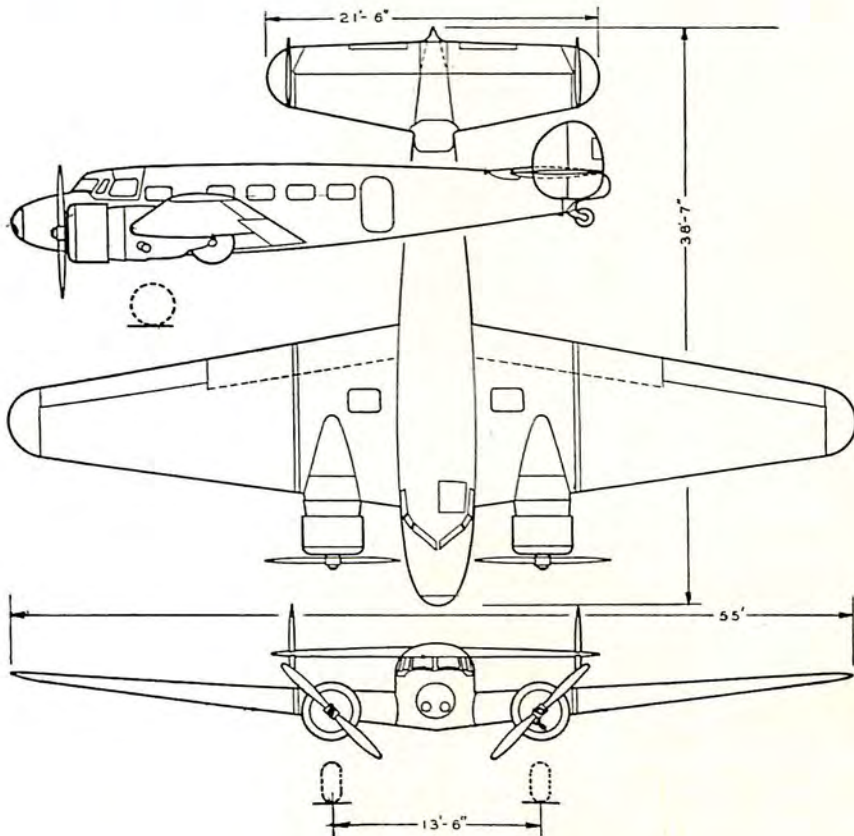
#### LOCKHEED 14

This 14-passenger transport is powered with either two Pratt & Whitney Hornets or two Wright Cyclone engines.

tra-large windows provide maximum vision for every passenger. Overhead, a rack extends lengthwise on each side of the cabin and provides space for carrying wraps and small packages. Space for baggage, mail and express is available in the fuselage, nose compartment and three supplementary compartments located below the passenger cabin. This baggage arrangement was made possible by the mid-wing design and construction of the Lockheed 14. The cabin is sound-proofed, air-conditioned and heated. The Lockheed 14 has a provision gross weight of 17,500 pounds, is equipped with hydraulically operated retractable landing gear and is designed to accommodate any

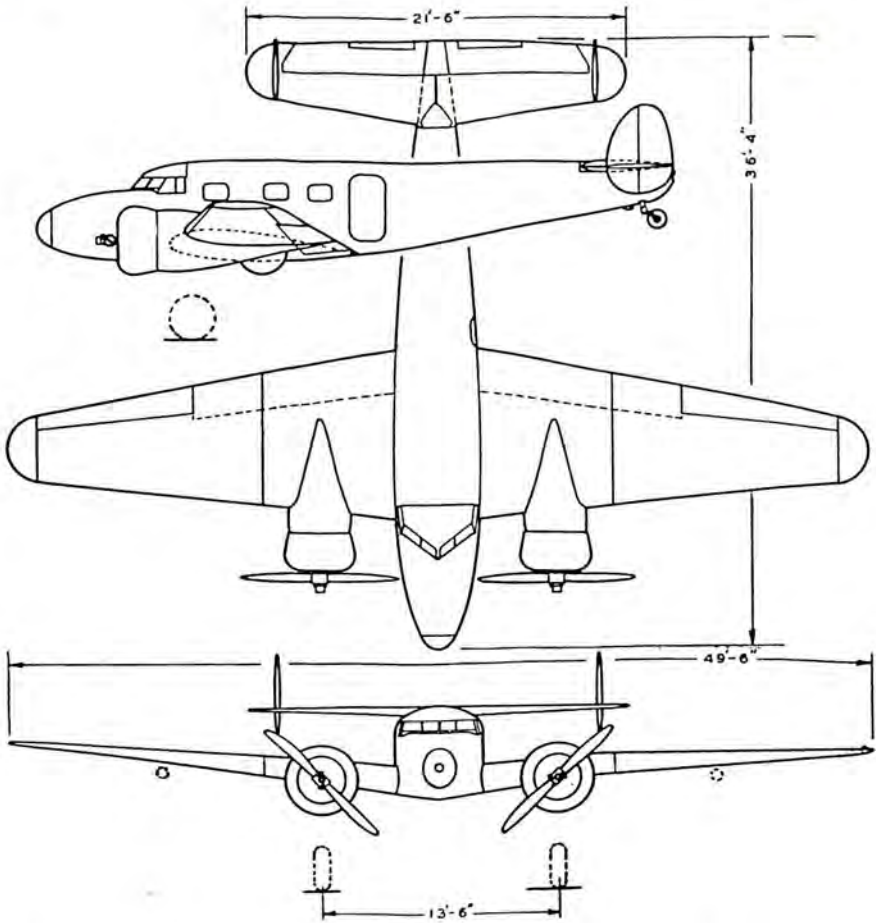
of the commercial radial engines up to 1,000 horsepower. Pratt and Whitney Hornet and Wright Cyclone engines are normally supplied with this type.

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. The principal effect of those flaps is to increase the maximum lift coefficient without increasing the vertical sinking speed. The flaps also permit shorter take-offs with steeper climb after take-off for clearance of obstacles. This increase in lift is not accompanied by 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



LOCKHEED ELECTRA

A 12-place, twin-engine transport, powered with either two Pratt & Whitney Wasp engines or two Wright Whirlwinds.



LOCKHEED 12A

An eight-place, twin-engine transport with a choice in power plants including Wright Whirlwinds, Pratt & Whitney Wasp Juniors and Menascos.

load for a given wing area. 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.

Late in 1938 Lockheed's subsidiary, Vega Airplane Company, Burbank, Calif., announced a new airplane, as follows: "Known as the Vega, the plane will be a low-wing monoplane carrying five to six persons, and will generally qualify for the requirements of current air line transports. It will be metal structured and have a dual

engine power plant unit mounted in the nose of the fuselage and geared to a single constant speed propeller.

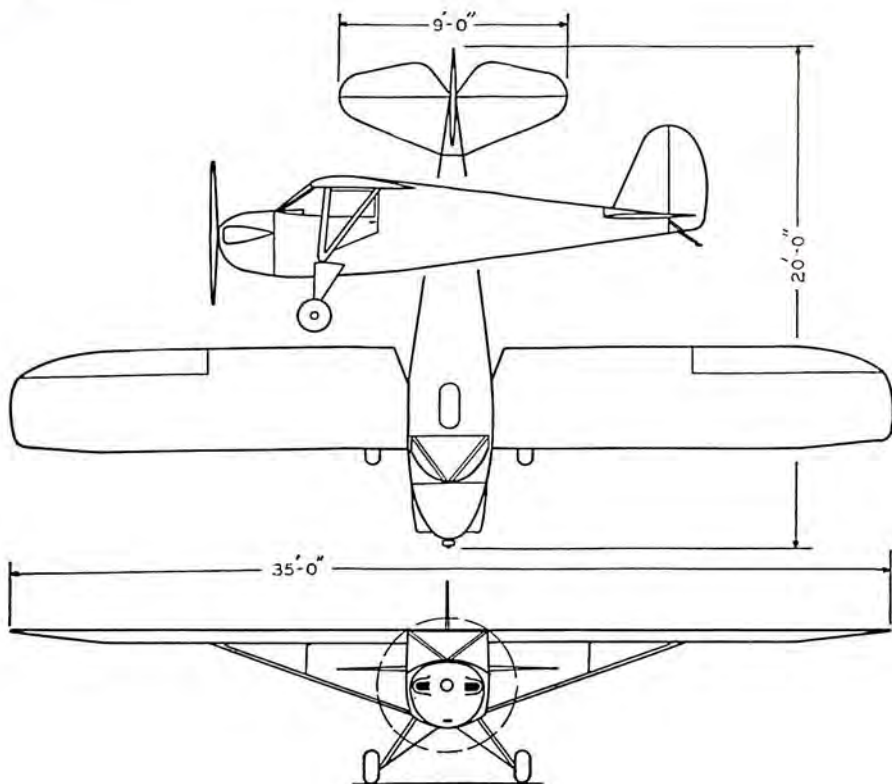
"Wing span of the new plane will be 41 ft. Overall length will be 31 ft. 5½ in., and the plane will be 9 ft. 1 in. in height. Estimated gross weight is 5,411 pounds. Retractable tricycle landing gear will be a feature of the plane. The Vega airplane will follow the general trend of the Lockheed transports produced by the parent company, and will utilize trailing edge wing flaps, twin rudder-and-fin tail arrangement and other advanced aerodynamic features.

"The Unitwin power plant consists of two Menasco engines of 260 h.p., each mounted side by side, and driving a single constant-speed propeller through a new method of gearing. The gear arrangement embodies over-running clutches which operate on the same plan as the overdrive installations in modern automobiles. Through this arrangement close synchronization of the two engines is unnecessary, as they continue to run at the same speed even though the power output of one may be exceeding the other. Likewise, if one engine should stop, the other engine does not have to work against the inertia of the dead engine. Another feature pointed out by the officials of the company is the fact that by placing both engines in one center compartment, excessive drag from the wing nacelles is almost entirely eliminated.

"The body structure of the plane will consist of two main sections. The forward section will be constructed of steel tube truss upon which is mounted the cabin shell fabricated from aluminum alloy. The rear section of the body will be a semi-monocoque structure of aluminum alloy and will be attached to the steel tube structure aft of the cabin. The power plant will be supported by a welded steel tube engine mount removable from the forward structure of the cabin.

"The wing will be of metal and there will be two main panels bolted directly to the fuselage truss. With this arrangement there will be no center section in the airplane. Wing flaps of metal structure and fabric covered will be provided in each wing panel, and in addition, there will be a center section flap of split-type metal construction. Ailerons will be fabric covered, with static and dynamic balances. The tail group will consist of an all-metal stabilizer, fabric covered elevator equipped with a trimming tab for maintaining longitudinal balance, and twin vertical metal tail surfaces mounted at the tips of the stabilizer.

"The tricycle landing gear unit will be retractable, the two main wheels being retracted into the wings, while the nose wheel will be retracted into the engine compartment. Even when retracted, all three wheels will still provide for emergency landing.



LUSCOMBE 50

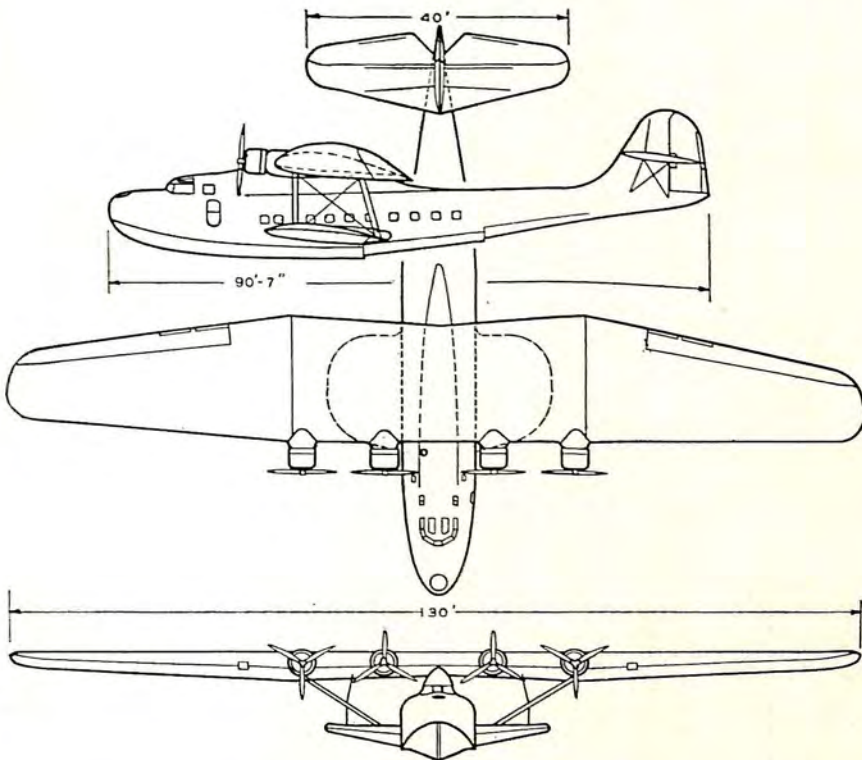
A two-place plane powered with a Continental 50 h.p. engine.

"The cabin is designed after the manner of the modern automobile, two different cabin styles being produced. The custom or private owner version will provide commodious comfort for five persons while the feeder air line version provides accommodations for pilot and five passengers. The cabin will be sound-proofed, heated and ventilated. The main baggage compartment will be located below the rear seats, and may be loaded through an exterior door in the side of the cabin. Mail may be carried in the wing adjacent to the cabin."

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 ceil-

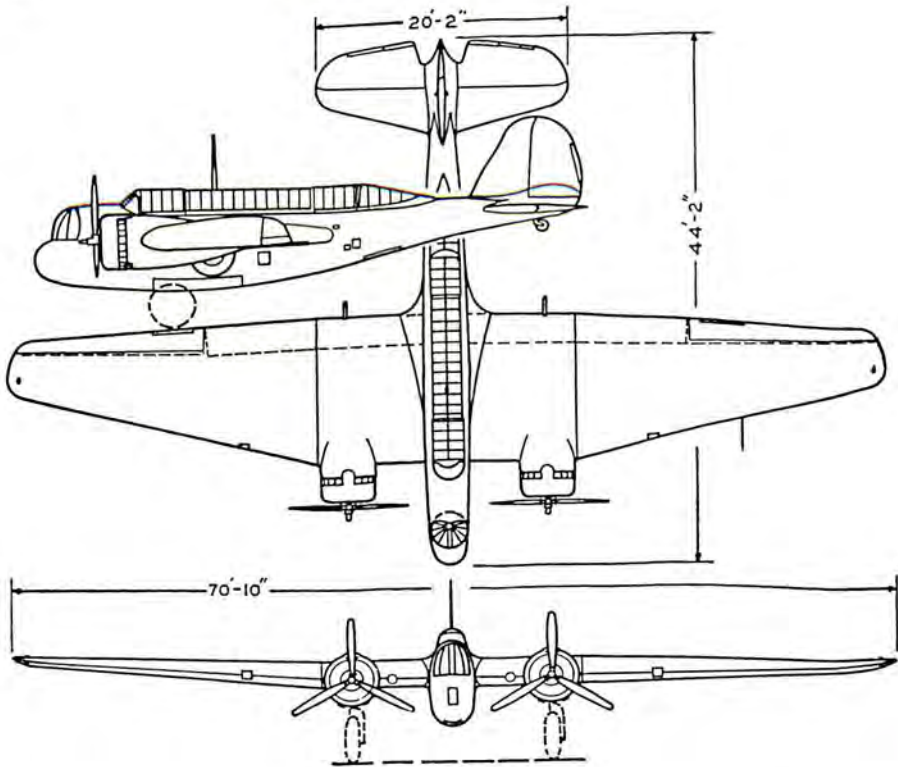
ing 19,000 feet and range of 650 miles, landing speed 45 m.p.h., and cruising speed of 140 m.p.h. The company produced a smaller ship similar to the Phantom in construction, a two-place high-wing all metal cabin monoplane, with a light weight of 1,100 pounds and a useful load of 625 pounds, stated top 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 1939 was producing several models for military service. The Martin 166 was a two-engine bomber, wing area 678 sq. ft., gross weight 16,000 lbs., stated high speed of 260 m.p.h., cruising at 200 m.p.h. and optimum altitude of 18,500 ft. Other Martin aircraft included the 156-C, a 33 to 53 place flying boat powered by four Wright Cyclone engines of 850 h.p. each at 2,100 r.p.m. at 5,800 ft. The company also produced the XPBM-1 patrol bomber for the U. S. Navy.



MARTIN 130

A 50-place commercial flying boat powered with four Pratt & Whitney Twin Wasps.



**MARTIN 166**

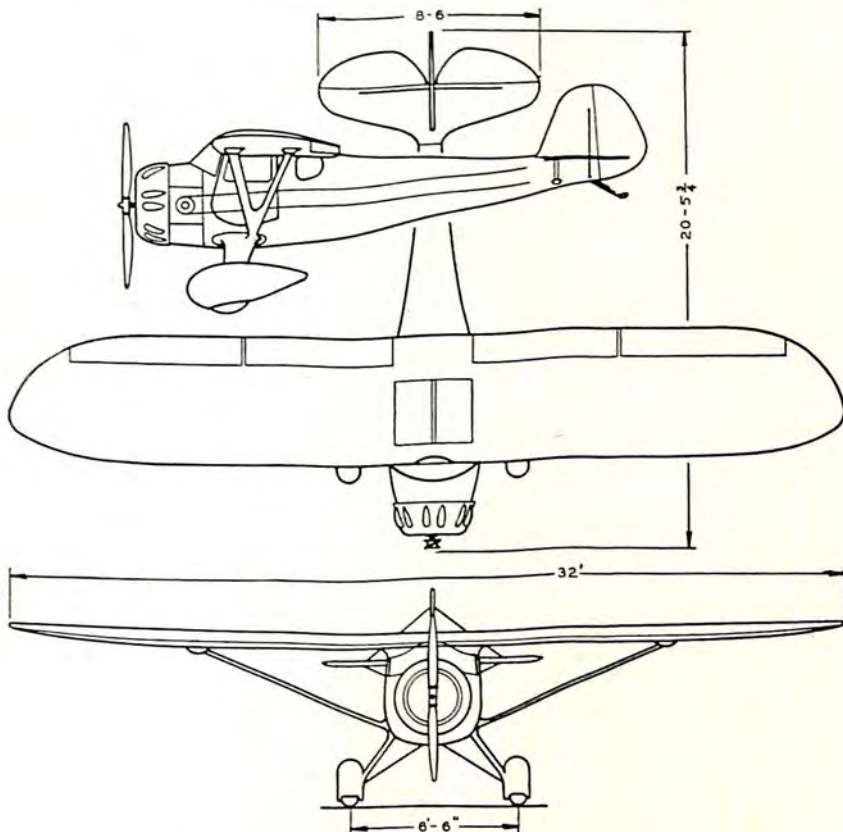
This bomber carries a crew of four, and may be powered with two Wright Cyclones of 850 h.p. each, or two Pratt & Whitney Wasps of 1050 h.p. each.

Monocoupe Corporation, Robertson, Mo., reported 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.

North American Aviation, Inc., Inglewood, Calif., delivered and built many new planes, and developed a system of rapid production. Setting new records for peace time production by delivering 60 airplanes for both the months of August and September, 1938, the

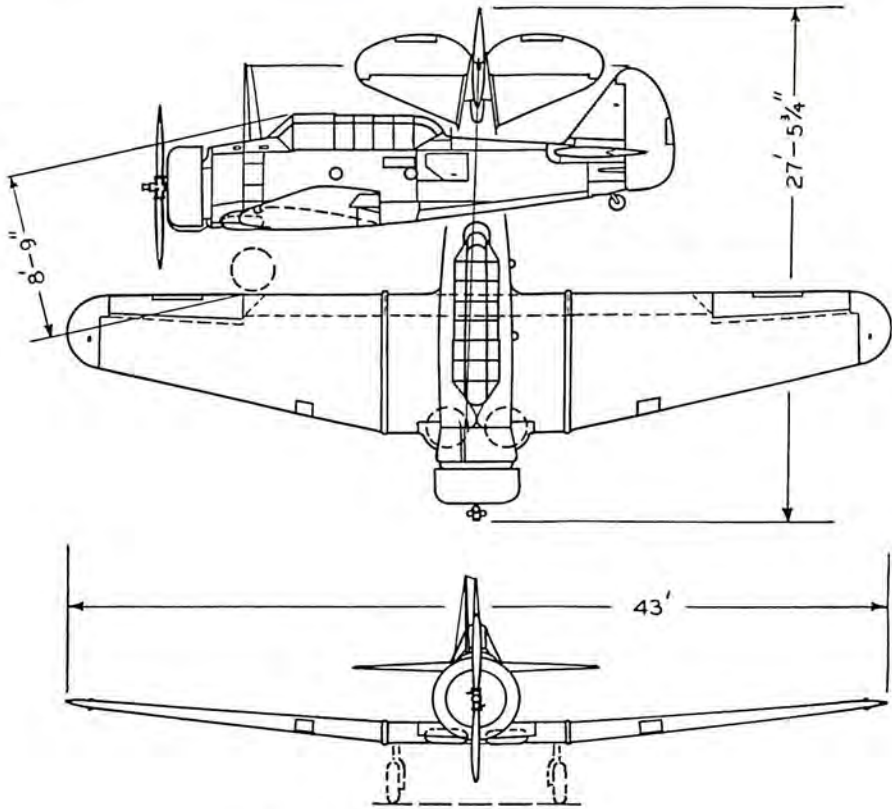


company maintained its fast output, and in the early part of 1939 six different models were in scheduled production. Facilitating North American's rapid output during 1938, was the addition of a new building approximately 400 feet long to house the shipping department, wood shop, material preparation department and storage of material and supplies. A new unit was also built to provide for a tool design room, and, with the addition to the main office building, the total floor space of the plant approximated 500,000 square feet at the end of 1938. The plant proper is approximately 300 ft. x 750 ft., with an unobstructed assembly floor from one end of the plant to the other. Large mezzanine floors are located on both sides where sub-assembly work is accomplished, and parts from these floors are fed



MONOCOUPÉ

This deluxe two-place cabin plane built by the Monocoupe Corporation is powered with a Lambert R-266, 90 h.p. engine.



NORTH AMERICAN NA 16-3

A two-place fighter with Wright Cyclone engine.

to the main floor by overhead monorails. A separate unit houses the drop hammers and one of the largest hydraulic presses used in the aircraft industry.

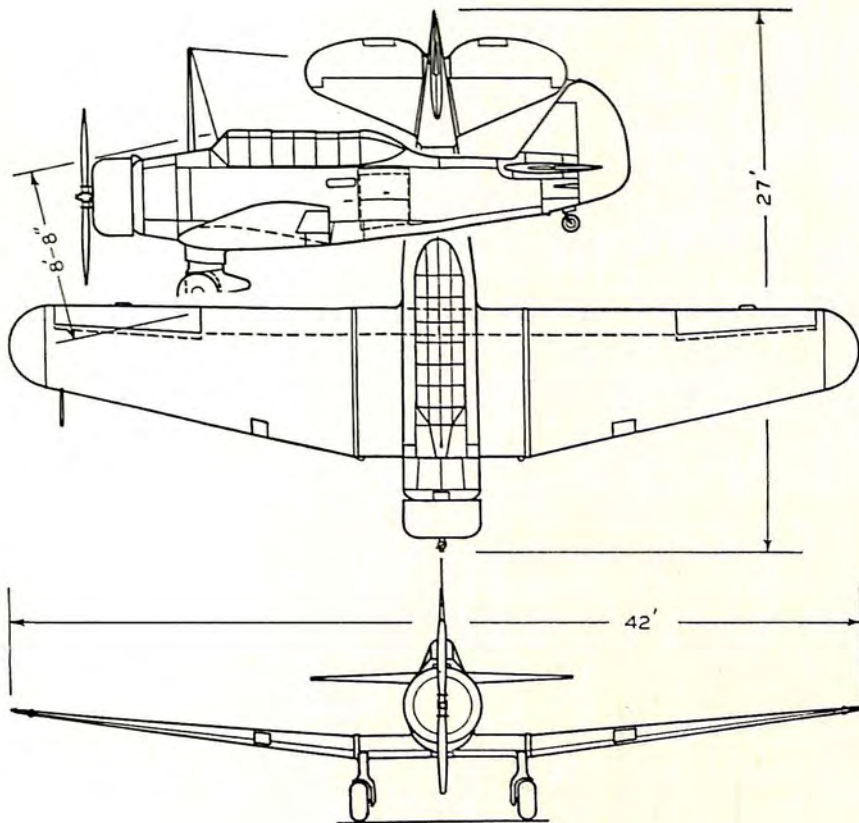
It was a matter of only a few weeks from the time that the French ordered 200 North American basic trainers to the time when the first airplane on the production line was wheeled out the doors for its first test flight. Several hundred basic trainers are now in active service in the U. S. Army and Navy, as well as the air services of foreign countries. Many repeat orders were received during 1938. During 1938 employment and wages reached the highest peak in the company's history.

Design rights were sold to a company in Canada on one of North American's more popular types, and activities have been continued in connection with the construction of North American aircraft in Swe-

den and Australia. Business of this nature is expected to increase during 1939.

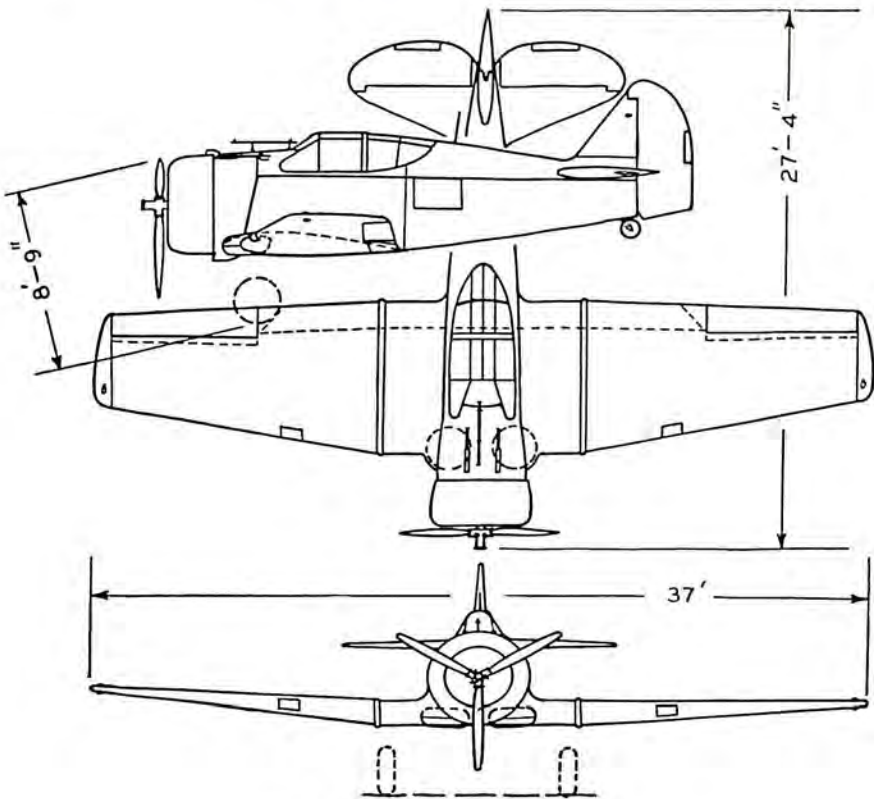
Among the new planes designed and built by North American are the NA-44 attack dive-bomber, the NA-16 "Harvard" trainer for Great Britain, the NA-40 twin-engine attack-bomber and the NA-50 single place pursuit. Several innovations of the BT-9 trainer have been delivered to South American countries.

The 200 of the NA-16 type being built for France will be used for training purposes only. The ship is a low-wing full cantilever monoplane, with an all-metal wing and steel tube fuselage, fabric covered. The landing gear is fixed. The power plant is a Wright R-975-E3 engine developing 420 h.p. with a Hamilton Standard two-position propeller. Still another version of the NA-16 is the type of plane



NORTH AMERICAN NA-16-4

A two-place general purpose and trainer plane with a 550 h.p. Wasp or 420 h.p. Whirlwind engine.



NORTH AMERICAN NA-50

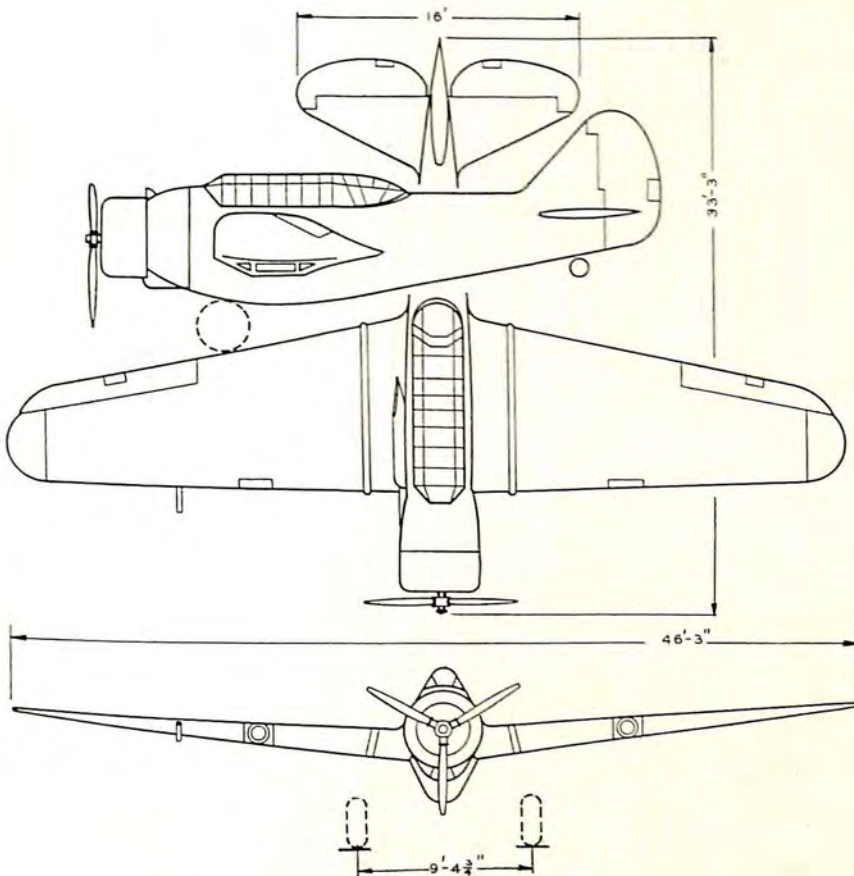
A single-seat fighter with a Wright Cyclone engine.

ordered in quantity by the Brazilian Navy. This airplane, like the one for France, is a two-seat trainer with sliding cockpit enclosure.

The airplane most responsible for North American setting new production records is the BC-1, of which a total of 174 were delivered to the U. S. Army Air Corps before the end of the year. The BC-1 is the first basic combat airplane ever purchased by the Air Corps, its design having been originated by North American. Three of a more advanced version, the NA-54, are to be developed in 1939.

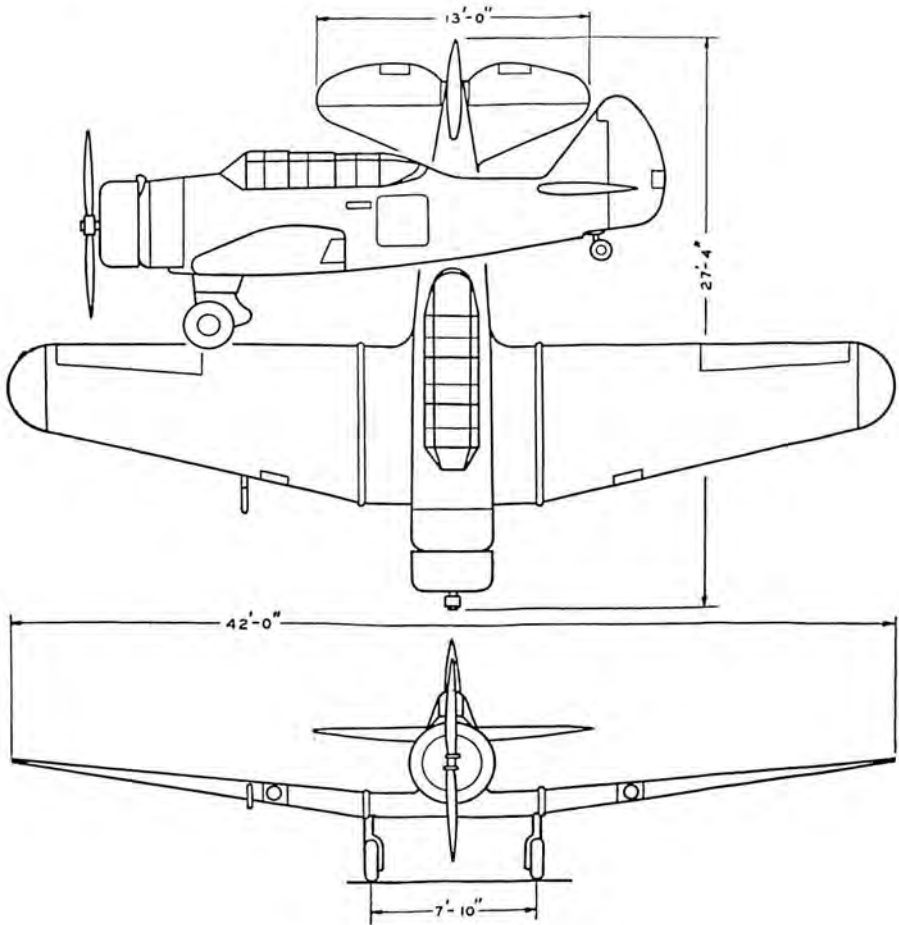
Adapted from the BC-1 is the NA-16 "Harvard", of which 400 airplanes in lots of 200 were ordered by Great Britain. It is a two-place, low-wing trainer with retractable landing gear, powered by a Pratt & Whitney Wasp 550 h.p. engine. Like previous models, the steel tubing fuselage has removable side-panels for easy maintenance and an all-metal bottom aft for protection when taxiing. The two-spar

wing is made up of a center section and two outer panels and is metal covered. Provisions are made in the center section for landing gear wells and two fuel tanks carrying a total of 111 gallons. Split trailing edge type flaps are incorporated inboard of the ailerons and on the center section, while booster tabs are present on the ailerons. All the movable control surfaces are of metal construction but fabric-covered to insure ease of control. The engine mount is of steel tubing structure, and the engine installation has been so designed that it may be taken off the airplane as one complete unit and another installed in a very short time. The flaps and brakes are hydraulically operated, as is the retractable landing gear. The tail wheel is steerable.



NORTH AMERICAN O-47A

A three-place U. S. Air Corps observation plane, powered by an 850 h.p. Wright Cyclone engine.



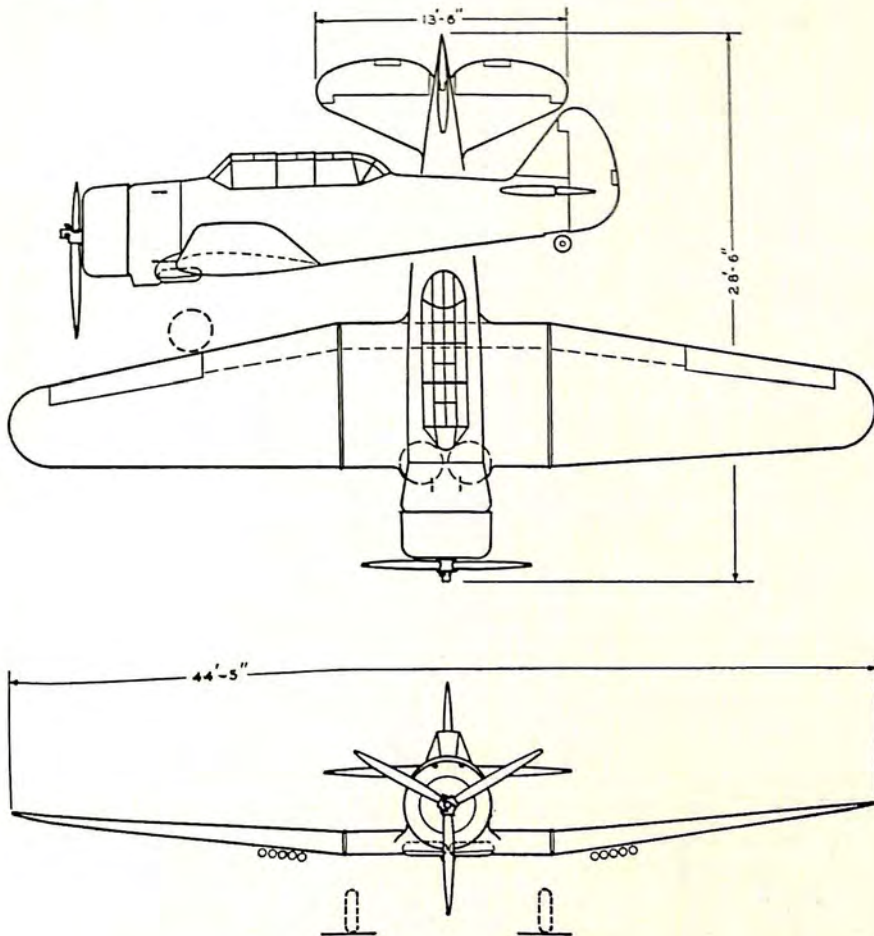
#### NORTH AMERICAN BT9

An Army Air Corps two-place trainer, powered with a Wright Whirlwind 400 h.p. engine.

A complete set of instruments, electrical equipment, radio equipment, photographic equipment and other miscellaneous equipment such as flares and fire extinguisher are installed. Provisions are made for a fixed Browning machine gun and bomb racks. At the end of 1938, North American was well into production of the "Harvard" although only a few months had passed since placement of the order.

Production was also begun on 71 three-place O-47A observation airplanes for the U. S. Army Air Corps and 93 for the National Guard. During the year 24 and 50 O-47B airplanes were ordered by the Air

Corps and National Guard respectively. The O-47A is a mid-wing, all-metal, full-cantilever monoplane with retractable landing gear. In the fuselage belly are accommodations for an observer and his equipment, making it the first high-speed airplane designed for the Air Corps with facilities for the observer as the prime factor. A Wright Cyclone engine developing 1,000 h.p. at take-off is used on the O-47. The O-47 is one of North American's first completely all-metal products. During the first few months of 1938, a development of the basic combat type was constructed with an all-metal fuselage. The first of this type was finished and test flown in the middle of the year, and



NORTH AMERICAN NA-44

A two-place Wright Cyclone-powered light attack dive bomber.

because of its exceptional performance the Navy ordered 16 of like design shortly afterward. The NA-44 series, as the type is called, has a monocoque fuselage, except for the steel tube structure forward of the rear pilot seat. Like its predecessors, it is a two-place, low-wing monoplane. The center section structure incorporates two integral fuel tanks. Having a larger engine than former airplanes of similar type, the NA-44 is able to carry a greater load, making possible increased armament, such as a .30 caliber flexible machine gun, two fixed fuselage .30 caliber guns and North American designed bomb-racks and controls.

The company's single-seat fighter, the NA-50, was successfully completed and test flown early in 1939. Several are being delivered to the Peruvian Government. A trim little low-wing monoplane, it carries complete oxygen equipment for spanning the high mountains of South America. Among its more noted features are its integral fuel tanks, Frise ailerons, and "stub" wing tips introduced by North American, which will be seen on other forthcoming models.

The NA-50 has removable metal fuselage side panels on each side of the pilot's enclosure, giving a smooth outside surface with no rivet beads protruding. Differing from former North American designs, the fuselage sides are flush with the engine cowl, resulting in improved aerodynamic efficiency. Set into the upper front part of the fuselage are two .30 caliber synchronized machine guns, and under the outer wing panels are North American flush-type, built-in bomb racks. Each bomb rack can accommodate two 100 lb. or five 30 lb. bombs. Gun sights are provided forward of the well designed enclosure that boasts of exceptionally fine visibility for maneuvering in combat. The NA-50 is powered with an 840 h.p. Wright Cyclone engine.

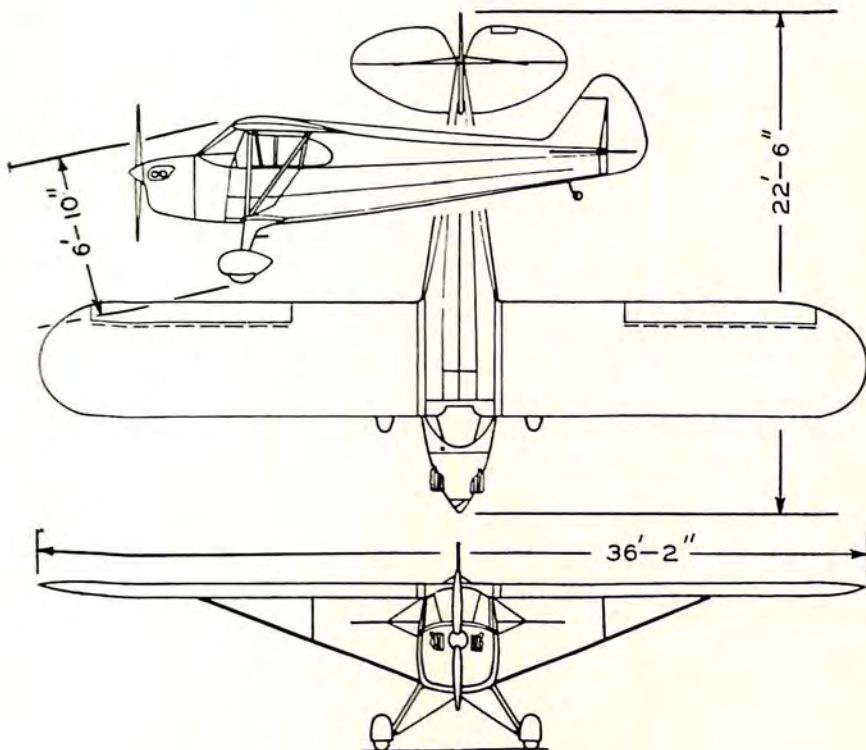
A twin-engine attack-bomber, NA-40, with tricycle landing gear was built during 1938, and delivered to Wright Field for test, as was a twin-engine heavy bomber with turbo-superchargers carrying the XB-21 designation.

The NA-40 is equipped with two of the latest Wright 1350 h.p. R-2600 engines with 3-blade constant speed full-feathering propellers. The airplane is an all-metal high-wing monoplane using the typical underslung type of engine nacelle installation which was pioneered by North American Aviation and which was found to be highly efficient from a standpoint of low drag and high propulsive efficiency. The wings are full cantilever, all-metal, with a new type of flap which permits much slower landing than the conventional type. The body is of all-metal semi-monocoque construction. The airplane weighs approximately 18,000 lbs. fully loaded with a crew of three, the span 66 ft., the length approximately 48 ft., height 10 ft. It is equipped with



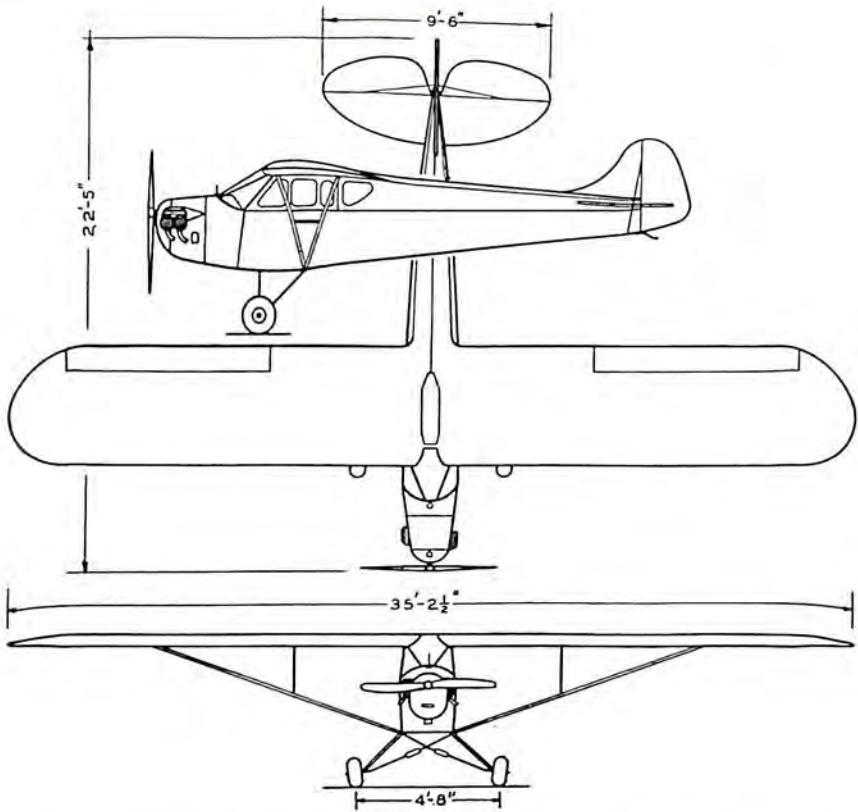
the latest type of automatic hydraulically-controlled tricycle landing gear, providing excellent maneuverability on the ground and permitting of its use in rough fields.

The type has been designed to combine the desirable features of the attack plane and of the bomber with high performance both near ground level and at altitude. The outside skin of the body and wings is entirely flush-riveted and is extremely clean. This, together with the modern design of all of the equipment usually contributing to drag is the reason for the extremely high performance of this airplane which has greatly exceeded all estimates. The forward section of the body is made up of transparent panels, allowing maximum visibility for the crew; the pilot being located in such a manner as to provide vision in all directions without interference from engine nacelles. Installations are provided for an unusually large number of fixed and flexible machine guns; and a large bomb load of assorted types of bombs is carried internally.



THE PIPER CUB COUPE

It is powered by a 60 h.p. Franklin engine.



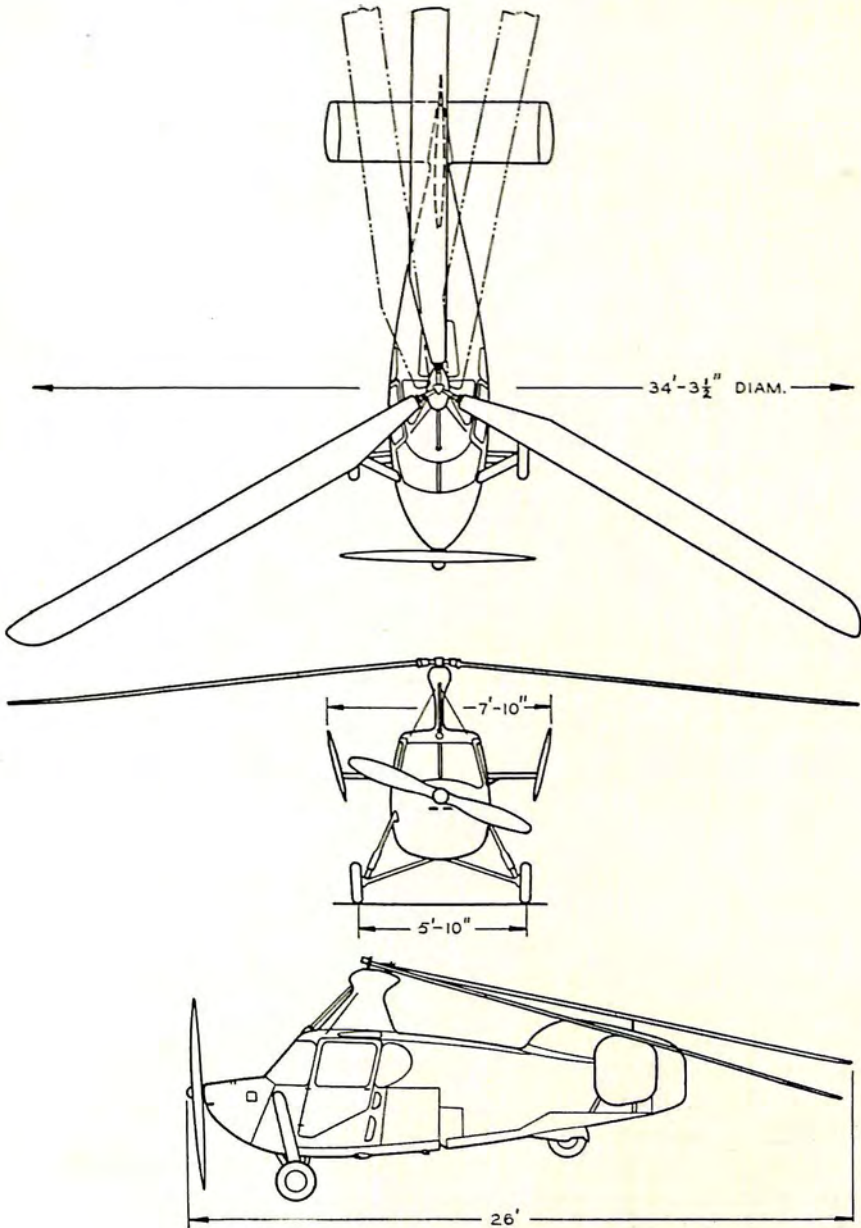
PIPER CUB J-3

A two-place plane for the private owner manufactured by the Piper Aircraft Corporation, Lock Haven, Pa., powered with a choice of five engines ranging from 40 to 50 h.p.

Piper Aircraft Corporation, Lock Haven, Pa., broke records for civil airplane production in 1938, when 737 Cub planes left the assembly line. Of that number 81 were shipped abroad.

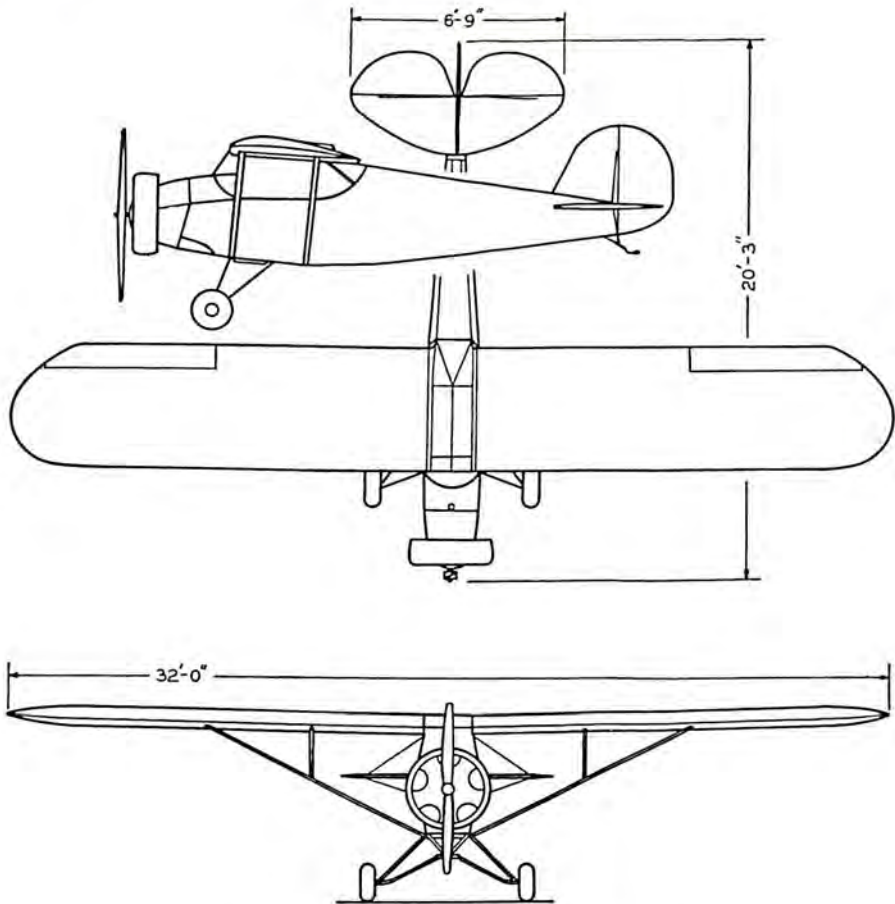
The J3 model Cub Sport was further improved by the introduction of the various 50 h.p. motors which became available in the early summer. With the added power thus obtained, and with increased fuel capacity, the Cub became even more popular for private ownership.

In response to growing demand from the private owner, the Piper plant announced, in the fall of 1938, its Cub Coupe, a ship designed from the beginning for private owner operation. Featuring side-by-side seating with comfort formerly unknown in the light plane field, adequate fuel capacity for four hours flight, deluxe equip-



PITCAIRN ROADABLE AUTOGIRO

A two-place cabin autogiro for private operations with 90 h.p. engine.



PORTERFIELD 35

A private plane for two, powered with a Warner Scarab Junior engine.

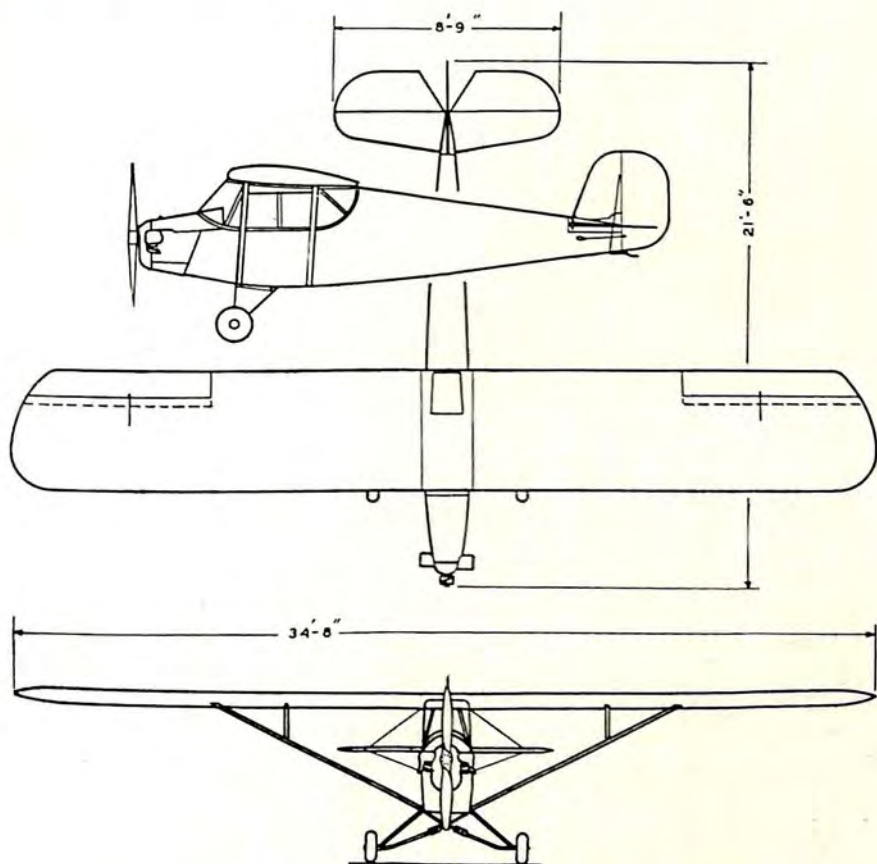
ment as standard, space and provision for over 100 lbs. of baggage, and new standards of beauty of line and finish, the Coupe became a distinct success. The announcement of more power, with the Franklin 60 and the Continental 65 h.p. motors, early in 1939, and consequent increased performance to a top speed of 100 m.p.h. and cruising speed of 90 or better, and equally improved take-off and climb promises even more for the private owner.

One of the important events of the year 1938 for the Cub was the selection by the State of Tennessee of five Cubs as training ships, to be used in the first civilian training program by a State. This was followed later by selection of Cubs in all of the college training courses

held under the direction of the C. A. A. and under the auspices of the N. Y. A.

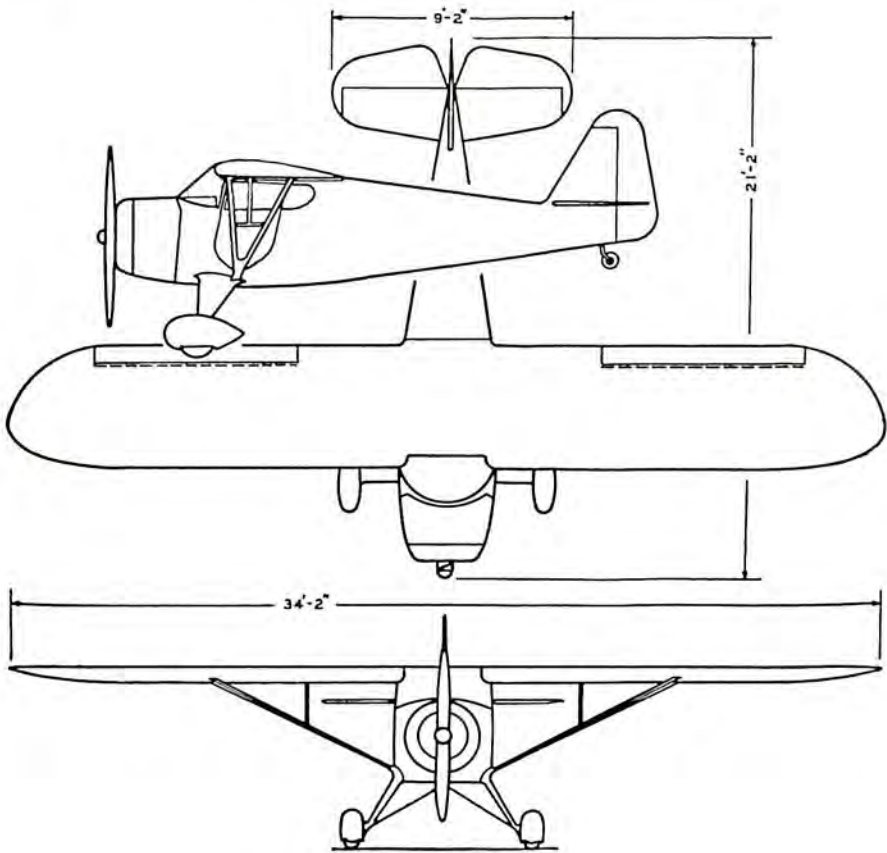
Important aeronautical records established by Cubs in 1938 included the long distance non-stop light plane refueling record of 2,390 miles, held by Test Pilots Kress and Englert; and the light plane endurance record of 218 hours set in Lancaster, Calif., by Pilots Smith, Long and Schlieper.

Porterfield Aircraft Corporation, Kansas City, Mo., produced three models—the CP-50 with 50 h.p. Continental engine; the 35-W with 90 h.p. Warner engine and the Advanced Biplane Trainer with 90, 125, 145, and 165 h.p. Warner engines. The Zephyr, renamed Model 40, was also in production.



PORTERFIELD ZEPHYR

A Continental-powered two-place plane for the private flier.



REARWIN 8000

A two-place private owner plane with LeBlond engines from 67 to 120 h.p.

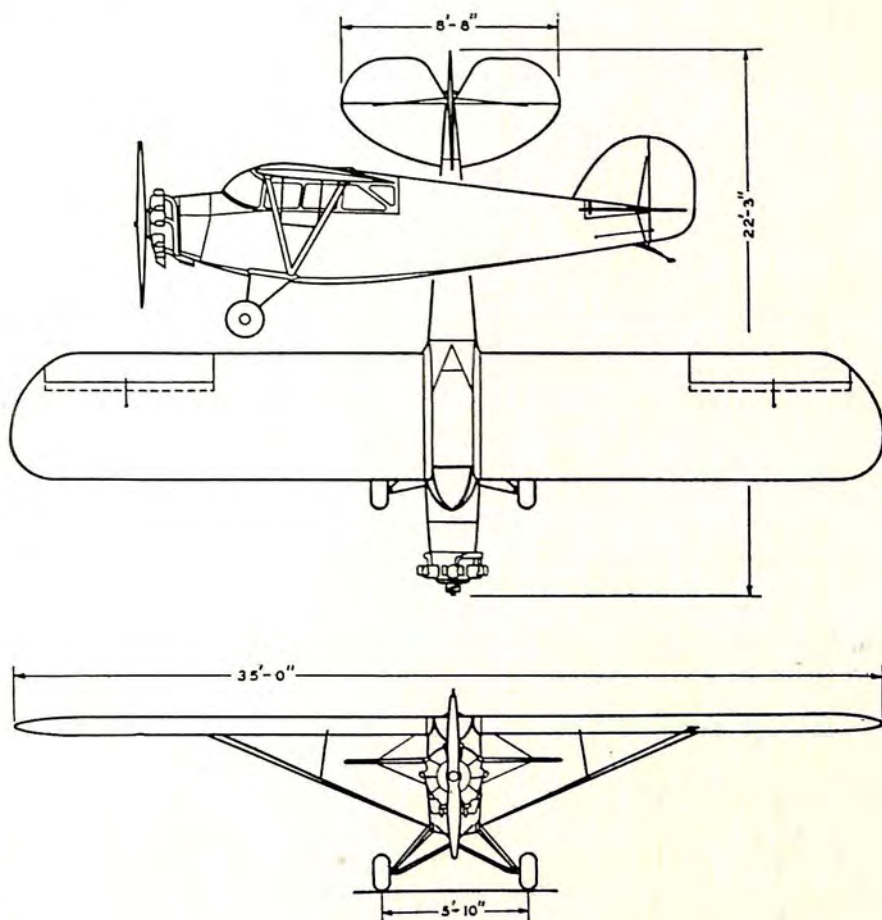
Rearwin Airplanes, Kansas City, Mo., produced a new two-place, side-by-side, high wing cabin monoplane powered with a choice of two motors, the five cylinder 90 h.p. radial LeBlond or the seven cylinder 125 h.p. radial LeBlond. The new Rearwin, to be known as the Model 8000, dual stick controls, for better "feel"; belly flap, automatically controlled; 80-inch wheel tread; hydraulic oil and spring landing gear with 7 inch travel; all controls dynamically balanced, and ailerons also statically balanced; trimming tab on elevator; adjustable rudder tab and ball bearings throughout the control system.

Ryan Aeronautical Company, San Diego, Calif., produced the S-T open cockpit plane for sport and military training and the S-C cabin plane for the private owner. The company planned to build

a new two-story factory 200 ft. wide and 300 ft. long. A growing foreign trade was reported. Three models of the S-T series were produced, the chief difference being the horsepower of the Menasco engine.

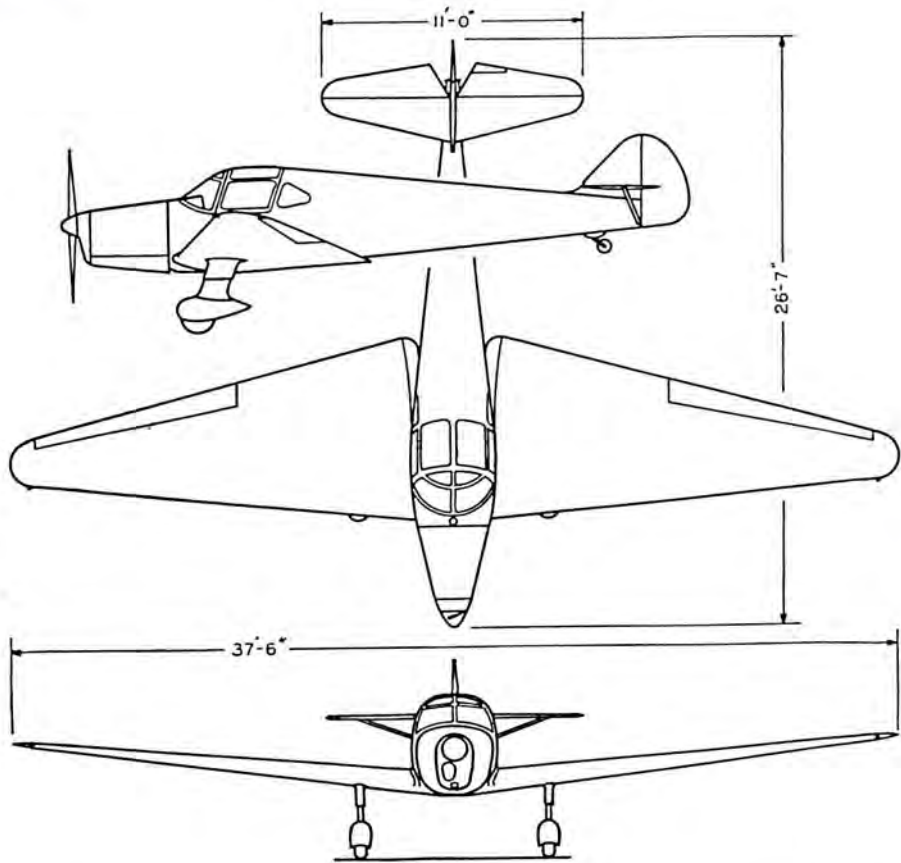
Seversky Aircraft Corporation, Farmingdale, N. Y., produced three models—the EP-1, 2PA-200, and the 2PA-230, the last a two-place low-wing monoplane amphibion.

Sikorsky Aircraft, Stratford, Conn., one of the manufacturing divisions of United Aircraft Corporation, continued production of the Sikorsky S-43 amphibion during 1938. Government contracts



#### REARWIN SPORTSTER

A plane for the private flier, LeBlond or Warner powered.



RYAN S-C

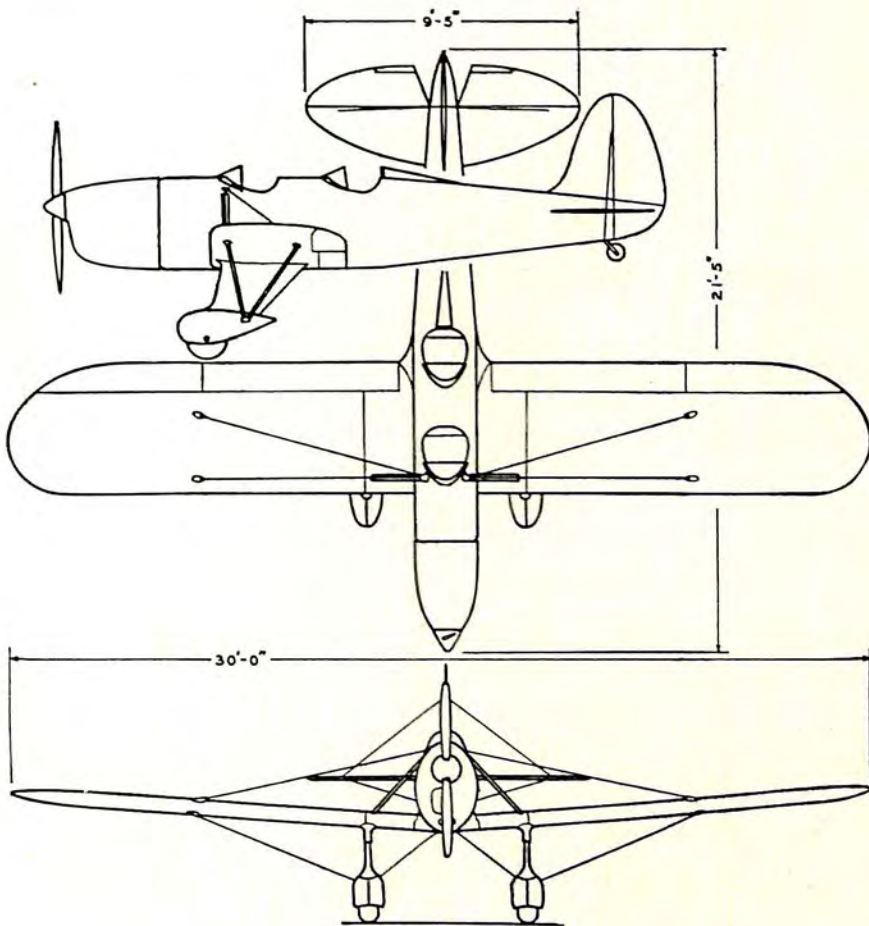
A Menasco-powered plane for the private owner that carries three. It is also available with a Warner engine.

called for delivery of S-43's to the U. S. Army, Navy and the Marine Corps. In addition a number of commercial deliveries were made during this period. Early in 1939, this division was consolidated with the Chance Vought Aircraft division to form a new airplane division known as Vought-Sikorsky Aircraft, to occupy enlarged quarters in Stratford, Conn.

The S-43 is a Hornet-powered twin-engine amphibian with accommodations for 15 passengers and a crew of three. It has a gross weight of 19,500 lbs. and a useful load of 6,600 lbs. The S-43 has a span of 86 ft., wing area of 780.6 sq. ft., length 51 ft. 2 in., wing loading 25 lbs. per sq. ft., power loading 13 lbs. per h.p., a stated top speed of 190 m.p.h. and a cruising speed of 166 m.p.h.

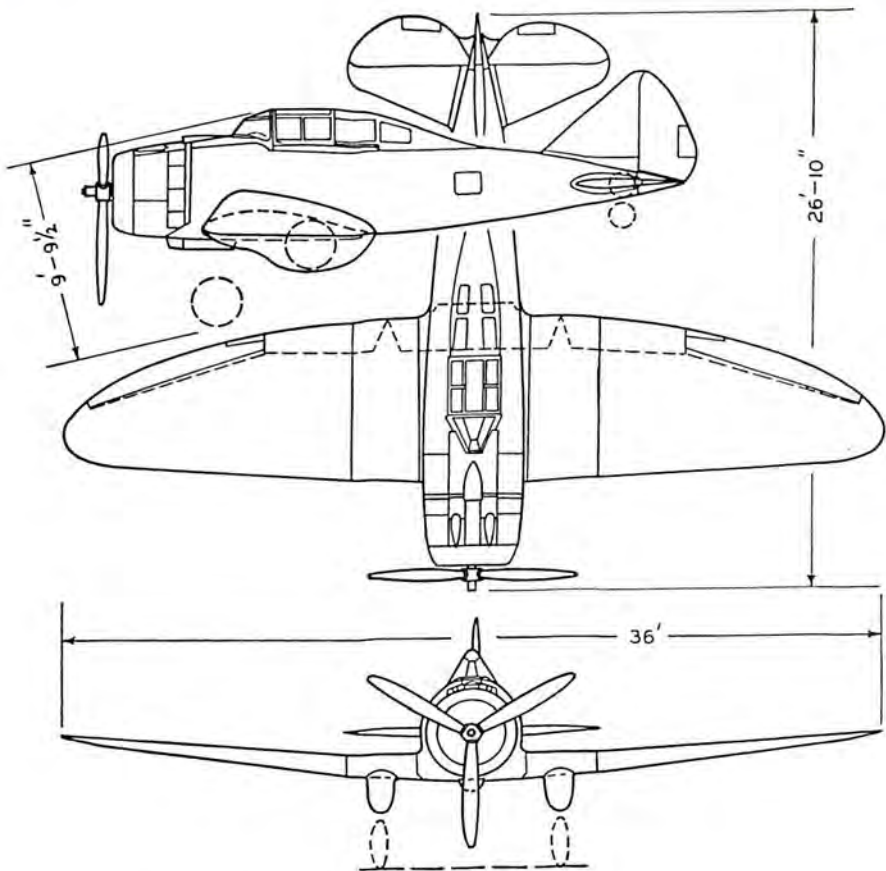


Sikorsky announced the 1939 model of the S-43, designated as the S-43-B. The S-43-B incorporates three changes over the earlier models: an increase to 20,000 lbs. gross weight with a subsequent increase to 6,900 lbs. useful load. A double tail provides improved single engine performance; and a longer bow is provided, increasing the hull length to 52 ft. 3 in. with resultant improvement in water handling characteristics. Interior arrangement, power plants and equipment were not changed over the original model. Performance varied only in single engine performance due to the installation of Hamilton Standard full-feathering propellers.



RYAN S-T

A two-place sport-trainer, Menasco-powered.



THE SEVERSKY EP-1

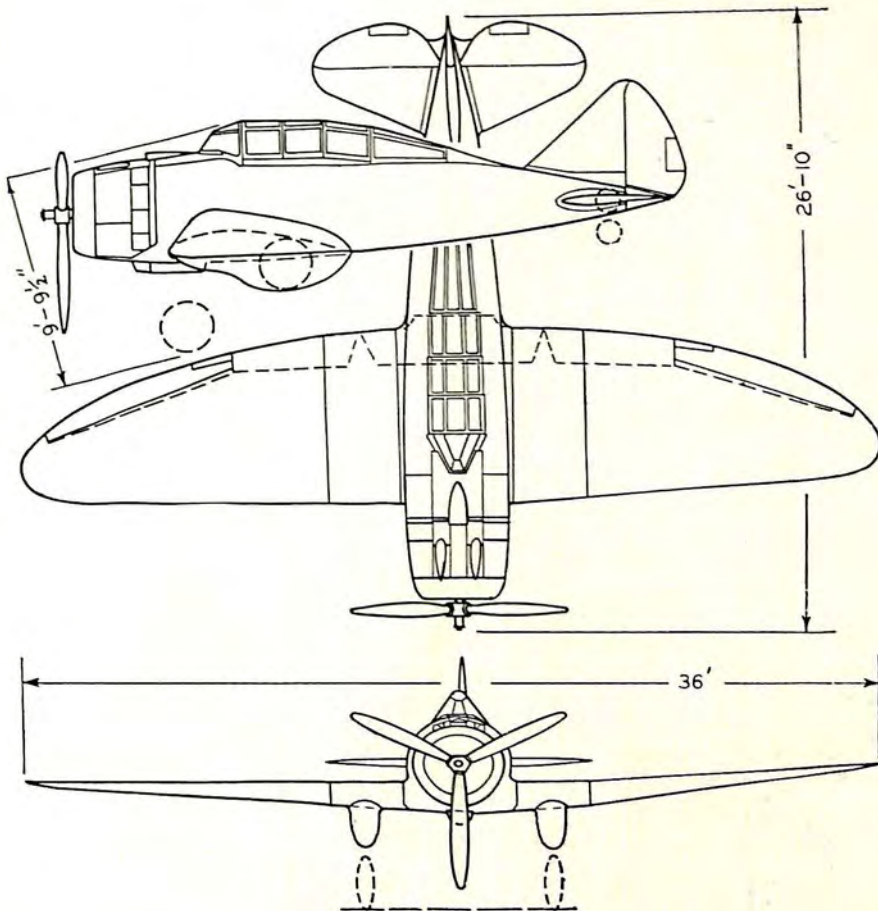
A single-seat fighter with a Pratt & Whitney Twin Wasp engine.

Early in the spring of 1938 Sikorsky submitted a design to Pan American Airways for a 100-passenger Atlantic Flying Boat in competition with three other manufacturers. The proposed airplane would have luxurious accommodations for 100 passengers, including individual staterooms, a large dining salon, a cocktail lounge and promenade decks. It would have a cruising range in excess of that required for a non-stop Atlantic crossing with cruising speeds of not less than 200 m.p.h. and up to 300 m.p.h.

The Sikorsky S-42-B seaplanes, pioneers of the Pacific and Atlantic air routes of Pan American Airways, carried out routine passenger and mail service on the Bermuda and South American routes during 1938.

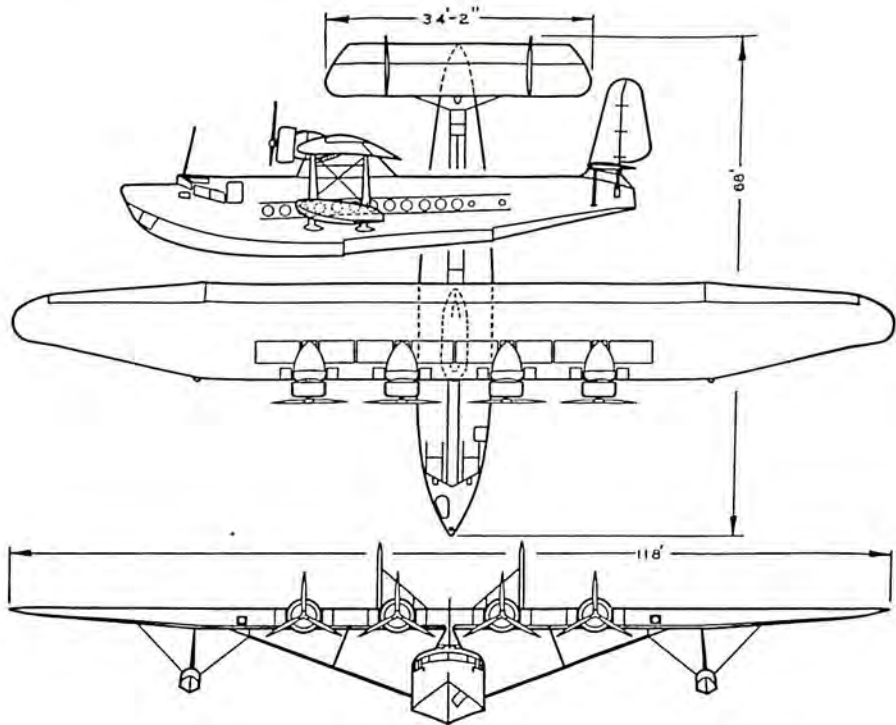
The four-motored Twin Wasp-powered Sikorsky Flying Dreadnaught XPBS-1 continued Navy tests at Norfolk, Va., during 1938.

The Spencer-Larsen Aircraft Corporation of Farmingdale, N. Y., produced its new Model SL-15 amphibian, a two-place cabin plane. The principal features are its unique type of tricycle landing gear and wing pontoon combination, in connection with the extremely low center of gravity brought about by the engine installation within the hull. The shaft and gear type of propeller angle drive is one of the features which has contributed largely to the design as a whole. The construction is of spruce and Bakelite bonded plywood, copper and



THE SEVERSKY 2PA

A two-place pursuit plane with a Pratt & Whitney Twin Wasp engine.



SIKORSKY S-42B

Powered with four Pratt & Whitney Hornets, this flying boat carries 32-40 passengers.

brass fastened throughout for elimination of salt water corrosion. The hull is the N. A. C. A. Model 35, slightly modified, the principal feature of which is the pointed main step. The power plant requirement is the in-line type of 175 to 200 h.p. engine. The gross weight and stated performance is based on the Ranger engine of 175 brake horsepower at 2450 r.p.m.; gross weight 2,600 lbs.; weight empty 1,700 lbs.; useful load 900 lbs.; cruising range 450 mi.; top speed 134 m.p.h.; cruising 118 m.p.h.; landing speed 48 m.p.h.

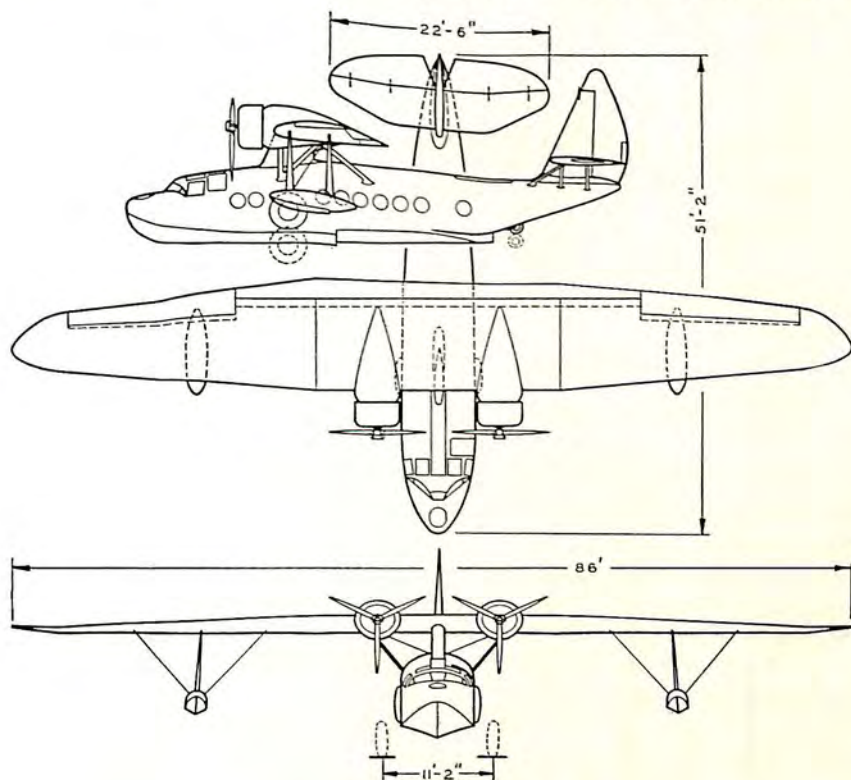
In addition to that project the company has developed preliminary designs for military aircraft, incorporating features proven by test flights with their SL-12C model.

Spartan Aircraft Company, Tulsa, Okla., produced its five-place cabin, low-wing monoplane with a 400 h.p. Wasp engine. It had a span of 39 ft., length 26 ft., 10 in., a gross weight of 4,000 lbs., stalled top speed of 212 m.p.h., and cruising range 900 miles.

Stearman Aircraft, Wichita, Kans., Division of Boeing Airplane

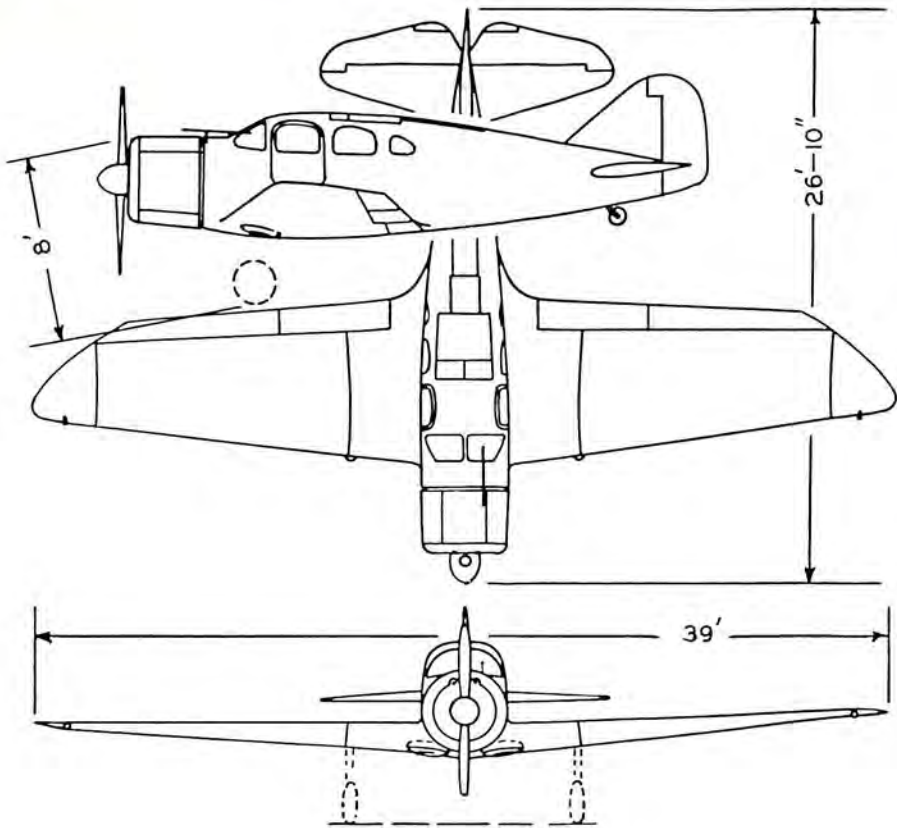
Company, produced primary and advanced training planes, which are now in service in the U. S. Navy, U. S. Army Air Corps, the Argentine Naval Aviation Service, the Brazilian Army Air Corps and the Philippine Army Air Corps. The largest single order under production was a fleet of 92 Stearman PT-13A primary trainers, final deliveries of which were 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



SIKORSKY S-43

A 15-25 place commercial amphibian, powered with two Pratt & Whitney Hornets.



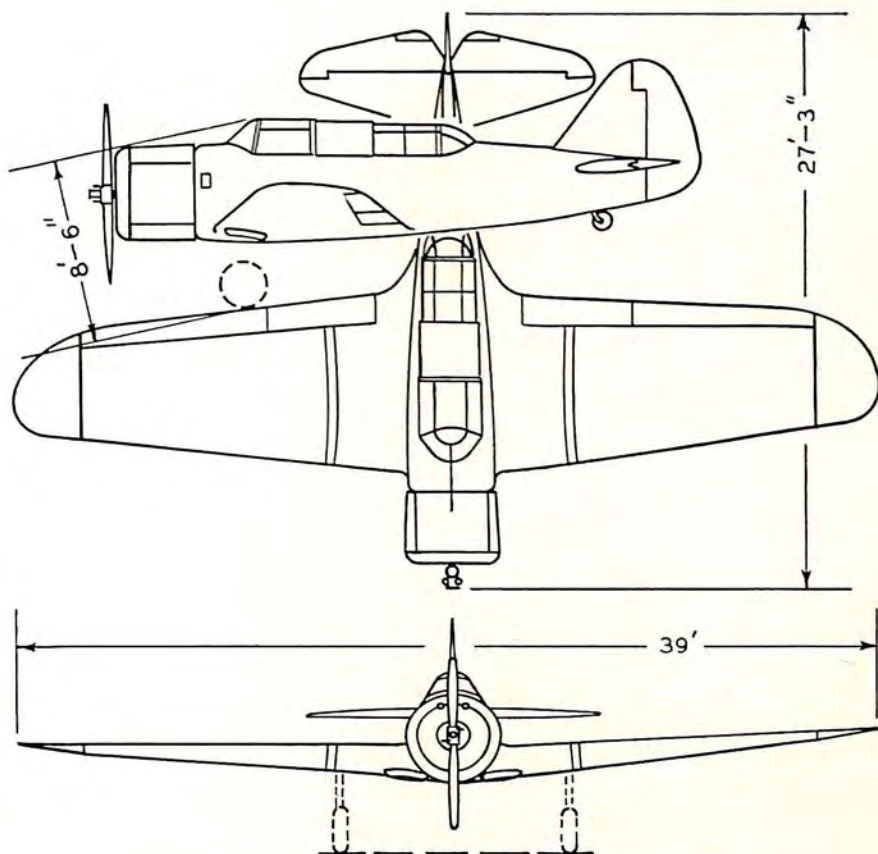
#### THE SPARTAN 7WF

A two-place experimental plane with 400 h.p. Wasp Junior engine.

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.

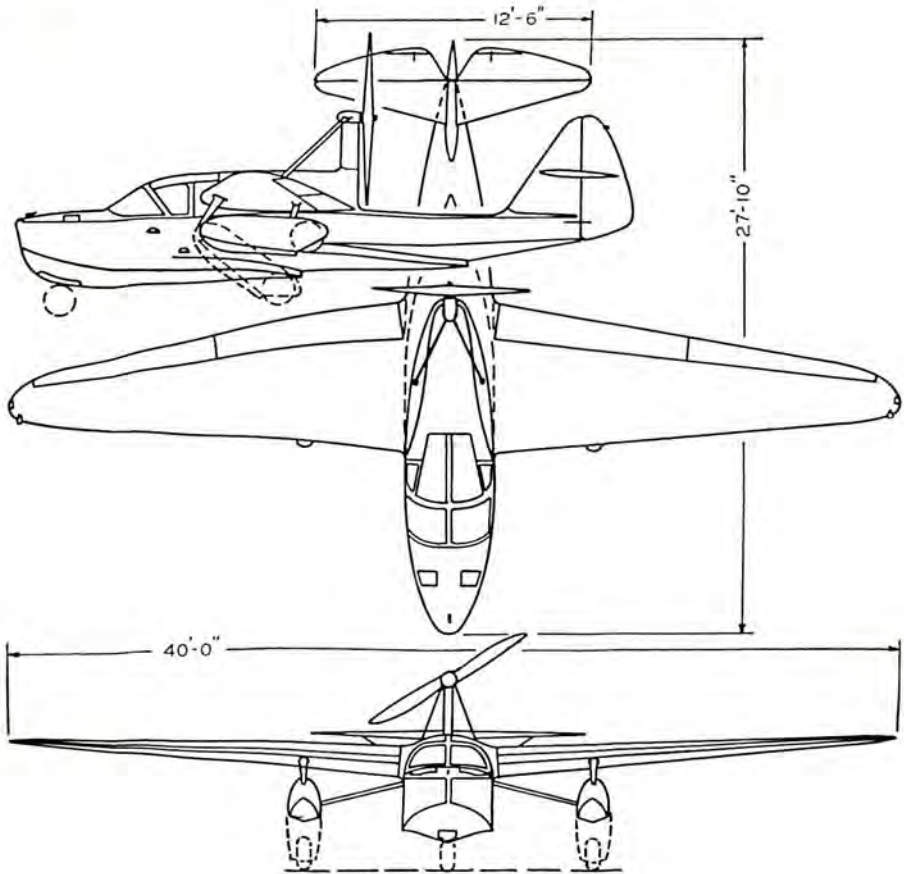
Four Stearman Model 73L3 primary trainers and three Model 76D1 advanced trainers were delivered to the Philippine Army Air Corps. The 73L3 is powered by a 225 h.p. Lycoming R-680-C1 engine, while the 76D1 is equipped with a 320 h.p. Pratt & Whitney Wasp Junior.

The fleet of Stearman Model 76C<sub>3</sub> 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 76C<sub>3</sub> 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



SPARTAN ZEUS

An experimental two-place military plane with Pratt & Whitney 550 h.p. Wasp engine.



#### THE SPENCER-LARSEN

It is powered by a 150 h.p. Menasco engine.

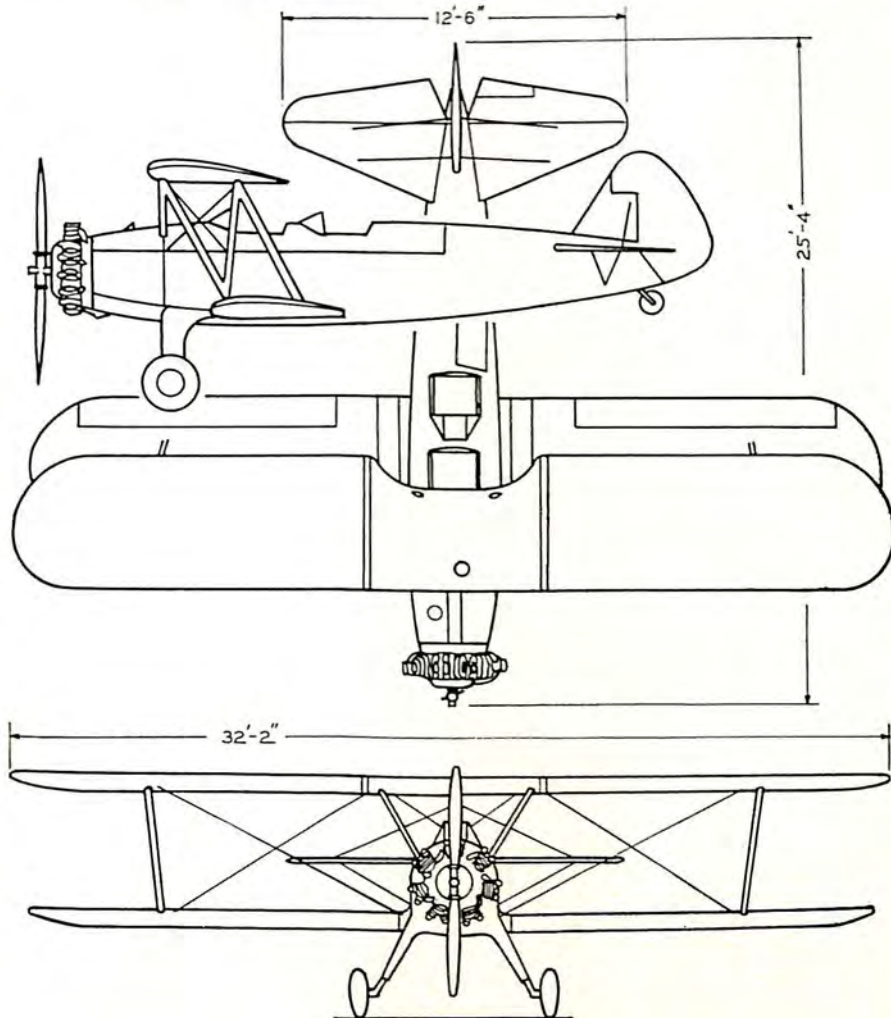
nine feet two inches, empty weight 2,495 pounds and gross weight approximately 3,652 pounds.

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

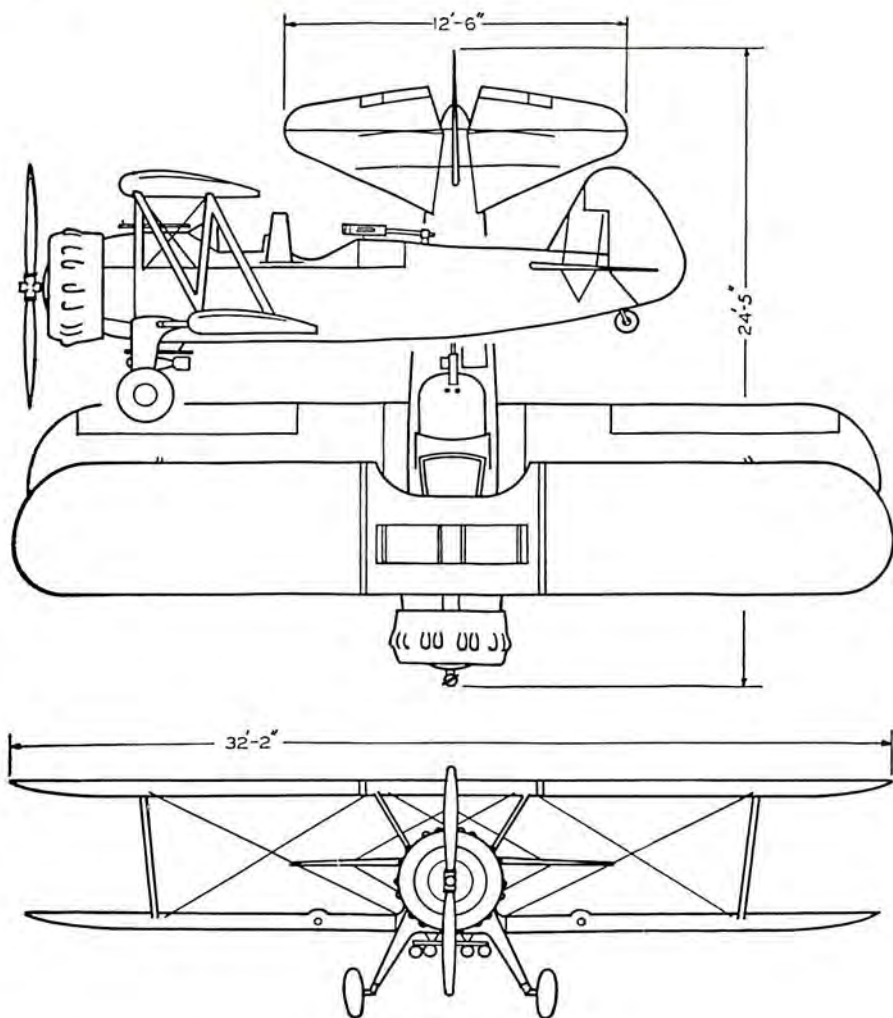


76C3, an advanced training and expeditionary type plane. The general performance characteristics of the Model 73, varying somewhat in accordance with the equipment employed on different models, are reported as follows: Maximum speed 123 m.p.h., cruising speed 105 m.p.h., landing speed 51 m.p.h., service 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



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.

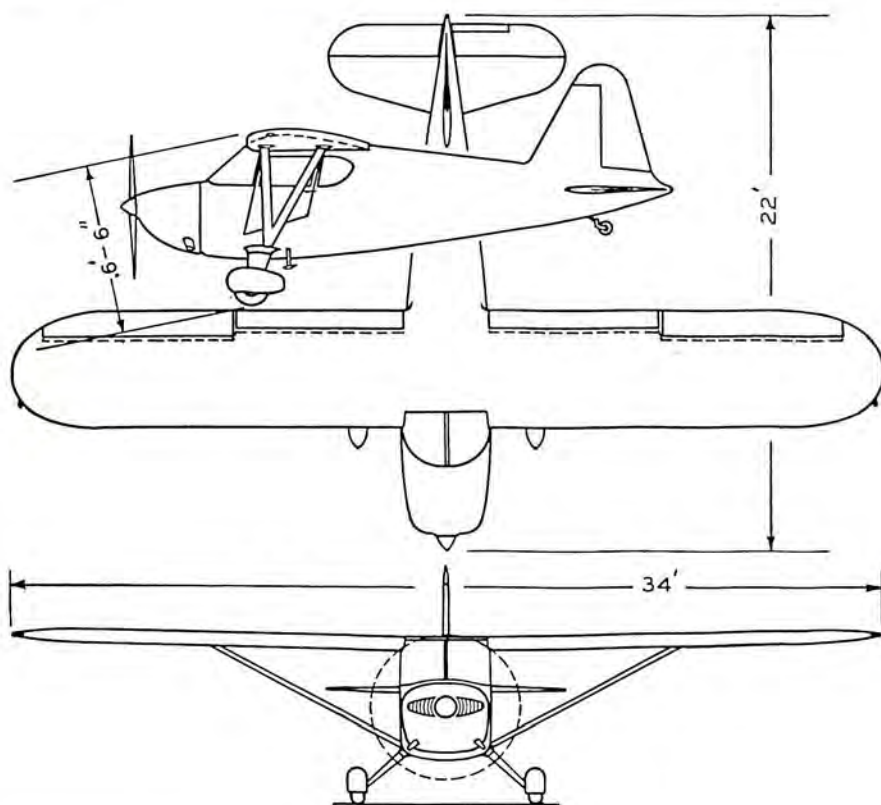
Model 76, also varying according to equipment installed, are: Maximum speed 153 m.p.h., cruising speed 135 m.p.h., landing speed 56 m.p.h., service ceiling 16,700 feet, absolute ceiling 18,600 feet; rate of climb at sea level 1,000 feet per minute; range at cruising speed 472 miles.

A new secretly-developed high speed twin-engine attack bomber, the X-100, was produced by Stearman early in 1939. Designed and

produced at the Stearman plant in Wichita, Kansas, the new airplane was built as an experimental model for entry in the Army Air Corps attack bomber design competition. It is an all-metal high-wing monoplane, designed to combine the desirable features of attack planes and bombardment planes, with high performance both at the ground level and at altitude. Flush type rivets are used over the entire outside area of wings and body, giving the airplane a completely smooth surface. For maximum crew visibility, the entire portion of the forward section of the body is made up of transparent panels. The X-100 is powered by two 1400 h.p. Pratt & Whitney R-2180 engines, driving Hamilton Standard three-blade, constant speed full-feathering propellers. It has a gross weight of approximately nine tons, a wing span of 65 ft., a length of approximately 52 ft. and an over-all height of approximately 12 ft. It carries a crew of four, and has machine gun and bomb installations. It has full cantilever all-metal wings, is equipped with landing flaps, and the body is of all-metal monocoque construction, with electrically controlled landing gear and tail wheel.

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 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 Division, of the Aviation Manufacturing Corporation, Wayne, Mich., brought out eight new models of its five-place Reliant high-wing cabin monoplane, and early in 1939 introduced its



THE STINSON 105

Three-place private owner plane with either Continental or Lycoming 75 h.p. engine.

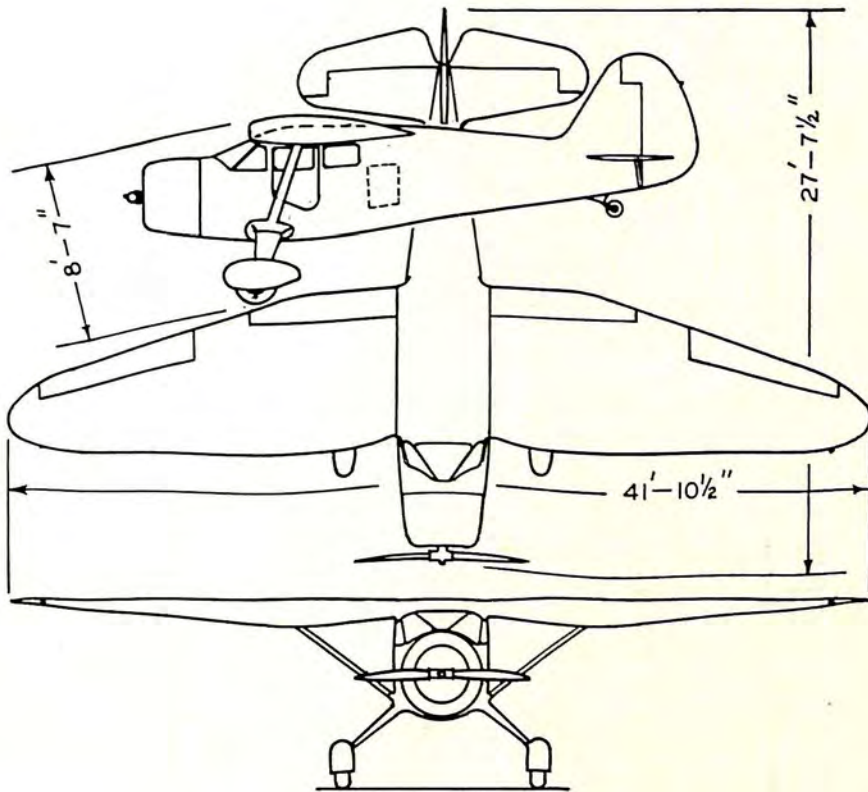
Stinson 105, a three-place high wing cabin monoplane for private owners.

The Stinson 105 marked the company's entry in the low-price field. The 105 was designed to sell for \$2,995, a figure which fell between the prices charged for four and five-place models and those charged for the so-called light planes. The 105 was a fabric-covered plane with welded steel fuselage, wing spread 34 ft., length 22 ft., wing area 155 sq. ft., wing loading 10.2 lbs. per sq. ft., power loading 21 lbs. per h.p., weight empty 900 lbs., useful load 680 lbs., and gross weight 1,580 lbs. It was equipped with slots, flaps and hydraulic brakes, the first time that a plane in its price class had possessed such advanced equipment.

The Stinson 105 was powered by a 75 h.p. Continental or Ly-

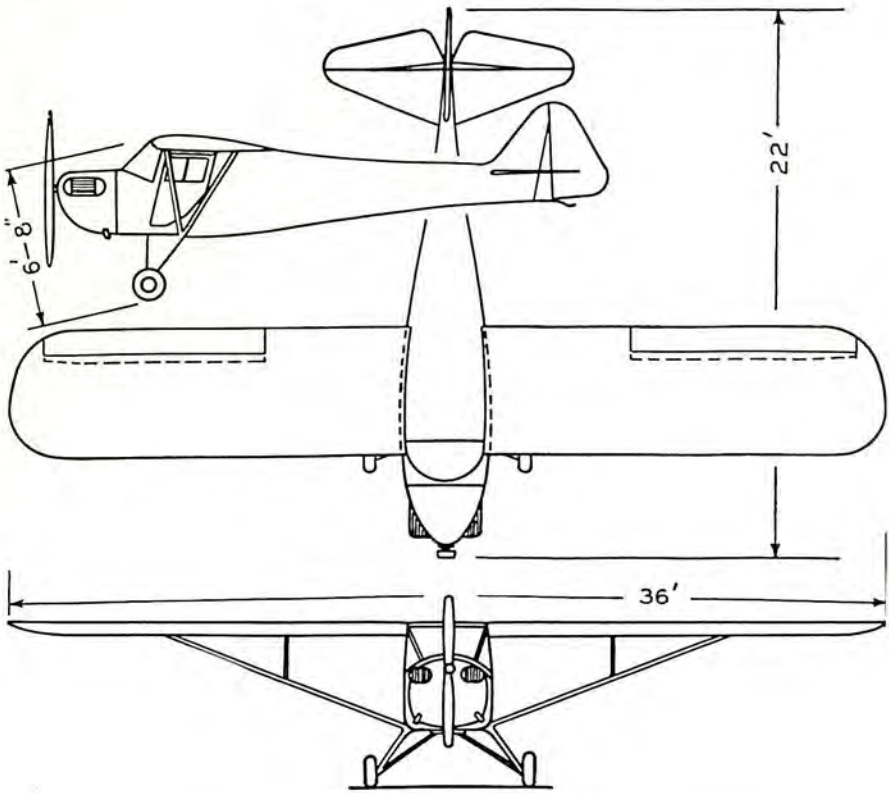
coming engine. It had a stated high speed of 115 m.p.h., cruising at 105 m.p.h., landing speed with flaps down 43 m.p.h., an economical range of 391 miles, ceiling 10,000 ft. and rate of climb from sea level 452 ft. per minute. The 105 carried an 18 gal. fuel tank, its range of 391 miles, in still air, giving it a fuel consumption of more than 21 miles per gallon.

The flaps were of the new N. A. C. A. balanced type, mounted on the trailing edge of the wing between the cabin and ailerons, to obtain a steep glide angle and shorter and slower landings. The slots were of the fixed type, to obtain greater lateral, or aileron, control at slow speeds, and at the same time tending to prevent unintentional spins. The wings were semi-cantilever braced by streamlined metal struts. The 105 was equipped with stainless steel fittings both inside and out;



THE STINSON RELIANT

One of the 1939 Series five-place planes with eight different engine installations.



#### THE TAYLORCRAFT

A private owner light plane, with Continental, Franklin or Lycoming 50 h.p. engine.

and marked an interesting advance toward modern motor car design and construction in its cabin appointments.

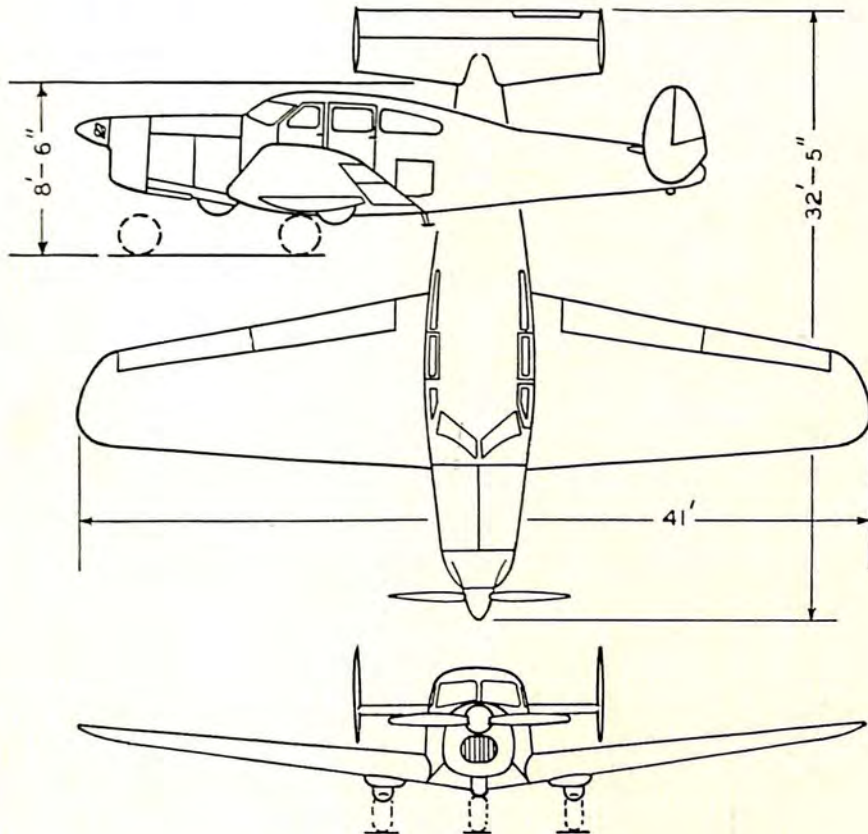
The 1939 Reliants also reflected the trend toward advanced motor styling, with emphasis on the comfort of the occupants and efficiency in the pilot's seat, in both accessibility of instruments and improved vision. The manufacturer claimed 25 improvements over former Reliants, and offered eight different power plant installations, including the 245 h.p., 260 h.p., 290 h.p. and 300 h.p. Lycoming engines; the 300 h.p., 350 h.p. and 450 h.p. Wright Whirlwinds and the 450 h.p. Pratt & Whitney Wasp.

The Reliant had a wing span of 41 ft. 10½ in., length 27 ft. 7½ in., gross weights ranging from 3,875 lbs. to 4,650 lbs., depending on size of the power plant. The cruising speed also varied with the

power plant from 147 m. p. h. to 179 m. p. h. The useful load ranged from 1,365 lbs. to 1,605 lbs.

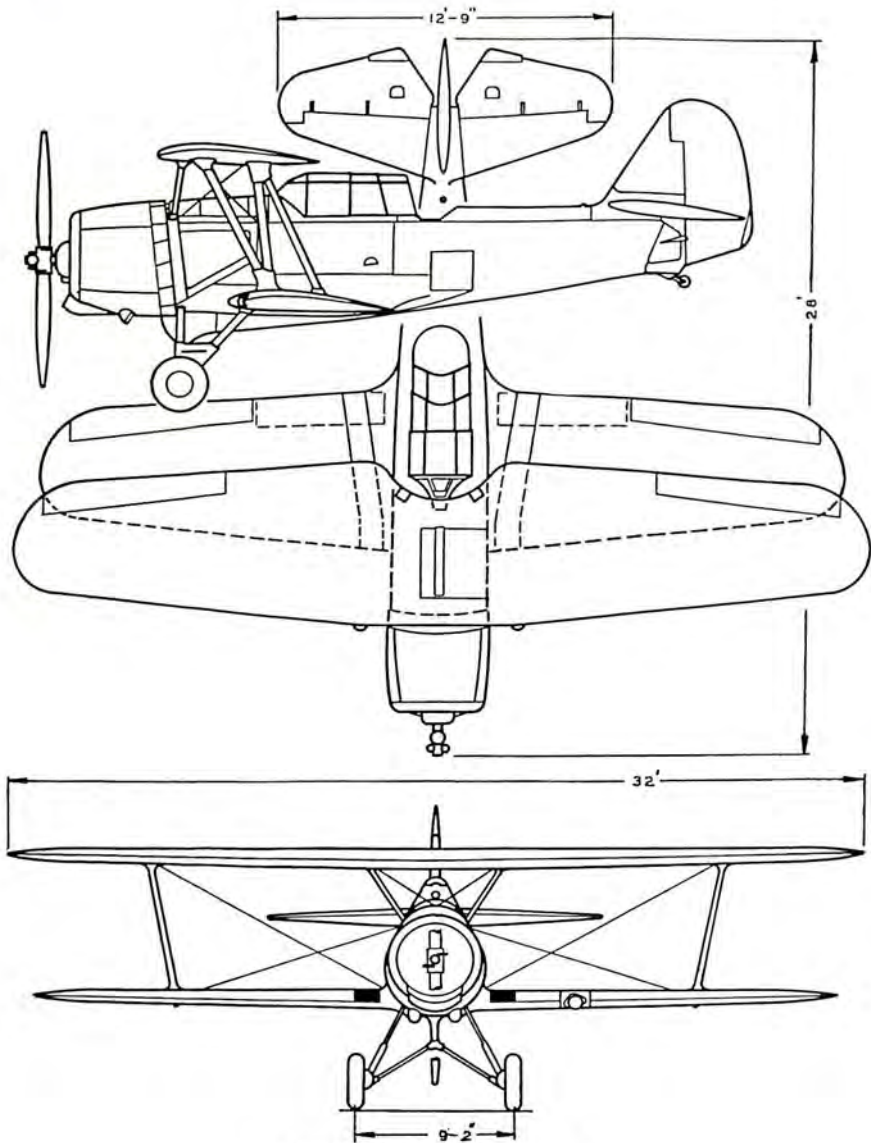
Stinson also continued to produce its multi-purpose Reliant for ambulance, fire and police patrol and other utility missions. Many air lines used Reliants for instrument flight training. The New York air police bought Reliants for emergency patrol work; and similar models were purchased by several Federal Bureaus and foreign governments.

Taylor-Young Airplane Company, Alliance, O., changed its name to Taylorcraft Aviation Corporation on February 17, 1939, but it involved no change in capital structure, management or policies. The company is in production on the 50 h.p. Taylorcraft, two-place, cabin monoplane, the model BL with the Lycoming 50 h.p. engine, model



THE VEGA

A five- to six-place experimental plane with the 520 h.p. Menasco Unitwin engine. The plane is the product of Vega Airplane Co., a Lockheed subsidiary.



VOUGHT CORSAIR SBU-2

A two-seat scout-bomber with a Pratt & Whitney Twin Wasp Junior engine.

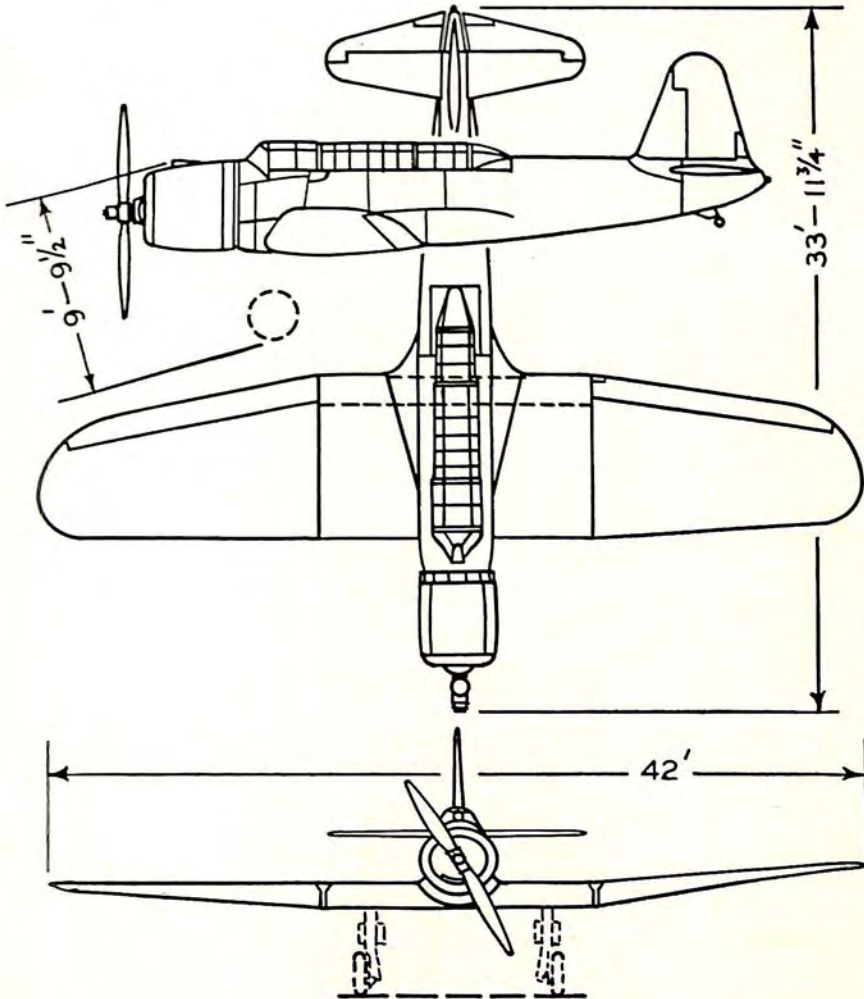
BC with the Continental 50 h.p. engine and model BF with the Franklin 50 h.p. engine. An early type, the Model A with Continental 40 h.p. engine is produced on special order.

The above airplanes are two place, side-by-side closed cabin mono-



planes of the high wing type. They have been produced in large quantities during the last two years, over 750 having been delivered to date.

Chance Vought Aircraft, one of the manufacturing divisions of United Aircraft Corporation, continued production of the Vought military airplanes during 1938. Early in 1939, plans were completed



VOUGHT V-156

A two-place dive bomber with Pratt & Whitney 750 h.p. Twin Wasp Junior engine

for consolidation of Chance Vought Aircraft with Sikorsky Aircraft to form a new manufacturing division known as Vought-Sikorsky Aircraft, at Stratford, Conn.

Having completed a contract with the U. S. Navy for Vought SBU-1 and SBU-2 scout bombers, a two-seater biplane with a 700 h.p. Pratt & Whitney geared Twin-Wasp Jr. engine, Chance Vought Aircraft proceeded with the construction of SB2U-1 scout bombers during the early part of 1938. The Vought SB2U-1 is a low wing scout bomber landplane powered with a 750 h.p. Pratt & Whitney Twin-Wasp Jr. engine and Hamilton Standard constant speed propeller. Its structure is all metal with fabric covering on the movable tail surfaces and on the after portion of the wing and fuselage. The landing gear is retractable and the wheels lie flat in recesses in the wing. Night flying equipment and flotation gear are provided.

The Vought Model V-156 airplane, powered by a Twin Wasp Jr. engine, was released for export. This airplane is a two-place, single engine, low wing, internally braced, all-metal monoplane substantially similar to the model SB2U-1 scout dive bomber designed for the Navy. The crew consists of two men, a pilot and a gunner, the latter being able to act as observer, radio operator or reserve pilot. Provision is made for maintaining two flexible guns in the wing outboard of the propeller disc with a flexible gun in the rear cockpit. Various types and sizes of bombs may be carried.

Also available for export is the Vought V-143, a low wing, all metal, single place fighter. It is powered with a 750 h.p. Pratt & Whitney Twin Wasp Jr. engine and Hamilton Standard constant speed propeller. This model may also be powered with a single row Wasp Jr. engine where high performance is not essential, in which case it is designated as the V-150.

The company began construction of an order for SB2U-2 scout bombers for the United States Navy. The SB2U-2 is a modified version of the SB2U-1, incorporating changes in landing gear design and improvement in performance.

In 1939 the Vought-Sikorsky Division received quantity orders for its latest observation scout type, OS2U-1. It is a full cantilever low wing monoplane, with an all metal monocoque fuselage, carrying a crew of two. It is powered with a nine-cylinder Pratt & Whitney Wasp Junior engine rated at 400 h.p. for take-off, and is equipped with a two-bladed Hamilton Standard constant speed propeller. It is convertible either as a landplane or single-float seaplane, but its chief function is that of a seaplane, operating from battleship or cruiser catapults, and used to direct gun fire and to conduct long range observation scouting missions.

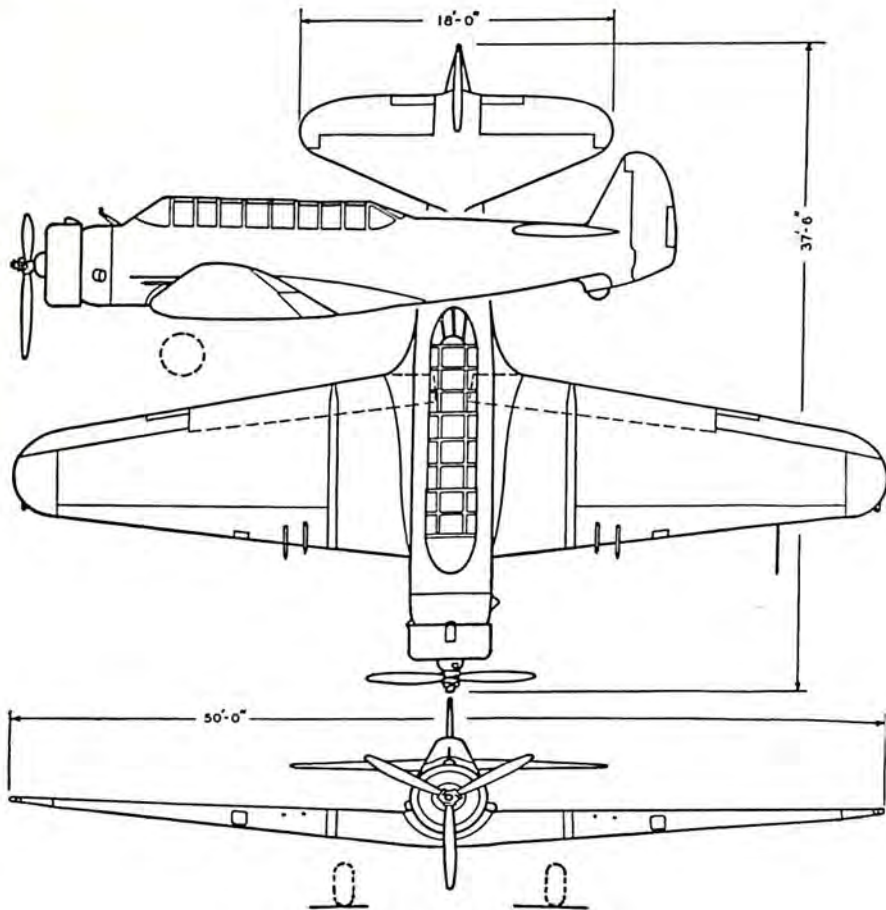
Three aerodynamic developments used here in combination for the first time, have so improved the lift and controllability of the monoplane at low speeds as to render the use of this type feasible. Two of these are high-lift devices, the first being the new and highly effective "deflector plate" flaps used on the trailing edge of the wing, and the second the use of "drooping" ailerons, so rigged that at low speeds they serve the same function as flaps and further increase the lift of the wing. The third device consists of "spoilers" in the wings which supplant the ailerons at low speeds and provide the rolling moments necessary for lateral control.

The structure of the new airplane incorporates a marked departure from previous practice in the use of spot welded aluminum alloy construction for the major portion of the airplane. The spot welded structure provides an absolutely smooth surface in contrast to the studded surface of the usual riveted construction and thus permits a smooth glossy finish conducive to high speed, as well as being more economical from the manufacturing standpoint. The Vought-Sikorsky organization has pioneered in the use of spot welding on aircraft and the new XOS2U-1 represents the first application of this process to the primary structure of an airplane. No difficulties have been experienced in more than 200 hours of test flying.

The OS2U-1 has an overall span of 36 ft., with a length of 33 ft. 10 in. as a seaplane, and 30 ft. 1 in. as a landplane. Its gross weight as a seaplane is 4,764 lbs., and as a landplane 4,542 lbs.

Vultee Aircraft, a division of Aviation Manufacturing Corporation, at Downey, Calif., began intensive experimental development late in 1938 and continued production of the V11-GB attack bombers which already were in use by the air forces of Russia, China, Brazil and Turkey. A new model was the Vultee V-12 attack bomber, with a streamlined canopy, flush riveted construction and butt joints.

The V-12 had a wing span of 50 ft., and length 37.5 ft. Power plants varied with the basic purpose of the attack bomber. The standard V-12 was equipped with a Pratt & Whitney 950 h.p. Twin Wasp engine, giving it a stated top speed of 205 m.p.h. for bombing and 225 m.p.h. for attack, with a maximum speed of 262 m.p.h. for attack at 15,300 ft. altitude. Maximum range was 1,130 mi. for attack and 1,670 mi. for bombing; service ceiling 25,500 ft. for attack and 21,500 ft. for bombing. It carried bomb loads up to 1,100 lbs. in weight. The pilot's armament included four fixed wing machine guns fired by an electric trigger grip control, the charging of the wing guns accomplished by a direct cable system. Two 30-caliber and two 50-caliber machine guns comprised the wing armament. The gunner's cockpit in back of the pilot carried a 30-caliber flexible machine gun.



**VULTEE V-11-GB ATTACK BOMBER**

It is powered by a 900 h.p. Wright Cyclone engine.

The bombardier's compartment back toward the tail also carried a 30-caliber machine gun.

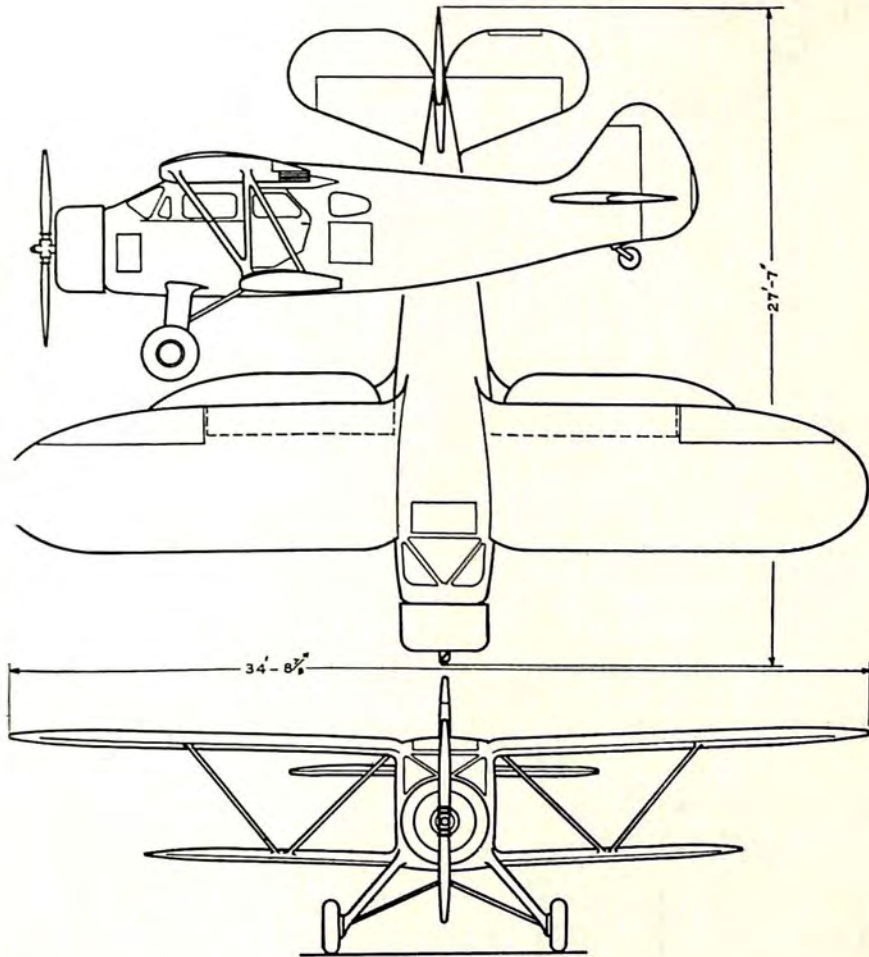
Vultee also announced the V-11-TS torpedo seaplane, like the V-12 for land operations. The seaplane had a 1,050 h.p. Twin Wasp engine and was designed to carry a 1,600 lb. torpedo, with a range of about 600 mi. with that load. It also was equipped with six machine guns.

Vultee was also in production on an Air Corps order for YA-19 single engine attack planes. The YA-19 was an all-metal, low-wing monoplane, powered by the Pratt & Whitney 1,050 h.p. Twin Wasp

engine, carrying a crew of three, six machine guns and a large load of bombs.

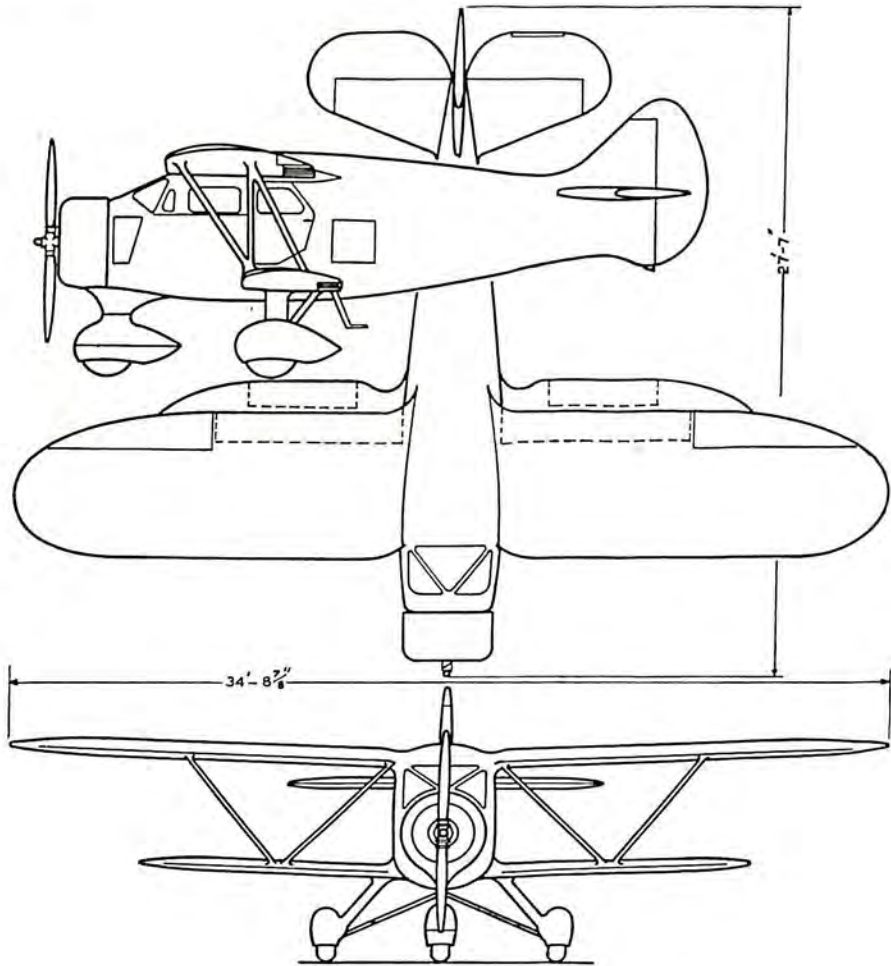
Vultee expanded plant facilities to take care of augmented engineering personnel and production equipment.

The Waco Aircraft Company, Troy, O., produced several models for the private owner. The Waco N with tricycle landing gear accounted for about 34 per cent of the company's sales in 1938. It was a four-place cabin biplane powered by a Jacobs L-5 engine. Its char-



THE WACO MODEL C

A four- to five-place private owner plane powered with a Jacobs or Wright engine.



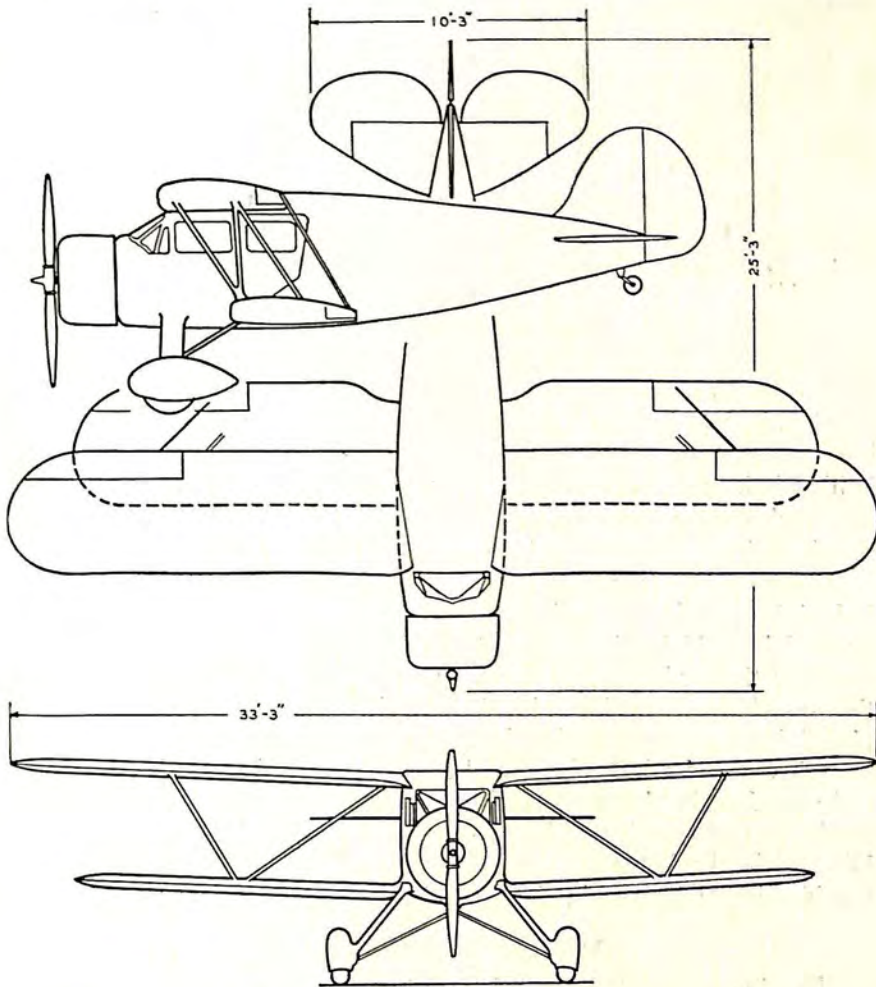
THE WACO N

A five-place private owner plane with tricycle landing gear and 285 h.p. Jacobs engine.

acteristics because of the three-wheel landing gear were described by the company, as 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 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



THE WACO MODEL S

A four- to five-place private owner plane, powered by a Jacobs L-4 or L-5 engine.

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."

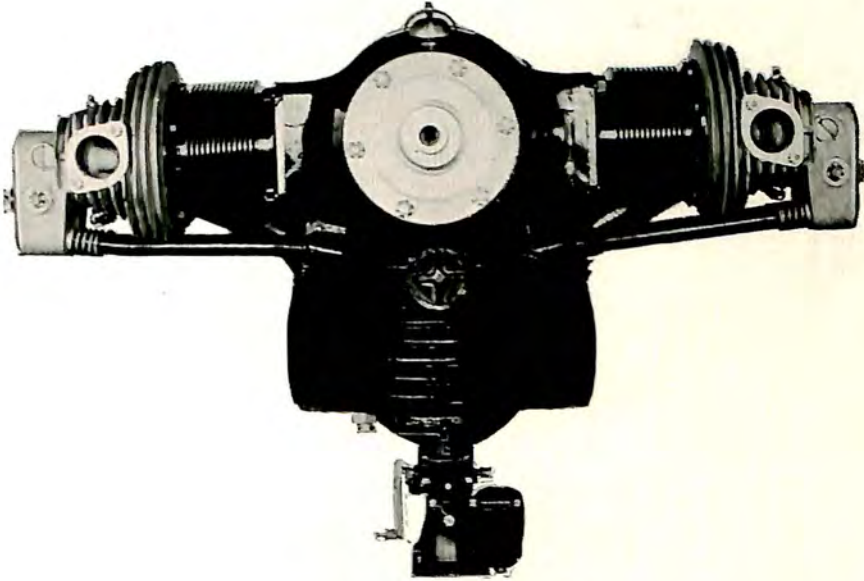
Improved and modified versions of the Waco basic design were the Waco C and Waco S, four- and five-place biplanes with two wheel landing gear and powered by various engines. Model S had either the 225 h.p. Jacobs L-4 or 285 h.p. L-5 engine. Model C had the 285 h.p. Jacobs L-5, the 330 h.p. Jacobs L-5 or the 320 h.p. Wright Whirlwind. The Waco Model D, military type, and the Model F-T unarmed trainer were among Waco planes offered for export. Approximately 42 per cent of the company's business in 1938 was export.

Waterman Arrowplane Corp., Santa Monica, Calif., reported that it had been doing experimental work on a revised version of the Arrowbile "which will be practically identical to our 1938 model except that the engine will be moved up to the thrust line and geared to the propeller, dispensing with the V-belt drive. The radiator will be placed in the center section instead of the nose of the nacelle; and the wheel tread will be increased ten inches. This model is designed to be produced either as a straight airplane or as a flying automobile. In the former case it will be 200 lbs. lighter than the original Arrowbile and in the latter case 100 lbs. lighter. In all other respects the specifications will remain the same."

#### Builders of Aircraft Engines

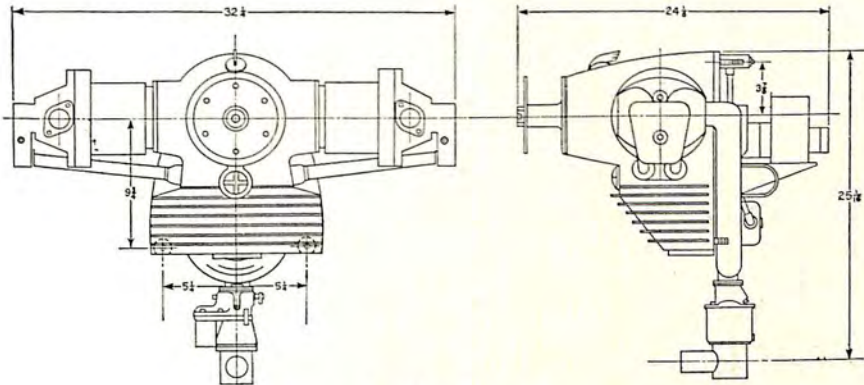
The Aeronautical Corporation of America, Cincinnati, O., reported that it had produced a record number of Aeronca engines in 1937. The Aeronca E-113C engine was a two-cylinder, horizontally opposed





AERONCA E-113C-CBD

A two-cylinder horizontally opposed aircooled engine rated at 40 to 45 h.p. at 2,500 r.p.m.



AERONCA E-113C

A two-cylinder, horizontally opposed aircooled engine rated at 40 to 45 h.p. at 2,500 r.p.m.



CONTINENTAL A-50

A four-cylinder horizontally opposed engine rated at 50 h.p.

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.

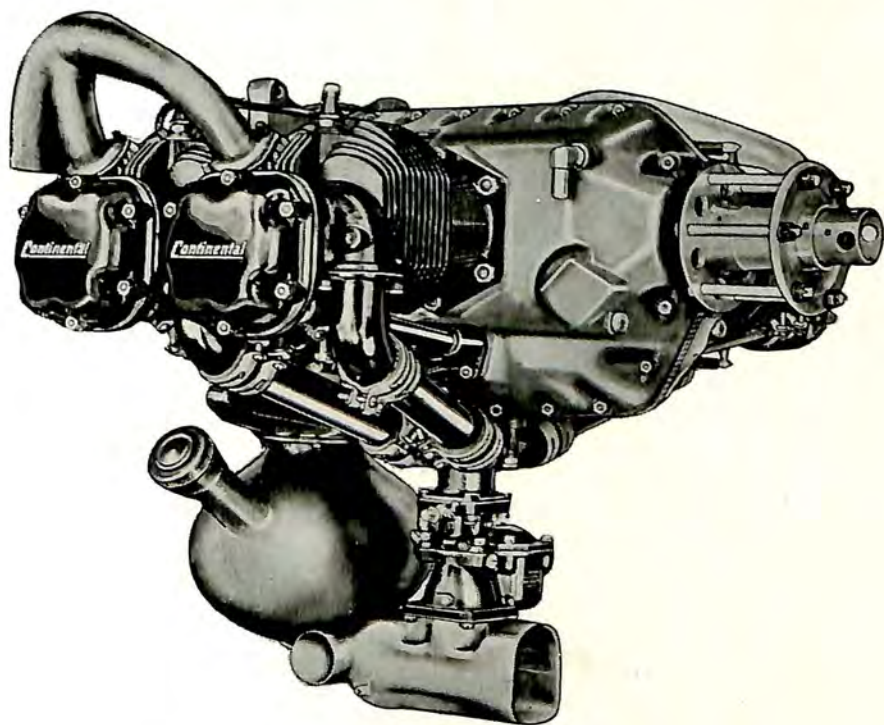
The use of Allison V-1710 engines with special extension shaft drive for pusher installation in the Bell XFM-1 two-engine fighter also develops speculation as to the importance of the return of high pow-

ered liquid cooled engines for high performance military usage in the United States. The ready adaptation of this type of engine to the use 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.

Allison was establishing additional manufacturing facilities at Indianapolis to meet the requirements of the Air Corps incident to its expansion program.

Continental Motors Corporation, Detroit, Mich., reported a production of 1,356 aircraft engines in 1938, ranging from 40 h.p. to



CONTINENTAL A-65

A four-cylinder horizontally opposed engine rated at 65 h.p.



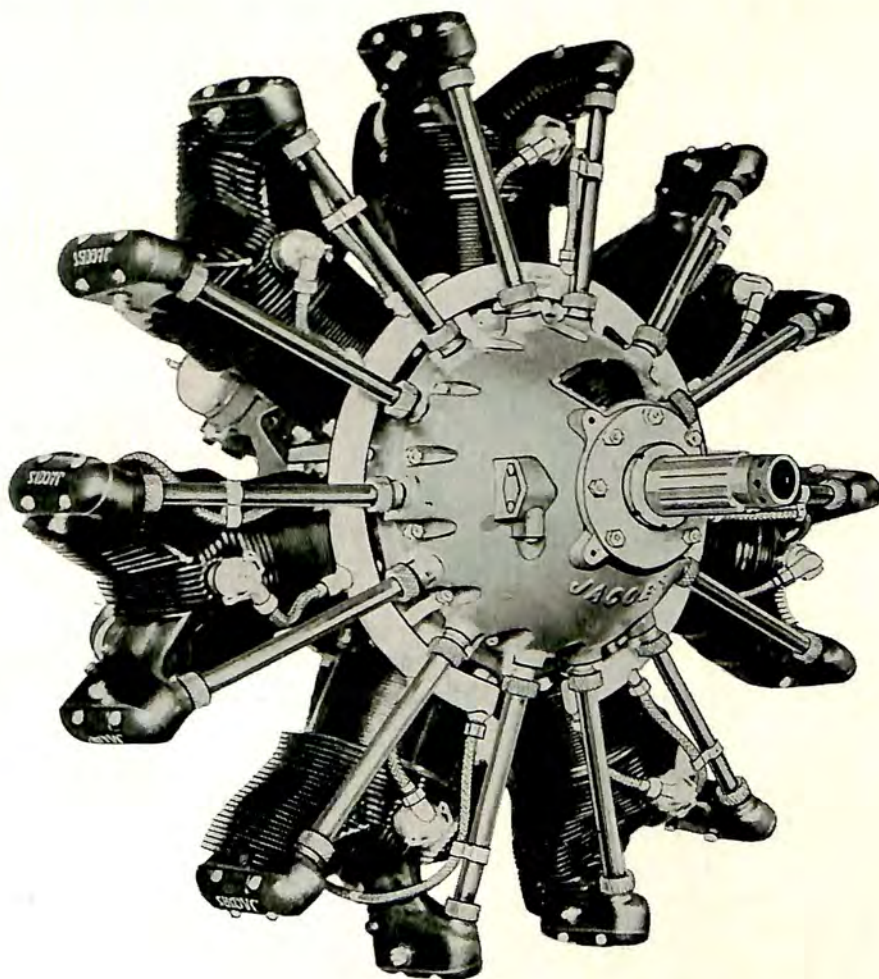
THE CONTINENTAL W-670

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.

250 h.p. Users of Continental engines included Piper, Luscombe, Aeronca, Taylorcraft, Stinson, Waco, Porterfield, Welch and others. The Continental A50, a 50 h.p. engine, introduced in 1938, was to have increased production in 1939. The A65, a 65 h.p. engine also was to go on the market. Later in the year a 75 h.p. Continental was to be available.

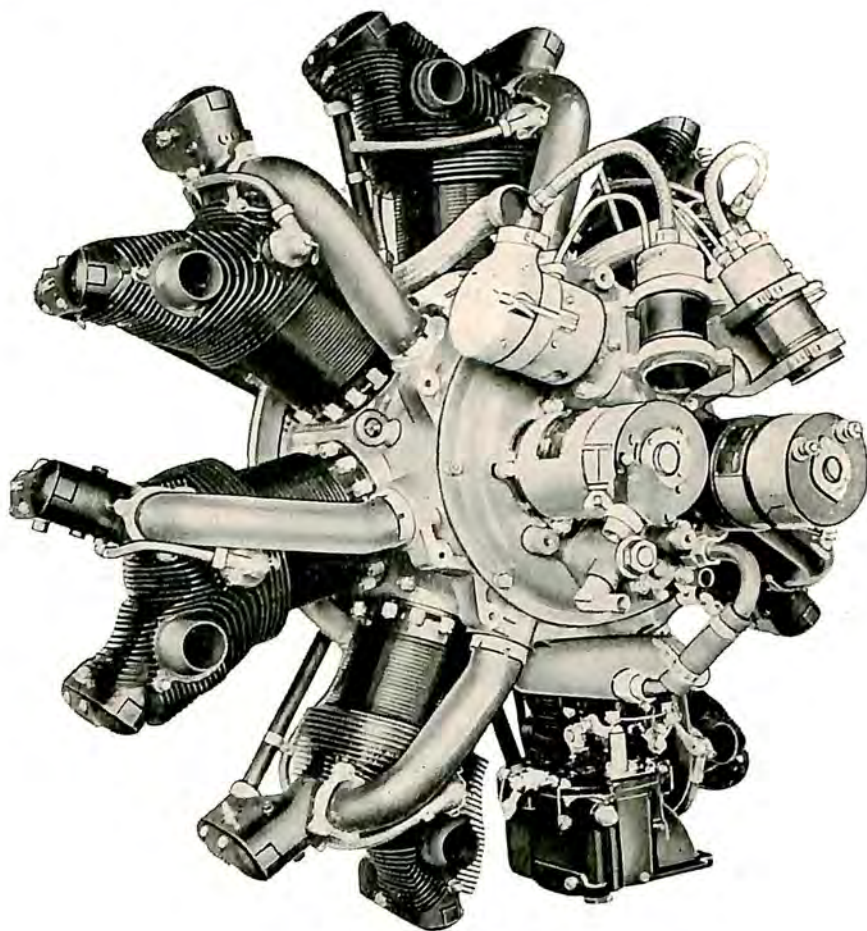
Jacobs Aircraft Engine Company, Pottstown, Pa., continued pro-

duction 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  $1\frac{2}{3}$  pounds per horsepower. These models carried two Scintilla battery ignition distributors and Eclipse generator as standard



THE JACOBS L-4

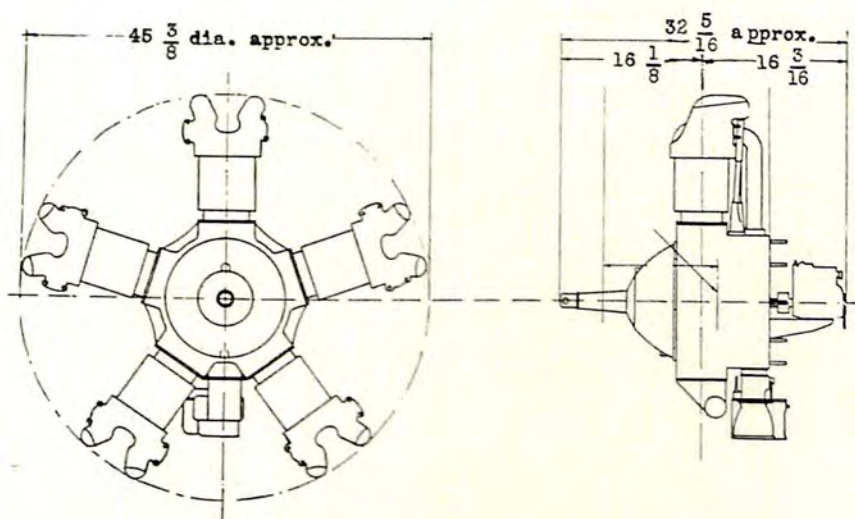
A seven-cylinder, radial, aircooled engine rated at 225 h.p.



#### THE JACOBS L-5

This seven-cylinder radial engine is rated at 285 h.p.

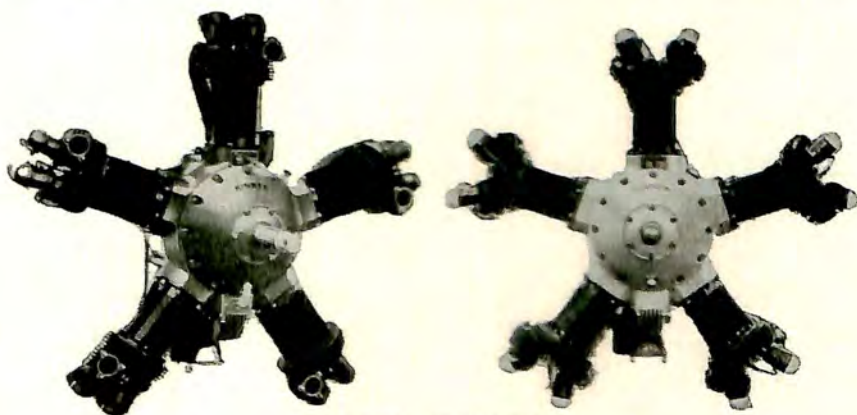
equipment. Both types were also supplied with two Scintilla magnetos, designated as Models L-4M and L-5M, or with one magneto and one battery distributor, designated as Models L-4MB and L-5MB. A two-piece main crankcase was used on all models, the front half being an aluminum casting carrying the front 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 cylinder heads, with an increased number of deeper fins for cooling,



KINNER R-5

This five-cylinder aircooled radial engine is rated at 160 h.p.

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-



KINNER ENGINES

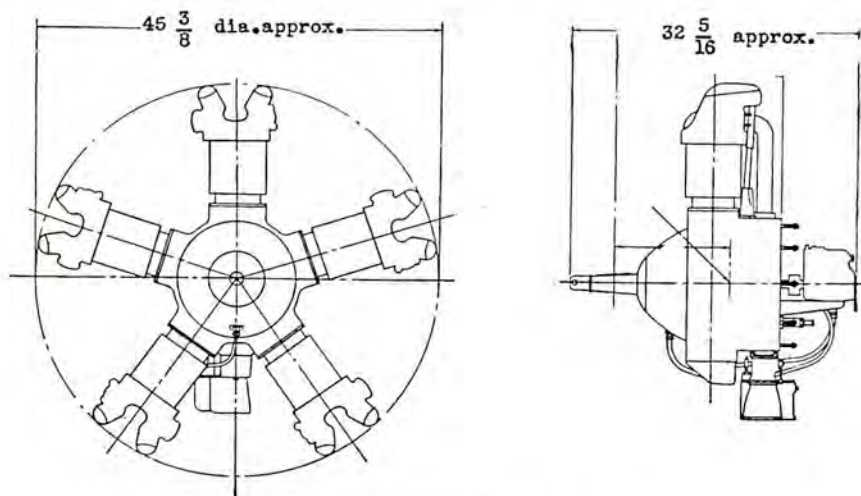
Kinner K-5, 100 h.p. (left); Kinner R-5, 160 h.p. (right).

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 it would bring out a new series of engines in 1938, with  $\frac{1}{4}$  in. more stroke and 85 cu. in. more displacement than the L-5 series.

Ken-Royce Aircraft Engine Company, Kansas City, Mo., manufactured the LeBlond engines. A seven-cylinder model was being re-rated to develop between 120 and 125 h.p. at 2,250 r.p.m. The 90 h.p. LeBlond engines were sold to Swedish flying schools.

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-7 300 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.

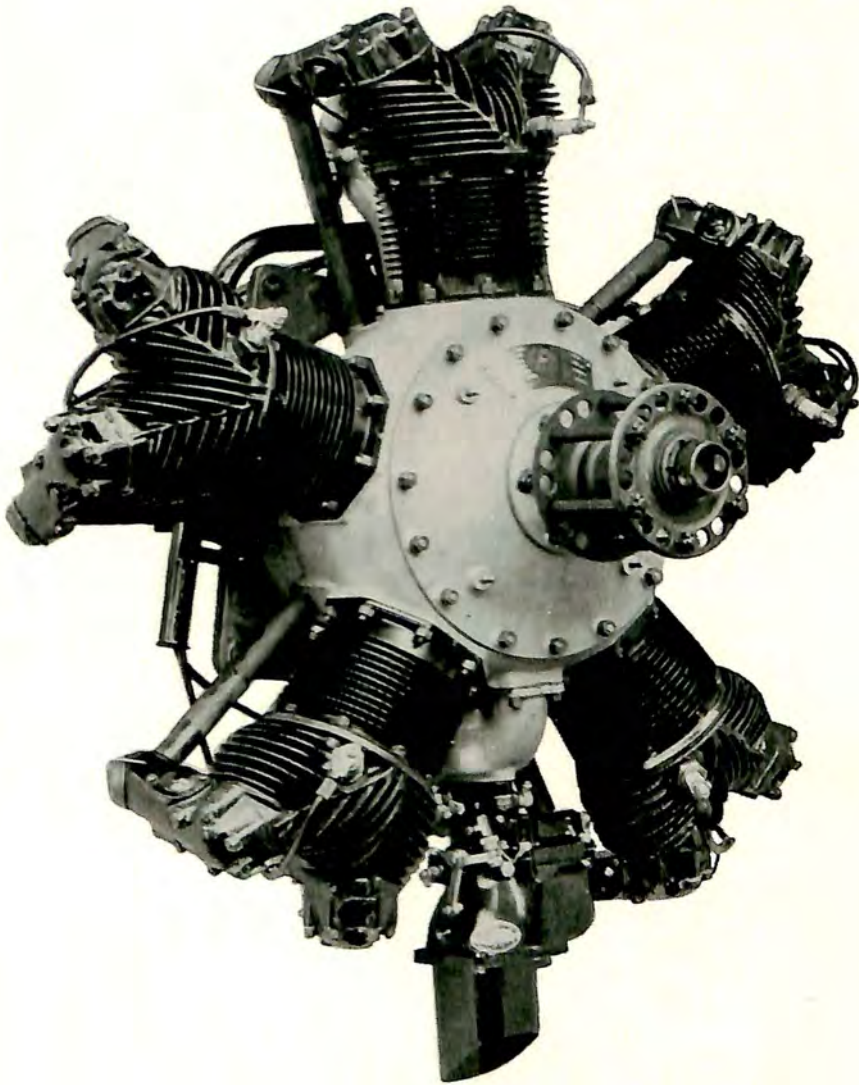
Lambert Engine & Machine Company, Moline, Ill., produced the Lambert R-266 radial aircooled engine, direct drive, 90 h.p. at 2,375 r.p.m., cruising rating 60 h.p. at 5,000 feet, compression ratio 5.55:1, bore 4.25 inches, stroke 3.75 inches, displacement 266 cubic inches,



KINNER B-5

This is a five-cylinder aircooled radial which is rated at 125 h.p.





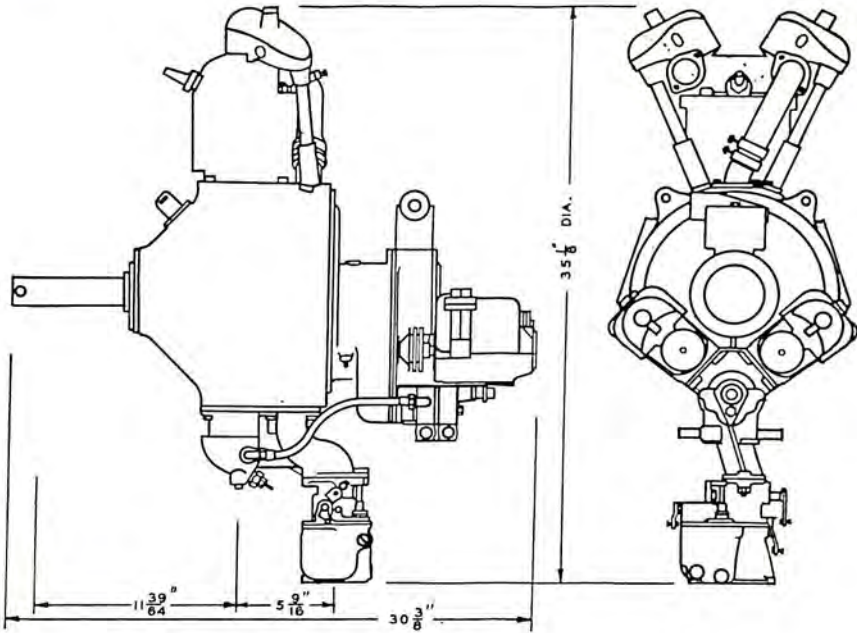
LEBLOND 70

A five-cylinder engine rated at 90 h.p.

length 30 inches, diameter 34 inches, weight overall 225 pounds, 2.5 pounds per horsepower.

Lawrance Engineering & Research Corporation, Linden, N. J., continued its development work on aircraft motors.

Lenape Aircraft & Motors, Inc., Matawan, N. J., built an addition to its plant, and continued production of its 50 h.p. Lenape

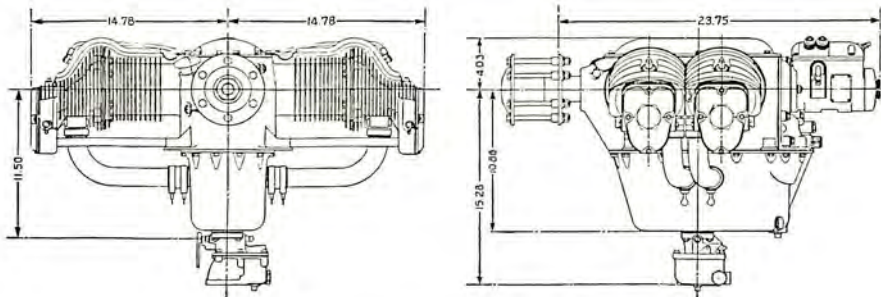


LAMBERT R-266

A five-cylinder aircooled radial engine rated at 90 h.p.

Papoose, with two other projects under way—the 90 h.p. Lenape Brave and the 125 h.p. Lenape Chief.

Lycoming Division, Aviation Manufacturing Corporation, Williamsport, Pa., manufacturers of aircraft engines and controllable propellers continued production of the R-680-D nine cylinder 245 h.p. series engines and R-530-D seven cylinder 190 to 220 h.p. series en-



LYCOMING SERIES O-145-B

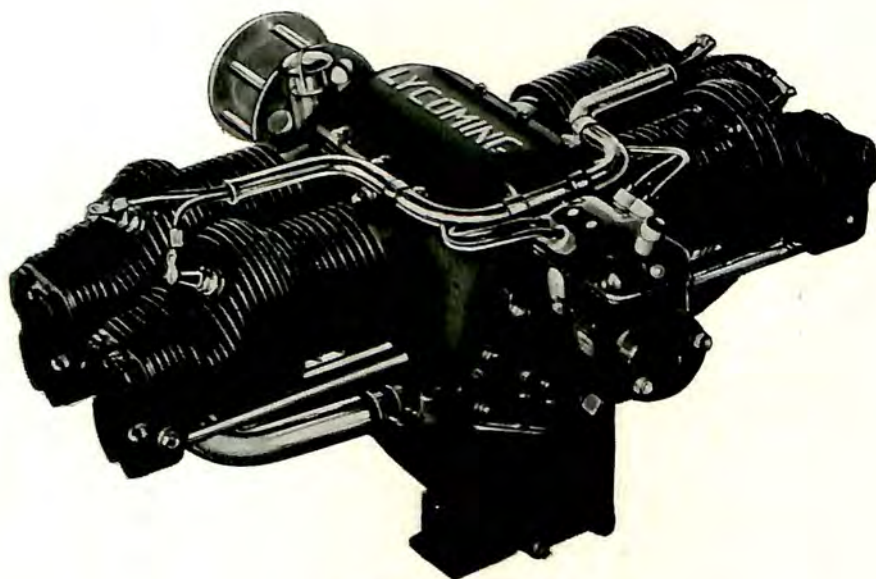
A four-cylinder horizontally opposed engine rated at 75 h.p. at 3,100 r.p.m.

gines as well as the O-145-A series 50 and 55 h.p. and 65 h.p. four cylinder horizontally opposed engines for light airplanes.

The O-145-A1 50 and 55 h.p. series engines were installed in the Aeronca, Piper and Taylorcraft light planes. Shipments also were made to Crowther Limited, London, England, who purchased 50 for installation in Taylorcraft planes being manufactured in England. Engines were available with single or dual magneto ignition and provision for starter, generator or fuel pump drives as well as with radio shielding and altitude mixture control carburetor.

Early in 1939 Lycoming received an A. T. C. on a 75 h.p. direct drive engine known as the O-145-C series and developing 75 h.p. at 3,100 r.p.m. These engines were available with the same accessory drives as the O-145-A series engines. Considerable development work had also been carried on with a 75 h.p. geared engine, to develop 75 h.p. at 3,100 r.p.m. with a propeller speed of approximately 2,050 r.p.m.

The R-680-E series nine cylinder engines were announced with ratings as follows: Model R-680-E2 with a take-off rating of 280 h.p. at 2,300 r.p.m., normal rating 265 h.p. at 2,200 r.p.m.; Model R-680-E1 with a take-off rating of 290 h.p. at 2,300 r.p.m., normal rating of 275 h.p. at 2,200 r.p.m.; and Model R-680-E3 with a take-off rating of 300 h.p. at 2,300 r.p.m., normal rating of 285 h.p. at 2,200 r.p.m. Those



LYCOMING O-145

A four-cylinder horizontally opposed engine rated at 50 h.p. at 2,300 r.p.m.



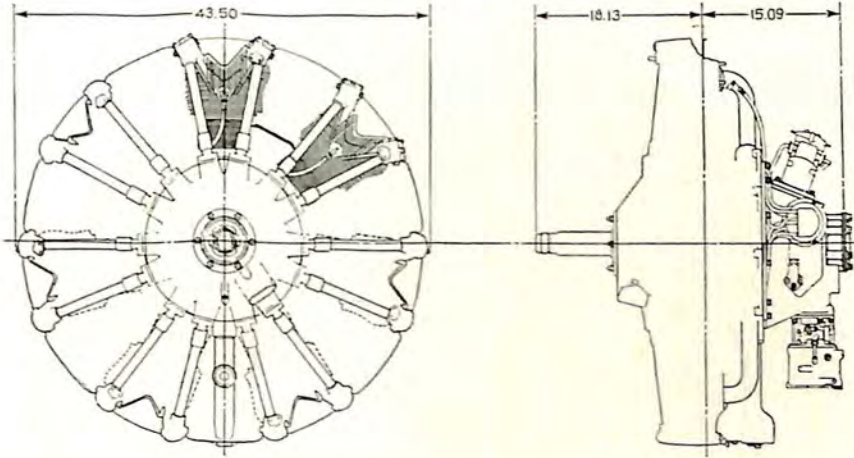
LYCOMING SERIES R-530-D

A seven-cylinder engine rated at 190 to 220 h.p.

engines were similar in design to the R-680-D series, the increased horsepower being obtained by the use of higher compression ratios.

In the military field, Lycoming R-680-7 engines were produced in 1938 for use in the Stearman PT-12A Army primary training airplanes. The Model R-680-7 engine, rated at 220 h. p., was also equipped with automatic valve gear lubrication and complete accessory drive equipment. The latest model R-680-D series engines were used in the Stinson SR-10 Reliant and other airplanes in commercial and private flying service.

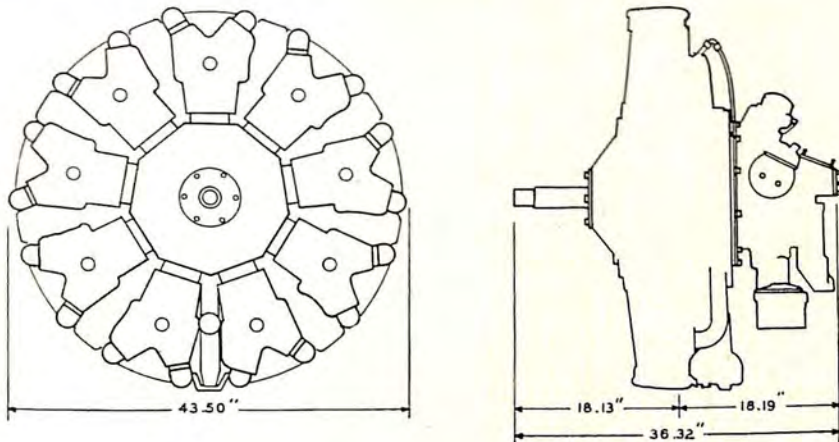
In 1938 a Lycoming-powered trio of light planes—an Aeronca, a Piper Cub and a Taylorcraft all with 50 h.p. Lycoming engines—made a country-wide demonstration tour. The planes covered 29



LYCOMING SERIES R-530-D

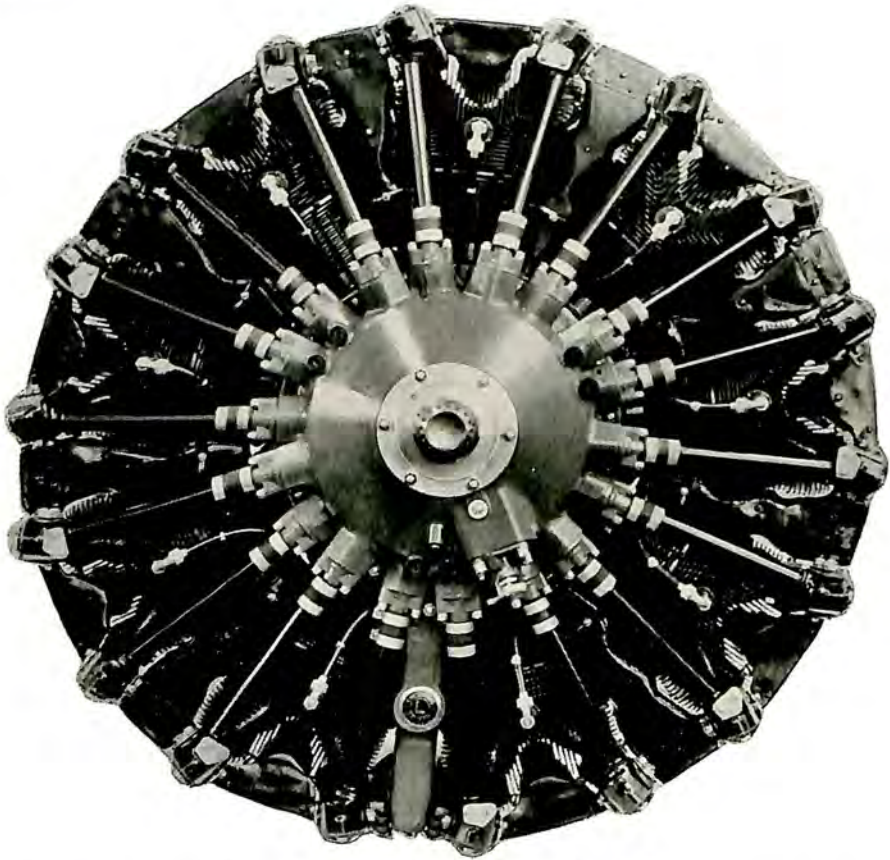
A seven-cylinder engine rated at 190 to 220 h.p.

States. The three pilots, combined, visited a total of 293 airports, contacted 71 airplane distributors, gave 1,106 flight demonstrations, and made 2330 landings and take-offs. They recorded a total of 731 flying hours, and logged about 61,987 miles of flying, in temperatures ranging from zero in Minneapolis to 95 degrees in Miami. They used only 1,971 gallons of gasoline, much of it automotive fuel, and 15 quarts of oil. They averaged 84.8 m.p.h., 2.7 gallons of fuel an



LYCOMING R-680-D

This nine-cylinder, radial, aircooled engine is rated at 245-260 h.p.

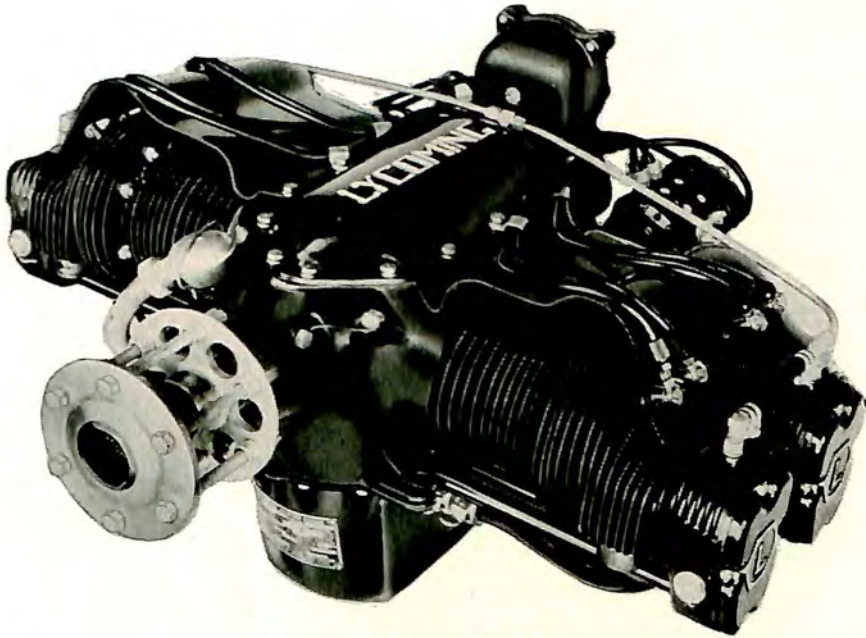


LYCOMING SERIES R-680-D and E

A nine-cylinder engine rated at 245 to 260 h.p. for the R-680-D and 300 h.p. for the R-680-E.

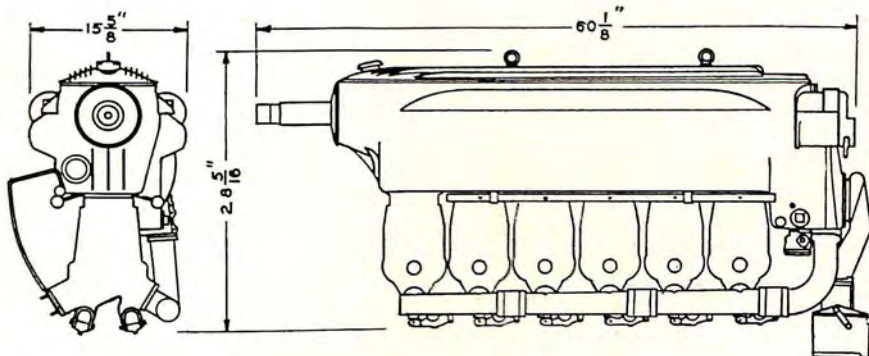
hour, 31.4 miles per gallon, .0205 quart of oil per hour and 4,133 miles per quart of oil.

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  $2\frac{1}{2}$  acres was purchased by the company thereby nearly doubling



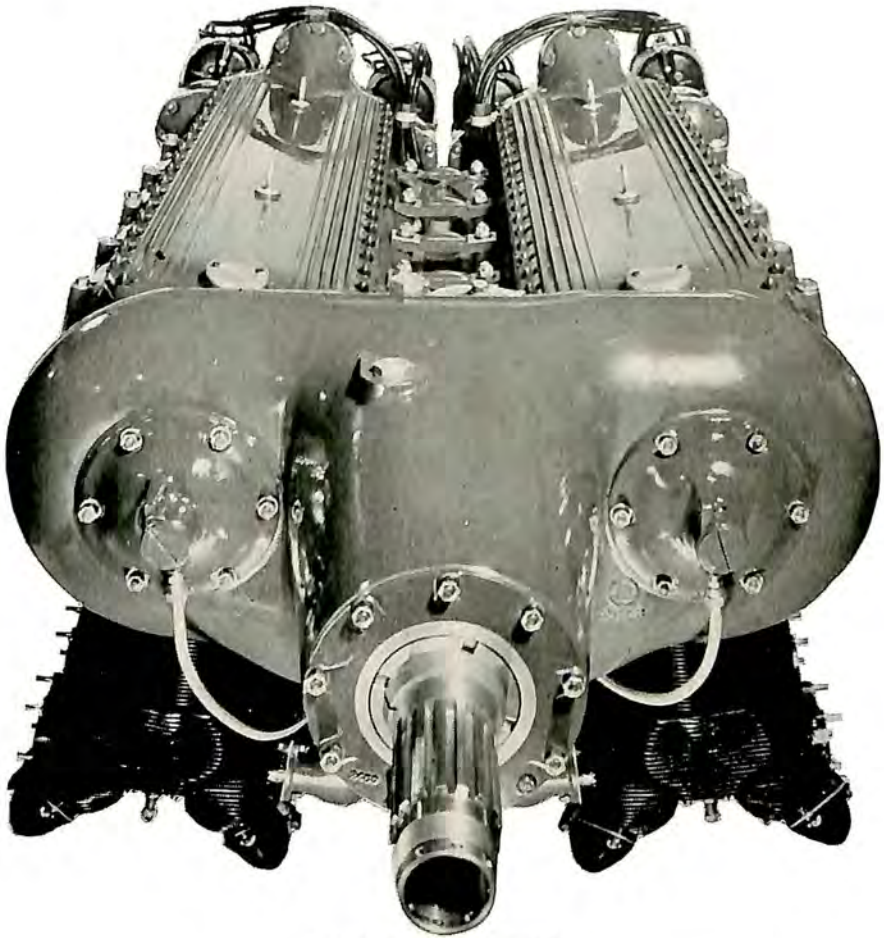
LYCOMING "65" SERIES O-145-B

A four-cylinder horizontally opposed engine rated at 75 h.p. at 3,100 r.p.m., and 65 h.p. with 10 h.p. reserve.



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.



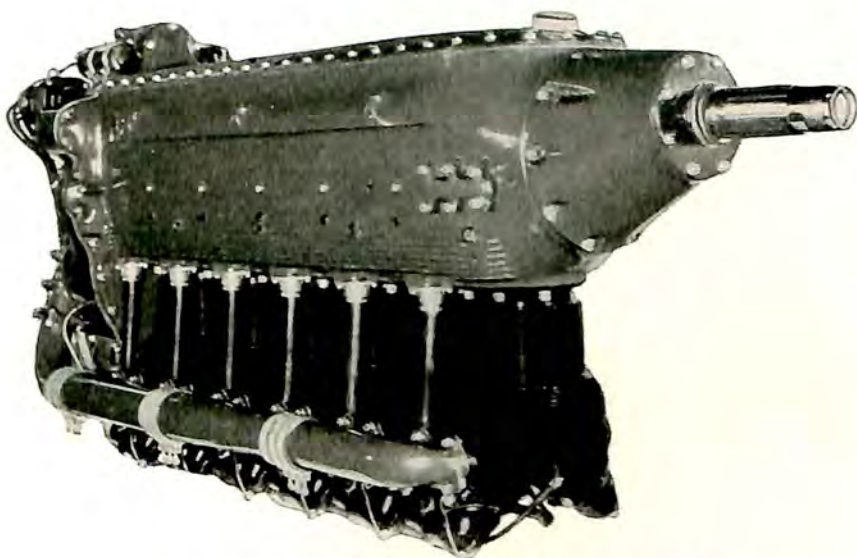
#### MENASCO UNITWIN

Developing 520 h.p. for take-off it is a combination of two Menasco C6S-4 six-cylinder inverted in-line engines.

its previous plant size. The C6S-4 was granted Approved Type Certificate No. 197 with the following specifications: 260 h.p. at 2300 r.p.m. at 7,500 feet with a manifold pressure of 39.5 in. Hg. on fuel of 80 octane. Take off rating: 290 h.p. at 2400 r.p.m. with a manifold pressure of 44 in. Hg. with a fuel of 87 octane.

The Menasco Unitwin was in the final stages of development, with the A.T.C. pending. It consists of two Menasco C6S-4 engines placed side by side and geared to a single, constant-speed propeller through a gear box containing over-riding clutches. These clutches provide automatic engagement and disengagement of the engines so that





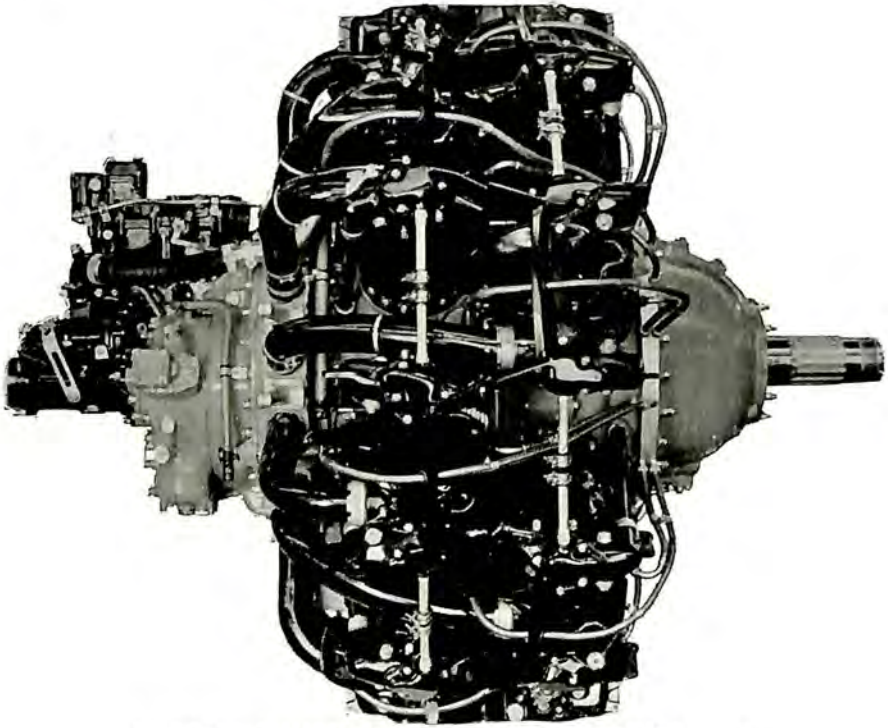
#### MENASCO C6S-4 SUPER-BUCCANEER ENGINE

A six-cylinder inverted, in-line model supercharged and developing 290 h.p. for take-off.

either engine may be cut out at will without any effect on the other. The propeller governor is driven from the propeller shaft rather than from either engine's crankshaft. Power rating: 520 h.p. at 2300 r.p.m. at 7,500 feet. Take off rating: 580 h.p. at 2400 r.p.m.

Monocoupe Corporation, Robertson, Mo., continued to manufacture their 90 h.p. Lambert engine, a five-cylinder fixed radial.

Pratt & Whitney Aircraft, a division of United Aircraft Corporation at East Hartford, Conn., continued to produce two basic types of aircooled engines. One was the 9-cylinder single-row radial, which was in use on a long list of commercial and military aircraft in the United States and abroad. The other was the 14-cylinder two-row radial, first produced in the United States by Pratt & Whitney in 1933. The popularity of the two-row type was indicated by the use of these engines in a rapidly growing list of high-performance aircraft, including such outstanding examples as the Douglas DC-3's of United Air Lines and Northwest Airlines; the four-engine Douglas DC-4 transport; Curtiss and Seversky Pursuits; Consolidated Navy Patrol Bombers; Vought, Douglas, and Curtiss Scout Bombers; Sikorsky and Consolidated four-engined Patrol Bombers; Boeing B-15 Bomber; and Vultee Attack airplanes. All models of both single-row and two-row types were available with the latest Pratt & Whitney design



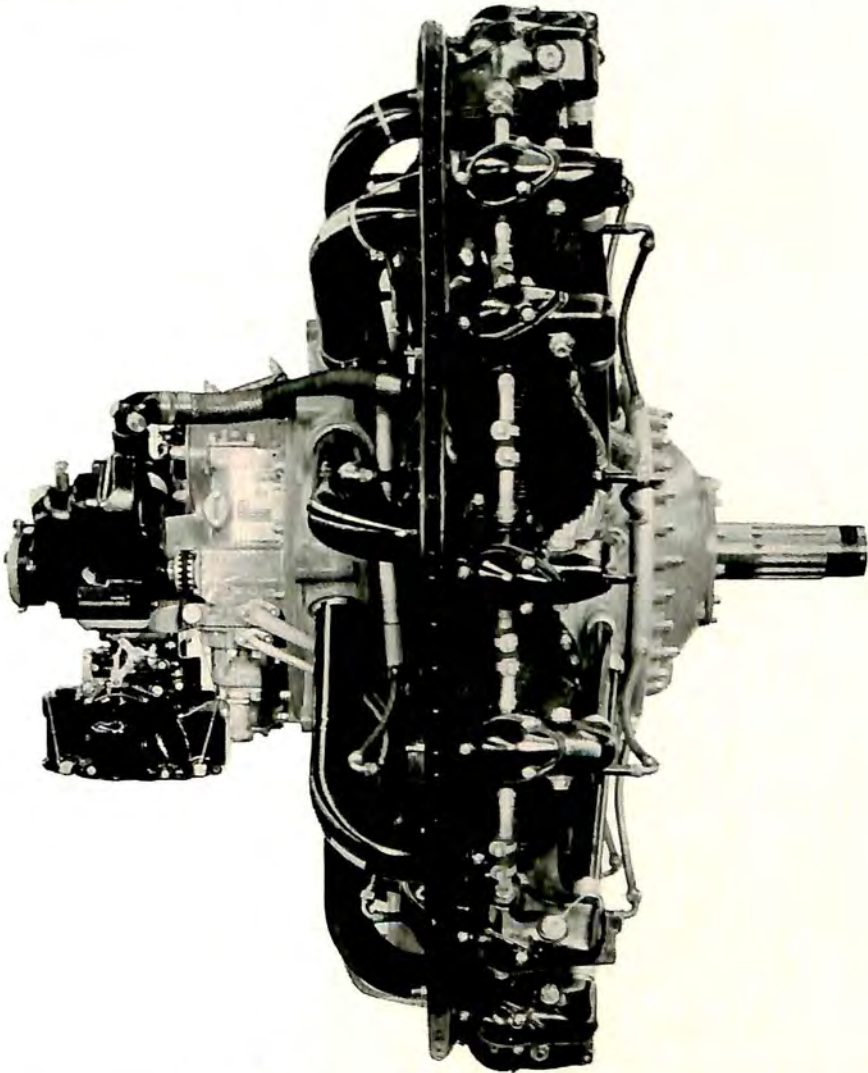
PRATT & WHITNEY TWIN HORNET SERIES A-1G

A 14-cylinder two-row geared engine rated at 1,400 h.p. at 2,500 r.p.m. for take-off. features, including automatic valve gear lubrication and automatic power and mixture control.

The two-row engines were built in three sizes, the Twin Wasp Junior, Twin Wasp, and Twin Hornet. Largest of these was the Twin Hornet, with a displacement of 2180 cubic inches and a take-off rating of 1400 horsepower at 2500 r.p.m. on 100 octane fuel; the normal rating being 1150 horsepower at 2350 r.p.m. on 100 octane fuel.

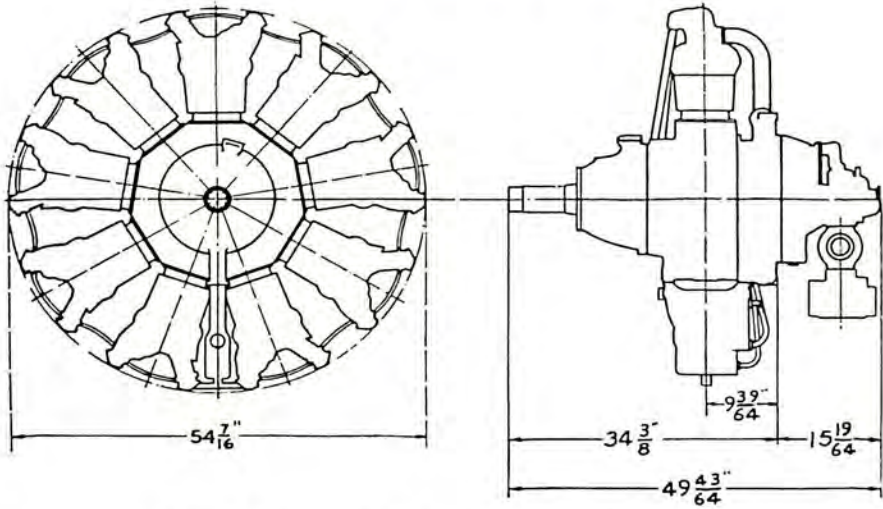
The Twin Wasp engine was built in three models, all being of the geared type. Model SC<sub>3</sub>-G had a take-off rating of 1050 h.p. at 2,700 r.p.m. and a normal rating of 900 h.p. at 12,000 ft. at 2550 r.p.m. on 87 octane fuel, using a 7.15:1 blower ratio. Model S1C<sub>3</sub>-G was rated at 1200 h.p. at 2,700 r.p.m. for take-off, and 1050 h.p. at 7500 feet at 2550 r.p.m., on 100 octane fuel, the blower ratio being 7.15:1. Model S<sub>3</sub>C<sub>3</sub>-G had a take-off rating of 1100 h.p. at 2700 r.p.m. and a normal rating of 950 h.p. at 14,300 ft. at 2700 r.p.m. on 100 octane fuel, with a blower ratio of 8:1. All three of the Twin Wasp models had a dry weight of 1413 lbs.

One model of the Twin Wasp Junior was in production. This was the SB4-G, a geared engine with a take-off rating of 825 h.p. at 2625 r.p.m. and normal rating of 750 h.p. at 9500 ft. at 2550 r.p.m. using 87 octane fuel, with a blower ratio of 11:1. The engine had a dry weight of 1120 lbs.



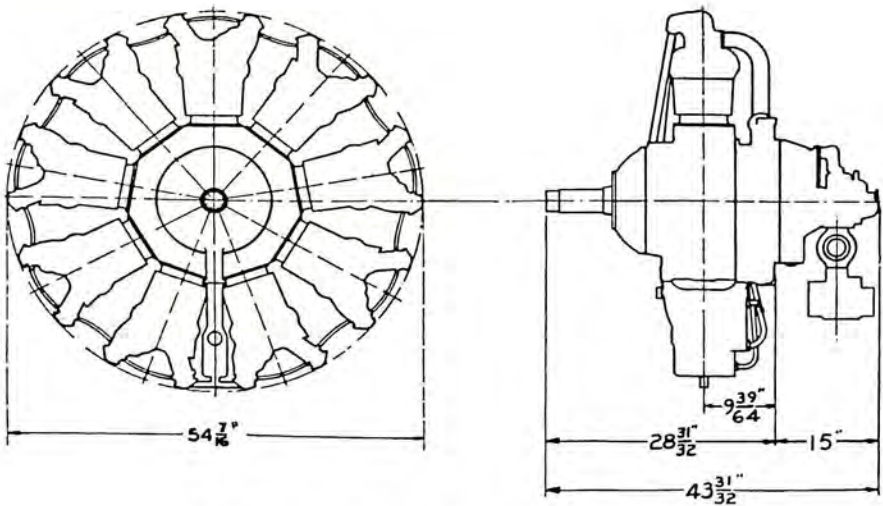
#### PRATT & WHITNEY HORNET SERIES E

A nine-cylinder single-row engine in two direct drive and two geared models: S1E (direct) and S1E2-G (geared) rated at 875 h.p. at 2,300 r.p.m. for take-off; S5E (direct) rated at 700 h.p. at 2,050 r.p.m. for take-off; and S2E-G (geared) rated at 800 h.p. at 2,300 r.p.m. for take-off.



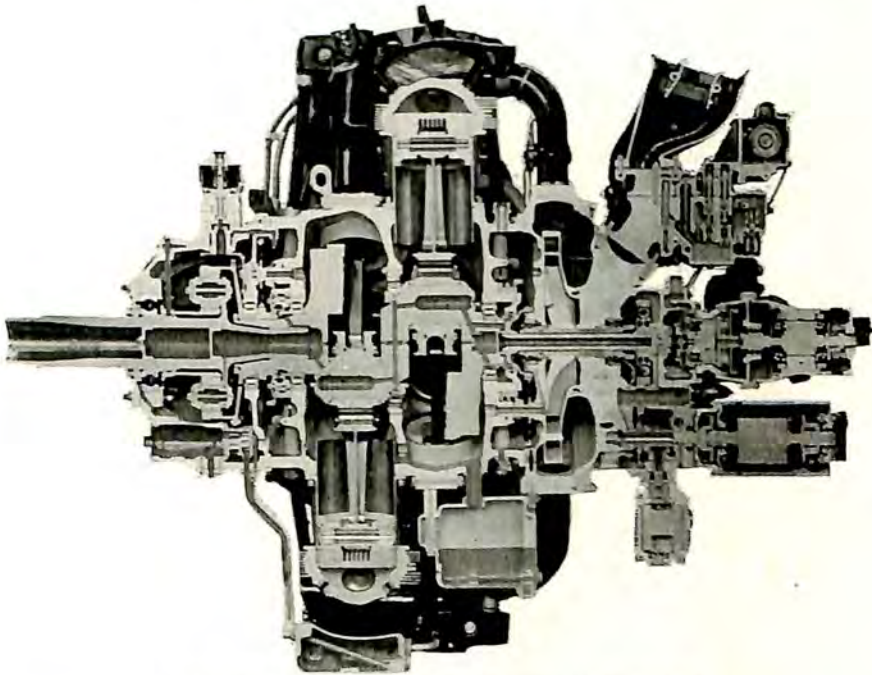
PRATT & WHITNEY HORNET SERIES E GEARED

The nine-cylinder S1E2-G geared engine rated at 875 h.p. at 2,300 r.p.m. for take-off.



PRATT & WHITNEY HORNET SERIES E

The nine-cylinder direct drive S1E engine rated at 875 h.p. at 2,300 r.p.m. for take-off.



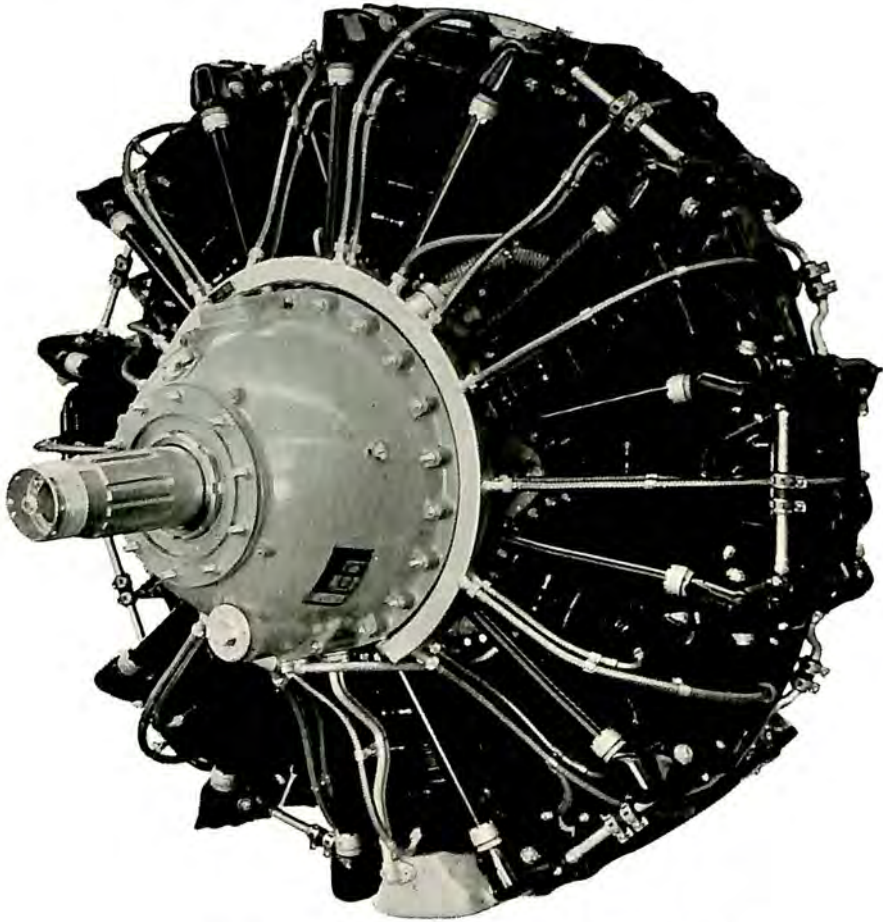
#### PRATT & WHITNEY TWIN WASP ENGINE

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

Three classes of the Pratt & Whitney single-row engines were in production during the year, these being the Hornet, Wasp, and Wasp Junior.

There were four Hornet models, two of these being direct drive and two geared. Models S1E (direct drive), and S1E2-G (geared) had take-off ratings of 875 h.p. at 2300 r.p.m. and normal ratings of 750 h.p. at 7000 ft. at 2250 r.p.m. on 87 octane fuel. The blower ratio for the S1E model was 12:1, and for the S1E2-G model, 10:1. Model S2E-G (geared) had a take-off rating of 800 h.p. at 2300 r.p.m. and normal rating of 750 horsepower at 2500 ft. at 2250 r.p.m. on 87 octane fuel with a 10:1 blower ratio; while model S5E (direct) had a take-off rating of 700 h.p. at 2050 r.p.m., and a normal rating of 700 h.p. at 6000 ft. at 2050 r.p.m. on 87 octane fuel, with a blower ratio of 12:1. The direct drive models weighed 975 lbs. dry, while the dry weight of the S1E2-G was 1070 lbs. and of the S2E-G, 1064 lbs.

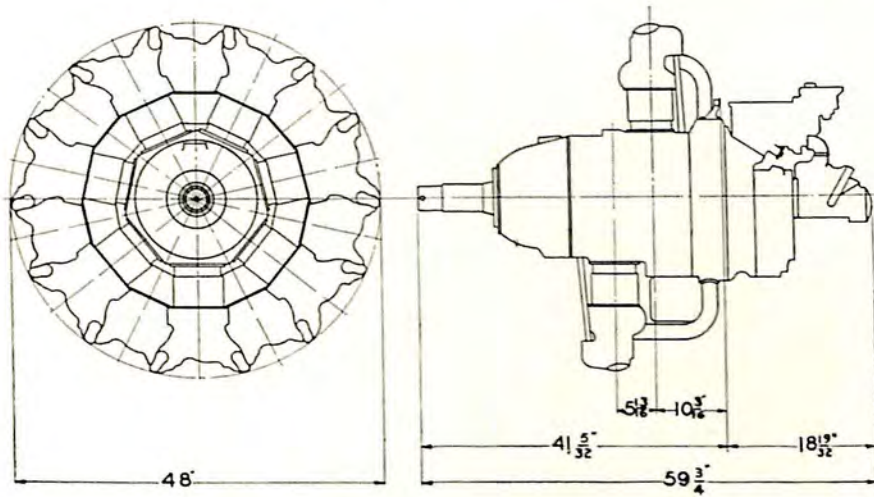
The Wasp class was represented by no less than six models, three of these being direct drive and three geared. The S1H1 (direct) and S1H1-G (geared) models had take-off ratings of 600 h.p. at 2250



PRATT & WHITNEY TWIN WASP SERIES C<sub>3</sub>-G

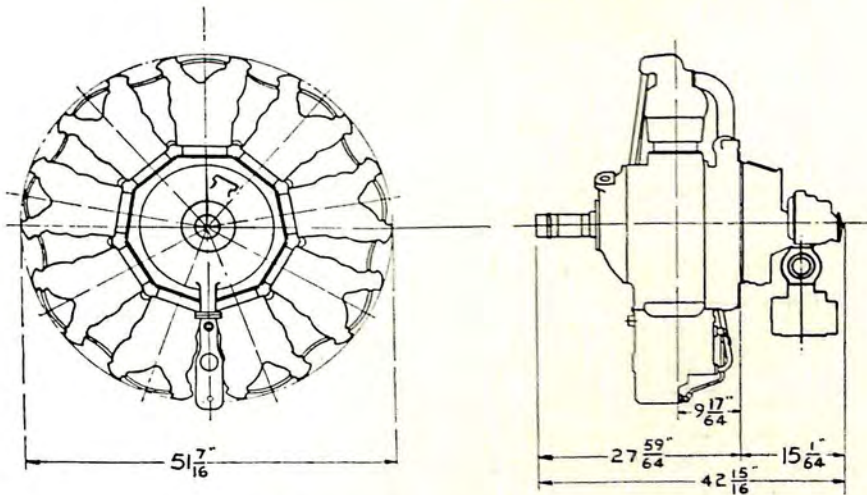
A 14-cylinder two-row engine in three geared models; SC<sub>3</sub>-G rated at 1,050 h.p. at 2,700 r.p.m. for take-off; S<sub>1</sub>C<sub>3</sub>-G rated at 1,200 h.p. at 2,700 r.p.m. for take-off; and S<sub>3</sub>C<sub>3</sub>-G rated at 1,100 h.p. at 2,700 r.p.m. for take-off.

r.p.m. and normal ratings of 550 h.p. at 8000 ft. at 2200 r.p.m. on 87 octane fuel, with blower ratios of 12:1. Models S<sub>2</sub>H<sub>1</sub> (direct) and S<sub>2</sub>H<sub>1</sub>-G (geared) had take-off ratings of 600 h.p. at 2250 r.p.m. on 87 octane fuel and normal ratings of 500 h.p. at 10,500 ft. at 2200 r.p.m. on 80 octane fuel, using 12:1 blower ratios. Models S<sub>3</sub>H<sub>1</sub> (direct) and S<sub>3</sub>H<sub>1</sub>-G (geared) had take-off ratings of 600 h.p. at 2250 r.p.m. on 87 octane fuel, and normal ratings of 550 h.p. at 5000 ft. at 2200 r.p.m. on 80 octane fuel, with blower ratios of 10:1. The



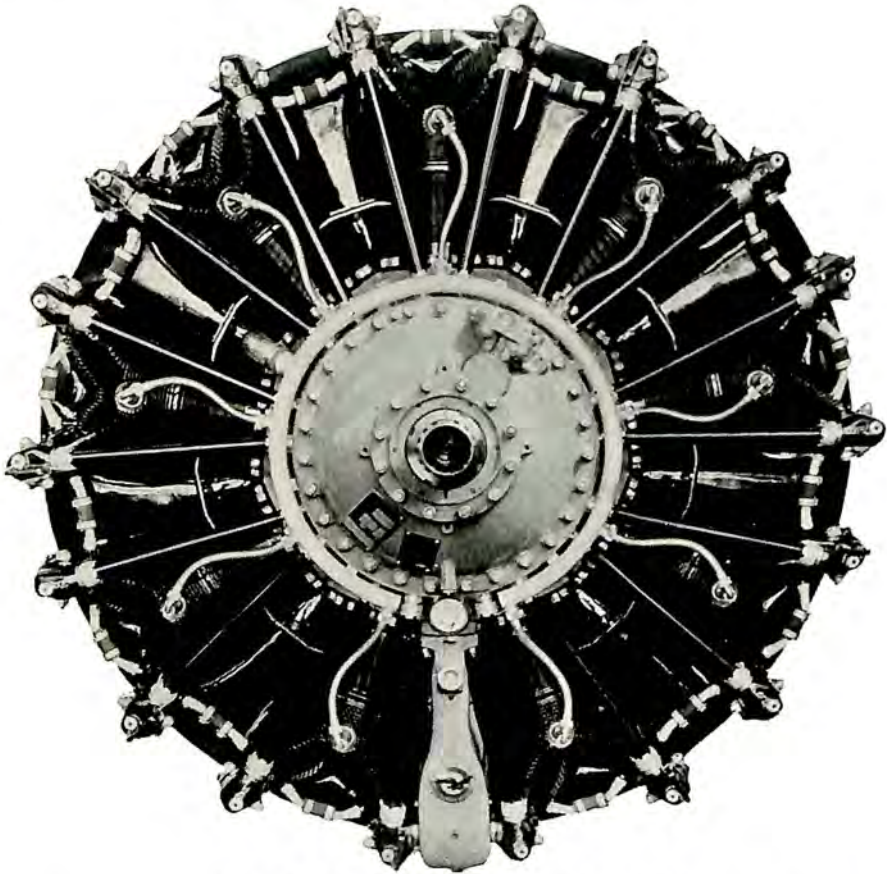
PRATT & WHITNEY TWIN WASP SERIES C<sub>3</sub>-G

The 14-cylinder two-row SIC<sub>3</sub>-G geared engine rated at 1,200 h.p. at 2,700 r.p.m. for take-off.



PRATT & WHITNEY WASP SERIES H<sub>1</sub>

The nine-cylinder single-row direct drive S<sub>1</sub>H<sub>1</sub> rated at 600 h.p. at 2,250 r.p.m. for take-off.



#### PRATT & WHITNEY WASP SERIES H<sub>1</sub>

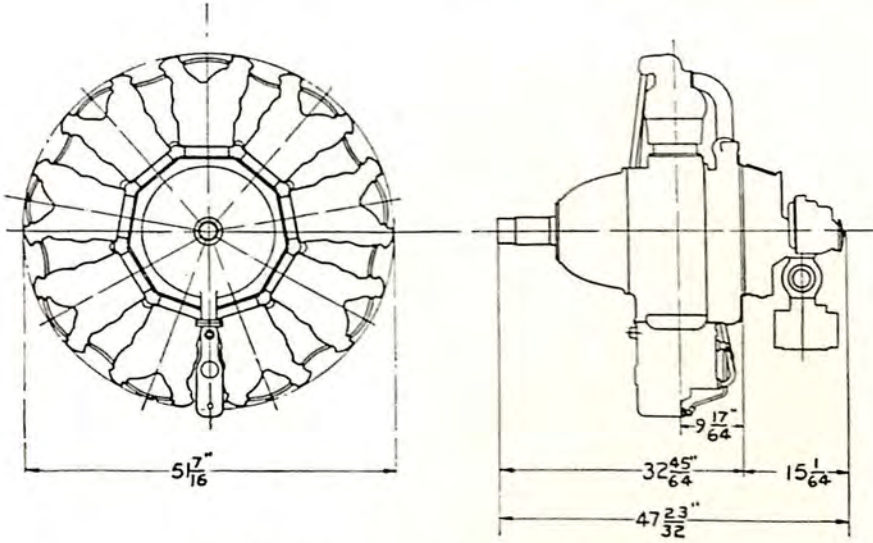
A nine-cylinder single-row engine in three direct and three geared models: S<sub>1</sub>H<sub>1</sub> and S<sub>1</sub>H<sub>1</sub>-G; S<sub>2</sub>H<sub>1</sub> and S<sub>2</sub>H<sub>1</sub>-G; and S<sub>3</sub>H<sub>1</sub> and S<sub>3</sub>H<sub>1</sub>-G, all rated at 600 h.p. at 2,250 r.p.m. for take-off.

dry weight of the direct drive models was 864 lbs., and of the geared models, 930 lbs.

Two models of the Wasp Junior were in production during the year, both of these being direct drive. Model SB had a take-off rating of 450 h.p. at 2300 r.p.m. on 87 octane fuel, and a normal rating of 400 h.p. at 5000 ft. at 2200 r.p.m. on 80 octane fuel, with a blower ratio of 10:1. Model TB had a take-off rating of 440 h.p. at 2300 r.p.m. and normal rating of 420 h.p. at sea level at 2200 r.p.m. using 80 octane fuel, the blower ratio being 8:1.

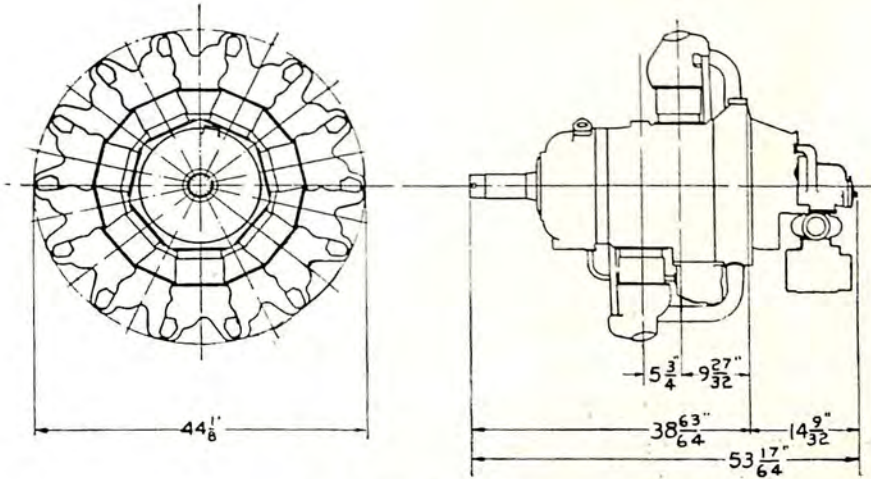
Early in 1939, Pratt & Whitney Aircraft expanded its manufacturing facilities by occupying the existing plant of the Hamilton





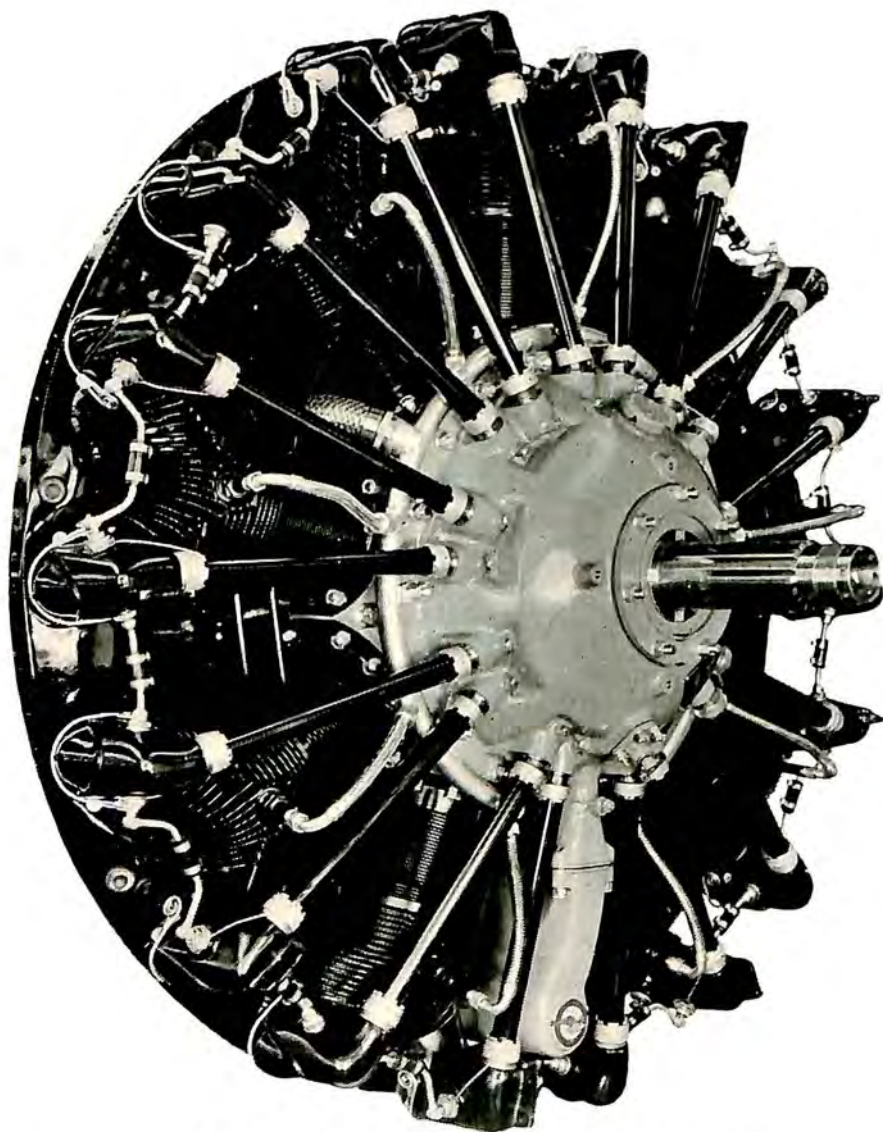
PRATT & WHITNEY WASP SERIES H1-G

The nine-cylinder single-row geared S1H1-G rated at 600 h.p. at 2,250 r.p.m. for take-off.



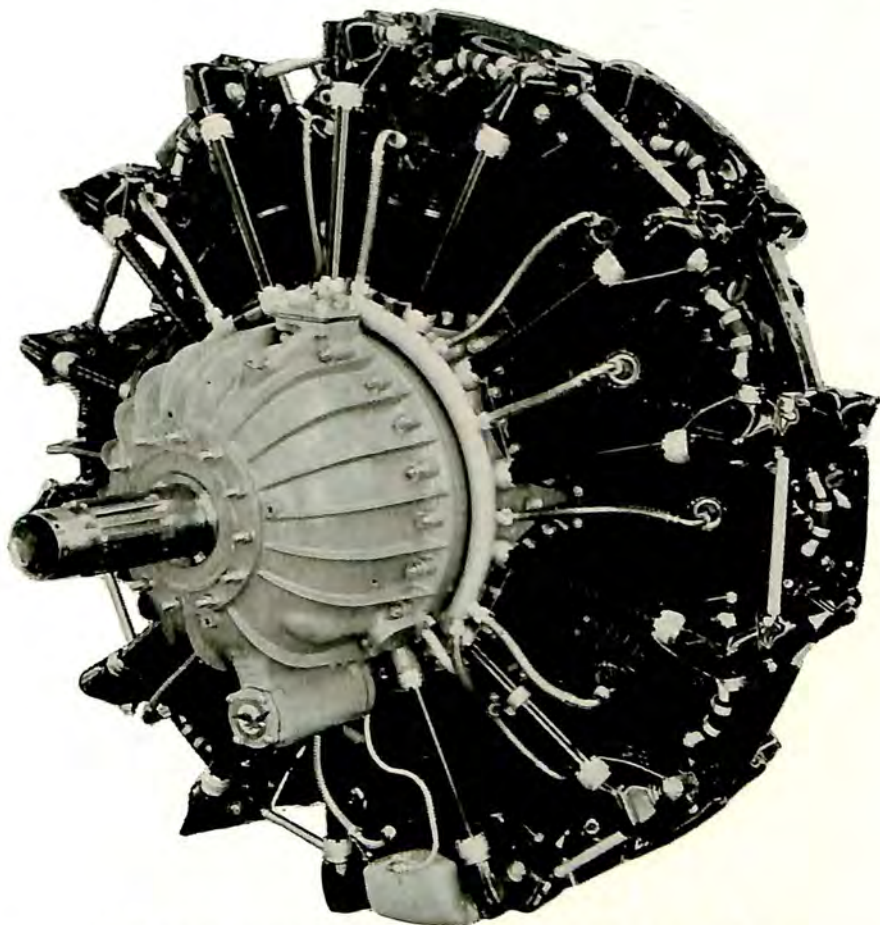
PRATT & WHITNEY TWIN WASP JUNIOR SERIES B4-G

A 14-cylinder two-row geared engine with a take-off rating of 825 h.p. at 2,625 r.p.m.



PRATT & WHITNEY WASP JUNIOR SERIES B

A nine-cylinder single-row engine in two models with direct drive: SB with a rating of 450 h.p. at 2,300 r.p.m. for take-off; and TB rated at 440 h.p. at 2,300 r.p.m. for take-off.



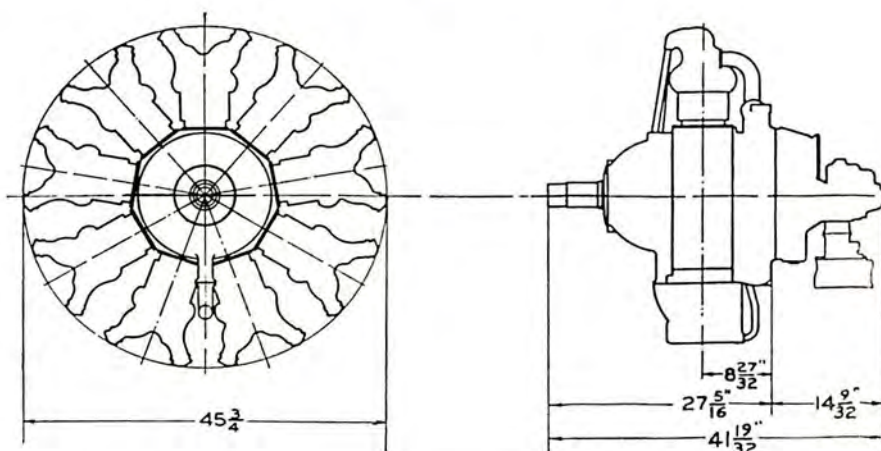
PRATT & WHITNEY TWIN WASP JUNIOR SERIES B4-G

A 14-cylinder two-row geared engine with a take-off rating of 825 h.p. at 2,625 r.p.m.

Standard Propellers division immediately adjoining its own factory. Hamilton Standard was scheduled to occupy the Chance Vought Aircraft factory in East Hartford as soon as that division had been consolidated with the Sikorsky Aircraft division in an enlarged plant at Stratford, Conn.

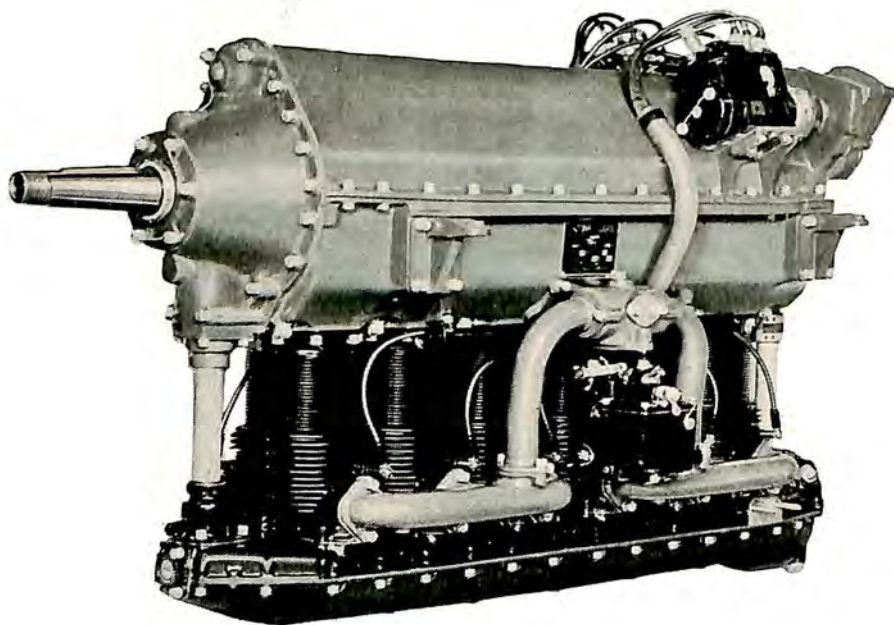
Pratt & Whitney completed and placed in service during the year a new engine test house costing approximately a quarter of a million dollars, and capable of testing engines of 3,000 horsepower.

Ranger Engineering Corporation, Farmingdale, N. Y., a division of the Fairchild Engine and Airplane Corporation, produced several models of inverted, in-line, air-cooled engines for commercial and



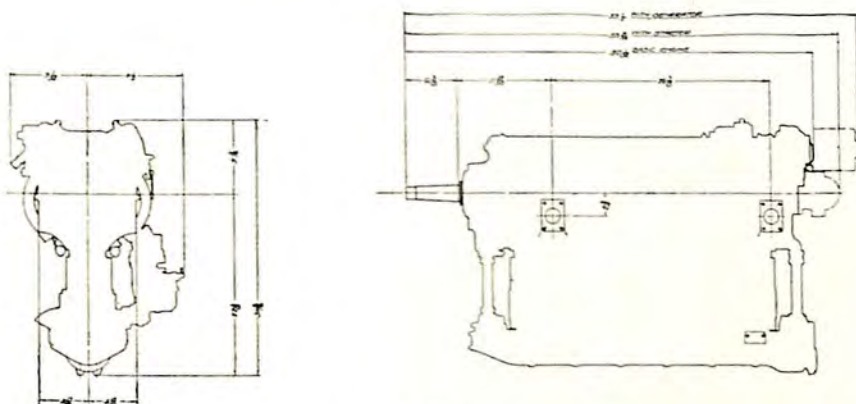
PRATT & WHITNEY WASP JUNIOR SERIES B

The nine-cylinder single-row SB direct drive engine rated at 450 h.p. at 2,300 r.p.m. for take-off.



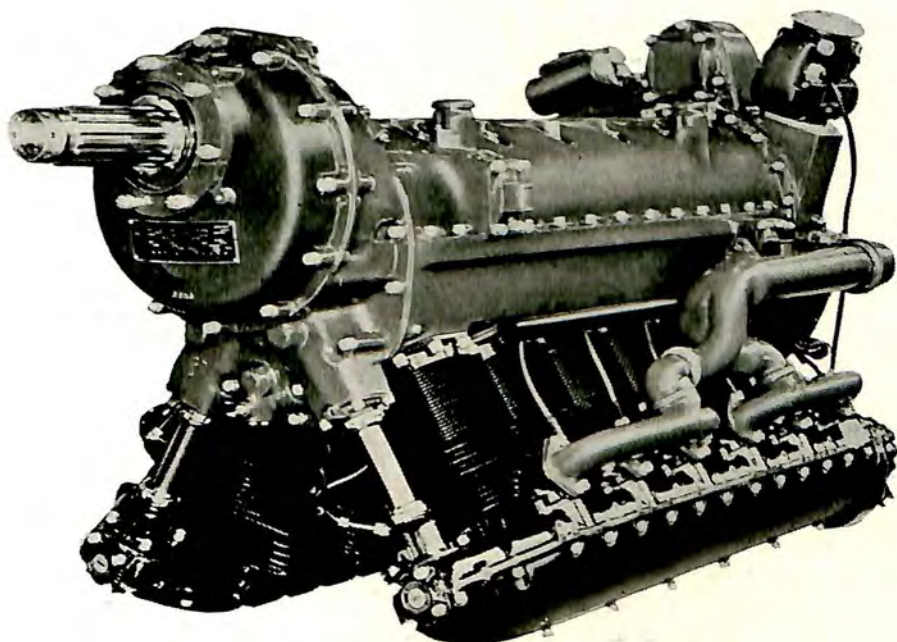
RANGER 6-410B-2

A six-cylinder engine developing 165 h.p. at 2,450 r.p.m.



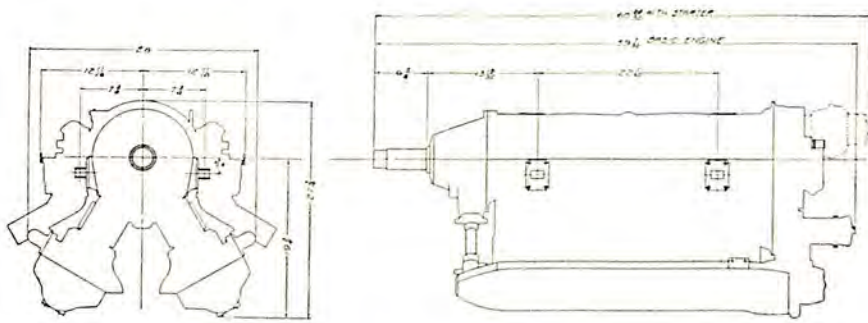
RANGER 6-410B-2

A six-cylinder inverted in-line engine rated at 165 h.p. at 2,450 r.p.m.



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.



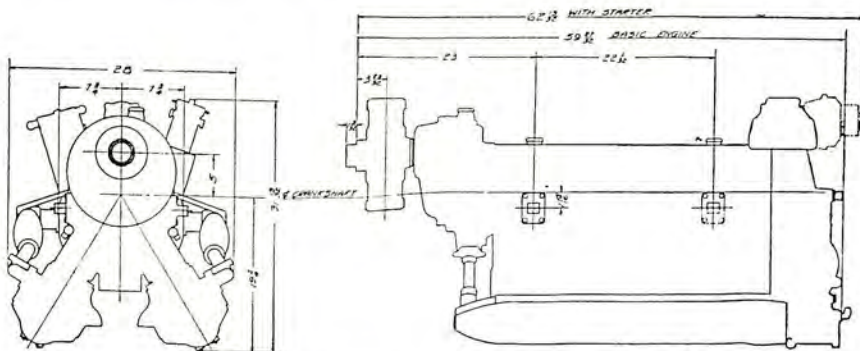
RANGER V-770B-4

A direct drive 60-degree V-type 12-cylinder engine with normal rating of 305 h.p. at 2,300 r.p.m. for take-off.

military purposes. The current production models listed here, which have been released for export sale, cover a power range from 165 h.p. to 500 h.p. Ranger 6-410B-2 is a six-cylinder, in-line, direct drive, unsupercharged engine with a sea level rating of 165 h.p. at 2450 r.p.m. with a bore of  $4\frac{1}{8}$  in., stroke  $5\frac{1}{8}$  in., compression ratio 6.5:1, it is rated on 80 Octane fuel, and has a dry weight, including standard equipment, of 345 lbs. A.T.C. Number 187.

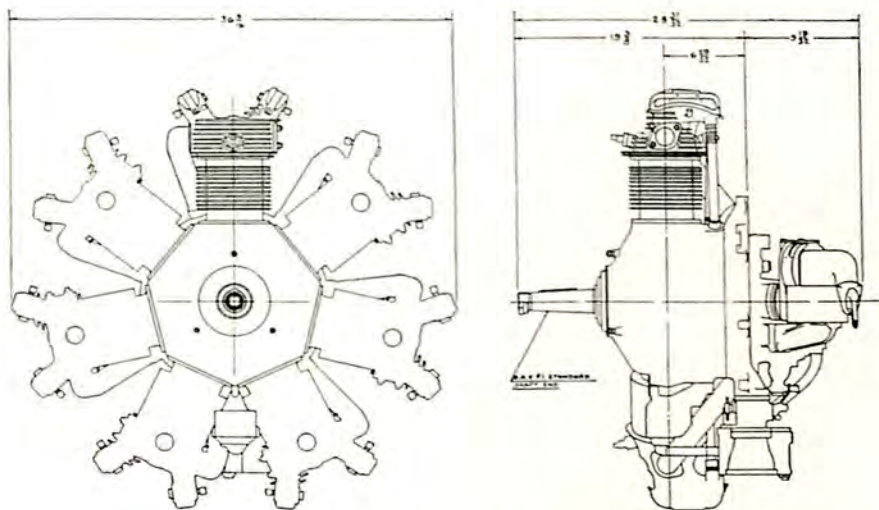
Ranger V-770B-4 is the 12-cylinder, 60 degree Vee, direct drive unsupercharged engine having a sea level rating of 305 h.p. at 2300 r.p.m. with a 315 h.p. take-off rating. The bore is 4 in., stroke  $5\frac{1}{8}$  in., compression ratio 6.5:1, rated on 80 Octane fuel, the dry weight including standard equipment is 565 lbs. A.T.C. Number 184.

Ranger SGV-770B-5 is a geared and supercharged model of the



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

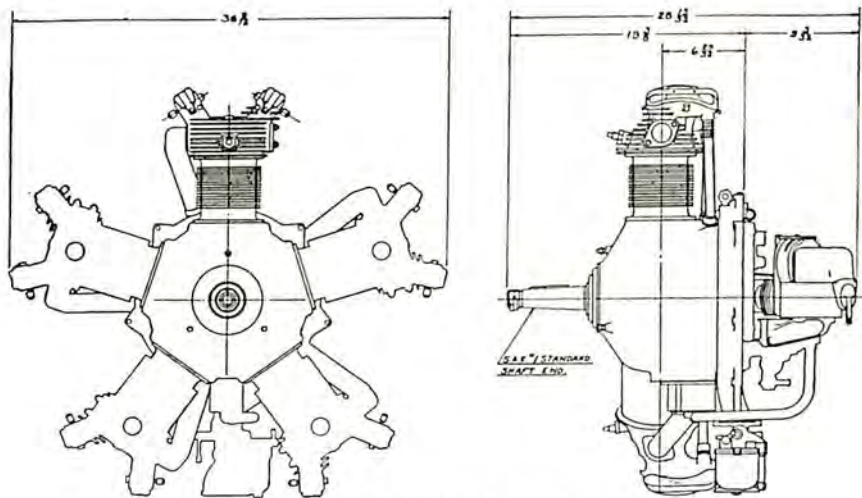
A seven-cylinder aircooled radial engine rated at 125 h.p. at 2,050 r.p.m.

12 cylinder, 60 degree Vee engine. This engine has an altitude rating of 420 h.p. at 2800 r.p.m. at 3000 ft. altitude with a take-off rating of 450 h.p. from sea level to 2000 ft. altitude. The bore is 4 in., stroke  $5\frac{1}{8}$  in., compression ratio 6:1, supercharged ratio 8.84:1, reduction gear ratio 3:2, rated on 87 Octane fuel, the dry weight, including standard equipment is 640 lbs. A.T.C. Number 185.

Ranger SGV-770B-6 engine is very similar to the SGV-770B-5 engine, with the exception of several design refinements which include changes in the supercharger section, piston, main bearings, and connecting rod bearings. This engine has an altitude rating of 420 h.p. at 2850 r.p.m. at 5700 ft. altitude with a take-off rating of 500 h.p. at 2950 r.p.m. from sea level to 1700 ft. altitude. The bore is 4 in., stroke  $5\frac{1}{8}$  in., compression ratio 6:1, supercharger ratio 8.84:1, reduction gear ratio 3:2, rated on 87 Octane fuel, the dry weight, including standard equipment is 640 lbs. A.T.C. Number 207.

Most recent installations of the 6-410 model, 6-cylinder engine have been made in the White "Gull", the 3-place amphibian built by the White Aircraft Company at Buffalo. The latest models of the Fairchild "24" four-place cabin airplanes and the Phillips "PT", a low-wing all-metal, 2-place training airplane built by Phillips Aviation Corporation of Los Angeles, California.

The latest type twin-engine photographic airplane built by the Koolhoven Vlughtuigen of Rotterdam, Holland, is powered with two



#### WARNER SCARAB JUNIOR

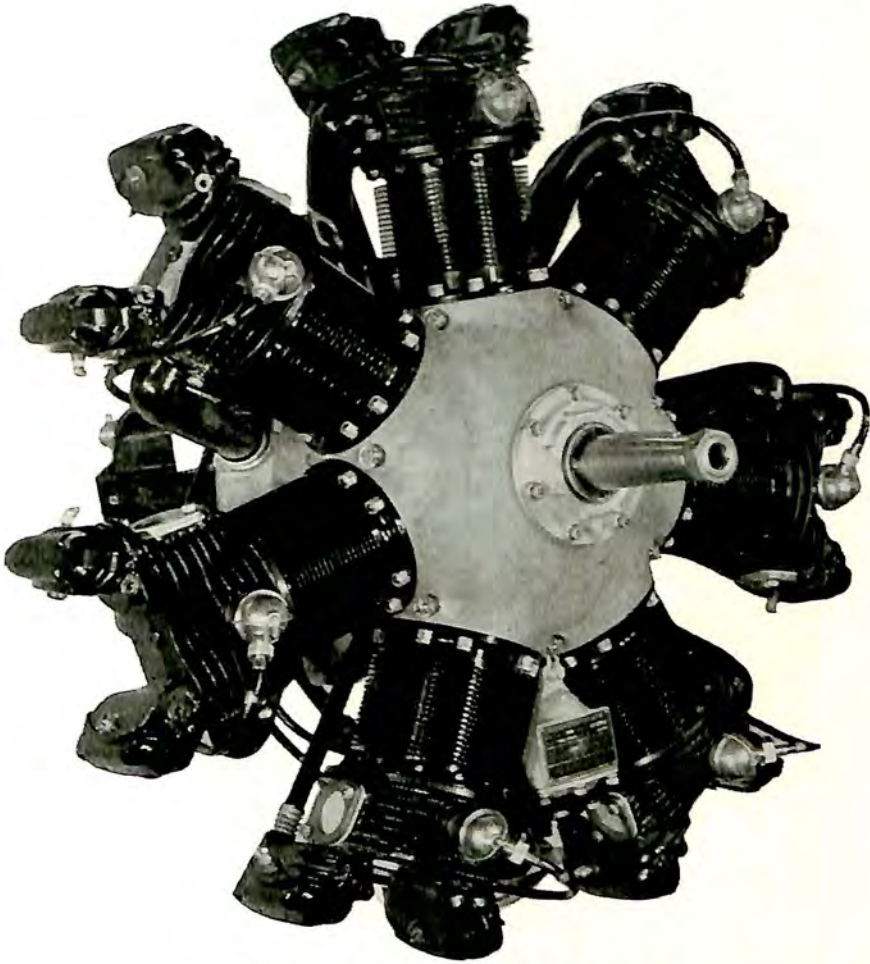
A five-cylinder aircooled radial engine rated at 90 h.p. at 2,050 r.p.m.

Ranger Model V-770B-4 direct drive, 12-cylinder engines. Installation of the geared and supercharged 12-cylinder SGV-770B-5, 450 h.p. Ranger engine has recently been made in the Clark "46". Two Ranger Model SGV-770B-5 engines are installed in PZL's new twin-engine high-performance fighter, built in Poland.

Early in 1939 development was completed on the new Series "C" six-cylinder engines for military training. Externally this series is identical in all dimensions to the present six-cylinder 6-410 series, the principal changes consisting of an increase in stroke from  $5\frac{1}{8}$  in. to  $5\frac{1}{2}$  in. and several refinements in the induction system. Ratings on the "C" series cover powers between 175 h.p. and 190 h.p. varying with the octane rating of the specified fuel. The new ratings have been obtained with only a five pound increase in dry weight.

Fundamentally, all models, both 6 and 12 cylinder, are alike. The cylinder design, for example, is identical on all models as is also the valve operating mechanism, the latter being the underhead camshaft type. All models are provided with automatic pressure lubrication throughout. The lubrication system, which includes built-in centrifugal oil cleaners, is so designed as to eliminate the necessity for all external pressure oil lines. No parts require periodic hand lubrication, and all working parts are fully enclosed. On all engines the accessory drive is taken from the front of the crankshaft at a point of minimum torsional vibration and transmitted through a single shaft to the accessory drive gears at the rear. The natural flexibility of this



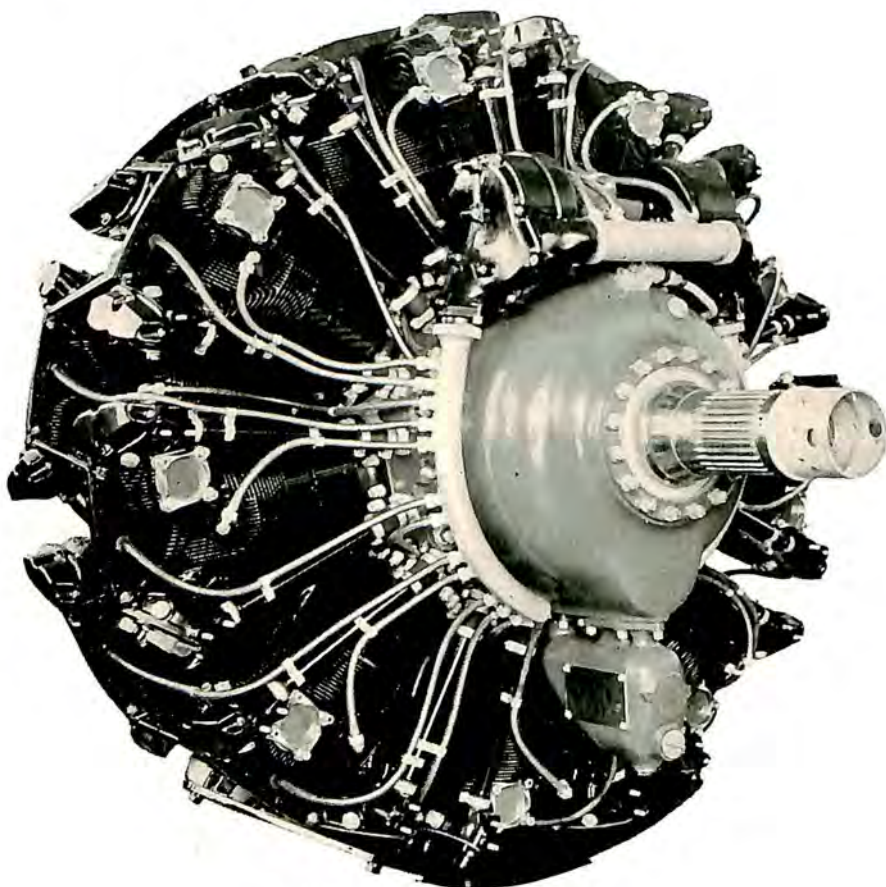


**WARNER SUPER-SCARAB ENGINE**

A seven-cylinder model developing 145 h.p.

shaft eliminates the transmission of destructive vibration and shock loads. On the supercharged engines the impeller is driven from the rear end of this shaft without the need of flexible couplings, clutches, or any other shock absorbing mechanism.

During the year, improvements were made in the engine testing facilities, including the rebuilding of one test house. The experimental department was enlarged and equipped with machinery for experimental production. New metallurgical laboratory and engineering research equipment was procured. Among the latter were Sperry-

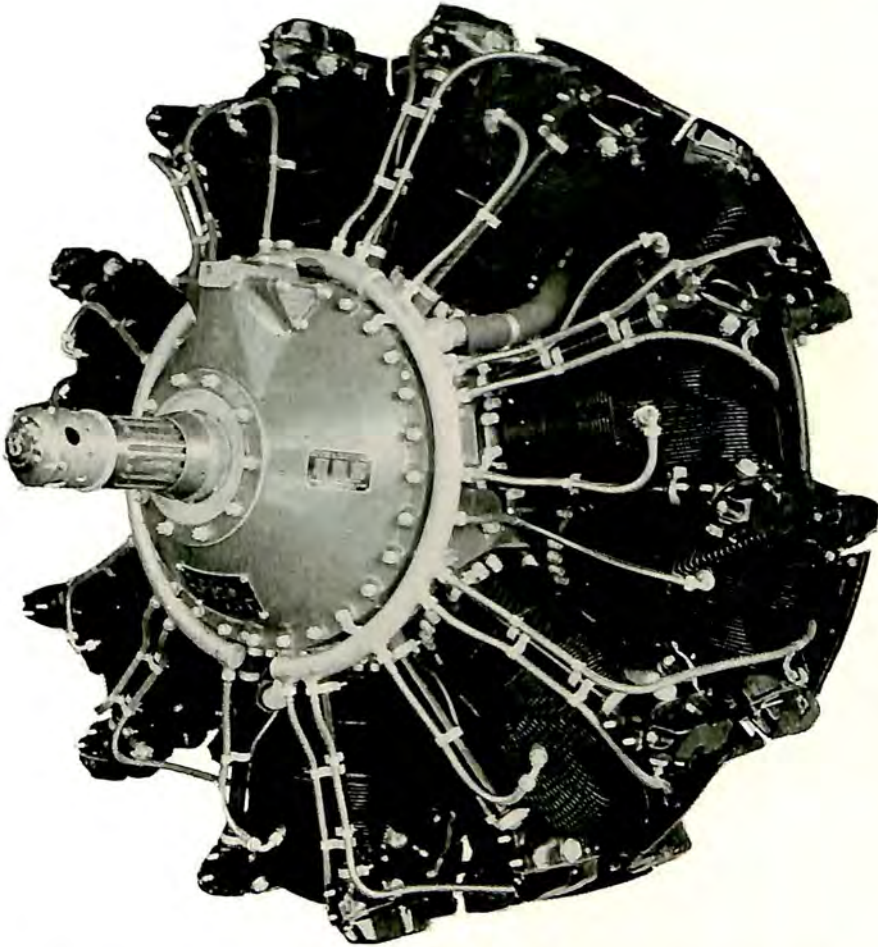


#### WRIGHT DUPLEX CYCLONE

An 18-cylinder double-row engine with a rating of 2,000 h.p. for take-off.

M.I.T., and other special equipment for the complete analysis and study of vibration and of dynamic stresses. Considerable new machining and production equipment was installed, and inspection facilities greatly enlarged, including the installation of precision gear testing and complete magnaflux equipment.

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.

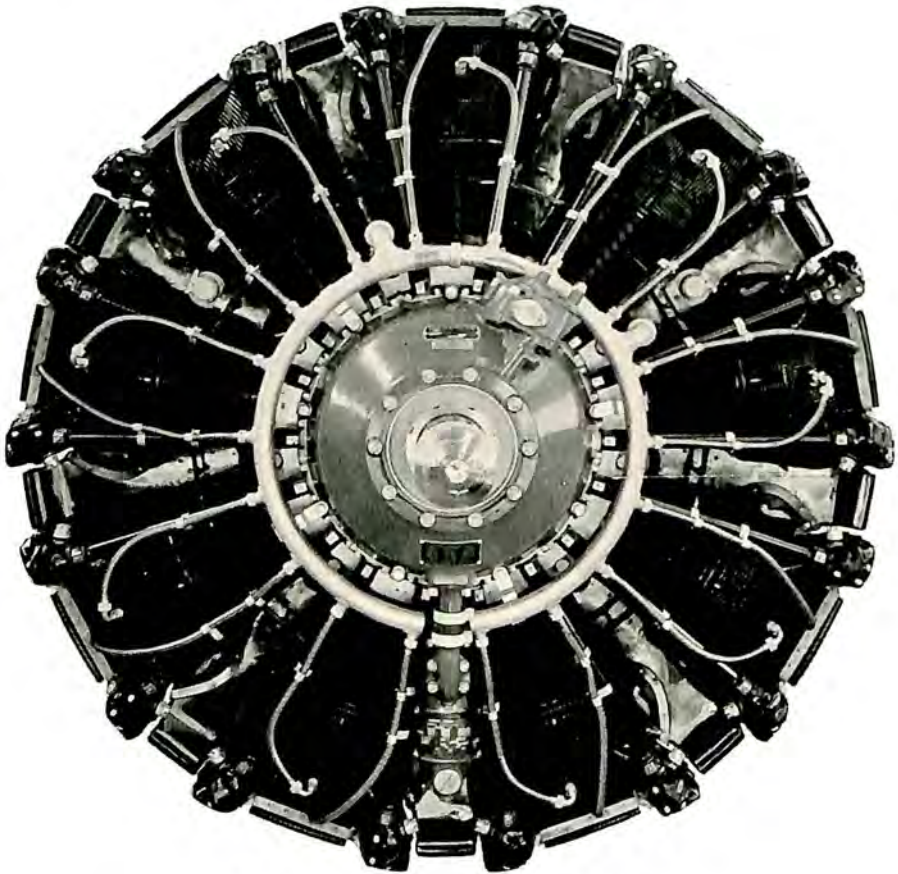


WRIGHT CYCLONE 14

A 14-cylinder double-row engine with a rating of 1,600 h.p. for take-off.

Wright Aeronautical Corporation, Paterson, N. J., the engine manufacturing division of the Curtiss-Wright Corporation, continued its production of high powered radial air-cooled engines for commercial and military aircraft, including those of air lines and military services in the United States and abroad.

Of these engines, the majority were nine-cylinder Cyclones in the 1000-1100 h.p. class, the remainder being seven and nine cylinder Whirlwinds ranging from 300 to 450 h.p. In addition to these, in 1938 the Wright Corporation put into production a later type of engine, the Double Row Cyclone 14, rated at 1500 h.p. for take-off,

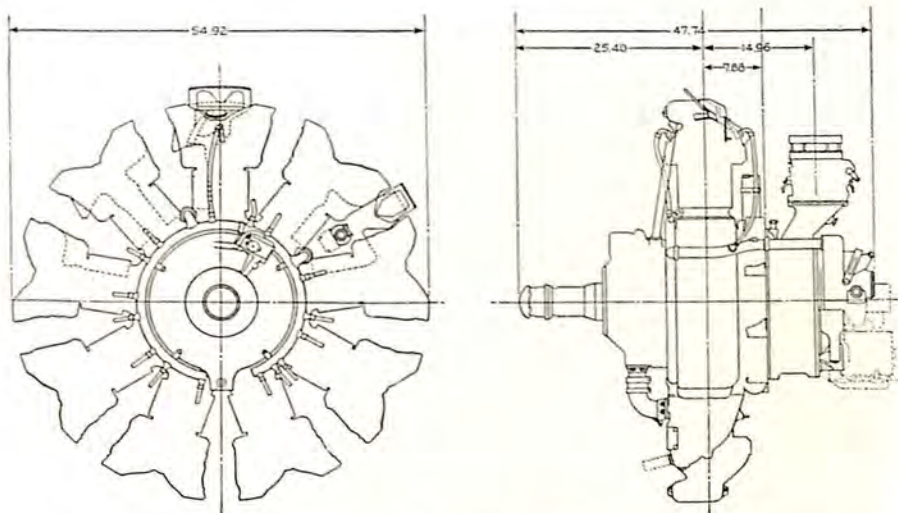


#### WRIGHT G-100 SERIES CYCLONE

A nine-cylinder single-row engine in four geared models rated at 2,350 r.p.m. for take-off as follows: GR-1820-G-102A, 1,100 h.p.; GR-1820-G-102B, 1050 h.p.; GR-1820-G-103A, 1,000 h.p.; GR-1820-G-103B, 950 h.p. These engines equipped with the Wright two speed supercharger give four additional models with comparative take-off ratings and increased altitude performance.

which was selected to power the Boeing 314 Clippers under construction for Pan American Airways System, the Curtiss-Wright Model 20 transport, to fly early in 1939, and the Martin twin-engine patrol boats for the U. S. Navy.

The 9-cylinder Cyclones can be classified as three distinct series of engines, representing successive advances in power output and design. The first of these is the F-50 Series, originally introduced in 1935, which now consists of direct drive or geared engines of four models, differing only in supercharger drive ratio, and consequently



#### WRIGHT CYCLONE SERIES G-100

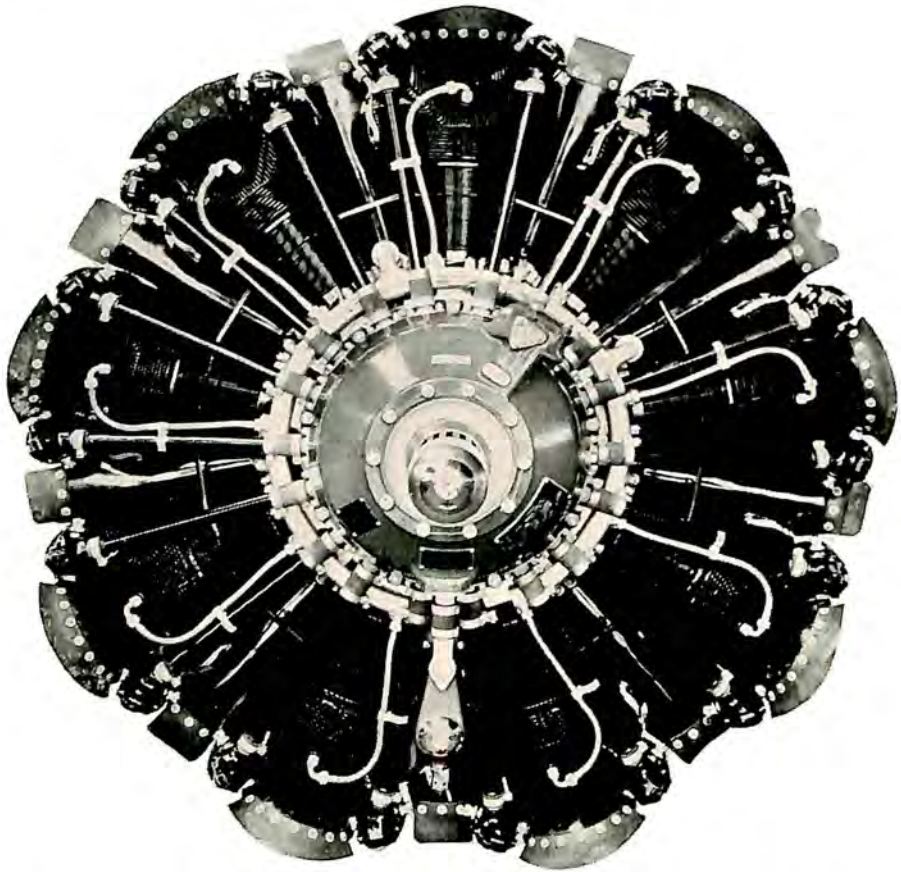
The nine-cylinder single-row GR-1820G-102A geared engine rated at 1,100 h.p. at 2,350 r.p.m. for take-off.

in power ratings. The F-50 Series is supplemented by a model known as the F-62 which has a higher take-off r.p.m., desirable for certain installations. The F-50, F-62 Series Cyclones cover a take-off range from 640 to 900 h.p.

The second series, known as the G, incorporates a number of improvements over earlier models, notably in cylinder design to permit better cooling and higher horsepowers. The G Series Cyclones consist of direct drive and geared engines of three models, differing in the degree of supercharging, and covering a take-off power range of from 875 to 1000 h.p.

The third series of single-row Cyclones, the G-100, represents still further advances in engine design, permitting take-off powers of up to 1100 h.p. It consists of three models, all geared, with varying degrees of supercharging. The most distinctive feature of the G-100 Series Cyclone is its steel crankcase which replaces the forged aluminum case of earlier models. This steel case, the first to be used in regular production by an American aircraft engine manufacturer, adds only slightly to the total weight of the engine, and permits an actual reduction in the specific weight of .05 pounds per horsepower.

All the single-row Cyclones are basically alike, having a displacement of 1823 cu. in., a bore of 6.125 in., and a stroke of 6.875 in. They all incorporate such features as the Wright Dynamic Damper which virtually eliminates torsional vibration arising from the power im-

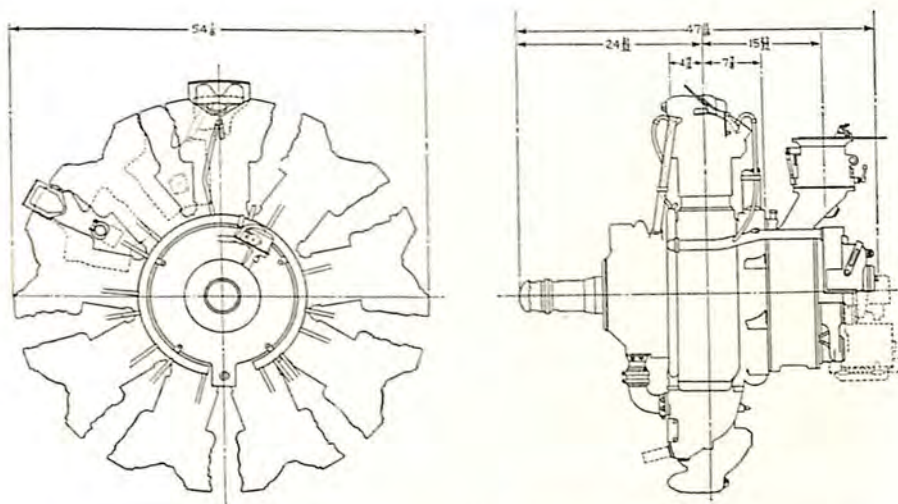


#### WRIGHT G SERIES CYCLONE

A nine-cylinder single-row engine in five geared models and their direct drive counterparts: GR-1820-G<sub>2</sub> rated at 1,000 h.p. at 2,200 r.p.m. for take-off, GR-1820-G<sub>2</sub>B rated at 1,000 h.p. at 2,350 r.p.m. for take-off, GR-1820-G<sub>3</sub> rated at 875 h.p. at 2,200 r.p.m. for take-off, and GR-1820-G<sub>3</sub>B rated 900 h.p. at 2,350 r.p.m. for take-off. The two speed supercharger model GR-1820-G<sub>5</sub> develops 1,000 h.p. for take-off and has improved altitude characteristics.

pulses, nitrided cylinder barrels, completely internal automatic valve gear lubrication, full pressure baffling, provision for either constant speed or full-feathering propeller, and drives for all standard flight instruments and accessories. The wide power range covered by these engines has made the Cyclone adaptable to a variety of installations, both in commercial and military aircraft.

The G-100 Series Cyclones, representing the latest single-row radial engine development of the company, include the following geared models: The GR-1820G-102A, rated at 1100 h.p. for take-off,



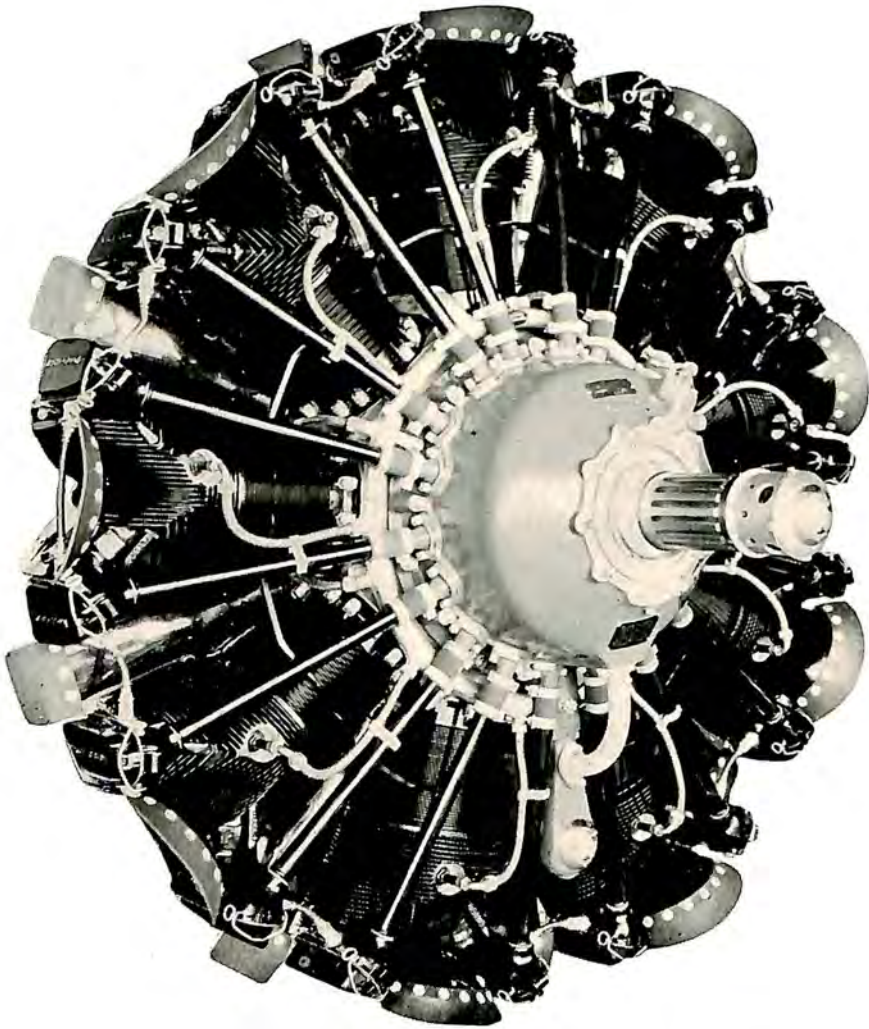
#### WRIGHT CYCLONE SERIES G

The nine-cylinder single-row GR-1820G-2 engine rated at 1,000 h.p. at 2,200 r.p.m. for take-off.

and 900 h.p. from sea level to 6700 ft.; the GR-1820G-103A, rated at 1000 h.p. for take-off, and 860 h.p. from sea level to 11,100 ft.; and the GR-1820G-106A, rated at 940 h.p. for take-off, and 830 h.p. from sea level to 13,300 ft. These engines are identical except for the amount of supercharging used, the G-102A having a 7 to 1 blower ratio, the G-103A an 8.31 to 1 ratio, and the G-106A a ratio of 9.39 to 1. The ratings are obtained with a compression ratio of 6.3 to 1 using 90 octane fuel. The engine diameter is 55.1 in. and the dry weight 1260 lbs.

The G Series Cyclones include three geared models and their direct drive counterparts. The GR-1820G-1 is rated at 940 h.p. for take-off, 825 h.p. at sea level, and 850 h.p. at 3000 ft., having a blower ratio of 5.91 to 1. The GR-1820G-2 is rated at 1000 h.p. for take-off, with 820 h.p. at sea-level and 850 h.p. at 5800 ft., and has a blower ratio of 7 to 1. The GR-1820G-3 has a rating of 875 h.p. for take-off, 760 h.p. at sea level, and 840 h.p. at 8700 ft., with a blower ratio of 8.31 to 1. The engines have a 6.45 to 1 compression ratio, use 87 octane fuel, are 54 $\frac{1}{4}$  in. in diameter, and weight 1198 lbs. for the geared model and 1103 lbs. for the direct drive.

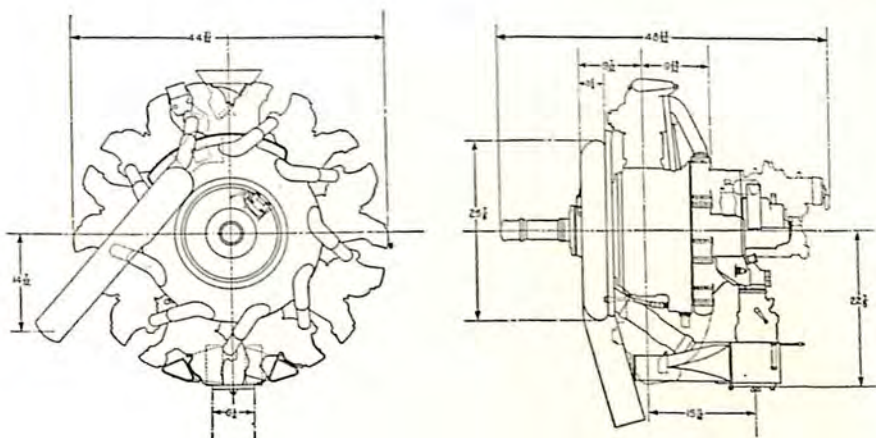
Four geared models and their direct drive counterparts make up the F-50 Series Cyclones. The following ratings apply to the geared engines. Ratings for the direct drive engines may be obtained by adding 15 horsepower in all cases. This rating difference applies only



#### WRIGHT F-50 SERIES CYCLONE

A nine-cylinder single-row engine in five geared models and their direct drive counterparts: GR-1820-F52 rated at 875 h.p. at 2,200 r.p.m. for take-off, GR-1820-F53 rated at 770 h.p. at 2,200 r.p.m. for take-off, the GR-1820-F54 rated at 640 h.p. at 2,100 r.p.m. for take-off; and the GR-1820-F56 rated at 770 h.p. at 2,200 r.p.m. for take-off. The two speed supercharger model GR-1820-F55 gives improved altitude performance.

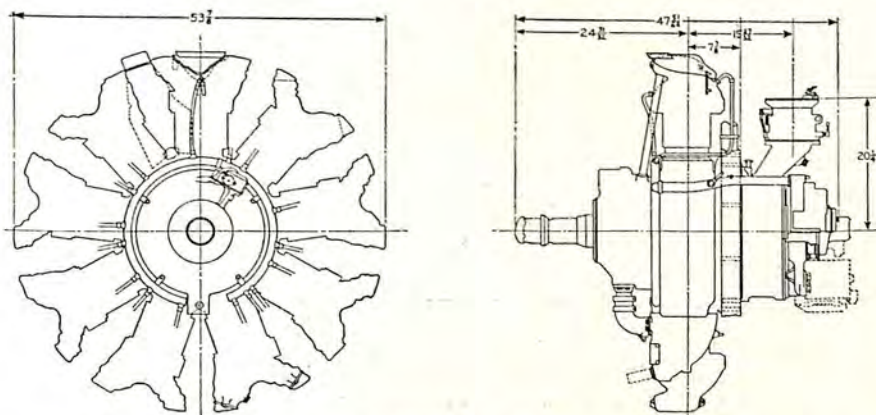




#### WRIGHT WHIRLWIND SERIES NINE

The nine-cylinder single-row R-975E-1 engine rated at 475 h.p. at 2,400 r.p.m. for take-off.

to the F-50 Series. The GR-1820F-52 develops 875 h.p. for takeoff, 730 h.p. at sea-level, and 760 h.p. at 5800 ft., and has a blower ratio of 7 to 1. The GR-1820F-53 is rated at 770 h.p. for take-off, 670 h.p. for normal sea-level operation, and 730 h.p. at 9600 ft., with a blower ratio of 8.31 to 1. GR-1820F-54 develops 640 h.p. at take-off, 590 h.p. at sea level, and 675 h.p. at 15,300 ft., with a blower ratio of 10 to 1. The GR-1820F-56, with a blower ratio of 8.83 to 1, is rated at 770 h.p. for take-off, 680 h.p. for sea level, and 740 h.p. at 11,300



#### WRIGHT CYCLONE SERIES F-50

The nine-cylinder single-row GR-1820-F52 geared engine rated at 875 h.p. at 2,200 r.p.m. for take-off.

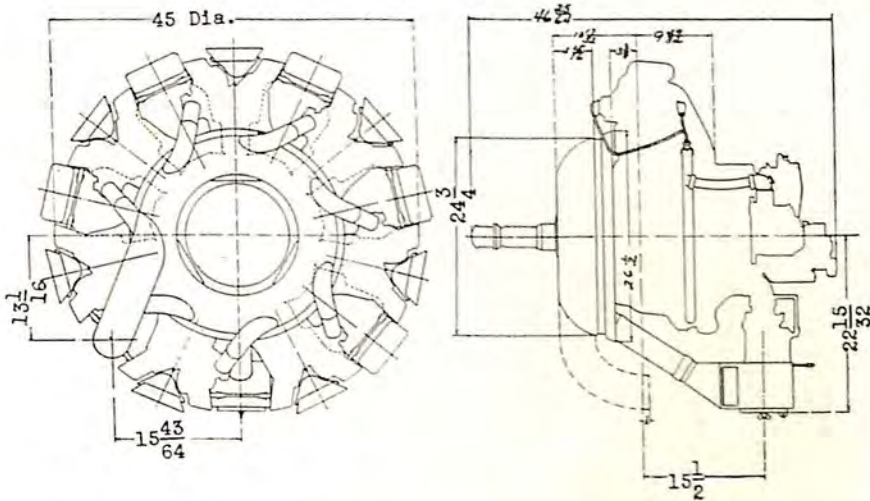


#### WRIGHT NINE-CYLINDER WHIRLWIND

A nine-cylinder single-row engine in three direct drive models: R-975E-1 rated at 365 h.p. at 2,100 r.p.m. for take-off; the R-975E-3 rated at 450 h.p. at 2,250 r.p.m. for take-off; and the R-975F rated at 475 h.p. at 2,400 r.p.m.

ft. A single geared model, the GR-1820F-62, is rated at 900 h.p. for take-off, with 760 h.p. available from sea level to 5800 ft. It has a blower ratio of 7 to 1. All of these models have a compression ratio of 6.40 to 1, use 87 octane fuel, are 54½ in. in diameter, and weight 1095 lbs. for the geared models and 1000 lbs. for the direct drive.

In addition to the above listed engines of the single row Cyclone Series, there is available the Wright Two Speed Supercharger, which



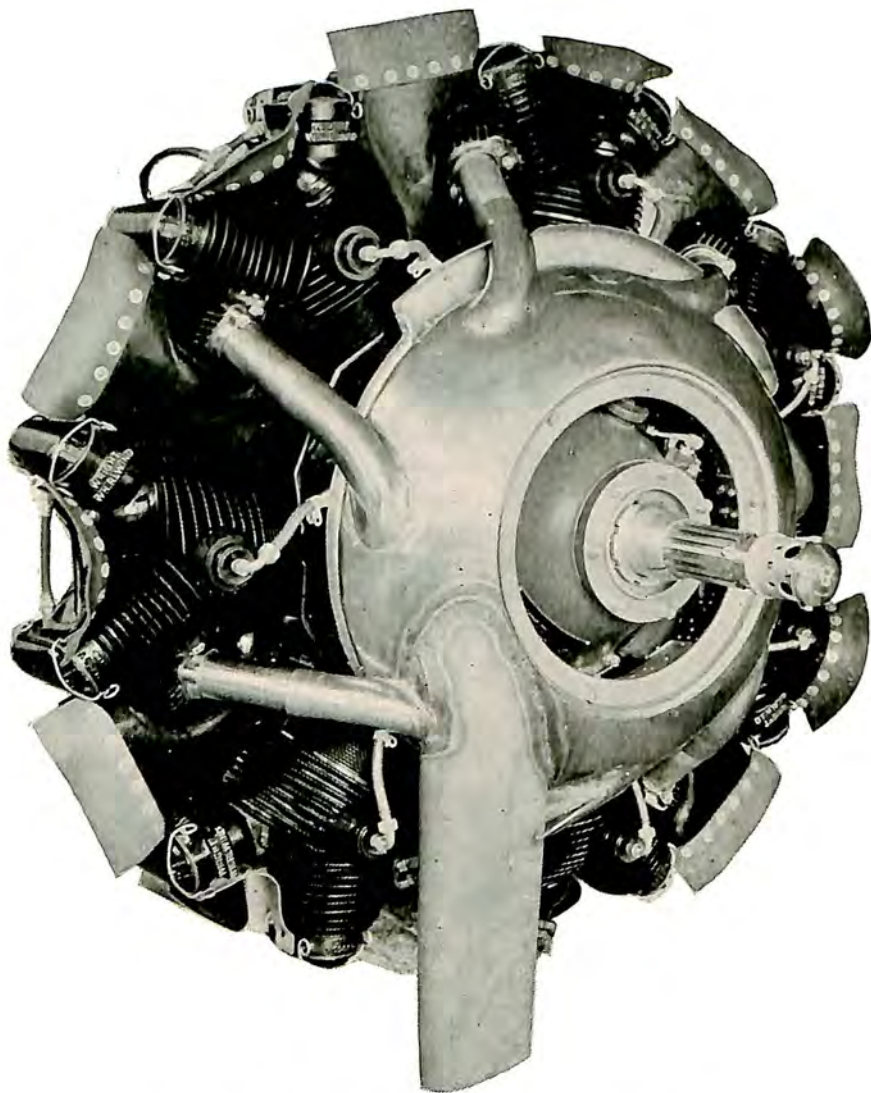
#### WRIGHT WHIRLWIND SERIES SEVEN

The seven-cylinder single-row direct drive engine in three models, 235 h.p. at 2,000 r.p.m. for take-off; 300 h.p. at 2,250 r.p.m. for take-off; 350 h.p. at 2,400 r.p.m. for take-off, and 375 h.p. at 2,400 r.p.m. for take-off.

may be applied to any of the engines, giving them completely new sets of performance characteristics. The Two Speed Supercharger mechanism is a drive which provides two blower ratios and makes possible the use of a moderate degree of supercharging for take-off and sea-level operation, and gives a higher degree of supercharging when it is needed for altitude operation. The device, which adds only a few pounds to the engine weight, replaces a solid shaft in the conventional supercharger mechanism. It incorporates a set of planetary reduction gears which, at the pilot's discretion, may be used to reduce the speed at which the supercharger is driven, or may be, in effect, bypassed to provide a higher drive ratio. Control is by means of a manual lever in the cockpit.

As ordinarily applied, the Two Speed Supercharger provides blower ratios of 7.14 to 1 and 10 to 1. It is available, however, in 8.37 to 1 and 10 to 1 ratios for the G-100 Series Cyclone, giving an engine known as the G-108A. Cyclones incorporating the 7.14 to 1 and 10 to 1 two speed unit are the F-55, F-65, G-5, and G-105A.

An outstanding development which is furnished as standard equipment with the G-100 Series Cyclones is the Chandler-Groves non-icing altitude compensating carburetor, manufactured by the Holley Carburetor Co. This carburetor represents a distinct departure from previous design using fixed throat venturis, and has instead a single large



#### WRIGHT SEVEN-CYLINDER WHIRLWIND

A seven-cylinder single-row engine in four direct drive models: R-760E-T rated at 235 h.p. at 2,000 r.p.m. for take-off, R-760E-1 rated at 300 h.p. at 2,250 r.p.m. for take-off; and the R-760E-2 rated at 350 h.p. at 2,400 r.p.m. for take-off, and the R-760F at 375 h.p. at 2,400 r.p.m.

variable throat venturi so designed as to prevent the formation of ice in the carburetor passages under adverse atmospheric conditions.

The Double Row Cyclone 14 is said to utilize the tried and proven principles of the single row Cyclone. Although details of the engine are still under Governmental restriction, it is known that it has a displacement of 2600 cu. in. and was initially rated at 1500 h.p. for take-off with 1200 h.p. available for normal sea level operation.

The Wright Whirlwind was produced in two series, one of seven cylinders, and one of nine. The seven cylinder series consisted of three direct drive models, the R-760E-T, an unsupercharged trainer engine rated at 235 h.p.; the R-760E-1 with a 7.05 to 1 blower ratio, rated at 300 h.p. for take-off (using 73 octane fuel) and 285 h.p. for normal sea level operation; and the R-760E-2 with a 9.17 to 1 blower ratio, which developed 350 h.p. for take-off and 320 h.p. normal sea level power using 80 octane fuel.

The nine cylinder series consisted of two direct drive models, the R-975E-1, a 365 h.p. engine having a blower ratio of 7.80 to 1 and using 73 octane fuel, and the R-975E-3, rated at 450 h.p. for take-off, 412 h.p. at sea level, and 420 h. p. at 1400 ft. This engine used 80 octane fuel and a 10.15 to 1 blower. The Whirlwinds have a diameter of 45 inches and range in weight from 515 lbs. to 675 lbs. The compression ratio is 6.10 to 1 except for the high powered engine of each series which use a compression of 6.30 to 1.

By the end of 1938, the Wright Aeronautical Corporation was nearing the completion of a two year program of rearrangement and expansion of its production facilities, which now occupy over 850,000 sq. ft. Space was acquired in an adjoining machinery manufacturing plant and alterations made to accommodate the crankshaft and piston machining departments. A large extension of the assembly building will include 14 new production test cells. Provision has been made in the design of these experimental cells for the accommodation of engines developing 3000 h.p., and tests can be run using flight propellers up to 20 ft. in diameter.

#### Manufacturers of Accessories

The Abrams Aerial Survey Corporation, Lansing, Mich., in 1938 developed a special photographic plane, the Abrams Explorer, incorporating a three-wheel undercarriage and pusher-type power plant. The cabin is designed for supercharging at high altitudes. The company manufactured a special aerial camera of large magazine capacity and sharp focal length lens for use at high altitude on large projects. The new feature of the camera is that it takes a roll of film 500 ft. long 9½ inches wide and makes 650 9 x 9 exposures. Other instru-

ments developed by this company include special projectors, contact printers for use in laboratory work and special contour finders of stereoscopic principal for studying aerial photographic maps in relief. With this last instrument it is also possible to measure the relief and draft contours directly from the photographic map.

Aero Supply Manufacturing Company, Inc., Corry, Pa., continued to produce a full line of accessories for the industry, including engine controls, fuel pumps, valves, hardware, strainers and armament fittings.

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, cowl-ing 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.

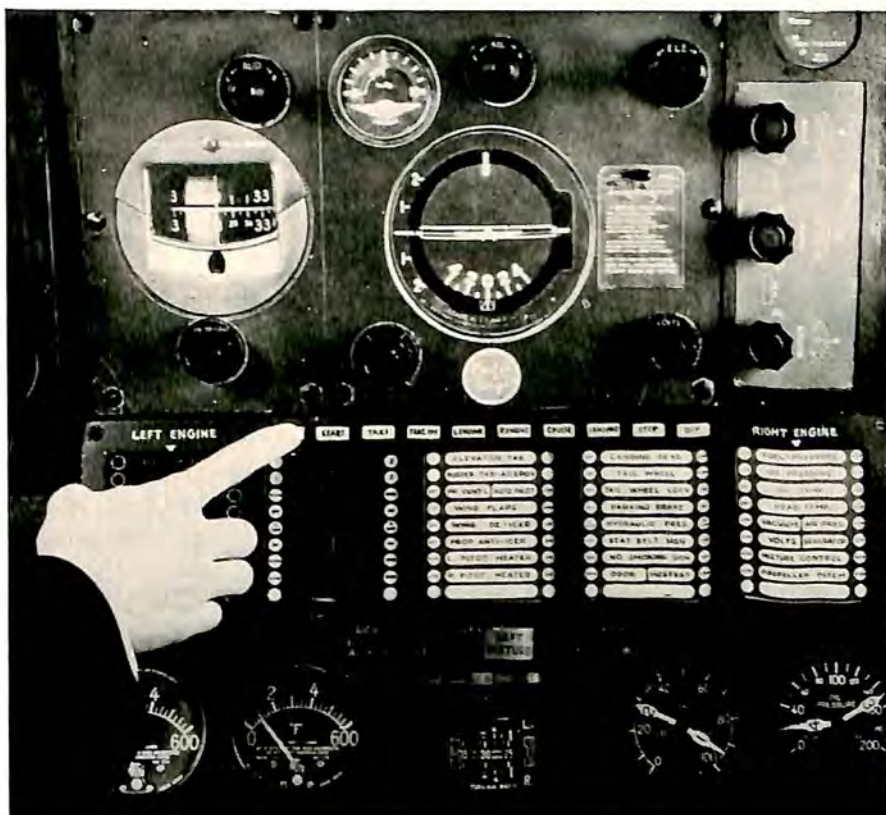
Air Transport Equipment, Inc., Garden City, N. Y., supplied a line of accessories to the industry and private owners.

Aircraft Radio Corporation, Boonton, N. J., produced aircraft radio equipment, and at the beginning of 1939 was expanding its facilities for a new line of radio parts.

The Ajax Metal Company, Philadelphia, Pa., supplied brass, bronze, nickel and aluminum alloys in ingot form for aircraft manufacture, in accordance with the latest specifications.

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.

The American Bosch Corporation, Springfield, Mass., pioneers in the ignition field, developed a line of aircraft magnetos "featuring great electrical output to assure efficient ignition;" stationery magnets to reduce strain on the magneto drive shaft; "permanent" lubrication which makes lubrication necessary only at overhauls; and provision for standard or compensating interrupter cams without the use of additional parts.



### NEW EYES FOR THE AIR LINE PILOT

To simplify the pilot's operation of the multi-motored, substratosphere flying, 30-passenger Curtiss-Wright CW-20 transport engineers have developed the above pictured "Tell-Tale" device which automatically checks the functioning of all instruments and vital parts of the plane. The pilot presses a pre-selector switch corresponding to whatever operation he requires and a battery of lights on the "Tell-Tale" panel indicates any necessary controls or instruments which must be adjusted.

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 Civil Aeronautics Authority for dissemination of weather information.

Bendix Products Division of Bendix Aviation 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 1939 it had available a full line of hydraulic brakes for

all wheels produced by the company, together with master cylinders and parking locks. The Bendix pilot seat met with increasing popularity during the year. It conformed to the latest Army and Navy standards requiring difficult strength tests. The seat weighed less than seven pounds and was constructed of electric spot welded high grade aluminum alloy sheet. 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 amphibians. 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. In October, 1938 the corporation gave the following description of tests with its new instrument landing equipment: "To date, over two thousand landings have been made, under hooded cockpits. These test landings have been made in cooperation with major commercial airlines and have proved the security of this practical landing device. In order to secure the most reliable and efficient system possible, the problem was attacked from the air. The greater emphasis during the early course of the investigation was placed on the flight problems associated with instrument landing. All test landings were made with multi-motored transport type craft, because of the fact that the larger planes are the most difficult to land on any instrument landing system. Briefly, the system consists of one main transmitter at the ground station and one receiver in the airplane which together give indications on a cross-pointer instrument both in elevation and azimuth. Additional low power transmitters may be placed at various points along the landing trajectory to provide marker indications in conjunction with an additional receiver in the airplane. No matter how overcast or low the ceiling, the Bendix Instrument Landing Device now makes it possible to make 'blind' landings with assured accuracy. The system insures safety by providing a definite radio course and



approach to the airport runway, and the system may be operated either with 'automatic' pilot or manual controls. At the present time installation of ground equipment is being made at some of the largest and busiest airports throughout the United States for service tests. It is now possible for the average well-trained pilot to make successful and consistent landings with this equipment after only a few hours of training."

The B. G. Corporation, New York, continued its aviation spark plug development work, and reported these activities: "During the year, a new test engine, complete with dynamometer was installed.



THE FAIRCHILD 24K DELUXE

It is powered by a Ranger engine.

This additional equipment greatly facilitates testing and development work. Due to the widespread acceptance and the success of the B G Spark Plug Service and Maintenance Manual introduced last year, a revised and enlarged edition has been made available. The service program has been greatly enlarged to the extent of cooperating with manufacturers and operators in investigating the difficulties so generally classified in the past as spark plug faults. Many production refinements have been incorporated in numerous models, resulting in greatly improved performance. An engineering program has been established to maintain development work on a suitable plane to meet the requirements of the engine manufacturers with the constantly increasing demand for higher powers."

Berry Brothers, Inc., Detroit, Mich., in 1938 conducted consider-

able development work in the perfection of dopes to eliminate blushing, and it was found possible to produce dopes with far greater blush resistance and longer life than was believed possible a few years ago, yet at no increase in cost. In the pigmented dope line various pigments were perfected, enabling Berry Brothers to produce colored dopes that would retain color and lustre without fading or chalking. A new zinc chromate primer for all types of metal surfaces was developed, filling the exposure and non-corrosion requirements of naval aircraft. New types of flexible synthetic aircraft lacquers were developed and were under severe service tests. Large quantities of aircraft finishes were supplied to governments abroad.

Breeze Corporations, Inc., Newark, N. J., produced a varied line of parts and accessories for all types of aircraft. Among these the most universally used is Breeze radio ignition engine and auxiliary shielding, which is recognized as standard on the most powerful engines produced in the United States. Other accessories include multiple circuit electrical connectors, conduit junction boxes, cartridge engine starters, internal tie rods, ammunition rounds counters, elevator and rudder tab controls, flexible shafts and case assemblies. Several new products were designed and manufactured by Breeze during 1938, and constant improvements were made on standard items. A new resistance type thermometer with a wide temperature range was completed, light in weight and so designed as to respond to rapid changes in temperature with minimum lag. The gas passages of the Breeze exhaust gas analyzer have been redesigned so as to increase the speed of response to changes in fuel air or mixture ratio, making it possible to obtain an accurate equilibrium reading in a very few seconds. Dichromate cartridge containers were also put on the market by Breeze.

The Champion Spark Plug Company, Toledo, Ohio, produced its line of mica aircraft spark plugs, using the exclusive Champion method of assembling the mica core with sillment powder to secure gas tightness and relieve electrical current leakage or corona underneath the mica insulation. The company utilized its Universal aviation single-cylinder test engine and other dynamometer equipment for development of improvements in the design and construction of its regular types of aviation plugs. Definite progress was made in the development of new plug designs for aviation use, employing domestic materials only.

Chandler-Evans Corporation, Detroit, Mich., produced an advanced carburetor with non-icing features, which the company described as follows: "Use of this carburetor precludes the necessity for installing intake air preheaters, thus effecting a weight saving

of between 30 to 40 lbs. on each engine installation. Despite its unusual features, the carburetor is not a complicated structure, being built up in sections to eliminate bulky castings and to permit easy maintenance. In place of the float mechanism which controls fuel flow in most carburetors, the Chandler-Evans uses a chamber walled on two sides by diaphragms against which the fuel in the chamber exerts pressure. The bulging of these diaphragms under this pressure operates levers connected with valves in the fuel inlet, cutting off the supply until consumption of fuel by the engine relieves the pressure on the diaphragms. Since the chamber between the diaphragms is always full, the attitude of the carburetor does not affect its metering, which means that it will not "cut out" during inverted flight or acrobatics. The automatic accelerating pump is another step in car-



#### THE FLEET TRAINER

The Brewster Aeronautical Corporation early in 1939 acquired rights to manufacture and sell this product of the Consolidated Aircraft Corporation.

buretor design to eliminate mechanical linkages. It consists of a chamber divided by a diaphragm. Fuel enters one side of the chamber through a one way valve. Its discharge is a nozzle in the carburetor air passage. The other side of the chamber is open to the vacuum that exists below the carburetor when the engine is running with the throttle partly closed. When the engine is idling this vacuum pulls the diaphragm against three springs in the vacuum chamber, and draws a charge of fuel into the chamber on the other side of the diaphragm. Sudden opening of the throttle breaks this vacuum and the pressure of the springs against the diaphragm discharges fuel from the nozzle.

"Provision is made for complete automatic mixture compensation, thus relieving the pilot of the necessity of adjusting his mixture con-

trol as the plane ascends or descends. This feature, which works from the fuel flow and the intake air density, provides such complete mixture compensation that the engine will function efficiently at any altitude without manual mixture adjustment. However, to insure maximum fuel economy for cruising operations, and to provide an effective fuel shut-off for stopping the engine, an additional manual mixture control is installed. With this control, 'cruising lean' may be adjusted to fit the fuel needs of the particular engine.

"Elimination of ice formation has been achieved by dispensing with the use of butterfly valves and other obstructions (on which ice could form) below the point where the fuel is introduced in the single large variable venturi. Two of the four walls of this venturi, which is rectangular in cross-section, form the adjustable valve for regulating the flow of air through the carburetor. Fuel centers at such a point that vaporization takes place in the unrestricted carburetor adapter."

The Cleveland Pneumatic Tool Co., Cleveland, O., in 1938 continued the design and manufacture of Aerol shock absorbing struts, furnishing their product for all the well-known makes of commercial and military ships. Among these were the Boeing flying fortress bombers, the Douglas DC4; Seversky, Martin, Vought, Curtiss 20, Bellanca, Barkley-Grow, Beech Aircraft, Brewster, North American, Lockheed 10, 12, and 14, including the famous 14 which carried Howard Hughes and his crew on their globe-circling flight in 1938. The Company added to their manufacturing equipment, installing many thousands of dollars worth of machine tools, special jigs and fixtures for the accurate and efficient fabrication of Aerol shock absorber parts. The installation of new and improved equipment for inspecting parts in process included Magnaflux, whereby the most minute defects are readily detected. Welding processes were studied and greatly improved. Additional drop-testing equipment was developed and built. At the same time, the company increased its line of pneumatic tools especially designed for aircraft manufacture, bringing out two new models of squeeze riveters, more varieties of light riveting hammers for steel and duralumin fabrication, as well as the new line of No. 9 drills, grinders, nut setters and screw drivers. An improved design of Cleco Sheet Holders went into production during 1938. Those devices, used for temporarily securing sheets to each other and to structural members, are now made in various colors to facilitate ready identification of the sizes, which range from 3/32 to 3/16 inches. Plans were made for adding 75,000 square feet of floor space to the factory, office, and engineering department.

The Curtiss Propeller Division of the Curtiss-Wright Corporation moved from the factory of the Curtiss Aeroplane Division at Buffalo, N. Y., to its new plant at Clifton, N. J., providing greater space and facilities for expansion. Increasing demands for electric, "full-feathering" propellers, a type which the Curtiss organization was the first to manufacture, made the move necessary, the company announced. It has since been following a steady program of expansion which contemplates the acquisition of additional factory area. Latest models of the Curtiss Electric propellers are for engines of 750 horsepower or more, and are supplied in several sizes equipped with either aluminum alloy blades or hollow steel blades. These propellers are equipped for constant speed operation as well as manual selective control, and may be feathered. In addition, single-piece fixed pitch metal propellers are made for engines of from 125 to 550 h.p.

Important among the Company's developments during 1938 was



#### NEW CURTISS PROPELLER PLANT

The Curtiss Propeller Division of the Curtiss-Wright Corporation moved into its own plant at Clifton, N. J., in 1938.

the introduction of a voltage booster system which permits fast feathering in from 10 to 15 seconds. Significantly, this equipment weighs 15 pounds per airplane regardless of the number of propellers used. De-icing equipment for operation with this type of propeller is also manufactured. Further, a new device for automatically controlling propeller pitch to maintain accurately any desired engine speed was developed. It is being applied on new installations, especially in multi-engine types when accurate synchronization of engine speeds is required. This governing unit provides a "proportional" type of control by means of which the electric pitch change motor on the hub is energized with current in impulses. This new feature permits the use of a fast basic rate of pitch change, in addition to providing an extremely accurate speed control. The unit is compact and rugged and is adapted for mounting directly on the standard governor drive on the engine nose pad. The contact mechanism is positive in action

and is designed to carry full propeller current, thereby eliminating the necessity of an auxiliary relay and resulting in an overall weight saving.

The Curtiss Electric propeller has become standard pursuit equipment of the U. S. Army Air Corps, having been purchased for the Curtiss P-36A and P-37 pursuit airplanes, and in addition is in use by patrol squadrons of the U. S. Navy and U. S. Coast Guard patrol planes. The new 30-passenger Curtiss-Wright "CW-20" sub-stratosphere plane was to be equipped with 15-foot Curtiss Electric propellers.

The Dow Chemical Company, Midland, Mich., reported a greatly increased use of Dowmetal by the aircraft manufacturing industry. A full third lighter than aluminum, these magnesium base alloys, sold under the trade name of Dowmetal, have become increasingly popular with aircraft manufacturers because of their extreme lightness combined with strength, toughness and durability. During the last year many new applications of Dowmetal were made. In addition to the use of sand and mold castings, Dowmetal die castings have found increasingly wide use. To meet the increased demand The Dow Chemical Company licensed one of the largest job producers of die castings to die cast Dowmetal. Another feature of the expansion program was the opening at Bay City, Mich., of a new, large foundry to care for the increased demand for Dowmetal sand castings.

On Menasco's Super Buccaneer engines there are more than 21 Dowmetal engine parts including valve tappet guides, manifolds and supercharger impellers operating at speeds up to 40,000 r.p.m. The Ranger SGV-770 engine uses approximately 60 pounds of Dowmetal, saving 20 pounds of weight, while the use of Dowmetal in certain of the Wright Cyclone models permits the remarkably low weight per horse power ratio of 1.07 pounds. The case of the Sperry Gyropilot is entirely of Dowmetal, in addition to the case of the Sperry Gyro-Horizon.

Eclipse Aviation, Division of Bendix Aviation Corporation, in 1938 to take care more capably of the industry's accessory requirements, moved to its new plant at Bendix, N. J., formerly Teterboro. The new plant is a modern one-story structure with nearly 400,000 square feet of floor space. Sufficient territory is available to provide for additional expansion. During 1938 Eclipse improved its current production models of starters, generators, air pumps, hydraulic pumps, landing gear and flap retraction motors, alternators, dynamotors, and numerous other aircraft appliances.

A new gear type of propeller anti-icer pump was developed to prevent formation of ice on the propeller blades. The pump delivers

an accurately metered supply of alcohol-glycerine solution to the slinger ring mounted on the propeller hub and centrifugal force spreads the solution over the blades. In addition, the fluid may be supplied to the carburetor venturi or to the airplane's windshield, if desired to prevent ice formations at those points. The electric motor which drives the pump is available for either 12 or 24 volt D.C. operation.

Improvements also were made in the line of Eclipse hydraulic pumps. Embodying the "Gerotor" principle of operation, they are available for engine drive, or can be driven by integral electric motors as desired. They are primarily designed to provide motive power for actuating landing gears, flaps, floats and propeller feathering. Selector valves are also available, integrally or separately mounted.

Eclipse air pumps for instrument and mechanical "De-Icer" use,



NORTH AMERICAN'S PLANT

Air view of the factory of North American Aviation, Inc., at Inglewood, Calif.

together with the "De-Icer" distributors and their related appurtenances also were modified for better and wider performance. Furtherance of the auxiliary power supply systems development also took place. Long range aircraft were equipped with the Eclipse system, notably the Douglas DC-4 transport, the Army Boeing XB-15 bomber, the Army Bell XFM-1 fighter, the Navy Sikorsky boat and the Navy Consolidated XPB2Y1 Patrol Boat. They are equipped with 110 volt A.C. high frequency systems.

For 1939 development was under way on numerous hydraulic appliances, auxiliary power systems, A.C. and D.C., starters and generators for the larger aircraft engines. Continued improvement of existing equipment was planned, including a combined electric starter and propeller feathering hydraulic pump, electrically operated hydromatic propeller control, electric motors for landing gear retrac-

tion purposes, autosyn power supply, fan-cooled generators, flow-meters direct and remote reading types, supercharger regulators and altitude mixture controls.

Edo Aircraft Corporation, College Point, N. Y., in 1938 continued its development and manufacture of all-metal aircraft floats for the commercial, private and military markets both here and abroad. In accordance with its usual policy a number of new models were introduced for the purpose of keeping up to the minute its regular standardized line. Edo carried 14 sizes of standard models in stock for immediate delivery, in addition to 13 custom models which were fully developed and tested, and could be produced on relatively short notice. Edo has now designed and built float gear with which more than 250 different types of land planes have been converted for seaplane use.

Interest in private and commercial water flying in the United States was greatly stimulated by the advent of the 50 h.p. land planes during 1938. A long distance non-stop world seaplane record was broken by a wide margin when Dewitt Eldred flew his 50 h.p. Lycoming powered Taylorcraft from Port Washington, N. Y., to Orlando, Florida; while spectators at the National Air Races were brought to their feet in amazement at the antics of Mike Murphy in his 50 h.p. Continental powered Cub when, for the first time, a public demonstration was given of a standard seaplane landing and taking off on dry land on its floats. Both ships were fitted with Edo standard float gear.

The Fafnir Bearing Company, New Britain, Conn., manufactured a complete line of ball bearings for aircraft and aircraft engines.

The Fairchild Aerial Camera Corporation, Jamaica, New York, produced a new wide-angle precision aerial mapping camera designed especially to produce photographs for extremely accurate mapping work. It was built to conform closely to the rigid specifications laid down by the U. S. Government departments and the American Society of Photogrammetry. It operates as either a fully-automatic or semi-automatic camera, but for vertical photography only. Negative size is 9 by 9 inches. Magazine carries roll film in any length up to 450 feet, enough for approximately 600 exposures. Focal plane is a vacuum back employing a venturi tube as the source of vacuum. Lenses of  $5\frac{1}{8}$ , 6 and  $8\frac{1}{4}$ -inch focal length are available. A newly designed high-efficiency between-the-lens shutter is adjustable for speeds of  $1/50$ ,  $1/100$ ,  $1/200$ , and  $1/300$  of a second. The entire shutter unit is made readily removable for inspection and cleaning with removal of outer lens element only, so that the accurate adjustment of the lens assembly does not need to be disturbed. All con-



trols for operation are within easy reach of operator. A special mount is supplied, designed to permit lowering of camera to any desired depth in floor of airplane to clear all parts of the undercarriage and permitting rapid, accurate levelling of camera.

Two new aircraft radio compasses were designed by Fairchild during 1938. Early in 1939 one of these, the Model C-6, was granted a C. A. A. Test Certificate. This model is a single-band unit having a frequency range of 195 to 415 kilocycles, designed for the usual radio compass applications with visual indication, as a radio range



FLEET OF RYAN TRAINERS

Menasco-powered planes purchased by Guatemala.

receiver using conventional antenna or loop, or as an aural null shielded loop receiver. Its simplified circuit eliminates possible errors in compass operation due to misalignment or changes in component parts. Remote control box features an illuminated tuning meter for simplified tuning of radio stations, and an illuminated direct-reading frequency scale with  $\frac{1}{4}$ -inch high numerals which are visible at a distance of ten feet. Only one frequency is visible at one time in steps of one kilocycle. In addition to the receiver and control box, the complete C-6 Radio Compass assembly included a shielded rotatable

loop antenna in a streamlined housing, remote loop control head, dynamometer type bearing indicator, junction box and complete set of cables and flexible drive shafts. Total weight of the entire assembly, exclusive of cables and flexible drive shafts, is less than 40 pounds.

Another new radio compass, the Fairchild Model C-7, is a two-band unit with a frequency range of 170 to 1200 kilocycles without gaps. One band covers from 170 to 460 kilocycles, the other from 450 to 1200 kilocycles, thus covering aircraft and marine bands, distress calls and the entire commercial broadcast band up to the point at which duplication of frequencies is too prevalent for satisfactory use of the radio compass. Featuring the same high degree of sensitivity, selectivity and fidelity embodied in the C-6 Radio Compass, the C-7 model consists of a 13-tube superheterodyne receiver, remote control panel, rotatable shielded loop antenna, loop remote control head, dynamometer type bearing indicator, dynamotor, junction box and necessary cables and flexible shafting. Because it is a two-band receiver, it is slightly larger than the C-6 compass described above, yet the weight complete is less than 42 pounds.

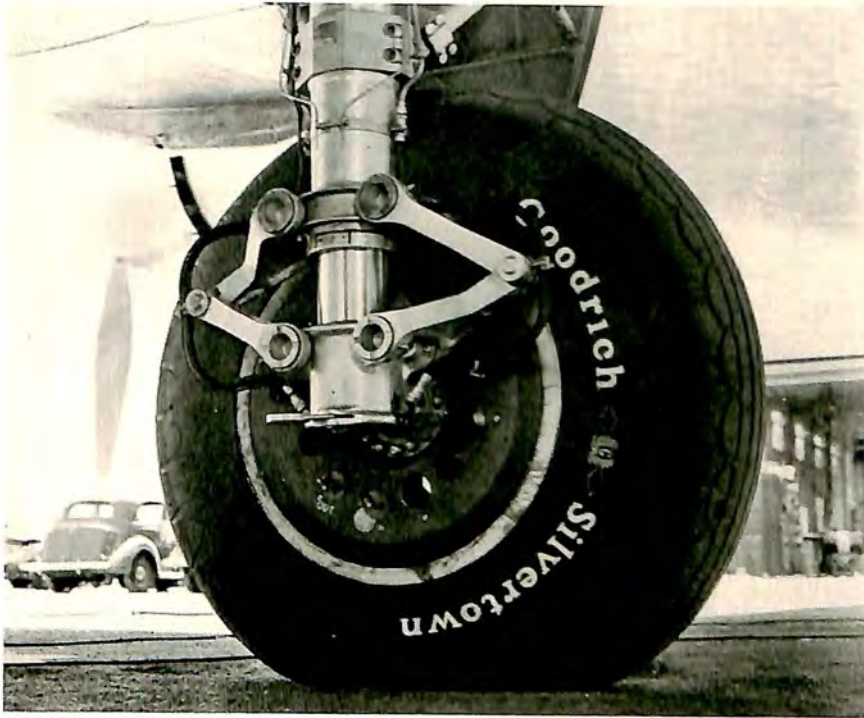
Federal Metal Hose Corporation, Buffalo, N. Y., manufactured a complete line of flexible metallic hose and tubing known as the "Interlock" type.

The Fuel Development Corporation, New York, N. Y., manufactured an anti-knock fluid known as "Anilol." Several formulae were manufactured to suit varying needs, all of which could be mixed directly with gasoline and other fuels. Certain formulae, however, were especially designed for injection into the air scoop of aircraft engines through a patented metering valve controlled by the manifold pressure. This valve so controlled the flow of Anilol that the quantity metered increased in direct proportion with the power output of the engine. The injection method had the advantage of economizing in the use of the fluid and also tended to cool the charge as it entered the intake manifold, thus further improving the engine characteristics. Anilol is an instantaneous de-icer and is widely used for the elimination of carburetor ice, as well as for its anti-knock properties. The Anilol system of octane control emerged from an experimental stage early in 1938.

The Firestone Tire & Rubber Company, Akron, O., manufactured a line of accessories, including airplane tires, tubes, wheels, brakes and seat cushions.

General Electric Company, Inc., Schenectady, N. Y., continued its development work on superchargers in conjunction with manufacture, with particular attention to turbo superchargers for high alti-

tude performance on engines of greater horsepower. Development work was being done on a supercharger control with improved performance characteristics. Sample cabin superchargers have been built with attention being paid to future improvement. Among General Electric instruments is the d-c Selsyn landing gear and flap position indicator, which has been in use over a year. The d-c Selsyn instrument line of remote indicating instruments is now available for all engine functions. A new two-pointer sensitive type of mag-



#### GOODRICH EXPANDER TUBE BRAKE

One of the giant tires on the Douglas DC-4. Each tire is 65 inches high and two feet wide.

netic drag tachometer has also been developed. Generators, motors and control of light weight are being manufactured for special aircraft applications.

The B. F. Goodrich Company, Akron, O., in 1938 continued a development and research program in connection with the use of rubber for the aviation industry. De-Icers enjoyed a far wider acceptance than ever before, being used almost universally on transport

planes and on many types of military aircraft. Service during the year proved that many of the minor difficulties encountered with De-Icer equipment in the past had been eliminated in the current design De-Icers. Electro-static effects were eliminated by the use of a conductive surface on the rubber, and the service life of De-Icers increased so the devices may now be employed for two full winter seasons in transport operation. With the widespread use of this safety appliance more and more airplanes are being designed by manufacturers to incorporate a De-Icer system as part of the original equipment of the airplane. With the closer coordination of De-Icer design to airplane design there has been some modification of both. Several airplanes have been designed and built which incorporated recesses in the wings to provide for flush attachment of De-Icers. In some cases the attachment has been recessed and the De-Icer provided with a special type bead construction to form a flush attachment; and in other cases, the entire leading edge of the wing has been recessed so that the outer surface of the rubber De-Icer forms the true contour line of the airfoil. De-Icers for the Boeing model 314 flying boat and the Douglas DC-4 were designed, built and flight-tested during the year. These De-Icers were the largest ever constructed.

The Goodrich refrigerated wind tunnel in Akron has been used extensively, not only in connection with De-Icer development, but for the testing of various accessories affected by icing. Goodrich has made its tunnel available to the aviation industry for that purpose. A number of tests were also conducted there during 1938 on various types of chemical coatings and other systems for the prevention of icing, none of which proved effective.

During the year the largest tire of the low-pressure type thus far made was introduced into the Goodrich tire line. Originally designed by Goodrich in 1934, the 19.00-23" Goodrich tire is now used as standard equipment on the Boeing flying fortresses, and is mounted on a Hayes wheel equipped with Goodrich Expander Tube brakes.

Many product improvements and refinements of design were also made in tires and tubes to meet the ever exacting demands of service performance brought about principally by the more continuous use of present flying equipment and the higher performance demands of the new. The introduction of heat-resisting tubes in many sizes, the provision of deeper treads for longer tread life, the balancing of tires to reduce take-off vibration to minimum, and improvements in valves and valve installations were some of the important progressive steps taken in 1938. Many new sizes of tire in the smooth contour type as covered by Army specifications were also introduced. Active

development of the Goodrich Expander Tube Brake continued in 1938 with introduction of a more complete range of sizes. Adopted by the Navy for beaching gear use in 1937, the stainless steel frame construction was employed in a new size brake during 1938.

High speed blind landing tests of the Douglas DC-4 tricycle geared land transport demonstrated the effectiveness and safety of the brake in severe service. Successful tests on a Boeing bomber resulted in specification of duplex expander tube brakes for a new fleet of those planes.

Availability of a line of suitable master cylinders developed during 1938 has enabled manufacturers to adopt expander tube brakes with but slight modifications to brake systems. Introduction of several new power brake valves permitted other manufacturers to operate large expander tube brakes from the same power hydraulic system provided for operation of automatic pilots, landing gear and other accessories. A new type of stamped steel brake frame, reducing overall brake width and greatly facilitating brake servicing, was developed late in 1938 and placed on test.

The Gulf Oil Corporation's Aviation Department, under the direction of Major Al Williams, continued to expand its activities during the year, both domestically and in the foreign field. Outstanding in the latter category was a two months' inspection trip to Europe by Major Williams to study the gasoline and oil problems in the European Air Powers. Major Williams took his single-seater Grumman Gulfhawk (Wright Cyclone) with him, and in addition to using it for transportation to the various centers of foreign air activity, he gave a number of exhibition flights to demonstrate the effectiveness of a standard American fighting airplane and display methods employed by our aircraft industry in constructing aircraft.

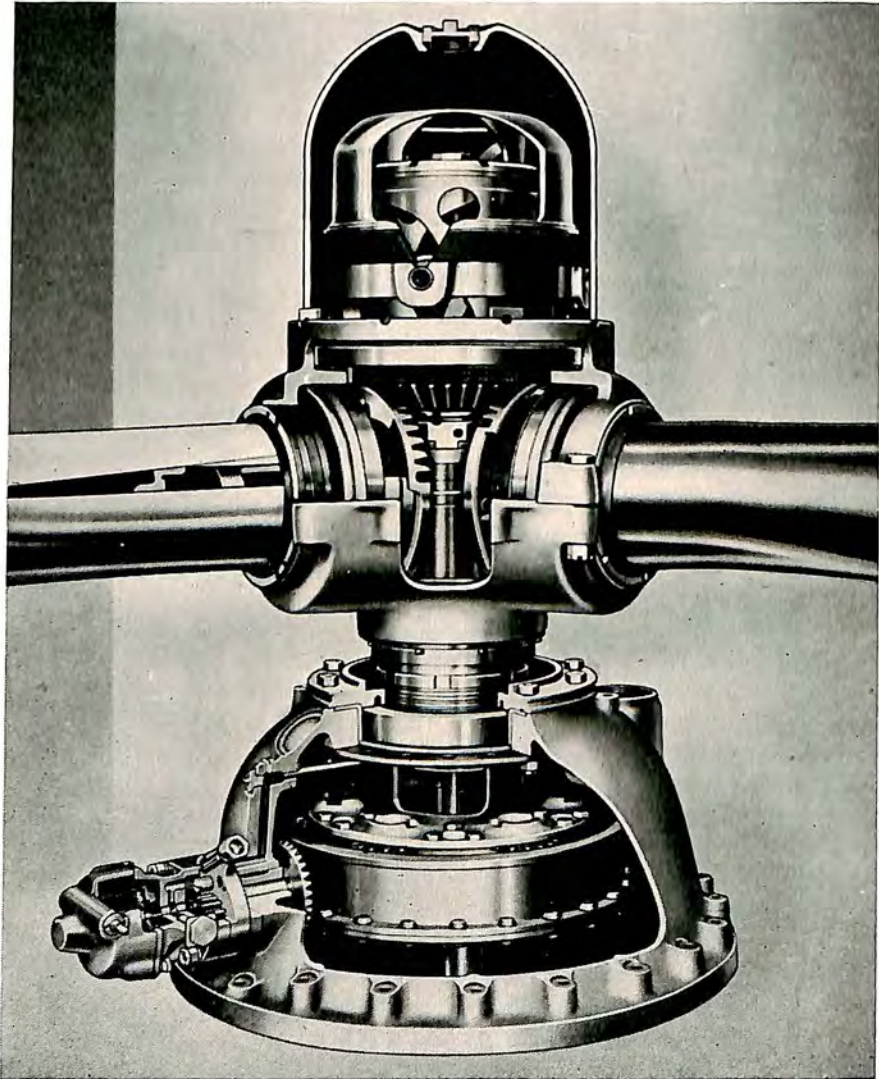
A new plane was added to Gulf's fleet of six. It is a two-seater, Grumman biplane, with a 1,000 horsepower Wright Cyclone engine. The ship is identical with the famous Gulfhawk single-seater, except for a slightly larger wing span and the additional seat. It is being used by Major Williams as a high-speed executive plane, in connection with his travels about Gulf territory. Each of Gulf's five pilots in the field flies a Stinson Reliant (Lycoming).

Gulf again joined with the manufacturers of the Aeronca, Cub, and Taylorcraft light planes in sponsoring the 1939 Light Plane Cavalcade to Florida. At the year's end, detailed plans had been made to furnish gasoline and oil without charge to the participants, and in the mass flight in January 1939, 400 of these little two-seater, 40 to 50 horsepower jobs, participated.

Gulf again renewed its gasoline and oil contracts with Eastern

Air Lines and Pennsylvania-Central Air Lines, the two major companies which operate entirely within its territory.

The Hamilton Standard Propellers division of United Aircraft Corporation, East Hartford, Connecticut, announced during the year two important developments, both contributing to increased



#### NEW HAMILTON STANDARD PROPELLER

Cutaway view of the Hamilton Standard Hydromatic propeller and constant speed governor installed in the nose of a Pratt & Whitney engine.

safety of aircraft. The first was the development of the "Hydromatic" quick-feathering propeller, in which the blades may be "feathered" directly into the air stream in the event of malfunctioning of an engine. Rotation of the engine is thus quickly stopped, preventing further damage to the powerplant; and at the same time the drag of the idle propeller is reduced and the performance of the airplane on the remaining engines materially increased. By the end of the year, the Hydromatic propeller had been adopted as standard equipment on air lines and in military service in this country and abroad.

In construction, the Hydromatic propeller retains the rugged and successful hub and blade mounting structure of the older Hamilton Standard types. This has been further improved by moulding a collar of plastic material between the roller bearing race and the fillet of the blade retaining shoulder. This plastic material insures perfect seating of the mating parts, gives a better stress distribution, and protects the aluminum alloy blade from any chafing action, thus increasing its resistance to fatigue. The presence of the plastic layer also permits the use of an effective oil seal between the hub and blade. Such an oil seal would not be considered safe in direct contact with the aluminum alloy blade, as it might lead to stress concentration. With an effective oil seal it is now possible to maintain a fairly high oil pressure on all the working parts inside the hub and wear of the parts is correspondingly reduced. The pitch control mechanism of the Hydromatic propeller is again of the simple, rugged hydraulic type, although differing somewhat in actual application from the earlier constant speed propellers. One of the reasons for this is the additional safety problem introduced as a result of the feathering procedure. Propellers in the feathered position will not carry out the normal propulsive function and it would obviously be dangerous if they could be feathered inadvertently or through improper functioning of the apparatus. Consequently, it is necessary to provide some means of restricting the pitch range during normal operation so that the blades cannot be feathered except by a deliberate action on the part of the pilot.

That problem was solved by Hamilton Standard by taking advantage of the fact that the centrifugal force acting on the blades tends to cause them to go into lower pitch. In the Hydromatic design, engine oil which has been boosted to higher pressure by the constant speed governor pump is used to overcome this centrifugal twisting moment when it is necessary to increase the pitch. This oil pressure acts on a large piston and the motion of the piston is transformed into rotary motion by means of a series of cam rollers acting on coaxial helical cams of opposite pitch slope. For the normal pitch

range the cam follows a steep helical angle so that the piston enjoys a high mechanical advantage. When the pitch reaches the maximum operating value, the slope of the cam becomes flatter so that the mechanical advantage of the piston is insufficient to overcome the centrifugal twisting moments of the blades when the normal operating pressures are used. Thus, a maximum pitch limit is provided for the normal flight conditions. If a considerably increased oil pressure is supplied from some other source under the control of the pilot, the piston will overcome the blade twisting moment and the pitch will increase until the feathered setting is reached. The adjustment toward low pitch is also accomplished by oil pressure, supplementing and augmenting the centrifugal force on the blades.



THE WACO N

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

In addition to developing the Hydromatic propeller, Hamilton Standard announced the perfection of a new method of vibration stress measurement, by which the stresses at any point in a propeller can be accurately determined, a feat hitherto impossible. As a result of this development, changes in propeller design leading to increased efficiency and reduced weight can now be made with the certain knowledge that the stresses involved do not exceed safe operating limits. Moreover the source of these vibration stresses, usually originating not in the propeller itself but in the engine or some other part of the airplane, can be located and corrected.



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, Tiptecanoe City, O., continued supplying its parachute flares and signals to commercial aviation, the U. S. Government and foreign governments. This equipment, which includes both electrically and pistol operated types, affords outstanding advantages in flexibility of installation and operation, safety and dependability.

Flares for emergency illumination from aircraft have been a major development of International during the past decade. The earlier flares were merely large "candles", wired for electrical ignition and affixed to brackets mounted under the lower wings toward the tips, from which their name "wing tip flares" was derived. Such installations obviously involved abnormal fire hazards, and the illuminative properties were unavoidably so limited that a plane had to descend to a low altitude for effective observation of the ground, thereby greatly reducing the area of illumination and seriously impairing the scope of maneuverability, and consequently the chances for a successful forced landing.

With increasing night flying operations it quickly became apparent that the "wing tip flares" were not only dangerous but extremely inadequate, and also that a suspended source of light effective from relatively high altitudes and independent of the plane, beneath which the pilot if flight conditions permitted could maneuver at will over a relatively large illuminated area, was an essential requirement. Parachute flares were of course known, but they had been designed primarily for military purposes, and the requirements of commercial aviation presented entirely different problems of installation, maintenance and operation.

The smallest approved parachute flare is required to burn not less than one minute and develop more than 70,000 candlepower. Next comes a 1½-minute parachute flare with a minimum requirement of 110,000 candlepower. The largest approved parachute flare commercially available is the 3-minute, which must develop more than 200,000 candlepower. All these parachute flares are required to have an average rate of descent of not more than 550 feet per minute.

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



STEARMAN TRAINERS AT RANDOLPH FIELD

Lycoming-powered PT-13-A planes form a long line at the Air Corps training center in Texas.

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. Four types of Trainers are manufactured, known as C, C-2, D and E. The C Trainer is the standard type used at the present by most American airlines and flying schools. The C-2 is a development of this, and includes a set of remote control instruments for the use of the instructor in effecting instrument landing instruction. The D Trainer is developed for European countries and contains the Lorenz Landing System but not the radio range stations. The E Type is a combination of the two and includes both the radio range stations, the remote control instruments, and Flight Path Indicator.

Walter Kidde & Company, New York, during 1938 installed various items of their equipment on many well known planes. The Douglas DC-4, the four-motored Boeing flying boats for Pan-American Airways, and the Boeing planes for Transcontinental and Western Air carried Lux carbon dioxide fire extinguishing systems to protect against engine fires. Howard Hughes, on his epochal round-the-world flight, carried a Lux fire extinguishing system and flotation bags, as well as two collapsible rubber life rafts for inflation by a carbon dioxide cylinder. Oxygen breathing equipment by Kidde was also used on this flight. During 1938 Lux lightweight cylinders were widely adopted for airplane work, in connection with the fire extinguishing systems, flotation bags, and gasoline expulsion equipment. Landing fields increased their use of the lightweight cylinder in portable equipment on crash trucks. Military or commercial planes in England, France, Italy, Japan and several Latin American countries are now using Lux extinguishing systems extensively.

The Kollsman Instrument Company, Elmhurst, N. Y., continued expanding manufacturing facilities in their new plant. At the end of 1938, the total employment exceeded three hundred. The most outstanding achievement was the Kollsman Direction Indicator, a new board compass with fixed dial and rotating pointer, which may be read like any other instrument. In addition to ease of reading, the magnetic characteristics have been developed so that flight performance is considerably improved. The Kollsman Electric Tachometer has been redesigned for longer life and greater accuracy. The generator has been changed to the direct drive type which permits lower rotor speeds and increased bearing life. Thrust bearings and a new method of rotor assembly in the Indicator improve its performance considerably. A calibration adjustment is employed to facilitate maintenance. A new accelerometer mechanism was developed, which effectively cancels outside movements, thus insuring a true measure of vertical acceleration.

Altitude and temperature compensation of vertical speed indicators was the subject of much research in the testing laboratory. New vertical speed indicators now have a simplified construction and screw adjustments facilitate calibration.

The telegon system of remote indication has been further improved. This system, which operates purely by induction—having no brushes or contacts, offers the advantage of light weight and extreme accuracy. The new Douglas DC-4 uses many Telegon instruments for indicating control positions and engine functions. One outstanding advantage of this system is the ability to operate from standard instruments near the engine, thus obviating the necessity of building

special transmitting instruments. Kollsman rim lighting has become standard throughout the industry and is used by agreement on instruments of other manufacturers. The number of foreign companies having a license to build Kollsman instruments was increased to six.

The Leece-Neville Company, Cleveland, O., supplied the industry with 12 volt voltage regulated engine driven generators made in three capacities, 15 amperes, 25 amperes and 50 amperes. The Leece-Neville voltage regulators protect the storage batteries from overcharge as they permit the generators to charge only at the correct rate for the state of charge that the battery is in. This greatly prolongs the life of the storage battery, as when the battery is in a state of full charge the current delivered by the generator will be very low.

The Liquidometer Corporation, Long Island City, N. Y., supplied many additional manufacturers and users with its various types of fuel and oil quantity gauges for aircraft. The Liquidometer Dial Change and Selector Switch Combination Unit which provides in one unit separate dials for a number of tanks, any of which can be read at will by turning the knob of a built-in selector switch, was used on many of the newer type airplanes. Tank units with built-in switches for use in connection with warning of low fuel level, or for controlling fuel levels, were developed. The Company also announced the availability of its new electric gauges for indicating manifold, fuel or oil pressures. Besides electric, fuel and oil quantity gauges, this company manufactures the Liquidometer Hydraulic Transmission type fuel and oil quantity gauge for aircraft. This type is completely self-contained and is automatic in operation, without requiring the use of any outside energy.

Macwhyte Company, Kenosha, Wis., developed a new type stainless steel tapered "spike" antenna, which is generally mounted on the underside of the fuselage. This antenna was designed to give greater signal strength, a more pronounced cone of silence signal, and was less subject to icing and static, with less drag than a cable antenna. Another development has been stainless steel terminals of a new alloy. They can be adjusted under tension without danger of seizure or sticking. Macwhyte tie rods are now produced from a molybdenum bearing 18-8 stainless steel which has improved their resistance to corrosion. Still another development has been the designing and producing of special cable slings. These slings are an integral part of the airplane and are put to use whenever the plane has to be lifted by a crane. Also, Macwhyte has continued to supply the industry with "Hi-Fatigue" Aircraft Cable in galvanized, tinned and stainless steel. This cable has been further improved by reducing constructional stretch without affecting its "Hi-Fatigue" properties.

Moore-Eastwood & Company, Dayton, O., manufactured tools, dies, jigs and airplane parts for the military services and aircraft manufacturers in the United States and abroad. Among the manufactured articles are bomb racks, bomb shackles, gun mount adapters, gun sights and sighting members.

Norma-Hoffmann Bearings Corporation, Stamford, Conn., manufacturers of precision ball, roller and thrust bearings, in 1938 reported the erection of a substantial addition to its factory, and the installation of new equipment to facilitate the production of bearings for aircraft use, particularly in the larger sizes. The company announced a complete line of precision bearings adapted for every aircraft requirement, not only in the controls and the plane itself, but also in engines, accessories, instruments and landing field equipment.

Northwest Air Service, Inc., Seattle, Wash., developed a propeller pitch setter, a machine to align blades by mechanical methods rather than by manual labor, requiring only 20 minutes to do the same work that formerly took three men an hour.

Parker Appliance Company, Cleveland, O., produced seamless tubular plumbing for aircraft with Parker tube couplings. To overcome the tendency of threaded aluminum alloy parts to seize when assembled, Parker developed a number of thread compounds, thread seals and valve lubricants. The company also produced a line of fabricating tools.

Pioneer Instrument Company, Inc., Bendix, N. J., 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.

One of the major recent developments has been a complete revision of the Turn and Bank Indicator mechanism. A greatly simplified construction of the gyro assembly including the replacement of loose ball type bearings and bimetal bearing clearance control with race magneto type bearings supported on a solid brass shaft has resulted in a large decrease in maintenance cost and vastly improved operation. A new filter for the air supply combining the action of layers of filter paper with the effect of fine mesh screens has proven a major step forward. The illumination of the bank indicator by the already famous Pioneer Ringlight system has been much improved by the addition of a carefully designed reflecting mask over the lower portion of the dial.

In line with the present trend toward instrument panel simplification, Pioneer engineers are now completing finishing touches on a combined rotatable airspeed indicator and rate of climb indicator. With this instrument the pilot merely keeps the concentric pointers

aligned after setting his rotatable airspeed for whatever flight condition he desires. The instrument is under test by the major airlines. It has merited enthusiastic comment from pilots and flight engineers.

The Pioneer Autosyn System of remote indication, which has proven itself on the Boeing flying fortresses and the Bell Airacuda, has been vastly improved by a new 400-cycle light weight unit. All the experience gained from thousands of hours of flight and laboratory testing of previous models has gone into this new "Midget" Autosyn. The new models will be about half the size of previous models and half of the weight and will be equipped with the new Pioneer electrical disconnect plug. This new electrical connector has undergone rigid airline service tests and represents a substantial step forward in wiring of electrical instruments.

Also in the line of remote indication, Pioneer engineers have developed a radically new D C operated Autosyn Position indicating system. This unit, built in standard instrument size gives the pilot a definite knowledge of flap and individual wheel positions and gives a definite warning indication if any wheel is not firmly locked in position.

A new type of pressure warning unit, has been developed and combines every possible safety feature with the finest available contact materials in the smallest pressure warning unit, Pioneer has built. The unit has merited the approval of the Air Corps and Airline operators. A safety diaphragm is provided so that even in case of rupture of the calibrating diaphragm, fuel or oil cannot possibly escape to the contacts.

A new Manifold Pressure Gauge was added to the Pioneer line. This instrument was the smallest manifold pressure instrument Pioneer has presented. It provides for complete isolation of the evacuated diaphragm in a cast chamber. The motion of the diaphragm is taken through the sealed wall of the chamber by means of an ingenious application of a small sylphon bellows, and no part of the mechanism is exposed to the detrimental action of manifold vapors. There is no differential pressure on the instrument case or cover glass and all adjustments are readily accessible without opening the sealed chamber. For replacement of the diaphragm, the chamber may be opened by the removal of the sealing screws.

To improve production and servicing of airspeed instruments, Pioneer has developed a new cast frame mechanism provided with sufficient adjustments so that all diaphragms selected can be used with the same etched dial. The elimination of the hand calibration and individually engraved dials is probably one of the major steps forward in aircraft instrument technique. The diaphragms for this

instrument are constructed of a carefully selected alloy and are thoroughly treated and seasoned to insure permanency of the calibration. A test calibration run is made on each diaphragm and the first differential of the calibration curve determines whether or not the diaphragm can be used in the mechanism with the standard dial.

The solution of the problem of obtaining a satisfactory pilot static tube that will remain clear of ice under all operating conditions has been reached in the Pioneer Laboratories. A new tube of the straight-out type carefully designed aerodynamically and having a built in multiple heating unit of high efficiency has been presented for Air Corps test and is being completed for commercial sale. This new tube will be in addition to the angle type of tube already in use which has been adapted for the latest Pioneer high efficiency type of de-icing heater.

Pioneer research engineers have been constantly at work raising the Sensitive Altimeter to an even greater degree of perfection. This instrument, which has the popular direct reading counter type of barometric setting, has undergone several minor changes along this line. Development work has proceeded on the Pioneer electrically operated Turn and Bank Indicator. Several units of this type are now undergoing flight tests throughout the country. The Pioneer type of case construction which employs a separable bezel ring holding the cover glass in place and sealing the instrument has been adapted to all Pioneer instruments. This type of case construction eliminates the use of sealing compounds and hand fitted snaprings. In line with this change non-shatterable glass has been included for all instruments wherein a differential pressure can exist on the cover glass.

The Pyle-National Company, Chicago, Ill., produced Civil Aeronautics Authority approved aircraft tail lights with both 15 and 21 candlepower 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, including three transmitters of various power ratings, five receivers, and two types of radiocompasses.

A great advance in aerial navigation was accomplished with the introduction of the Model AVR-8 series of radiocompasses developed by RCA. With these units it became possible for a pilot to tune in a Federal Airways beacon station, or a broadcast station, and then fly directly toward the station without any reference whatever to the

magnetic compass. The location of the station in respect to the plane's direction is shown on a left-right indicator on the pilot's instrument board. Bearings or "fixes" may be obtained by rotating the loop antenna, noting the readings on the azimuth scale, and plotting the findings on a chart. Two or more of these readings will establish a "fix".

RCA has been concentrating on radio equipment especially suited for the itinerant pilot flying the small, light-weight airplanes which are so popular today. In this connection, there will be introduced shortly the RCA Model AVT-15 light-weight aircraft transmitter especially designed for this application. It can be used also on planes of any size. A sensitive, light-weight receiver (AVR-15), companion



#### DART AIRPLANES

Manufactured by the Culver Aircraft Corporation. They are powered by Warner engines.

to the above transmitter, is being developed and will be introduced shortly, thus making an ideal combination for light planes.

Complete lines of receivers and transmitters are available as stock items to meet all requirements for any size plane. Radio equipment for airports is also available, including remotely controlled, crystal receiver units which make it possible to locate the receiver equipment at considerable distances from the airport and still control the functions from a traffic control tower or from any other designated location.

Aviation radio problems are constantly being studied by this company and extensive research with new systems of control and advances in apparatus design result. Thus, RCA is pioneering in this field to



still further increase the safety of air transportation and sport flying.

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 Division, Bendix Aviation Corporation, Sidney, N. Y., specializes in the manufacture of ignition devices for aircraft use. These include magnetos for all classes of engines of from one to 14 cylinders and more. Battery ignition equipment is also supplied as well as switches, spark plugs, and radio shield wiring harness. All types of equipment are radio shielded to prevent ignition noises from interfering with radio reception.

Among the developments of 1938 have been a new line of magnetos for light plane engines, which combine high electrical output with simplicity, light weight and inherent radio shielding. Numerous detail refinements were incorporated on magnetos for larger engines, including provision on some types for cooling the magneto by jacketing the lower part of the housing for air circulation. Bendix aircraft spark plugs are supplied for a wide variety of engines, radio shielded, both in finned and unfinned types.

Shell Petroleum Corporation, St. Louis, Mo., handled a considerably increased amount of aviation business in 1938. Noteworthy trends were greater use of higher octane gasolines, 80, 87, 90, and 100. As in previous years, a great deal of time was devoted to research work, both in the laboratories and in service tests. Active assistance was rendered to the work of the Aviation Fuels Division of the CFR Committee; notably in the study and development of new laboratory detonation test methods and in the correlation of test results with other engine and fuel manufacturers; in the study of fuel tank corrosion; of the piston ring-sticking tendencies of aircraft oils; of vapor lock problems in aviation engines; and of the extension of octane ratings beyond 100. One result of previous research work was the development of a new range of straight mineral aircraft oils, AeroShell 62, 80, 100, 120, and 140, which were introduced to the market toward the end of the year. Present indications are that the stability of the new oils is an outstanding characteristic. A further branch of research work that has lately proved of great interest concerns the development of "Safety Fuels."

Laboratory research work was materially assisted by actual performance tests carried out in the Shell Seversky Modified P-35 Pursuit Plane, powered by a 1,000 h.p. Wright Cyclone. This plane is

equipped with a large number of special instruments to make possible the testing of fuel and oil consumption and performance at moderate and high altitudes.

Sinclair Refining Company, New York, is continuing its research on aircraft engine oil and other special lubricants for the aircraft industry. During 1938 an improved Sinclair Pennsylvania 120-G Oil was developed and distributed throughout the entire marketing territory. This product has the approval of Wright Aeronautical Corporation and other engine builders for the high output engines used on the major air lines. In addition to this high grade engine oil, other Sinclair lubricants have been universally accepted, such as Sinclair High Temperature Grease No. 955 for wheel bearings, rocker arms and accessory units where high heat conditions prevail, Sinclair Counter Weight Lubricant for counterbalance units, and Sinclair A F-3 and Sinclair O U G-3 for blade bushings and thrust bearings of propellers.

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—Aero Mobiloils and Aero Mobilgas with grades ranging from 73 to 100 octane, which products meet all requirements of the U. S. Government services, air transport operators and engine manufacturers. Gargoyle Speed Reducer Oil No. 1 was developed for the particular requirements of the Curtiss electrically controlled feathering propeller. Extensive research work is being carried on continually with a view toward developing products which will meet the needs of the rapidly growing aviation industry.

Solar Aircraft Company, San Diego, Calif., pioneers in the development and manufacture of stainless steel exhaust manifolds, increased production of manifolds and other aircraft parts and accesso-

ries. Considerable effort is devoted by the Company to research leading toward the constant improvement of these parts, stressing careful layout and engineering. In line with that policy, a number of experimental installations have been produced in cooperation with leading aircraft companies. Due to increasing demands upon its time for assistance in working out various details of design and manufacture, the research laboratory has been expanded to provide additional facilities and equipment; and a large number of tests have been made on different materials and designs, especially in further perfecting the joints between manifold sections. Also, work was continued on the development of a flexible joint to allow for motor oscillation in flexible engine mount design. All of this research has had its bearing on the different experimental models evolved. New construction materials also received exhaustive tests, both in the laboratory and in actual service, and the experimental installations represented a composite of several materials, utilizing the best characteristics of each.

The Company planned to introduce and market a complete new line of steam heating equipment for aircraft, and first production units were approaching completion. The new designs represent considerable advance over present equipment, particularly in solving the problem of accurate control of heat output, necessary in meeting changing flight conditions, and new problems brought about by the supercharged cabin. Plans were completed by Solar for enlarging its plant facilities approximately 70 per cent and construction was under way early in 1939. Corresponding increases in equipment have also been made, with further additions contemplated for the near future.

Sperry Gyroscope Company, Inc., Brooklyn, N. Y., continued its active research and development program, and introduced an important new instrument in 1938. The Automatic Direction Finder was the new addition to the cockpit. Collaborating with Sperry in the development of the new direction finder was R.C.A. The new instrument, however, is sold and serviced by Sperry.

When tuned to a station the Automatic Direction Finder continuously and automatically points to the station tuned, thus the pilot merely has to glance at the pointer on the face of the instrument in order to get his bearings. As the airplane continues on its flight the pointer on the direction finder continues to indicate the position of the station. As a result, it completely eliminates the well known 180-degree ambiguity which heretofore has made it difficult to determine whether the plane is proceeding toward the station or away from the station. When the cone of silence is reached and the station is passed, the new direction finder continues to give a positive indication of the station which, of course, is then to the rear of the plane. Thus it pro-

vides an excellent indication of the cone of silence. Aside from locating the bearings of any station or obtaining a "fix" for the airplane, the Automatic Direction Finder provides a means of obtaining a drift or "crab" angle at any time.

Sperry continued its development of the Gyro Magnetic Compass, a combination of the Magnetic Compass and the Directional Gyro in a single instrument, incorporating the inherent advantages of both. The result is a compass having no northerly turning error, no other errors caused by dip, acceleration or change of course. Furthermore, it will not oscillate about the meridian before coming to rest. A number of the Gyro Magnetic Compasses are on extensive operating tests at the present time. Reports indicate that the new instrument is being received enthusiastically.

Early in 1939 Sperry opened a new radio research laboratory near Stanford University at Palo Alto, Calif., to facilitate the development of the klystron tube and to carry out the engineering applications of the new tube in the aviation field. The klystron has been described by one authority as "the most important advance in radio since the invention of the audion tube by Dr. Lee De Forest in 1906." This tube is a new type of ultra-high frequency generator and receiver working on principles strikingly different from those of the ordinary vacuum tube.

The first application of the klystron to aviation has been the production of a straight line glide path for blind landing of aircraft. The Sperry experiments are being carried out under the collaborative program of the Civil Aeronautics Authority with the Army Air Corps and the Massachusetts Institute of Technology.

On February 2, 1939, the American Institute of the City of New York presented its annual gold medal to the Sperry Gyroscope Company "for outstanding achievement in the development of flying and other navigation instruments, resulting in greater efficiency and safety on land, sea and in the air".

Sperry also carried on the development of a combined indicator called the Flightray, designed to simplify some of the problems of instrument flight and landing. The Flightray is engineered to allow a reduction in the number of instruments on the modern aircraft instrument panel by combining the more essential information on the face of a single indicator. A cathode ray tube is used as the indicator on which the various indications are assembled in a standard pattern. Thus the pilot is presented, on the face of a single instrument, with all the navigational information needed for instrument flight or landing. The Flightray reproduces indications from the artificial horizon, the directional gyro, the turn indicator and the altimeter. In addition it

also can show position on the glide path and localizer radio beam during an instrument approach.

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 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, through the Standard Oil Development Company has done intensive research work towards the improvement of petroleum aviation products. The chief accomplishment of 1938 was the development of new sources for the production of 100 octane fuels. This work has resulted in increasing materially the production of large quantities of clear fuels with octane numbers above 90. The production of hydrogenated gasolines has been increased, and this assures the availability of high quality base stocks, as well as products with good lead susceptibility.

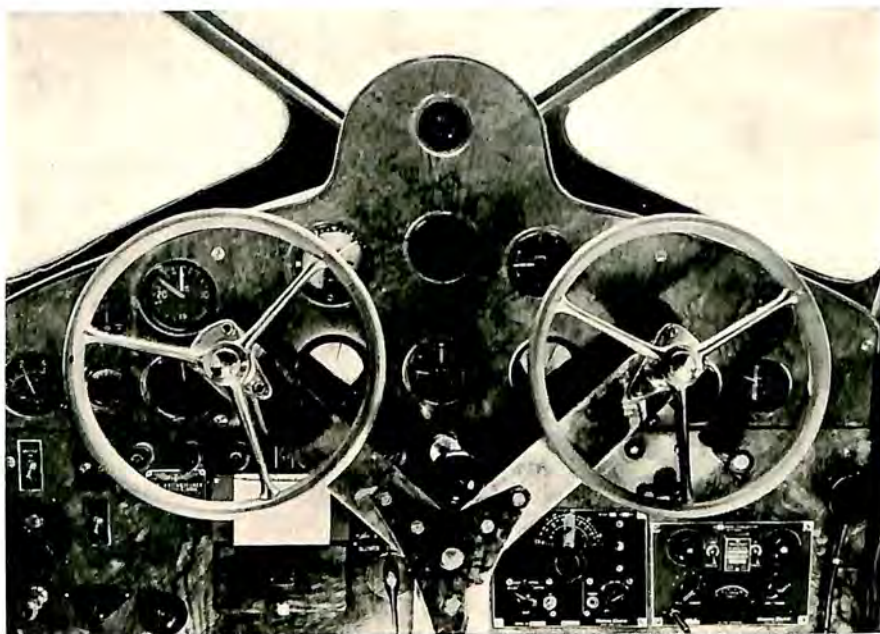
Safety fuels development by this company over the last several years continues, anticipating the present interest in these high flash fuels as a means of obtaining increased safety of aircraft operations. High flash fuels of 100 octane are available.

Improved aircraft lubrication has been made possible by the development of improved lubricating oils as a result of full scale aircraft engine tests, including service tests and intensive laboratory investigations.

During 1938, the Standard Oil Companies of New Jersey, Pennsylvania and Louisiana, as well as the Colonial Beacon Oil Company, made available to the aeronautical industry a new brand of aviation

fuels and lubricants known as Esso aviation products. The Standard Oil (Kentucky) and Standard Oil (Ohio) also undertook distribution of these new quality products. Coincident with the introduction of their new brand, Esso Marketers also arranged for the availability of higher grade gasolines, notably 90 and 100 octane, at key airports.

In 1938 a new Fairchild, equipped with Ranger engine, was added to the fleet of Esso Marketers, and early in 1939 that organization purchased a Beechcraft with a Jacobs engine. Both airplanes, in



RADIO ON WACO N

R. C. A. 25A receiver and transmitter installation on the Jacobs-powered Waco N.

addition to others in the fleet, are used for transporting sales supervisors.

Steel Products Engineering Company, Springfield, O., manufactured a line of accessories and instruments for the aviation industry.

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, and was developing new products to meet the higher standard

required by aircraft manufacturers. The technical and research laboratory at Beacon, N. Y., devotes considerable exclusive time to this end. It was contemplated that during 1939 The Texas Company would meet demands for a high octane aviation gasoline.

The Texas Company in the meantime is not overlooking requirements of motors powering lighter aircraft, and in that respect recently had approved by manufacturers of small engines new motor oils in several grades. This meets the demand for a lower priced high quality product for the smaller airplane owner and operator.

Thompson Products, Inc., Cleveland, O., 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 Stelliteing 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.

Titeflex Metal Hose Company, Newark, N. J., supplied Titeflex flexible fuel lines for aircraft work. This tubing is furnished in all sizes from  $\frac{1}{8}$ " to 3", and is very satisfactory for the carrying of gasoline and oil under pressure. It is approved by the U. S. Navy and by the Civil Aeronautics Authority for licensed aircraft. Titeflex supplied all metal pressure tubing for flexible landing gear lines, and oil and lubricating lines for cowl flap installations and for oil pressure lines on gyroscopes and other automatic appliances. The company also supplied a line of radio shielding.

United Aircraft Products, Inc., Dayton, O., continued to serve the industry in supplying fuel and oil line systems, which involve wobble pumps, fuel units, oil temperature regulators, strainers, and all other accessories needed. The company produced a viscosity valve which is attached to the oil temperature regulator. This viscosity valve maintains a predetermined viscosity of the oil at all times, and under all temperatures and conditions, and very gratifying results are being reported from large users. Another product was the new Y drain valve equipped with thermometer bulb wells. A series of new wobble pumps and fuel units adapted for increased carburetor back pressures and higher fuel flow requirements was produced.

The Western Electric Company, New York, produced a practical

terrain clearance indicator, and planned to make it available commercially before the end of 1939. It operates on the principle of measuring the elapsed time required for transmitting a radio signal from the plane to the terrain, and for the return of the reflected signal to a receiver in the airplane. Absolute altitude is then indicated directly on a small meter resembling the conventional barometric altimeter.

Western Electric also developed a midget aircraft transmitter and a companion receiver for use in light planes. These instruments establish new records for lightness, compactness and simplicity of operation. The transmitter, which weighs only 22 pounds complete, is arranged for multi-frequency transmission delivering more than 15 watts on the frequencies between 2800 and 6044 kilocycles. Either telephone or telegraph transmission may be employed. The device measures approximately 7" wide by 5" high and 4" deep. The receiver, which is divided into two units, enables the pilot to employ "finger-tip" control and it may be operated either as a crystal or manually-controlled unit. It weighs 16 pounds complete, is extremely simple to install and maintain, and covers all frequencies in the aircraft band including beacon and commercial transport.

Other Western Electric developments for 1938 included a static-free, two-way radio telephone system, which utilizes ultra-high frequencies; and a marker receiver that operates in conjunction with the recently installed radio transmitters of the Civil Aeronautics Authority. This latter receiver has been adopted as standard equipment by air lines. It utilizes automatic signal lamps for visual operation in addition to provision for aural indication through the ship's regular headset.

The company also demonstrated an automatic direction finder for ground station use, and an elaborate, all a. c. radio telephone system for large transports such as the Douglas DC-4. This latter equipment is five times more powerful than conventional airplane transmitters and enables the flight crew to make simultaneous observations of the beacon, weather and marker signals while holding two-way communication with the landing field. All power is supplied from the ship's 800 cycle lighting plant.

The Wilcox-Rich Division of Eaton Manufacturing Company, Detroit, Mich., made two important contributions to aircraft progress; development of the Rich valve in sodium-cooled form, and development of the Zero-Lash Hydraulic Valve Lifter. Working with S. D. Heron, who brought forth the first internally cooled valve at McCook Field in 1924, Wilcox-Rich engineers perfected the Rich Sodium Cooled Valve. The valve is made of Silcrome X Steels. It has a



hollow chamber in the head and stem which contains a liquid coolant. When splashed up and down with the valve movement, it transfers the heat from the intensely hot head to the cooled stem. Use of Sodium Cooled Valves in aircraft engines is now almost universal.

There are three large Wilcox-Rich plants, in Battle Creek, Marshall, and Saginaw, Michigan—in addition to the headquarters plant and laboratory at Detroit. These plants make other parts of the valve gear mechanism: tappets, valve springs, push rods, and valve seat inserts. In connection with the latter, company engineers have made important experiments in determining the best valve seat insert design and material to use when matched with a specific valve and to fit a certain type of engine requirement.

Probably the most interesting recent development of the Wilcox-Rich Division is the Zero-Lash Hydraulic Valve Lifter. This device employs mechanical tappets to give zero clearance, bringing many distinct benefits which include accurate valve timing, increased engine output with little or no increase in weight, prolonged life of valve and seat, simplified engine design, improved engine performance, and elimination of need for adjusting tappets. The Continental motor used in the record flight of Johnnie Jones (Los Angeles to New York, December, 1938) was Zero-Lash equipped.



#### SOLAR EXHAUST MANIFOLD INSTALLATION

Solar corrosion and heat resisting exhaust manifold on the Wright Cyclone engines in the new Boeing four-engine Stratoliner.

## Aviation Chronology and Records

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## CHRONOLOGY FOR 1938

- Jan. 3 Pan American Airways starts survey flights between United States and New Zealand. (Sikorsky S-42B, 4 Pratt & Whitney Hornets)
- Jan. 10 Eighteen long-range patrol bombing planes fly 2,570 miles non-stop to Honolulu from San Diego, Calif., in 20 hrs. 12 min. (Consolidated PBY patrol bombers, 2 Pratt & Whitney Twin Wasps.)
- Jan. 24-25 Attilio Biseo, Magg. Amedeo Paradisi, Giovanni Sacconi, Ubaldo Ardu and Giovanni Cubeddu, Italy, fly from Rome to Rio de Janeiro, Brazil, in record time of 41 hrs. 32 min. (Savoia S 79, 3 Alfa Romeo 126 R. C. 34 engines.)
- Jan. 26-Feb. 6 International Air Show held in International Amphitheatre, Chicago, Ill.
- Feb. 8 War Department awards Distinguished Flying Cross for air heroism to Lieut. Benjamin S. Kelsey and Second Lieut. Homer A. Boushey.
- Feb. 8 Comm. Rossi, pilot, and A. Vigroux, mechanic, set four world speed records for 2,000 kms. (See Official Air Records) (Amiot 370, 2 Hispano-Suiza engines.)
- Feb. 15 Frank W. Fuller, Jr., flies from San Francisco, Calif., to Los Angeles, Calif., in record time of 1 hr. 7 min. 7 sec. (Sukorsky, Pratt & Whitney Twin Wasp engine.)
- Feb. 15-27 Six bombers of U. S. Army Air Corps under command of Lt. Col. Robert Olds on good will flight to Buenos Aires and return to Langley Field, Va., in longest non-stop mass flight in history of Air Corps. (Boeing B-17, Wright Cyclone powered.)
- Feb. 24 Adriano Racula and Paolo d'Ambrosio, Italy, set world speed record for 1,000 kms. with 2,000 kgs. payload at 278.433 m.p.h. (Savoia S-79, 3 Piaggio P.X. R.C.40 engines.)
- March 15-26 Flying Officer A. E. Clouston and Victor Ricketts fly from England to New Zealand and return, setting speed records between England-Sydney; England-New Zealand; Australia-New Zealand; New Zealand-Australia; New Zealand-England; England-Australia-England. (de Havilland Comet airplane, 2 Gypsy engines.)
- March 20 Friedrich Ritz, Germany, sets eight world speed records for seaplanes. (See Official Records) (HE 115, 2 D-AEHF engines.)
- March 27-29 Capt. H. W. von Engel and Chief Pilot E. Gundermann, Germany, set long distance flight record for seaplanes in 4,970.059 mi. hop from Southampton, England, to Caravellas, Brazil. (Dornier DO 18, D-ANHR, NR 734 2 Juno 205 Diesel engines.)
- March 30 M. Stoppani, G. Gorini, Ing. Luzzatto and E. Accumolli, Italy, set eight world speed records for seaplanes. (See Official Records) (Cant Z 509, 3 Fiat A 80 RC 41 engines.)
- April 2-10 Third Annual National Pacific Aircraft & Boat Show, Pan Pacific Auditorium, Los Angeles, Calif.
- April 12 Richard V. Rhode, Langley Field, Va., awarded Wright Brothers' Medal for 1937 for his "new contributions to existing knowledge of the aeronautic art."
- April 16 Dedication of Wright Brothers' home and bicycle shop at Greenfield Village, Dearborn, Mich.
- April 16 Denis Mulligan named Director of the Bureau of Air Commerce to succeed Fred D. Fagg, Jr.
- April 17-22 H. F. Broadbent, Great Britain, flies from Darwin, Australia, to Lympne, England, in record time of 5 days 5 hrs., 21 min. (Percival Gull, Gypsy Six Series 2 engine.)
- April 18 Mrs. Edmee Jarland, France, sets women's world glider altitude record of 3,395.165 feet at Beynes-Thiberval (Avia 40 P.)

- April 19 Lewin B. Barringer sets national (U. S.) glider distance record of 212.45 miles from Wichita Falls, Tex., to Tulsa, Okla. (Goppinger 3 Minimoa sailplane.)
- April 19 Lt. Col. Robert Olds flies from Langley Field, Va. to March Field, Calif., in 12 hrs. 27 min., bettering previous record for military planes by one hour, with crew of three officers and five enlisted men. (Boeing B-17, 4 Wright Cyclone engines.)
- April 22 Capt. E. V. Rickenbacker buys Eastern Air Lines from North American Aviation, Inc., for \$3,500,000.
- April 23 Lt. Col. Robert Olds flies from March Field, Calif., to Langley Field, Va., in 10 hrs. 45 min., bettering previous mark for military planes by 16 min., crew of three officers and five enlisted men. (Boeing B-17, 4 Wright Cyclone engines.)
- April 30 Lt. Col. Robert Olds receives Distinguished Flying Cross for commanding good will flight of U. S. Army bombing planes to Buenos Aires.
- May 1 Sportsman Pilot Air Show, Ponca City, Okla.
- May 1 GHQ Air Force war maneuvers start in northeastern section using 217 airplanes.
- May 12 Lieut. C. B. Olson, U. S. Coast Guard, receives Distinguished Flying Cross for a 300 mile rescue flight at sea.
- May 13-15 Pilots Comdt. Y. Fujita and F. Takahashi and mechanic C. Sekine, Japan, set world closed course distance record of 7,239.588 miles. (Koken monoplane 700 h.p., Kasawaki engine.)
- May 13-15 Pilots Comdt. Y. Fujita and F. Takahashi, and mechanic C. Sekine, Japan, set world record for speed for 10,000 kms. of 115.694 m.p.h. (Koken monoplane 700 h.p., Kasawaki engine.)
- May 15-16 Mrs. Dupeyron, France, makes women's world distance record of 2,709.421 miles from Oran to Tel Laham, Irak. (Caudron C. 600 Aiglon, Renault-Bengali, Jr. engine.)
- May 15-21 National Air Mail Week, celebrating twentieth anniversary of U. S. Air Mail.
- May 19 Alexander P. de Seversky flies from Roosevelt Field, N. Y., to Washington-Hoover Airport, Washington, D. C. in record time of 58 mins. 38 secs. (Seversky, Pratt & Whitney Twin Wasp engine.)
- May 24 Lieut. P. Ossipenko and Lieut. V. Lomako, U. S. S. R., set women's world seaplane closed-course distance record of 1,086.908 miles. (MP-1, AM-34, 750 h.p. engine.)
- May 25 Frank W. Fuller, Jr., flies from San Francisco, Calif., to Seattle, Wash., in record time of 2 hrs. 31 mins. 41 secs. (Seversky, Pratt & Whitney Twin Row Wasp engine.)
- May 28 Empire Air Day celebrated throughout Great Britain.
- May 28 Frank W. Fuller, Jr., flies from Vancouver, B. C., to Oakland, Calif., in record time of 3 hrs. 8 mins. 43 secs. (Seversky, Pratt & Whitney Twin Wasp engine.)
- June 1 Earl Ortman, flies from San Francisco, Calif., to San Diego, Calif., in record time of 1 hr. 48 min. 1 sec. (Marcoux-Bromberg Special, Pratt & Whitney Wasp Jr. engine.)
- June 2-9 Richard Archbold flies from San Diego, Calif., to Hollandia, New Guinea with Russell Rogers, Lewis Yancey, G. D. Brown, S. Barrinka & Ray Booth—7,200 miles. (Consolidated flying boat, 2 Wright Cyclones.)
- June 4 Karlheinz Kindermann and Ruprecht Wendel, pilots and Ing. Hotopf, passenger, Germany, set world altitude record with pay-load of 5,000 kgs. of 30,551.120 feet at Dessau. (Junkers JU 90)

- June 5 Maj. Gen. Ernst Udet, Germany, sets world land-plane speed record for 100 kms. of 304.147 m.p.h. over Wustrow-Muritz course. (Heinkel HE 112U plane, BD 601 engine.)
- June 6 Daniel Guggenheim Medal for 1938 awarded to A. H. R. Fedden, for "contributions to the development of aircraft engine design and for the specific design of the sleeve valve aircraft engine."
- June 8 Comm. M. Rossi, pilot, and A. Vigroux, mechanic, France, set three world speed records for 5,000 kms.—without payload and with 500 and 1,000 kgs.—of 249.051 m.p.h. over Istres-Cazaux-Istres course. (Amiot 370, 2 Hispano-Suiza 860 H.P. engines.)
- June 8 Karlheinz Kindermann and Ing. Hotopf, Germany, set world altitude record with payload of 10,000 kgs. of 23,759.795 ft. at Dessau. (Junkers JU 90, D-ALAT.)
- June 10-12 International Air Races, Municipal Airport, Oakland, Calif.
- June 20 Engineer Karl Bode, Germany sets world helicopter distance record of 143,069 miles from Fassberg to Rangsdorf. (FW 61-VI, Siemens SH 14a, 160 h.p. engine.)
- June 23 President Roosevelt signs Civil Air Authority Act creating Civil Aeronautics Authority of five members, an Executive Administrator and a 3-man Safety Board.
- June 25 Forty-seven U. S. Navy planes make non-stop mass flight from San Diego, Calif., to Seattle, Wash., 1,100 miles. (Consolidated PBV-1, 2 Pratt & Whitney Twin Wasp engines.)
- June 25 Royal Air Force Display, Hendon, England.
- June 25-July 10 Ninth Annual National Soaring Contest, Elmira, N. Y.
- July 2 Poline Ossipenko, Vera Lomako, and Marina Raskova, U.S.S.R., set women's world seaplane distance record of 1,392.801 miles from Sebastopol to Lac Kholmkoie. (MP-1, AM-34, 750 h.p. engine.)
- July 4 Paul Mantz flies from Wichita, Kans., to Los Angeles, Calif., in record time of 7 hrs. 11 min. 5 sec. (Lockheed Orion, Pratt & Whitney Wasp engine.)
- July 5 Richard C. DuPont sets national (U. S.) glider altitude record of 6,806 ft. at Elmira, N. Y. (Minimoa)
- July 7 Bernhard Flinsch, Germany, sets world glider closed-course distance record of 189.906 miles from Bremen to Lubeck and return. (D-11-180 glider.)
- July 7-8 Four Royal Air Force bombing planes under command of Squadron Leader, R. Kellett, set record for long distance formation flight of 4,300 miles from England to Egypt. (Vickers Wellesley Single Bristol Pegasus engine.)
- July 10-14 Howard Hughes, pilot, Harry P. M. Connor and Lieut. Thomas Thurlow, navigators, Richard Stoddart, radio engineer and Ed Lund, flight engineer, fly around the world in 3 days 19 hrs. 8 min. 10 sec. New York, Paris, Moscow, Omsk, Yakutsk, Fairbanks, Minneapolis, New York—14,791 miles. (Lockheed 14 monoplane, two 1,100 h.p. Wright Cyclone engines.)
- July 17-18 Douglas Corrigan flies non-stop from Floyd Bennett field, New York, to Baldonnel Airport, Dublin, Ireland, in 28 hrs. 13 min., 3,150 miles. (Curtiss Robin, 175 h.p. Wright Whirlwind, J-6 engine.)
- July 28 1st Lt. Harold L. Neely, U. S. Army Air Corps, crossed United States at speed of approximately 278 m.p.h., total elapsed time 11 hrs., 29 min. (Seversky, P-35 Pratt & Whitney Twin Wasp engine.)
- Aug. 1 Forty-one U. S. Navy planes make non-stop mass flight from Seattle, Wash., to San Diego, Calif., 1,400 miles. (Consolidated PBV-1, 2 Pratt & Whitney Twin Wasp engines.)

- Aug. 5 Three U. S. Army planes make non-stop flight from Langley Field, Va., to Techo Airport, Bogota, Colombia, 1,540 miles in 8 hrs. 19 min. (Boeing B-17, 4 Pratt & Whitney Twin Wasp engines.)
- Aug. 10-11 Alfred Henke, Rudolf von Moreau, Paul Dierberg and Walter Kober, Germany, fly from Berlin, Germany, to New York City in record time of 24 hrs. 56 min. 12 sec. (Focke-Wulf FW 200, 4 BMW Hornet engines.)
- Aug. 13-14 Alfred Henke, Rudolf von Moreau, Paul Dierberg and Walter Kober, Germany, fly from New York City to Berlin, Germany in record time of 19 hrs. 55 min. 1 sec. (Focke-Wulf FW 200 4 BMW Hornet engines.)
- Aug. 22 Civil Aeronautics Act becomes effective coordinating all non-military aviation under Civil Aeronautics Authority.
- Aug. 29 Major Alexander de Seversky makes east-west transcontinental speed record of 10 hrs. 3 min. New York to Los Angeles. (Seversky Pursuit, Pratt & Whitney Twin Wasp engine.)
- Aug. 29 Edwin Francis Conway Memorial Trophy recommended for award to Oakland, Calif., Naval Reserve aviation base.
- Aug. 31-Sept. 1 Fourteen U. S. Navy planes make mass flight from San Diego, Calif., to Coco Solo, Canal Zone in 26 hrs. 40 mins. (Consolidated PBY, 2 Pratt & Whitney Twin Wasp engines.)
- Sept. 2-6 Merrill Phoenix and Howard Allen make world light plane endurance record of 106 hrs. 6 min. at Syracuse, N. Y. (Piper Cub, Franklin Aircooled 50 h.p. engine.)
- Sept. 3 Jacqueline Cochran wins Bendix Trophy Race, Burbank, Calif., to Cleveland, Ohio, 2,042 miles in 8 hrs. 10 mins. 31 secs. (Seversky Pursuit, Pratt & Whitney Twin Wasp engine.)
- Sept. 3 Jacqueline Cochran flies from Burbank, Calif., to New York City, setting women's west-east transcontinental record of 10 hrs. 27 min. 55 sec. (Seversky, Pratt & Whitney Twin Wasp engine.)
- Sept. 3-5 National Air Races, Cleveland, Ohio.
- Sept. 6-7 Seventeen U. S. Navy planes make mass flight from San Diego, Calif., to Hawaii, 2,570 miles in 17 hrs. 21 mins. (Consolidated PBY, 2 Pratt & Whitney Twin Wasp engines.)
- Sept. 11-12 Poland declared winner of 26th James Gordon Bennett Balloon Race in traveling 990 miles from Liege, Belgium, to Trogan, Bulgaria.
- Sept. 16 U. S. Army Air Corps awarded the Collier Trophy for 1937 for the development of the Lockheed XC-35 stratosphere plane.
- Sept. 24-25 V. Grisodubova, P. Ossipenko, and M. Raskova, U.S.S.R., set women's world distance record of 3,671.432 miles. (Soukhoi Rodina, 2 M-86 engines.)
- Sept. 29 Brig. Gen. Henry H. Arnold named chief of U. S. Army Air Corps.
- Oct. 1-9 Tenth anniversary of nation-wide air transport service commemorated by National Air Travel Week.
- Oct. 6-8 Capt. D. C. T. Bennett and First Officer I. Harvey, Great Britain, set world seaplane distance record of 5,997.462 miles from Dundee, Scotland to Port-Nolloth, South Africa. (Short-Mayo, 4 Napier Rapier J. 1 engines.)
- Oct. 13-15 SAE National Aircraft Production Meeting, Ambassador Hotel, Los Angeles, Calif.
- Oct. 14 Mackay Trophy awarded to Captains Carl J. Crane and George V. Holloman, U. S. Army Air Corps, for developing and demonstrating automatic landing system for airplanes.
- Oct. 14-16 Second Annual International Aerobatic Competition and St. Louis Air Races, St. Louis, Mo.

- Oct. 14-16 Annual meeting of National Association of State Aviation Officials, Omaha, Neb.
- Oct. 22 Col. Mario Pezzi, Italy, sets world altitude record for airplanes of 56,046.473 ft. at Guidonia, Italy. (Caproni 161, Piaggio XI RC engine.)
- Oct. 28-29 National Rotating Wing Aircraft meeting, Franklin Institute, Philadelphia, Pa.
- Nov. 5-7 Kellett, Gaine, Combe and Gray, Great Britain, set world distance record of 7,158.440 miles, Ismailia, Egypt, to Darwin, Australia. (Vickers Wellesley, Bristol Pegasus engine.)
- Nov. 17-18 Aeronautical Law Symposium, Federal Court House, Foley Square, New York.
- Nov. 18-Dec. 4 Sixteenth International Aviation Exhibition, Grand Palais, Paris.
- Dec. 4 A. Tondi, G. Pontonutti, D. Risaliti and M. Razzano, Italy, set four world speed records for 2,000 kms., without payload and with 500, 1,000, and 2,000 kgs., of 291.305 m.p.h. (Savoia S-79, 3 Piaggio P-XI RC-40 engines.)
- Dec. 4 A. Tondi, G. Pontonutti, D. Risaliti and M. Razzano, Italy, set world speed record for 1,000 kms. with 2,000 kgs. payload of 293.799 m.p.h. (Savoia S-79, 3 Piaggio P-XI, RC-40 engines.)
- Dec. 17 Rear Admiral Wm. A. Moffett Memorial Trophy awarded Aviation Unit of U.S.S. Northampton. Lieut. Robert Goldthwaite, U.S.N., Senior Aviator of the ship, receives the trophy on behalf of the personnel.
- Dec. 17 Dr. Hugh L. Dryden, National Bureau of Standards, delivers second Wright Brothers' lecture at Columbia University, New York City.
- Dec. 21 President Roosevelt presents Herbert Schiff Memorial Trophy to Lieutenant Commander Arnold J. Isbell's naval training squadron at Pensacola, Fla. for best safety record in flying.
- Dec. 30 A. Tondi and G. Pontonutti, Italy, set world speed record for 1,000 kms. with 5,000 kgs. payload of 251.878 m.p.h. (Savoia S-79, 3 Piaggio P-XI, RC-40 engines.)
- Dec. 30 A. Tondi and G. Pontonutti, Italy, set world speed record for 2,000 kms. with 5,000 kgs. payload of 250.906 m.p.h. (Savoia S-79, 3 Piaggio, P-XI, RC-40 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, 1939

### 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

Francesco Agello, Italy, October 23, 1934.	709.209 km.p.h. (440.681 m.p.h.)
DISTANCE, AIRLINE	11,520.421 kilometers (7,158.440 miles)
Kellett, Gething Gaine, Combe, Burnett Gray, Great Britain, November 5-7, 1938.	
DISTANCE, CLOSED CIRCUIT	11,651.011 kilometers (7,239.588 miles)
Fujita, Takahashi and Sekine, Japan, May 13-15, 1938.	
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	11,651.011 kilometers (7,239.588 miles)
Comdt. Yuzo Fujita and Fukujiro Takahashi, pilots; Chikakichi Sekine, mechanic; Japan, "Koken" monoplane, Kawasaki special engine of 700 HP, May 13-15, 1938.	
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.	

## AIRLINE DISTANCE

International Record	11,520.421 kilometers (7,158.440 miles)
Kellett, Gaine, Combe & Gray, Great Britain, Vickers Wellesley, Bristol Pegasus engine, from Ismailia, Egypt, to Darwin, Australia, November 5-7, 1938.	
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	10,148 kilometers (6,295.662 miles)
Col. Mikhail Gronov, Comdt. Andrei Youmichev and Ing. Sergei Daniline, U.S.S.R., ANI-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	None established.

## ALTITUDE

International Record	17,083 meters (56,046.473 feet)
Col. Mario Pezzi, Italy, Caproni 161 airplane, Piaggio XI R C engine at Montecelio, October 22, 1938.	
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, 634.320 km.p.h. (394.147 m.p.h.)
Major General Ernst Udet, Germany, Heinkel He 112 U airplane, BD 601 engine, Wustrow-Muritz course, June 5, 1938.	
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, 328.139 km.p.h. (203.895 m.p.h.)  
 Miss Jacqueline Cochran, Beechcraft biplane, X-17081, Pratt & Whitney "Wasp" 600  
 h.p. engine, July 26, 1937.

**SPEED FOR 2000 KILOMETERS (1242.739 MILES)**

International Record.....Speed, 468.811 km.p.h. (291.305 m.p.h.)  
 A. Tondi and G. Pontonutti, pilots; D. Risaliti and M. Razzano, mechanics; Italy,  
 Savoia S. 79 airplane, 3 Piaggio P.XI R.C. 40 1000 HP engines, December 4, 1938.  
 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, 400.810 km.p.h. (249.051 m.p.h.)  
 M. Rossi, pilot; A. Vigroux, mechanic; France, Amiot 370 airplane, 2 Hispano-Suiza 860  
 HP engines, Istres-Cazaux-Istres course, June 8, 1938.  
 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, 186.197 km.p.h. (115.697 m.p.h.)  
 Comdt. Yuzo Fujita and Fukujiro Takahashi, pilots; Chikakichi Sekine, mechanic;  
 Japan, "Koken" monoplane, Kawasaki special engine of 700 HP, May 13-15, 1938.  
 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, 468.811 km.p.h. (291.305 m.p.h.)  
 A. Tondi and G. Pontonutti, pilots; D. Risaliti and M. Razzano, mechanics; Italy,  
 Savoia S. 79 airplane, 3 Piaggio P.XI R.C. 40 1000 HP engines, December 4, 1938.  
 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, 400.810 km.p.h. (249.051 m.p.h.)  
 M. Rossi, pilot; A. Vigroux, mechanic; France, Amiot 370 airplane, 2 Hispano-Suiza  
 860 HP engines, Istres-Cazaux-Istres course, June 8, 1938.  
 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, 468.811 km.p.h. (291.305 m.p.h.)  
 A. Tondi and G. Pontonutti, pilots; D. Risaliti and M. Razzano, mechanics; Italy, Savoia S. 79 airplane, 3 Piaggio P. XI R.C. 40 1000 IIP engines, December 4, 1938.
- 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, 400.810 km.p.h. (249.051 m.p.h.)  
 M. Rossi, pilot; A. Vigroux, mechanic; France, Amiot 370 airplane, 2 Hispano-Suiza 860 HP engines, Istres-Cazaux-Istres course, June 8, 1938.
- 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, 472.825 km.p.h. (293.799 m.p.h.)  
 A. Tondi and G. Pontonutti, pilots; D. Risaliti and M. Razzano, mechanics; Italy, Savoia S.79 airplane, 3 Piaggio P. XI R.C. 40 1000 HP engines, December 4, 1938.
- 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, 468.811 km.p.h. (291.305 m.p.h.)  
 A. Tondi and G. Pontonutti, pilots; D. Risaliti and M. Razzano, mechanics; Italy, Savoia S.79 airplane, 3 Piaggio P. XI R.C. 40 1000 HP engines, December 4, 1938.
- 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 .....9,312 meters (30,551.120 feet)  
Karlheinz Kindermann and Ruprecht Wendel, pilots; Ing. Hotopf, passenger; Germany,  
Junkers Ju 90 D-ALAT airplane at Dessau, June 4, 1938.  
National (U.S.) Record.....None established.

**SPEED FOR 1000 KILOMETERS**

International Record .....405.359 km.p.h. (251.878 m.p.h.)  
A. Tondi and G. Pontonutti, Italy, Savoia. S. 79, 3 Piaggio P. XI RC 40 engines,  
December 30, 1938.  
National (U.S.) Record.....None established.

**SPEED FOR 2000 KILOMETERS**

International Record .....403.908 km.p.h. (250.906 m.p.h.)  
A. Tondi and G. Pontonutti, Italy, Savoia. S. 79, 3 Piaggio P. XI RC 40 engines,  
December 30, 1938.  
National (U.S.) Record.....None established.

**CLASS C—WITH PAY LOAD OF 10,000 KILOGRAMS  
(22,046 lbs.)**

**ALTITUDE**

International Record .....7,242 meters (23,759.795 feet)  
Karlheinz Kindermann, pilot; Ing. Hotopf, passenger, Germany, Junkers Ju 90 D-ALAT  
airplane, at Dessau, June 8, 1938.  
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**

**SINGLE-SEATER AIRCRAFT HAVING AN ENGINE CYLINDER DIS-  
PLACEMENT BETWEEN 6.5 AND 9 LITERS (397-549 CUBIC INCHES)**

**ALTITUDE**

International Record .....7,985 meters (26,197.452 feet)  
Nicolas D. Fedoseev, U.S.S.R., G-23-2 airplane, M-11 150 HP engine of 8.6 liters  
cylinder displacement, Moscow-Touchino, August 2, 1938.  
National (U.S.) Record.....None established.

**SPEED FOR 100 KILOMETERS**

International Record .....Speed, 372.979 km.p.h. (231.758 m.p.h.)  
Maurice Arnoux, France, Caudron 685 airplane, Renault engine of 7.85 liters cylinder  
displacement, Villesauvage-La Marmogne, Oct. 1, 1938.  
National (U.S.) Record .....Speed, 333.179 km.p.h. (207.027 m.p.h.)  
Clarence R. McArthur, Delgado "Flash" monoplane, Menasco C6S-4 engine of 544.9  
cubic inches cylinder displacement, New Orleans, La., June 26, 1938.

**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.

**ALTITUDE**

International Record .....6,095 meters (19,996.679 feet)  
 V. Glebov and A. Bossounov, U.S.S.R. October 12, 1938.  
 National (U.S.) Record .....None established.

**SPEED FOR 100 KILOMETERS (62.137 MILES)**

International Record .....Speed, 343.839 km.p.h. (213.651 m.p.h.)  
 Maurice Arnoux, pilot; Miss Lallus, passenger; France, Caudron 686 monoplane, Renault engine of 7.950 liters cylinder displacement, December 30, 1937.  
 National (U.S.) Record.....None established.

**LIGHT AIRPLANES—CLASS C—SECOND CATEGORY**

**SINGLE-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 4 AND 6.5 LITERS (244-397 CUBIC INCHES)**

**AIRLINE DISTANCE**

International Record .....5,099.300 kms. (3,168.365 miles)  
 Andre Japy, France, Caudron 600 "Aiglou" monoplane, Renault Bengali Junior engine of 6.33 liters cylinder displacement, from Istres to Djibouti, November 30, 1937.  
 National (U.S.) Record.....None established.

**ALTITUDE**

International Record.....8,303 meters (27,240.757 feet)  
 Helmuth Kalkstein, Germany, Klemm KL 35 B airplane, Hirth IM 506 engine of 5.96 liters cylinder displacement, at Boblingen, October 18, 1938.  
 National (U.S.) Record.....None established.

**SPEED FOR 100 KILOMETERS (62.137 MILES)**

International Record.....Speed, 383.386 km.p.h. (238.225 m.p.h.)  
 S. J. Wittman, United States, Wittman "Special" monoplane, Menasco C-4-S engine of 5.95 liters cylinder displacement, Detroit, Sept. 19, 1937.  
 National (U.S.) Record.....Same as above.

**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-Bonice course, November 13, 1937.  
 National (U.S.) Record.....None established.

**SPEED FOR 2,000 KILOMETERS (1,242.739 MILES)**

International Record.....Speed, 317.779 km.p.h. (197.458 m.p.h.)  
 Maurice Arnoux, France, Caudron 660 airplane, Renault engine of 6.33 liters cylinder displacement, Etampes, October 23, 1938.  
 National (U.S.) Record.....None established.

**MULTI-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 4 AND 6.5 LITERS (244-397 CUBIC INCHES)**

**AIRLINE DISTANCE**

International Record .....3,415.900 kms. (2,122.538 miles)  
 Andre Japy, pilot; Georges Morizot, passenger, France, Caudron 600 "Aiglou" monoplane, Renault Bengali Jr. engine of 6.33 liters cylinder displacement, from Istres to Wadi-Halfa, December 20-21, 1937.  
 National (U.S.) Record.....None established.

**ALTITUDE**

International Record.....6,827 meters (22,398.247 feet)  
 Maurice Arnoux, pilot; Miss Lallus, passenger; France, Farman type 357 monoplane,

- Renault Bengali 140 HP engine of 6.340 liters cylinder displacement, Orly, Dec. 18, 1937.  
 National (U.S.) Record.....None established.
- SPEED FOR 100 KILOMETERS (62.137 MILES)**  
 International Record.....Speed, 330.760 km.p.h. (205.524 m.p.h.)  
 H. Boris, pilot; A. Garnier, passenger; France, Caudron Rafale C.660 monoplane,  
 Renault engine of 6.351 liters cylinder displacement, Dec. 24, 1937.  
 National (U.S.) Record.....None established.
- SPEED FOR 1,000 KILOMETERS (621.369 MILES)**  
 International Record.....Speed, 318.431 km.p.h. (197.863 m.p.h.)  
 H. Boris, pilot; A. Garnier, passenger; France, Caudron Rafale C.660 monoplane,  
 Renault engine of 6.351 liters cylinder displacement, Dec. 27, 1937.  
 National (U.S.) Record.....None established.
- SPEED FOR 2,000 KILOMETERS (1,242.739 MILES)**  
 International Record.....Speed, 249.930 km.p.h. (155.299 m.p.h.)  
 Roger Bellon, pilot; Miss Chandron, passenger; France, Caudron Rafale C.530 mono-  
 plane, Renault Bengali engine of 6.33 liters cylinder displacement, Dec. 24, 1937.  
 National (U.S.) Record.....None established.

**LIGHT AIRPLANES—CLASS C—THIRD CATEGORY**

**SINGLE-SEATER AIRCRAFT HAVING AN ENGINE CYLINDER DIS-  
 PLACEMENT BETWEEN 2 AND 4 LITERS (122-244 CUBIC INCHES)**

**AIRLINE DISTANCE**

- International Record.....909.100 kilometers (564.887 miles)  
 Jean Chas, France, Leopoldoff Colibri L.3 biplane, Salmson engine of 2.97 liters cylinder  
 displacement, from St. Inglevert to Perpignan, December 31, 1937.  
 National (U.S.) Record.....None established.

**ALTITUDE**

- International Record.....7,470 meters (24,507.823 feet)  
 Maj. Karel Brazda, Czechoslovakia, Tatra T 101 airplane, Tatra HM 504 engine of  
 3.98 liters cylinder displacement, at Brno, March 16, 1938.  
 National (U.S.) Record.....None established.

**SPEED FOR 100 KILOMETERS**

- International Record.....Speed, 231.243 km.p.h. (143.687 m.p.h.)  
 Capt. Jan Cervenka, Czechoslovakia, Tatra T.001-1 airplane, Tatra HM 504 engine of  
 3.98 liters cylinder displacement, Praha-Nove Benatky-Rup-Praha course, May 6, 1938.  
 National (U.S.) Record.....None established.

**SPEED FOR 1,000 KILOMETERS**

- International Record.....Speed, 229.040 km.p.h. (142.319 m.p.h.)  
 Hans A. Lucher, Germany, Arado Ar-79, D-EKCX, airplane, Hirth IM 504 A 2  
 engine of 3.98 liters cylinder displacement, Schonhausen-Gross Behnitz course, July 15,  
 1938.  
 National (U.S.) Record.....None established.

**SPEED FOR 2,000 KILOMETERS**

- International Record.....Speed, 227.029 km.p.h. (141.069 m.p.h.)  
 Friedrich Seelbach, Germany, Arado Ar-78, D-EHCR, airplane, Hirth IM 504 A 2  
 engine of 3.984 liters cylinder displacement, Tornau-Tegeler See course, July 29, 1938.  
 National (U.S.) Record.....None established.

**AIRLINE DISTANCE**

- International Record.....4,175.431 kilometers (2,594.484 miles)  
 Major Jan Ambrus and Chief Pilot Vojtech Matena, Czechoslovakia, Tatra T-101-1  
 airplane, Tatra HM 504 98 HP engine of 3.98 liters cylinder displacement, from  
 Prague to Khartoum, May 17-18, 1938.  
 National (U.S.) Record.....None established.

**ALTITUDE**

- International Record.....7,113 meters (23,336.565 feet)  
 Maj. Karel Brazda, pilot; Jaroslav Valda, passenger; Czechoslovakia, Tatra T 101  
 airplane, Tatra HM 504 engine of 3.98 liters cylinder displacement, at Brno, March 16,  
 1938.  
 National (U.S.) Record.....None established.

## SPEED FOR 100 KILOMETERS

International Record.....Speed, 231.035 km.p.h. (143.558 m.p.h.)  
 Capt. Jan Cervenka, pilot; Lt. Miles Stepanek, passenger; Czechoslovakia, Tatra  
 T.001-1 airplane, Tatra HM 504 engine of 3.98 liters cylinder displacement, Praha-  
 Nove Benatky-Rip-Praha course, April 30, 1938.  
 National (U.S.) Record.....None established.

## SPEED FOR 1,000 KILOMETERS

International Record.....Speed, 228.241 km.p.h. (141.822 m.p.h.)  
 Capt. Jan Cervenka, pilot; Lt. Miles Stepanek, passenger; Czechoslovakia, Tatra  
 T.001-1 airplane, Tatra HM 504 engine of 3.98 liters cylinder displacement, Praha-  
 Nove Benatky-Rip-Praha course, April 30, 1938.  
 National (U.S.) Record.....None established.

## LIGHT AIRPLANES—CLASS C—FOURTH CATEGORY

SINGLE-SEATERS HAVING AN ENGINE CYLINDER DISPLACE-  
MENT OF LESS THAN 2 LITERS (122 CUBIC INCHES)

## AIRLINE DISTANCE

International Record.....1,631.878 kilometers (1,014 miles)  
 Robert E. Bryant, United States, Aeronca C-3 monoplane, Aeronca E-113-B engine of  
 1.86 liters cylinder displacement, from Miami, Florida to Camden, New Jersey, July 31,  
 1938.  
 National (U.S.) Record.....Same as above.

## ALTITUDE

International Record.....5,851 meters (19,196.154 feet)  
 Jan Anderle, Czechoslovakia, Praga E 115-1 airplane, Praga B. II engine of 1.904  
 liters cylinder displacement, at Letnany aerodrome, March 22, 1938.  
 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)

## AIRLINE DISTANCE

International Record.....309.800 kilometers (192.500 miles)  
 M. Blazy, pilot; M. Varon, passenger; France, S.F.A. N. 4 monoplane, Train engine  
 of 1.995 liters cylinder displacement, from Guyancourt to Champniers, Vienna, Dec. 30,  
 1937.  
 National (U.S.) Record.....None established.

## ALTITUDE

International Record.....4,872 meters (15,984.219 feet)  
 Jan Anderle, pilot; Emanuel Franek, passenger; Czechoslovakia, Praga E 115-1 air-  
 plane, Praga B. II engine of 1.904 liters cylinder displacement, at Letnany aerodrome,  
 March 21, 1938.  
 National (U.S.) Record.....None established.

## SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record.....Speed, 174.064 km.p.h. (108.158 m.p.h.)  
 Comdt. Jaroslav Polma, pilot; Capt. F. Zeleny, passenger; Czechoslovakia, Benes-Mraz  
 "Bibi Be 550" airplane, Walter Minor engine of 1.978 liters cylinder displacement,  
 Praha-Nove Benatky-Rip-Praha course, May 12, 1938.  
 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, PN-10, 2 Packard 600 HP each, San Diego, Cal.,  
 August 15-16, 1927.

**AIRLINE DISTANCE**

International Record.....9,652.001 kilometers (5,997.462 miles)  
 Capt. D. C. T. Bennett and First Officer I. Harvey, pilots; Great Britain, Short-Mayo  
 "Mercury" seaplane, 4 Napier "Rapier J.L." 370 HP engines, from Dundee, Scotland  
 to near Port-Nolloth, S. Africa, Oct. 6-8, 1938.  
 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.....8,435 kilometers (5,241.256 miles)  
 Capt. H. V. von Engel and Chief Pilot Erich Gundermann, Germany, Dornier Do  
 18 monoplane seaplane, D-ANHR, nr 734 2 Jumo 205 Diesel 6 cylinder engines, from  
 Start Bay, Angleterre to Caravellas-Bahia, Brazil, March 27-29, 1938.  
 National (U.S.) 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; Navy XP3Y-1  
 seaplane, 2 Pratt & Whitney 825 HP engines, from Cristobal Harbor, C. Z., to San  
 Francisco Bay, Alameda, Cal., Oct. 14-15, 1935.

**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, 403.424 km.p.h. (250.676 m.p.h.)  
 M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accumolli, passengers; Italy,  
 Cant Z 509 seaplane, 3 Fiat A.80 RC 41 1,000 HP engines, March 30, 1938.  
 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, 396.464 km.p.h. (246.351 m.p.h.)  
 M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accumoli, passengers; Italy,  
 Cant Z 509 seaplane, 3 Fiat A.80 RC 41 1,000 HP engines, March 30, 1938.  
 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.....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 "Wasp" 420 HP engines,  
 supercharged, Bridgeport, Connecticut, July 21, 1930.

**SPEED FOR 1000 KILOMETERS (621.369 MILES)**

International Record.....Speed, 403.424 km.p.h. (250.676 m.p.h.)  
 M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accumoli, passengers; Italy,  
 Cant Z 509 seaplane, 3 Fiat A.80 RC 41 1,000 HP engines, March 30, 1938.  
 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, 396.464 km.p.h. (246.351 m.p.h.)  
 M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accumoli, passengers; Italy,  
 Cant Z 509 seaplane, 3 Fiat A.80 RC 41 1,000 HP engines, March 30, 1938.  
 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, 403.424 km.p.h. (250.676 m.p.h.)  
 M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accumoli, passengers; Italy,  
 Cant Z 509 seaplane, 3 Fiat A.80 RC 41 1,000 HP engines, March 30, 1938.  
 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, 396.464 km.p.h. (246.351 m.p.h.)  
 M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accumolli, passengers; Italy,  
 Cant Z 509 seaplane, 3 Fiat A.80 RC 41 1,000 HP engines, March 30, 1938.  
 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, 403.424 km.p.h. (250.676 m.p.h.)  
 M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accumolli, passengers; Italy,  
 Cant Z 509 seaplane, 3 Fiat A.80 RC 41 1,000 HP engines, March 30, 1938.  
 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, 396.464 km.p.h. (246.351 m.p.h.)  
 M. Stoppani and G. Gorini, pilots; Ing. Luzzatto and E. Accumolli, passengers; Italy,  
 Cant Z 509 seaplane, 3 Fiat A.80 RC 41 1,000 HP engines, March 30, 1938.  
 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 sea-  
plane, 3 Isotta-Fraschini Asso 11 R.C. 40 836 HP engines, Monfalcone, Apr. 13, 1937.  
National (U.S.) Record.....None established.

**SPEED FOR 1000 KILOMETERS**

International Record.....Speed, 211.002 km.p.h. (131.110 m.p.h.)  
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere  
521 seaplane, "Lt. de Vaisseau Paris", 6 Hispano-Suiza 650 HP engines, Lucon-  
Aureilhan base, December 27, 1937.  
National (U.S.) Record.....None established.

**CLASS C2—WITH PAY LOAD OF 15,000 KILOGRAMS  
(33,069.33 lbs.)**

**ALTITUDE**

International Record.....3,508 meters (13,509.162 feet)  
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere  
521 seaplane, "Lt. de Vaisseau Paris", 6 Hispano-Suiza 650 HP engines, at Biscarosse,  
December 30, 1937.  
National (U.S.) Record.....None established.

**SPEED FOR 1,000 KILOMETERS**

International Record.....Speed, 189.741 km.p.h. (117.899 m.p.h.)  
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere  
521 seaplane, "Lt. de Vaisseau Paris", 6 Hispano-Suiza 650 HP engines, Lucon-  
Aureilhan course, December 29, 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, 18,040 kilograms (39,771 lbs.)  
Guillaumet, Leclaire, Comet, Le Duff, Le Morvan and Chapaton, France, Latecoere  
521 seaplane, "Lt. de Vaisseau Paris", 6 Hispano-Suiza 650 HP engines, at Biscarosse,  
December 30, 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**

**SINGLE-SEATER AIRCRAFT HAVING AN ENGINE CYLINDER DIS-  
PLACEMENT BETWEEN 6.5 AND 9 LITERS (397-549 CUBIC INCHES)**

**ALTITUDE**

International Record .....4,086 meters (13,405.484 feet)  
Catherine Mednikova, U.S.S.R., Yakovlev UT-1 seaplane, M-11 engine of 8.600 liters  
cylinder displacement, at Moscow, September 27, 1938.  
National (U.S.) Record.....None established.

**SPEED FOR 100 KILOMETERS (62.137 MILES)**

International Record .....Speed, 197.271 km.p.h. (122.578 m.p.h.)  
Catherine Mednikova, U.S.S.R., Yakovlev UT-1 seaplane, M-11 G engine of 8.600 liters  
cylinder displacement, at Moscow, September 23, 1938.  
National (U.S.) Record.....None established.

**LIGHT SEAPLANES—CLASS C2—SECOND CATEGORY**

**SINGLE-SEATER AIRCRAFT HAVING AN ENGINE CYLINDER DIS-  
PLACEMENT OF LESS THAN 6.5 LITERS (397 CUBIC INCHES)**

**ALTITUDE**

International Record.....6,649 meters (21,814.261 feet)  
Helmuth Kalkstein, Germany, Klemm WKL 35 B seaplane, Hirth IM 506 engine of  
5.96 liters cylinder displacement, September 11, 1938.  
National (U.S.) Record.....None established.

**AIRLINE DISTANCE**

Neither International nor National (U.S.) Record has been established.

**SPEED FOR 100 KILOMETERS (62.137 MILES)**

International Record.....Speed, 228.717 km.p.h. (142.118 m.p.h.)  
Helmuth Kalkstein, Germany, Klemm WKL 35 B seaplane, Hirth IM 506 engine of  
5.96 liters cylinder displacement, Lindau-Reichenau course, September 11, 1938.  
National (U.S.) Record.....None established.

**SPEED FOR 1,000 KILOMETERS (621.369 MILES)**

International Record.....Speed, 228.027 km.p.h. (141.689 m.p.h.)  
Helmuth Kalkstein, Germany, Klemm WKL 35 B seaplane, Hirth IM 506 engine of  
5.96 liters cylinder displacement, Lindau-Reichenau course, September 11, 1938.  
National (U.S.) Record.....None established.

**MULTI-SEATER AIRCRAFT HAVING AN ENGINE CYLINDER DIS-  
PLACEMENT OF LESS THAN 6.5 LITERS (397 CUBIC INCHES)**

**ALTITUDE**

International Record.....5,390 meters (17,683.692 feet)  
Helmuth Kalkstein, pilot; Karl Voy, passenger, Germany, Klemm WKL 35 B seaplane,  
Hirth IM 506 engine of 5.96 liters cylinder displacement, Lindau-Reichenau course,  
September 12, 1938.  
National (U.S.) Record.....None established.

**SPEED FOR 100 KILOMETERS (62.137 MILES)**

International Record.....Speed 227.704 km.p.h. (141.488 m.p.h.)  
Helmuth Kalkstein, pilot; Karl Voy, passenger; Germany, Klemm WKL 35 B seaplane,  
Hirth IM 506 engine of 5.96 liters cylinder displacement, Lindau-Reichenau course,  
September 12, 1938.  
National (U.S.) Record .....None established.

**AMPHIBIONS—CLASS C3**

**AIRLINE DISTANCE**

International Record.....2,300.860 kilometers (1,429.685 miles)  
Major General F. M. Andrews, pilot; Major John Whiteley, co-pilot; and crew, United  
States, Douglas YOA-5 amphibion, 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 amphibion, 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 Amphibion, 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  
 amphibion, 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 amphibion, 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  
 amphibion, 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 amphibion, 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  
 amphibion, 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 amphibion, 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  
 amphibion, 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 amphibion, 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, LZ 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—SINGLE PLACE

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 Iarygen-skaya, May 27, 1937.  
 National (U.S.) Record.....341.906 kms. (212.45 miles)  
 Lewin B. Barringer, Goppinger 3 "Minimoa" Sailplane, G-16923, from Wichita Falls, Texas to Tulsa, Oklahoma, April 19, 1938.

DISTANCE WITH RETURN TO POINT OF DEPARTURE

International Record.....305.624 kilometers (189.906 miles)  
 Bernhard Flinsch, Germany, D-11-180 glider, type D-30, from Bremen to Lubeck and return, July 7, 1938.  
 National (U.S.) Record.....None established.

DURATION WITH RETURN TO POINT OF DEPARTURE

International Record.....36 hrs., 35 min.  
 Kurt Schmidt, Germany, Grunau Baby glider, "D-Loerzer" at Korschenruh, Prusse Orientale, August 3 and 4, 1933.  
 National (U.S.) Record.....21 hrs., 34 min.  
 Lieut. William A. Cocks, Jr., Cocks "Nighthawk" glider, Honolulu, Hawaii, December 17 and 18, 1931.

ALTITUDE ABOVE STARTING POINT

International Record.....6,687 meters (21,938,932 feet)  
 Walter Drechsel, Germany, Goppinger 3 "Minimoa" glider, Wasserkuppe (Rhoen), August 5, 1938.  
 National (U.S.) Record.....2,075 meters (6,806 feet)  
 Richard C. duPont, Minimoa glider, Harris Hill, Elmira, New York, July 5, 1938.

GLIDERS—CLASS D—MULTI PLACE

DISTANCE, AIRLINE

International Record.....619.748 kilometers (385.093 miles)  
 I. Kartachev, pilot; P. Savtsov, passenger, U.S.S.R., Stakhanovetz glider, from Moscow-Izmailovo to Ouchnia, July 17, 1938.  
 National (U.S.) Record.....None established.

DISTANCE, WITH RETURN TO POINT OF DEPARTURE

International Record.....258.830 kilometers (160.829 miles)  
 Heinrich Huth, pilot; Heinrich Brandt, passenger; Germany, Kranich glider, from Hambourg-Altona to Hanovre-Vahrenwald and return, August 10, 1938.  
 National (U.S.) Record.....None established.

## DURATION, WITH RETURN TO POINT OF DEPARTURE

International Record.....	40 hours, 38 minutes.
Toni Kahlbacher, pilot; Karl Tauschegg, passenger; Germany, Mg 9a glider, at Spitzerberg, September 8-10, 1938.	
National (U.S.) Record.....	None established.

## ALTITUDE ABOVE STARTING POINT

International Record.....	3,304 meters (10,839.872 feet.)
E. Ziller, pilot; Quadfasel, passenger; Germany, D-6 405 "Kranich" Glider, at Hartau, September 18, 1937.	
National (U.S.) Record.....	None established.

## POWERED GLIDERS—CLASS D—FIRST CATEGORY

SINGLE-PLACE POWERED GLIDERS WEIGHING, WHEN READY TO FLY, LESS THAN 350 KILOGRAMS (771.618 LBS.) AND HAVING AN ENGINE WITH A CYLINDER DISPLACEMENT OF LESS THAN 1,000 CUBIC CENTIMETERS (61 CUBIC INCHES).

## DURATION WITH RETURN TO POINT OF DEPARTURE

International Record.....	5 hrs., 24 min., 19 sec.
Micha Offierski, Poland, "BAK" SP-1102 motorplane, Kroeber-Koller 16 HP engine, Warsaw Mokotow, February 23, 1938.	
National (U.S.) Record.....	None established.

## ALTITUDE WITH RETURN TO POINT OF DEPARTURE

International Record.....	4,595 meters (15,075.428 feet)
Micha Offierski, Poland, "BAK" SP-1102 motorplane, Kroeber-Koller 16 HP engine, Warsaw Mokotow, February 16, 1938.	
National (U.S.) Record.....	None established.

## HELICOPTERS—CLASS G

## DURATION, CLOSED CIRCUIT

International Record.....	1 hour, 20 mins., 49 seconds.
Ewald Rohlfis, 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.....	230.248 kilometers (143.069 miles)
Engineer Karl Bode, Germany, FW 61-VI Helicopter, Siemens Sh 14a 160 HP engine, from Fassberg to Rangsdorf, June 20, 1938.	
National (U.S.) Record.....	None established.

## DISTANCE, CLOSED CIRCUIT

International Record.....	80.604 kilometers (50.085 miles)
Ewald Rohlfis, 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 Rohlfis, 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 Rohlfis, 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.....5,908.610 kilometers (3,671.432 miles)  
 V. Grisodoubova and P. Ossipenko, pilots; M. Raskova, Navigatrix; U.S.S.R., Soukhoi  
 Redina airplane, 2 M-86 800 HP engines, September 24-25, 1938.  
 National (U.S.) Record.....3,939.245 kilometers (2,447.728 miles)  
 Amelia Earhart, Lockheed Vega monoplane, Pratt and Whitney Wasp 450 HP engine,  
 from Los Angeles, California to Newark, New Jersey, August 24-25, 1932.

ALTITUDE

International Record.....14,310 meters (46,948.725 feet)  
 Mrs. Maryse Hilsz, France, Potez 506 biplane, Gnome & Rhone 900 HP engine, at Villa-  
 coublay, 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, 411.899 km.p.h. (255.942 m.p.h.)  
 Jacqueline Cochran, modified Seversky monoplane, Pratt and Whitney Twin Row Wasp  
 engine, Miami, Florida, December 13, 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—SECOND CATEGORY

SINGLE-SEATERS HAVING AN ENGINE CYLINDER DISPLACE-  
 MENT BETWEEN 4 AND 6.5 LITERS (244-397 CUBIC INCHES)

AIRLINE DISTANCE

International Record.....4,360.400 kilometers (2,709.421 miles)  
 Mrs. Dupeyron, France, Caudron C. 600 monoplane, Renault-Bengali Junior engine of  
 6.33 liters cylinder displacement, from Oran to Tel el Laham, Iraq, May 15-16, 1938.  
 National (U.S.) Record.....None established.

ALTITUDE

International Record.....6,782 meters (22,250.610 feet)  
 Mrs. Claire Roman, France, Caudron "Rafale" C.530 monoplane, Renault Bengali  
 engine of 6.33 liters cylinder displacement, at Istres, Dec. 29, 1937.  
 National (U.S.) Record.....None established.

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.

## SPEED FOR 2,000 KILOMETERS (1,242.739 MILES)

International Record.....	Speed, 245.223 km.p.h. (152.374 m.p.h.)
Mrs. Claire Roman, France, Caudron "Rafale" C.530 monoplane, Renault Bengali engine of 6.33 liters cylinder displacement, at Istres, December 30, 1937.	
National (U.S.) Record.....	None established.

## MULTI-SEATERS HAVING AN ENGINE CYLINDER DISPLACEMENT BETWEEN 4 AND 6.5 LITERS (244-397 CUBIC INCHES)

## ALTITUDE

International Record.....	5,811 meters (19,064.921 feet)
Miss Elizabeth Lion and Miss Robert, France, Caudron "Aiglon" monoplane, Renault Bengali 140 HP engine of 6.333 liters cylinder displacement, December 30, 1937.	
National (U.S.) Record.....	None established.

## 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 C-530 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.

## SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record.....	Speed, 164.940 km.p.h. (102.489 m.p.h.)
Catherine Mednikova, U.S.S.R., G.22 airplane, Walter-Mikron engine of 2.16 liters cylinder displacement, Likoboty-Lochki-Ikoha-Likoboty course, July 3, 1938.	
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.....	5,343 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 HAVING AN ENGINE CYLINDER DISPLACEMENT OF LESS THAN 2 LITERS (122 CUBIC INCHES)

## AIRLINE DISTANCE

International Record.....	427.200 kilometers (265.449 miles)
Miss Madeleine Renaud, France, Taupin monoplane, Mengin engine of 1.561 liters cylinder displacement, from Buc to St. Martial de Mirambeau, December 29, 1937.	
National (U.S.) Record.....	None established.

ALTITUDE

International Record.....4,935 meters (16,190.911 feet)  
 Mrs. Lafargue, France, Touya monoplane, Train engine of 1.994 liters cylinder displacement, at Bordeaux, December 27, 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

AIRLINE DISTANCE

International Record.....2,241.501 kilometers (1,392.801 miles)  
 Poline Ossipenko and Vera Lomako, pilots; Marina M. Raskova, navigatrix; U.S.S.R., MP-1 seaplane, AM-34 750 HP engine, from Sebastopol to Lac Kholmokoie, July 2, 1938.  
 National (U.S.) Record.....None established.

BROKEN LINE DISTANCE

International Record.....2,371.990 kilometers (1,473.883 miles)  
 Poline Ossipenko and Vera Lomako, pilots; Marina M. Raskova, navigatrix; U.S.S.R., MP-1 seaplane, AM-34 750 HP engine, from Sebastopol to Lac Kholmokoie via Novgorod, July 2, 1938.  
 National (U.S.) Record.....None established.

DISTANCE IN A CLOSED CIRCUIT

International Record.....1,749.213 kilometers (1,086.908 miles)  
 Lt. P. Ossipenko, and Lt. V. Lomako, U.S.S.R., MP-1 monoplane seaplane, AM-34 750 HP engine, May 24, 1938.  
 National (U.S.) Record.....None established.

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.

SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record.....Speed, 127.361 km.p.h. (79.138 m.p.h.)  
 Miss Crystal Mowry and Miss Edith McCann, United States, Kitty Hawk seaplane, Kinner 125 HP engine, Miami, Florida, December 9, 1936.  
 National (U.S.) Record.....Same as above

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

#### ALTITUDE

International Record.....	4,086 meters (13,405.484 feet)
Catherine Mednikova, U.S.S.R., Yakovlev UT-1 seaplane, M-11 G motor of 8,600 liters cylinder displacement, at Moscow, September 27, 1938.	
National (U.S.) Record.....	None established.

#### SPEED FOR 100 KILOMETERS (62.137 MILES)

International Record.....	Speed, 197.271 km.p.h. (122.578 m.p.h.)
Catherine Mednikova, U.S.S.R., Yakovlev UT-1 seaplane, M-11 G motor of 8,600 liters cylinder displacement, at Moscow, September 23, 1938.	
National (U.S.) Record.....	None established.

### 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 Bezmicchowa, May 13-14, 1937.	
National (U.S.) Record.....	7 hours, 28 minutes.
Helen M. Montgomery, Stevens-Franklin glider, Crystal Downs Beach, 5 miles North of Frankfort, Michigan, September 4, 1938.	

#### AIRLINE DISTANCE

International Record.....	349 kilometers (216.858 miles)
Hanna Reitsch, Germany, Reiher D-11-95 Glider, from the Wasserkuppe to Hamburg-Fuhlsbittel airport, July 4, 1937.	
National (U.S.) Record.....	None established.

#### ALTITUDE ABOVE STARTING POINT

International Record.....	1,184 meters (3,895.165 feet)
Mrs. Edmee Jarlaud, France, Avia 40 P glider, Beynes-Thiberval, April 18, 1938.	
National (U.S.) Record.....	None established.

#### AIRLINE DISTANCE

International Record.....	152.638 kilometers (94.845 miles)
O. V. Klepikova, pilot; E. L. Rastorgoueva, passenger; U.S.S.R., Ch-10 glider, from Miasnovo to Lomskia, June 10, 1938.	
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 Carrier Operations

Air Lines of the United States

(Corrected by U. S. Civil Aeronautics Authority)

(Revised to include Territorial Operations)

Year	Operators	Planes in Service	Miles Flown	Passengers	Passenger Miles	Express Pounds	Mail <sup>4</sup> Pound-Miles
1926	13	...	4,318,087	5,782	(1)	3,555	(3)
1927	19	128	5,870,489	8,679	(1)	45,859	.....
1928	36	325	10,673,450	49,713	(1)	216,644	.....
1929	39 <sup>2</sup>	525	25,141,499	173,405	(1)	257,443	.....
1930	43 <sup>2</sup>	600	36,945,203	417,505	103,747,249	468,571	.....
1931	41 <sup>2</sup>	590	47,646,407	531,662	121,122,777	1,200,243	6,280,409,884
1932	34 <sup>2</sup>	564	51,171,887	547,560	148,186,337	1,672,806	5,402,249,740
1933	29 <sup>2</sup>	504	54,878,014	576,612	199,776,034	2,489,719	5,135,897,406
1934 <sup>1</sup>	25 <sup>2</sup>	518	49,064,773	572,265	226,650,857	3,482,403	4,922,822,780
1935 <sup>1</sup>	27 <sup>2</sup>	459	63,867,698	874,116	362,370,920	5,565,137	8,265,416,188
1936 <sup>1</sup>	33 <sup>2</sup>	380	73,611,770	1,166,043	494,283,871	8,414,184	11,482,872,622
1937 <sup>1</sup>	20 <sup>2</sup>	386	77,403,365	1,289,735	552,648,589	8,984,049	13,396,460,117
1938 <sup>1</sup>	23 <sup>2</sup>	345	81,058,127	1,536,111	635,556,184	9,452,600	14,845,719,671

<sup>1</sup> Not requested prior to 1930.<sup>2</sup> In several cases the same company operates both domestic and foreign services.<sup>3</sup> 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.<sup>4</sup> Mail pound miles flown are for domestic services and Inter-Island Airways which company holds a domestic air mail contract.

## Summary of United States Air Carrier Operations

January 1, 1939

Miles of American-operated air-transport routes:

Domestic.....	35,492
Territorial.....	2,068
Foreign.....	35,707
	<u>73,267</u>

Miles in operation with United States mail:

Domestic.....	34,272
Territorial.....	1,000
Foreign.....	29,020
	<u>64,301</u>

# FLYING FACTS AND FIGURES

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Miles in operation with passengers:	
Domestic.....	35,492
Territorial.....	2,068
Foreign.....	35,707
	<u>73,267</u>
Miles in operation with express:	
Domestic.....	34,945
Territorial.....	2,068
Foreign.....	35,707
	<u>72,720</u>
Airplane-miles scheduled daily (average):	
Domestic.....	197,972
Territorial.....	1,748
Foreign.....	28,539
	<u>228,259</u>
With United States mail:	
Domestic.....	187,206
Territorial.....	1,000
Foreign.....	20,609
	<u>208,905</u>
With passengers:	
Domestic.....	197,972
Territorial.....	1,748
Foreign.....	28,539
	<u>228,259</u>
With express:	
Domestic.....	197,176
Territorial.....	1,748
Foreign.....	28,539
	<u>227,463</u>
Number of air transport services in operation.....	
Mail.....	146
Passenger.....	116
Express.....	146
Domestic routes.....	
Mail.....	143
Passenger.....	104
Express.....	91
Territorial routes.....	
Mail.....	7
Passenger.....	4
Express.....	7
Foreign routes.....	
Mail.....	7
Passenger.....	35
Express.....	21
Number of scheduled air-transport operators <sup>1</sup> .....	
Domestic.....	35
Territorial.....	22
Foreign.....	18
	<u>2</u>
	<u>6</u>

<sup>1</sup> 3 companies operated both domestic and foreign services and 1 company Territorial and foreign services.

## United States Air Transport Routes

Official Reports of U. S. Civil Aeronautics Authority

January 1, 1939

Routes	Airway miles <sup>1</sup>	Schedule (round trips)	Plane-miles scheduled daily average <sup>2</sup>	Present operator
DOMESTIC				
New York-Westfield, Mass. . . . .	127	Weekly . . . . .	36	Airline Feeder System, Inc.
New York-Boston (direct) . . . . .	190	4 times daily . . . . .	1,520	American Airlines, Inc.
New York-Boston via Providence . . . . .	221	2 times daily . . . . .	884	"
New York-Boston via Hartford . . . . .	203	Daily . . . . .	406	"
New York-Boston via Springfield . . . . .	206	"	412	"
New York-Los Angeles via Nashville and Dallas . . . . .	2,759	"	5,518	"
New York-Los Angeles via Washington, Memphis, and Fort Worth . . . . .	2,759	2 times daily . . . . .	11,036	"
New York-Washington . . . . .	209	Daily . . . . .	418	"
Washington-Nashville . . . . .	599	"	1,198	"
Boston-Buffalo via Albany . . . . .	414	"	828	"
New York-Albany . . . . .	134	2 times daily . . . . .	536	"
Albany-Cleveland . . . . .	442	Daily . . . . .	884	"
New York-Chicago via Buffalo and Detroit . . . . .	754	8 times daily . . . . .	12,064	"
Detroit-Chicago via Battle Creek . . . . .	263	Daily . . . . .	526	"
Washington-Chicago via Cincinnati . . . . .	684	2 times daily . . . . .	2,736	"
Washington-Cincinnati . . . . .	423	Daily . . . . .	846	"
Cleveland-Nashville . . . . .	469	2 times daily . . . . .	1,876	"
Chicago-Fort Worth via St. Louis, Tulsa, and Dallas . . . . .	934	"	3,736	"
Boston-Bangor . . . . .	213	"	852	Boston-Maine Airways, Inc.
Bangor-Caribou, Maine . . . . .	164	Daily . . . . .	328	"
Boston-Burlington . . . . .	193	2 times daily . . . . .	772	"
Chicago-Dallas via Kansas City and Wichita . . . . .	929	"	3,716	Braniff Airways, Inc.
Dallas-Brownsville . . . . .	546	"	2,184	"
Amarillo-Dallas . . . . .	345	"	1,380	"
Dallas-Galveston . . . . .	273	"	1,092	"
Houston-San Antonio . . . . .	191	Daily . . . . .	382	"
Houston-Corpus Christi . . . . .	186	"	372	"
Chicago-New Orleans . . . . .	892	2 times daily . . . . .	3,568	Chicago & Southern Air Lines, Inc.
Denver-El Paso . . . . .	581	Daily . . . . .	1,162	Continental Airlines, Inc.
Denver-Albuquerque . . . . .	351	"	702	"
Charleston-Atlanta . . . . .	311	"	622	Delta Air Corp.
Atlanta-Fort Worth . . . . .	784	2 times daily . . . . .	3,136	"
Atlanta-Birmingham . . . . .	140	Daily . . . . .	280	"
New York-Washington . . . . .	209	3 times daily . . . . .	1,254	Eastern Air Lines, Inc.
"	209	4 times daily . . . . .	1,672	"
New York-Richmond . . . . .	305	Daily . . . . .	610	"
New York-San Antonio . . . . .	1,727	"	3,454	"
New York-Houston . . . . .	1,536	"	3,072	"
New York-Atlanta . . . . .	786	"	1,572	"
New York-Miami via Charleston . . . . .	1,210	3 times daily . . . . .	7,260	"
New York-Miami via Orlando . . . . .	1,220	Daily . . . . .	2,440	"
Atlanta-Tampa via Tallahassee . . . . .	434	"	868	"



## United States Air Transport Routes—Continued

Routes	Airway miles	Schedule (round trips)	Plane-miles scheduled daily average	Present operator
DOMESTIC—continued				
Chicago-Miami via Atlanta and Jacksonville.....	1,267	Daily .....	2,534	Eastern Air Lines, Inc.
Chicago-Miami via Atlanta, Jacksonville and Orlando.....	1,277	"	2,554	"
Cheyenne-Great Falls.....	572	"	1,144	Inland Airlines, Inc.
Cheyenne-Billings.....	380	"	760	"
Cheyenne-Huron, South Dakota.....	542	"	1,084	"
St. Louis-Cincinnati.....	310	4 times weekly.	354	Marquette Airlines, Inc.
Cincinnati-Detroit.....	237	6 times weekly.	406	"
Minneapolis-Kansas City via Sioux City.....	488	Daily.....	976	Mid-Continent Airlines, Inc.
Minneapolis-Huron.....	256	"	512	"
Huron-Omaha.....	245	"	490	"
Huron-Bismarck.....	221	"	442	"
Omaha-Tulsa.....	383	"	766	"
Daytona Beach-Miami via St. Petersburg.....	361	"	722	National Airlines, Inc.
Orlando-St. Petersburg.....	98	"	196	"
Jacksonville-New Orleans.....	524	"	1,048	"
Chicago-Minneapolis via Milwaukee.....	397	"	794	Northwest Airlines, Inc.
Chicago-Minneapolis via Rochester.....	367	"	734	"
Chicago-Fargo (direct).....	571	2 times daily...	2,284	"
Chicago-Fargo via Milwaukee.....	612	Daily.....	1,224	"
Fargo-Seattle via Butte.....	1,266	2 times daily...	5,064	"
Fargo-Seattle via Helena and Wenatchee.....	1,305	Daily.....	2,610	"
Spokane-Portland via Yakima.....	291	"	582	"
Washington-Detroit via Pittsburgh and Cleveland.....	410	6 times daily...	4,920	Pennsylvania-Central Airlines.
Norfolk-Washington.....	146	Daily.....	292	"
Cleveland-Detroit.....	93	"	186	"
Detroit-Milwaukee.....	250	2 times daily...	1,036	"
Grand Rapids-Chicago.....	131	"	524	"
Washington-Buffalo via Harrisburg and Baltimore.....	318	Daily.....	636	"
Washington-Buffalo via Pittsburgh.....	401	"	802	"
Detroit-Saulte Ste. Marie, Michigan.....	347	"	694	"
New York-Los Angeles via St. Louis.....	2,533	"	5,066	Transcontinental & Western Air.
New York-Los Angeles via Philadelphia and St. Louis.....	2,555	"	5,110	"
New York-Los Angeles via St. Louis and Boulder City.....	2,592	"	5,184	"
New York-Kansas City via St. Louis.....	1,106	"	2,212	"
New York-Chicago via Philadelphia and Dayton.....	809	"	1,618	"
New York-Pittsburgh.....	307	2 times daily...	1,228	"

## United States Air Transport Routes—Continued

Routes	Airway miles	Schedule (round trips)	Plane-miles scheduled daily average	Present operator
DOMESTIC—continued				
New York-Kansas City via Chicago.....	1,126	Daily.....	2,252	Transcontinental & Western Air.
Pittsburgh-Kansas City via Chicago.....	819	"	1,638	"
Pittsburgh-Chicago (direct).....	417	"	834	"
Phoenix-San Francisco via Las Vegas.....	764	"	1,528	"
New York-Chicago.....	719	8 times daily...	11,504	United Air Lines Transport Corp.
New York-Chicago via Allentown.....	719	Daily.....	1,438	"
Chicago-San Francisco via Denver.....	2,022	2 times daily...	8,088	"
Chicago-San Francisco via Cheyenne.....	1,935	Daily.....	3,870	"
Chicago-Salt Lake City via Cheyenne.....	1,302	"	2,604	"
Chicago-Omaha.....	437	"	874	"
Des Moines-Lincoln.....	174	"	348	"
Denver-Cheyenne.....	96	3 times daily...	576	"
Salt Lake City-Seattle via Portland.....	816	Daily.....	1,632	"
Salt Lake City-Portland.....	672	"	1,344	"
Portland-Spokane via Pendleton.....	341	"	682	"
San Diego-Seattle via Fresno.....	1,161	"	2,322	"
Los Angeles-Seattle via Fresno and Sacramento.....	1,084	"	2,168	"
San Diego-San Francisco (direct).....	462	"	924	"
San Francisco-Sacramento.....	80	"	160	"
Los Angeles-San Francisco (direct).....	348	"	696	"
Los Angeles-San Francisco via Santa Barbara and Monterey.....	366	"	732	"
Los Angeles-San Francisco (direct).....	348	"	696	"
San Diego-Salt Lake City.....	702	2 times daily...	2,808	Western Air Express Corporation.
Los Angeles-Salt Lake City.....	588	Daily.....	1,176	"
Salt Lake City-Great Falls.....	489	2 times daily...	1,956	"
Wilmington-Avalon.....	31	"	124	Wilmington-Catalina Airline, Ltd.
Total domestic routes <sup>3</sup> .....	35,492		197,972	
FOREIGN				
Burlington-Montreal.....	73	"	292	Boston-Maine Airways, Inc.
New York-Montreal.....	332	"	1,328	Canadian-Colonial Airways, Inc.
Fargo-Winnipeg.....	211	"	844	Northwest Airlines, Inc.
Baltimore-Hamilton, Bermuda via Port Washington, N. Y.....	947	2 times weekly.	541	Pan American Airways, Inc.
Miami-Nassau.....	188	Daily.....	376	"
Miami-Havana.....	226	3 times daily...	1,356	"
Miami-San Juan.....	1,161	4 times weekly	1,327	"
San Juan-Port of Spain.....	725	3 times weekly.	621	"
Port of Spain-Buenos Aires.....	5,173	2 times weekly.	2,956	"
Port au Prince-San Juan.....	415	Weekly.....	119	"
Port au Prince-La Guaira via Maracaibo.....	888	"	253	"

United States Air Transport Routes—Continued

Routes	Airway miles	Schedule (round trips)	Plane-miles scheduled daily average	Present operator
Port au Prince-Kingston.....	455	Weekly.....	130	Pan American Airways, Inc.
Miami-Cristobal via Kingston.....	1,397	"	399	"
Miami-Cristobal via Barranquilla.....	1,662	2 times weekly.	949	"
Barranquilla-Port of Spain.....	944	"	539	"
Maracaibo-Port of Spain.....	730	3 times weekly.	626	"
Miami-Merida.....	717	Weekly.....	205	"
Brownsville-Mexico City.....	466	Daily.....	932	"
Mexico City-Cristobal.....	1,765	3 times weekly.	1,513	"
San Francisco-Hong Kong via Hawaii, Guam, Manila, and Macao.	8,748	Weekly.....	2,499	Pan American Airways, Inc. (Panair do Brasil, S. A.).
Belem, Br.-Recife.....	1,231	"	352	"
Recife-Porto Alegre.....	1,988	2 times weekly.	1,136	"
Belem-Rio Branco, Br. via Amazon River.....	1,685	Weekly.....	481	"
Rio de Janeiro-Bello Horizonte.....	210	6 times weekly.	360	"
Havana-Guantanamo.....	656	8 times weekly.	1,312	Pan American Airways, Inc. (Cia Nacional Cubana de Aviacion).
Havana-Santiago via Cienfuegos..	472	Weekly.....	135	"
Havana-Cienfuegos.....	140	Daily.....	280	"
Los Angeles-Mexico City.....	1,684	3 times weekly.	1,443	Pan American Airways, Inc. (Cia Mexicana de Aviacion).
Mexico City-Merida.....	736	6 times weekly.	1,262	"
Tampico-Mexico City via Tuxpan.	244	"	418	"
Cristobal, Canal Zone-Buenos Aires via Santiago, Chile. <sup>4</sup> .....	4,436	2 times weekly.	2,535	Pan American-Grace Airways, Inc.
Arica, Chile-Buenos Aires via La Paz, Bolivia, and Cordoba, Argentina.....	1,649	Weekly.....	471	"
Arica, Chile-La Paz, Bolivia.....	190	"	54	"
Santiago, Chile-Buenos Aires via Cordoba.....	871	"	249	"
Seattle-Vancouver.....	123	Daily.....	246	United Air Lines Transport Corp.
Total Foreign Routes <sup>3</sup> .....	35,707		28,539	
TERRITORIAL				
Honolulu-Hilo.....	229	"	458	Inter Island Airways, Inc.
Honolulu-Wailuku.....	102	"	204	"
Honolulu-Port Allen.....	120	"	240	"
Juneau-Fairbanks via Whitehorse.	660	Weekly.....	188	Pan American Airways, Inc. (Pacific Alaska Airways, Inc.).
Fairbanks-Nome.....	528	2 times weekly.	302	"
Fairbanks-Bethel via Flat.....	531	Weekly.....	152	"
Total Territorial routes <sup>3</sup> .....	2,068		1,748	
Grand total <sup>3</sup> .....	73,267		228,259	

<sup>1</sup> Airway miles here given are the air line distances between cities.

<sup>2</sup> Plane miles scheduled to be flown, averaged on a daily basis.

<sup>3</sup> Airway miles total corrected for duplications when airways are used for two or more services.

<sup>4</sup> Chilean local passengers not carried.

## Monthly Air Transport Operations

Air Lines of the United States<sup>1</sup>

(Corrected tables compiled by C.A.A.)

1935	Miles Flown	Passengers	Passenger Miles	Mail Pound-Miles Domestic <sup>1</sup>	Express Pounds
January	3,926,483	38,289	17,403,416	508,804,263	294,874
February	4,050,400	46,489	20,343,551	528,397,869	293,622
March	4,858,631	67,822	29,223,756	643,043,623	397,927
April	4,897,995	72,259	30,733,468	632,506,602	382,060
May	5,446,387	74,853	30,836,665	609,748,710	408,756
June	5,700,346	83,636	35,122,539	677,231,608	466,914
July	6,325,267	96,387	38,001,274	728,599,715	475,506
August	6,527,460	100,813	39,785,183	761,384,770	542,995
September	6,013,880	86,701	35,692,047	732,874,751	572,782
October	5,979,193	80,716	32,708,299	807,459,824	623,797
November	4,945,415	60,486	24,869,433	717,264,459	524,949
December	5,106,232	65,665	28,651,289	858,099,895	580,046
Total	63,867,698	874,116	362,370,920	8,265,416,188	5,595,137
1936					
January	4,970,616	55,030	22,767,440	761,833,426	448,194
February	4,696,006	54,242	22,891,020	745,844,095	453,064
March	5,652,850	84,455	37,153,072	902,748,876	675,491
April	5,655,182	83,493	34,927,305	885,274,141	584,367
May	6,274,374	106,474	43,866,299	920,628,971	604,465
June	6,417,033	107,238	44,043,656	949,827,992	814,850
July	6,884,715	122,524	48,694,192	1,055,014,828	727,537
August	6,902,994	118,693	48,255,725	1,051,115,146	679,521
September	6,587,349	112,867	48,367,743	998,893,813	790,220
October	6,769,263	114,061	49,481,010	1,060,488,440	926,258
November	6,511,845	107,910	48,558,220	984,287,593	877,283
December	6,288,643	98,146	45,278,189	1,166,914,401	832,925
Total	73,611,770	1,166,043	494,283,871	11,482,872,622	8,414,184
1937					
January	5,101,539	62,025	27,421,934	907,002,712	687,123
February	5,453,733	76,503	32,760,121	1,003,256,476	627,113
March	6,309,851	95,539	42,143,416	1,174,070,937	726,721
April	6,323,672	92,148	39,492,791	1,097,607,786	794,577
May	6,760,105	111,714	48,014,250	1,104,136,925	735,898
June	6,744,848	124,602	53,148,680	1,129,742,717	811,513
July	7,168,502	135,673	56,728,913	1,124,011,779	735,939
August	7,206,816	137,888	58,056,462	1,151,850,637	738,676
September	7,177,828	144,591	60,092,993	1,146,860,144	892,849
October	7,066,874	128,161	55,569,159	1,202,650,001	861,107
November	6,302,133	95,495	49,799,149	1,121,521,232	793,556
December	5,787,464	85,426	38,420,811	1,233,749,611	758,977
Total	77,493,365	1,289,735	552,648,589	13,396,460,117	8,984,049
1938					
January	5,969,297	87,095	39,154,080	1,107,694,279	588,045
February	5,530,601	95,239	42,094,076	1,057,451,924	594,194
March	6,575,703	114,590	51,151,371	1,278,562,116	730,622
April	6,583,095	120,098	50,858,243	1,155,775,372	681,948
May	7,208,948	132,747	54,708,573	1,302,524,805	671,007
June	7,141,519	131,234	53,689,575	1,254,096,591	740,696
July	7,280,518	144,748	57,616,806	1,199,405,168	718,620
August	7,314,693	160,377	63,192,402	1,272,873,777	805,922
September	7,022,225	151,960	60,273,327	1,235,017,708	1,046,441
October	7,203,867	156,921	62,592,446	1,299,263,414	1,040,741
November	6,653,776	126,284	51,588,004	1,251,886,341	867,677
December	6,573,885	114,818	48,637,281	1,430,568,176	966,687
Total	81,058,127	1,536,111	635,556,184	14,845,719,671	9,452,600

<sup>1</sup> Includes Inter-Island Airways.

U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1938

Mileage and cost of service on Government-operated and contract air-mail routes and amount of annual appropriation, for the fiscal years 1918 to 1938, inclusive

<i>Fiscal year</i>	<i>Miles flown</i>	<i>Cost of service</i>	<i>Average cost per mile</i>	<i>Appropriation</i>
<b>Government operation:</b>				
1918.....	16,000	\$ 13,604.00	\$0.850	\$ 100,000
1919.....	160,066	717,177.00	4.481	100,000
1920.....	549,744	1,264,405.00	2.302	850,000
1921.....	1,554,985	2,653,882.00	1.707	1,375,000
1922.....	1,537,927	1,418,146.00	.922	1,425,000
1923.....	1,500,037	1,897,151.00	1.193	1,900,000
1924.....	1,522,765	1,498,074.00	.984	1,500,000
1925.....	2,076,764	2,743,750.00	1.321	2,750,000
1926.....	2,256,137	2,782,422.00	1.233	2,885,000
1927.....	2,329,553	2,255,919.00	.968	2,650,000
1928.....	173,987	166,314.00	.956	2,150,000
<b>Contract air-mail service:</b>				
1926.....	396,345	89,753.71	.226	500,000
1927.....	2,805,781	1,363,227.82	.486	2,000,000
1928.....	5,585,224	4,042,777.16	.724	4,500,000
1929.....	10,212,511	11,169,015.13	1.094	12,430,000
1930.....	14,939,468	14,618,231.50	.978	15,000,000
1931.....	21,381,852	16,943,605.56	.792	18,000,000
1932.....	32,202,170	19,938,122.61	.619	20,000,000
1933.....	35,909,811	19,400,264.81	.540	19,460,000
1934.....	29,111,474	<sup>1</sup> 12,129,959.64	.417	15,000,000
1935.....	31,147,875	8,814,295.61	.283	<sup>2</sup> 12,003,291
1936.....	38,700,643	12,104,797.31	.313	12,172,500
1937.....	39,958,771	<sup>1</sup> 12,938,576.77	.324	13,028,000
1938.....	46,112,904	<sup>1</sup> 14,182,243.93	.308	14,500,000

<sup>1</sup> Subject to final adjustment.

<sup>2</sup> \$3,291 of this amount was a special appropriation for the purpose of salary restoration.

Statistical report showing the total mileage of air-mail routes, the miles of service scheduled and actually flown, and cost of air-mail service during the fiscal years 1926-38

<i>Fiscal year</i>	<i>Miles of route</i>	<i>Miles of service</i>		<i>Cost of service</i>
		<i>Scheduled</i>	<i>Actually flown</i>	
1926.....	3,597	411,070	396,345	\$ 89,753.71
1927.....	5,551	3,092,016	2,805,781	1,363,227.82
1928.....	10,932	5,999,948	5,585,224	4,042,777.16
1929.....	14,406	11,032,508	10,212,511	11,169,015.13
1930.....	14,907	16,228,453	14,939,468	14,618,231.50
1931.....	23,488	22,907,160	21,381,852	16,943,605.56
1932.....	26,745	34,509,483	32,202,170	19,938,122.61
1933.....	27,079	38,114,425	35,909,811	19,400,264.81
1934.....	<sup>1</sup> 28,820	31,223,641	29,111,474	<sup>2</sup> 12,129,959.64
1935.....	28,884	33,770,091	31,147,875	8,814,295.61
1936.....	29,198	40,802,141	38,700,643	12,104,797.31
1937.....	29,622	42,051,957	39,958,771	<sup>2</sup> 12,938,576.77
1938.....	33,655	48,735,120	46,112,904	<sup>2</sup> 14,182,243.93
Total.....	277,484	328,878,022	308,464,829	\$147,734,871.56

<sup>1</sup> Advertised mileage of new system.

<sup>2</sup> Subject to final adjustment.

## U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1938

Statistical report showing the total passengers carried on air-mail routes, by months, as reported by contractors for the fiscal years 1932-38

	1935	1936	1937	1938
July.....	38,770	75,040	103,075	110,257
August.....	43,797	80,324	99,342	123,754
September.....	38,207	70,615	97,347	125,520
October.....	47,053	66,725	98,618	112,991
November.....	40,731	48,812	96,860	83,511
December.....	32,883	50,947	83,321	71,069
January.....	28,332	42,415	47,645	73,642
February.....	33,483	39,008	58,047	78,153
March.....	50,851	68,372	76,448	98,916
April.....	57,191	68,259	77,226	107,854
May.....	59,847	90,508	97,933	120,738
June.....	66,555	90,404	109,478	118,391
Total.....	537,700	793,328	1,046,240	1,234,606

## U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1938

Statistical report showing the air mail pound-miles performed, by months, for the fiscal years 1935-1938

	1935	1936	1937	1938
July.....	454,192,862	728,599,715	1,055,014,828	1,124,011,779
August.....	511,005,729	761,384,770	1,051,115,146	1,151,850,937
September.....	487,706,543	732,874,751	998,893,813	1,146,872,384
October.....	580,238,792	807,459,824	1,060,488,440	1,202,650,061
November.....	516,204,870	717,264,459	984,287,593	1,121,521,232
December.....	581,405,062	858,099,895	1,166,914,401	1,233,749,611
January.....	508,804,263	761,833,426	907,002,712	1,107,694,279
February.....	528,397,860	745,844,095	1,003,256,476	1,057,451,924
March.....	643,043,623	902,748,876	1,174,070,037	1,278,562,116
April.....	632,506,692	885,274,141	1,097,607,786	1,155,775,372
May.....	669,748,719	920,628,971	1,104,136,925	1,302,524,805
June.....	677,231,608	949,827,992	1,129,742,717	1,254,606,591
Total.....	6,790,486,632	9,771,841,815	12,732,530,874	14,137,360,791

## U. S. AIR MAIL SERVICE

From report of the Postmaster General for fiscal year 1938.

Statistical report showing by routes the miles of service scheduled and actually flown, pound-miles performed, and the amount paid air mail contractors for service by airplanes for the fiscal year ended June 30, 1938

Route	Present contractor	Termini	Miles of service			Pound-miles performed		Payments to contractors	
			Scheduled	Actually flown	Percent flown	Total	Percent of whole	Total	Percent of whole <sup>1</sup>
1	United Air Lines Transport Corp.	Newark-Oakland . . . . .	6,369,820	5,911,412	92.80	3,961,997,721	28.02	\$2,363,994.30	16.67
11		Seattle-San Diego . . . . .	1,863,908	1,779,842	95.49	507,966,760	3.59	506,859.52	3.58
12		" Salt Lake City-Seattle . . . . .	1,203,174	1,175,962	97.74	225,499,174	1.60	391,962.45	2.70
17		" Cheyenne-Denver . . . . .	199,713	192,123	96.20	17,202,369	.12	55,715.67	.39
		Total . . . . .		9,630,615	9,059,339	94.01	4,712,666,033	33.33	3,318,531.94
2	Transcontinental & Western Air, Inc.	Newark-Los Angeles . . . . .	5,728,875	5,404,134	94.33	2,512,034,623	17.77	1,683,240.62	11.867
3/6		Dayton-Chicago . . . . .	144,035	123,397	85.32	8,171,115	.06	122.40	.001
3/7		" Winslow-San Francisco . . . . .	391,726	355,938	90.86	28,727,250	.20	346.93	.002
	Total . . . . .		6,265,236	5,883,469	93.91	2,548,932,088	18.03	1,683,709.95	11.87
3	Northwest Airlines, Inc.	Fargo-Seattle . . . . .	2,712,033	2,538,496	93.58	558,111,462	3.95	786,766.76	5.55
1/6		" Chicago-Winnipeg . . . . .	1,403,150	1,395,772	92.35	398,994,232	2.82	385,123.54	2.71
	Total . . . . .		4,115,783	3,834,268	93.16	957,105,694	6.77	1,171,890.30	8.26
4	American Airlines, Inc.	Fort Worth-Los Angeles . . . . .	2,845,764	2,813,526	98.87	955,602,065	6.76	776,721.01	5.48
7		" Newark-Chicago . . . . .	1,617,944	1,527,666	94.47	739,355,626	5.23	604,997.39	4.26
18		" Boston-Newark . . . . .	456,714	421,562	92.30	84,149,788	.59	137,005.19	.96
21		" Boston-Cleveland . . . . .	477,682	432,364	90.51	13,815,302	.10	144,101.34	1.02
22		" Cleveland-Nashville . . . . .	685,281	653,494	95.36	36,459,427	.26	211,311.15	1.49
23		" Albany-Fort Worth . . . . .	3,197,158	3,071,275	96.06	963,999,086	6.82	789,857.99	5.57
25		" Washington-Chicago . . . . .	977,318	892,701	91.34	68,239,655	.48	287,803.50	2.03
26		" Chicago-Fort Worth . . . . .	980,348	916,322	93.47	176,189,388	1.25	262,973.39	1.85
30		Total . . . . .		11,237,309	10,728,910	95.48	3,037,510,337	21.49	3,212,971.95

FLYING FACTS AND FIGURES

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**U. S. AIR MAIL SERVICE (Cont.)**

5	Eastern Air Lines, Inc. ....	Newark-New Orleans. ....	1,774,897	1,687,990	95.10	409,361,105	2.89	\$ 436,058.56	3.08
6	" .....	Newark-Miami. ....	2,107,825	2,005,464	97.99	795,471,831	5.63	564,736.12	3.98
10	" .....	Chicago-Jacksonville. ....	1,369,134	1,332,563	97.33	278,692,976	1.97	358,566.26	2.53
20	" .....	New Orleans-Houston. ....	267,868	262,858	98.13	25,325,087	.18	80,878.50	.57
	Total .....	.....	5,519,724	5,348,875	96.90	1,508,851,089	10.67	1,440,239.44	10.16
9	Braniff Airways, Inc. ....	Chicago-Dallas. ....	1,068,065	999,050	93.54	257,977,472	1.82	298,416.01	2.10
15	" .....	Amarillo-Brownsville. ....	1,244,120	1,186,381	95.36	125,691,595	.89	324,773.28	2.29
	Total .....	.....	2,312,185	2,185,431	94.52	383,669,067	2.71	623,189.29	4.39
13	Western Air Express Corporation. ....	Salt Lake City-San Diego. ....	1,431,627	1,384,484	96.71	396,084,493	2.80	407,088.74	2.87
19	" .....	Great Falls-Salt Lake City. ....	778,721	726,587	93.31	43,250,763	.31	237,165.14	1.67
	Total .....	.....	2,210,348	2,111,071	95.51	439,335,166	3.11	644,253.88	4.54
14	Pennsylvania-Central Airlines Corporation. ....	Norfolk-Detroit. ....	991,995	914,453	92.27	158,707,998	1.12	304,722.65	2.15
32	" .....	Detroit-Milwaukee. ....	392,144	358,302	91.37	11,434,655	.08	113,551.73	.80
34	" .....	Washington-Buffalo. ....	137,280	106,621	77.67	2,953,735	.02	.08	0
	Total .....	.....	1,520,519	1,379,376	90.72	172,196,388	1.22	418,274.46	2.95
28	Wyoming Air Service, Inc. ....	Great Falls-Cheyenne. ....	447,404	415,114	92.78	10,379,282	.08	118,072.48	.83
35	" .....	Huron-Cheyenne. ....	82,864	78,332	94.53	3,258,219	.02	15,578.18	.11
	Total .....	.....	530,268	493,446	93.06	13,637,501	.10	133,650.66	.94
8	Chicago & Southern Air Lines, Inc. ....	Chicago-New Orleans. ....	1,297,413	1,236,356	95.29	135,336,555	.96	397,499.58	2.80
24	Delta Air Corporation. ....	Charleston-Fort Worth. ....	1,323,368	1,274,978	96.34	114,139,748	.81	368,137.94	2.60
26	Hanford Airlines, Inc. ....	Minneapolis-Tulsa. ....	1,009,672	947,473	93.84	57,498,253	.40	302,338.16	2.13
27	Boston-Maine Airways, Inc. ....	Boston-Caribou-Montreal. ....	652,197	595,840	86.76	12,602,355	.09	176,493.76	1.24
29	Continental Air Lines, Inc. ....	Denver-El Paso. ....	575,565	538,328	93.53	19,006,697	.13	155,651.15	1.10
31	National Airlines, Inc. ....	Daytona-Beach-Miami. ....	351,696	349,451	99.36	20,550,633	.15	91,430.47	.65
33	Inter-Island Airways, Ltd. ....	Honolulu-Hilo-Port Allen. ....	177,222	176,284	99.47	4,352,287	.03	44,071.00	.31
	Total .....	.....	5,387,133	5,088,719	94.46	363,456,528	2.57	1,535,532.06	10.83
	Grand total. ....	.....	48,735,120	46,112,004	94.62	14,137,360,791	100.00	14,182,243.93	100.00

<sup>1</sup> Subject to final adjustment.



## U. S. FOREIGN AIR MAIL

From annual report of the Postmaster General.  
For Fiscal Year 1938

Route	Service Scheduled	Service Performed	Compensation	Percentage of Performance
	<i>Miles</i>	<i>Miles</i>		
1. New York to Montreal (1 way).....	104,542.0	96,902.0	\$ 58,141.20	92.69
5. Miami to Cristobal (via Kingston direct <sup>1</sup> ).....	76,304.2	76,304.2	131,186.54	100.00
Miami to Barranquilla.....	261,004.0	261,004.0	521,866.24	100.00
Miami to Habana.....	117,711.0	117,711.0	235,422.00	100.00
Habana to Belize <sup>2</sup> .....	32,648.0	29,957.4	53,874.40	91.76
Barranquilla to Cristobal.....	56,258.0	56,258.0	107,272.40	100.00
San Salvador to Cristobal.....	189,838.7	189,253.3	340,553.44	99.69
Port of Spain to Paramaribo.....	119,818.1	119,818.1	210,481.86	100.00
Barranquilla to Port of Spain.....	198,797.9	198,753.3	357,566.68	99.98
6. Miami to San Juan.....	351,254.9	350,547.0	677,950.84	99.79
San Juan to Port of Spain.....	208,642.3	208,642.3	294,660.84	100.00
7. Miami to Nassau (1 way).....	25,944.0	25,944.0	32,430.00	100.00
8. Brownsville to Mexico City.....	339,077.6	331,428.7	596,665.32	97.74
Mexico City to San Salvador.....	166,831.8	153,470.8	279,850.68	93.19
9. Cristobal to Buenos Aires.....	1,017,569.7	1,013,250.6	1,520,860.10	99.58
10. Paramaribo to Buenos Aires.....	876,649.9	874,007.1	1,482,991.02	99.71
12. Bangor to Halifax (suspended).....				
14. San Francisco to Hongkong.....	915,159.1	831,347.3	1,666,151.10	90.84
15. Juneau to Whitehorse <sup>3</sup> .....	2,857.7	2,857.7	4,429.44	100.00
16. Fairbanks to Whitehorse <sup>3</sup> .....	8,358.9	8,358.9	6,687.12	100.00
17. New York/Baltimore to Hamilton <sup>4</sup> .....	46,591.0	46,591.0	.02	100.00
Salaries, postal agency, Barranquilla <sup>5</sup> .....			483.33	
Total.....	5,115,048.8	4,994,557.6	\$8,579,524.57	97.63

<sup>1</sup> Service commenced Dec. 4, 1937.

<sup>2</sup> Service discontinued Nov. 30, 1937.

<sup>3</sup> Service commenced May 3, 1938.

<sup>4</sup> Rate of pay is \$0.00001 per pound.

<sup>5</sup> Agency discontinued July 31, 1937.

## PROGRESS OF CIVIL AERONAUTICS IN THE UNITED STATES

Compiled by U. S. Civil Aeronautics Authority

All statistics as of Dec. 31 each year

Revised to include Territorial Operations

	1936	1937	1938
Firms engaged in the industry <sup>2</sup> .....	1,600	1,700	1,700
<b>Scheduled air-line operations</b>			
Airplanes:			
In service and reserve:			
Domestic <sup>1</sup> .....	272	282	253
Foreign <sup>1</sup> and territorial.....	108	104	92
Total.....	380	386	345
Value of <sup>2</sup> .....	\$15,200,000	\$19,500,000	.....
Airways (domestic and foreign <sup>1</sup> and territorial)			
Services in operation.....	110	108	139
Express mileage.....	61,458	63,656	70,652
Mail mileage.....	51,740	57,480	63,292
Passenger mileage.....	61,458	63,656	71,199
<b>Total mileage:</b>			
Domestic <sup>1</sup> .....	28,874	31,084	35,492
Foreign extensions <sup>1</sup> .....	32,658	32,572	35,707
Total.....	61,532	63,656	71,199
Accidents (domestic and foreign <sup>1</sup> and territorial)			
Number of accidents.....	70	50	44
Miles flown per accident.....	1,051,597	1,548,067	1,842,230
Number of fatal accidents.....	10	6	8
Miles flown per fatal accident.....	7,361,177	12,900,561	10,132,266
Number of pilot fatalities.....	9	5	6
Miles flown per pilot fatality.....	8,179,086	15,480,673	13,509,688
Number of co-pilot fatalities.....	7	6	7
Number of crew fatalities (other than pilot and co-pilot).....	5	4	16
Number of passenger fatalities.....	46	51	32
Passenger miles flown per passenger fatality.....	10,745,302	10,836,246	19,861,131
Total fatalities <sup>3</sup> .....	67	66	61
Express and freight carried (pounds):			
Domestic <sup>1</sup> .....	6,958,777	7,127,360	7,335,967
Foreign <sup>1</sup> and Territorial.....	1,455,407	1,856,680	2,116,633
Total.....	8,414,184	8,984,040	9,452,600
Express, ton-miles (domestic <sup>1</sup> ).....	1,860,809	2,156,070	2,173,706
Fuel (consumed) (domestic and foreign <sup>1</sup> and territorial)			
Gasoline..... gallons..	37,057,069	41,424,384	45,310,192
Oil..... do.....	871,663	844,570	829,870
Mail:			
Carried by contractors:			
Domestic <sup>1</sup> ..... pounds..	17,706,159	20,112,829	Not available
Foreign <sup>1</sup> ..... do.....	617,853	714,180	785,025
Total.....	18,324,012	20,812,829 est.	.....
Ton-miles of mail (domestic <sup>1</sup> and territorial).....	5,741,436	6,698,230	7,422,860
Income to contractors:			
Domestic <sup>1</sup> and territorial.....	\$12,433,931	\$13,100,147	\$15,041,198
Foreign <sup>1</sup> .....	7,290,558	8,194,068	8,600,769
Total.....	\$19,724,489	\$21,294,215	\$23,641,967

See end of table for footnotes.

	1936	1937	1938
<b>Scheduled air-line operations—</b>			
Continued			
Miles of mail airways (domestic and foreign <sup>1</sup> and territorial).....	51,740	57,480	63,292
Miles flown:			
Daily average (domestic and foreign <sup>1</sup> and territorial).....	201,017	210,948	222,077
Mail (domestic and foreign <sup>1</sup> and territorial).....	44,027,794	46,806,584	54,659,684
Domestic routes.....	63,777,226	66,071,507	69,668,827
Foreign routes and territorial.....	0,834,544	11,331,858	11,389,300
Total.....	73,611,770	77,403,365	81,058,127
Operators, number of:			
Domestic <sup>1</sup> .....	21	17	18
Foreign <sup>1</sup> and territorial.....	7	7	8
Total.....	4 25	4 21	4 23
Passenger-miles flown (1 passenger carried 1 mile):			
Domestic <sup>1</sup> .....	435,740,353	476,603,165	557,710,268
Foreign and territorial.....	58,453,618	76,045,424	77,836,916
Total.....	494,283,871	552,648,589	635,556,184
Passengers carried:			
Domestic <sup>1</sup> .....	1,020,031	1,102,707	1,343,427
Foreign <sup>1</sup> and Territorial.....	145,112	187,028	192,684
Total.....	1,166,043	1,289,735	1,536,111
Passenger-seat-miles flown (domestic <sup>1</sup> ).....	680,708,230	828,188,184	949,421,755
Passenger-seat-miles, percentage used (domestic <sup>1</sup> ).....	64.01	57.55	58.74
Passenger fare, average per mile (domestic <sup>1</sup> ).....	\$0.057	\$0.056	\$0.057
Personnel employed (domestic and foreign <sup>1</sup> territorial)			
Mechanics and ground crew.....	2,874	3,280	3,415
Pilots.....	604	755	820
Copilots.....	547	602	605
Hostesses and stewards.....	390	420	451
Other hangar and field personnel.....	1,767	2,356	2,635
Operation and office personnel.....	3,723	4,179	5,383
Total.....	9,995	11,592	13,309
Trips, percentage completed of those started (domestic <sup>1</sup> ).....	95.60	95.41	95.36
Trips, percentage started of those scheduled (domestic <sup>1</sup> ).....	93.97	91.13	91.37
Trips, percentage completed of those scheduled (domestic <sup>1</sup> ).....	94.05	89.51	90.48
Trips, passenger, average length (domestic <sup>1</sup> ).....	427	432	415
<b>Miscellaneous flying operations</b>			
(all domestic) <sup>1</sup>			
Airplanes in operation (certificated and uncertificated).....	8,849	10,446	10,718
Accidents:			
Number of accidents.....	1,698	1,917	.....
Miles flown per accident.....	54,959	53,728	.....
Number of fatal accidents.....	159	185	.....

See end of table for footnotes.

	1936	1937	1938
<b>Miscellaneous flying operations (all domestic)<sup>1</sup> Continued</b>			
Miles flown per fatal accident.....	586,921	556,737	.....
Pilot fatalities.....	130	152	.....
Copilot or student fatalities.....	15	16	.....
Passenger fatalities.....	119	112	.....
Aircraft crew fatalities (other than pilot, co- pilot or student).....	6	2	.....
Total fatalities <sup>2</sup> .....	272	283	.....
Miles flown per pilot fatality.....	717,849	667,608	.....
Miles flown per passenger fatality.....	784,205	1,000,768	.....
Fuel (consumed):			
Gasoline..... gallons.....	10,451,496	10,618,240	.....
Oil..... do.....	316,502	310,851	.....
Miles flown.....	93,320,375	102,996,355	.....
Passengers:			
Carried for hire.....	1,215,405	1,205,004	.....
Carried for pleasure.....	250,653	284,508	.....
Total.....	1,466,058	1,580,412	.....
<b>Airports and Department of Com- merce Intermediate landing fields</b>			
Airports:			
Commercial and private.....	525	492	528
Municipal.....	738	764	791
Intermediate—Department of Commerce— lighted.....	284	278	265
Intermediate—Department of Commerce— unlighted.....	12	5	2
Auxiliary—marked.....	622	602	628
Army, Navy, Marine Corps, National Guard, reserve and miscellaneous air- ports.....	161	158	160
Total airports in operation.....	2,342	2,290	2,374
Lighted, total.....	795	720	719
Of entry, regular.....	12	21	37
Of entry, temporary.....	43	34	23
<b>Federal Airways System and Aids to Air Navigation</b>			
Communication:			
Radio broadcast stations.....	80	72	91
Radio range beacon stations.....	146	167	225
Radio marker beacons.....	57	55	48
Weather reporting airway and airport sta- tions—Weather Bureau and Depart- ment of Commerce operated, long line teletypewriter equipped.....	213	271	346
Miles of teletypewriter service.....	13,120	20,588	23,771
Weather Bureau—first order stations (does not include airport stations).....	182	198	182
Airway lighting:			
Beacons:			
Revolving.....	1,677	1,717	1,753
Flashing.....	241	252	214
Beacons—privately owned and certified....	410	466	530
Intermediate landing fields, lighted by De- partment of Commerce.....	284	278	271
Mileage lighted by Department of Com- merce.....	22,245	22,319	23,723
Miles under construction by Department of Commerce.....	0	945	1,849

See end of table for footnotes.

	1936	1937	1938
<b>Licenses and approvals</b>			
Approved type certificates (issued by the Department of Commerce):			
Airplanes.....	620	658	681
Engines.....	168	186	196
Gliders.....	4	4	4
Parachutes.....	53	59	59
Propellers.....	507	658	666
Wheels.....	35	40	
Pontoons.....	17	19	
Skis.....	13	14	83
Flares and signals.....	4	5	
Approvals (without approved type certificates):			
Airplanes.....	520	541	547
Engines.....	11	11	11
Engines—foreign (temporarily approved).....	15	15	15
Gliders.....	3	7	7
Pontoons.....	32	32	32
Propellers.....	119	120	120
Repair stations.....	181	193	212
Schools.....	27	20	24
Skis.....	31	31	31
Flares.....	0	0	0
Wheels.....	0	0	0
Uncertificated aircraft (active):			
Airplanes.....	1,805	1,684	1,159
Gliders.....	370	320	176
Certificated (active):			
Airplanes.....	7,424	9,152	10,000
Gliders.....	31	41	45
Instructors, flying.....	105	91	.....
Instructors, ground.....	48	55	92
Mechanics.....	8,738	9,314	9,884
Pilots, airplane.....	15,052	17,681	22,983
Pilots having scheduled air transport ratings.....	842	1,064	1,159
Pilots, glider.....	138	161	172
Riggers, parachute.....	393	362	397
Student pilot certificates issued:			
Airplane.....	17,675	21,770	.....
Glider.....	209	125	.....
Personnel employed:			
By aircraft manufacturers.....	23,531	.....	.....
By engine, propeller, and accessory manufacturers.....	7,944	.....	.....
<b>Production and exports of aircraft</b>			
Exports:			
Airplanes.....	515	621	875
Airplanes, value.....	\$17,386,896	\$21,027,361	\$37,977,324
Engines.....	945	1,047	1,307
Engines, value.....	\$5,397,460	\$5,944,004	\$7,899,144
Parts and accessories aircraft, value.....	\$6,060,483	\$12,157,337	\$21,930,343
Parachutes and parts, value.....	\$298,358	\$267,771	\$400,939
Production:			
Airplanes.....	3,010	<sup>6</sup> 3,773	<sup>7</sup> 2,698
Airplanes and parts, value.....	\$47,531,565	<sup>6</sup> \$75,877,256	.....
Engines.....	4,205	<sup>6</sup> 6,084	.....
Engines and parts, value.....	\$26,383,955	<sup>6</sup> \$39,115,607	.....

<sup>1</sup> Domestic scheduled air lines operate within the continental limits of the United States.

<sup>2</sup> Estimate.

<sup>3</sup> Does not include ground crew or third parties.

<sup>4</sup> In several cases the same company operates both domestic and foreign services.

<sup>5</sup> Value of engine parts for these years not available.

<sup>6</sup> Aeronautical Chamber of Commerce of America production figures.

<sup>7</sup> Does not include aircraft produced for the U. S. Military Services.

## U. S. AERONAUTICAL EXPORTS

Compiled by Automotive-Aeronautics Trade Division  
U. S. Bureau of Foreign and Domestic Commerce

## Total Value for Calendar Years

<i>Country of Destination</i>	<i>1937 Value</i>	<i>1938 Value</i>
Aden.....	\$ .....	\$ .....
Albania.....	.....	.....
Algeria.....	.....	.....
Argentina.....	4,403,507	6,187,342
Australia.....	1,389,806	1,240,510
Azores & Madeira.....	11,664	.....
Barbados.....	.....	.....
Belgium.....	164,292	102,526
Belgian Congo.....	.....	52
Bermuda.....	17,783	1,264
Bolivia.....	25,928	461,958
Brazil.....	1,675,092	1,946,947
British East Africa.....	5,040	526
British Guiana.....	5,592	3,834
British Honduras.....	1,237	.....
British India.....	168,896	83,656
British Malaya.....	190	8,180
British Oceania.....	541	529
Bulgaria.....	4,895	173,295
Burma (*).....	.....	52,994
Canada.....	1,856,775	3,511,093
Canary Islands.....	.....	.....
Ceylon.....	1,275	282
Chile.....	34,565	64,331
China.....	3,961,819	6,391,713
Colombia.....	383,792	685,185
Costa Rica.....	34,474	122,915
Cuba.....	67,113	33,941
Czechoslovakia.....	180,891	172,549
Denmark.....	7,588	63,269
Dominican Republic.....	41,453	3,728
Ecuador.....	53,099	10,827
Egypt.....	11,100	8,317
Estonia.....	.....	456,574
Finland.....	47,349	82,357
France.....	200,894	878,775
French Guiana.....	103,138	561
French Indochina.....	.....	480
French Oceania.....	.....	.....
French West Indies.....	1,129	154
Germany.....	1,077,947	591,127
Gibraltar.....	.....	.....
Gold Coast.....	.....	.....
Greece.....	34,794	36,353
Guatemala.....	82,678	53,866
Haiti, Republic of.....	989	2,338
Honduras.....	193,638	175,789
Hong Kong.....	482,581	1,213,442
Hungary.....	37	.....
Iceland.....	.....	46
Iran.....	8,385	9,271
Iraq.....	2,476	1,222
Ireland.....	10,480	510
Italian Africa.....	.....	.....
Italy.....	470,131	187,005
Jamaica.....	1,974	10,820
Japan.....	2,483,946	11,062,477
Kwantung.....	8,190	546
Latvia.....	5,033	148
Liberia.....	.....	.....
Lithuania.....	7,549	16,602
Madagascar.....	.....	.....
Malta, Gozo & Cyprus.....	.....	.....
Mexico.....	1,921,406	1,246,789
Mozambique.....	.....	14,482
Netherlands.....	2,954,394	3,278,755

(\*) Included in British India Year 1937

<i>Country of Destination</i>	<i>1937 Value</i>	<i>1938 Value</i>
Netherlands Indies.....	546,859	8,495,288
Netherland West Indies.....	2,722	479,891
Newfoundland & Labrador.....	26,398	2,434
New Zealand.....	209,595	160,566
Nicaragua.....	3,134	3,968
Nigeria.....	.....	.....
Norway.....	95,448	28,661
Other Asia.....	26	65
Other British South Africa.....	.....	65
Other British West Africa.....	.....	.....
Other British West Indies.....	19,674	34,435
Other French Africa.....	56,489	191,330
Other Portuguese Africa.....	16,505	4,475
Other Spanish Africa.....	.....	.....
Palestine.....	.....	2,260
Panama.....	126,252	13,011
Panama Canal Zone (**). .....	.....	150,141
Paraguay.....	10,378	6,162
Peru.....	847,753	223,490
Philippine Islands.....	621,830	464,973
Poland & Danzig.....	543,853	753,296
Portugal.....	80,910	49,100
Rumania.....	704,013	810,775
Salvador.....	882	9,303
Saudi Arabia.....	.....	61
Siam.....	1,154,648	842,892
Spain.....	443,085	.....
Surinam.....	3,411	176
Sweden.....	631,141	1,004,291
Switzerland.....	27,281	256,465
Syria.....	5,683	9,986
Trinidad & Tobago.....	69,581	49,738
Tunisia.....	610	445
Turkey.....	2,450,391	3,160,336
Union of South Africa.....	472,410	465,690
United Kingdom.....	1,729,271	3,916,117
Uruguay.....	9,541	115,207
U. S. S. R.....	3,212,729	5,171,303
Venezuela.....	412,009	517,138
Yugoslavia.....	262,412	163,264
Totals.....	\$39,404,469	\$68,209,050

Airplanes, Seaplanes, Amphibions and Lighter-than-air Craft

<i>Country of Destination</i>	<i>1937</i>		<i>1938</i>	
	<i>No.</i>	<i>Value</i>	<i>No.</i>	<i>Value</i>
Aden.....	.....	\$ .....	.....	\$ .....
Albania.....	.....	.....	.....	.....
Algeria.....	.....	.....	.....	.....
Argentina.....	82	3,220,842	93	4,648,105
Australia.....	23	913,937	11	341,376
Azores & Madeira.....	.....	.....	.....	.....
Barbados.....	.....	.....	.....	.....
Belgium.....	1	8,235	.....	.....
Belgian Congo.....	.....	.....	.....	.....
Bermuda.....	.....	.....	.....	.....
Bolivia.....	.....	.....	9	352,445
Brazil.....	46	1,008,523	45	1,579,731
British East Africa.....	.....	.....	.....	.....
British Guiana.....	.....	.....	.....	.....
British Honduras.....	.....	.....	.....	.....
British India.....	10	150,864	9	52,020
British Malaya.....	.....	.....	.....	.....
British Oceania.....	.....	.....	.....	.....
Bulgaria.....	.....	.....	.....	.....
Burma.....	.....	.....	.....	.....
Canada.....	62	657,664	52	1,303,546
Canary Islands.....	.....	.....	.....	.....
Ceylon.....	1	1,250	.....	.....
Chile.....	.....	.....	1	1,836

(\*\*) Included in Panama Year 1937

Country of Destination	1937		1938	
	No.	Value	No.	Value
China	41	2,317,969	142	4,683,079
Colombia	9	185,200	10	301,000
Costa Rica	3	12,750	12	94,988
Cuba	..	..	1	5,070
Czechoslovakia	2	164,417	1	112,500
Denmark	..	..	6	6,924
Dominican Republic	1	26,100	..	..
Ecuador	1	1,103	1	5,937
Egypt	2	10,103	..	..
Estonia	..	..	..	..
Finland	1	1,200	2	10,647
France	..	..	12	479,681
French Guiana	1	100,000	..	..
French Indochina	..	..	..	..
French Oceania	..	..	..	..
French West Indies	..	..	..	..
Germany	2	17,700	2	30,787
Gibraltar	..	..	..	..
Gold Coast	..	..	..	..
Greece	1	4,500	1	10,622
Guatemala	8	65,999	7	46,250
Haiti, Republic of	..	..	..	..
Honduras	23	111,300	6	93,234
Hong Kong	3	184,386	5	214,186
Hungary	..	..	..	..
Iceland	..	..	..	..
Iran	..	..	..	..
Iraq	..	..	..	..
Ireland	..	..	..	..
Italian Africa	..	..	..	..
Italy	1	10,500	..	..
Jamaica	..	..	..	..
Japan	12	966,132	66	5,515,439
Kwantung	..	..	..	..
Latvia	..	..	..	..
Liberia	..	..	..	..
Lithuania	1	1,463	1	1,300
Madagascar	..	..	..	..
Malta, Gozo & Cyprus	..	..	..	..
Mexico	81	1,572,104	58	1,029,778
Miquelon & St. Pierre Is.	..	..	..	..
Morocco	..	..	..	..
Mozambique	..	..	..	..
Netherlands	25	1,914,578	8	843,612
Netherlands Indies	3	148,018	70	6,333,915
Netherland West Indies	..	..	7	414,868
Newfoundland & Labrador	..	..	..	..
New Zealand	6	168,820	5	126,818
Nicaragua	1	1,398	..	..
Nigeria	..	..	..	..
Norway	11	45,897	3	9,736
Other Asia	..	..	..	..
Other British South Africa	..	..	..	..
Other British West Africa	..	..	..	..
Other British West Indies	..	..	2	33,918
Other French Africa	..	..	1	145,000
Other Portuguese Africa	4	11,671	3	3,892
Other Spanish Africa	..	..	..	..
Palestine	..	..	1	2,100
Panama	7	21,850	1	8,500
Panama Canal Zone	..	..	1	5,000
Paraguay	3	6,169	..	..
Peru	9	429,283	1	1,992
Philippine Islands	16	337,507	14	281,910
Poland & Danzig	6	346,920	7	468,889
Portugal	3	60,235	10	15,426
Rumania	7	469,880	7	551,794
Salvador	..	..	1	2,500
Saudi Arabia	..	..	..	..
Siam	4	355,190	20	569,886
Spain	8	325,000	..	..
Surinam	..	..	..	..
Sweden	9	381,349	7	216,823
Switzerland	..	..	5	124,270
Syria	..	..	1	9,200
Trinidad & Tobago	1	1,137	..	..
Tunisia	..	..	..	..



Country of Destination	1937		1938	
	No.	Value	No.	Value
Turkey	22	1,799,734	48	2,646,494
Union of South Africa	20	87,467	12	44,955
United Kingdom	25	615,505	57	1,647,748
Uruguay	3	5,768	6	109,920
U. S. S. R.	10	1,419,146	13	1,969,766
Venezuela	8	302,254	10	351,378
Yugoslavia	2	116,153	2	117,133
Totals	631	\$21,085,170	876	\$37,977,924

Aircraft Engines

Country of Destination	1937		1938	
	No.	Value	No.	Value
Argentina	104	\$ 526,779	25	\$ 170,716
Australia	15	90,141	9	63,669
Belgium	10	108,562	5	43,625
Bermuda	1	7,000	...	.....
Bolivia	2	9,798	...	.....
Brazil	54	161,959	43	62,520
British East Africa	2	4,976	...	.....
British Guiana	2	4,750	1	2,393
British India	1	2,215	3	8,274
British Malaya	...	.....	1	750
Bulgaria	...	.....	28	165,398
Canada	107	395,219	204	600,690
Chile	1	9,000	14	37,225
China	96	720,355	84	776,871
Colombia	13	54,816	24	138,056
Costa Rica	13	15,690	19	18,442
Cuba	7	14,000	7	13,000
Czechoslovakia	1	7,355	3	31,000
Denmark	2	7,000	31	19,027
Dominican Republic	1	3,352	1	1,500
Ecuador	1	900	1	1,000
Egypt	...	.....	37	434,484
Estonia	...	.....	2	13,249
Finland	3	40,000	12	167,087
France	95	747,905	41	381,445
Germany	...	.....	1	1,000
Haiti, Republic of	21	32,953	13	9,350
Honduras	...	.....	59	255,180
Hong Kong	1	7,000	...	.....
Ireland	17	198,067	4	57,000
Italy	1	1,000	1	5,000
Jamaica	...	.....	56	466,398
Japan	56	366,940	...	.....
Kwantung	1	3,520	...	.....
Latvia	1	2,800	...	.....
Mexico	62	161,714	30	65,648
Netherlands	69	367,263	170	1,301,631
Netherlands Indies	13	108,267	43	351,700
Netherland West Indies	...	.....	4	35,455
Newfoundland & Labrador	1	7,000	...	.....
New Zealand	2	12,617	1	5,900
Nicaragua	...	.....	2	1,200
Norway	3	3,832	...	.....
Other French Africa	1	9,000	2	32,027
Panama	27	26,000	...	.....
Panama Canal Zone	...	.....	4	5,000
Paraguay	1	1,881	1	5,018
Peru	17	79,913	14	36,502
Philippine Islands	21	111,490	6	50,293
Poland & Danzig	5	49,385	5	43,853
Portugal	2	7,363	4	5,544
Rumania	6	50,289	9	78,010
Siam	62	484,183	23	143,800
Spain	1	4,500	...	.....
Sweden	9	79,565	70	308,223
Switzerland	...	.....	8	67,200
Trinidad & Tobago	14	33,000	7	35,000
Turkey	16	199,448	7	67,000

## FLYING FACTS AND FIGURES

<i>Country of Destination</i>		<i>1937 Value</i>		<i>1938 Value</i>
Union of South Africa .....	38	271,648	25	224,262
United Kingdom.....	15	45,841	104	833,818
U. S. S. R. ....	20	226,817	19	171,969
Venezuela.....	14	60,986	20	86,442
Totals.....	1,048	\$5,946,054	1,307	\$7,899,844

## Parachutes and Parts

<i>Country of Destination</i>		<i>1937 Value</i>		<i>1938 Value</i>
Argentina.....		\$22,815		\$80,249
Australia.....		500		.....
Brazil.....		16,428		540
Canada.....		10,370		4,227
China.....		396		.....
Colombia.....		1,500		190
Cuba.....		6,858		.....
Dominican Republic.....		550		825
Finland.....		356		.....
France.....		47		.....
Greece.....		30,281		25,731
Guatemala.....		350		.....
Honduras.....		.....		2,745
Hong Kong.....		.....		1,267
Japan.....		.....		26,075
Latvia.....		450		.....
Lithuania.....		4,480		1,680
Mexico.....		.....		3,480
Netherlands Indies.....		24,349		120,117
Norway.....		.....		514
Other British West Indies.....		123		.....
Peru.....		34		195
Philippine Islands.....		1,075		4,863
Rumania.....		33,000		35,276
Siam.....		.....		24,620
Spain.....		104,000		.....
Sweden.....		.....		450
Trinidad & Tobago.....		25		.....
Tunisia.....		.....		445
Turkey.....		7,080		67,200
United Kingdom.....		2,263		250
U. S. S. R.....		441		.....
Totals.....		\$267,771		\$400,939

## Aircraft Parts, Instruments and Accessories (Except Tires)

<i>Country of Destination</i>		<i>1937 Value</i>		<i>1938 Value</i>
Argentina.....		\$633,071		\$1,288,272
Australia.....		385,228		835,465
Azores & Madeira Is.....		11,664		.....
Belgium.....		47,495		58,901
Belgian Congo.....		.....		52
Bermuda.....		10,783		1,264
Bolivia.....		16,130		109,513
Brazil.....		488,182		304,156
British East Africa.....		64		526
British Guiana.....		842		1,441
British Honduras.....		1,237		.....
British India.....		15,817		23,362
British Malaya.....		190		7,430
British Oceania.....		541		529
Bulgaria.....		4,895		7,897
Burma.....		.....		52,994
Canada.....		793,522		1,602,630
Ceylon.....		25		282
Chile.....		25,565		25,270
China.....		923,099		931,763
Colombia.....		142,276		245,939
Costa Rica.....		6,034		9,485

FLYING FACTS AND FIGURES

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<i>Country of Destination</i>	<i>1937 Value</i>	<i>1938 Value</i>
Cuba	46,255	15,871
Czechoslovakia	9,119	29,049
Denmark	7,588	37,318
Dominican Republic	7,803	1,403
Ecuador	48,644	3,890
Egypt	97	8,317
Estonia		22,090
Finland	45,793	58,461
France	160,847	232,007
French Guiana	3,138	561
French Indochina		480
French West Indies	1,129	154
Germany	312,342	178,895
Greece	13	
Guatemala	16,329	7,616
Haiti, Republic of	989	1,338
Honduras	49,385	70,460
Hong Kong	298,195	742,809
Hungary	37	
Iceland		46
Iran	8,385	9,271
Iraq	2,476	1,222
Ireland	3,480	510
Italy	261,564	130,005
Jamaica	974	5,820
Japan	1,150,874	5,054,565
Kwantung	4,670	546
Latvia	1,783	148
Lithuania	1,606	13,622
Mexico	187,588	147,883
Mozambique		14,482
Netherlands	672,353	1,133,512
Netherlands Indies	266,225	1,689,556
Netherland West Indies	2,722	29,568
Newfoundland & Labrador	19,398	2,434
New Zealand	28,158	27,848
Nicaragua	1,736	2,768
Norway	45,719	18,411
Other Asia	26	65
Other British South Africa		65
Other British West Indies	19,551	517
Other French Africa	47,489	14,303
Other Portuguese Africa	4,834	583
Palestine		160
Panama	78,402	4,511
Panama Canal Zone		140,141
Paraguay	2,328	1,144
Peru	338,523	184,801
Philippine Islands	171,758	127,907
Poland & Danzig	147,548	240,554
Portugal	13,312	28,130
Rumania	150,844	145,695
Salvador	882	6,803
Saudi Arabia		61
Siam	315,275	104,586
Spain	9,585	
Surinam	3,411	176
Sweden	170,227	478,795
Switzerland	27,281	64,995
Syria	5,683	786
Trinidad & Tobago	35,419	14,738
Tunisia	610	
Turkey	444,129	379,642
Union of South Africa	113,295	196,473
United Kingdom	1,065,662	1,434,301
Uruguay	3,773	5,287
U. S. S. R.	1,566,325	3,029,568
Venezuela	48,769	79,318
Yugoslavia	146,259	46,131
Totals	\$12,105,474	\$21,930,343

## NON-MILITARY AIRCRAFT IN THE UNITED STATES

January 1, 1939

Compiled by Civil Aeronautics Authority

<i>State</i>	<i>Certificated</i>	<i>Uncertificated</i>	<i>Total</i>	<i>Gliners</i>
Alabama.....	82	4	86	1
Arizona.....	80	6	86	0
Arkansas.....	61	11	72	1
California.....	1,199	71	1,270	30
Colorado.....	101	10	111	5
Connecticut.....	150	3	153	2
Delaware.....	53	2	55	2
District of Columbia.....	126	3	129	2
Florida.....	249	17	266	0
Georgia.....	154	18	172	0
Idaho.....	52	2	54	1
Illinois.....	680	39	719	11
Indiana.....	357	65	422	10
Iowa.....	186	18	204	5
Kansas.....	181	36	217	0
Kentucky.....	70	16	86	0
Louisiana.....	109	5	114	0
Maine.....	100	7	107	0
Maryland.....	128	8	136	1
Massachusetts.....	275	8	283	9
Michigan.....	449	53	502	22
Minnesota.....	215	60	275	4
Mississippi.....	97	6	103	0
Missouri.....	270	35	305	1
Montana.....	55	25	80	1
Nebraska.....	123	30	153	1
Nevada.....	25	8	33	0
New Hampshire.....	45	6	51	1
New Jersey.....	317	18	335	22
New Mexico.....	35	3	38	0
New York.....	927	33	960	26
North Carolina.....	197	37	234	1
North Dakota.....	57	24	81	0
Ohio.....	604	68	672	20
Oklahoma.....	213	22	235	0
Oregon.....	115	42	157	2
Pennsylvania.....	784	25	809	11
Rhode Island.....	72	4	76	0
South Carolina.....	78	10	88	0
South Dakota.....	62	3	65	1
Tennessee.....	137	11	148	0
Texas.....	522	89	611	2
Utah.....	38	4	42	2
Vermont.....	34	2	36	0
Virginia.....	137	0	137	2
Washington.....	204	17	221	5
West Virginia.....	104	14	118	0
Wisconsin.....	217	32	249	4
Wyoming.....	45	12	57	0
Alaska.....	82	2	84	0
Canada <sup>1</sup> .....	1	0	1	0
Canal Zone.....	0	0	0	0
Hawaii.....	24	1	25	0
Mexico <sup>1</sup> .....	0	0	0	0
Philippine Islands <sup>2</sup> .....	1	0	1	0
Foreign <sup>1</sup> (miscellaneous).....	5	0	5	0
Puerto Rico.....	14	1	15	0
Total.....	10,698	1,046	11,744	<sup>3</sup> 208

<sup>1</sup> Figures for these countries are for aircraft certificated or registered by the United States.<sup>2</sup> Civil aircraft in the Philippine Islands are now registered with the local government.<sup>3</sup> Includes 169 certificated and 39 uncertificated gliders.

## LICENSED PILOTS IN THE UNITED STATES

January 1, 1939

Compiled by Civil Aeronautics Authority

State	Airline transport	Com- mercial	Limited com- mercial	Private	Solo	Total	Glid- er pilots
Alabama.....	1	59	5	90	13	168	0
Arizona.....	0	33	3	79	17	132	0
Arkansas.....	0	43	2	45	14	106	0
California.....	145	1,117	123	2,171	853	4,409	8
Colorado.....	29	57	14	80	88	268	0
Connecticut.....	0	80	12	170	99	361	1
Delaware.....	0	13	4	46	8	71	2
District of Columbia.....	6	116	4	134	56	316	1
Florida.....	63	219	12	267	58	619	1
Georgia.....	49	67	6	124	54	300	0
Idaho.....	0	27	4	47	69	147	0
Illinois.....	161	338	54	660	225	1,438	8
Indiana.....	4	160	35	279	171	649	7
Iowa.....	5	103	16	166	145	435	0
Kansas.....	4	87	10	130	18	312	1
Kentucky.....	0	43	6	66	14	129	0
Louisiana.....	13	107	7	79	64	270	0
Maine.....	1	41	9	61	36	148	0
Maryland.....	6	80	11	69	58	224	0
Massachusetts.....	20	154	37	311	289	811	7
Michigan.....	23	266	49	421	172	931	16
Minnesota.....	47	113	32	139	66	397	1
Mississippi.....	1	39	2	57	18	117	0
Missouri.....	107	156	14	165	137	579	2
Montana.....	1	30	5	53	29	118	1
Nebraska.....	0	51	9	85	63	208	1
Nevada.....	2	9	2	12	7	32	0
New Hampshire.....	0	23	5	39	26	93	0
New Jersey.....	148	189	20	379	34	770	18
New Mexico.....	1	17	1	35	12	66	0
New York.....	3	579	86	1,081	421	2,170	20
North Carolina.....	0	67	16	157	38	278	0
North Dakota.....	0	31	1	30	16	78	0
Ohio.....	21	336	79	579	200	1,215	8
Oklahoma.....	2	102	17	136	54	311	0
Oregon.....	22	69	8	109	85	293	0
Pennsylvania.....	6	314	68	730	254	1,372	11
Rhode Island.....	1	12	6	33	25	77	1
South Carolina.....	2	26	6	76	22	132	0
South Dakota.....	0	32	4	45	27	108	0
Tennessee.....	30	61	12	233	26	362	0
Texas.....	106	412	31	386	126	1,061	0
Utah.....	31	29	4	44	25	133	0
Vermont.....	0	20	6	32	25	83	0
Virginia.....	13	144	19	188	54	418	0
Washington.....	39	147	21	225	142	574	0
West Virginia.....	2	43	18	93	61	217	0
Wisconsin.....	3	117	28	167	60	375	1
Wyoming.....	23	24	0	23	15	85	0
Alaska.....	1	68	2	19	5	95	0
Canada.....	1	11	3	9	1	25	0
Canal Zone.....	5	31	0	6	0	42	0
Hawaii.....	1	56	9	66	15	147	0
Mexico.....	0	1	0	1	0	2	0
Philippine Islands.....	0	20	0	5	0	25	0
Foreign (miscellaneous).....	15	67	1	37	3	123	0
Puerto Rico.....	0	7	2	7	2	18	0
Total.....	1,164	6,665	960	10,973	4,678	124,443	116
Percentages.....	4.77	27.27	3.93	44.89	19.14		

<sup>1</sup> Includes 712 women pilots divided as follows: 75 commercial, 30 limited commercial, 425 private, and 182 solo. The glider pilots include 3 women.

## AIRPORTS AND LANDING FIELDS

January 1, 1930

Compiled by Civil Aeronautics Authority

<i>State</i>	<i>Municipal</i>	<i>Commercial</i>	<i>Intermediate</i>	<i>Auxiliary</i>	<i>Navy</i>	<i>Army</i>	<i>Miscellaneous Government, Private and State</i>	<i>Totals</i>	<i>Partially or fully lighted</i>
Alabama.....	11	2	7	14	0	2	1	37	12
Alaska.....	1	7	0	106	0	0	0	114	2
Arizona.....	9	5	8	20	0	1	0	43	15
Arkansas.....	12	1	4	9	0	0	3	29	7
California.....	51	40	19	43	5	4	15	177	63
Colorado.....	12	4	3	15	0	0	0	34	7
Connecticut.....	7	6	1	3	0	0	1	18	7
Delaware.....	1	3	0	0	0	1	1	6	3
District of Columbia.....	0	1	0	0	1	1	0	3	3
Florida.....	47	13	3	54	5	2	5	129	27
Georgia.....	23	3	10	21	0	1	0	58	19
Idaho.....	18	0	8	11	0	0	9	46	13
Illinois.....	14	30	6	0	0	2	3	55	27
Indiana.....	15	18	7	6	0	2	3	51	20
Iowa.....	16	8	3	5	0	0	2	34	10
Kansas.....	22	5	5	0	0	2	0	43	15
Kentucky.....	9	0	3	6	0	1	1	20	4
Louisiana.....	13	1	3	7	0	1	5	30	9
Maine.....	10	5	0	6	0	0	1	22	5
Maryland.....	2	8	1	1	1	3	3	19	8
Massachusetts.....	10	22	1	6	2	0	0	41	11
Michigan.....	57	13	0	19	1	3	34	127	24
Minnesota.....	13	3	3	14	0	1	1	35	9
Mississippi.....	13	0	6	11	1	0	0	31	13
Missouri.....	10	5	12	4	0	0	4	35	18
Montana.....	25	0	12	26	0	0	11	74	18
Nebraska.....	15	3	4	7	0	2	1	32	14
Nevada.....	3	3	8	7	1	0	0	22	11
New Hampshire.....	6	2	0	6	0	0	0	14	3
New Jersey.....	5	12	0	1	2	1	1	22	8
New Mexico.....	4	3	10	14	0	1	4	36	13
New York.....	26	34	4	12	0	5	11	92	27
North Carolina.....	15	6	2	6	0	1	0	30	10
North Dakota.....	17	3	6	13	0	0	1	40	10
Ohio.....	31	36	9	19	0	3	14	112	24
Oklahoma.....	22	6	7	5	0	1	1	42	22
Oregon.....	13	3	9	9	0	0	2	36	17
Pennsylvania.....	22	58	8	10	1	1	13	113	37
Rhode Island.....	0	2	0	3	1	0	2	8	1
South Carolina.....	11	3	4	7	2	0	2	29	7
South Dakota.....	19	2	0	6	0	0	0	27	1
Tennessee.....	9	1	8	5	0	0	0	23	14
Texas.....	52	9	24	31	0	12	5	133	49
Utah.....	6	1	11	2	0	0	0	20	13
Vermont.....	6	2	0	3	0	1	0	12	1
Virginia.....	12	12	8	10	2	1	1	46	17
Washington.....	25	7	6	7	1	4	4	54	17
West Virginia.....	11	5	0	7	0	0	1	24	2
Wisconsin.....	26	17	4	5	0	0	3	55	18
Wyoming.....	14	0	10	17	0	0	0	41	14
Totals.....	791	433	267	628	26	60	169	2,374	719

## AIRCRAFT APPROPRIATIONS, UNITED STATES

<i>Fiscal Year</i>	<i>Department Appropriations</i>	<i>Total</i>	<i>Increase or Decrease</i>	<i>Net</i>
1924-25	Army..... \$13,476,619(1) Navy..... 15,150,000 N.A.C.A..... 470,000	\$ 29,096,619	+ \$1,050,619 + 502,826 + 187,000	+ \$1,740,445
1925-26	Army..... 18,061,191(2) Navy..... 15,130,000 Air Mail..... 500,000 N.A.C.A..... 534,000	34,225,191	+ 4,584,572 - 20,000 + 500,000 + 64,000	+ 5,128,572
1926-27	Army..... 18,256,604(3) Navy..... 19,065,288 Air Mail..... 2,000,000 N.A.C.A..... 513,000 Commerce.... 550,000(4)	40,384,982	+ 195,503 + 3,935,288 + 1,500,000 - 21,000 + 550,000	+ 6,159,791
1927-28	Army..... 25,612,494(5) Navy..... 20,100,000 Air Mail..... 4,650,000(6) N.A.C.A..... 550,000 Commerce.... 3,791,500(7)	54,703,994	+ 7,355,800 + 1,034,712 + 2,650,000 + 37,000 + 3,241,500	+ 14,319,012
1928-29	Army..... 33,911,431(8) Navy..... 32,189,000 Air Mail..... 14,480,000(9) N.A.C.A..... 628,770 Commerce.... 5,519,350(10)	86,728,551	+ 8,298,937 + 12,089,000 + 9,830,000 + 78,770 + 1,727,850	+ 32,024,557
1929-30	Army..... 34,910,059 Navy..... 31,430,000 Air Mail..... 19,300,000(11) N.A.C.A..... 1,508,000 Commerce.... 6,416,620(12)	93,564,679	+ 998,628 - 759,000 + 4,820,000 + 879,230 + 897,270	+ 6,836,128
1930-31	Army..... 38,892,968(13) Navy..... 32,033,211 Air Mail..... 24,600,000(14) N.A.C.A..... 1,321,000 Commerce.... 9,204,830(15)	106,052,009	+ 3,982,909 + 603,211 + 5,300,000 - 187,000 + 2,788,210	+ 12,487,330

(1) Includes \$678,043 under title of "reclassification of salaries."

(2) Includes \$2,150,000 contract authorization and \$1,000,000 for the construction of Wright Field.

(3) Includes \$3,000,000 contract authorization.

(4) Consists of \$250,000 for "aircraft in commerce" and \$300,000 for "air navigation facilities."

(5) Includes \$4,495,000 contract authorization and \$514,900 deficiency appropriation.

(6) Made up as follows: Domestic, \$4,500,000; Foreign, \$150,000.

(7) Consists of \$700,000 for "aircraft in commerce" and \$3,091,500 for "air navigation facilities."

(8) Includes \$5,000,000 contract authorization and \$3,482,869 deficiency appropriation.

(9) Made up as follows: Domestic, \$12,430,000; Foreign, \$2,050,000.

(10) Consists of \$859,500 "aircraft in commerce" and \$4,659,850 for "air navigation facilities."

(11) Made up as follows: Domestic, \$15,000,000; Foreign, \$4,300,000.

(12) Consists of \$958,000 for "aircraft in commerce" and \$5,458,620 for "air navigation facilities."

(13) Includes deficiency appropriations of \$871,100 and \$1,298,810.

(14) Made up as follows: Domestic, \$18,000,000; Foreign, \$6,600,000.

(15) Consists of \$1,260,830 for "aircraft in commerce" and \$7,944,000 for "air navigation facilities".

## AIRCRAFT APPROPRIATIONS, UNITED STATES (Cont.)

<i>Fiscal Year</i>	<i>Department Appropriations</i>	<i>Total</i>	<i>Increase or Decrease</i>	<i>Net</i>
1931-32	Army..... \$31,850,892(16) Navy..... 31,145,000 Air Mail..... 27,000,000(17) N.A.C.A..... 1,051,070 Commerce..... 10,362,300(18)	\$101,409,262	-\$7,042,076 -888,211 +2,400,000 -269,930 +1,157,470	-\$4,642,747
1932-33	Army..... 25,673,236 Navy..... 32,745,420(19) Air Mail..... 26,460,000(20) N.A.C.A..... 920,000 Commerce..... 8,553,500(21)	94,352,156	-6,177,656 +1,600,420 -540,000 -131,070 -1,808,800	-7,057,106
1933-34	Army..... 34,037,769(22) Navy..... 21,957,459 Air Mail..... 22,000,000(23) N.A.C.A..... 695,000 Commerce..... 7,600,780(24)	86,351,008	+8,364,533 -10,787,961 -4,460,000 -225,000 -892,720	-8,001,148
1934-35	Army..... 30,917,702(25) Navy..... 34,842,253(26) Air Mail..... 19,003,291(27) N.A.C.A..... 726,492 Commerce..... 5,681,029(28)	91,170,767	-3,120,067 +12,884,794 -2,996,709 +31,492 -1,979,751	+4,819,759
1935-36	Army..... 50,287,197(29) Navy..... 40,732,310 Air Mail..... 18,700,000(30) N.A.C.A..... 1,177,550 Commerce..... 5,909,800(31)	116,806,857	+19,369,495 +5,809,057 -303,291 +451,058 +228,771	+25,636,090
1936-37	Army..... 62,607,727(32) Navy..... 38,588,270(33) Air Mail..... 20,230,000(34) N.A.C.A..... 2,544,550 Commerce..... 6,850,000(35)	130,820,547	+12,320,530 -2,144,040 +1,530,000 +1,367,000 +940,200	+14,013,690
1937-38	Army..... 67,308,374(36) Navy..... 49,500,000(37) Air Mail..... 24,405,860(38) N.A.C.A..... 1,733,850 Commerce..... 13,238,500(39)	156,186,584	+4,700,647 +10,911,730 +4,175,860 -810,700 +6,388,500	+25,366,037
1938-39	Army..... 73,799,532(40) Navy..... 48,075,000(41) Air Mail..... 27,592,275(42) N.A.C.A..... 2,508,000(43) C.A.A..... 16,231,130(44)	168,205,937	+6,491,158 -1,425,000 +3,186,415 +774,150 +2,992,630	+12,019,353
1939-40	Army..... 108,116,375(45) Navy..... *83,298,000(46) Air Mail..... 28,130,000(47) N.A.C.A..... 3,735,980(48) C.A.A..... 21,238,000(49)	223,301,593	+34,315,843 +35,223,000 +537,725 +1,227,980 +5,006,870	+76,311,468

(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 \$10,660,786 contract authorization; provides that \$20,322,602 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, \$8,250,000.

(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 \$10,126,894 contract authorization.

(37) Includes \$27,180,000 for new aircraft of which \$15,000,000 is contract authorization.

(38) Includes \$14,500,000 for domestic air mail and \$9,905,800 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 \$10,126,894 contract authorization.

(41) Includes \$24,633,000 for new aircraft of which \$15,000,000 is for contract authorization.

(42) Includes \$17,240,000 for domestic air mail and \$10,352,275 for foreign air mail.

(43) Includes \$975,000 for beginning of construction of a new wind tunnel.

(44) Includes \$4,575,000 for establishment of air navigation facilities and \$249,750 for aircraft.

(45) Includes \$56,113,200 for combat planes and \$32,205,988 contract authorization.

(46) Includes \$46,898,000 for new aircraft and \$20,000,000 contract authorization.

(47) Includes \$17,930,000 for domestic and \$10,200,000 including \$995,680 for Atlantic air mail service.

(48) Includes \$1,805,000 for completion of wind tunnel and additional research facilities.

(49) Includes \$7,000,000 for airways, besides an amount for new aircraft.

\* Proposed expenditures.

+ Shows amount of increase over preceding year.

- Shows amount of decrease from preceding year.

## AVIATION GASOLINE TAX SUMMARY

January 1, 1939

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; Aeronautics	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¢ <sup>(1)</sup>
Minnesota	4¢	Highways	Yes	Refund
Mississippi	6¢	Highways	Yes	Refund 5¢ <sup>(3)</sup>
Missouri	2¢	Highways	Yes	Refund
Montana	5¢	Highways	Yes	Refund
Nebraska	5¢	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	4¢	Highways	Yes	Refund
Ohio	4¢	Highways; Schools	Yes	Refund
Oklahoma	4¢	Highways; Debt Service	Yes	Exemption
Oregon	5¢	Highways; Aeronautics	Yes	Refund 4¢
Pennsylvania	4¢	Highways; Relief; Aeronautics	Yes	No
Rhode Island	3¢	Highways; General Fund; Relief	Yes	Refund
South Carolina	6¢	Highways; Aeronautics	Yes	No
South Dakota	4¢	Highways; Aeronautics	Yes	No
Tennessee	7¢	Highways; General Fund except \$50,000 to Airways	Yes	No
Texas	4¢	Highways; Schools	Yes	Refund
Utah	4¢	Highways; Aeronautics	Yes	No
Vermont	4¢	Highways; Aeronautics	Yes	No
Virginia	5¢	Highways; Bridges; Aeronautics	Yes	Refund 2¢ <sup>(2)</sup>
Washington	5¢	Highways	Yes	Refund
West Virginia	5¢	Highways	Yes	Refund
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) 5¢ refunded on inter-state traffic.

(3) Law also provides for exemption from 5¢ of the gasoline tax of airplane fuel, for interstate use only, at licensed airports.





**INJURIES CLASSIFIED**

July-December, 1937

Kind of Flying	Total Persons Involved	Pilots					Co-Pilots or Students				
		Fatal	Severe	Minor	No Injury	Total	Fatal	Severe	Minor	No Injury	Total
Scheduled . . . . .	231	3	0	0	19	22	3	0	0	17	20
Instructional . . . . .	513	41	23	46	290	400	9	5	8	42	64
Experimental . . . . .	24	0	1	3	11	15	0	0	0	1	1
Commercial . . . . .	491	16	10	28	164	218	1	0	1	5	7
Pleasure . . . . .	874	37	33	51	358	479	2	0	2	4	8
<b>Total . . . . .</b>	<b>2,133</b>	<b>97</b>	<b>67</b>	<b>128</b>	<b>842</b>	<b>1,134</b>	<b>15</b>	<b>5</b>	<b>11</b>	<b>69</b>	<b>100</b>

Kind of Flying	Total Persons Involved	Passengers					Aircraft Crew				
		Fatal	Severe	Minor	No Injury	Total	Fatal	Severe	Minor	No Injury	Total
Scheduled . . . . .	231	20	8	1	127	165	2	2	0	20	24
Instructional . . . . .	513	12	13	3	16	44	0	0	0	4	4
Experimental . . . . .	24	0	0	5	3	8	0	0	0	0	0
Commercial . . . . .	491	16	15	26	201	258	2	0	0	6	8
Pleasure . . . . .	874	40	37	34	270	381	0	0	0	1	1
<b>Total . . . . .</b>	<b>2,133</b>	<b>97</b>	<b>73</b>	<b>69</b>	<b>617</b>	<b>856</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>31</b>	<b>37</b>

January-June, 1938

Kind of Flying	Total Persons Involved	Pilots					Co-Pilots or Students				
		Fatal	Severe	Minor	No Injury	Total	Fatal	Severe	Minor	No Injury	Total
Scheduled . . . . .	226	5	0	0	16	21	5	0	0	14	19
Instructional . . . . .	381	18	21	27	217	283	5	3	7	45	60
Experimental . . . . .	17	1	1	2	11	15	0	0	0	0	0
Commercial . . . . .	312	11	5	5	116	137	1	0	0	4	5
Pleasure . . . . .	780	35	24	45	310	414	2	0	1	13	16
<b>Total . . . . .</b>	<b>1,716</b>	<b>70</b>	<b>51</b>	<b>79</b>	<b>670</b>	<b>870</b>	<b>13</b>	<b>3</b>	<b>8</b>	<b>76</b>	<b>100</b>

Kind of Flying	Total Persons Involved	Passengers					Aircraft Crew				
		Fatal	Severe	Minor	No Injury	Total	Fatal	Severe	Minor	No Injury	Total
Scheduled . . . . .	226	22	0	0	139	161	8	0	0	17	25
Instructional . . . . .	381	12	0	0	20	38	0	0	0	0	0
Experimental . . . . .	17	0	0	0	2	2	0	0	0	0	0
Commercial . . . . .	312	12	4	17	134	167	1	0	0	0	1
Pleasure . . . . .	780	36	15	30	268	349	0	0	0	0	0
<b>Total . . . . .</b>	<b>1,716</b>	<b>82</b>	<b>19</b>	<b>53</b>	<b>563</b>	<b>717</b>	<b>9</b>	<b>0</b>	<b>0</b>	<b>17</b>	<b>26</b>

## COMPARATIVE TABULATION OF ACCIDENTS IN CIVIL AERONAUTICS

1935, 1936, 1937, and the First Six Months of 1938

Compiled by Bureau of Air Commerce, U. S. Department of Commerce

### Mileage Flown Per Accident

	<i>January- June, 1935*</i>	<i>July- December, 1935</i>	<i>January- June, 1936*</i>	<i>July- December, 1936</i>	<i>January- June, 1937*</i>	<i>July- December, 1937</i>	<i>January- June, 1938*</i>
Miles flown in air carrier operations.....	28,880,242	34,987,456	33,666,961	39,944,809	36,693,748	40,709,617	39,000,163
Miles flown in miscellaneous operations including student instruction and experimental flying.....	40,234,185	44,521,445	41,517,085	51,803,290	45,259,950	57,936,495	56,400,045
Total.....	69,114,427	79,508,901	75,184,046	91,748,099	81,953,698	98,646,022	95,508,208
Accidents, all services.....	737	842	831	937	870	1,097	861
Miles flown per accident, all services.....	93,778	94,429	90,474	97,917	94,200	89,923	110,927
Accidents, air carrier operations.....	29	33	42	28	28	22	21
Miles flown per accident, air carrier operations.....	995,870	1,060,226	801,594	1,426,600	1,310,491	1,850,437	1,857,579
Accidents, miscellaneous operations.....	708	800	789	909	842	1,075	840
Miles flown per accident, miscellaneous operations.....	56,828	55,032	52,620	56,989	53,753	53,804	67,261
Fatal accidents, all services**.....	86	86	65	104	75	116	85
Miles flown per fatal accident in all services.....	803,650	924,522	1,156,678	882,193	1,092,716	850,397	1,123,626
Fatal accidents, air carrier operations**.....	5	3	5	5	3	3	5
Miles flown per fatal accident in air carrier operations.....	5,776,048	11,662,485	6,733,392	7,988,962	12,231,249	13,569,872	7,801,833
Fatal accidents, miscellaneous operations**.....	81	83	60	99	72	113	80
Miles flown per fatal accident, miscellaneous operations.....	496,718	536,403	691,951	523,266	628,610	512,712	706,238
Pilot fatalities, all services.....	72	70	52	87	60	97	70
Miles flown per pilot fatality, all services.....	959,923	1,135,841	1,445,847	1,054,576	1,365,895	1,016,969	1,364,403
Pilot fatalities, air carrier operations.....	5	3	4	5	2	3	5
Miles flown per pilot fatality, air carrier operations.....	5,776,048	11,662,485	8,416,740	7,988,962	18,346,874	13,569,872	7,801,833
Pilot fatalities, miscellaneous operations.....	67	67	48	82	58	94	65
Miles flown per pilot fatality, miscellaneous operations.....	600,510	664,499	864,939	631,747	780,344	616,345	869,216

\* 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.

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729 Fifteenth Street, N.W.,  
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30 Rockefeller Plaza, New York

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First Lieutenant.....	Robert M. Losey

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Codes and Specifications..... A. S. McAllister  
Office..... D. E. Thomas  
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.....	Chief Pay Clerk L. T. Robbins
Senior Aeronautical Engineer.....	H. S. Cocklin
Civil Engineer.....	E. L. McGandy

**Coast Guard Air Stations**

Salem, Massachusetts.....	Lieut. Comdr. F. A. Leamy
New York, N. Y.....	Lieutenant W. S. Anderson
Charleston, S. C.....	Lieutenant K. P. Maley
Miami, Florida.....	Commander C. C. von Paulsen
St. Petersburg, Fla.....	Lieutenant C. F. Edge
Biloxi, Miss.....	Lieut. Comdr. R. L. Raney
San Diego, Calif.....	Lieut. S. C. Linholm
Port Angeles, Wash.....	Lieut. Comdr. N. M. Nelson

**Coast Guard Air Patrol Detachment**

Cape May, N. J.....	Lieut. R. L. Burke
El Paso, Texas.....	Lieut. (j.g.) R. L. Grantham

**Inspectors of Coast Guard Aircraft**

Lieut. Comdr. W. J. Kossler	Chief Carpenter O. G. Tobiason
Chief Machinist W. R. Kenly	A. C. M.M.A. N. Fisher
Chief Machinist H. D. Olmstead	

**POST OFFICE DEPARTMENT AIR MAIL SERVICE**

Washington, D. C.

Postmaster General.....	James A. Farley
First Assistant Postmaster General.....	W. W. Howes
Deputy First Assistant Postmaster General.....	J. M. Donaldson
Superintendent, Air Mail Service.....	Charles P. Graddick
Assistant Superintendent, Air Mail Service.....	C. M. Knobler
J. C. Young, Assistant Superintendent.....	New York, N. Y.
J. A. Cruickshank, Assistant Superintendent.....	Chicago, Ill.
B. H. Lockett, Assistant Superintendent.....	Atlanta, Ga.
A. C. Hodges, Assistant Superintendent.....	Fort Worth, Tex.
A. O. Willoughby, Assistant Superintendent.....	San Francisco, Calif.

## CIVIL AERONAUTICS AUTHORITY

Washington, D. C.

Robert H. Hinckley.....	Chairman
Harlee Branch.....	Vice-Chairman
Oswald Ryan.....	Third Member
G. Grant Mason, Jr.....	Fourth Member
Edward P. Warner.....	Fifth Member
Clinton M. Hester.....	Administrator and Supervisor
L. W. Pogue.....	General Counsel
Paul J. Frizell.....	Coordinator and Secretary
Planning & Procedure Division.....	Jas. C. Sinnigen
Planning Section.....	Walter W. LeMat
Survey Section.....	Alfred Hand (Acting)
Budget & Finance Division.....	A. J. Naylor
Budget & Statistics Section.....	E. W. Gifford
Finance Section.....	W. R. Behn
Personnel Division.....	Dick Carlson
Assistant Director.....	A. O. Preil (Acting)
Placement Section.....	Mercedes Berry (Acting)
Classification Section.....	Kathryn Luginbuhl (Acting)
Appointment & Record Unit.....	Guy Dorsey
Payroll & Leave Unit.....	Mary A. Bishop
Office Service Division.....	C. M. Estep
Purchase & Property Section.....	E. R. Ryan
Purchase & Lease Unit.....	L. W. Lawrence
Property Unit.....	A. Ruderman
Reproduction & Service Section.....	S. A. Kemp
Printing & Reproduction Unit.....	R. C. Leachman
Service Unit:	
Traffic Manager.....	W. C. Klietsch
Dictaphone Pool.....	Mrs. G. Kibler
Mail & Messenger.....	C. S. Shields
Communications.....	Mrs. Isabel Burton
Bolling Field.....	F. C. Cullers
Records Division.....	R. R. Reining
Minutes Section.....	C. D. Flanner
Docket Section.....	Lolita Toothaker
Central Files Section.....	Lillie Nielsen
Certificate Section.....	Clark Conway
Registration Unit.....	Donie Hatch
Recordation Unit.....	Kathryn Pickett
Aircraft Unit.....	Nella Morrow
Airmen Unit.....	Helen Holmes
Certificate Files Unit.....	Mabel Harris

## Air Safety Board

Col. Sumpter Smith.....	Chairman
Tom Hardin.....	Vice-Chairman
C. B. Allen.....	Third Member
Chief Counsel.....	Darrell T. Lane
Executive Officer.....	W.S. McDuffee
Asst. Executive Officer.....	L. R. Inwood
Asst. to Executive Officer.....	John Foscue
Investigation Division.....	R. D. Hoyt (Acting)
Examiners Section.....	Fred Glass
Investigation Section.....	R. D. Hoyt
Information & Publication Division:	
Liaison Section.....	W. S. Stapler
Information & Statistical Section.....	Frank Miller
Recommendations Division.....	G. C. Miller
Analysis Section.....	J. W. Lankford
Technical Section.....	Ronald Rohlfis

Interdepartmental Commission, Washington National Airport:  
 Chairman..... Col. Sumpter Smith  
 Resident Engineer..... H. H. Houk  
 Administrative Assistant..... Thos. G. Early

Director of Statistics & Information:..... Daniel Sayre  
 Information Division..... John Stuart  
     Flight Information Section..... John Groves  
     Editorial Section..... Catherine O'Malley  
     Reference & Research Unit..... L. Bedford  
 Publications & Statistics Division..... F. B. Brinkley  
     Statistical Section..... Stafford Kernan  
     Publications Section..... John Parker  
     Correspondence Unit..... W. B. Fulton

**Bureau of Federal Airways**

Charles I. Stanton..... Director  
 Airways Engineering Division..... T. B. Bourne  
     Survey Section..... H. A. Hook  
     Utilities Section..... A. J. LaBaie  
     Construction Section..... G. E. Stratton  
     Radio Section..... W. F. McBride  
     Maintenance Section..... Chris Lampe  
     Drafting Unit..... W. T. Huntress  
 Airways Operation Division..... Earl F. Ward  
     Communications Section..... Eugene Sibley  
     Airway Traffic Control Section..... G. A. Gilbert  
     Airport Traffic Control Section..... F. L. Smith  
     Technical Development Division..... R. C. Gazley  
     Aircraft Section..... John Easton  
     Power Plant Section..... John Geisse  
     Aeronautical Charts Section..... K. Keefe (Acting)  
     Project Section..... J. M. Farrar  
     Airport Section..... A. B. McMullen  
     Air Transport Section..... R. W. Knight  
     Radio Development Section..... W. E. Jackson

**Bureau of Safety Regulation**

Richard S. Boutelle

Private Flying Development Division..... Grove Webster  
     Development Section..... Jack R. Cram (Acting)  
     Analysis Section..... J. C. Edgerton  
     State Coordination Section..... Elwood B. Cole  
 Certificate & Inspection Division..... A. S. Koch  
     Aircraft Airworthiness Section..... Jack Gray  
     Aircraft Unit..... H. D. Hoekstra  
     Appliance Unit..... J. Vitol  
     Power Plant Unit..... G. W. Newton  
     Specifications Unit..... J. M. Chamberlain  
     Air Carrier Inspection Section..... E. L. Yuravich  
     General Inspection Section:..... C. F. Dycer  
         Engineering Flight Test & Inspection Unit..... Dr. E. S. Adams  
     Medical Section.....

**Bureau of Economic Regulation**

R. W. Stouch

Assistant to Director..... F. A. Toombs  
 Formal Proceedings Division:..... Senior Examiner  
     C. Edward Leasure..... F. H. Crozier  
 Accounts & Analysis Division..... J. C. Freeland  
     Field Audits & Investigations Section..... A. H. Gilbert  
     Analysis & Research Section..... Edward P. Ridley  
 Economic Compliance Division.....

**U. S. WEATHER BUREAU  
DEPARTMENT OF AGRICULTURE**

Washington, D. C.

Henry A. Wallace, Secretary of Agriculture

Chief..... Francis W. Reichelderfer  
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.  
Seattle, Wash..... Julius C. Smith  
Salt Lake City..... Harry M. Hightman  
San Francisco (Oakland)..... John A. Riley

CONGRESSIONAL COMMITTEES  
INTERESTED IN AVIATION

Standing Committees of the 76th Congress, first session, 1939

Senate

Appropriations

Carter Glass	(D)	Harry S. Truman	(D)
Kenneth McKellar	(D)	Edward R. Burke	(D)
Carl Hayden	(D)	Theodore F. Green	(D)
Elmer Thomas	(D)	Francis T. Maloney	(D)
James F. Byrnes	(D)	Dennis Chavez	(D)
Millard E. Tydings	(D)	Frederick Hale	(R)
Richard B. Russell	(D)	Gerald P. Nye	(R)
Alva B. Adams	(D)	John G. Townsend	(R)
Pat McCarran	(D)	H. Styles Bridges	(R)
John H. Overton	(D)	Henry Cabot Lodge	(R)
John H. Bankhead, 2d	(D)	Rufus C. Holman	(R)
Joseph C. O'Mahoney	(D)	Robert A. Taft	(R)

Interstate Commerce

Burton K. Wheeler	(D)	H. H. Schwartz	(D)
Ellison D. Smith	(D)	Lister Hill	(D)
Robert F. Wagner	(D)	Ernest Lundeen	(D)
Alben W. Barkley	(D)	Tom Stewart	(D)
M. M. Neely	(D)	Wallace H. White, Jr.	(R)
Homer T. Bone	(D)	Warren R. Austin	(R)
Vic Donahey	(D)	Charles W. Tobey	(R)
Sherman Minton	(D)	Clyde M. Reed	(R)
Harry S. Truman	(D)	Chan Gurney	(R)
Charles O. Andrews	(D)	Henrik Shipstead	(FL)
Edwin C. Johnson	(D)		

Military Affairs

Morris Sheppard	(D)	Lister Hill	(D)
J. Hamilton Lewis	(D)	Bennett Champ Clark	(D)
M. M. Logan	(D)	Sheridan Downey	(D)
Robert R. Reynolds	(D)	Warren R. Austin	(R)
Elbert D. Thomas	(D)	Gerald P. Nye	(R)
Sherman Minton	(D)	H. Styles Bridges	(R)
Edwin C. Johnson	(D)	Chan Gurney	(R)
Josh Lee	(D)	Rufus C. Holman	(R)
H. H. Schwartz	(D)	Ernest Lundeen	(FL)

Naval Affairs

David I. Walsh	(D)	Guy M. Gillette	(D)
Millard E. Tydings	(D)	Allen J. Ellender	(D)
Ellison D. Smith	(D)	Scott W. Lucas	(D)
Richard B. Russell	(D)	Frederick Hale	(R)
Homer T. Bone	(D)	James J. Davis	(R)
Harry Flood Byrd	(D)	Hiram W. Johnson	(R)
Peter G. Gerry	(D)	Ernest W. Gibson	(R)
Rush D. Holt	(D)	W. Warren Barbour	(R)
Charles O. Andrews	(D)		

Post Offices and Post Roads

Kenneth McKellar	(D)	Allen J. Ellender	(D)
Carl Hayden	(D)	William H. Smathers	(D)
Josiah William Bailey	(D)	James M. Mead	(D)
W. J. Bulow	(D)	D. Worth Clark	(D)
James F. Byrnes	(D)	Lynn J. Frazier	(R)
M. M. Logan	(D)	H. Styles Bridges	(R)
Joseph C. O'Mahoney	(D)	James J. Davis	(R)
James E. Murray	(D)	Clyde M. Reed	(R)
Dennis Chavez	(D)	Robert M. La Follette, Jr.	(P)
Rush D. Holt	(D)		

## CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION

(Continued)

## House of Representatives

## Appropriations

Edward T. Taylor	(D)	Ross A. Collins	(D)
Clarence Cannon	(D)	Charles H. Leavy	(D)
Clifton A. Woodrum	(D)	Joseph E. Casey	(D)
Louis Ludlow	(D)	John H. Kerr	(D)
Thomas S. McMillan	(D)	George H. Mahon	(D)
Malcolm C. Tarver	(D)	John Taber	(R)
Jed Johnson	(D)	Richard B. Wigglesworth	(R)
J. Buell Snyder	(D)	W. P. Lambertson	(R)
James McAndrews	(D)	D. Lane Powers	(R)
Emmet O'Neal	(D)	J. William Ditter	(R)
George W. Johnson	(D)	Albert E. Carter	(R)
James G. Scrugham	(D)	Robert F. Rich	(R)
James M. Fitzpatrick	(D)	Charles A. Plumley	(R)
Louis C. Rabaut	(D)	Everett M. Dirksen	(R)
Joachim O. Fernandez	(D)	Albert J. Engel	(R)
Millard F. Caldwell	(D)	Karl Stefan	(R)
David D. Terry	(D)	Francis H. Case	(R)
John M. Houston	(D)	Dudley A. White	(R)
J. Burrwood Daly	(D)	Clarence J. McLeod	(R)
Joe Starnes	(D)	Chester C. Bolton	(R)

## Interstate and Foreign Commerce

Clarence F. Lea	(D)	James P. McGranery	(D)
Robert Crosser	(D)	Donald L. O'Toole	(D)
Alfred L. Bulwinkle	(D)	Luther Patrick	(D)
Virgil Chapman	(D)	Carl E. Mapes	(R)
William P. Cole, Jr.	(D)	Charles A. Wolverton	(R)
Edward A. Kelly	(D)	James Wolfenden	(R)
John A. Martin	(D)	Pehr G. Holmes	(R)
Herron Pearson	(D)	B. Carroll Reece	(R)
Lyle H. Boren	(D)	James W. Wadsworth	(R)
Martin J. Kennedy	(D)	Charles A. Halleck	(R)
Elmer J. Ryan	(D)	Oscar Youngdahl	(R)
Charles L. South	(D)	Carl Hinshaw	(R)
		Clarence J. Brown	(R)

## Military Affairs

Andrew J. May	(D)	John J. Sparkman	(D)
R. Ewing Thomason	(D)	Paul J. Kilday	(D)
Dow W. Harter	(D)	Walter G. Andrews	(R)
Charles I. Faddis	(D)	Dewey Short	(R)
Clarence W. Turner	(D)	Leslie C. Arends	(R)
Andrew Edmiston	(D)	Charles R. Clason	(R)
Edwin M. Schaefer	(D)	Albert G. Rutherford	(R)
J. Joseph Smith	(D)	J. Parnell Thomas	(R)
Matthew J. Merritt	(D)	Paul W. Shafer	(R)
John M. Costello	(D)	Thomas E. Martin	(R)
C. Arthur Anderson	(D)	Charles H. Elston	(R)
Stephen Pace	(D)	Forest A. Harness	(R)
Overton Brooks	(D)	Samuel W. King	(R)

## Naval Affairs

Carl Vinson	(D)	William S. Jacobsen	(D)
Patrick Henry Drewry	(D)	Franck R. Havenner	(D)
Leonard W. Schuetz	(D)	Michael J. Bradley	(D)
William H. Sutphin	(D)	John K. Griffith	(D)
Joseph B. Shannon	(D)	Beverly M. Vincent	(D)
Warren G. Magnuson	(D)	Colgate W. Darden, Jr.	(D)
Lyndon B. Johnson	(D)	Pat Cannon	(D)



CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION

(Continued)

Military Affairs (Continued)

James H. Fay	(D)	William E. Hess	(R)
Melvin J. Maas	(R)	George P. Darrow	(R)
Ralph E. Church	(R)	Arthur B. Jenks	(R)
James W. Mott	(R)	Thomas M. Eaton	(R)
W. Sterling Cole	(R)	Walter S. Jefiries	(R)
George J. Bates	(R)	Samuel W. King	(R)

Post Office and Post Roads

Milton A. Romjue	(D)	Michael J. Kennedy	(D)
Thomas G. Burch	(D)	Lee E. Geyer	(D)
Martin L. Sweeney	(D)	Joseph W. Byrns, Jr.	(D)
William A. Ashbrook	(D)	Fred A. Hartley, Jr.	(R)
Arthur W. Mitchell	(D)	E. Harold Cluett	(R)
B. Frank Wheelchel	(D)	Noah M. Mason	(R)
Joe Hendricks	(D)	Charles F. Risk	(R)
Noble J. Gregory	(D)	William W. Blackney	(R)
Thomas A. Flaherty	(D)	Ben F. Jensen	(R)
Clyde L. Garrett	(D)	Albert E. Austin	(R)
J. Harold Flannery	(D)	James Seccombe	(R)
Carl T. Durham	(D)	George W. Gillie	(R)
		John McDowell	(R)

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 C. N. Woods, 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

(Continued)

## House of Representatives

## Appropriations

Edward T. Taylor	(D)	Ross A. Collins	(D)
Clarence Cannon	(D)	Charles H. Leavy	(D)
Clifton A. Woodrum	(D)	Joseph E. Casey	(D)
Louis Ludlow	(D)	John H. Kerr	(D)
Thomas S. McMillan	(D)	George H. Mahon	(D)
Malcolm C. Tarver	(D)	John Taber	(R)
Jed Johnson	(D)	Richard B. Wigglesworth	(R)
J. Buell Snyder	(D)	W. P. Lambertson	(R)
James McAndrews	(D)	D. Lane Powers	(R)
Emmet O'Neal	(D)	J. William Ditter	(R)
George W. Johnson	(D)	Albert E. Carter	(R)
James G. Scrugham	(D)	Robert F. Rich	(R)
James M. Fitzpatrick	(D)	Charles A. Plumley	(R)
Louis C. Rabaut	(D)	Everett M. Dirksen	(R)
Joachim O. Fernandez	(D)	Albert J. Engel	(R)
Millard F. Caldwell	(D)	Karl Stefan	(R)
David D. Terry	(D)	Francis H. Case	(R)
John M. Houston	(D)	Dudley A. White	(R)
J. Burrwood Daly	(D)	Clarence J. McLeod	(R)
Joe Starnes	(D)	Chester C. Bolton	(R)

## Interstate and Foreign Commerce

Clarence F. Lea	(D)	James P. McGranery	(D)
Robert Crosser	(D)	Donald L. O'Toole	(D)
Alfred L. Bulwinkle	(D)	Luther Patrick	(D)
Virgil Chapman	(D)	Carl E. Mapes	(R)
William P. Cole, Jr.	(D)	Charles A. Wolverton	(R)
Edward A. Kelly	(D)	James Wolfenden	(R)
John A. Martin	(D)	Pehr G. Holmes	(R)
Herron Pearson	(D)	B. Carroll Reece	(R)
Lyle H. Boren	(D)	James W. Wadsworth	(R)
Martin J. Kennedy	(D)	Charles A. Halleck	(R)
Elmer J. Ryan	(D)	Oscar Youngdahl	(R)
Charles L. South	(D)	Carl Hinshaw	(R)
		Clarence J. Brown	(R)

## Military Affairs

Andrew J. May	(D)	John J. Sparkman	(D)
R. Ewing Thomason	(D)	Paul J. Kilday	(D)
Dow W. Harter	(D)	Walter G. Andrews	(R)
Charles I. Faddis	(D)	Dewey Short	(R)
Clarence W. Turner	(D)	Leslie C. Arends	(R)
Andrew Edmiston	(D)	Charles R. Clason	(R)
Edwin M. Schaefer	(D)	Albert G. Rutherford	(R)
J. Joseph Smith	(D)	J. Parnell Thomas	(R)
Matthew J. Merritt	(D)	Paul W. Shafer	(R)
John M. Costello	(D)	Thomas E. Martin	(R)
C. Arthur Anderson	(D)	Charles H. Elston	(R)
Stephen Pace	(D)	Forest A. Harness	(R)
Overton Brooks	(D)	Samuel W. King	(R)

## Naval Affairs

Carl Vinson	(D)	William S. Jacobsen	(D)
Patrick Henry Drewry	(D)	Franck R. Havenner	(D)
Leonard W. Schuetz	(D)	Michael J. Bradley	(D)
William H. Sutphin	(D)	John K. Griffith	(D)
Joseph B. Shannon	(D)	Beverly M. Vincent	(D)
Warren G. Magnuson	(D)	Colgate W. Darden, Jr.	(D)
Lyndon B. Johnson	(D)	Pat Cannon	(D)

CONGRESSIONAL COMMITTEES INTERESTED IN AVIATION

(Continued)

Military Affairs (Continued)

James H. Fay	(D)	William E. Hess	(R)
Melvin J. Maas	(R)	George P. Darrow	(R)
Ralph E. Church	(R)	Arthur B. Jenks	(R)
James W. Mott	(R)	Thomas M. Eaton	(R)
W. Sterling Cole	(R)	Walter S. Jeffries	(R)
George J. Bates	(R)	Samuel W. King	(R)

Post Office and Post Roads

Milton A. Romjuc	(D)	Michael J. Kennedy	(D)
Thomas G. Burch	(D)	Lee E. Geyer	(D)
Martin L. Sweeney	(D)	Joseph W. Byrns, Jr.	(D)
William A. Ashbrook	(D)	Fred A. Hartley, Jr.	(R)
Arthur W. Mitchell	(D)	E. Harold Cluett	(R)
B. Frank Whelchel	(D)	Noah M. Mason	(R)
Joe Hendricks	(D)	Charles F. Risk	(R)
Noble J. Gregory	(D)	William W. Blackney	(R)
Thomas A. Flaherty	(D)	Ben F. Jensen	(R)
Clyde L. Garrett	(D)	Albert E. Austin	(R)
J. Harold Flannery	(D)	James Seccombe	(R)
Carl T. Durham	(D)	George W. Gillie	(R)
		John McDowell	(R)

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 C. N. Woods, 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

## DIPLOMATIC SERVICE TO THE UNITED STATES

The following foreign aeronautical representatives may be addressed at their respective embassies in Washington, D. C.

Argentina.....	Col. Pedro Zanni, Military and Air Attaché.
Belgium.....	Count Robert van der Straten-Ponthoz, Ambassador E. and P.
Bolivia.....	Lt. Col. Victor M. Acosta, Military Attaché.
Brazil.....	Lieutenant Commander Raul Reis, Naval Attaché.
Bulgaria.....	Mr. C. S. Baer, Consul.
Canada.....	Mr. Merchant M. Mahoney, First Secretary.
Chile.....	Squadron Leader Ismael Sarasua, Air Attaché.
China.....	Dr. Chang-Lok Chen, Counselor of Embassy.
Colombia.....	Senor Don Jose Camacho Lorenzana, Commercial Attaché.
Costa Rica.....	Senor Don Ricardo Castro-Beeche, Minister Resident.
Cuba.....	Major Felipe Munilla, Military Attaché.
Denmark.....	Mr. Otto Wadsted, E. E. and M. P.
Egypt.....	Mahmoud Hassan Bey, E. E. and M. P.
El Salvador.....	Senor Dr. Don Hector David Castro, E. E. and M. P.
Finland.....	Dr. Sigurd von Numers, Secretary of Legation.
France.....	Lt. Col. René P. G. Weiser, Air Attaché.
Germany.....	Lieutenant General Friedrich von Boetticher, Air and Military Attaché.
Great Britain.....	Group Captain G. C. Pirie, M. C., D. F. C., Air Attaché.
Greece.....	Mr. George S. Depasta, Counselor of Legation.
Guatemala.....	Senor Dr. Don Enrique Lopez-Herrarte, First Secretary.
Honduras.....	Senor Dr. Don Julian R. Caceres, First Secretary of Legation.
Hungary.....	Major Loránd de Utassy, Military Attaché.
Irish Free State.....	Mr. Garth Healy, Secretary of Legation.
Italy.....	Colonel Vincenzo Coppola, Air and Military Attaché.
Japan.....	Commander Taro Taguiti, Assistant Naval Attaché.
Lithuania.....	Secretary of Legation.
Mexico.....	Senor Dr. Don Francisco Castillo Nájera, Ambassador E. and P.
Netherlands.....	Mr. A. F. H. van Troostenburg de Bruyn, Secretary of Legation.
Norway.....	Oluf Tostrup, First Secretary of Legation.
Panama.....	Senor Don Julio E. Briceño, Secretary of Legation.
Peru.....	Col. Carlos Gilardi Vera, Air Attaché.
Poland.....	Lieutenant Colonel Andrzej Chramiec, Military and Air Attaché.
Portugal.....	Mr. João de Deus Ramos, Secretary of Legation.
Rumania.....	Mr. George Boncesco, Financial Counselor of Legation.
Siam.....	Phya Abbibal Rajamaitri, E. E. and M. P.
South Africa.....	Mr. Robert Webster, Secretary of Legation.
Spain.....	Senor Dr. Don Pedro Lecuona, M. P., Counselor of Embassy.
Sweden.....	Mr. Harry Eriksson, Commercial Counselor of Legation.
Switzerland.....	Mr. Eduard Feer, Counselor of Legation.
Turkey.....	Mr. Mehmet Münir Erteğün, Ambassador E. and P.
U.S.S.R.....	Col. Ivan Leontovich Okunev, Assistant Military Attaché.
Uruguay.....	Mr. J. Richling, E. E. and M. P.
Venezuela.....	Senor Don Arturo Lares, Secretary of Legation.
Yugoslavia.....	Mr. Rastko Petrović, Secretary of Legation.

## STATE AVIATION OFFICIALS

- ALABAMA: Alabama State Aviation Commission  
Theodore Swann, Chairman, 930 Brown-Marx Bldg., Birmingham
- ARIZONA: No aeronautical regulatory body.  
(Arizona Corporation Commission, Wilson T. Wright, Chairman,  
Phoenix, has jurisdiction over aircraft common carriers.)
- ARKANSAS: No aeronautical regulatory body.
- CALIFORNIA: No aeronautical regulatory body.
- COLORADO: State Aviation Commission,  
Verry C. Vasconcelles, Chairman, Denver
- CONNECTICUT: Department of Aeronautics  
Charles L. Morris, Commissioner of Aeronautics, P. O. Box 537,  
Hartford.
- DELAWARE: No aeronautical regulatory body.
- FLORIDA: No aeronautical regulatory body.  
(Promotion work is under the direction of the State Road Depart-  
ment.)
- GEORGIA: No aeronautical regulatory body.
- IDAHO: Department of Public Works  
Edward M. Bryan, Director of Aeronautics, Boise.
- ILLINOIS: Illinois Aeronautics Commission  
L. P. Bonfoey, Chairman, Quincy.  
(Illinois Commerce Commission, 205 S. Sixth St., Springfield, has  
jurisdiction over common carriage.)
- INDIANA: No aeronautical regulatory body.
- IOWA: Iowa Aeronautics Commission  
Lt. Col. Charles W. Gatschet, Chairman, Des Moines.
- KANSAS: No aeronautical regulatory body.
- KENTUCKY: No aeronautical bureau.
- LOUISIANA: Louisiana Aeronautics Commission,  
D. O. Langstaff, Chairman, New Orleans.
- MAINE: Office of Secretary of State  
Burtis F. Fowler, Chief Inspector in charge of aviation, State House,  
Augusta.
- MARYLAND: Maryland Aviation Commission  
Dr. Hugh H. Young, Chairman, Johns Hopkins Hospital, Baltimore.
- MASSACHUSETTS: Registrar of Motor Vehicles  
Frank A. Goodwin, Registrar, 100 Nashua St., Boston.
- MICHIGAN: Department of Aeronautics  
Col. Floyd E. Evans, Director, Lansing.
- MINNESOTA: Minnesota Aeronautics Commission  
Major Ray S. Miller, Chairman, Athletic Club, St. Paul.
- MISSISSIPPI: No aeronautical regulatory body.
- MISSOURI: No aeronautical regulatory body.

## STATE AVIATION OFFICIALS (Continued)

MONTANA:	Montana Aeronautics Commission Fred B. Sheriff, Commissioner, Helena.
NEBRASKA:	Nebraska Aeronautics Commission Clinton J. Campbell, Chairman, 1523 Sharp Bldg., Lincoln.
NEVADA:	No aeronautical regulatory body. (Nevada Public Service Commission, Harley A. Harmon, Chairman, Carson City, has jurisdiction over aircraft common carriers.)
NEW HAMPSHIRE:	New Hampshire Public Service Commission Nelson Lee Smith, Chairman, Concord.
NEW JERSEY:	New Jersey Department of Aviation Gill Robb Wilson, State Director of Aviation, Trenton.
NEW MEXICO:	State Corporation Commission Don R. Casados, Chairman, Santa Fe.
NEW YORK:	No regulatory body.
NORTH CAROLINA:	State Aviation Commission, E. G. Meyers, Chairman, Raleigh.
NORTH DAKOTA:	No aeronautical regulatory body. (Board of Railroad Commissioners, Ben C. Larkin, President, Bismarck, has limited regulatory powers.)
OHIO:	State Bureau of Aeronautics, Ernest C. Hall, Acting Director, Columbus.
OKLAHOMA:	Oklahoma State Highway Commission J. M. Gentry, Member-Secretary and State Aircraft Officer, State Capitol, Oklahoma City.
OREGON:	Oregon State Board of Aeronautics Dr. Raymond R. Staub, Chairman, 619 Lumbermens Bldg., Portland.
PENNSYLVANIA:	Department of Revenue, Division of Aeronautics Cammy Vinet, Chief of Aeronautics, Harrisburg
RHODE ISLAND:	Department of Public Works, Division of State Airports Willard M. Fletcher, Director State Airports, Box 223, Hillsgrove.
SOUTH CAROLINA:	South Carolina Aeronautics Commission J. O. Williamson, Chairman, Greenville.
SOUTH DAKOTA:	South Dakota Aeronautics Commission T. B. Roberts, Jr., Chairman.
TENNESSEE:	State Aeronautics Commission Walter Williams, Director of Aeronautics, Nashville.
TEXAS:	No aeronautical regulatory body.
UTAH:	Utah State Aeronautics Commission, W. D. Hammond, Chairman, Salt Lake City.
VERMONT:	Motor Vehicle Department Raymond B. Thompson, Inspector, Montpelier.

## STATE AVIATION OFFICIALS (Continued)

VIRGINIA:	State Corporation Commission R. E. Steele, Director of Aviation, Richmond.
WASHINGTON:	Washington State Patrol, Harry C. Huse, Chief, Olympia.
WEST VIRGINIA:	West Virginia Board of Aeronautics David H. Giltinan, Chairman, Charleston.
WISCONSIN:	No aeronautical regulatory body.
WYOMING:	Department of Aviation, J. Kirk Baldwin, Director, Cheyenne.

## AERONAUTICAL PERIODICALS OF THE UNITED STATES

AERO DIGEST	515 Madison Avenue, New York, N. Y.
AIR LAW REVIEW	Washington Square East, New York, N. Y.
AIR LINE PILOT	3145 W. 63rd Street, Chicago, Ill.
AIR TRAILS	79 Seventh Avenue, New York, N. Y.
AMERICAN AVIATION	Earle Building, Washington, D. C.
AVIATION	330 W. 42nd St., New York, N. Y.
JOURNAL OF AIR LAW	357 E. Chicago Avenue, Chicago, Ill.
JOURNAL OF THE AERONAUTICAL SCIENCES	30 Rockefeller Plaza, New York, N. Y.
MODEL AIRPLANE NEWS	551 Fifth Avenue, New York, N. Y.
NATIONAL AERONAUTIC MAGAZINE	Dupont Circle, Washington, D. C.
OFFICIAL AVIATION GUIDE OF THE AIRWAYS	608 S. Dearborn Street, Chicago, Ill.
PILOT	Grand Central Air Terminal, Glendale, Calif.
POPULAR AVIATION	608 S. Dearborn Street, Chicago, Ill.
SOARING	1500 Locust Street, Philadelphia, Pa.
SOUTHERN FLIGHT	Ledger Building, Fort Worth, Tex.
SPORTSMAN PILOT	515 Madison Avenue, New York, N. Y.
U. S. AIR SERVICES	Transportation Building, Washington, D. C.
WESTERN FLYING	420 South San Pedro Street, Los Angeles, Calif.

**FLYING AND GROUND SCHOOLS OPERATING ON CERTIFICATES OF  
COMPETENCY OR LETTERS OF AUTHORITY ISSUED BY  
THE CIVIL AERONAUTICS AUTHORITY**

- Alabama Institute of Aeronautics, Inc., Municipal Airport, Tuscaloosa, Ala. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Baltimore Flying Service, Inc., Curtiss-Wright Airport, Smith & Greenspring Aves., Baltimore, Md. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Barnes Air Service Company, Barnes Municipal Airport, Westfield, Mass. Flying and Ground, Solo, Private.
- Boeing School of Aeronautics, Oakland Municipal Airport, Oakland, Calif. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Brinkerhoff Flying Service, Inc., College Park Airport, College Park, Md. Flying and Ground, Solo, Private.
- Brooklyn Flying Service (Flying), Hangar #6, Floyd Bennett Field, Brooklyn, N. Y. In conjunction with: New York University (Ground), School of Education, 100 Washington Square East, New York, N. Y. Flying and Ground, Solo, Private.
- California Flyers, Inc., Los Angeles Municipal Airport, Inglewood, Calif. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Cape Cod School of Aeronautics, Inc., Hyannis Airport, Hyannis, Mass. Flying and Ground, Solo, Private.
- Dallas Aviation School & Air College, Love Field, Dallas, Texas. Flying and Ground, Solo, Commercial, Private, Lim. Com.
- Erickson & Remmert (Flying), Hangar #6, Floyd Bennett Field, Brooklyn, N. Y. In conjunction with: New York University (Ground), School of Education, 100 Washington Square East, New York, N. Y. Flying and Ground, Solo, Private.
- Grand Central Flying School (Flying), 1435 Flower St., Glendale, Calif. In conjunction with: Curtiss-Wright Technical Institute of Aero. (Ground), 1224 Airway, Glendale, Calif. Flying and Ground, Solo, Private, Lim. Com., Commercial.
- Inter City Airlines, Inc. (Flying), Boston Municipal Airport, East Boston, Mass. In conjunction with: New England Aircraft School (Ground), Boston Municipal Airport, E. Boston, Mass. Flying and Ground, Solo, Private, Lim. Com., Commercial.
- Inter City Airlines, Inc., Falmouth Base, Falmouth Airport, Hatchville, Cape Cod, Mass. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Lincoln Airplane & Flying School, 2415 "O" Street, Municipal Airport, Lincoln, Nebr. In conjunction with: Additional ground school at: Union Airport, Lincoln, Nebr. Flying and Ground, Solo, Private, Lim. Com., Commercial.
- Mountain States Aviation, Inc., 38 and Dahlia Streets, Denver, Colo. Flying and Ground, Solo, Private.
- North Suburban Flying Corp. (Flying), Curtiss Airport, Glenview, Ill. In conjunction with: Chicago Aviation Corp. (Ground), Curtiss Airport, Glenview, Ill. Flying and Ground, Solo, Private, Lim. Com., Commercial.
- Oklahoma Military Academy, Will Rogers Airport, Claremore, Okla. Flying and Ground, Solo, Private.
- Parks Air College, Inc., Parks Airport, East St. Louis, Ill. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Pittsburgh Institute of Aeronautics, Bettis Airport, Dravosburg, Pa. Flying and Ground, Solo, Private.
- Portland Flying Service, Inc., Municipal Airport, Portland, Maine. Flying and Ground, Solo, Private.



- Robertson Aircraft Corp., Lambert-St. Louis Municipal Airport, Robertson, Mo. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Roosevelt Field, Inc., Aviation School Division, Roosevelt Field, No. 1, Mineola, L. I., N. Y. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Ryan School of Aeronautics, Ltd., Lindbergh Field, San Diego, Calif. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Safair, Inc., Hangar B, Roosevelt Field, Garden City, L. I., N. Y. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Santa Maria School of Flying, Inc., Santa Maria Airport, Santa Maria, Calif. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Southern Air Service, Inc., Municipal Airport, Memphis, Tenn. Flying and Ground, Solo, Private.
- Spartan School of Aeronautics, Box 2649, Tulsa, Okla. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Standard Flying School (Flying), Hangar #3, Floyd Bennett Field, Brooklyn, N. Y. In conjunction with: New York University (Ground), School of Education, 100 Washington Square East, New York, N. Y. Flying and Ground, Solo, Private.
- Western Air College, 620 East Valley Blvd., Alhambra, Calif. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- E. W. Wiggins Airways, Inc. (Flying), Boston Municipal Airport, East Boston, Mass. In conjunction with: New England Aircraft School (Ground), Boston Municipal Airport, E. Boston, Mass. Flying and Ground, Solo, Private, Lim. Com., Commercial.
- E. W. Wiggins Airways, Inc., Rhode Island State Airport, Providence, R. I. Flying and Ground, Solo, Lim. Com., Private, Commercial.
- Ray Wilson Flying School, Park Hill Airport, Denver, Colo. Flying and Ground, Solo, Lim. Com., Private, Commercial.

**AIRPLANE AND ENGINE MECHANICS' SCHOOLS GRANTED  
LETTERS OF RECOGNITION BY THE U. S. CIVIL  
AERONAUTICS AUTHORITY**

- Aero Industries Technical Institute, 5245 W. San Fernando Road, Los Angeles, Calif.
- Aeronautical University, The, Inc., 1330 South Michigan Ave., Chicago, Ill.
- Boeing School of Aeronautics, Oakland Municipal Airport, Oakland, Calif.
- California Flyers, Inc., School of Aviation, Los Angeles Municipal Airport, Inglewood, Calif.
- California State Polytechnic School, San Luis Obispo, Calif.
- Curtiss-Wright Tech. Institute of Aeronautics, Grand Central Air Terminal, Glendale, Calif.
- Casey Jones School of Aeronautics, Inc., 534 Broad Street, Newark, N. J.
- Dallas Aviation School and Air College, Love Field, Dallas, Texas.
- Lincoln Airplane & Flying School, 2415 "O" Street, (Ground), Municipal Airport, (Flying), Lincoln, Nebr.

- Luscombe School of Aeronautics, Bear Tavern Road, West Trenton, N. J.  
 New England Aircraft School, 126 Newbury Street, Boston, Mass.  
 Parks Air College, Inc., Parks Airport, East St. Louis, Ill.  
 Pittsburgh Institute of Aeronautics, Bettis Airport, Dravosburg, Pa.  
 Rising Sun Aircraft School, Inc., 191 W. Roosevelt Blvd., Philadelphia, Pa.  
 Roosevelt Field, Inc., Aviation School Division, Roosevelt Field No. 1, Mineola, L. I., N. Y.  
 Ryan School of Aeronautics, Ltd., Lindbergh Field, San Diego, Calif.  
 Sansom's Aviation School, Capt., 157 Charter Oak Ave., Hartford, Conn.  
 Spartan School of Aeronautics, Apache Blvd. & Chamberlain Dr., Tulsa, Okla.  
 State Trade School, 28 Providence Street, Putnam, Conn.  
 Stewart Technical Trade School, The, 253-5-7 West 64th Street, New York, N. Y.  
 Stinson School of Aviation, 27-01 Bridge Plaza North, Long Island City, N. Y.

## THE NATIONAL DEFENSE ACT OF 1939

[PUBLIC—No. 18—76TH CONGRESS]

[CHAPTER 35—1ST SESSION]

[H. R. 3791]

AN ACT

To provide more effectively for the national defense by carrying out the recommendations of the President in his message of January 12, 1939, to the Congress.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That the Act approved June 24, 1936 (49 Stat. 1907), is hereby repealed. Section 8 of the Act of July 2, 1926 (44 Stat. 780), is hereby stricken out and the following is substituted in lieu thereof:

"SEC. 8. The Secretary of War is hereby authorized to equip and maintain the Air Corps with not to exceed six thousand serviceable airplanes, and such number of airships and free and captive balloons as he may determine to be necessary for training purposes together with spare parts, equipment, supplies, hangars, and installation necessary for the operation and maintenance thereof:

and there is hereby authorized to be appropriated for such purposes an amount not exceeding \$300,000,000, together with such annual appropriations as may be necessary to maintain such air force. In order to maintain the number specified above, the Secretary of War is hereby authorized to replace obsolete or unserviceable aircraft from time to time: *Provided*, That the total number of airplanes and airships herein authorized shall be exclusive of those awaiting salvage or undergoing experiment or service tests, those authorized by the Secretary of War to be placed in museums, and those classified by the Secretary of War as obsolete: *And provided further*, That the total number of airplanes authorized in this section shall include the number necessary for the training and equipment of the National Guard and the training of the Organized Reserves as may be determined by the Secretary of War."

SEC. 2. When the facilities of the Army for instruction and training in aviation are deemed by the Secretary of War to be insufficient he may, under such regulations as he may prescribe, and without reference to any limitation contained in section 127a of the National Defense Act, as amended (10 U. S. C. 535), detail personnel of the Regular Army as students at any technical, professional, or other educational institution, or as students, observers, or investigators at such industrial plants or other places as shall be best suited to enable such personnel to acquire a knowledge of or experience in the specialties incident to aviation in which the training of such personnel is essential: *Provided*, That no expense shall be incurred by the United States in addition to the authorized emoluments of the personnel so detailed except for the cost of tuition at such educational institutions, and the cost of maintenance of necessary personnel who may be detailed as supervisors or inspectors and of the equipment assigned to them for their official use: *Provided further*, That the tuition for the personnel during the period of their detail may be paid from any funds which may hereafter be made available for the procurement branches.

SEC. 3. The Secretary of War, in his discretion and under such rules and regulations as he may prescribe, is authorized to enroll as students at the Air Corps Training Center, for the pursuit of such courses of instruction as may be prescribed therefor, such civilians, upon their own applications, as may be selected from the instructional staffs of those civilian flying schools which have been accredited by the War Department for the education, experience, and training of personnel of the Military Establishment: *Provided*, That except for the furnishing of such supplies, matériel, or equipment as may be necessary for training purposes, the training of such students shall be without cost to the United States: *Provided further*, That in case of injury to or sickness of such students, hospital or medical treatment may be given in Government hospitals, but shall be without expense to the United States other than for services of Medical Department personnel and the use of hospital equipment, not including medicines or supplies: *And provided further*, That the United States shall be under no obligation in respect to payment of a pension, compensation, or other gratuity to the dependents of any such student who dies of disease or injury while undergoing such training, nor to any such student in the event of personal injury sustained by him.

SEC. 4. The Secretary of War is hereby authorized, in his discretion and under rules, regulations, and limitations to be prescribed by him, to lend to accredited civilian aviation schools, one or more of which shall be designated by the Civil Aeronautics Authority for the training of any Negro air pilot, at which personnel of the Military Establishment are pursuing a course of education and training pursuant to detail thereto under competent orders of the War Department, out of aircraft, aircraft parts, aeronautical equipment and

accessories for the Air Corps, on hand and belonging to the Government, such articles as may appear to be required for instruction, training, and maintenance purposes.

SEC. 5. Section 1 of the Act entitled "An Act to amend the National Defense Act", approved August 30, 1935 (49 Stat. 1028), is hereby amended to read as follows:

"That the President is hereby authorized to order annually, with their consent, upon application to and selection by the War Department, for a period of not more than one year for any one officer, for active duty with the Regular Army, such numbers of Reserve officers, in the grade of second lieutenant, as are necessary to maintain on active duty at all times not more than one thousand Reserve officers of the promotion-list branches other than the Air Corps, not more than three thousand Reserve officers of the Air Corps, and not more than three hundred Reserve officers of the non-promotion-list branches: *Provided*, That in the non-promotion-list branches and the Judge Advocate General's Department, such Reserve officers may be in any grade not above captain: *Provided further*, That until July 1, 1949, the tour of active duty of Air Corps Reserve officers may, in the discretion of the Secretary of War, be extended not to exceed a total of seven years' active service in all, and thereafter not to exceed a total of five years' active service in all: *Provided further*, That in the non-promotion-list branches and the Judge Advocate General's Department, the tour of active duty may, in the discretion of the Secretary of War, be extended not to exceed a total of two years' active service in all: *And provided further*, That nothing herein contained shall require the termination of active duty of any Reserve officer because of promotion to a higher grade after his tour of active duty begins. The tour of any Reserve Corps officer on active duty may be terminated at any time, in the discretion of the Secretary of War": *Provided further*, That all officers, warrant officers, and enlisted men of the Army of the United States, other than the officers and enlisted men of the Regular Army, if called or ordered into the active military service by the Federal Government for extended military service in excess of thirty days, and who suffer disability or death in line of duty from disease or injury while so employed shall be deemed to have been in the active military service during such period and shall be in all respects entitled to receive the same pensions, compensation, retirement pay, and hospital benefits as are now or may hereafter be provided by law or regulation for officers and enlisted men of corresponding grades and length of service of the Regular Army.

SEC. 6. Section 2 of the said Act is hereby amended to read as follows:

"That, for the period of ten years beginning July 1, 1939, the Secretary of War is authorized to select annually, to be commissioned in the Regular Army in approximately equal annual increments, in accordance with the provisions of, and from the groups described in, section 24e of the National Defense Act, as amended, such proportion of the total number of officers as, in the judgment of the Secretary of War, will be required to bring the commissioned personnel of the Regular Army to peacetime strength, as hereinafter provided, on June 30, 1949."

SEC. 7. Section 24e of the National Defense Act, as amended (41 Stat. 774), is hereby amended to read as follows:

"Except as otherwise herein provided, all appointments in the Regular Army shall be made in the grade of second lieutenant from the following groups: Group 1, from graduates of the United States Military Academy; group 2, from warrant officers and enlisted men of the Regular Army who have had at least two years' service; group 3, from honor graduates of the senior division

of the Reserve Officers' Training Corps; group 4, from members of the Officers' Reserve Corps and flying cadets, who have performed active duty under the provisions of this Act, which duty may include service as a flying cadet in the Air Corps Training Center; and group 5, from reserve officers and from officers, warrant officers, and enlisted men of the National Guard, members of the Enlisted Reserve Corps, and graduates of technical institutions approved by the Secretary of War: *Provided*, That, after all qualified members of group 1 have been appointed, appointments from the second, third, fourth, and fifth groups shall be made in accordance with such regulations as the Secretary of War may prescribe, from persons between the ages of twenty-one and thirty years: *Provided further*, That the number to be selected from each of the second, third, fourth, and fifth groups, and the number to be assigned to each branch of the service within the limits prescribed by law from all groups shall be determined by the Secretary of War in his discretion: *Provided further*, That until June 30, 1949, the total number of officers to be appointed annually from group 4, not including flying cadets, in the promotion list branches other than the Air Corps shall be not less than 10 per centum of the total number of Reserve officers of such branches other than the Air Corps authorized to be called annually under appropriation Acts, and in no event less than fifty, and that any officers added to the Army under existing authorizations shall be within the total authorized commissioned strength of sixteen thousand seven hundred and nineteen: *And provided further*, That immediately upon the effective date of this Act, the President is authorized to commission not to exceed three hundred second lieutenants in the Air Corps of the Regular Army, from among Reserve officers and flying cadets who have qualified for such appointment under existing laws. Any vacancy in the grade of captain in the Judge Advocate General's Department, not filled by transfer or detail from another branch, may, in the discretion of the President, be filled by appointment from Reserve judge advocates between the ages of thirty and thirty-six years, and such appointee shall be placed upon the promotion list immediately below the junior captain on said list. Appointments in the Medical, Dental, and Veterinary Corps in the grade of first lieutenant shall be made from Reserve Medical, Dental, and Veterinary officers, respectively, between the ages of twenty-three and thirty-two years. Appointments in the Medical Administrative Corps shall be made in the grade of second lieutenant from pharmacists between the ages of twenty-one and thirty-two years who are graduates of recognized schools or colleges of pharmacy requiring four years of instruction for graduation, under such regulations and after such examination as the Secretary of War shall prescribe. To be eligible for appointment in the Dental Corps, a candidate must be a graduate of a recognized dental college, and have been engaged in the practice of his profession for at least two years subsequent to graduation. Appointments as chaplain shall be made from persons duly accredited by some religious denomination or organization, and of good standing therein, between the ages of twenty-three and forty-five years."

SEC. 8. On and after July 1, 1939, the peacetime commissioned strength of the Regular Army to be attained by approximately equal annual increments, as hereinbefore provided, shall be sixteen thousand seven hundred and nineteen officers, including sixty-seven general officers of the line as now authorized by law. Commissioned officers, other than general officers, shall be assigned to the several branches as follows: Infantry, four thousand one hundred and eighty-four; Cavalry, one thousand and thirty-four; Field Artillery, one thousand seven hundred and twenty-six; Coast Artillery Corps, one thousand three hundred and forty-one; Air Corps, three thousand two hundred and three exclu-

sive of officers detailed from other arms and services for training and duty as aircraft observers and other members of combat crews; Corps of Engineers, seven hundred and ninety-five; Signal Corps, three hundred and forty-one; Adjutant General's Department, one hundred and thirty-one; Judge Advocate General's Department, one hundred and twenty-one; Quartermaster Corps, one thousand and sixteen; Finance Department, one hundred and seventy-six; Ordnance Department, four hundred and seventeen; Chemical Warfare Service, one hundred and twenty-four; Medical Corps, one thousand four hundred and twenty-four; Dental Corps, three hundred and sixteen; Veterinary Corps, one hundred and twenty-six; Medical Administrative Corps, sixteen; and Corps of Chaplains, one hundred and fifty-two: *Provided*, That the President may increase or diminish the number of officers assigned to any branch by not more than a total of 30 per centum: *Provided further*, That nothing herein contained shall affect the number of professors, United States Military Academy, as now authorized by law, or require the separation from the service of any officer now commissioned in the Medical Administrative Corps. Subject to the authorized increase or decrease of 30 per centum hereinabove provided, the number of officers detailed in the Inspector General's Department shall be fifty-five.

SEC. 9. The Act approved June 11, 1938 (ch. 337, Seventy-fifth Congress, third session), is hereby amended by striking out the words "twenty-one thousand five hundred" in the last line thereof and inserting in lieu thereof the words "forty-five thousand".

SEC. 10. Nothing contained in this Act shall be construed to affect the operation of the Act of August 30, 1935 (49 Stat. 1028), with respect to the selection and commissioning, in accordance with the provisions of section 2 of that Act, of Reserve officers now on active duty under the provisions of that Act. Upon the effective date of this Act, Air Corps Reserve officers who are then on active duty under the provisions of section 1 of the Act of June 16, 1936 (49 Stat. 1524), shall be deemed to be on active duty under the provisions of this Act: *Provided*, That on and after the effective date of this Act no Air Corps Reserve officers shall be called to active duty under the provision of section 1 of the said Act of June 16, 1936. Except as otherwise herein provided, nothing contained in this Act shall be construed to affect the number of Reserve officers that may be called to active duty under existing laws, nor the conditions and the purposes for which they may be called.

SEC. 11. Section 2 of the Act of June 16, 1936 (49 Stat. 1524), is hereby amended to read as follows:

"Any Air Corps Reserve officer who has not been selected for commission in the Regular Army shall be paid upon release from active duty following the termination of any period of active duty of three years or more in duration a lump sum of \$500 which sum shall be in addition to any pay and allowances which he may otherwise be entitled to receive."

SEC. 12. There is hereby authorized to be appropriated not to exceed \$23,750,000 to be expended for the construction, rehabilitation, and installation in the Panama Canal Department of such buildings, utilities, and appurtenances thereto as may be necessary to house antiaircraft, seacoast defense, and auxiliary units most urgently needed for defense of the Panama Canal.

SEC. 13. That section 4 of the Act approved June 16, 1938, entitled "An Act to provide for placing educational orders to familiarize private manufacturing establishments with the production of munitions of war of special or technical design, noncommercial in character", be amended to read as follows:

"SEC. 4. That funds appropriated to accomplish the purposes of this Act shall be available for expenditures incidental to the accomplishment of the pro-

curements made thereunder, including production studies, factory plans, and other production data and the storage and maintenance of gages, dies, jigs, tools, fixtures, and other special aids and appliances procured thereunder. To carry out the provisions of this Act there is authorized to be appropriated the sum of \$34,500,000, which amount shall be available during the fiscal years 1939, 1940, and 1941, and there is further authorized to be appropriated the sum of \$2,000,000 during each of the four fiscal years succeeding the fiscal year 1941."

SEC. 14. All the provisions of section 3 of the Act of March 27, 1934, as amended (48 Stat. 505; 49 Stat. 1926), and as amended by this section shall be applicable with respect to contracts for aircraft or any portion thereof for the Army to the same extent and in the same manner that such provisions are applicable with respect to contracts for aircraft, or any portion thereof for the Navy: *Provided*, That the Secretary of War shall exercise all functions under such section with respect to aircraft for the Army which are exercised by the Secretary of the Navy with respect to aircraft for the Navy: *Provided further*, That section 3b of the Act of March 27, 1934 (48 Stat. 505), as amended (49 Stat. 1926; 34 U. S. C. Supp. IV 496), is hereby further amended by inserting in the first sentence after the words "in excess of 10 per centum of the total contract prices" the words "for the construction and or manufacture of any complete naval vessel or portion thereof, and in excess of 12 per centum of the total contract prices for the construction and or manufacture of any complete aircraft or portion thereof"; by inserting in the first proviso after the words "That if there is a net loss on all such contracts or subcontracts" the words "for the construction and or manufacture of any complete naval vessel or portion thereof"; and by inserting at the end of the first proviso after the words "income taxable year" a comma and the words "and that if there is a net loss, or a net profit less than 12 per centum, as aforesaid on all such contracts or subcontracts for the construction and or manufacture of any complete aircraft or portion thereof completed by the particular contractor or subcontractor within any income taxable year, such net loss or deficiency in profit shall be allowed as a credit in determining the excess profit, if any, during the next succeeding four income taxable years, and that the method of ascertaining the amount of excess profit, initially fixed upon shall be determined on or before June 30, 1939": *Provided further*, That when aircraft are procured by the Secretary of War as a result of competitive bids requiring the submission of sample aircraft with bid, the Secretary is authorized, in his discretion, to purchase sample aircraft of competitors to whom an award is not made, not more than one each from not more than three such competitors, in order of merit, at prices not exceeding 75, 60, and 50 per centum, respectively, of the cost applicable in the opinion of the Secretary to the development and manufacture of such sample aircraft.

Approved, April 3, 1939.

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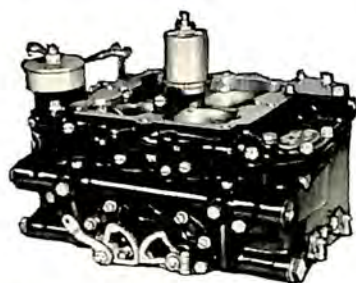
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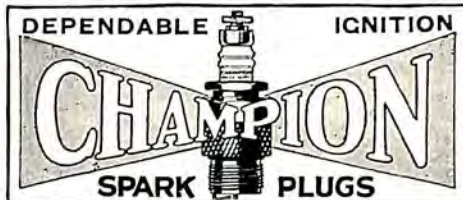
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