HOW AMERICA IS USING HER *Fighter*

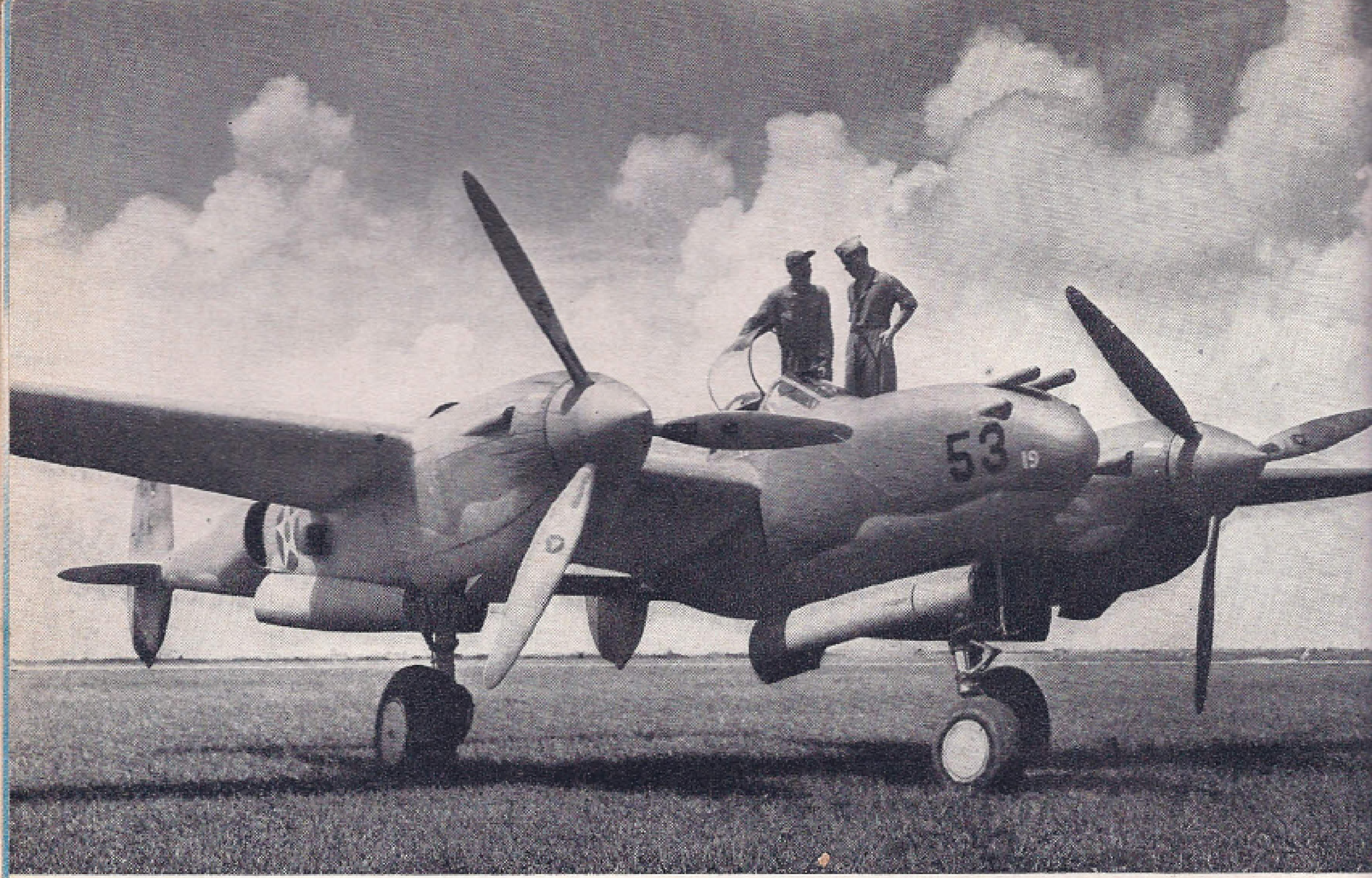
LOCKHEED P-38 "LIGHTNING" is one of our Army's twin-engine fighters designed for escort service and special missions. Armed with a 37-mm. cannon and four machine guns, it carries a crew of one or two men. For work at very high altitudes, it has turbo-superchargers

Ships

By CARL DREHER

HERE is a U. S. Army fighter plane—the Lockheed P-38—which, viewed from a certain angle, looks like three airplanes instead of one, until you see that it consists of a fuselage mounted between two slim engine nacelles and two sets of tail surfaces. Here is another—the Republic P-47B—packing about the same weight and wallop as the P-38, but utterly different in size and contour, with a single engine so large that it dwarfs the rest of the plane. And still others, some of more or less "conventional" design like the Curtiss P-40's, with the pilot sitting amidships behind the engine, or the engine in back of the pilot as in the Bell P-39C, or with pusher propellers like the Bell YFM. They differ in what can be seen and more in what cannot be seen—in armor, fuel tanks, superchargers, and auxiliary equipment—and yet every one of them is a U. S. Army fighter and nothing else.

Why should planes in the same general category, flown by the same service, show



With its tricycle landing gear and odd arrangement of central fuselage and twin engine nacelles, the P-38 presents a striking contrast to most other American fighter planes. The Army has one other twin-engine fighter, the Bell YFM-1A Airacuda. Weights of two-engine fighters are 11,000-14,000 pounds

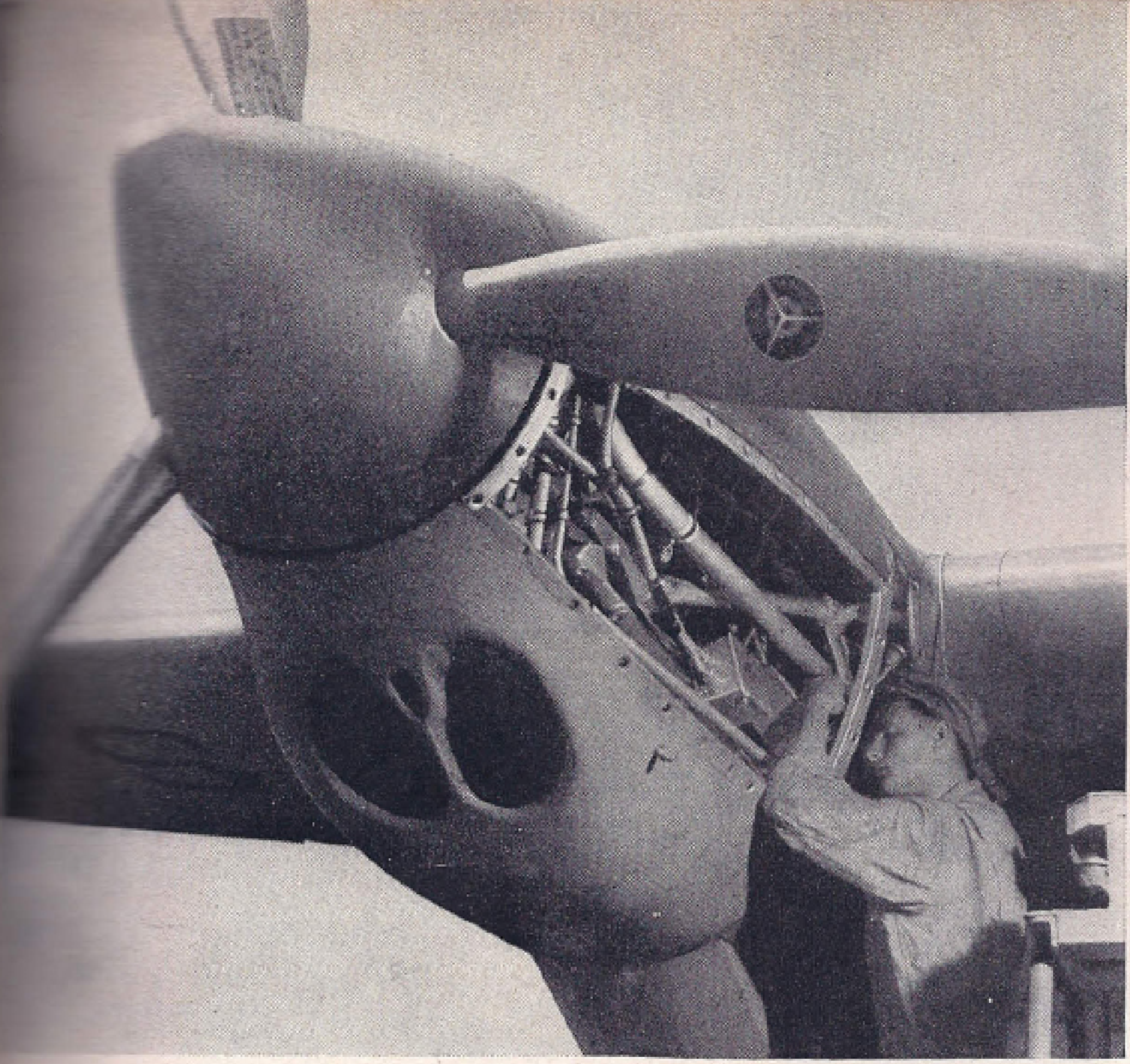
such variations in design? One reason is that development is proceeding at a very rapid pace, and a lot of good ideas are competing for supremacy. But a more compelling reason is the complexity of the problems which call for solution. After all, to say that a plane is designed to fight is pretty vague. When—by day or by night? Where—at 30,000 feet altitude or 3,000? Whom—is it to attack enemy bombers or protect friendly bombers? When such questions are asked it becomes evident that the fighter plane must be designed for one or two fairly specialized jobs.

When we survey existing models of fighters on this basis, a more or less logical pattern of design and development begins to emerge. There are three principal types of fighters on the basis of range. The interceptor is designed for operations close to its base. The pursuit plane for night fighting and extended day operations requires a considerably longer range, while heavy fighters for escort duty with bombers cover still greater distances.

First, the interceptor. The name indicates what its job is—to get off the ground on the shortest possible notice, climb with the greatest possible speed, and scare off or shoot down bombers, if possible before they can reach their objective. It is essentially a flying machine-gun nest—a small, highly maneuverable plane with a big engine. The engine must be big to get the plane up there fast and to give it the advantage over the bomber in speed—which, nowadays, calls for 400 m.p.h. and up.

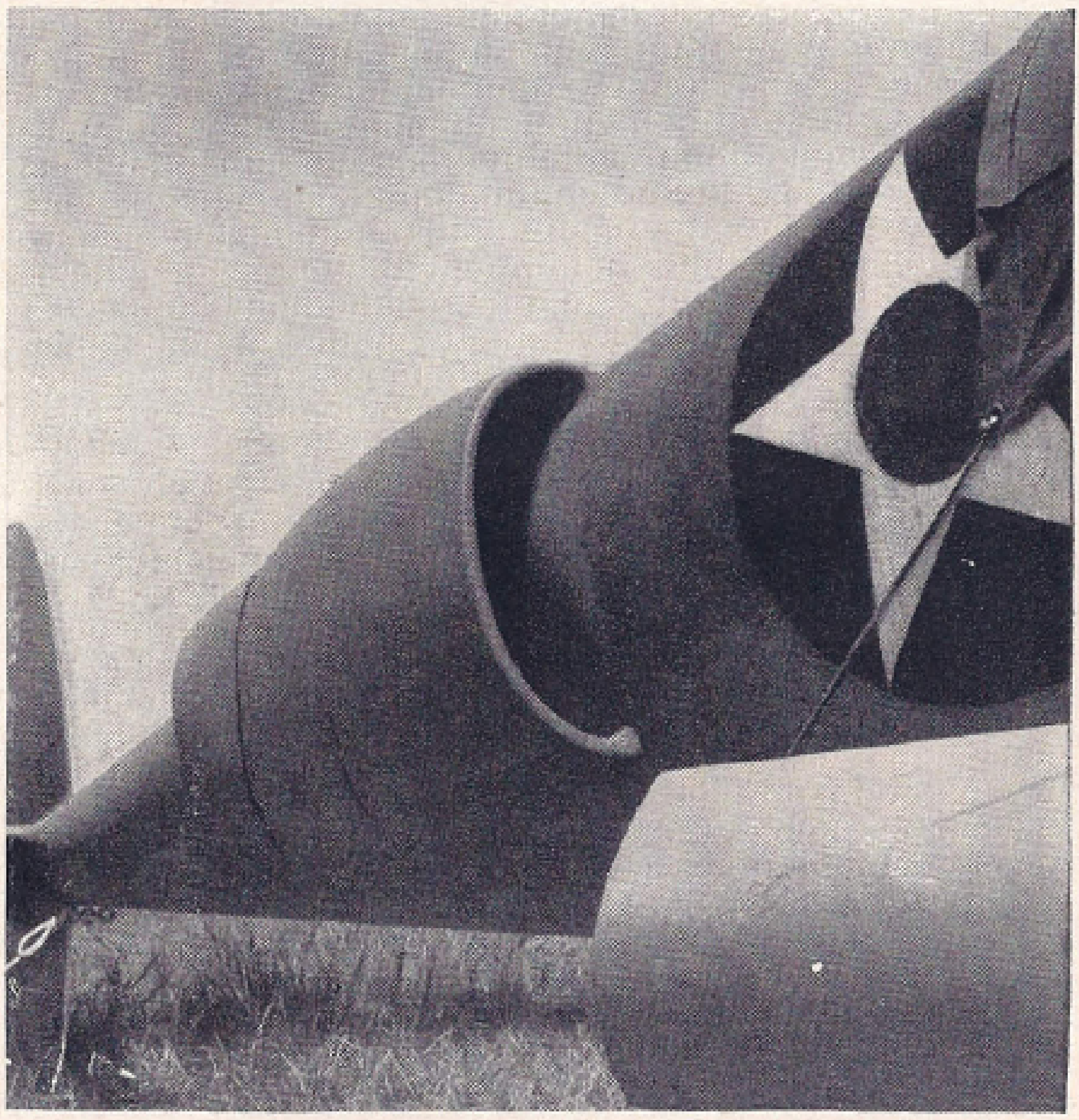
The interceptor is an inherently limited type of plane, capable of carrying only a few guns, no great amount of ammunition, only enough gas for a few hundred miles of flight, and one man to do all the work of piloting and shooting. For the interceptor pilot the motto is, If at first you don't succeed, give up and fly home. He just hasn't the ammunition or the fuel to do anything else. And there is no point in sending him up unless the general locality where he will meet the bomber is pretty definitely known. For all these reasons the interceptor is essentially a daylight weapon.

But because the interceptor can do deadly work when the conditions are right, bombers fly mainly at night. The night pursuit plane does not need the high maneuverability and top speed of the day interceptor. It is not going to engage in a dogfight. On the other hand, it needs much more gas capacity, for ordinarily it will take some time to find the bomber. For this purpose the night fighter is equipped with some form of long-range detection device. Even after the bomber is located and sighted, considerable stalking time must remain in the gasoline tanks. When the opportunity for the kill finally presents itself, the pursuit plane must close in and do the job quickly.



To counteract the heat from the liquid-cooled Allison engine, a big scoop on each tail boom drags in a hurricane of air. When the P-38 is used for observation, a camera is installed in one of the tail booms

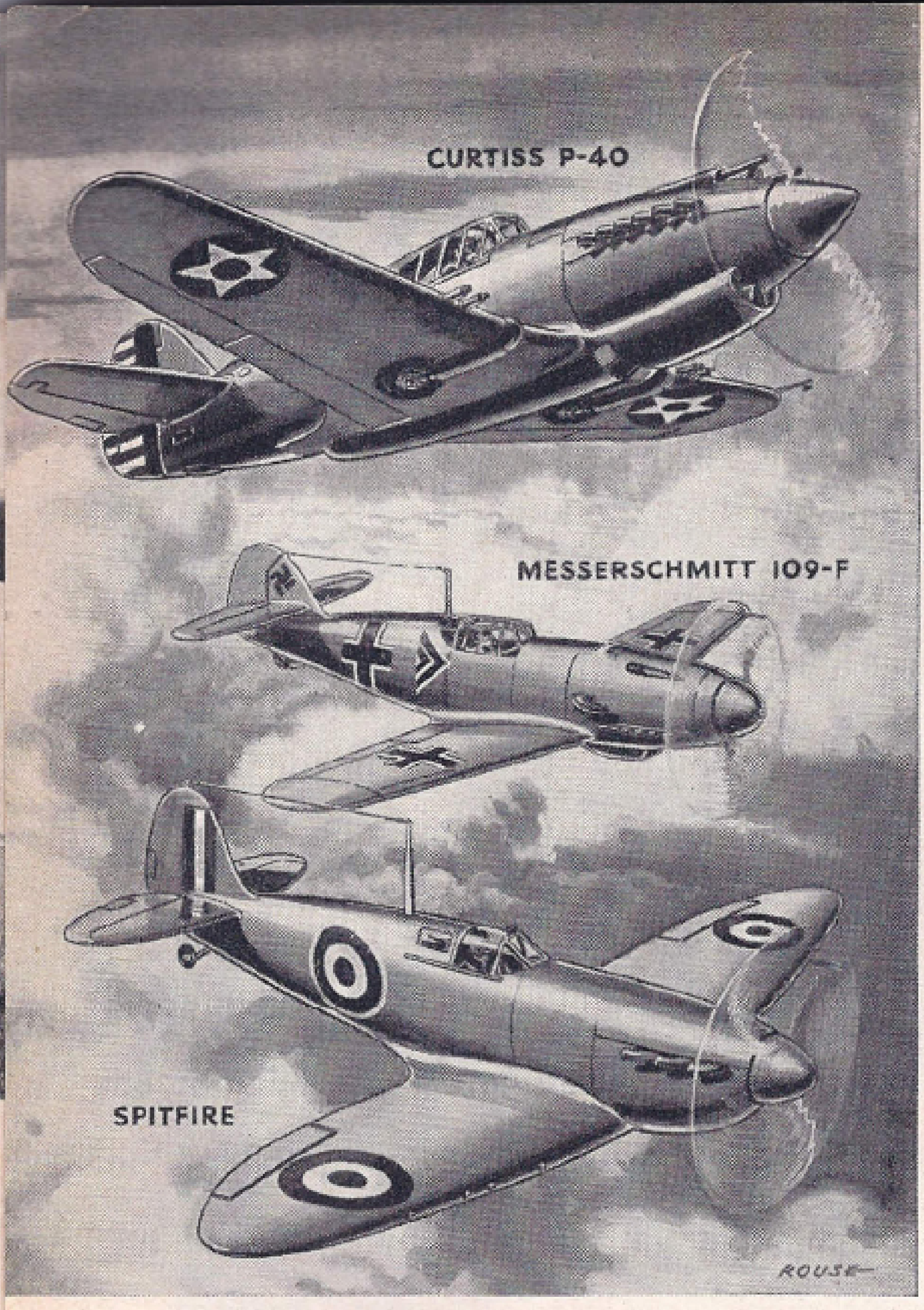
One of the engine housings of a P-38. The holes underneath it are openings for an air scoop that cools the oil



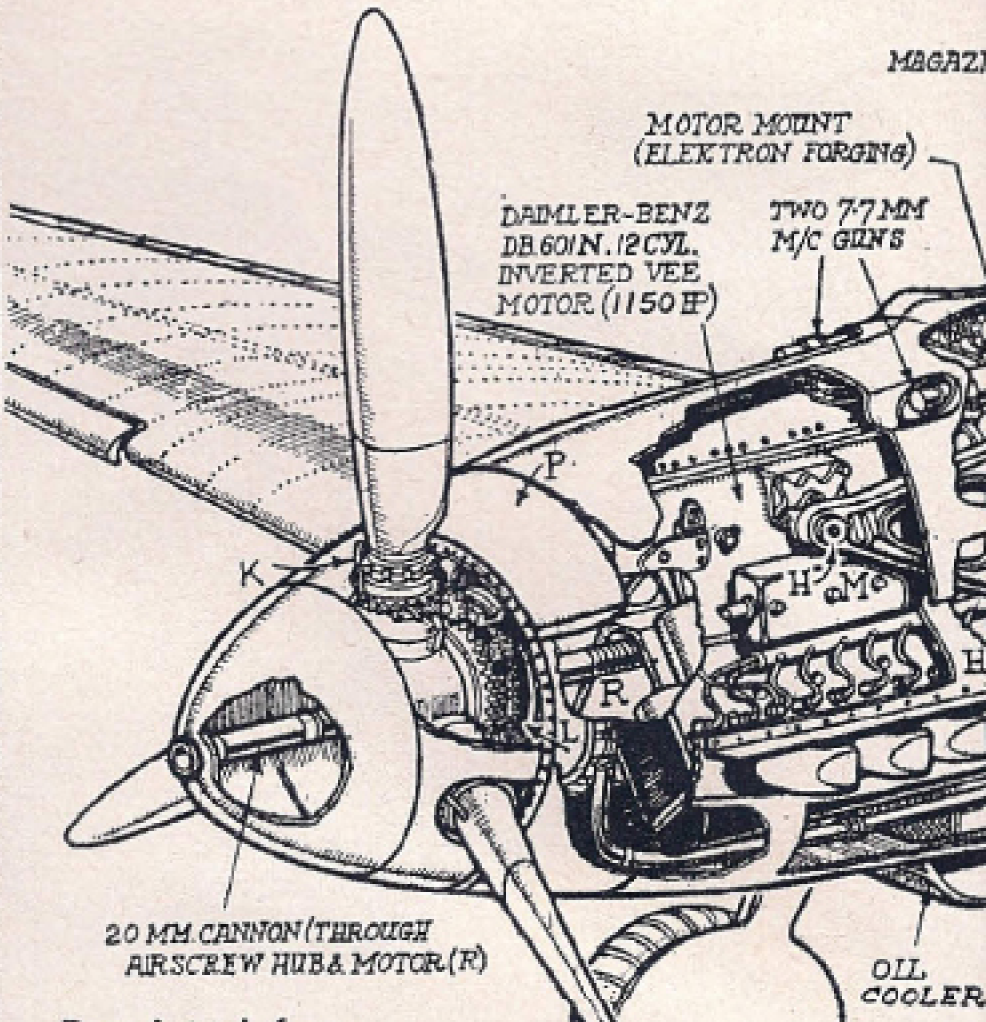
Day interceptors are almost always single-engine planes. For a given amount of power a single-engine plane is more maneuverable than a two-engine plane. Night fighters may have one engine or two. The multi-engine fighter may also be advantageously used in extended day pursuit operations. It carries considerable armament in the form of 20-mm. cannon or larger, and machine guns of .30 and .50 caliber. The crew normally consists of two men. Such planes are suitable for patrol work and long-range hunting, and also for escorting friendly bombers.

The design of fighter planes is conditioned as much by bomber performance as by the characteristics of other fighters. It is the bomber which works destruction on land and sea, and the ultimate function of the fighter is to down bombers. The fighter tackles an enemy fighter to put him out of the way so that he or someone else can get a whack at a hostile bomber or some similar flying objective.

The way in which bomber design affects fighter design is well illustrated by the application of superchargers, first to bombers, then to pursuit planes. A gasoline engine normally loses power as it gets into the rarefied atmosphere of the higher altitudes, where the cylinders gulp in less air for each piston stroke. This loss can be counteracted by increasing the size of the cylinders —to which there is a limit—or by supercharging. The original Boeing Flying Fortress had a top speed of 250 m.p.h. at 13,000



GERMANY'S MESSERSCHMITT ME-109. At left matched with comparable Allied planes, our P-40 and the British Spitfire



Reprinted from "The Aeroplane"

Span.......33 ft. 0 in.	Length.......29 ft. 8 in.
Wing Area (net) 164 sq. ft.	Track.......7 ft. 0 in.
Weight Empty.......4,740 lbs.	Weight Loaded..6,000 lbs.

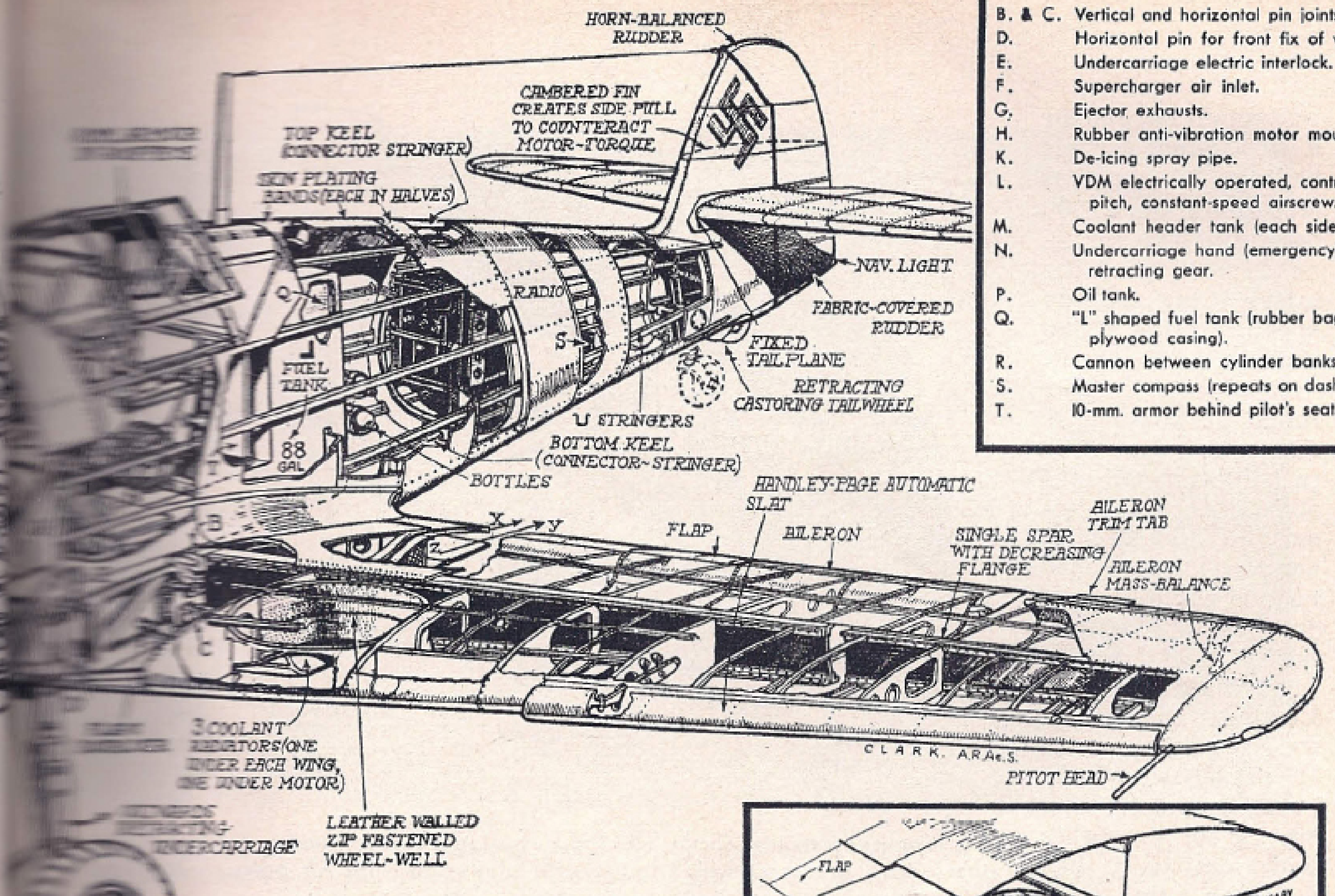
feet with its four motors wide open. With the same motors supercharged, it is good for more than 300 m.p.h. at 20,000 feet, and it can cruise comfortably at 245 m.p.h. at 30,000 feet. The same thing must be done for fighters intended to operate at high altitudes, but it is harder because of limited space and weight allowances.

With the above considerations in mind we can discern the general design pattern of our current Army fighter models. Almost all the types to be described have proved their merits in actual combat. Naturally some are better than others. A few will fall by the wayside, others will undergo further development. Later models will be quite different from their prototypes, and a lot better.

Typical of the one-engine, one-seat fighters designed for sea-level operation—which means between sea level and an altitude of about 20,000 feet—are planes like the Bell P-39 Airacobra and the Curtiss Hawk line. The P-39C is powered by a 12-cylinder, 1,150-h.p., liquid-cooled Allison motor which drives a three-bladed tractor propeller through a 10-foot extension shaft. Landing gear is of the tricycle type. The armament consists of a 20-mm. cannon in the propeller hub, as well as light and heavy-caliber machine guns. The weight of the plane, loaded, is 7,380 pounds, this includes sufficient ammunition for fairly sustained fire. The range at the most economical cruising speed is 1,100 miles, which is very good. A plane with these characteristics is more than a match for the equivalent Messerschmitt, the Me-109F, and approximately equal to the British Spitfire. But only up to about 16,000 feet.

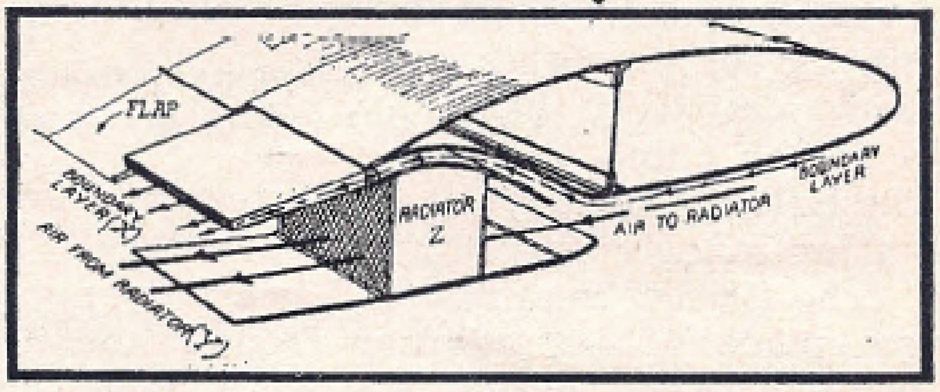
The later Curtiss Hawks are designed for somewhat higher ceilings. The current model stems from the original P-36, through the P-37 and the more highly streamlined P-40D and E. The earlier P-40's compared favorably with the older Spitfires and Hurricanes; the latest type is believed to equal or excel any of the European fighters. Increases in speed and high-altitude performance have been achieved in spite of greatly increased armament, ammunition loads, and armor plate.

U. S. Army fighters specifically designed for high-altitude operations —between say 16,000 feet and the present effective ceiling of about 35,000 feet—include the Republic P-43F Lancer and the same company's P-47B Thunderbolt. The P-43F is powered with a Pratt & Whitney Twin Wasp 1,200-h.p. air-cooled engine. The loaded weight is slightly less than that of the Airacobra—6,900 pounds. Armament consists of large



B. & C. Vertical and horizontal pin joints for spar.
D. Horizontal pin for front fix of wing.
E. Undercarriage electric interlock.
F. Supercharger air inlet.
G. Ejector exhausts.
H. Rubber anti-vibration motor mount.
K. De-icing spray pipe.
L. VDM electrically operated, controllable-pitch, constant-speed airscrew.
M. Coolant header tank (each side).
N. Undercarriage hand (emergency) retracting gear.
P. Oil tank.
Q. "L" shaped fuel tank (rubber bag in plywood casing).
R. Cannon between cylinder banks.
S. Master compass (repeats on dashboard).
T. 10-mm. armor behind pilot's seat.

Top Speed.......380 m. p. h. at 21,000 ft.
Range.......370 miles at 307 m. p. h.
Service Ceiling.......Approx. 40,000 ft.



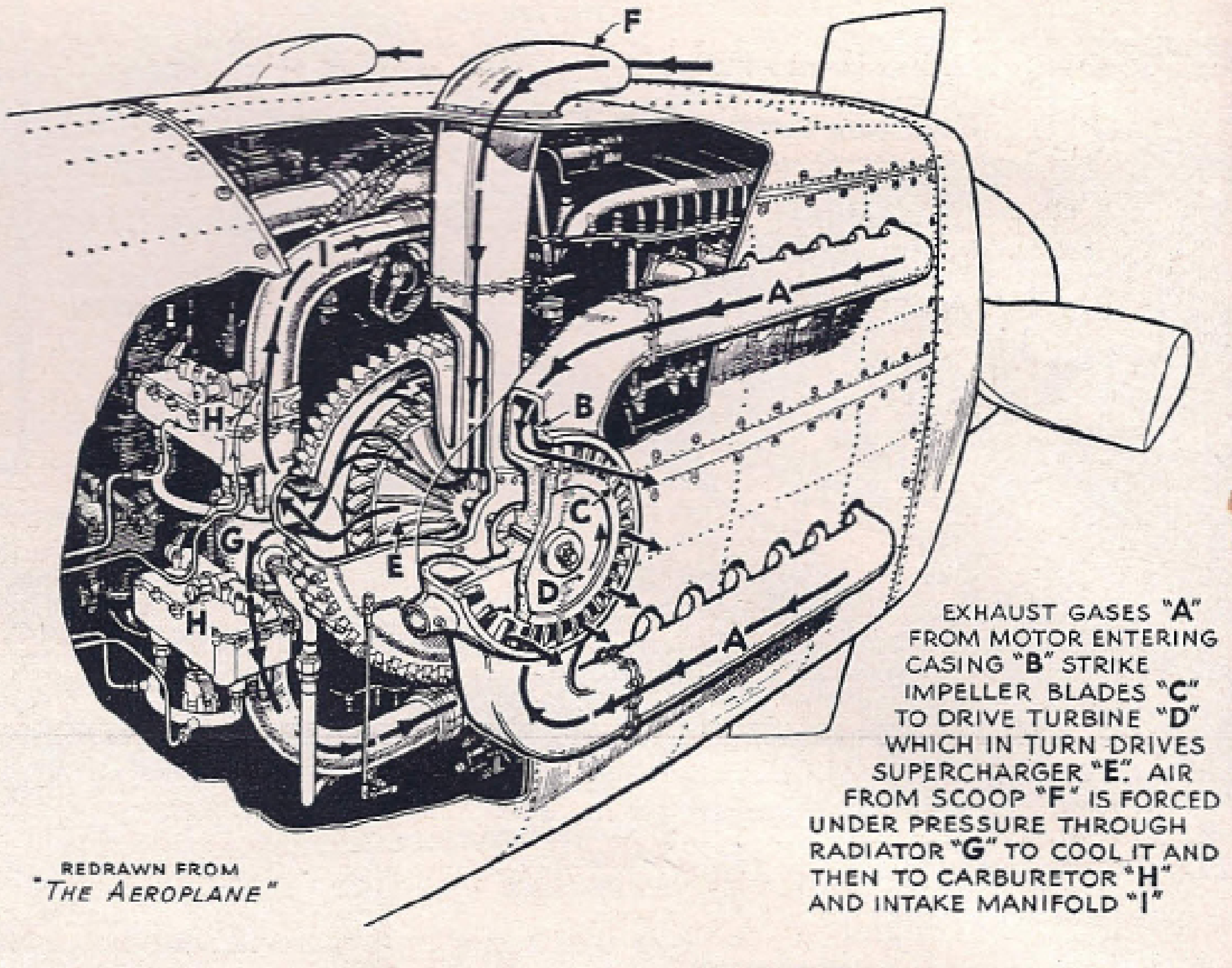
and small-caliber machine guns. The companion Republic pursuit plane, the P-47B, is at present the most powerful of American single-engine, single-seater fighters. The motor is a 14-cylinder, 2,000-h.p. Pratt & Whitney radial, driving a four-blade propeller. High-altitude performance is obtained by means of a turbo-supercharger. This plane is said to have reached a speed of 680 m.p.h. in a power dive.

The U. S. Army has two twin-engine fighters for escort service and special missions. One is the Lockheed P-38 Lightning and the other the Bell YFM-1A Airacuda. Both are armed with cannon and machine guns. The P-38 is the faster of the two, while the YFM has much the greater range—some estimates run as high as 3,000 miles. The P-38 carries a crew of one or two, the YFM a crew of five. For high-altitude service these heavy fighters are equipped with turbo-superchargers. Weights of two-engine fighters run around 11,000-14,000 pounds, as compared with 6,000-8,000 pounds for single-engine fighters.

The U. S. Navy uses air-cooled engines for its carrier-based fighters. Such planes must be equipped with arresting hooks which engage horizontal cables on the carrier deck to bring the plane to a quick stop in landing. This calls for stronger and heavier undercarriages. The wings of some of the later types fold so that more planes may be accommodated in a given deck space. Gasoline capacity is at least 50 percent higher than in land-based planes of the same type. In spite of these handicaps, naval fighters are nearly as fast as the equivalent Army aircraft and the service ceilings are about the same.

Principal naval fighters are the Brewster Buffalo (F2A) and Grumman Wildcat (F4F). The latest model of the latter, the F4F-3, is a single-place monoplane powered with a 1,200-h.p. Pratt & Whitney air-cooled twin-row engine. Its cruising range is about 1,000 miles. Most efficient operation is at 20,000 feet. Normal armament consists of four .50 caliber machine guns. For light dive-bombing operations two 11-pound bombs may be carried. This plane is said to have been dived at over 500 m.p.h., but another Navy fighter, the Vought-Sikorsky Corsair, F4U-1, is even faster. The Navy also has an experimental two-engine fighter, the Grumman Skyrocket (XF5F-1).

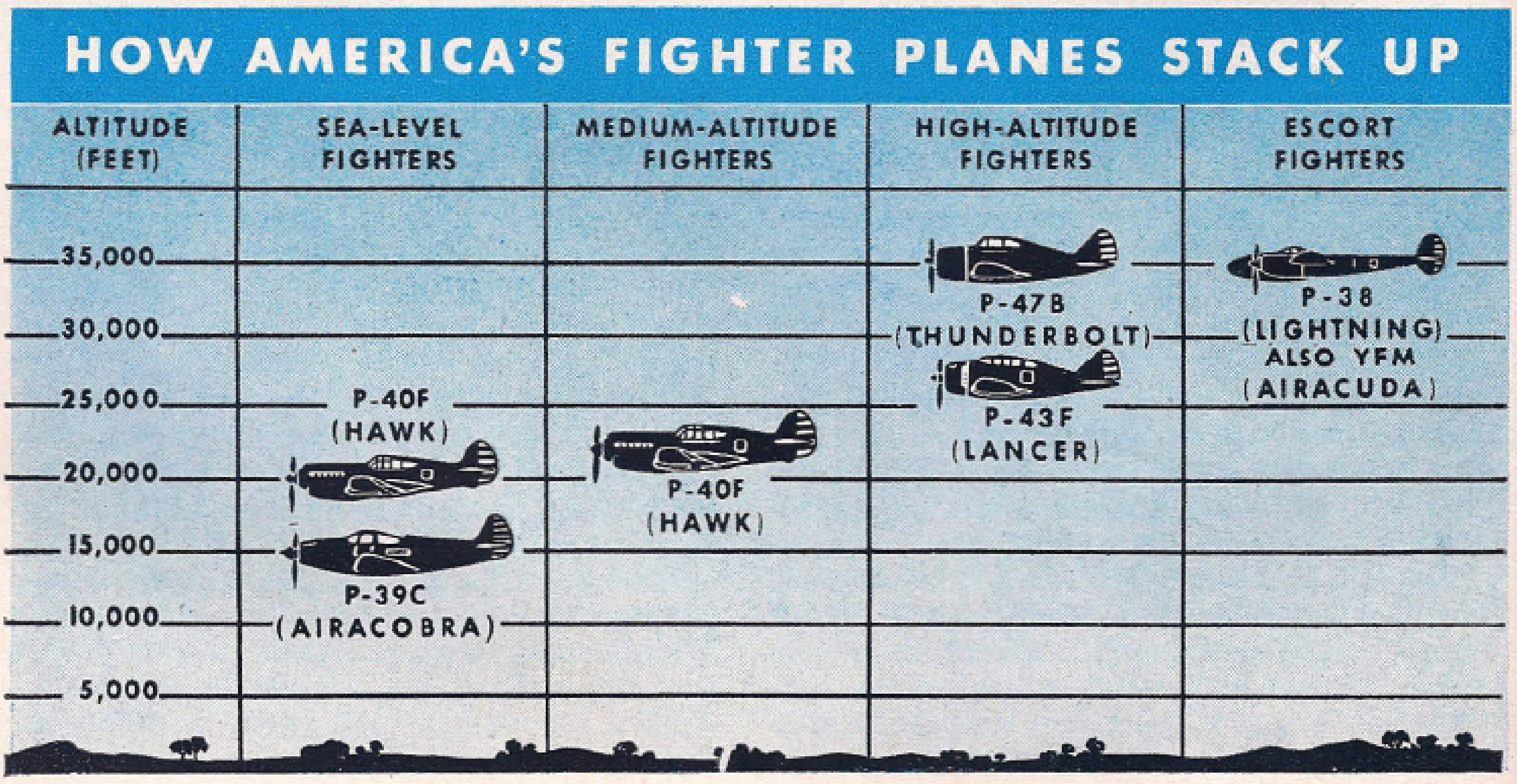
It is interesting to compare these American fighter planes with European models. The German Messerschmitt Me-109F is in the same class as our latest P-39's and P-40's. It is powered with a 1,150 h.p. Daimler-Benz DB-601N motor, liquid-cooled and supercharged for a 40,000-foot service ceiling. The speed is 362 m.p.h. at 13,000 feet, and 380 m.p.h. at 21,000 feet, the latter being the top speed. Range is 370 miles at 307 m.p.h. (1.2 hours), and 600 miles at 262 m.p.h. (2.3 hours). The principal novelty of this fighter is a Mauser 15 or 20-mm. cannon firing 900 rounds per minute—just below the normal rate of fire of a modern machine gun. Loaded, the plane weighs 6,000 pounds. It is said to have been especially designed for dogfights and admittedly has a faster climb than the British Spitfire, but the latter has shown better maneuverability in encounters.

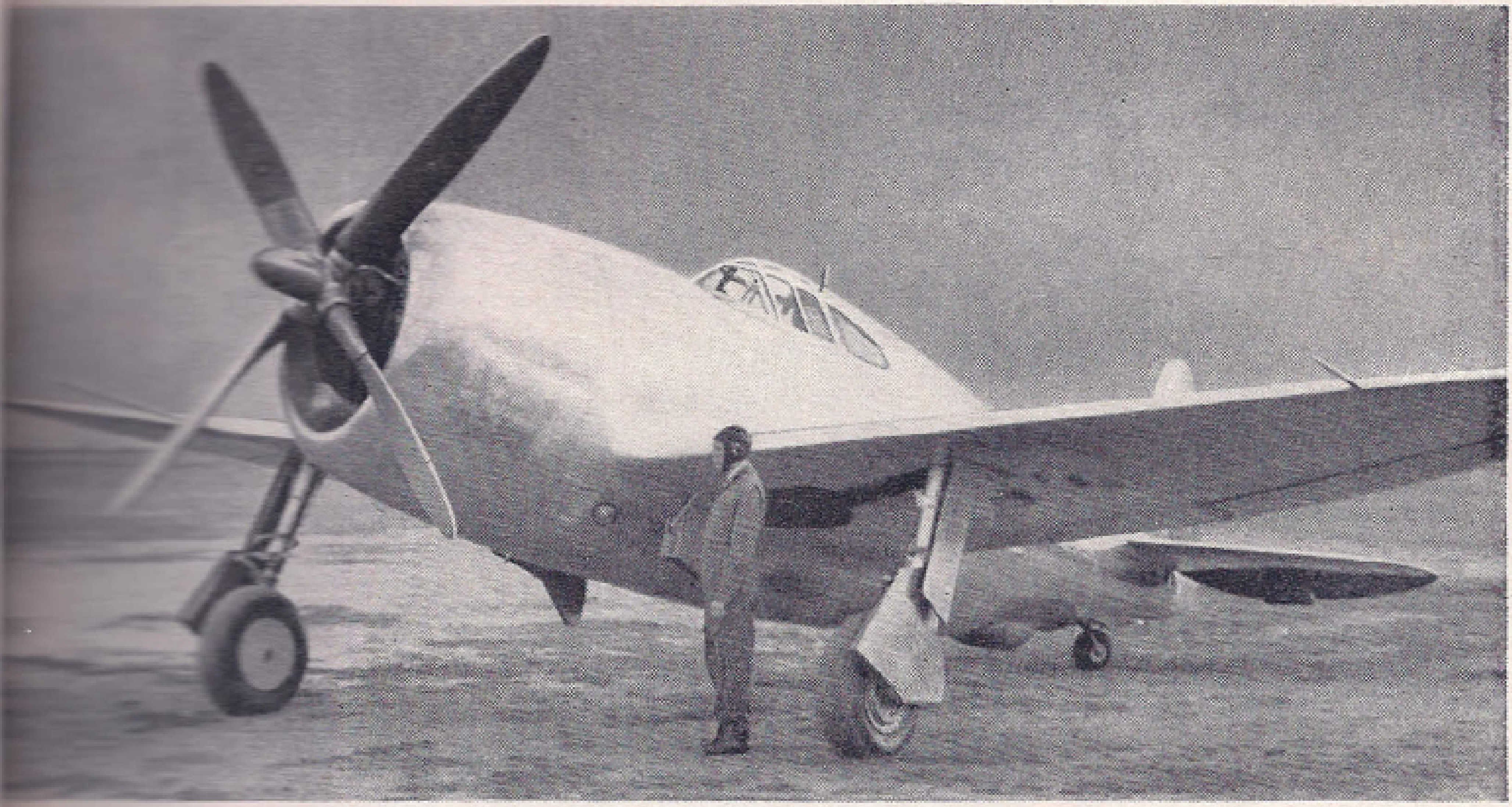


This idealized drawing shows how the turbo-supercharger works. Engine exhaust gases drive a turbine which operates a blower to raise air pressure at intake

The British Beaufighter I is a two-engine, two-place fighter adapted from a medium bomber. Each engine is rated at 1,400 h.p. The armament is very heavy—four fixed cannon in the fuselage and six fixed machine guns in the wings. The maximum speed is fair—330 m.p.h., and the service ceiling is 29,000 feet. The opposing German fighter, the twin-engine Me-110, has a higher top speed—365 m.p.h. Another German twin-engine fighter, the Focke-Wulf FW187, with about the same maximum speed (at 20,000 feet) is said to have a service ceiling of 39,000 feet. Equivalent American two-engine fighters like the Lockheed P-38 are believed to be superior in speed, climb, and hitting power.

The designer of a modern fighter plane strives for maximum speed, power and altitude performance, maneuverability, fire power, and armor protection. Speed, to prevent the enemy fighter or bomber from escaping by diving or straight flight. Power, to prevent the enemy from escaping by zooming, and maneuverability so that he cannot elude his pursuer by a sudden change





Said to be the world's fastest single-engine craft, the Republic P-47B has a 2,000-horsepower Pratt & Whitney radial 14-cylinder power plant that dwarfs the rest of the plane. One man flies and fights it

in direction. Fire power is vital so that the enemy may be put out of commission in the few seconds of close engagement. Since the enemy has exactly the same purpose, the best possible armor protection must be provided.

Almost all the basic factors—speed, power, altitude performance, weight, etc. are tending to rise. Speeds are or will soon be between 400 and 450 m.p.h. at altitudes between 20,000 and 35,000 feet. This means that the airplane must be as small as possible to reduce drag. Weights, nevertheless, are increasing because of ordnance, armor-protection, and engine requirements.

Supercharging is essential for efficient operation at high altitudes. Two general types of superchargers are at present available—centrifugal blowers or compressors gear-driven by the engine, and turbo-superchargers which utilize the exhaust gases to drive a turbine wheel which in turn drives the compressor. The geared superchargers are simpler, but they work well only at the middle altitudes.

The propeller presents a similar problem. A propeller which may be satisfactory at sea level and under take-off conditions will have entirely unsatisfactory propulsive efficiency at high altitudes and high speeds. A propeller suitable for a medium-powered engine will not work with a larger engine. The propeller tip speed can be increased only to a given point, and of course the diameter is limited by structural considerations. Consequently the tendency is toward a greater number of blades.

Modern propellers for high-altitude flight must be equipped with pitch control. Between take-off and terminal-velocity dive the pitch range may have to be as high as 40 degrees. The pilot cannot attend to it; he has too many other things to do. Automatic pitch-control devices are mandatory.

Protection and fire power seesaw in the air as in battleship design. Bigger guns call for thicker armor, thicker armor calls for bigger guns, but guns and ammunition add weight and cut down speed. Again the solution is by compromise—the continued installation of both .30 and .50 caliber machine guns on fighters is one example. At first .30 guns were adequate. Heavier armoring brought .50 guns and cannon.

Small cannon are valuable when the pursuit plane tackles a bomber. Aerial engagements with machine guns must be fought at close quarters, usually not exceeding 300 meters. On the other hand, a pursuit plane armed with a cannon can damage a bomber and sometimes bring it down, without coming within the effective fire area of the bomber's machine guns.

Radical developments in future fighter designs are possible, even probable. Perhaps the most rapid progress may be expected in night fighting and in what may be called engineering the pilot for combat at high altitudes. In wartime these and other matters are best left to the imagination. The enemy will find out about them in due course, but he will have to get the information in the air, and, we may hope, at a high cost.