RESTRICTED

AAF MANUAL 51-127-5

PILOT TRAINING MANUAL

FOR THE MUSTANG

P-51

CHECK TITLE PAGE
FOR THE DATE
OF THIS MANUAL

HEADQUARTERS

ARMY AIR FORCES

RESTRICTED

PILOT TRAINING MANUAL FOR THE P-51 MUSTANG

This revised edition supersedes the original (gray cover) Pilot Training Manual for the Mustang

All copies of the latter are rescinded

Hq. Army Air Forces
Washington 25, D.C. 15 Aug 45

The use and authentication of this manual are governed by the provisions of AAF Regulation 50-17.

BY COMMAND OF GENERAL ARNOLD

Ira C. Eaker
Lieutenant General, United States Army
Deputy Commander, Army Air Forces

ADDITIONAL COPIES of this manual should be requested from: Headquarters AAF, Office of Flying Safety, Safety Education Division, Winston-Salem 1, North Carolina

INITIAL DISTRIBUTION revised edition: Headquarters AAF, 3rd Air Force, AAF Training Command


U.S.

INTRODUCTION

THIS MANUAL is the text for your training as a P-51 pilot.

The Air Forces' most experienced training and supervisory personnel have collaborated to make it a complete exposition of what your pilot duties are, how each duty will be performed, and why it must be performed in the manner prescribed.

The techniques and procedures described in this book are standard and mandatory. In this respect the manual serves the dual purpose of a training checklist and a working handbook. Use it to make sure that you learn everything described herein. Use it to study and review the essential facts concerning everything taught. Such additional self-study and review will not only advance your training, but will alleviate the burden of your already overburdened instructors.

This training manual does not replace the Technical Orders for the airplane, which will always be your primary source of information concerning the P-51 so long as you fly it. This is essentially the textbook of the P-51. Used properly, it will enable you to utilize the pertinent Technical Orders to even greater advantage.

H. H. Arnold

COMMANDING GENERAL, ARMY AIR FORCES

HISTORY OF THE P-51

Like the Indian braves of the old southwest whose favorite in battle was the small speedy Mustang, young fighter pilots today, with their newly won wings, almost without exception want to fly the famous namesake of that sleek and powerful war horse.

And no wonder.

For the P-51 is truly a pilot's airplane. In mission after mission it has proved that it can more than hold its own against any opposition. Its speed and range are tops. It operates effectively on the deck and all the way up to 40,000 feet. In maneuverability and load-carrying capacity, it ranks with any other fighter in the world.

The P-51 was the first airplane of this war to be built entirely on the basis of combat experience. Its design was started after Hitler's Luftwaffe had begun to overwhelm Europe—after a good many lessons had been learned about modern aerial warfare from actual experience.

Mustangs were built originally for the British. Flown by RAF pilots, they saw their initial action in the summer of 1942. They were used by the British primarily for reconnaissance and rhubarb missions—for zooming in at low altitudes and strafing trains, troops, and enemy installations.

P-51s were the first American-built fighters to carry the war back across the English channel after Dunkirk. And a short time later they set another record by being the first single-engine planes of any country to penetrate Germany proper from bases in England.

So successful were the powerful little Mustangs that the United States AAF decided to adopt this American-built plane for its own.

Two improved models were built—a P-51A and an attack version known as the A-36. This attack model was equipped with bomb racks and diving brakes and was given six 50-cal. guns instead of the four 20-mm. cannon of the pursuit models. Thus, as the A-36, the Mustang became a triple-threat performer—fighter, strafer, and dive bomber. As such, it helped write aerial history in the momentous days when the Allies took Sicily and Italy.

When the need for higher altitude, longer range fighters developed so urgently, it was decided to see what the Mustang could do in these departments. So the Allison engine, with a single-speed blower, was replaced by the more

powerful Rolls-Royce Merlin engine with a 2-speed blower. Along with other improvements, the prop was increased from three to four blades.

Thus was developed the P-51B and C (B if built on the west coast, C if built in Texas—they are essentially the same otherwise).

The new model proved an unquestioned success. The Nazis learned to fear it at any altitude —as high as they wanted to go. As for range, the new Mustang made it possible for the first time for fighters to escort heavy bombers all the way from Britain to Berlin.

Later, Mustangs escorted bombers all the way to Poland. And when the great triangular shuttle raids connecting England, Russia, and Italy began, P-51's were the first fighters to operate all around the continent-girdling circuit. One of the legs of this triangle was some 1600 miles long!

Last on the list, the Japanese have learned to fear the fiery breath of the Mustang. First flown by the 14th Air Force in China, P-51s have since been used with great success as long-range bomber escorts, in fighter-bomber tactics, on fighter sweeps, and for other types of tactical missions. Important victories are being rung up whenever and wherever the Japs are encountered.

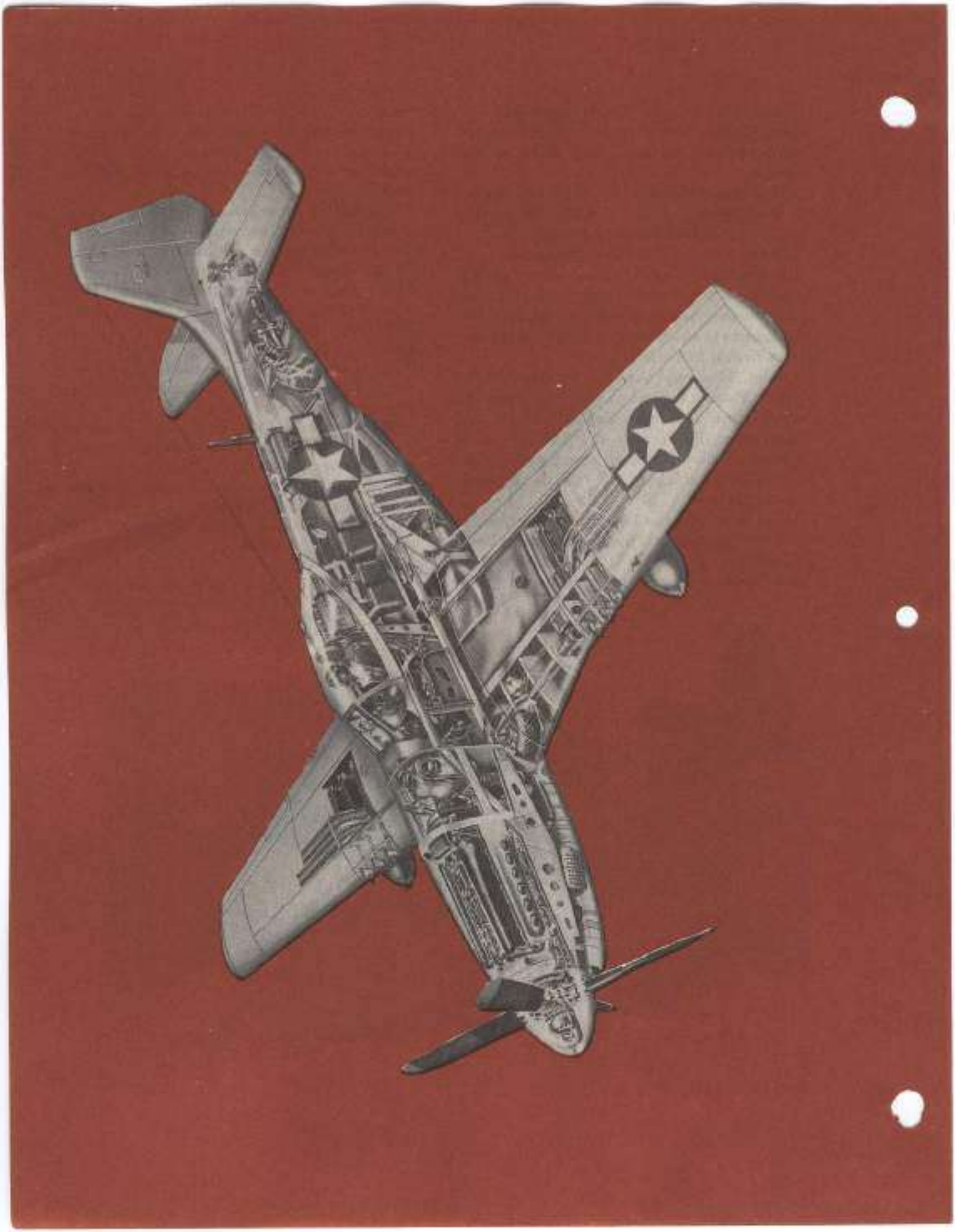
The P-51D you are going to fly is a truly great airplane. Quoting an outstanding authority, who recently made a comparative analysis of all the world's aircraft: "In the single-seat fighter class, the Mustang reigns supreme." He was speaking of the B-series Mustang. The P-51D retains all the good features of its predecessor, with important added improvements. Chief among these are increased visibility for the pilot, more convenient cockpit arrangement, and heavier firepower.

Mastering the P-51, however, takes plenty of hard work. For being a first-rate fighter pilot means being not only a pilot, but a whole crew —pilot, navigator, gunner, bombardier, and radio operator—all rolled into one.

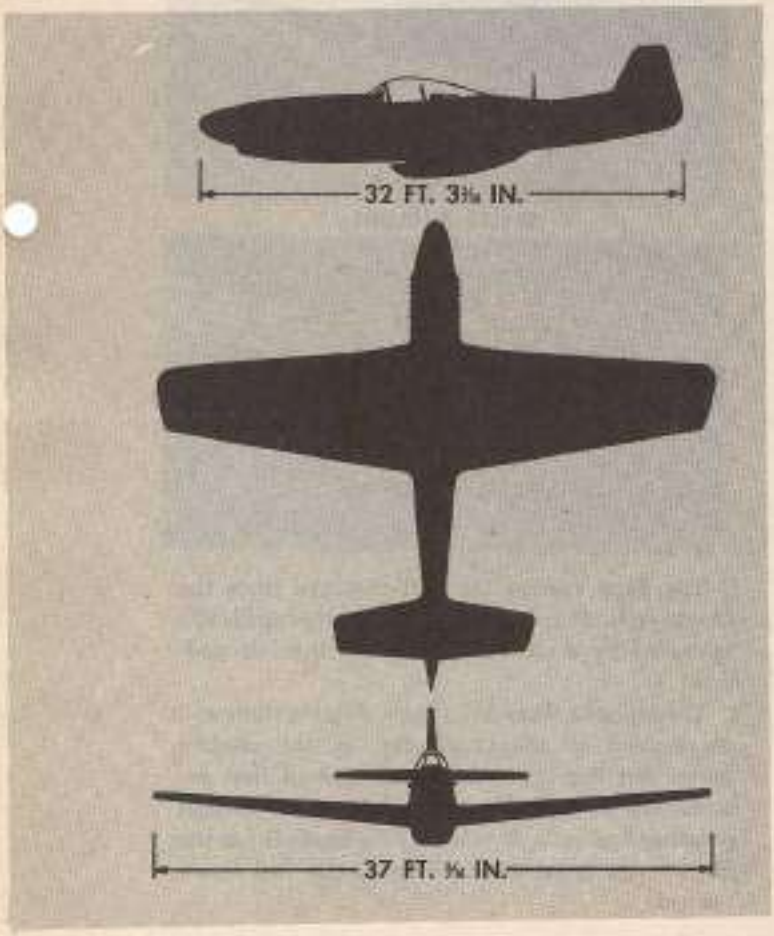
That's not a simple matter. It takes a good man to do the job right.

Remember that!

And now let's have a look at the airplane.



P-51



SERIES D AND K

Your Mustang is a single-place, low-wing monoplane—a high-speed, long-range, low and high altitude fighter built by North American Aviation, Inc.

The fuselage is a semi-monocoque, all-metal structure, and is said to have the smallest frontal area ever placed around any high-powered liquid-cooled engine.

The all-metal wings are built in two halves which are joined at the airplane center line and are of full cantilever structure. The airfoil is of laminar-flow design which gives low drag even at high speeds.

The tail section is metal with fabric-covered elevator and rudder control surfaces. A dorsal fin gives increased lateral stability and adds to the strength of the vertical stabilizer.

The airplane is flush-riveted throughout—another factor contributing to its great speed.

CONTROLS

The ailerons, elevator, and rudder are controlled by the conventional stick and rudder pedals arrangement. All control surfaces have fiber trim tabs controllable from the cockpit by means of knobs on the left pedestal. In addition to being adjustable for trim, the rudder tab is linked so as to apply reverse boost to the rudder, improving the flight characteristics of the airplane.

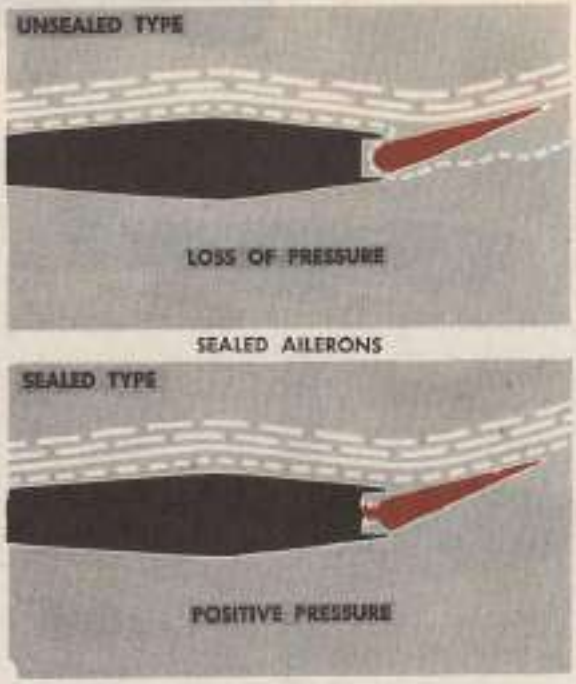
The surface control lock at the base of the stick is easily operated. To lock the controls, simply bring the locking arm and the stick together while pulling out the knob on the locking arm; then release the knob. This locks all the controls. The rudders catch and are locked when moved into neutral position. To release the lock, just pull out the knob and let the locking arm spring forward out of the way.

CONTROL LOCK

Note that there are two holes in the locking lug. When you use the bottom hole, the tailwheel is locked along with the controls. Using the top hole leaves the tailwheel full swiveling so the plane can be towed.

CONTROL SURFACES

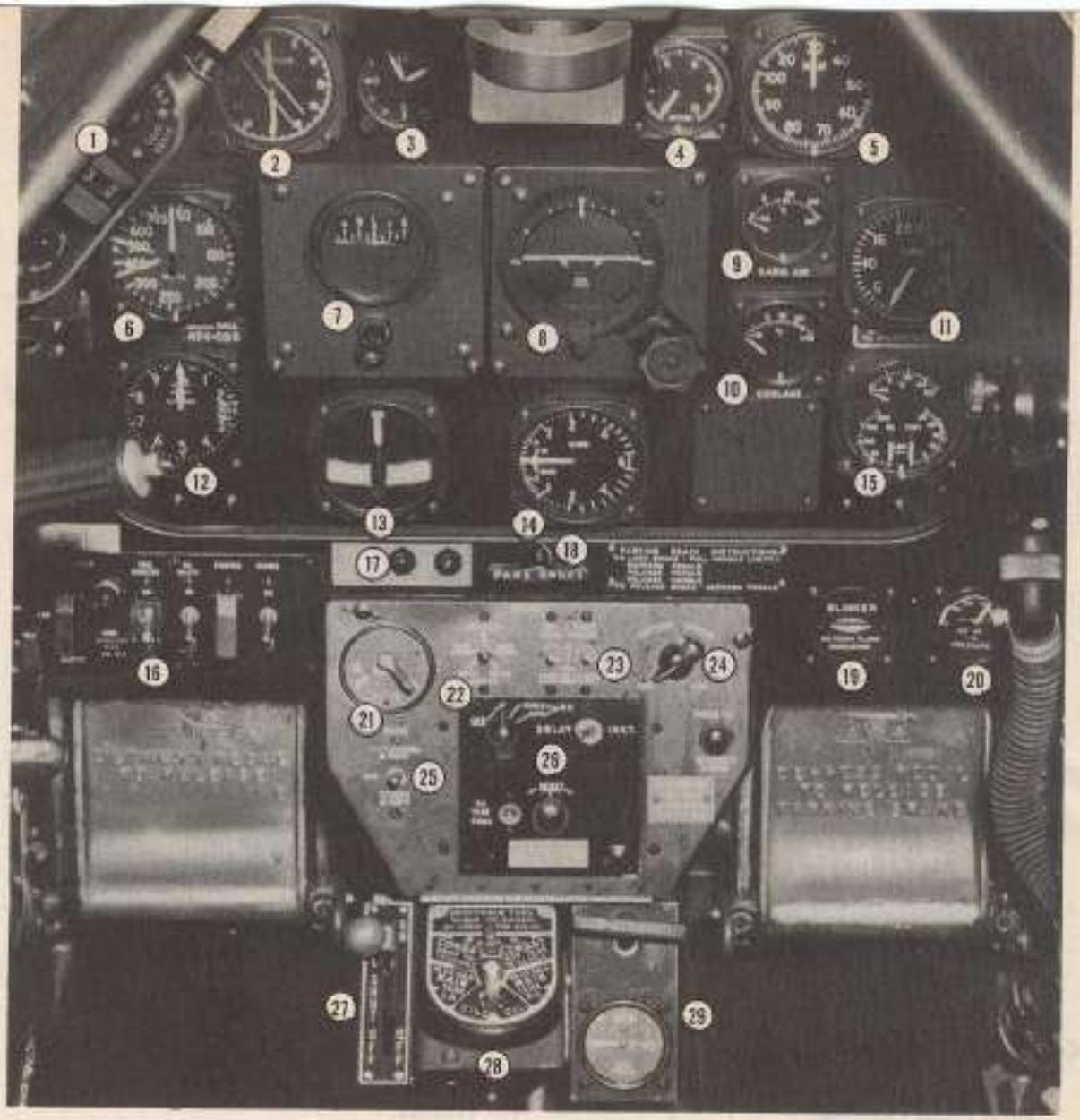
The ailerons are sealed internally so that no air can pass through the opening between the aileron and the wing section. This lightens the pressures on the control stick and at the same time gives more positive action.



SEALED AILERONS

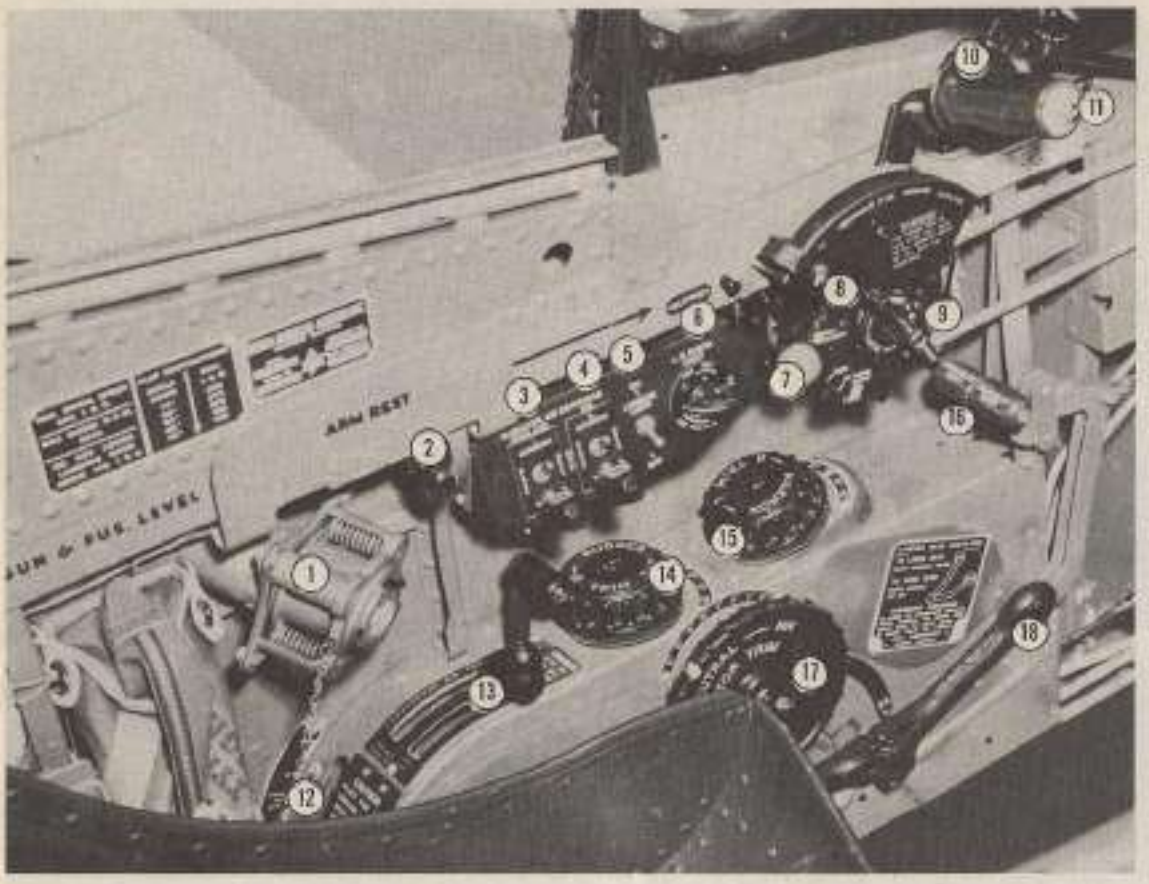
The flaps extend the full distance from the fuselage to the ailerons and are hydraulically operated by a control handle on the left pedestal.

Throughout their 50° range, flap position will correspond to that indicated at the control lever. Set the lever to the degree of flap desired; the flaps will automatically move to that position and stop. It takes 11-15 seconds for the flaps to go from the full up to the full down position.



COCKPIT (Front)

1. Selector Dimmer Controls
2. Remote Indicator Compass
3. Clock
4. Suction Gage
5. Manifold Pressure Gage
6. Airspeed Indicator
7. Directional Gyro
8. Artificial Horizon
9. Carburetor Air Temperature
10. Coolant Temperature
11. Tachometer
12. Altimeter
13. Bank-and-Turn Indicator
14. Rate-of-Climb Indicator
15. Oil Temperature, Fuel and Oil Pressure Gage
16. Engine Control Panel
17. Landing Gear Warning Lights
18. Parking Brake
19. Oxygen Flow Blinker
20. Oxygen Pressure Gage
21. Ignition Switch
22. Bomb and Rocket Switch
23. Chemical Release Switches
24. Cockpit Light Control
25. Gun, Camera and Sight Switch
26. Rocket Control Panel
27. Fuel Shut-off Valve
28. Fuel Selector Valve
29. Emergency Hydraulic Release

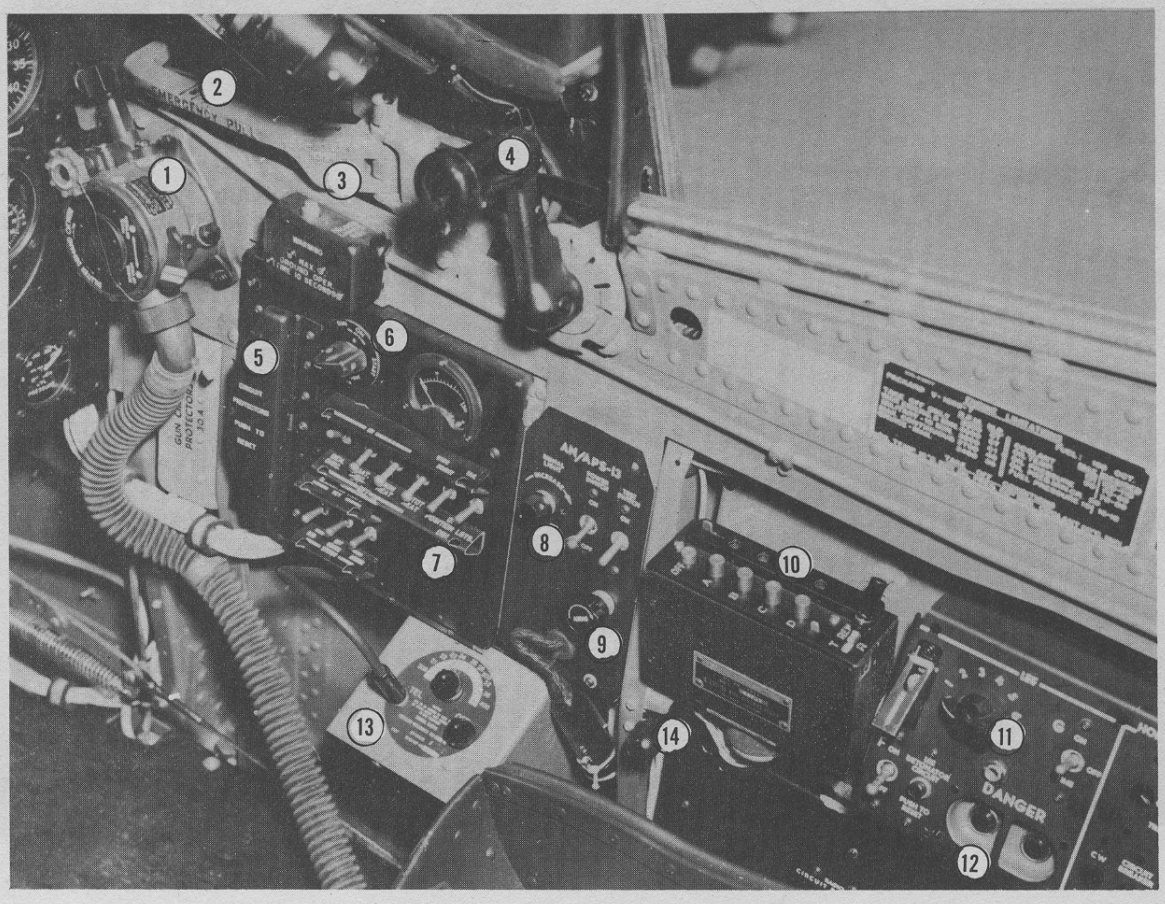


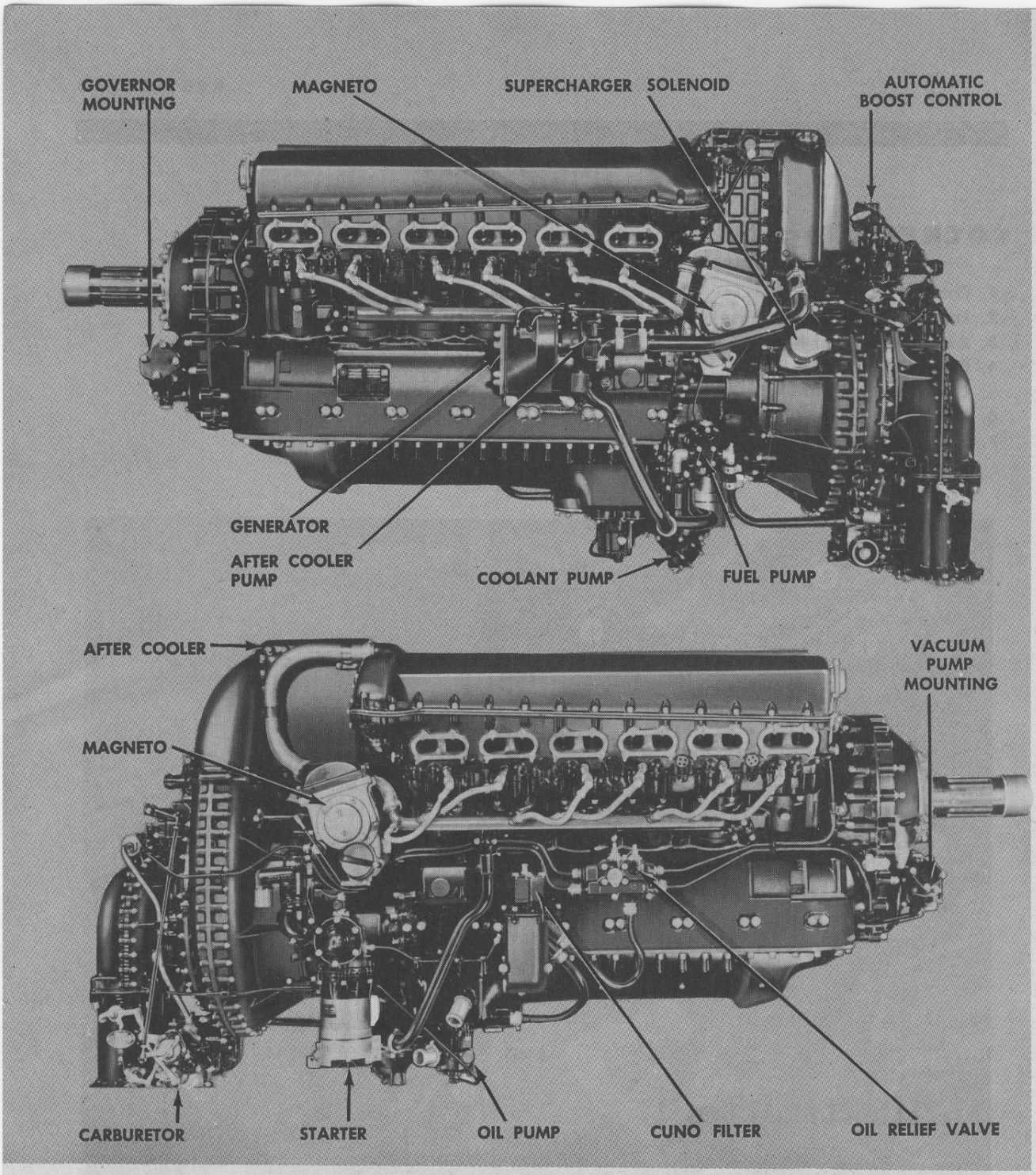
COCKPIT (Left Side)

1. Flare Pistol Opening
2. Cockpit Light
3. Coolant Radiator Air Control Switch
4. Oil Radiator Air Control Switch
5. Landing Light Switch
6. Left Fluorescent Light Switch
7. Mixture Control
8. Propeller Control
9. Throttle Quadrant Locks
10. Throttle
11. Microphone Button
12. Flap Control Handle
13. Carburetor Air Controls
14. Rudder Trim Tab Control
15. Aileron Trim Tab Control
16. Bomb Salvo Releases
17. Elevator Trim Tab Control
18. Landing Gear Control

COCKPIT (Right Side)

1. Oxygen Regulator
2. Emergency Canopy Release
3. Recognition Light Key
4. Canopy Crank and Lock
5. Circuit Breakers (under)
6. Right Fluorescent Light Switch
7. Electrical Control Panel
8. Rear Warning Radar Control Panel
9. VHF Volume Control Knob
10. VHF Control Box
11. IFF Control Panel
12. Detonator Buttons
13. Detrola Control Box
14. Cockpit Light





THE ENGINE

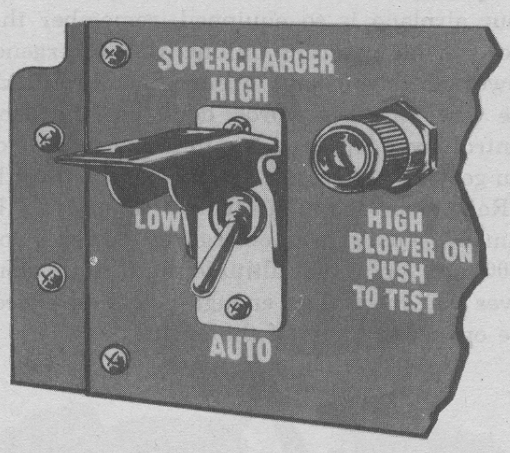
The power plant of the Mustang is a liquid-cooled, 12-cylinder, Packard-built, Rolls-Royce Merlin V-1650-3 or -7. It is equipped with an injection-type carburetor, has two-stage supercharging, and develops over 1400 hp on takeoff.

SUPERCHARGER

The engine has a two-speed, two-stage supercharger which cuts into high blower automatically. The -3 engine cuts in at 19,000 feet, the -7 engine at from 14,500 to 19,500 feet, depending on the amount of ram. The supercharger increases the blower-to-engine ratio from a low of about 6 to 1 to a high of about 8 to 1.

You can also control the supercharger manually by a switch on the instrument panel.

The switch has three positions—AUTOMATIC, LOW and HIGH.



For all normal operations, keep the switch in AUTOMATIC. In this position the supercharger is controlled by an aneroid-type pressure switch, which automatically cuts the unit into high or low blower as required. This switch is so adjusted that it cuts the unit back into low blower approximately 1500 feet under the altitude at which it cuts into high blower. This prevents the high blower from going on and off repeatedly with slight changes in altitude at about the point where the high blower cuts in.

If the aneroid switch fails, the supercharger automatically returns to low blower.

The LOW position on the manual switch on the instrument panel makes it possible to operate the supercharger in low blower at high altitudes. This gives you better range at high altitudes—which, of course, is important on long-range flights.

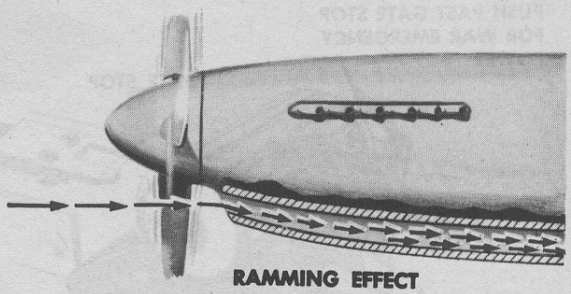
The HIGH position on the manual switch makes it possible to test the high blower on the ground. You have to hold the switch in the HIGH position, however, because it is spring-loaded and flips back to the LOW position as soon as you let go.

An amber jewel indicator light next to the manual switch on the instrument panel goes on when the supercharger is in high blower.

CARBURETOR

The engine has an injection-type carburetor and an automatic manifold pressure regulator. With this automatic regulator, you don't have to jockey the throttle to maintain a constant manifold pressure in the high-speed range as you climb or let down. All you have to do is select the desired pressure by setting the throttle lever, and the pressure regulator does the rest. It compensates automatically for the difference in air density at different altitudes by gradually opening the carburetor butterfly valve as you climb and smoothly closing it as you let down.

On later airplanes, the automatic regulator covers practically your entire operating range, going into action whenever you use more than 20″ of manifold pressure. Airplanes equipped with this type regulator can be distinguished by the START position plate on the throttle quadrant. In earlier airplanes the manifold pressure regulator is effective only at pressures in excess of 41″.



RAMMING EFFECT

Carburetor air comes through a long carburetor air scoop directly under the engine. The plane's motion forces the air at high speed (or rams it) directly into the carburetor. This is called ram air.

If the scoop becomes obstructed by ice or foreign matter, a door in the air duct opens automatically to admit hot air from the engine compartment to the carburetor.

Ordinarily you will always use ram air, but, in the event of extreme icing or dust conditions, the carburetor air controls on the left cockpit pedestal allow you to select either unrammed filtered or, in later airplanes, unrammed hot air for operation. In order to obtain hot air, the hot air control must be at HOT and the cold air control at UNRAMMED FILTERED AIR. If the cold air control is in RAM AIR position, the hot air control will be ineffective.

Don't use hot air above 12,000 feet. At high altitudes its use will disturb the carburetor's altitude compensation, and may cause too lean a mixture.

WAR EMERGENCY POWER

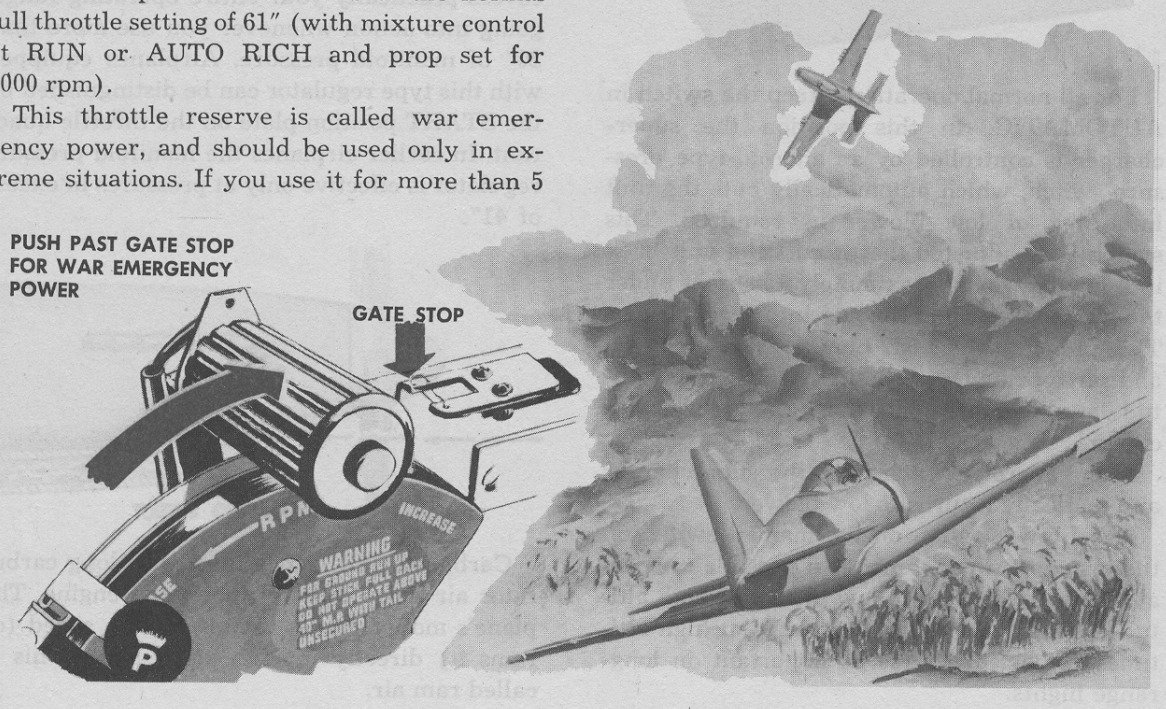
In order to give your engine an extra burst of power should you get into an extremely tight situation, move the throttle full forward past the gate stop by the quadrant, breaking the safety wire. The engine will then be opened up to its absolute limit, and will give you about 6″ of manifold pressure in excess of the normal full throttle setting of 61″ (with mixture control at RUN or AUTO RICH and prop set for 3000 rpm).

This throttle reserve is called war emergency power, and should be used only in extreme situations. If you use it for more than 5 minutes at a time you'll risk damaging vital parts of the engine. In training, therefore, the throttle must never be moved beyond the gate stop.

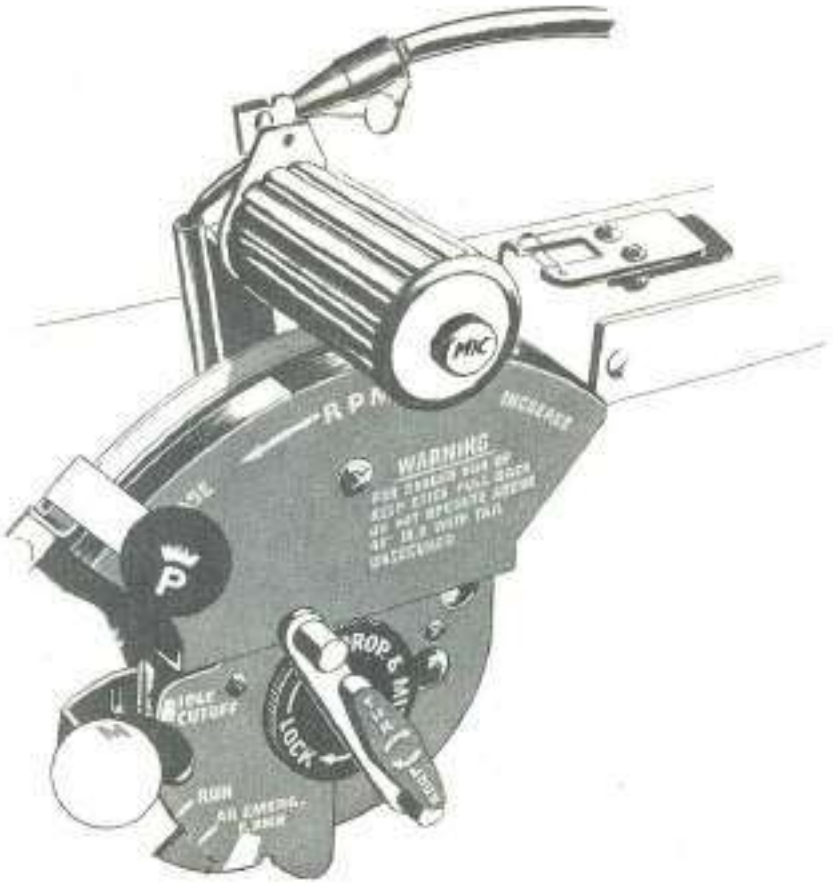
Whenever you do use war emergency power, be sure to note the length of time on Form 1A, and also report it to the crew chief or engineering officer so that a record can be kept and the engine inspected before the airplane is flown again. The engine must be removed for a complete knock-down inspection after 5 hours.

On some early airplanes, war emergency power is not incorporated into the throttle, but is obtained by pulling a boost control lever, on the panel forward of the control quadrant. If your airplane is so equipped, remember that there is no point in pulling war emergency power until you have opened the throttle all the way. In other words, don't use the boost control lever to increase your power when you can get the same result by opening the throttle.

Remember too, that there's nothing to be gained by using war emergency power below 5000 feet. Up to that altitude the throttle alone gives you more than enough power to exceed the operating limits of the engine.



THROTTLE QUADRANT



There are two types of throttle quadrants, the principal difference depending upon whether the airplane is equipped with a single- or two-position carburetor. On later airplanes with single-position carburetors, the mixture control has the following settings: IDLE CUT-OFF, RUN, and EMERGENCY FULL RICH. These carburetors are fully automatic and the normal operating position is RUN. The EMERGENCY FULL RICH position is for use in case the carburetor fails to function properly in RUN. To place the mixture control in the EMERGENCY FULL RICH setting, a spring latch on the lever must be pressed with the thumb as the control is moved past a break-through seal. On earlier airplanes with two-position carburetors, the mixture control positions are IDLE CUT-OFF, AUTO LEAN, and AUTO RICH.

If your airplane has the latest type manifold pressure regulator, you'll find a START position designated on the throttle quadrant, necessary because this pressure regulator requires a 2-inch throttle opening for starting the engine, whereas in earlier airplanes the throttle is to be opened only one inch.

Some throttles are fitted with special twist grips, used in operation of the K-14A gunsights installed in later airplanes.

The quadrants have two friction-lock adjusting knobs. One adjusts the friction of the propeller and mixture control levers, the other the throttle control lever.

PROPELLER

The P-51D propeller is a Hamilton Standard, four-blade, hydraulic, constant-speed prop with a diameter of 11 feet 2 inches and a blade angle range of 42°. As is the case with all single-engine aircraft, the prop cannot be feathered. You control propeller rpm manually by a single lever on the throttle quadrant.

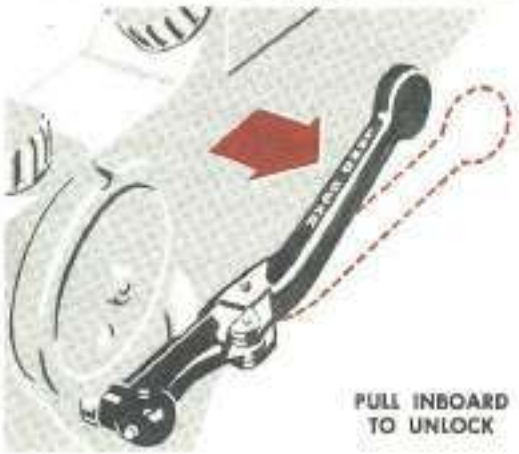
P-51K airplanes are provided with Aeroproducts propellers. These, too, are four-blade, hydraulically operated, constant-speed propellers, diameter 11 feet and with a pitch range of 35°.

The P-51D and P-51K series airplanes are distinguished from each other solely by the prop installation. And, although the Hamilton Standard and Aeroproducts propellers are radically different in construction, they are identical in operation.

LANDING GEAR

The main gear and tailwheel are fully retractable, and are controlled hydraulically by a single lever on the left pedestal.

Note in the accompanying illustration that this lever is locked in position; you must pull it inboard before pulling it up to raise the gear. Note also that in lowering the gear, the landing gear lever must be all the way down **and locked.** If it isn't locked, the lever may creep back up.



Do not raise the control lever when the airplane is on the ground. There is no safety downlock on a P-51D, and the gear will retract as soon as you start taxiing.

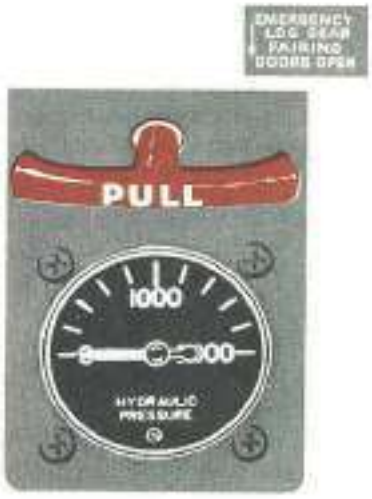
The tailwheel is both steerable and full swiveling. It is steerable 6° right or left with the rudder. The tailwheel lock is different from that of most other planes—it is operated by the control stick. When the stick is in neutral position or pulled back, the tailwheel is locked and steerable. When you push the stick full forward, the tailwheel is unlocked and full swiveling.

The tailwheel drops almost instantly when you push the landing gear lever to the DOWN position. The main gear takes 10 to 15 seconds to move into position. You can definitely feel the gear lock into place when it is lowered.

There'll be occasions, such as go-arounds, when you'll want to raise the landing gear immediately after lowering it. In doing so, always wait until the gear is down and locked before pulling up the control lever. If you attempt to raise the gear while it's still on the way down, you'll succeed only in damaging it or the fairing doors.

You can release the landing gear in an emergency by means of a red handle just above the hydraulic pressure gage. Pulling this red handle releases the pressure in the hydraulic lines. This allows the gear to drop of its own weight **when the landing gear lever is in the DOWN position.** The landing gear lever must be in the DOWN position—all the way down—or the mechanical locks which hold the gear in place are not unlocked.

Note that the red handle releases the pressure in the hydraulic lines. Therefore, if you want to operate the flaps or the fairing doors after you have dropped the gear by means of the red handle, you must push the handle back to its original position. If you leave it out—all or even part way out—you won't have any hydraulic pressure to operate the flaps.



EMERGENCY HYDRAULIC RELEASE

If the gear is not down and locked when you come in for a landing, you'll be warned by a combination of red and green warning lights below the instrument panel and a horn aft of the seat. The horn sounds only when the landing gear is up and locked, while the throttle is retarded below the minimum cruise condition, and may be silenced by the cut-out switch on the front switch panel. This switch automatically resets when the throttle is advanced.

Horn Blowing

THROTTLE . . . RETARDED
DOORS . . . . CLOSED
GEAR. . . . . UP AND LOCKED OR DOWN AND UNLOCKED

THROTTLE . . . ANY POSITION
DOORS . . . . OPEN
GEAR. . . . . DOWN AND UNLOCKED OR UP AND LOCKED

THROTTLE . . . ANY POSITION
DOORS . . . . ANY POSITION
GEAR. . . . . DOWN AND LOCKED

THROTTLE . . . ADVANCED
DOORS . . . . CLOSED
GEAR. . . . . UP AND LOCKED

Operation of the lights and horn is explained in the accompanying illustration. The lights are equipped with adjustable dimmer masks, and are of the push-to-test type, so that you can readily check to see if the bulbs are okay.

BRAKES

The brakes are hydraulic, of the disc type. The usual toe action on the rudder pedals controls each brake individually.

After takeoff, never brake the wheels to stop them from turning. If the brakes are hot from excessive ground use, they are likely to freeze. The design of the gear and the wheel wells is such that under normal conditions the turning of the wheels has no harmful effect even after they have been retracted into the wheel wells.

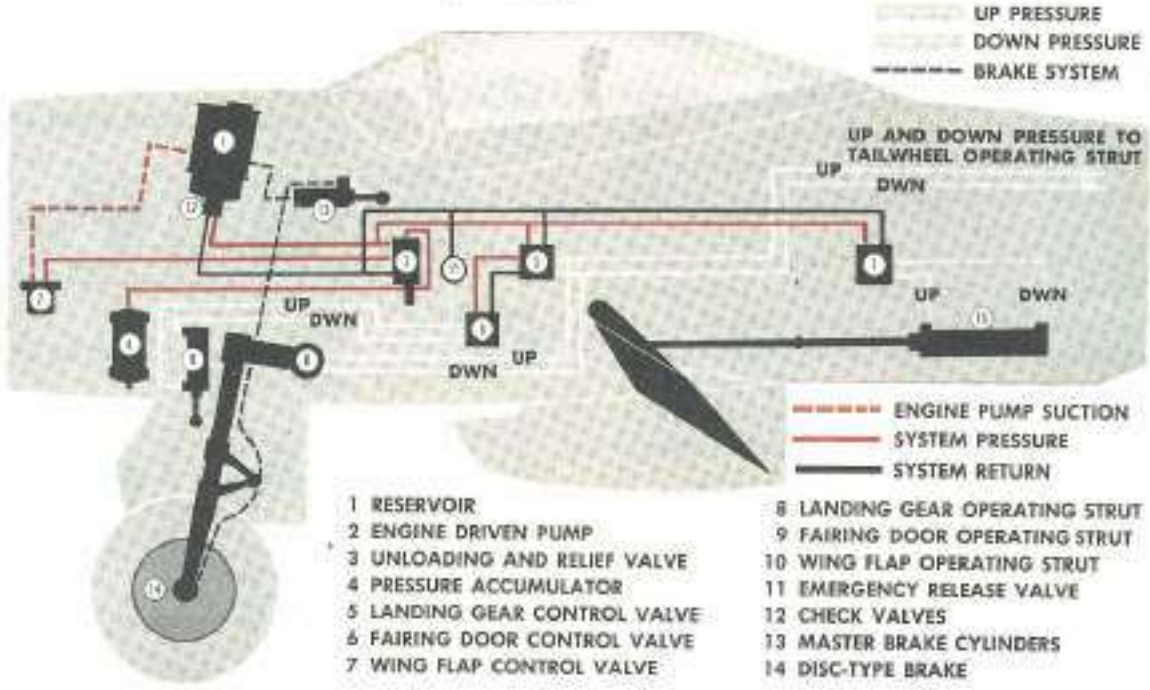
The parking brake handle is just below the center of the instrument panel. You operate the parking brakes in the conventional manner:

1. Hold the brakes;
2. Pull the parking brake handle out;
3. Release the pressure on the brake;
4. Then release the parking brake handle.

To release the parking brakes, simply push down on the foot pedals.

Caution: Never set the parking brakes when the brakes are hot; the discs may freeze.

HYDRAULIC SYSTEM

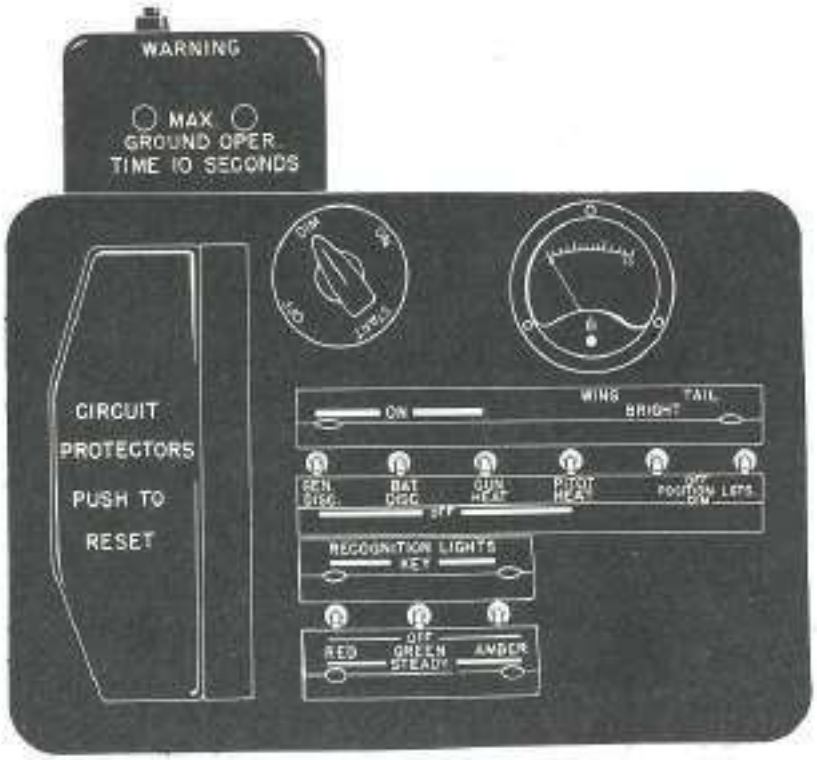


The hydraulic system is extremely simple and almost foolproof in its operation. It has two separate parts. One part of the system operates under pressure from a pump which is driven directly off the engine. This part operates the landing gear and the wing flaps. This "power" part of the system operates at a pressure of 1000 pounds per square inch (psi) while the engine is running.

The second part of the system works the brakes only. It is operated by the foot pressure of the pilot.

The only connection between the two parts of the system is that they both receive their supply of fluid from the same tank. However, the tank is so designed that even if all the hydraulic fluid from the power part of the system is lost, there still is enough fluid to operate the brakes. So even if you lose the hydraulic pressure in your landing gear and flaps, you still can operate your brakes.

ELECTRICAL SYSTEM



ELECTRICAL CONTROL PANEL

The electrical system is a 24-volt, direct-current system which provides power for operating the booster pumps, starter, radios, guns, the various electric lights, the bomb racks, and the coolant and oil radiator controls.

The electrical system runs off the battery until the engine reaches 1500-1700 rpm, when the generator is cut in by the voltage regulator. Power for the electrical system then is supplied by the generator. To prevent any damage to the electrical system from overload, circuit breakers are used. These eliminate the use of fuses and allow you to re-set broken circuits while still in flight.

The circuit breaker re-set buttons are on the right switch panel. On late models all the buttons can be re-set at once by means of one bar plate across the switches. All you have to do is simply bump this plate to restore the circuits.

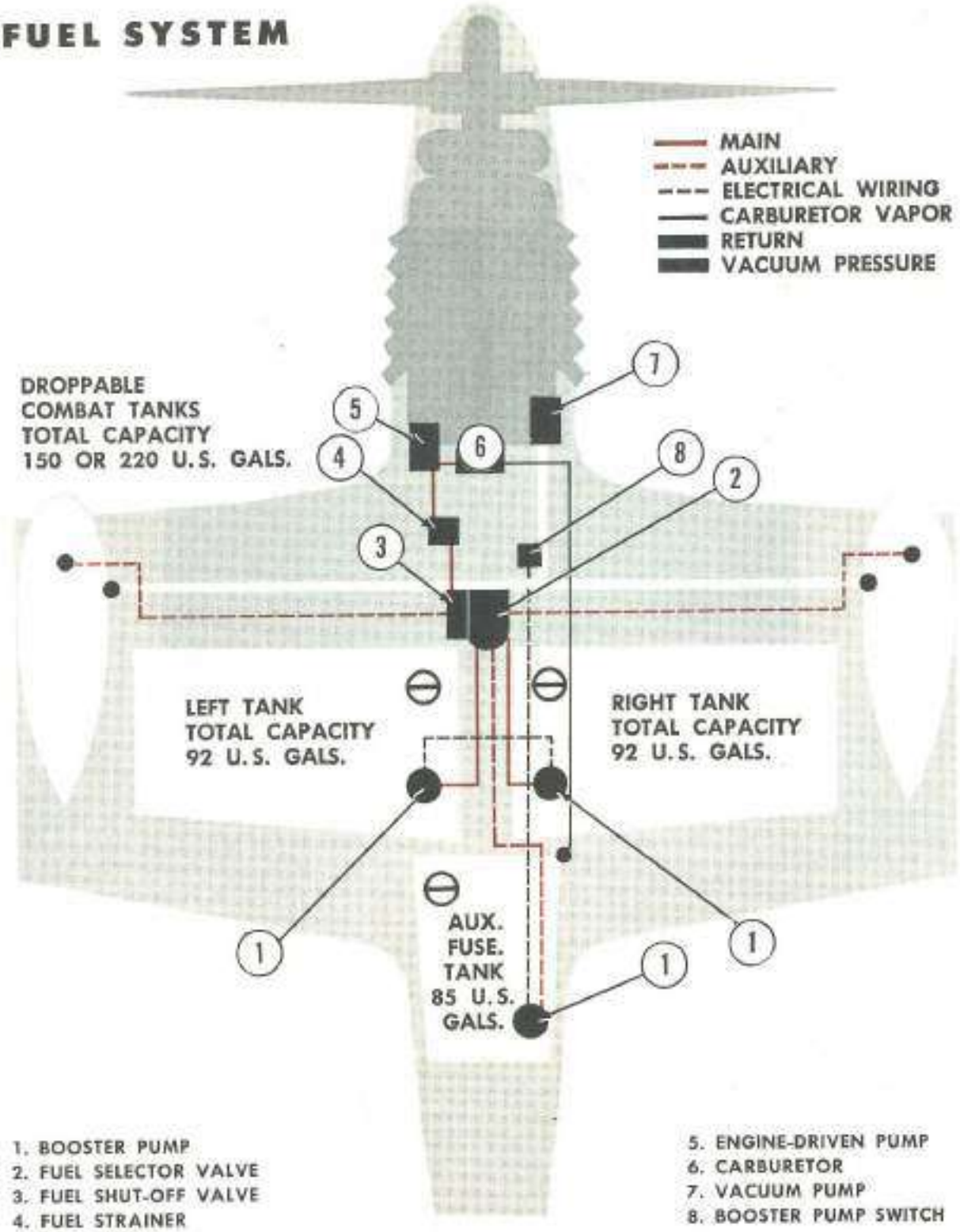
An ammeter is on the same panel as the circuit breaker switches. This ammeter shows you how much current is flowing from the generator and also shows whether or not the generator has cut in at 1500-1700 rpm as it should.

The battery is just behind the pilot's armor plate in the radio compartment. The battery and generator disconnect switches are on the panel with the circuit breaker switches.

The lights of the electrical system include cockpit and gunsight lights, one powerful sealed-beam landing light in the left wheel well, recognition lights, and standard navigation lights on the wingtips and on the rudder.

Except for the booster coil, which is used only in starting, the ignition system is completely independent of the electrical system, and will continue to function normally in case of electrical system failure. Ignition power is supplied by the magnetos; the switch is on the front switch panel.

FUEL SYSTEM



1. BOOSTER PUMP
2. FUEL SELECTOR VALVE
3. FUEL SHUT-OFF VALVE
4. FUEL STRAINER
5. ENGINE-DRIVEN PUMP
6. CARBURETOR
7. VACUUM PUMP
8. BOOSTER PUMP SWITCH

The Mustang has two main fuel tanks, one in each wing. They are self-sealing, and have a capacity of 92 gallons each. An auxiliary 85-gallon self-sealing tank is installed in the fuselage, aft of the cockpit. There is also provision for carrying two droppable combat tanks on the bomb racks. These are available in 75-gallon and 110-gallon sizes; normally you'll use only drop tanks of 75-gallon capacity, since the extra weight of the larger tanks imposes near-limit loads on the wings and bomb racks. Droppable tanks are not self-sealing. Making them so would add unnecessary weight, for it has been found that shot-up external tanks will not remain afire when the airplane is in flight.

Total fuel capacity of the airplane, with 110-gallon droppable tanks, is 489 gallons. Normally, Grade 100/130 fuel is used, and the consumption under selected cruising conditions varies considerably. To cruise the Mustang scientifically, plan your flight in accordance with the Flight Operation Instruction Charts included at the end of this manual.

Fuel is forced to the carburetor by an engine driven pump at a normal operating pressure of 16-19 psi. In addition, there is an electrically powered booster pump in each internal tank. These booster pumps prevent vapor lock at high altitudes, assure sufficient fuel supply under all flight conditions, and, in case of engine driven pump failure, will provide enough fuel to the carburetor for normal engine operation.

The three booster pumps are controlled by a single switch on the front switch panel. You simply turn this switch to ON; then, turning the fuel selector valve from one position to another automatically shuts off the booster pump in the tank just used and starts the pump in the tank selected.

On some of the earlier P-51D's, the booster pump switches have three positions—EMERGENCY, OFF, and NORMAL. In the NORMAL position the booster pump supplies fuel to the engine driven pump at a pressure of 8-10 psi. EMERGENCY increases this pressure to about 19 psi.

Use the EMERGENCY position in takeoffs and landings and in the event of engine-driven pump failure.

Fuel is boosted from the droppable tanks by means of tank pressurizing. Pressure is supplied by venting the tanks to the vacuum pump exhaust, and is maintained at a constant 5 psi by an automatic relief valve.

Fuel gages for the wing tanks are on the floor, to the left and right of your seat. The gage for the fuselage tank is mounted on the upper left side of the tank itself; you'll have to look over your left shoulder to read it. There are no gages for the droppable tanks.

FUSELAGE TANK GAGE

The fuel selector control is on the floor of the cockpit, just in front of the stick. As you rotate the valve handle you'll notice a definite snap as each tank position is reached. Be sure you feel this snap—it's your guarantee that the valve is properly set.

Whenever the engine is running, vaporized fuel is returned from the carburetor to one of the fuel tanks through the vapor return vent line. On later airplanes, this line is led to the fuselage tank, while on some of the earlier P-51D's the vapor return is to the left wing tank. Find out to which tank the vapor return line is connected by asking your engineering officer, and use fuel from that tank first to allow space for the return. Also, check the tank occasionally in flight to make sure that it isn't completely full. If you don't do this, the recovered gas, which may amount to as much as 10 gallons per hour depending on operating conditions, will be lost through the overflow pipe.

The electric primer installed on later airplanes is controlled by a momentary toggle switch next to the starter switch. Earlier series planes have a hand primer on the right side of the instrument panel. One second's operation of the electric primer is about equivalent to one stroke of the hand primer.

CAUTION

When changing tanks, don't stop the selector valve at an empty tank position, or at a droppable tank position if you have no droppable tank. If you should accidentally do this, or if you run a tank completely dry, your engine will fail, and you must act immediately as follows:

1. Turn the fuel selector to a full tank;
2. Make sure that the booster pump switch is ON;
3. As your engine takes hold, adjust the throttle setting as required.

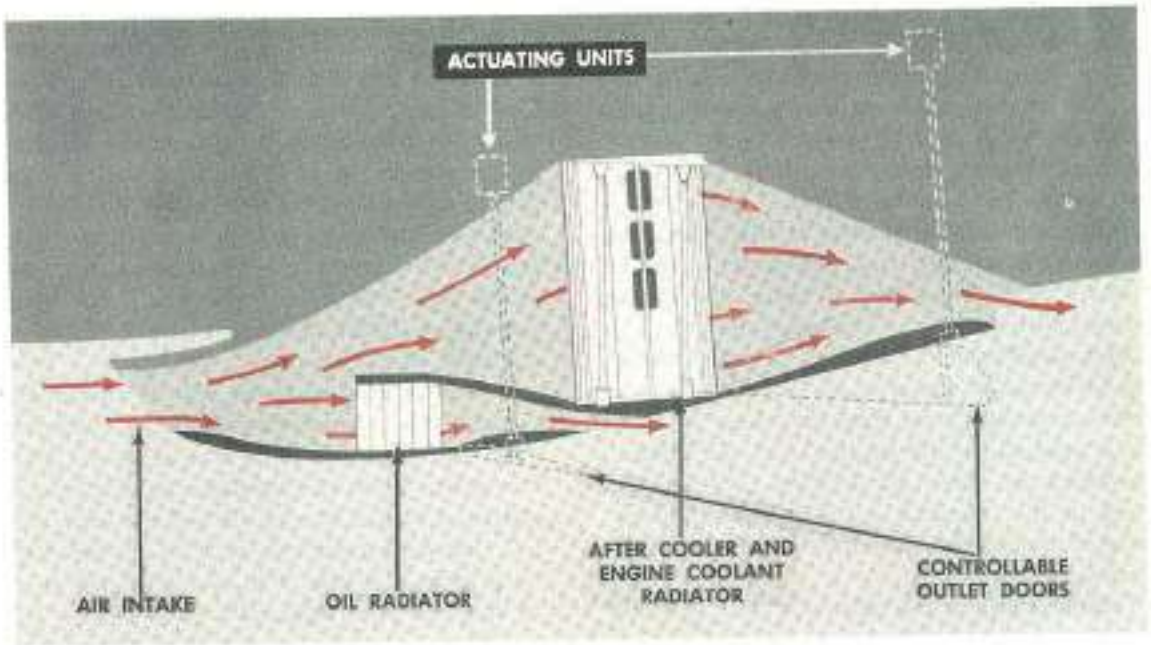
OIL SYSTEM

The oil system includes a tank, located just forward of the firewall, and a radiator in the air scoop under the fuselage.

The tank is a hopper type—that is, it is designed with hoppers or compartments which facilitate quick warm-up and also make it possible to fly the airplane in abnormal positions, with little oil in the system.

With this tank you can fly the P-51 in any attitude when the tank is full. Or you can put it into a vertical climb or dive when the tank is only ¼ full and still get proper lubrication. However, when the plane is in inverted flight, the oil pressure falls off because no oil reaches the scavenger pump. For that reason you must limit inverted flying to 10 seconds—which is plenty of time for any normal or combat maneuvers.

INVERTED FLYING LIMITED TO 10 SECONDS



An outlet door on the bottom of the air scoop controls the oil temperature. Under ordinary circumstances this door operates automatically. However, if you want to operate it manually—when you're running your engine on the ground, for example, or in case the automatic regulator fails in the air—you can do so by means of an electrical switch on the left side of the cockpit.

This switch has three positions: AUTOMATIC, OPEN, and CLOSE. You can stop the door at any position by holding the toggle switch in the OPEN or CLOSE position for the necessary length of time, then returning the switch to neutral.

The oil system has standard AAF oil dilution equipment. This allows you to thin the oil with gasoline to make the engine easier to start in temperatures below 40°F.

OIL DILUTION SWITCH

Operation of the oil dilution equipment is simple. Allow the engine to idle, coolant flaps open, until the oil temperature drops to 50°C or less. Then, before stopping the engine, use the dilution switch on the pilot's switch panel. This dilutes the oil until you are ready to start the engine again. Once the engine warms up, the gasoline in the oil is quickly evaporated.

If the engine temperature is high, stop the engine and allow it to cool to an oil temperature of about 40°C. Then start it again, and immediately dilute the oil as explained above.

Two minutes of oil dilution is sufficient for any temperature down to 10°F. When starting in temperatures lower than that, heat is sometimes applied to the engine and oil system. Therefore, no fixed oil dilution time can be given in this manual; you'll be specially instructed in accordance with local operating conditions.

Total capacity of the oil system is 21 gallons.

COOLANT SYSTEM

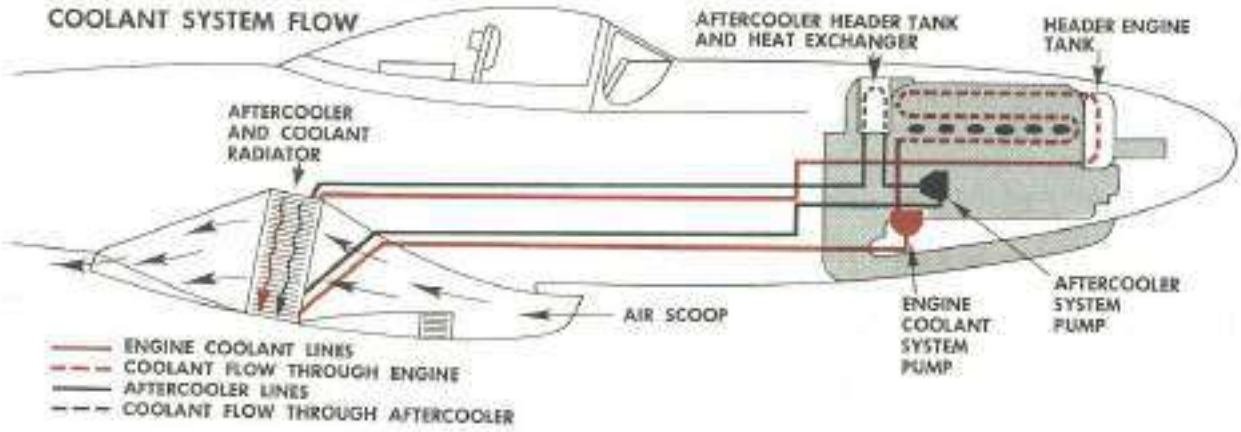
With the radiators located in the big airscoop aft of the cockpit under the fuselage, the cooling of the P-51 engine is quite different from that of any other airplane.

The engine is cooled by liquid in two separate cooling systems. The first system cools the engine proper, the second (called the after-cooling system) cools the supercharger fuel-air mixture. Each performs a separate function and the systems are not connected in any way. They both pass through a single large radiator, but in different compartments.

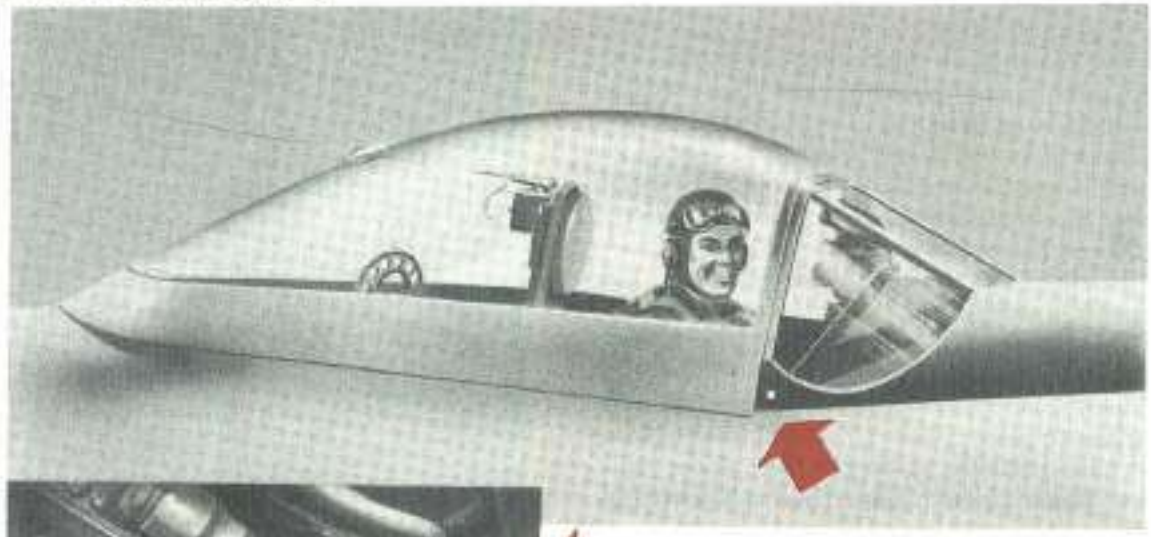
The engine coolant system is a high-pressure system (30 psi) and its capacity is 16½ gallons. Operating pressure of the after-cooling system is lower (20 psi), and its capacity is 5 gallons.

The coolant used is a mixture of ethylene glycol and water, treated with "NaMBT" (a corrosion preventive). There are two types—type D for normal use, which consists of 30% glycol and 70% water, and type C for winter use (below 10°F), which consists of 70% glycol and 30% water.

An air outlet door at the rear of the air scoop controls the temperature of the coolant. This door operates similarly to that of the oil cooler. Normally, it works automatically, but you can control it manually by means of a switch on the left side of the cockpit, next to the oil cooler door control switch. Both switches are on the radiator air control panel.



THE CANOPY



CANOPY CRANK AND EMERGENCY RELEASE INSIDE

The cockpit enclosure is of the half-teardrop type; it consists of an armor glass windshield and a sliding canopy formed from a single piece of transparent plastic. The canopy is designed to give you the best possible vision in all directions, since obstructions above, at the sides, and to the rear have been eliminated.

You get into the cockpit from the left side. To help you up on the wing, there is a handhold in the left side of the fuselage. You can step on the fairing in getting up on the wing, but be careful that you **don't** step on the flaps.

To open the canopy from the outside, push in on the spring-loaded button at the right forward side of the canopy, and slide the canopy aft.

You control the canopy from within by means of a hand crank. Depressing the latch control on the crank handle unlocks the canopy, after which you can turn the crank to slide the canopy open or closed. Releasing the latch control locks the canopy in any position.

To warn you against taking off without having the canopy properly secured to the airplane, there are two red indicator pins, one at each side of the canopy. If these pins are visible the canopy isn't properly locked.

Never take off if you can see the pins. If you do, your canopy will blow off.

EMERGENCY RELEASE INDICATOR

The emergency release for the canopy is the long red handle on your right, above the oxygen controls. When you pull this handle, the entire canopy flies off. The handle is safetied with light safety wire.

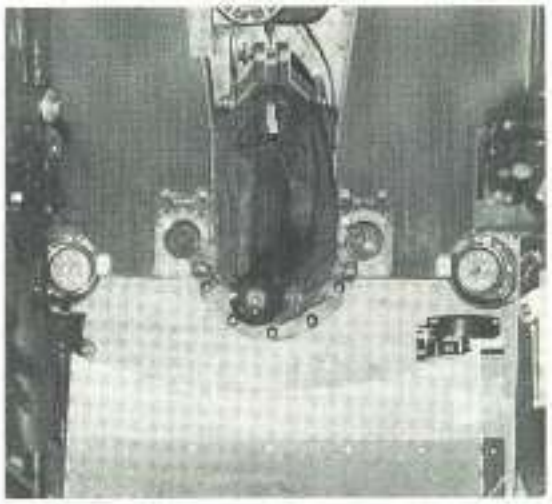
COCKPIT

The cockpits of fighter-type airplanes are generally pretty cramped, and that of the Mustang is no exception. Concentration of numerous instruments and controls into a small space is unavoidable. In the case of the P-51D, the controls are simplified, and their grouping has been planned to give you the greatest possible efficiency. As fighter airplanes go, the cockpit is comparatively comfortable.

The cockpit can be both heated and ventilated. Cold air is fed into the cockpit through a small scoop located between the fuselage and the big air scoop. Warm air is fed into the cockpit from inside the scoop just back of the radiator. Warm air from this source also serves to defrost the windshield.

The controls for regulating cold and warm air and the defroster are on the floor of the cockpit, around the seat, as shown in the accompanying illustration.

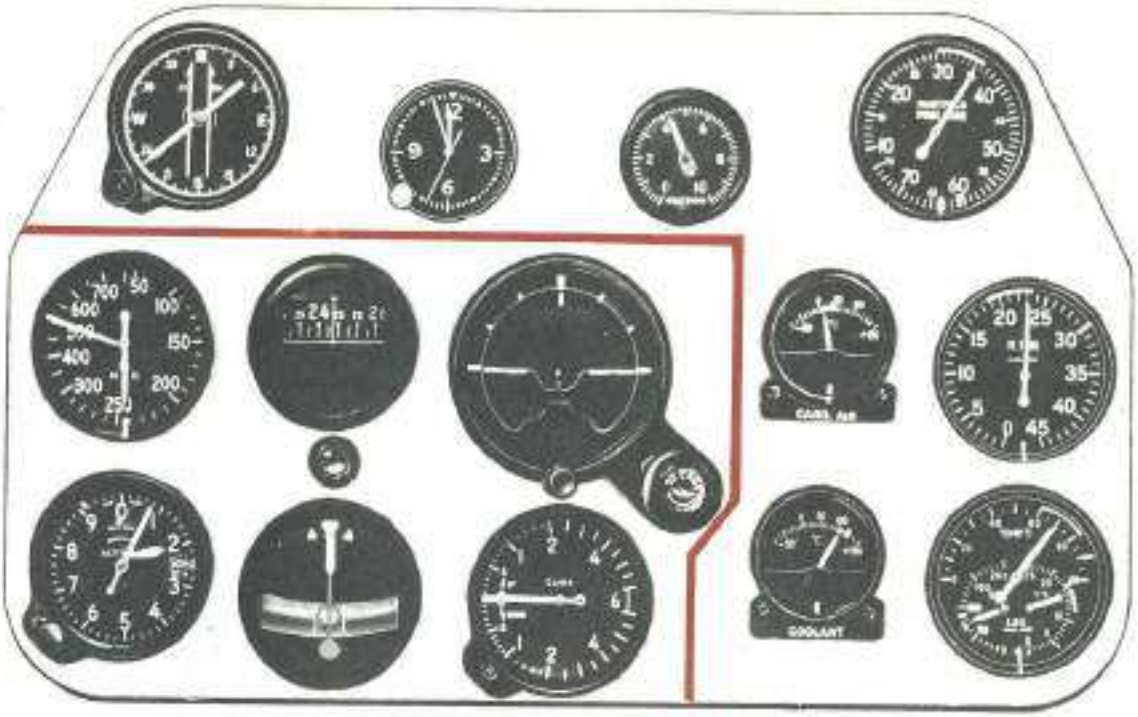
The pilot's seat is designed to accommodate either a seat-type or a back-pack parachute. The back cushion is kapok-filled and can be used as a life preserver. The seat is adjustable vertically; you'll find the lock on your right.



No fore-and-aft adjustment is possible.

Your comfort on long flights will be increased by a small, folding arm rest on the left side of the cockpit.

A standard safety belt and shoulder harness are provided. There is a lever on the left side of the seat for relaxing the tension on the shoulder harness. This permits you to lean forward whenever necessary—for example, to look out of the canopy in taxiing.



INSTRUMENTS

The instruments in the P-51D cockpit are shown above and on the following pages. Most of the instruments are mounted on the instrument panel, flight instruments being grouped at the center and to the left, engine instruments to the right. Exceptions are the hydraulic pressure gage, which is below the pilot's switch panel; the fuel gages, on the floor and aft of the cockpit; and the ammeter on the electrical switch and circuit breaker panel.

The instruments can be classified into four general groups, as follows:

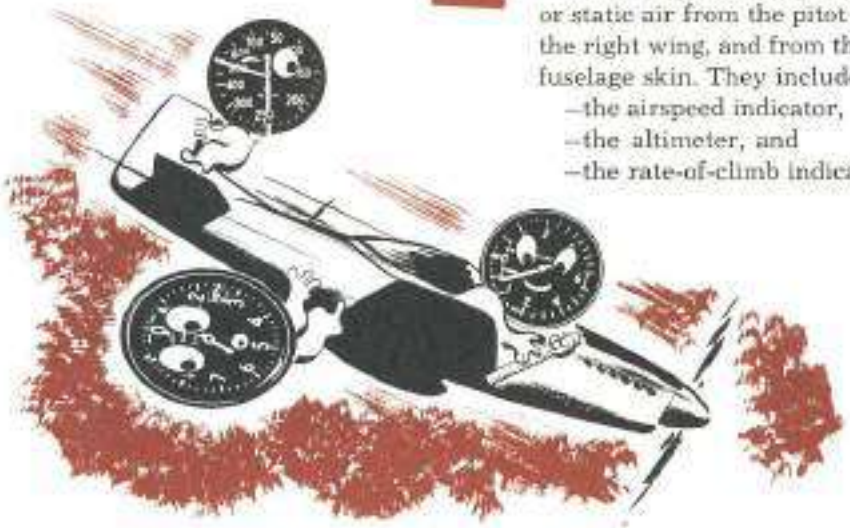
1 VACUUM SYSTEM INSTRUMENTS

These are operated by a vacuum pump driven off the engine and include:

–the flight indicator,
–the bank-and-turn indicator,
–the directional gyro, and
–the suction gage.

The suction gage shows whether the vacuum pump is providing proper vacuum for the system. If this gage reads more than 4.25 or less than 3.75, you know that the vacuum instruments are not functioning properly and are not giving reliable readings. Normal suction reading is 4.00.

2 PITOT STATIC SYSTEM INSTRUMENTS



These instruments are operated by pressure or static air from the pitot tube, which is under the right wing, and from the static plates on the fuselage skin. They include:

–the airspeed indicator,
–the altimeter, and
–the rate-of-climb indicator.

3 ENGINE INSTRUMENTS

The engine instruments include:
- –the manifold pressure indicator,
- –the tachometer,
- –the carburetor air temperature indicator,
- –the coolant temperature gage, and
- –the engine gage.

The engine gage consists of three instruments in one–showing oil temperature, oil pressure, and fuel pressure.

4 MISCELLANEOUS INSTRUMENTS

Miscellaneous instruments include:
- –the remote indicator compass,
- –the hydraulic pressure gage,
- –the oxygen pressure gage,
- –the fuel gages,
- –the ammeter, and
- –the clock.

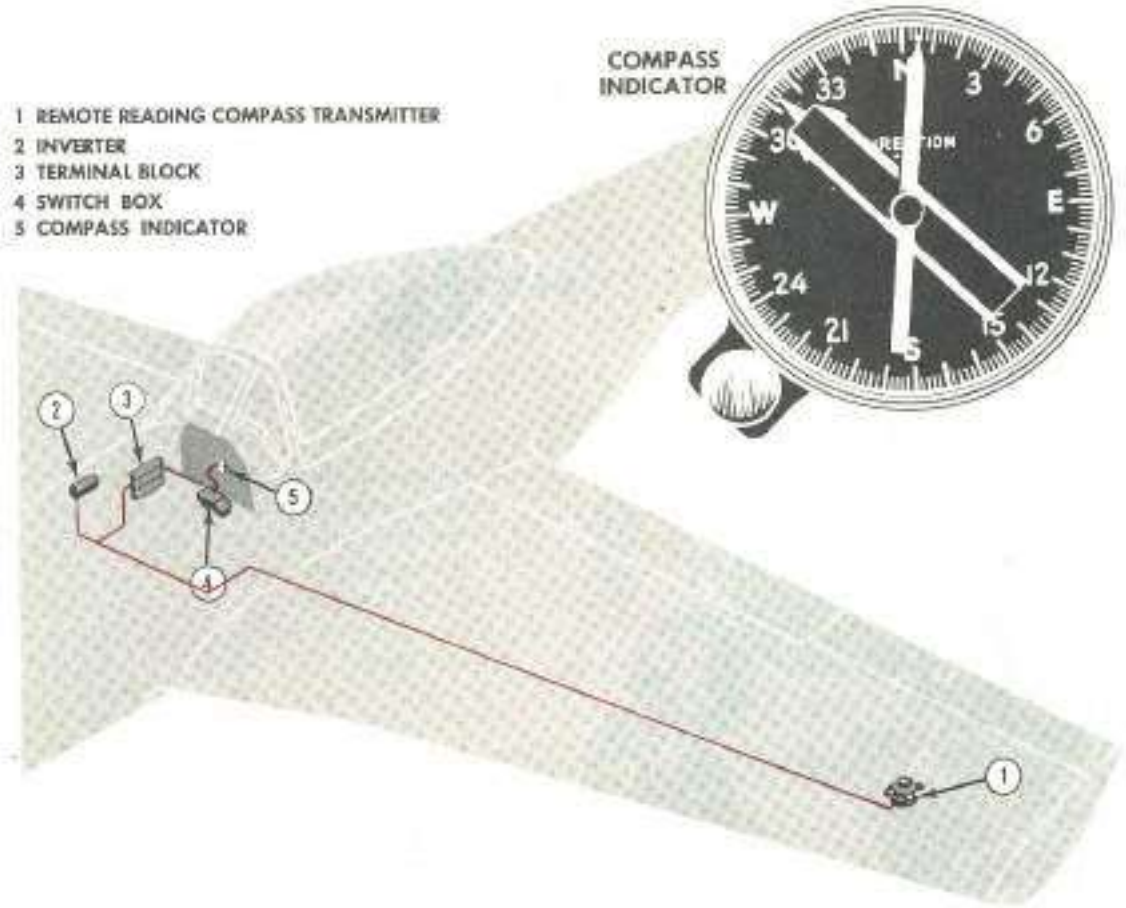
Note: The engine instruments are grouped on the right side of the instrument panel, the flight instruments in the center, and the miscellaneous instruments at the left.

You are already familiar with most of the instruments in the P-51, having used them in other aircraft. However, two of the instruments are probably new to you—the remote indicator compass, which is of new design, and the electrical tachometer, which differs in its operation from the mechanical type tachometer.

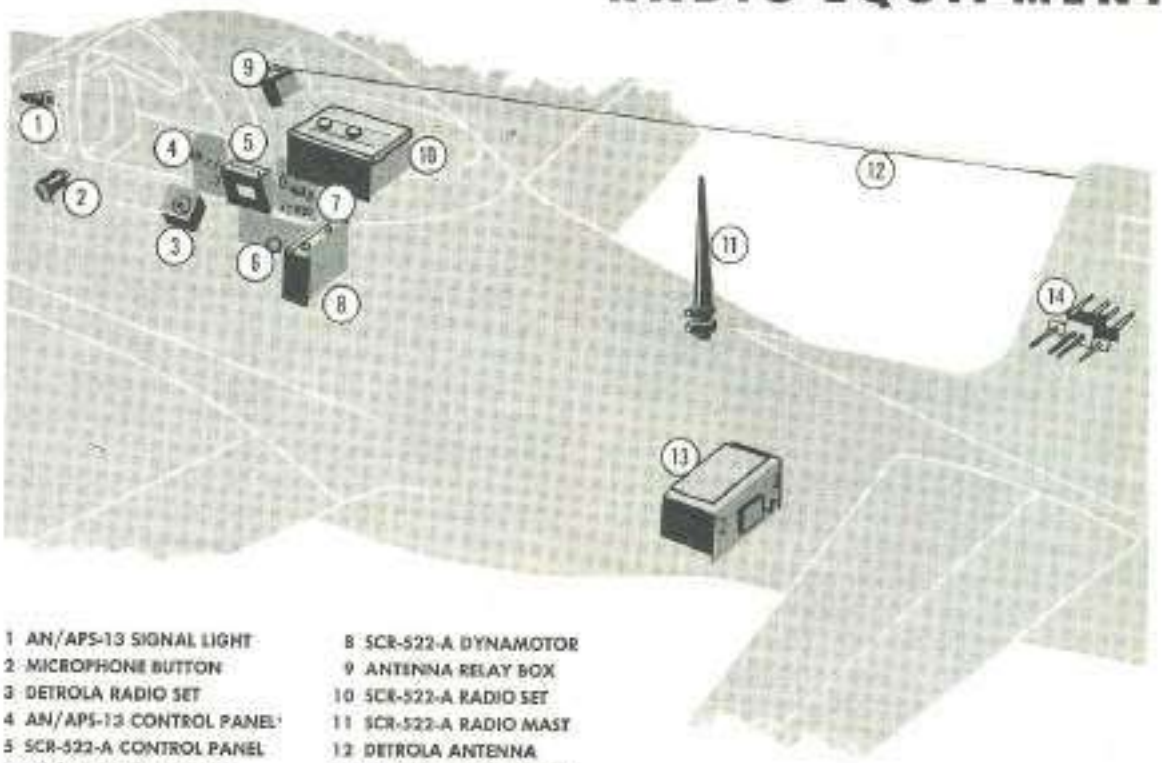
The remote indicator compass used on P-51D's replaces the conventional magnetic compass, although on late series airplanes a direct-reading, standby magnetic compass is also provided. The remote compass unit is in the left wingtip and transmits its readings electrically to an indicator on the instrument panel.

This type of compass doesn't float around and fluctuate when the plane maneuvers, and it gives you all the advantages of the directional gyro without the precession inevitable in the directional gyro. Both are provided, however, the directional gyro being available in an emergency should the electrical system fail.

The electrical-type tachometer operates directly from a small generator driven by the engine. The faster the engine turns over, the greater the output of this generator. The tachometer measures this generator output in terms of rpm. It operates independently of the main electrical system.



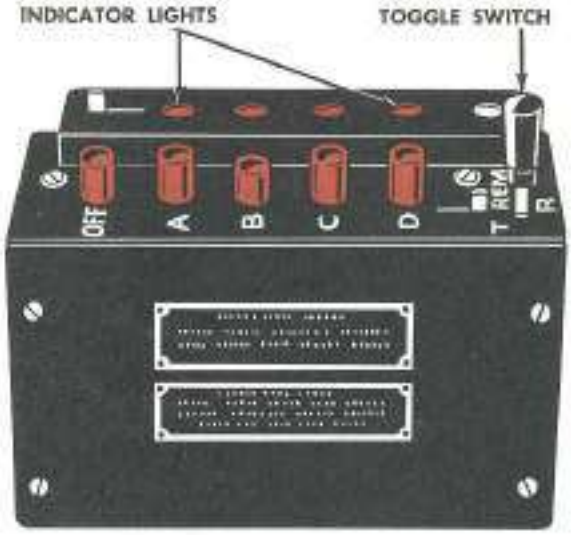
RADIO EQUIPMENT



1 AN/APS-13 SIGNAL LIGHT
2 MICROPHONE BUTTON
3 DETROLA RADIO SET
4 AN/APS-13 CONTROL PANEL
5 SCR-522-A CONTROL PANEL
6 AN/APS-13 SIGNAL BELL
7 IFF CONTROL PANEL
8 SCR-522-A DYNAMOTOR
9 ANTENNA RELAY BOX
10 SCR-522-A RADIO SET
11 SCR-522-A RADIO MAST
12 DETROLA ANTENNA
13 AN/APS-13 RADIO SET
14 AN/APS-13 ANTENNA

The radio equipment in the latest P-51D consists of a VHF (Very High Frequency) transmitter and receiver, a Detrola receiver, an AN/APS-13 rear-warning radio set, and an IFF (Identification, Friend or Foe) unit.

All radio equipment is in the fuselage, aft of the cockpit. Controls are in the cockpit, and are grouped at your right. Each set has its own antenna arrangement; the VHF antenna mast extends vertically above the fuselage aft of the cockpit, the Detrola wire antenna runs from the back armor plate to the top of the fin, the AN/APS-13 antenna rods extend horizontally from the sides of the fin, and the IFF antennae project from the undersides of the wings.



VHF CONTROL BOX

The VHF Set

You operate the VHF set by means of a control box which has five push buttons—an OFF switch and A, B, C, and D switches for selection of four different frequencies. These frequencies are crystal controlled and, therefore, cannot be adjusted in flight. You can transmit and receive on only one channel at a time.

Channel A is for communication with CAA radio ranges.

Channel B is the "American common" frequency; use it for contacting all towers in the continental United States equipped with VHF facilities. You will also use this channel for emergency homings.

Channel C is for interplane communications.

Channel D is the local homing channel used for practice homings.

Small colored lights alongside the four buttons show you which channel is in operation. These lights have a dimmer device which can be moved over the lights to dim them for night flying.

The toggle switch on the control box has three positions--REM (remote), T (transmit), and R (receive). This switch is usually safety-wired in the REM position.

When the toggle switch is in the REM position, the VHF set is controlled remotely by a push button on the throttle. When this throttle button is pushed in, you are transmitting; when it is out in normal position, you are receiving. Under ordinary circumstances you use the remote control and the throttle button.

A tiny white light besides the toggle switch shows you whether you are transmitting. This light stays on except while you're transmitting. If it doesn't go out when you press the throttle button you know that your transmitting equipment is not working.

On the other hand, the transmitter light may go out and stay out, indicating that your transmitter is on, because of either a stuck or shorted throttle switch, or a jammed relay. In either case, try to correct the condition by operating the throttle switch a few times, and turning the main radio switch off and on. If this doesn't help, break the safety wire and move the toggle switch from REM to R or T, as required.

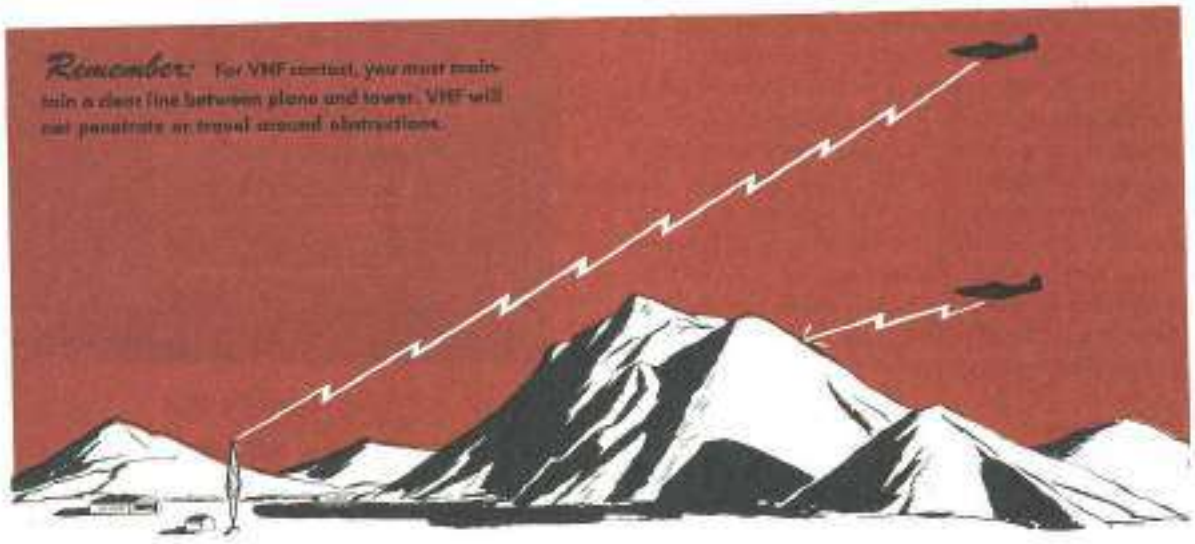
But remember, don't leave your transmitter on. If you do, the carrier wave will jam the channel so that no one else can use it.

You control the volume of the VHF set by means of a knob on the AN/APS-13 control panel located at your right side.

The chief advantage of VHF equipment is that it is not affected nearly as much by atmospheric interference as low-frequency equipment. Accordingly, it provides much better reception in bad weather.

The range of VHF equipment is normally about 200 miles at an altitude of 20,000 feet. Altitude and terrain determine range, because VHF transmission travels only in straight lines. In general, operation improves with increase in altitude.

To contact a VHF tower you must maintain an unobstructed line between the tower and your antenna. Remember, if the tower is below your horizon, if mountains, tall buildings, or



parts of your airplane are in the way, your transmission and reception will be blocked out. And here's a tip—if the tower you're contacting is close by, make a big turn around it, keeping the tower on the inside of the turn.

Don't forget that if you want to make contact with a distant VHF station you must get up high, above all obstructions. At 90 miles, for example, you must be up around 7000 feet; at 120 miles, about 10,000 feet.

The Detrola

The Detrola is a low-frequency receiver. It operates between 200 and 400 kc, which covers the transmission band for towers and range stations throughout the United States.

Operation of the Detrola is simple. It has only two controls—a station selector knob and a combination ON-OFF switch and volume control.

DETROLA CONTROL BOX

Although your headset plugs into the VHF equipment, you don't have to change your headset connection to use the Detrola. The Detrola is interconnected with the VHF equipment so that both units operate through one headset.

You can operate the Detrola and the VHF set independently or both at once. By turning on both sets you pick up not only the Detrola reception but also whatever is in the air on the particular VHF channel you are using.

Don't expect extreme long-range reception from the Detrola. When flying at altitudes of approximately 8000 feet or less, the range of your Detrola will normally be limited to about 50 miles, increasing with altitude to about 75 miles. That's about the maximum you can depend on, although under favorable conditions longer range reception may be obtained.

Remember, the Detrola is a receiver only. You can't talk to towers and range stations with this equipment. Your only means of talking to towers and range stations is the VHF set. That is the advantage of being able to use both sets at once—you can receive on one and transmit or receive on the other.

Rear Warning Radio

The AN/APS-13 unit is a light weight radar set that warns you, by means of an indicator light and a bell, of the presence or approach of other aircraft to your rear.

The red jewel indicator light is mounted on the left side of the instrument cowl, the bell is to the left of the seat. Control switches are provided on the panel at your right.

The equipment is automatic and is turned on and off by a toggle switch. There's also a check-

AN/APS-13 CONTROL PANEL

ing switch to test the operation of the light and bell, and a rheostat for controlling the intensity of the indicator light.

The IFF Set

The IFF set is an identification device for use in combat zones. Its operation is simple, so far as the pilot is concerned. It is automatic; all you have to do is turn it on and off with a toggle switch.

The IFF set has a detonator to destroy vital parts of the equipment if you have to abandon the airplane over unfriendly territory. The detonator is set off by pressing two push button switches which are in a box on the right side of the cockpit. Both buttons must be pressed simultaneously.

The IFF set also has an impact switch to set off the detonator in a crash landing. Thus, the equipment can be destroyed even if you have to bail out in a hurry and don't have time to press the two buttons.

RADIO NAVIGATION

To assist you in navigation, you have at your disposal a Detrola and a VHF set, which can be used independently or together. Using this equipment with regular radio navigation facilities, you should have no excuse for ever getting lost in this country, where radio facilities are unlimited.

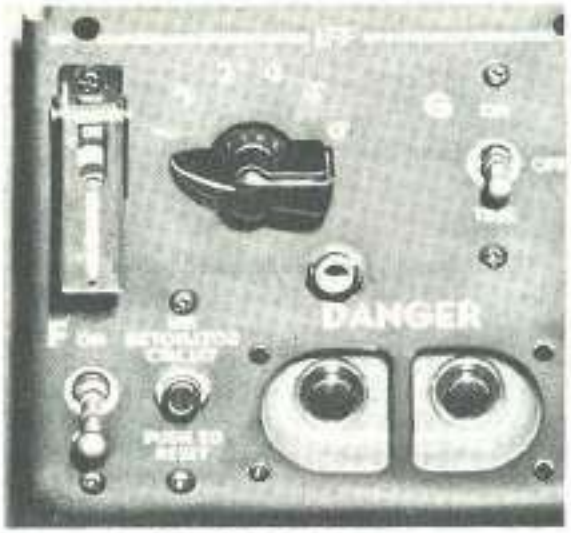
You should be thoroughly familiar with all the aids available in order to make full use of them. Unless you are, you may find yourself helpless in a situation which requires the particular equipment with which you are **not** familiar.

Too often pilots have a tendency to concentrate on only one facility. They use their VHF set, for example, almost exclusively, neglecting their Detrola. The danger of such faulty practice is obvious, so be as thoroughly experienced as possible with all the equipment at your command.

HOMING

Homing facilities are usually available on two of the VHF channels, B and D.

The detonator destroys the equipment internally, and the explosion won't harm you or the airplane.



IFF CONTROL PANEL

If you ever get into an **emergency** situation and require a homing, remember these two things:

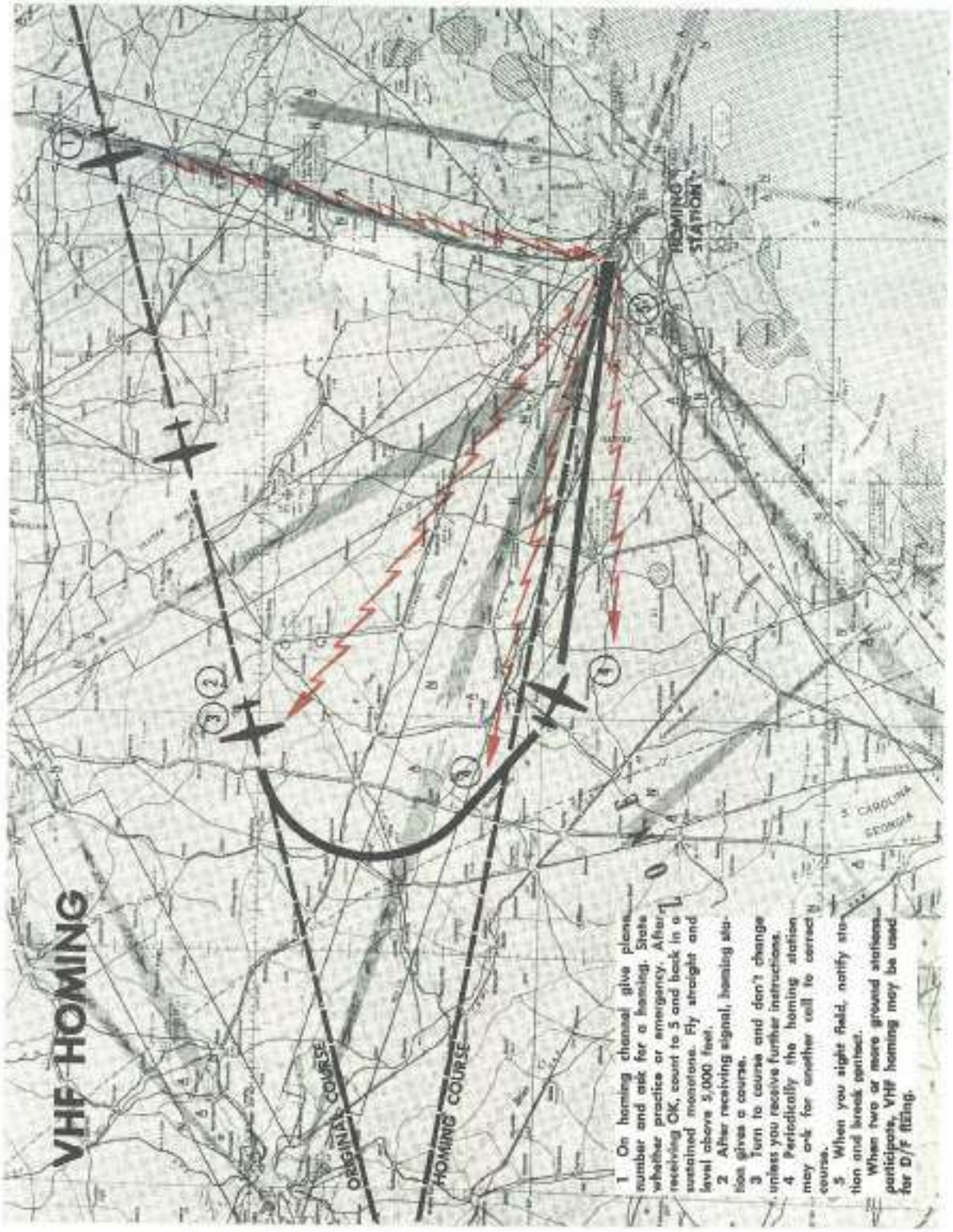
1. State definitely that you are requesting an **emergency** homing.

2. Call a known station if you know the approximate locality, but call for **any** station if it is an extreme emergency.

Many a pilot who could easily have been helped by the use of homing facilities has been lost because he failed to call **any** station that might have been listening and failed to make clear that he wanted an **emergency** homing. Other stations within hearing failed to take a fix on him because they thought he was only practicing.

If by any chance your VHF receiver is not working on the homing frequency, but you are able to transmit, inform the homing station accordingly, and request that a bearing be given to you on low frequency (200-400 kc), which you can pick up on your Detrola.

If your radio fails after you have received a fix, stay on your course and be on the lookout for the field.


VHF HOMING
ORIGINAL COURSE
HOMING COURSE
HOMING STATION
1 On homing channel give plane number and ask for a homing. State whether practice or emergency. After receiving OK, count to 5 and back in a sustained monotone. Fly straight and level above 5,000 feet.
2 After receiving signal, homing station gives a course.
3 Turn to course and don't change unless you receive further instructions.
4 Periodically the homing station may ask for another call to correct course.
5 When you sight field, notify station and break contact.
When two or more ground stations participate, VHF homing may be used for D/F fixing.

The most important thing to remember if you ever have to send an emergency message is:—**speak slowly** and **don't shout.**

If the emergency is at all serious you naturally want to say a lot in a few moments. If you aren't careful, however, you're likely to talk so fast and so loud that your message is garbled.

Also, don't be afraid that the people who pick up your message will judge the seriousness of your situation by the tone of your voice. You get just as much attention if you are calm and collected as you do if you shout.

In sending an emergency message, it is a good idea to use both the channel you are already on **and** the B (American common) channel, depending upon the urgency of the situation and the amount of time you have. All homing and VHF stations in the country stand by on B channel to relay emergency messages.

To free your hands if you want to transmit only, switch the lever on the VHF control box to T, the transmitting position. In this position you don't have to hold down the transmitter button on the throttle. Be sure your throat mike is firmly against your throat, above your Adam's apple.

Then call Mayday. Be sure to give your plane number or identification. Also give your approximate location, and, if possible, the nature of your trouble.

If you are making a forced landing or going to bail out, say so. That's the best way to make sure that help reaches you promptly. Rescue parties naturally concentrate their search when they know about where you are down.

In bailing out, put your VHF control switch on T and make sure you're on the B channel. Then, by means of the carrier wave, homing stations can get a fix on your plane as it goes down, even after you have left it.

Remember: On B channel you can give an open Mayday to **all** homing stations so that anyone receiving your call can give you a homing. You aren't limited to calling any individual station.

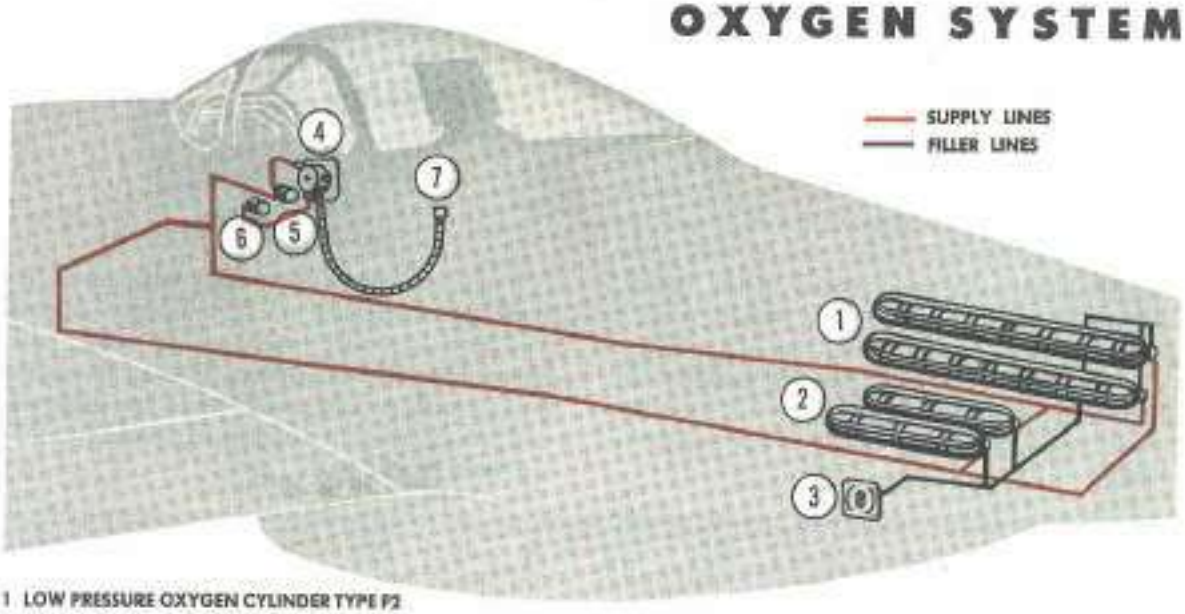
If you are in distress and your receiver isn't working, try transmitting regardless. Your transmitter may be working and others may pick up your signals. Even if you can't carry on a 2-way conversation, if you can report yourself, you will at least get the field cleared for an emergency landing, or if you come down elsewhere, get help promptly.

Don't hesitate to call if there is any emergency.

And once you call in for a landing in an emergency and get a clearance, go straight in and land without losing any time in circling the field or making any fancy traffic pattern. Get down as soon as possible. If you have time to circle the field, why call for an emergency landing?

If you hear an emergency message being transmitted, keep off the air. Give the man who is sending it a break—don't block out his message.

OXYGEN SYSTEM



1 LOW PRESSURE OXYGEN CYLINDER TYPE P2
2 LOW PRESSURE OXYGEN CYLINDER TYPE D2
3 FILLER VALVE
4 OXYGEN REGULATOR
5 PRESSURE GAGE
6 BLINKER FLOW INDICATOR
7 OXYGEN MASK TUBE

The oxygen system in the P-51 is the same as that used in all modern army fighter planes.

It is a low-pressure, demand-type system—that is, you don't have to control the oxygen manually as you change altitudes. A regulator furnishes the right amount of oxygen required at any altitude. It does this automatically—all you have to do is inhale in your mask.

Controls and gages for the oxygen system are in the right front section of the cockpit. These include:

—the automatic mixture regulator,
—a pressure gage, and
—a blinker indicator which indicates the flow of oxygen. The blinker opens when you inhale and closes when you exhale.

You can use several different types of masks with this equipment, including the A-10, A-12, and A-14.

Notice in the illustration that there are two controls on the automatic mixture regulator. The lever on the right turns the automatic mixing device on and off. For all normal operations it should be in the NORMAL OXYGEN position. Turn it to the 100% OXYGEN position if you want pure oxygen on demand. In this position the air intake is shut off and you breathe pure oxygen on demand at any altitude.

The other knob, which is red, is an emergency control. By turning this knob to the open position you bypass the regulator and receive a **continuous** flow of pure oxygen. If the tanks are full, you get a flow of oxygen for about 8 minutes.

Your oxygen supply is carried in four tanks, which are installed just aft of the fuselage fuel tank. There are two D-2 and two F-2 tanks (which have twice the capacity of the D-2's), for a total volume of 3000 cubic inches. A filler valve, accessible through a small door in the left side of the fuselage, permits refilling the oxygen tanks without removing them from the airplane. Normal full pressure of the system is 400 psi.

If oxygen comes in contact with oil or any material containing oil, spontaneous combustion and explosion are sure to occur. Take every precaution, therefore, to keep oil, grease, and all such readily combustible materials well away from all your oxygen equipment, including your mask.

APPROXIMATE OXYGEN SUPPLY

OXYGEN CONSUMPTION DEPENDS ON SO MANY VARYING FACTORS THAT ONLY AN APPROXIMATE TIME OF SUPPLY CAN BE GIVEN. THESE TIMES ARE BASED ON A 400 PSI INITIAL PRESSURE IN THE SYSTEM

ALTITUDE	NORMAL OXYGEN	100% OXYGEN	EMERGENCY
40,000	11.4 HRS.	11.4 HRS.	12.6 MIN.
35,000	8.1	8.1	12.6
30,000	6.0	6.0	12.6
25,000	6.0	4.9	12.6
20,000	7.1	3.3	9.0
15,000	8.1	2.7	9.0
10,000	10.2	2.1	9.0

OXYGEN AND HIGH-ALTITUDE FLYING

In high-altitude flying, never underestimate the importance of the correct use of oxygen. Have a mask that is properly fitted and inspected and check it frequently for leaks. Don't be satisfied that your mask is okay simply because it was all right when you first got it.

When you're going on a high-altitude mission, check your mask thoroughly:

1. Put your mask on and check for leaks by holding the palm of your hand over the male hose fitting and inhaling gently. The mask should tend to collapse on your face.

If the mask leaks, or if there seems to be anything wrong with it, don't try to correct the trouble yourself. See your Personal Equipment Officer.

2. Insert the male fitting of the mask into the metal coupling from the regulator. Be sure that the fit is snug.

3. Inspect the rubber mask-to-regulator tubing for any damage, such as tears, holes, and kinks. Be sure that the knurled collar at the outlet end of the regulator is tight.

4. Open the emergency knob slightly and check the flow. There should be a small drop in the pressure of the system. Pressure is normally about 400 psi when the system is full (300 psi if the tanks are shatterable type).

5. Turn the emergency knob off.

6. Turn the automatic mixture regulator to the 100% OXYGEN position. Make sure that, on inhaling, the regulator diaphragm goes in and that you get pure oxygen. Check the blinker indicator.

7. Turn the automatic mixture regulator to the NORMAL OXYGEN position.

When you're using your oxygen mask, be sure that the hose is firmly connected and that it doesn't become kinked or twisted. See that the clip is attached to your flying suit or parachute harness, with sufficient hose free to allow full head movement. If it's cold enough for ice to form in the mask, flex it with your fingers to break up the ice. However, ice rarely forms in a demand-type mask.

For additional information about the use of oxygen, see your PIF.

ARMAMENT

6—.50 CAL. MACHINE GUNS

2—500 LB. BOMBS

6—5-IN. ROCKETS

Gunnery Equipment

The main objective of a fighter airplane, as the name implies, is to fight—and that means gun-fight. Although its ability to carry bombs and rockets is of great importance, a fighter is primarily a flying gun platform—a means of taking firepower into the air.

Your success, then, as a fighter pilot will be measured not alone by how well you fly the Mustang, but by how well you use its guns.

Guns

The P-51D carries six free-firing .50 caliber machine guns, three in each wing. These guns are manually charged on the ground, and fire simultaneously when you press the trigger switch on the front of the control stick grip.

The maximum ammunition capacity is 400 rounds for each of the inboard guns, and 270 rounds for the center and outboard guns. This gives you a total ammunition load of 1880 rounds. The guns are adjustable on the ground, so that they can be harmonized to different patterns for various tactical situations. Usually they are aligned to converge at a range of from 250 to 300 yards.

An alternate installation is possible to meet situations where duration of fire rather than weight of firepower is of paramount importance. The center guns are removed; this allows 500 rounds of ammunition to be carried for each of the outboard guns. Your battery is thereby reduced to four guns, but the total ammunition load remains about the same.

This manual isn't intended to give you instructions in gunnery, but here's a tip—before you take off on a gunnery mission, be sure your guns are correctly loaded and charged, and that you know how fully loaded they are. There's no way of counting the number of rounds once you're in the air.

Gun Camera

A gun camera is mounted in the leading edge of the left wing, and is accessible for loading and adjustment from the left wheel well. A small door covers the camera aperture in the wing; this door remains open during flight, but is closed by a mechanical linkage when the landing gear is extended, thus protecting the lens from blown sand or pebbles when the airplane is on the ground.

Guns and camera are controlled by a three-position switch on the front switch panel; this same switch also turns on the lamp in the optical sight. With the switch flicked up to GUNS, CAMERA & SIGHT, the guns fire and the camera operates when you press the trigger on the stick. When the stick is down to CAMERA & SIGHT you'll take pictures by pressing the trigger, but the guns will not fire. Middle position of the switch is OFF; be sure to keep it there during takeoffs, landings, and all ground operations.

The guns and camera are heated electrically so that their operation is not affected by the extreme cold encountered at high altitude. Gun heaters are controlled by a switch on the right switch panel. The camera heater is built into the camera, and works automatically whenever the camera switch is turned on.

SELECTOR-DIMMER CONTROLS

GUN, CAMERA AND GUNSIGHT SWITCH

Be thoroughly familiar with your gunnery equipment and with it's limitations. The better you know your equipment, the better you know what to expect of it, in training and, most important of all, in combat.

GUNSIGHT

The P-51D carries a K-14 or K-14A gunsight, mounted on the instrument hood centerline. This sight contains both fixed and gyro-actuated optical systems, and computes the correct lead angle for targets at ranges of from 200 to 800 yards.

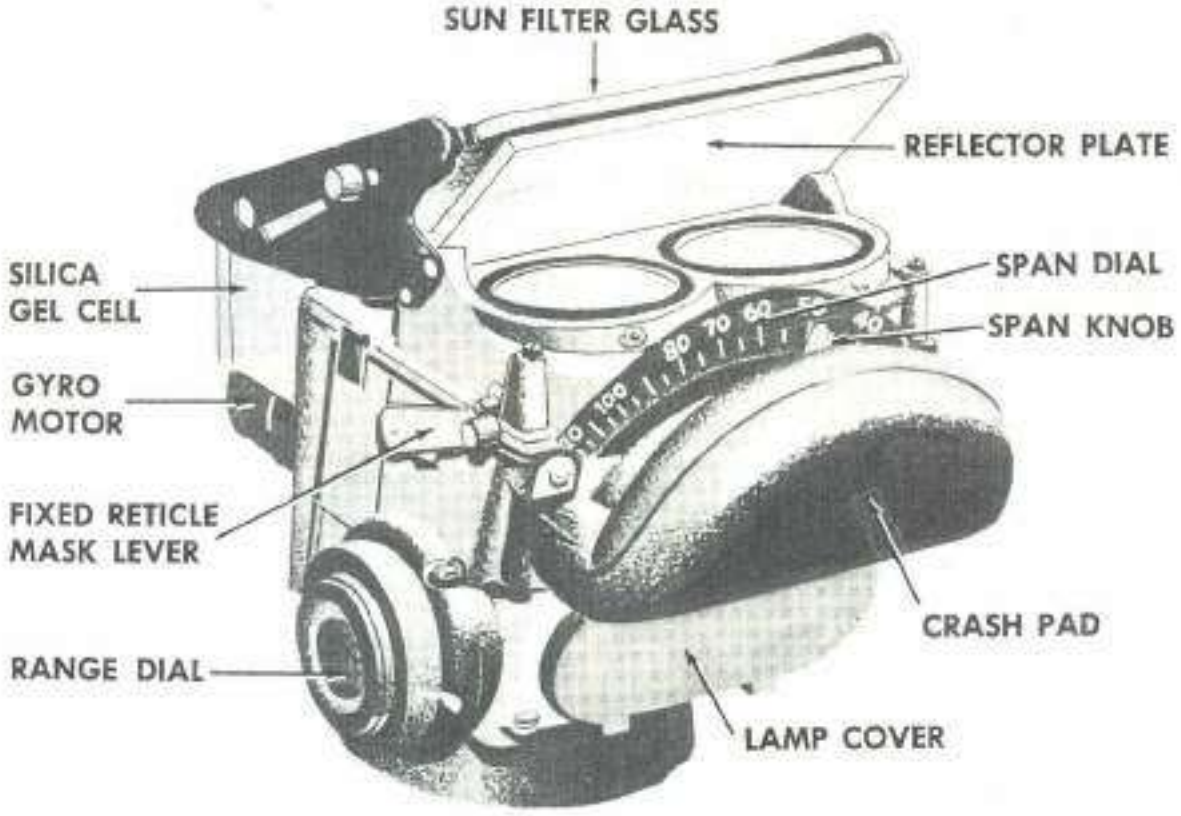
The fixed optical system projects on the reflector glass a cross, surrounded by a 70-mil ring which can be blanked out by pulling down the masking lever on the left side of the sight. The gyro system projects a variable-diameter circle of six diamond-shaped pips surrounding a central dot.

The images are selected and their brilliance adjusted from a selector-dimmer control panel located under the left side of the instrument hood. This panel also contains a two-position toggle switch controlling the gyro mechanism. Keep this switch ON at all times—in other words, see that the gyro is operating during takeoff, flight, landing, and ground operations. This will prevent the gyro from tumbling in its gimbals and possibly damaging the gunsight.

You adjust the sight for the size of the target by means of the span scale on the front of the sight. After that, range is set into the computing mechanism by rotating the throttle grip until the diameter of the gyro image coincides with the span of the target. Targets must be tracked for at least one second before the sight will compute effectively.

The K-14 sight differs from the K-14A only in that the latter has range lines on the fixed reticle; these lines are used for aiming rockets.

Earlier airplanes of the P-51D series are equipped with the N-9 gunsight. The rheostat for this conventional optical sight is on the front switch panel.



K-14A COMPUTING SIGHT

EFFECTS OF GUNNERY ON FLIGHT

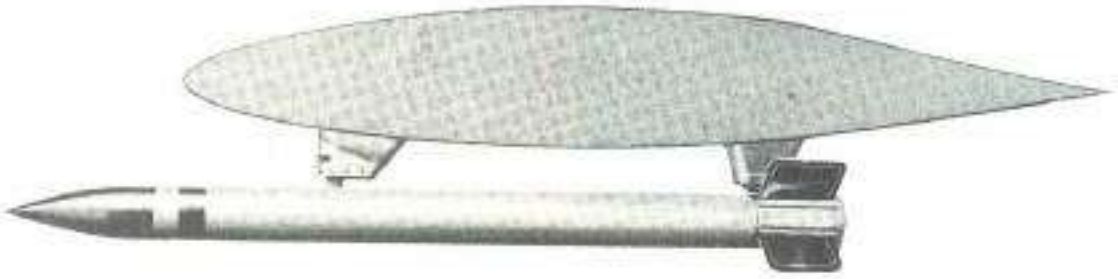
The weight of ammunition carried makes no appreciable difference in the handling of the airplane, but you will notice the effect of firing the guns. With all six guns firing, you feel a slight braking action, although the actual decrease in speed is insignificant.

A one-gun jam will make the airplane yaw slightly in the direction of the wing that has all guns firing. Two- or three-gun jams, all in the same wing, will make the skid more noticeable, especially if you hold a long burst. You can still use the other guns effectively—the trick is to fire short bursts.

Don't attempt to fire long bursts and compensate for the skid by using opposite rudder. Accurate compensation is impossible and you'll just be wasting ammunition.

PILOT FEELS SKID TO LEFT IF LEFT GUNS JAM

ROCKETS



The comparatively recent development of high-velocity aircraft rockets has greatly increased the destructive capacity of fighter airplanes. Self-propelling, the missiles have no recoil and consequently can be launched from a light airplane without danger to its structure.

Later airplanes of the P-51D series are equipped to carry ten 5-inch, zero rail rockets, five under each wing. Each rocket is supported at nose and tail by a pair of launchers which are attached to the wing structure. The forward launcher contains an arming solenoid and supports the rocket by means of a forward-opening slot which engages a lug on the rocket. A safety-wired latch on the aft launcher restrains the rocket from slipping forward and falling off. When the rocket is ignited, its forward thrust shears the safety wire, allowing it to shoot forward from the launchers.

Four of the rockets are installed close to the bomb racks. Consequently, when bombs or droppable tanks are attached to the racks, only six rockets can be carried, three on each wing.

Rocket control switches are located on the front switch panel. The rockets are fired by pressing the button on top of the control stick

grip. Setting the rocket release control to SINGLE or AUTO allows you to fire the rockets either one at a time or in train.

ROCKET CONTROL PANEL

Your procedure for firing rockets is as follows:

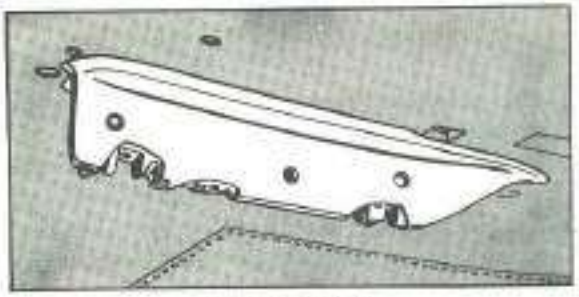
1. Turn the ROCKET TO BE FIRED dial to 1.
2. Flip the bomb-rocket selector switch to ROCKETS.
3. Move the arming switch to INST. or DELAY, as desired.
4. To fire the rockets one at a time, turn the rocket release control to SINGLE and press the button on the stick, once for each rocket.
5. To fire all the rockets in train, turn the release control to AUTO, and hold the button down. All ten rockets will be released within about one second.

Rockets cannot be jettisoned, nor can they be released in a safe condition, since the base fuse will always detonate the rocket after impact regardless of whether or not the instantaneous nose fuse is armed. Therefore, if an emergency situation (an anticipated belly landing, for example) makes it desirable for you to get rid of the rockets, use good judgment in doing so. Fire them into terrain where the resultant explosions will not endanger human lives.

BOMBING EQUIPMENT

One of the features that makes the P-51 such an outstanding airplane is its adaptability as a fighter-bomber. Though not originally designed for this purpose, its surprising load carrying capacity, ultra high speed, and excellent diving ability made it a natural for bombing assignments. As the war developed, the P-51 proved to be a better dive and skip bomber than most other airplanes, including many of those especially designed for the purpose.

The removable bomb racks slung under each wing are designed to hold either 100-, 250-, or 500-pound bombs. 1000-pound bombs can be carried to accomplish particular missions, but the extra weight is undesirable and restricts the airplane to straight and level flight. If bombs are not installed, chemical smoke tanks or droppable fuel tanks may be carried.



BOMB RACK

Under normal circumstances you will drop the bombs by means of the electrical release system. The bomb circuits are controlled from the front switch panel, and the release button is on top of the stick. To operate them you will:

1. Turn the bomb-rocket selector to either BOTH or TRAIN. With the switch at BOTH, the two bombs will be dropped simultaneously when the release button is pressed. At TRAIN, pressing the button will release the left bomb only; pressing it a second time releases the right bomb.

2. Flip the arming switches to ARM, unless you're jettisoning bombs over friendly territory, in which case leave the switches at OFF.

3. Press the release button on top of the control stick grip.

You can safely drop bombs when the airplane is in any flight attitude from a 30° climb to a 90° dive. But if you're sideslipping in a vertical or near-vertical dive, don't release bombs; one of them **might** fall into the prop and that wouldn't be good.

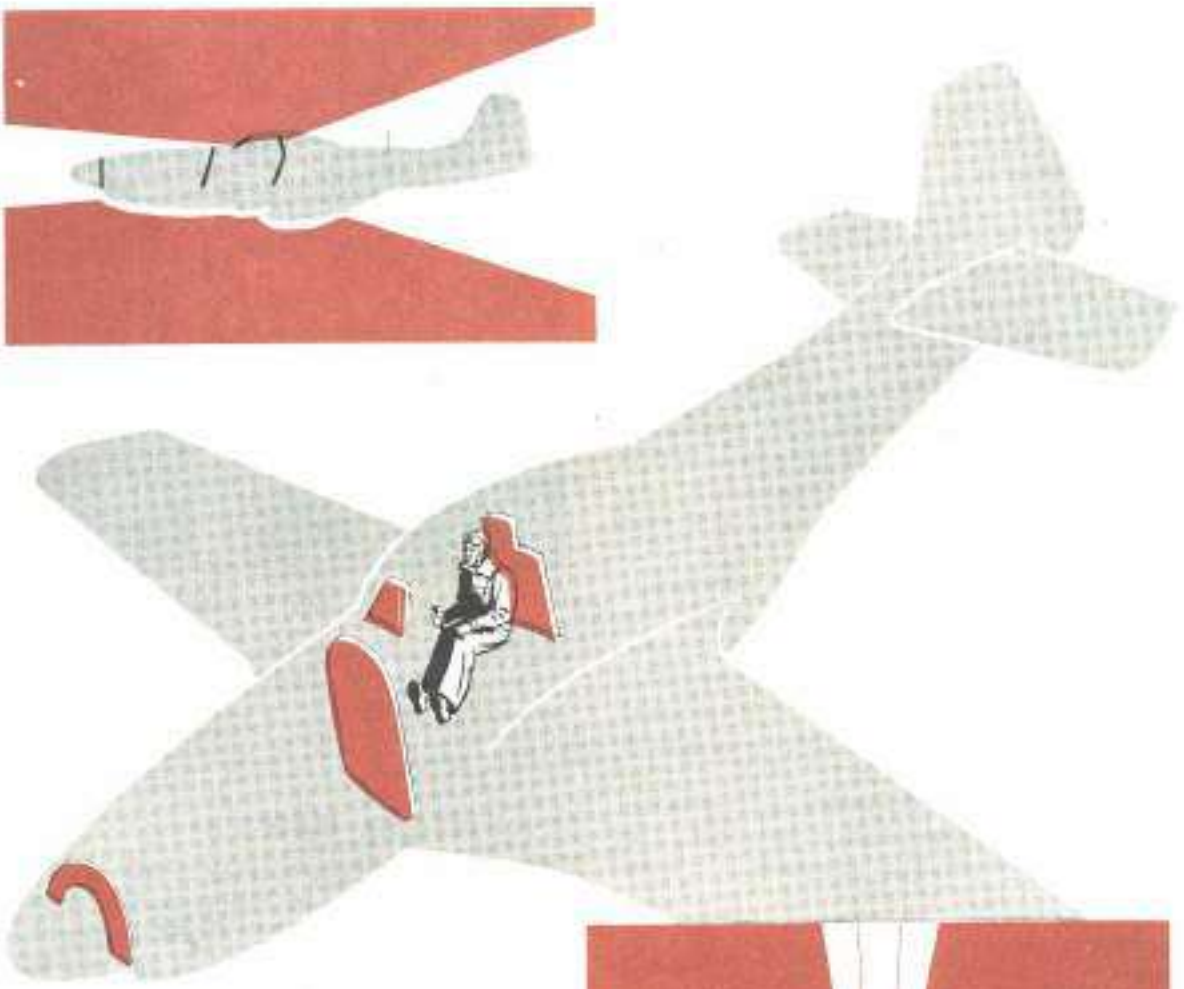
In case of emergency, either or both bombs can be released mechanically by pulling the salvo handles, located just below the throttle quadrant. Bombs can be salvoed in armed or safe condition, except in the event of electrical system failure, in which case the bombs cannot be armed.

Chemical tanks or droppable fuel tanks are released like bombs, either electrically or mechanically. Notice that you have to use the mechanical release if, for any reason, you want to drop the right hand bomb or tank before releasing the left.

BOMB SALVO RELEASE

CHEMICAL TANKS

You operate smoke or spray tanks by holding the left or right (or both) bomb arming switches in the CHEM. RELEASE position. Return the switch to OFF when you see that smoke or spray is being ejected; the action will continue automatically until the tank is empty.

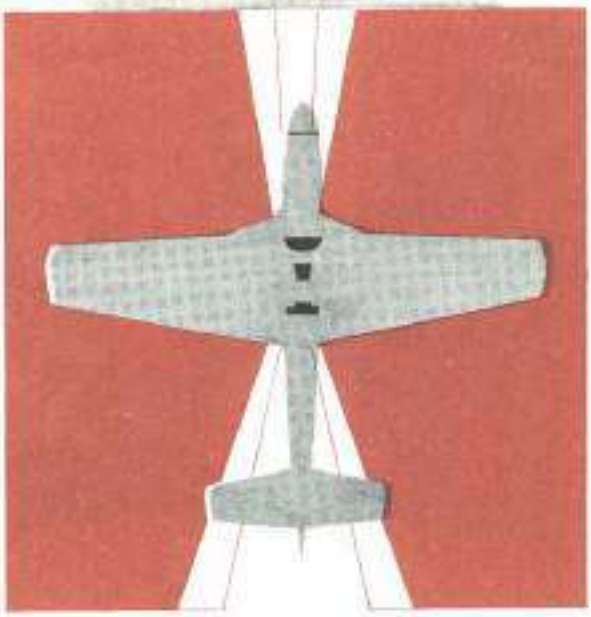


ARMOR

The armor protection is shown in the accompanying illustration. Note that there is armor plate at three points:

1. Back of the pilot's seat, which gives you protection from the rear.
2. At the firewall in the opening between the engine and the fuselage, and
3. Behind the spinner, in front of the coolant tank.

You are further protected by the bulletproof glass windshield and the engine itself, which protects you from head-on gunfire.



SIGNALING EQUIPMENT

The signaling equipment on a P-51 for use in an emergency, in the event of radio failure, or in combat zones when it is necessary to maintain radio silence, includes the following:

FLARE GUN

CAUTION: Insert the gun into the tube before loading it. Don't load the gun first, as there is danger of accidentally discharging the flare into the cockpit.

The flare gun, otherwise known as a pyrotechnic recognition signal pistol, is stowed in a canvas holster which is to the left and in back of the pilot's seat. There is a tube opening in the left side of the cockpit which enables you to fire the flare gun from inside the plane. The position of the tube is such that the signal is discharged in a rear upward direction.

Cartridges for the flare gun are stowed in a bag under the holster.

The flare gun can be used to indicate distress when coming in for an emergency landing, or as a recognition signal in cooperation with ground troops.

If you load the gun and then decide not to use it, always remove the flare cartridge, since there's no safety on the breech mechanism. Never leave a loaded gun in the mount, or stowed in the holster. There's no percentage in booby-trapping your ground crew.

RECOGNITION LIGHTS

Three colored recognition lights (red, green, and amber) are located on the underside of the right wing, near the tip. By means of three-position toggle switches on the electrical switch panel at your right, these lights can be used in any combination. You can burn them steadily, or flash code signals with them.

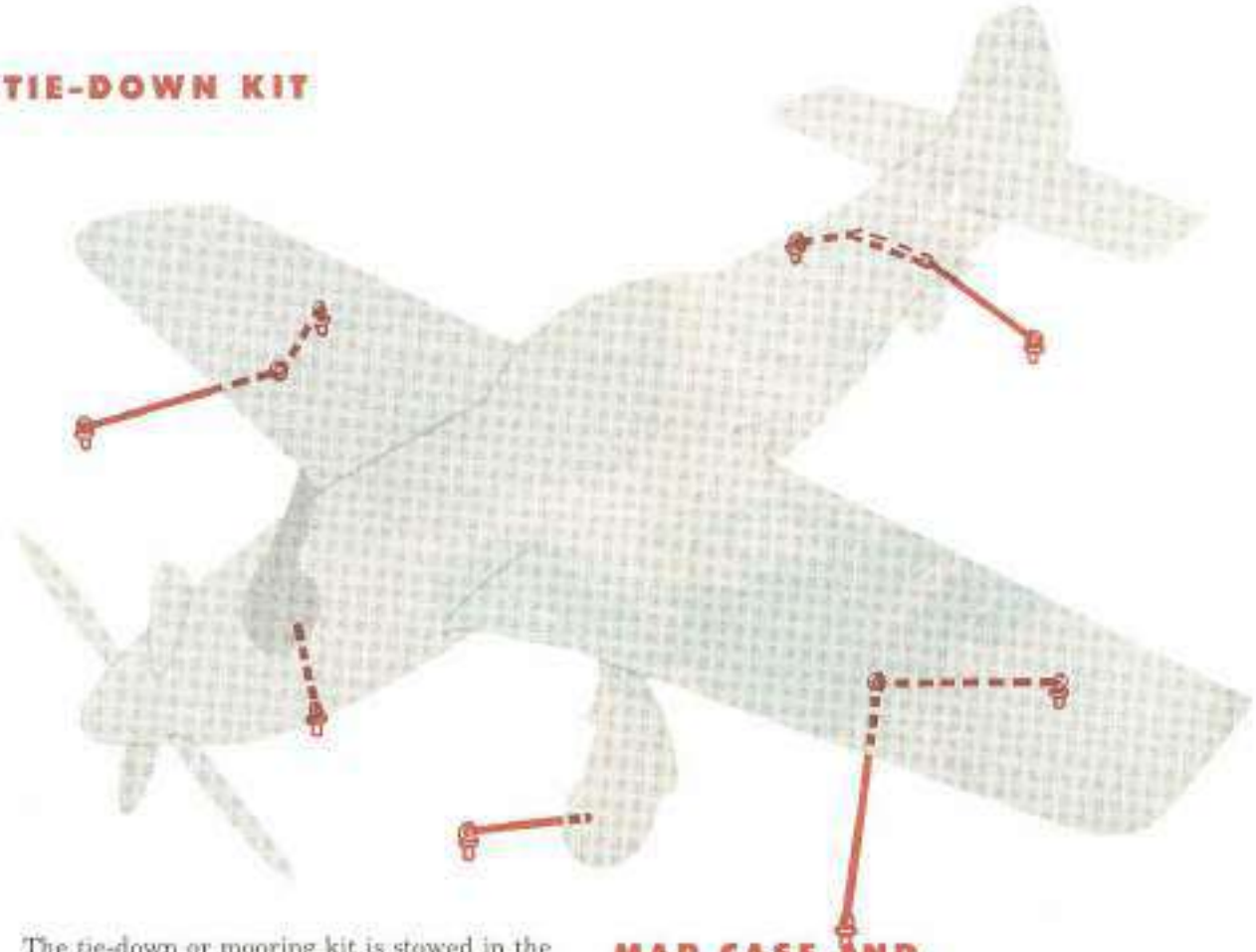
When these switches are in the down position, the lights burn steadily. When in the center position, they are off.

When in the up position, you can operate the lights intermittently, in code signals, by means of the key on top of the small box just above the switches.

DO NOT OPERATE FOR OVER 10 SECONDS ON GROUND, OR HEAT WILL MELT PLASTIC LENS

MISCELLANEOUS EQUIPMENT

TIE-DOWN KIT



The tie-down or mooring kit is stowed in the right side of the fuselage, above the fuselage fuel tank.

The kit includes several sections of rope and standard metal tie-down stakes. A recommended method for tying down the P-51 is shown in the accompanying illustration.

DATA CASE

The airplane's data case is kept stowed in the fuselage, just aft of the oxygen cylinders.

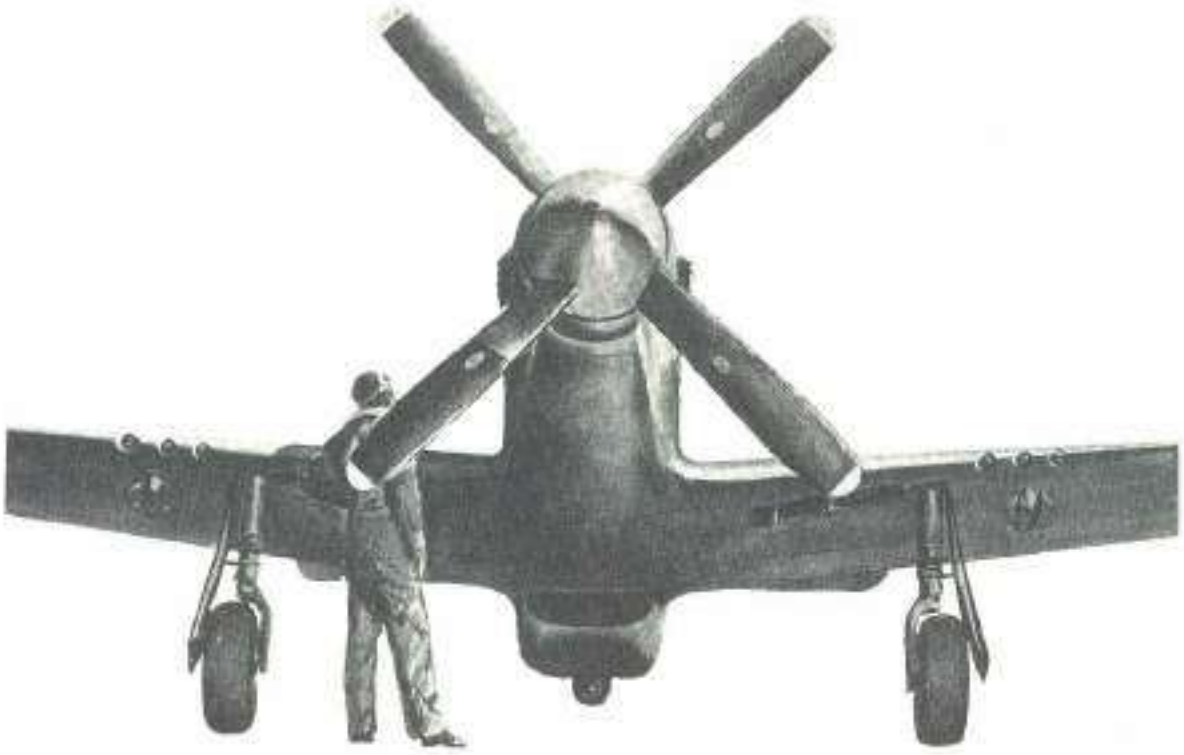
MAP CASE AND DROP MESSAGE BAG

The map case is located just to the left of your seat. Attached to it is a fiber holder containing a drop message bag.

PILOT'S RELIEF TUBE

The relief tube is stowed on a bracket on the floor of the cockpit at the left of your seat.

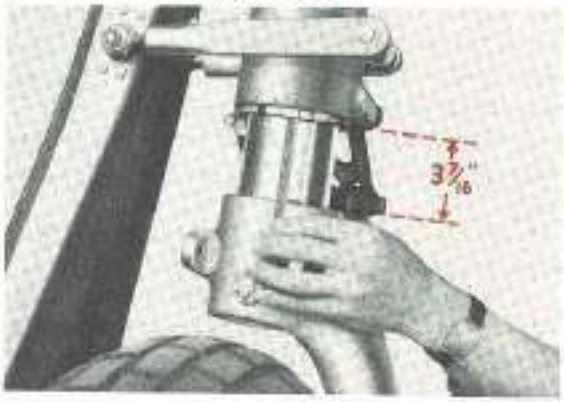
FLYING THE P-51



EXTERNAL CHECK

In walking up to the plane and going around it:

1. Check the tires. See that they are properly inflated—especially that they are not too low—and not worn deeply in spots.



2. Check the clearances of the landing gear struts. The clearance should be about 3-7/16 inches, and equal on both struts.

3. Check the pitot tube to make sure the cover is removed.

4. Make sure the covers on the gun hatches are securely fastened.

5. Check the caps on the gas tanks, making sure they are properly closed.

In looking over the plane, check all the Dzus fasteners, especially those around the nose section. Also, be sure to check the screws in the fairings, especially those between the wing and the fuselage.

It's a good habit to approach the plane from the front and go around it in a clockwise direction, ending up at the left wing ready to hop into the cockpit.

CHECK BEFORE STARTING

As soon as you've climbed into the cockpit, make sure that the ignition switch is OFF and that the mixture control is at IDLE CUT-OFF. Have a couple of mechs pull the prop through at least 12 blades. After you have done this, make the following check around the cockpit, working from left to right:

1. Form 1-A—take the form 1-A from the case and check the status of the airplane. Make sure
   —that the airplane has been released for flight;
   —that it has been serviced with gas, oil, and coolant. If everything is okay, initial the Form 1-A.
2. Fuselage fuel—check the gage on top of the fuselage fuel tank.
3. Flap handle—UP.
4. Carburetor air control—forward in RAM AIR position.
5. Trim tabs—set as shown below.

6. Landing gear handle—DOWN.
7. Left fuel gage—check gage, located on floor at your left.
8. Mixture control—IDLE CUT-OFF.
9. Propeller control—full forward to INCREASE.
10. Throttle—open to START when quadrant is so marked, otherwise open one inch.
11. Armament switches—bomb and rocket switches OFF, gun safety switch OFF, gunsight selector-dimmer switch ON.
12. Altimeter—zero or set at field elevation, as required.
13. Gyro instruments—uncage directional gyro and flight indicator.
14. Controls—Adjust your rudder pedals to comfortable position, then unlock the controls and check to see that they operate without binding. Watch the control surfaces for correct response.
15. Parking brakes—set. Don't try to hold plane with foot brakes.
16. Supercharger—AUTO.
17. Fuel shut-off valve—ON.
18. Fuel selector valve—set at the tank to which vapor return line is connected.
19. Right fuel gage—check gage, located on floor at your right.
20. Fuel booster—ON (NORMAL in earlier airplanes).
21. Ignition switch—turn to BOTH.
22. Battery and generator switches—ON.
23. Coolant and oil switches—operate manually from CLOSE to OPEN several times, and check by listening to determine whether the doors are operating. Then turn the switch to AUTOMATIC.
24. Prime and start—having completed this left to right check, you're now ready to start the engine in accordance with the procedure given below. But before you do, this may be a good time to make some of the following checks, depending on the type of mission anticipated.

a. Before any flight, check the landing gear warning lights by pushing in on the lamp housings.

b. If you expect to use oxygen, check the gage for a pressure of 400 psi.

c. If night flight is anticipated, check all essential lights—instrument fluorescent lights, cockpit swivel lights, position and recognition lights, and landing lights.

STARTING PROCEDURE

After completing the Before Starting Check, proceed as follows:

1. Prime the engine three to four seconds if it is cold, one if hot.

2. Raise the starter switch cover and hold the switch at START.

3. As the engine starts, move the mixture control to RUN (AUTO RICH on some earlier airplanes). If the engine fails to take hold after several revolutions, give it one second's more prime.

Note: If the engine cuts out after starting, return the mixture control immediately to IDLE CUT-OFF.

4. Check that oil pressure goes up to at least 50 psi within 30 seconds. If it doesn't, stop the engine.

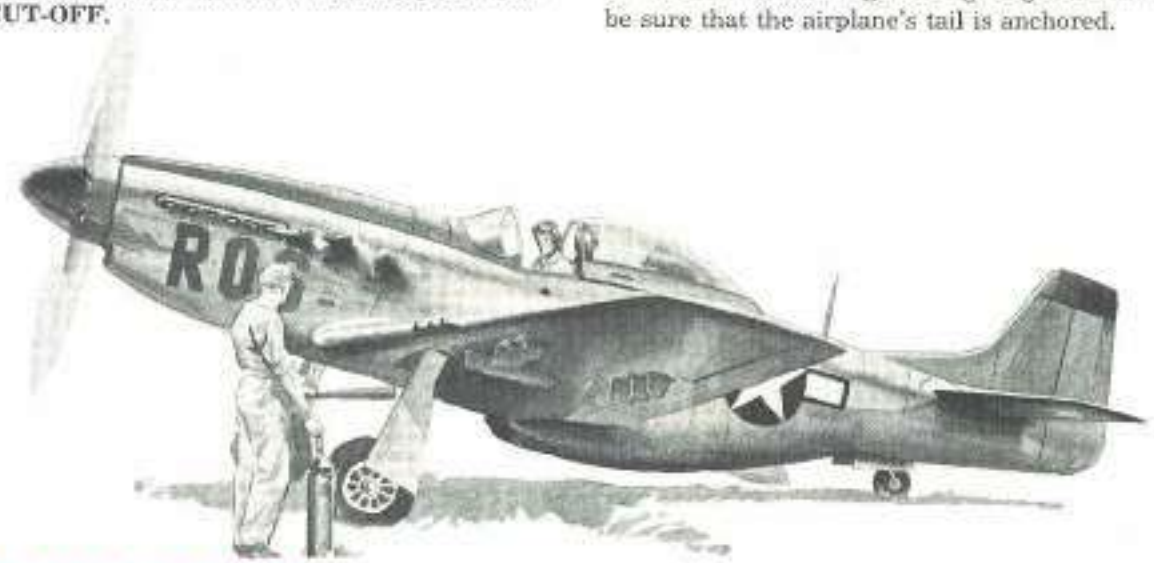
5. Idle at about 1200-1300 rpm until the oil temperature reaches 40°C and the oil pressure is steady.

6. Check the suction gage for from 3.75" to 4.25" of vacuum.

7. Check all the engine instruments. Make sure they don't exceed or fall below their limits.

After the engine is warmed up, idle at 1000 rpm or slightly less. This keeps your engine clean but not too hot.

If for any reason you expect to pull more than 40" of manifold during the engine ground run, be sure that the airplane's tail is anchored.



STARTING TIPS

1. Throttle position is important. To obtain a rich starting mixture without excessive priming, be sure your throttle is opened to the START position, or 1 inch if your throttle quadrant doesn't have the starting position designated. When the engine catches, advance the throttle to idling rpm.

With the V-1650-7 engine, the spark advance operates with the throttle. Therefore, if the throttle opening is too great, the spark will be advanced too far for starting and the prop may kick back when the engine is turned over.

2. The P-51 is easily overprimed. Use one second's prime if the engine is warm, three or four if the engine is cold. If the engine doesn't start on the first few revolutions and flames from the exhaust spread up over the cowl:

a. Immediately cut the mixture control back into IDLE CUT-OFF.

b. Then open the throttle gradually, and keep the starter turning the engine over.

c. Turn off the booster pump.

d. Turn off the starter as soon as the engine is cleared.

Do not operate the starter for over 15 seconds continuously.

If the engine is underprimed, prime it for an additional second while the engine is turning over. It should start immediately. If it doesn't, shut off the starter and repeat the process after a few moments.

STOPPING THE ENGINE

1. Put the propeller control full forward. This makes the engine easier to start next time.
2. Idle at 1500 rpm.
3. Turn the booster pump off.
4. Move the mixture control to IDLE CUT-OFF, opening the throttle as the rpm drops below 700 rpm. (Don't open the throttle above 700 rpm as any sudden opening of the throttle at this point discharges fuel into the carburetor and this causes after-firing—the engine sputters and attempts to fire again.)
5. Turn the ignition switch OFF.
6. Turn off all electrical switches. Don't forget the battery switch.
7. Lock the controls, and move the carburetor air lever to UNRAMMED FILTERED AIR.

If you are going to use the parking brakes, give them plenty of time to cool or they may freeze in place. Unless you have to, better not use the parking brakes at all except in tying down the airplane for the night.

Caution: Before leaving the cockpit, be sure all the switches are in the OFF position.

TABLE OF MANIFOLD PRESSURE AND RPM LIMITS FOR FLIGHT

	TAKEOFF MAXIMUM	WAR EMERGENCY	MILITARY POWER	MAXIMUM CONTINUOUS	MAXIMUM CRUISE
MANIFOLD PRESSURE	61"	67"	61"	46"	42"
RPM	3000	3000	3000	2700	2400

TABLE OF ENGINE INSTRUMENT LIMITS

	COOLANT TEMPERATURE	OIL TEMPERATURE	OIL PRESSURE	FUEL PRESSURE
MINIMUM			50 PSI	14 PSI
DESIRED	100°-110°C	70°-80°C	70-80 PSI	16-18 PSI
MAXIMUM	121°C	105°C		19 PSI

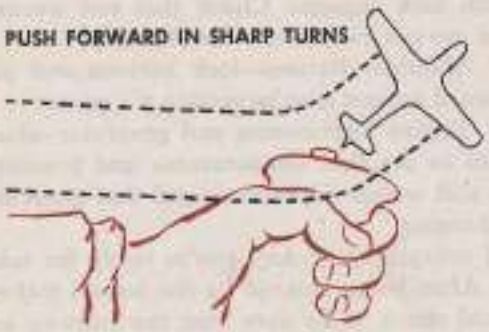
TAXIING

When the airplane is in a 3-point attitude, the nose restricts forward visibility. This means that in taxiing you must keep S-ing continually.

Taxi with the canopy open. This not only aids visibility, but keeps the cockpit cooler on the ground.

In ordinary taxiing, keep the stick in neutral or slightly aft of neutral. This locks the tailwheel and makes it steerable 6° right or left with the rudder.

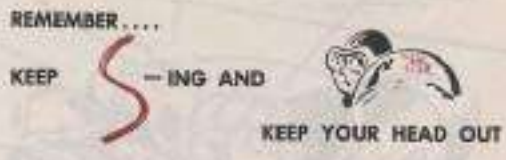
To make sharp turns or to go around corners, unlock the tailwheel by pushing the stick full forward. In this position the tailwheel is full swiveling. Be careful not to start a sharp turn before unlocking the tailwheel; it tends to bind.



If you have any trouble in unlocking the tailwheel:

1. Roll the airplane straight ahead for a short distance, and push the stick forward to release it, or
2. Wiggle the rudder controls while holding forward pressure on the stick.

Throttle back when taxiing and use the brakes as little as possible. There is no point in wasting a lot of gasoline and burning up your brakes on the taxi strip.



After taxiing out to the end of the taxi strip, stop at a crosswind angle so that you can look out for other airplanes and avoid dusting those behind you.

PRE-TAKEOFF CHECK

Before taxiing out onto the runway for takeoff, run up the engine and check the mags, prop, and supercharger.

1. Check the mags at 2300 rpm, and don't hold the check for longer than 15 seconds. The maximum allowable drop is 100 rpm on the right mag, and 130 rpm on the left. If either drops more than allowable, it may be that the plugs have been fouled by excessively slow engine speed in taxiing. In this case, you can often clear the plugs by the following procedure:

a. Run the engine up to about 30° of manifold pressure. Hold this for one minute, watching the coolant and oil temperatures to see that they remain within limits.

b. Test the mags again. If either one still drops too much, return to the line.

2. Check the prop by moving the control towards DECREASE RPM. After a drop of 300-400 rpm is indicated on the tachometer, return the prop control full forward to INCREASE RPM position. The engine should resume its former speed.

3. With the engine running at 2300 rpm, check the supercharger by holding the switch in HIGH. A drop of at least 50 rpm should be noted. Return the switch to AUTO.

LOOK AROUND BEFORE LINING-UP FOR TAKEOFF

After you've seen that the mags, prop control, and supercharger are okay, check each of the following points:

1. Coolant and oil switches—AUTOMATIC.

2. Mixture and prop controls—mixture control must be at RUN or AUTO RICH, prop control full forward to INCREASE RPM.

3. Prop and throttle friction locks—tighten these sufficiently to ensure that controls will stay put during takeoff.

4. Fuel booster—check switch at ON. If your plane has a three-position booster pump switch, flip it to EMERGENCY.

5. Hydraulic pressure—should check at 800-1100 psi with an engine speed of about 2300 rpm.

6. Canopy lever—close canopy and make sure crank lock engages. Check that red warning pins are not visible at sides of canopy.

7. Shoulder harness—lock harness and pull forward against it to be certain it's secure.

8. Engine instruments and generator—check again to see that temperatures and pressures are still within limitations, and that generator is charging.

If everything is okay you're ready for takeoff. After being cleared by the tower, make a visual check to be sure that the runway and approaches are clear.

TAKEOFF

REMEMBER: Avoid sudden bursts of power in the takeoff. Make it smooth and steady.

After you have pulled out and lined up on the runway, make sure that the steerable tailwheel is locked—it must be locked with the stick back for takeoff.

Then advance the throttle, gradually and smoothly, to 61" of manifold and 3000 rpm. Don't hoist the tail up by pushing forward on the stick until you have sufficient airspeed to give you effective rudder control.

This is important to watch in the takeoff, since the P-51, like all single-engine planes, has a tendency to turn left because of torque. If you horse the tail off the ground too quickly with the elevators, better be ready to use right rudder promptly.

Keep the airplane in a 3-point attitude until you have plenty of airspeed. In a normal takeoff, the rudder trim tab is sufficient to make the torque almost unnoticeable.

After takeoff:

1. Raise the landing gear by pulling the landing gear lever inward and up. Be sure the lever catches in the up position.

Caution: Don't brake the wheels after takeoff. Doing so may fuse the discs of brakes that are hot from extended taxiing. If this happens you'll nose up or groundloop on landing.

2. After reaching an altitude of 500 feet, throttle back to 46" of manifold at 2700 rpm.

3. Re-trim the ship for climbing attitude desired.

4. If your airplane has a three-position booster pump switch, set it at NORMAL when an altitude of 500 feet has been attained. With later planes, leave the switch ON at all times.

5. Then check over all your instruments. See that they are functioning properly and not exceeding their limitations.

In checking the instruments, make sure the ammeter indicator shows the generator is charging properly. Immediately after takeoff, the rate of charge should not exceed 100 amps, dropping back to the normal 50 amps or less after 5 minutes' operation. If it doesn't drop back to normal, turn the generator disconnect switch OFF and return to the field.

Make sure, also, that hydraulic pressure builds up to approximately 1000 psi after the landing gear has been retracted.