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AAF MANUAL 51-127-4

# PILOT TRAINING MANUAL FOR THE THUNDERBOLT

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# P-47

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AAF MANUAL 51-127-4

# PILOT TRAINING MANUAL FOR THE THUNDERBOLT

# P-47N

Hq. Army Air Forces
Washington 25, D. C. 1 Sep 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: 1st Air Force, 2nd Air Force

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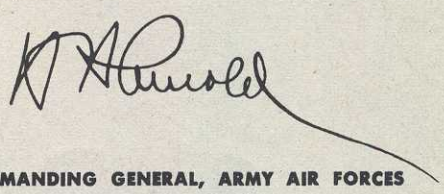
# Introduction

This Manual is the text for your training as a P-47N pilot and airplane commander.

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 described.

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-47N so long as you fly it. This is essentially the textbook of the P-47N. Used properly, it will enable you to utilize the pertinent Technical Orders to even greater advantage.



COMMANDING GENERAL, ARMY AIR FORCES

U.S.

This manual deals with the P-47N, a very long range fighter-bomber developed to blast the Japs in the Pacific. Since its birth U. S. bases have crept much closer to the Japanese Islands, so the chances are that few 2000-mile fighter missions will be required.

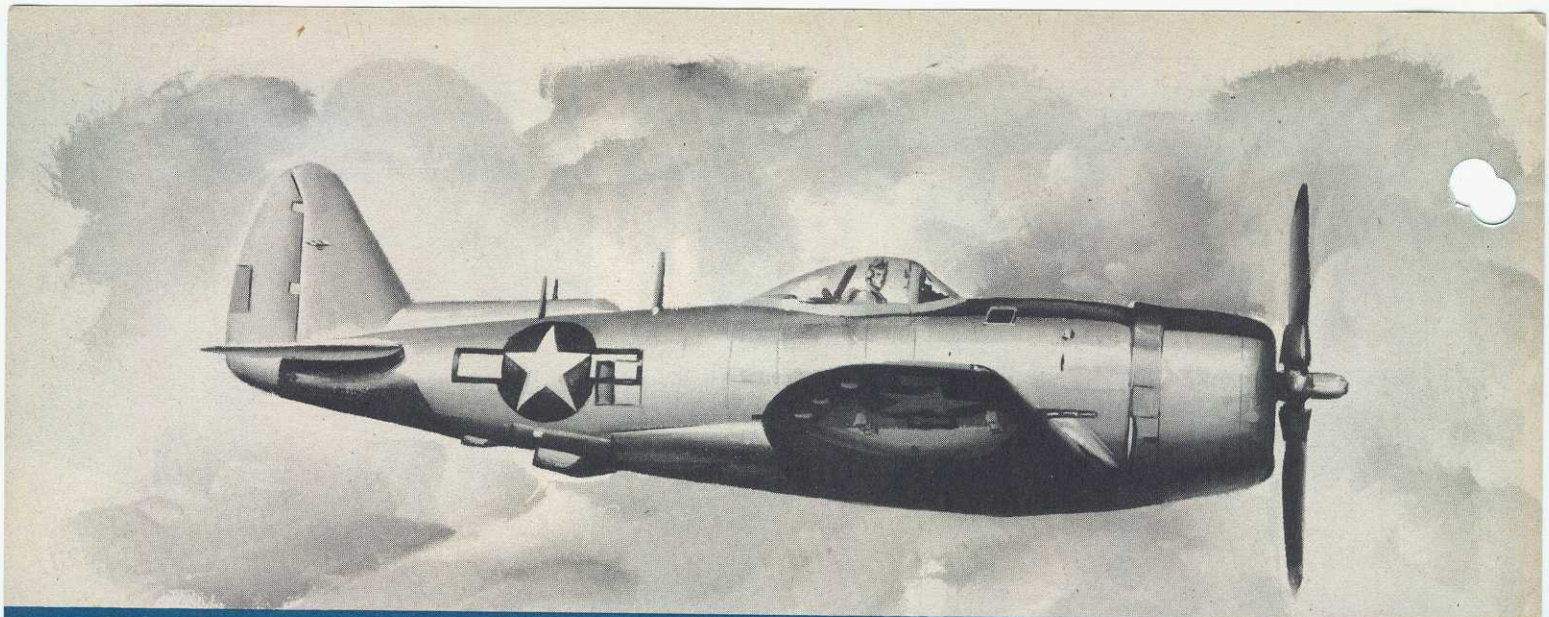
Nevertheless, the strategic value of such an airplane is enormous. Wherever N's are based, the Japs are in danger of escorted bomber strikes or fighter sweeps over a radius of 1000 miles or more. This takes in quite a lot of territory, even in the broad reaches of the Pacific, and provides a constant headache for the diminishing Japanese air force. The airplane's value as a fighter-bomber is enhanced by the large internal fuel capacity.

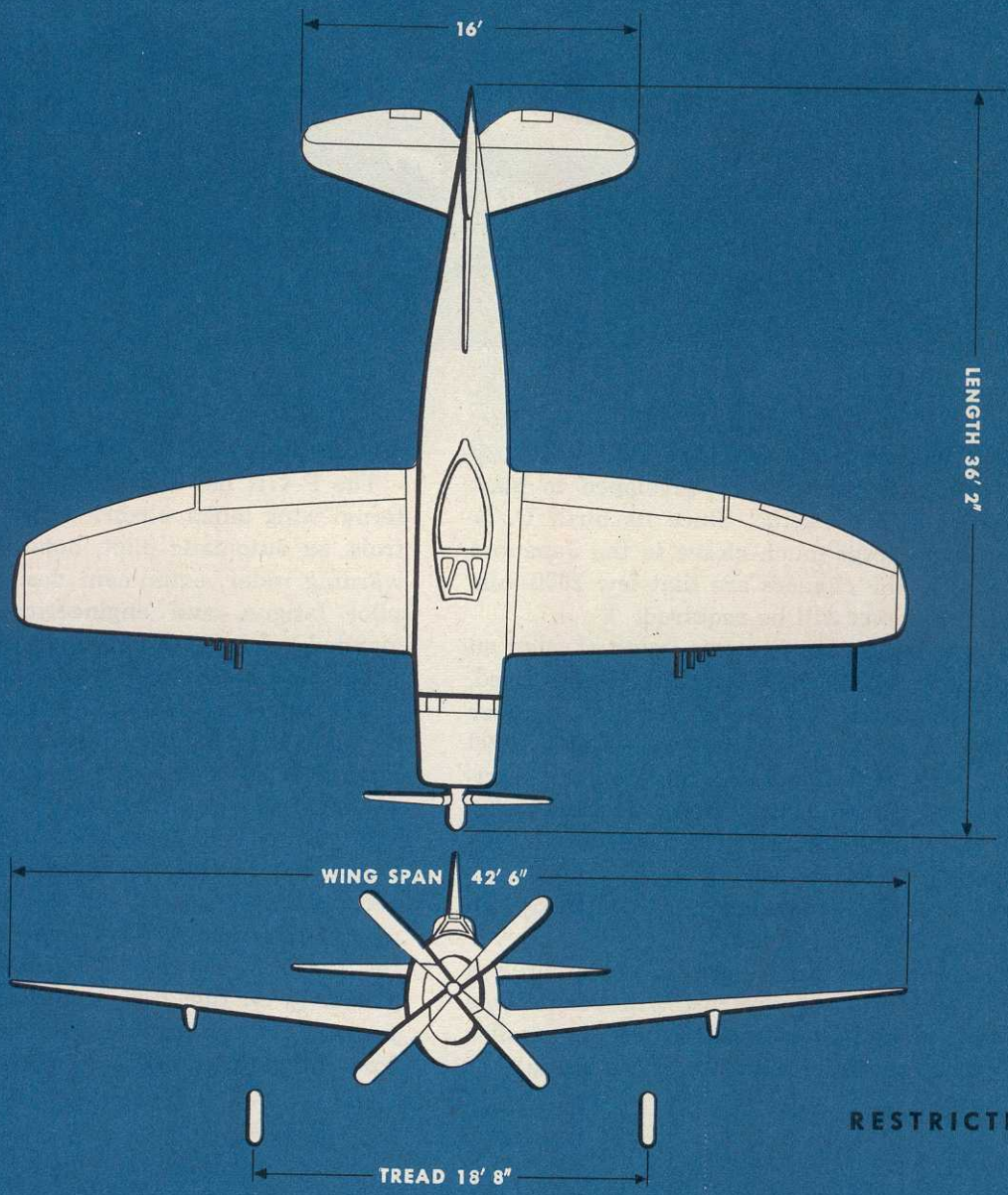
At first glance, the N appears to be merely a P-47D with squared wing tips. With comparable loading, the flight characteristics are similar and much of the equipment is the same, but actually the P-47N is a different airplane.

The P-47N has a more powerful engine, internal wing tanks, electrification of many controls, an automatic pilot, homing radio, a tail warning radar, equipment designed to reduce pilot fatigue, and engineering changes demanded by the greater weight.

The N is not difficult to fly, but study is required to get the most out of the plane. It was designed for missions requiring maximum performance. The pilot—you—must also be capable of that type of performance.

The N is still undergoing development. As bugs or possibilities for improvement show up, subsequent series will be modified. However, most major changes have been incorporated in the P-47N-5. Therefore this manual is based primarily on that series. Master the N-5 and you will have no trouble with any N that comes from the production line or modification center.





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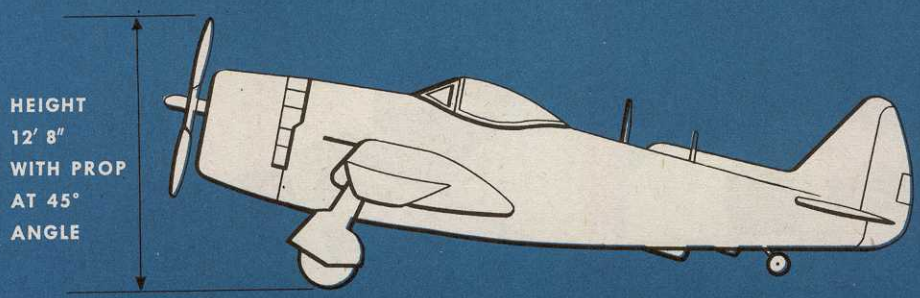
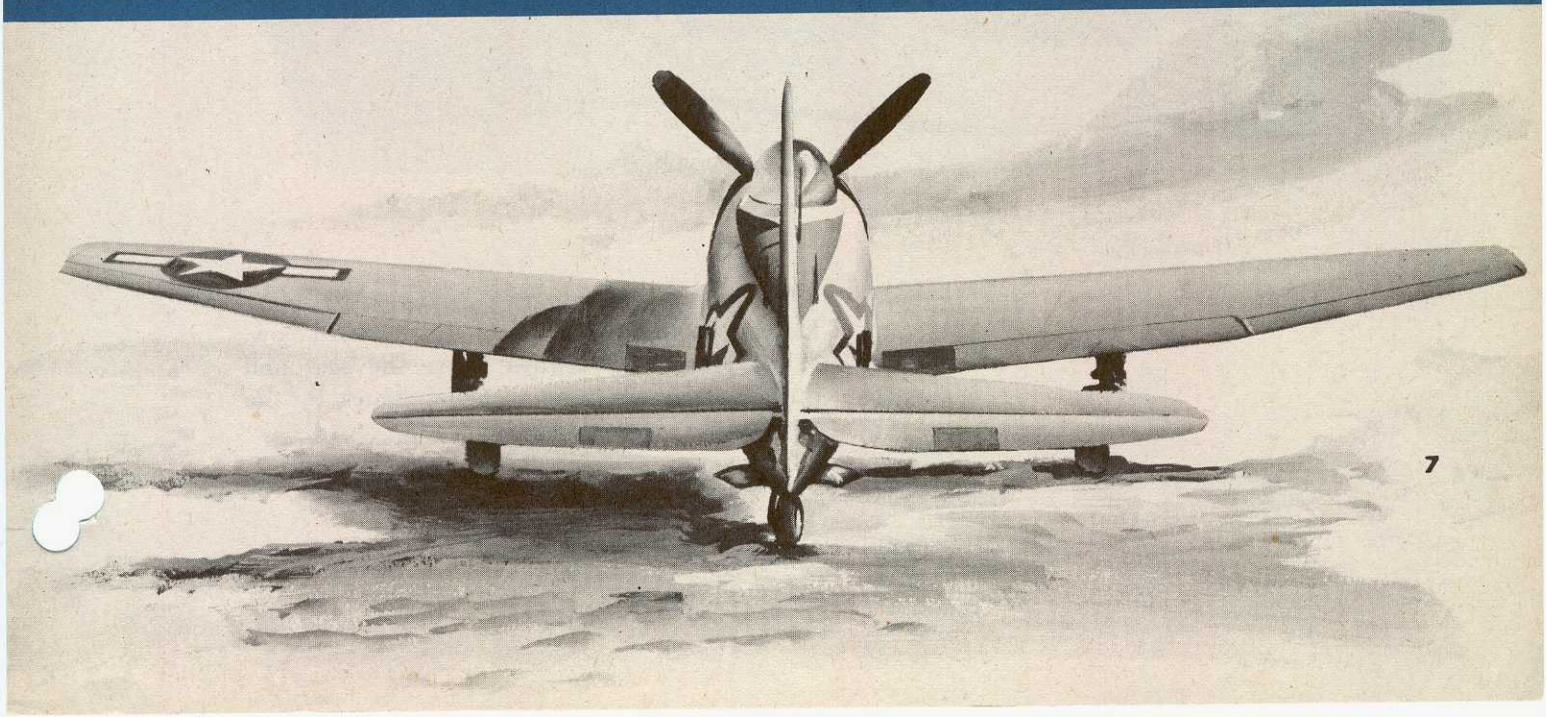



| | |
|---|---|
| **WING AREA:** | 322.2 sq. ft., giving a wing loading of approx. 43 lbs. sq. ft. with normal gross weight 13,854 lbs. |
| **WEIGHT:** | Empty—10,998 lbs. Useful load varies from 2,824 to 10,199.9 lbs. |
| **FUEL CAPACITY:** | Internal load: approx. 550 gals.<br>External load: approx. 440 gals.<br>Total max. load: approx. 990 gals. |
| **RADIUS OF ACTION:** | More than 1000 miles. |
| **ENGINE:** | 18-cylinder, twin-row, Pratt and Whitney "C series," developing 2100 rated hp., and 2800 hp. with water injection. |
| **STALLING SPEED* (POWER OFF):** | Flaps and landing gear up: Approx. 115 IAS.<br>With landing gear extended, flaps retracted: Approx. 117 IAS.<br>With both gear and flaps extended: Approx. 100 IAS. |

*Without external load, or with drop tanks attached but empty.



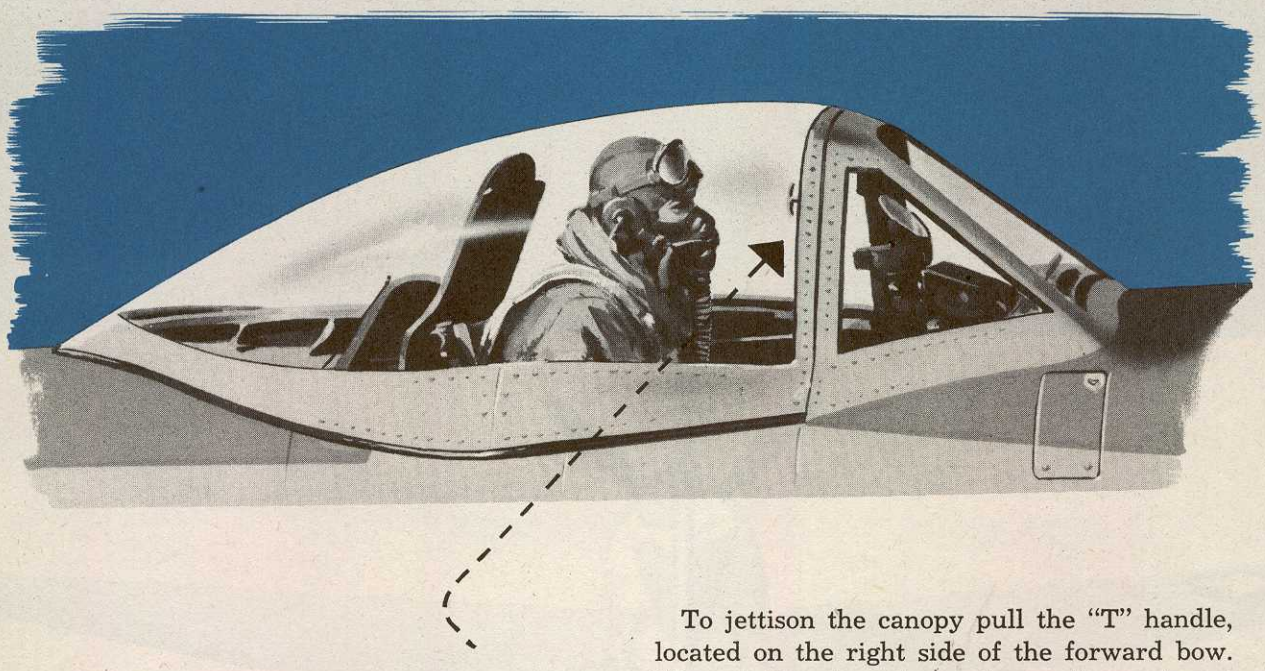
# Canopy

You operate the canopy either electrically or manually.

Electric operation is managed by a toggle switch above the propeller control box. When you release the toggle, the canopy remains fixed in the last position.

To operate manually, pull inward on the knobs at the leading edges and slide the canopy to the desired position.

To open the canopy from the outside, pull open the flush mounted lever just below canopy rails on the left side.



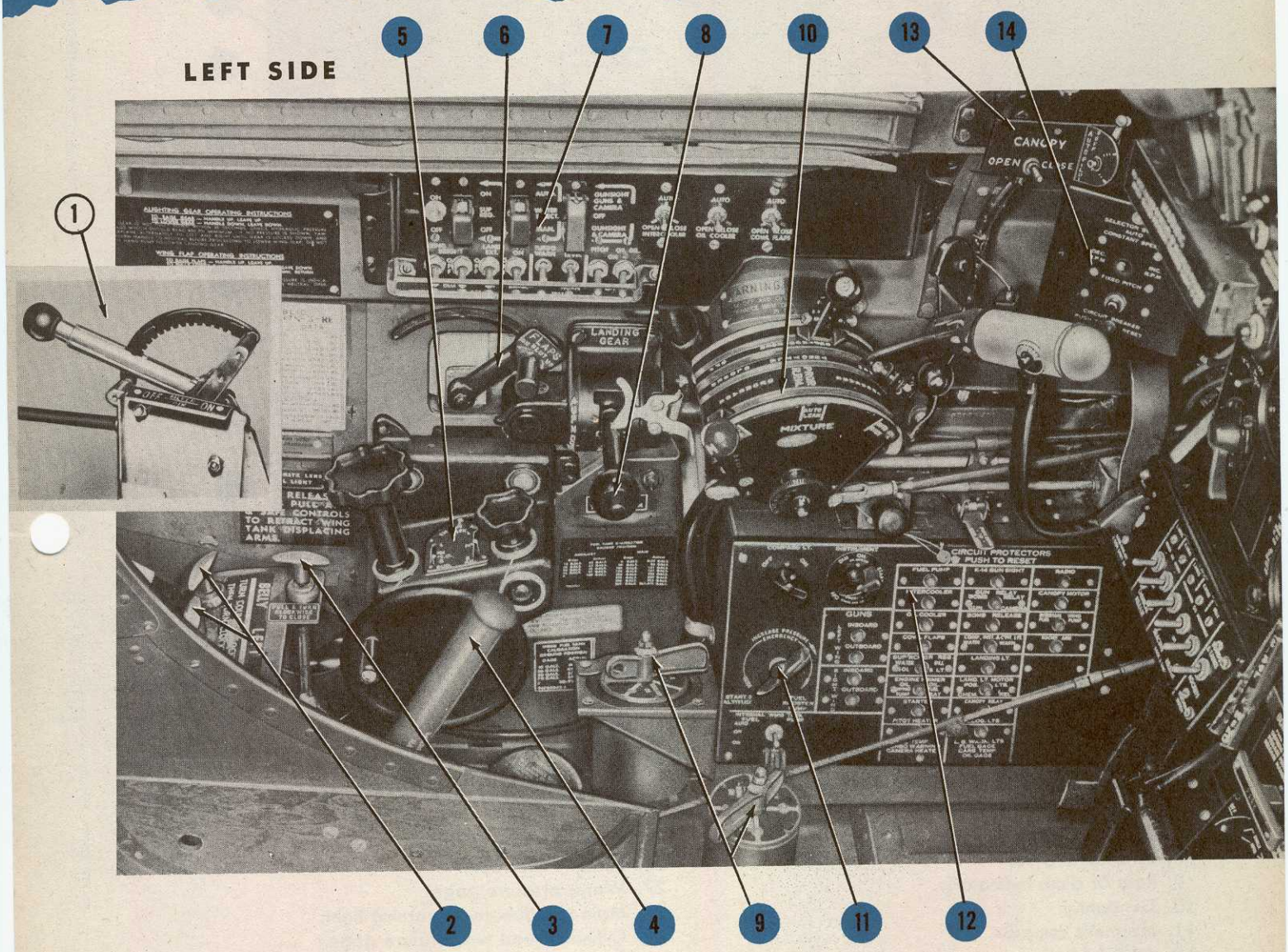
To jettison the canopy pull the "T" handle, located on the right side of the forward bow. When jettisoning always lower the seat and duck your head, to avoid being struck by the bow.

# The Cockpit

## OF THE P-47N-5

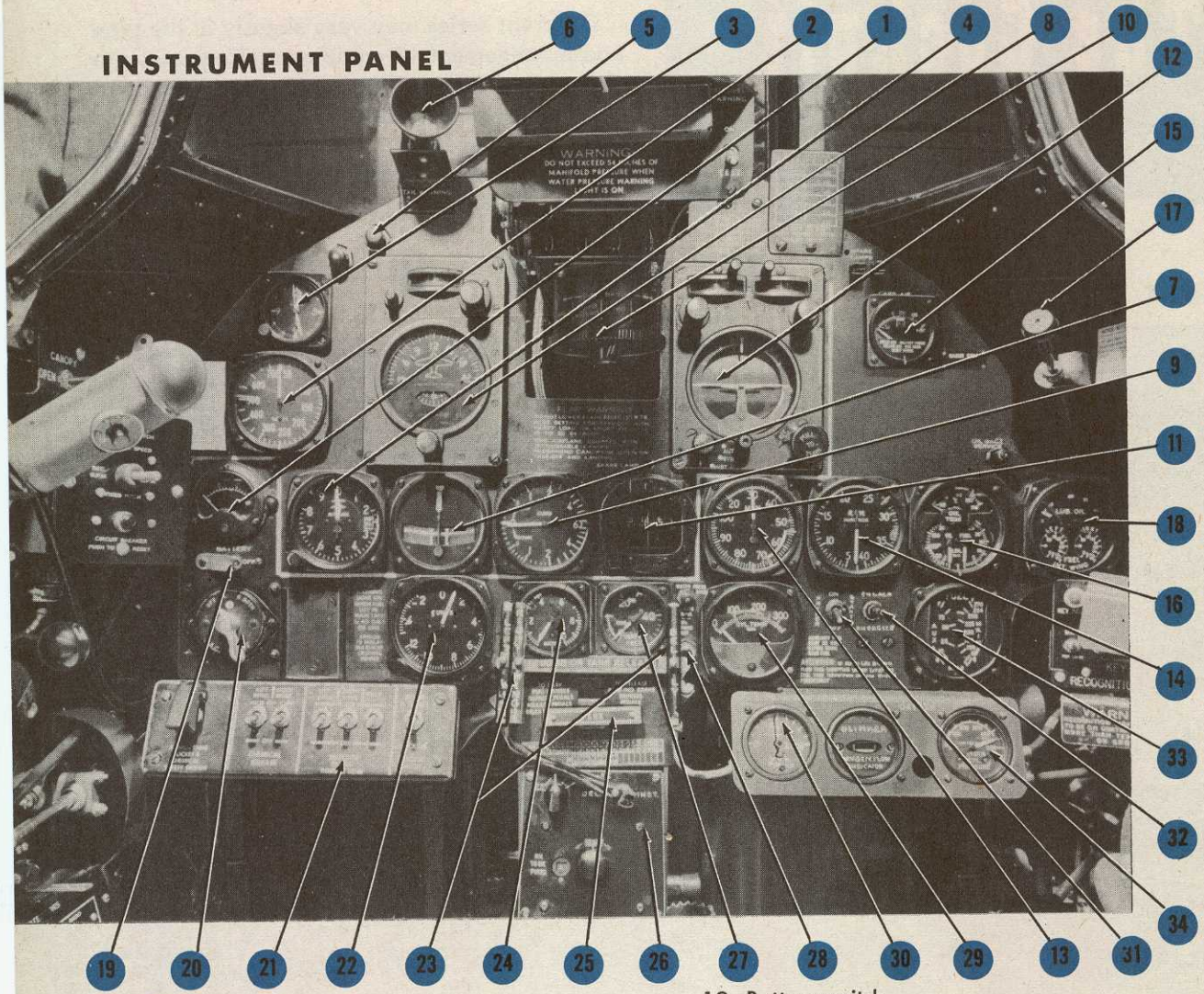
Different series may vary slightly in the type and arrangement of equipment. However, the changes are minor. Where reference is made to a control or gage in the succeeding pages, if it is considered necessary, the number of the item will be given to enable you to check its position in the cockpit.

### LEFT SIDE



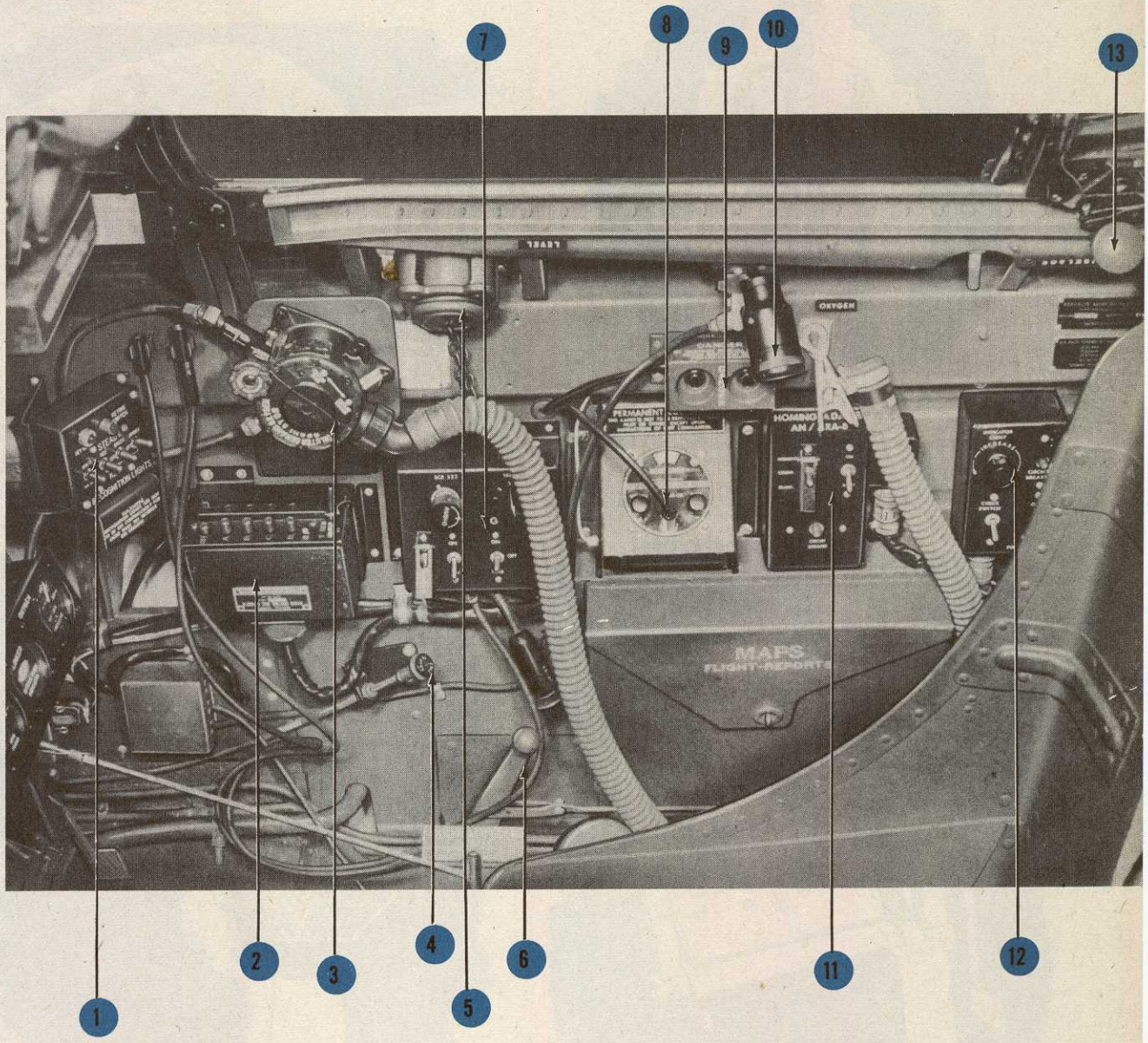

1. Air filter control.
2. Bomb arming handles.
3. Gunbay heat control.
4. Manual hydraulic pump.
5. Trim tab control unit.
6. Flap control.
7. Main switch panel.
8. Landing gear control.
9. Fuel selector cocks.
10. Throttle quadrant.
11. Fuel booster pump rheostat.
12. Circuit protectors panel.
13. Propeller selector panel.
14. Autopilot ON-OFF control.

## INSTRUMENT PANEL




1. Ammeter.
2. Airspeed indicator.
3. Clock.
4. Altimeter.
5. Landing gear warning lights.
6. Tail warning light.
7. Bank and turn indicator.
8. Directional gyro.
9. Rate of climb indicator.
10. Gunsight.
11. Magnetic compass.
12. Artificial horizon.
13. Manifold pressure gage.
14. Tachometer.
15. Carburetor air temperature gage.
16. Fuel and oil pressure and oil temperature gage.
17. Defroster control.
18. Internal wing fuel and oil quantity gages.
19. Battery switch.
20. Ignition switch.
21. Armament switch panel.
22. Accelerometer.
23. Manual bomb releases.
24. Suction gage.
25. Parking brake.
26. Rocket switch box.
27. Water pressure gage.
28. Main tank fuel level warning light.
29. Cylinder-head temperature gage.
30. Hydraulic pressure gage.
31. Primer.
32. Starter.
33. Main and auxiliary tank fuel gages.
34. Oxygen pressure gage.
    (Earlier series contain a turbo tachometer and warning light.)

## RIGHT SIDE




1. Recognition lights.
2. VHF radio.
3. Oxygen regulator.
4. Cockpit ventilator control.
5. Flare gun adapter.
6. Tailwheel lock.
7. IFF.
8. Detrola radio.
9. Secret equipment detonator.
10. Fluorescent light.
11. VHF homing adapter.
12. Tail warning switch box.
13. Manual canopy handle.

### Flight Controls

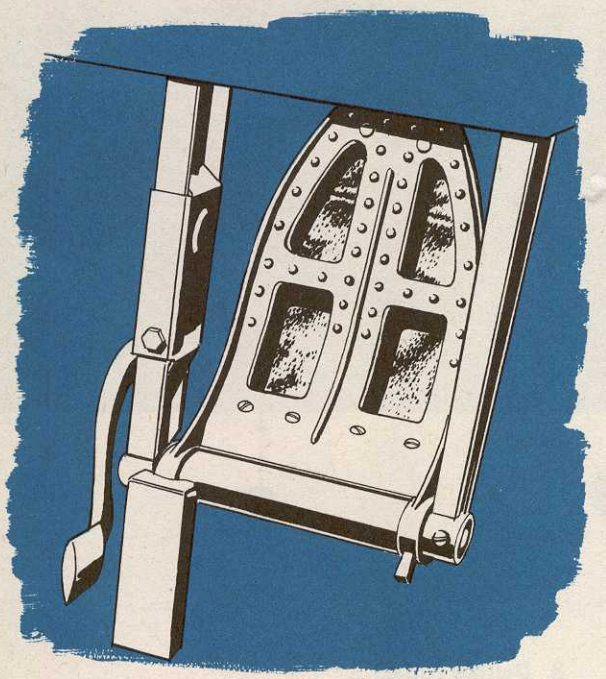
The flight controls are the conventional rudder-pedal and stick type.

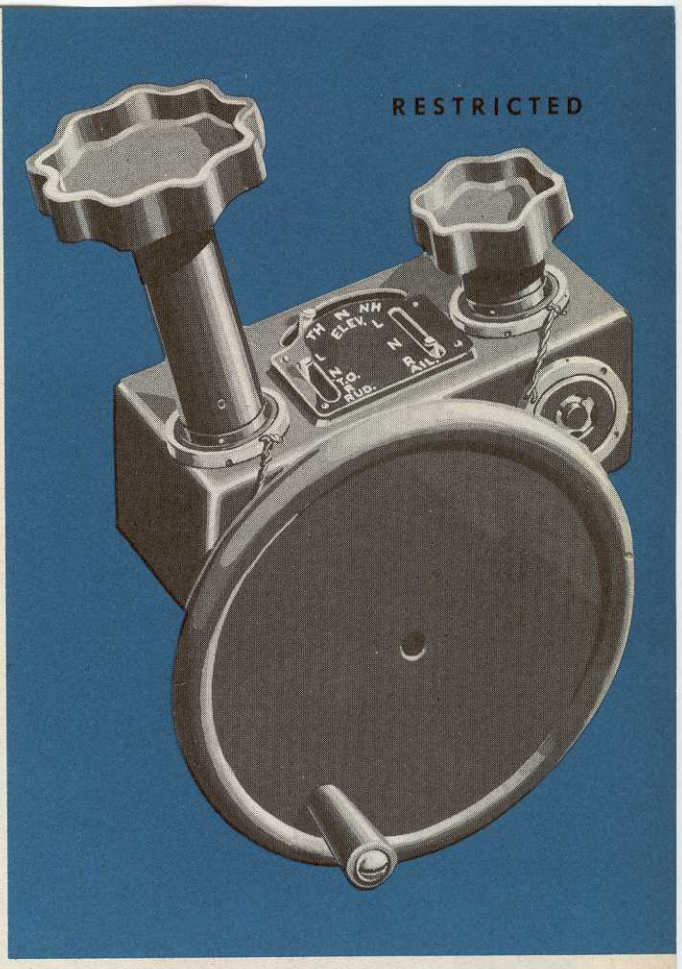
Adjust the pedals for length by pushing aside a lever at the base of each. Always get the pedals evened up, or during takeoff you'll throw your plane off course when you instinctively line up your feet.

From the N-5 on, the pedals have a unique feature. You can let them fall back to stretch your legs during long flights. The pedals have special latches for this purpose.

The stick has a pistol grip, with a trigger for the guns, and a button on top used for firing rockets, releasing bombs or dropping gas tanks.

You lock the controls by attaching a strap, fastened to the bottom of the seat, to a knob at the base of the stick. The rudder pedals are included in the system by means of a rod extending from the stick lock. The strap won't reach unless the seat is in its lowest position.






**Trim Tabs**

The trim tab control unit (Left Side, No. 5) has three wheels with accompanying position indicators.

Adjust the controls as follows:

1. Ail. (ailerons). Turn the wheel clockwise to trim the right wing down.
2. Elev. (elevator). Turn the wheel forward to trim the nose down.
3. Rud. (rudder). Turn the wheel clockwise to turn to the right. Note that the indicator has a "TO" (takeoff) position, which is used to offset takeoff torque.

## Trim With Care

Use trim with care because the tabs are sensitive. It's hard work to overcome the heavy pressures exerted by improperly adjusted tabs. Get your plane in proper trim for every maneuver or condition of flight. You'll save yourself much labor, and perhaps an unnecessary risk or so.

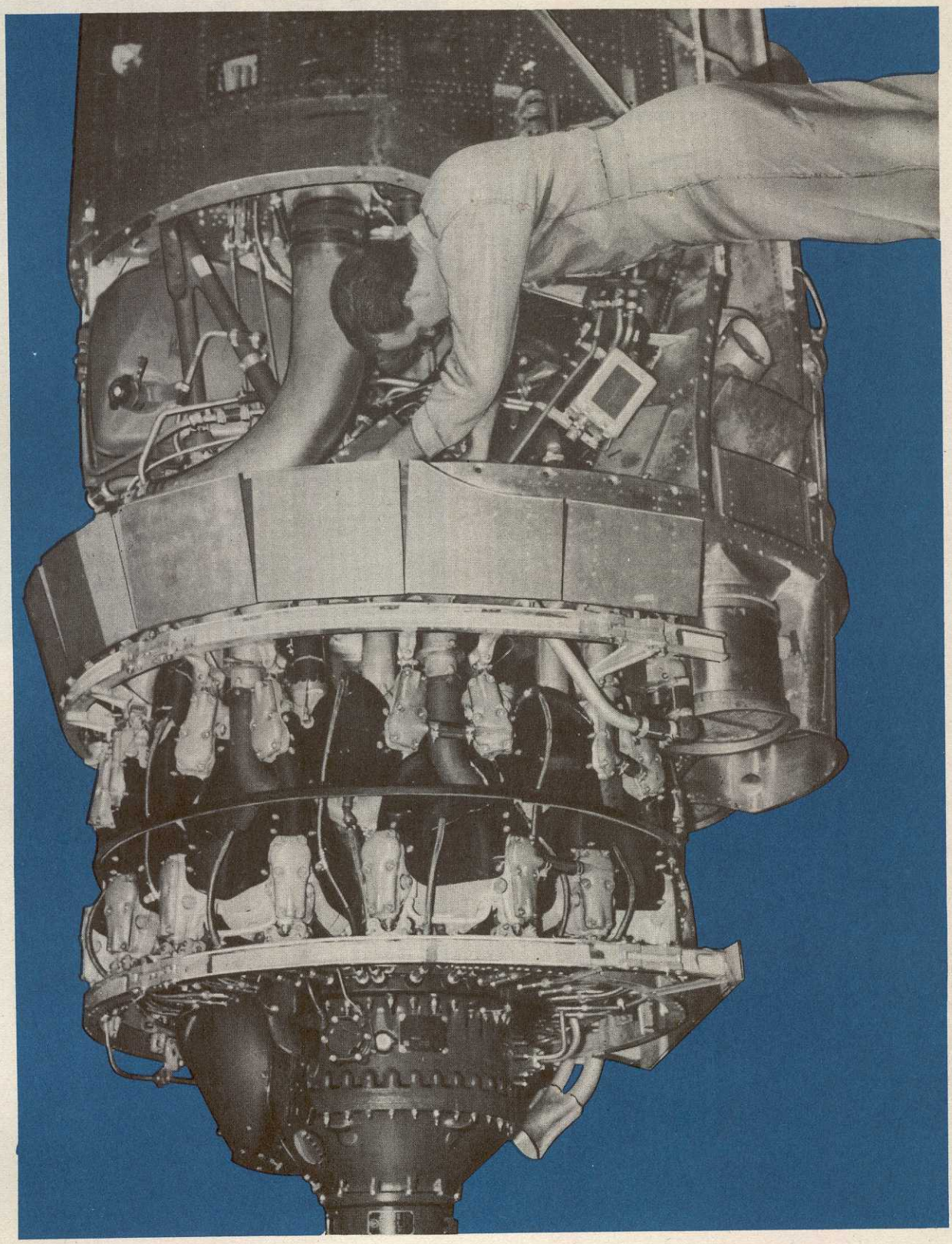
**Rudder "Softening"**

Extreme uncoordinated use of alieron and rudder may cause a decreased and possibly a negative effect on the rudder pedal forces. This is most likely to be encountered at low speeds with high power, due to the twist of the slipstream around the fuselage. The installation of the dorsal fin has reduced the chances of encountering the trouble but hasn't eliminated them altogether.

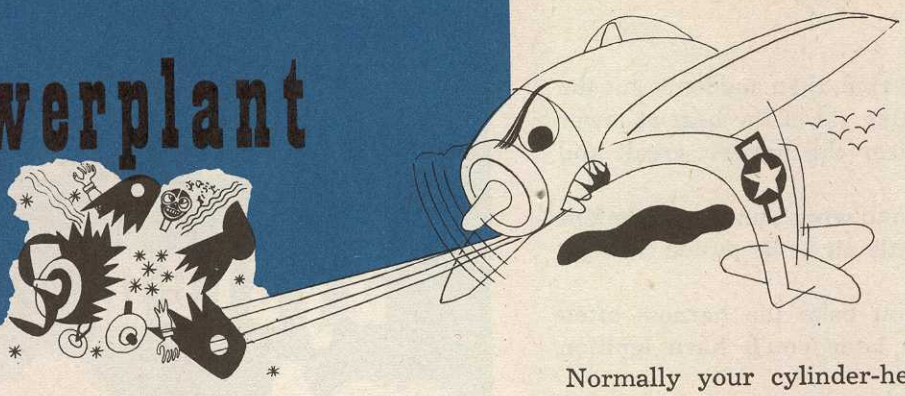
Recovery is simple:

1. Reduce power.
2. Coordinate the controls as much as possible.
3. Increase airspeed by nosing down.
4. Overpower the forces with opposite rudder.

Center the rudder trim or, if you desire, use it with the opposite rudder in the recovery.

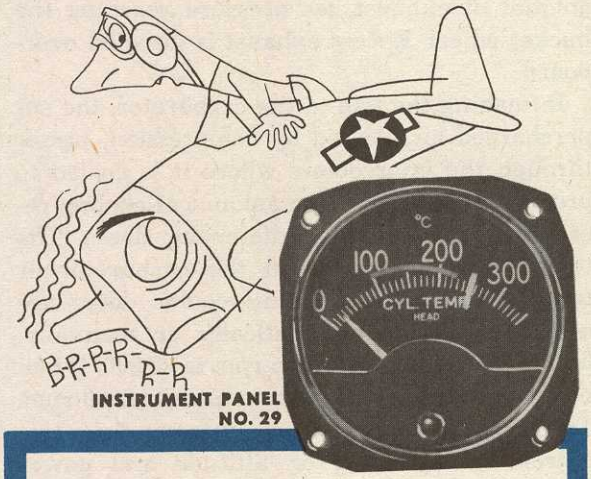


# Powerplant



The Pratt & Whitney Aircraft R-2800 "C" series engine is much the same as the R-2800 "B" series engine which powered Thunderbolts prior to the M and N. Its greater rated power was achieved by small refinements without any increase in weight. Actually, it weighs slightly less. The piston displacement remains 2,804 cubic inches.

The "C" engine has added fin area for cooling. The engine cools very well. In fact, during a let-down it's wise to watch the cylinder-head temperature for excessive cooling.




INSTRUMENT PANEL NO. 29

**Maximum allowable temperatures:**

**260 degrees C When using AUTO RICH**

**232 degrees C When using AUTO LEAN**

Normally your cylinder-head temperatures in the air will range from 145° to 160°C, although a greater variation may be experienced under extreme weather conditions. **Leave cowl flaps full open for all ground operations.**

High temperatures usually are caused by using high boost and low rpm, incorrect use of AUTO LEAN, or climbing at low speeds with cowl flaps closed.

To correct: Increase rpm, resort to AUTO RICH, increase air speed or open cowl flaps manually. (When left in AUTO, the cowl flaps adjust themselves.)

Excessive temperatures are usually a cause of detonation.

Inadequate temperatures usually are caused by dives with cowl flaps partly open or long power-off glides.

To correct: Close cowl flaps, increase power.

Note: If your engine ever should cut out from low cylinder-head temperature, take these steps:

1. Be sure the cowl flaps are closed.
2. Increase power.
3. Move mixture control to AUTO RICH.
4. Reduce altitude to 10,000 feet.

Though AUTO RICH ordinarily is employed to cool an engine, when an engine cuts out because of excessively low temperatures you need the richer mixture to regain your power.

The engine has a Stromberg injection-type carburetor and either a Scintilla or G. E. ignition system. The spark is automatically advanced when you operate the engine below 800 hp.

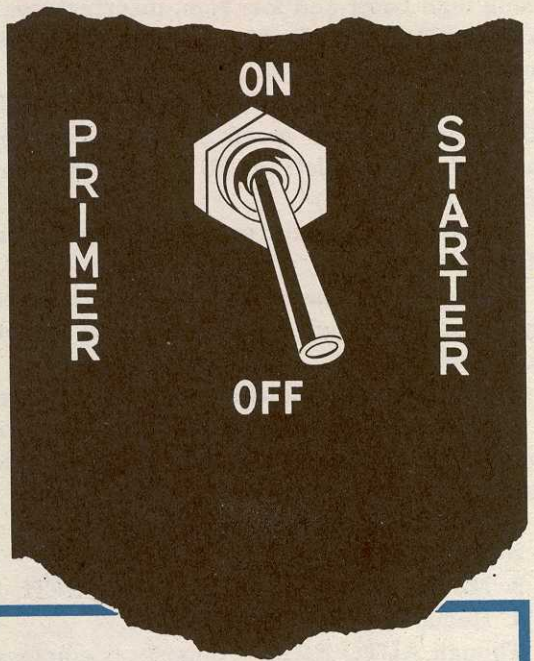
Despite the engine's good cooling characteristics, it's still possible to bake the ignition harness by carelessness of the ground even with the cowl flaps full open. Avoid these two main trouble-makers:

1. Runup to high rpm, then suddenly cut the power without getting rid of the heat at lower speeds. You can hear the harness creak and groan.

2. Tail into the wind when running up before takeoff, allowing little air to be pulled through the engine.

Remember: If you bake the harness often enough, sooner or later you'll have ignition trouble.

The engine has two distributors, pressurized for high altitude performance. The primer is electrically operated, consisting of a toggle switch connected to a solenoid on the carburetor.




**INSTRUMENT PANEL NO. 13**

| | |
|---|---|
| **Maximum power (with 2800 rpm):** | |
| **Military power:** | **54" Hg** |
| **War Emergency Power (With water injection)** | **72" Hg** |

By exceeding these limitations, you invite a quick engine failure brought on by detonation.

# Induction System

## SUPERCHARGER

The P-47N has two superchargers; an impeller attached directly to the engine, and a turbo-supercharger which gives the plane its superb high altitude performance.

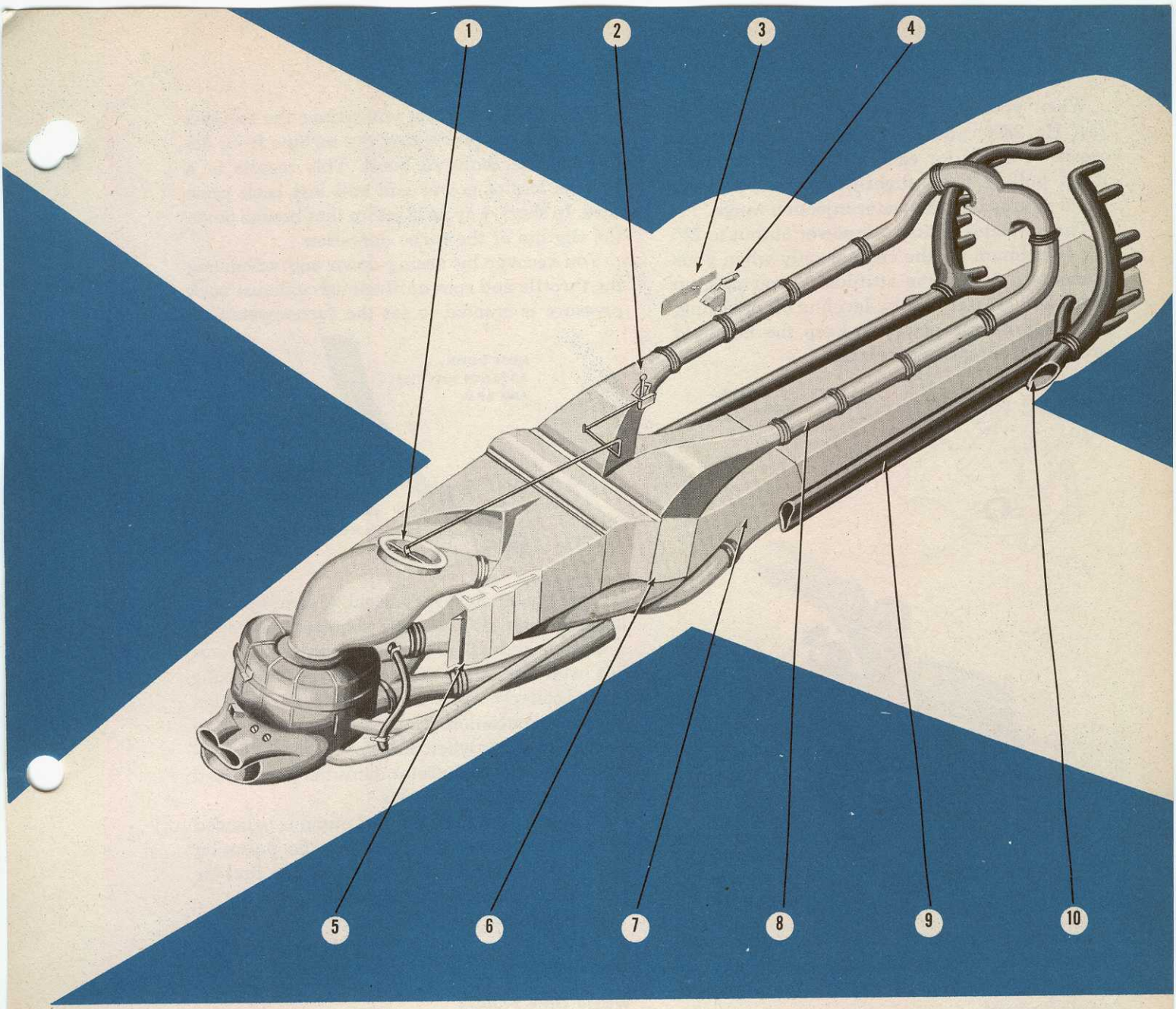
The turbine, which is spun by exhaust gases, sends supercharged or pressurized air to the carburetor where it is fed through the impeller into the intake manifold.

The turbine speed is controlled by electrically-operated waste gates which govern the amount of exhaust gas pressure reaching the bucket wheel. Excess exhaust is directed overboard.

In making the trip to the carburetor, the supercharged air, heated by compression, passes through the intercoolers where it is cooled to proper temperature. The amount of cooling received is regulated by intercooler doors. The temperature is shown on the carburetor-air temperature gage. The intercooler doors are controlled either automatically or manually. Maximum allowable turbo rpm is 22,000. When not in use the turbine idles at around 2000 rpm. The speed of the turbo varies between these two extremes, depending on altitude and power required.

Early N's contain a turbo tachometer and an overspeed warning light. The instruments were subsequently removed, inasmuch as turbo overspeed is prevented by the regulator.

An ON-OFF switch on the main switch panel enables you to cut off the current to the waste gear regulator and thus stop the gates in the last position. Normally the switch is left in the ON position, protected by a guard. If it should ever



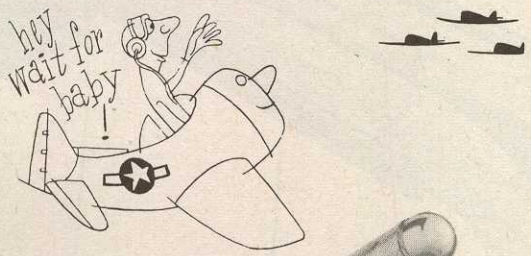

1. Air Filter
2. Air Filter Control
3. Intercooler Control Switch
4. Engine Control Quadrant
5. Intercooler Door
6. Intercooler
7. Ram Air to Turbo
8. Pressurized Air to Carburetor
9. Exhaust Pressure to Turbo
10. Waste Gate

be necessary to turn the switch OFF on the ground, pull the boost control all the way back, first. This is to make sure you don't leave your waste gates fixed in any but the full open position. Otherwise you might get some turbo pressure you don't want.

During a climb or dive, the regulator will maintain a constant manifold pressure at only one power setting,—approximately 39" Hg. This pressure will be held constant from sea level to the critical altitude for that power. At any higher or lower setting you must make minor power adjustments to keep your manifold pressure steady.

When you climb with full military power (54″ Hg, 2800 rpm), the regulator allows an increase of 1″ Hg for each 6000 feet of altitude. Keep pulling back slightly on the power to avoid getting into the water injection range.

The regulator limits your power output to 72″ Hg (maximum for the engine) only when your plane is in a climbing attitude. If you pick up speed and greater ram by leveling off or diving, pull back on the power to keep the manifold pressure from going overboard.



SAVE A SMALL MARGIN OF THROTTLE TO STAY IN FORMATION

You obtain the most stable and economical high-altitude flight by making power adjustments with your boost alone, after your throttle is full forward.

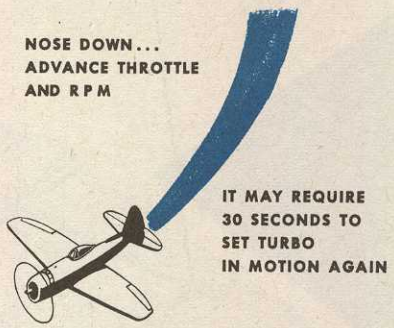
When flying in formation, however, you may find it profitable to vary this technique by leaving yourself a small margin of throttle. Use this bit of throttle range to stay in position. The plane responds more quickly to throttle than to boost.

### Turbo Trouble

Flying with the boost well forward, you can bring about a collapse of the turbo by retarding the throttle or reducing the rpm. This is not a physical failure but a collapse of pressure.

What happens is that you reduce the exhaust back pressure, preventing the turbine from delivering the required boost. This results in a further loss of power and still less back pressure. In short, a cycle is set up that breaks down the rhythm of the turbo operation.

You recover by nosing down and advancing the throttle and rpm until enough exhaust back pressure is created to set the turbo system in




motion again. Recovery from a complete collapse at high altitude may require 30 seconds.

If your reduction of power (with the boost left well forward) is not sufficient to bring about collapse, you may create a condition known as pulsation. The pulsation takes place in the air ducts when the closed down butterfly valve in the carburetor dams the pressurized air coming from the turbo.

Since the flow from the fuel pump is balanced against carburetor air pressure, the pulsation can cause sufficient fluctuation of the fuel-air ratio to bring about engine surge.

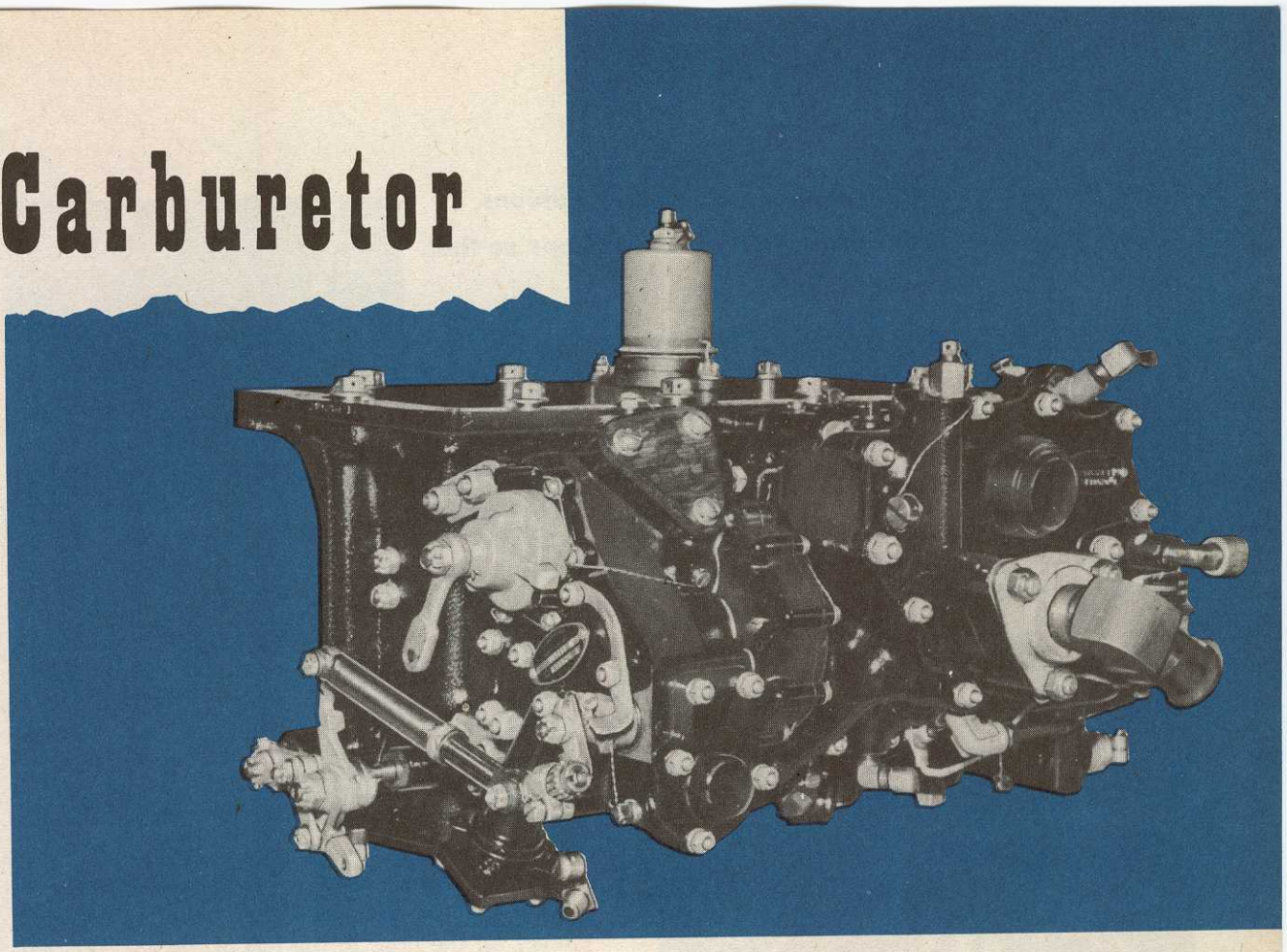
To eliminate the pulsation retard the boost or advance the throttle, and if necessary increase rpm.

### Waste Gate Failure

If you should ever experience a failure of operation of the electric waste gates, you can fly and land the plane even if the waste gates should be stuck fully closed.

If the failure occurs at high altitude, set the rpm at 2000 and come on down, using any manifold pressure between 20″ Hg and 35″ Hg. You won't get turbo surge. As altitude is decreased you get a wider range of possible manifold pressures for a given rpm until by the time you are ready to land you can use normal power settings.

# Carburetor



The Stromberg injection carburetor is one of the most successful developments occasioned by the war.

It automatically meters the proper amount of fuel to the discharge nozzle as required by the mass of air moving through it for all conditions of engine operation.

The mixture control on the quadrant selects one of three positions for desired operation: IDLE CUT-OFF, AUTO LEAN, and AUTO RICH.

Manual leaning between AUTO LEAN and IDLE CUT-OFF is possible but dangerous and must be used only for emergency range. (See Long Range Cruise Section.)

Fuel consumption varies on different N's depending on carburetor efficiency. Here's how to check the carburetor for proper mixture:

Idle your engine at 500 rpm. Pull the mixture control back to IDLE CUT-OFF. Return the control to AUTO RICH before the engine stops.

Watch the tachometer carefully. If you get a rise of about 20 rpm, your mixture is OK. If the rise is greater, your mixture is too rich. No rise at all indicates that your mixture is too lean. Have the mixture valve in your carburetor readjusted.

**Icing**

Carburetor icing is extremely unlikely in the P-47N but it may occur, especially when the outside air is a few degrees above freezing and contains a large amount of moisture. It is most likely to occur when you have the boost off and the throttle partly closed, as in a let-down.

Evidence of icing is a loss of power through a decrease in manifold pressure.

There is no separate carburetor heat control on the P-47 because the intercooler doors will do the same work. If you suspect icing, close the doors manually. If this isn't sufficient, raise the carburetor air temperature still further by advancing your boost.

Except in extreme temperatures, the automatic operation of the intercooler doors will

**When making a long let-down under icing conditions it may be necessary to lower your gear and flaps so that you can keep your power settings up.**

INSTRUMENT PANEL NO. 15.

keep the carburetor air temperature between 12°C and 35°C, well above the icing range.

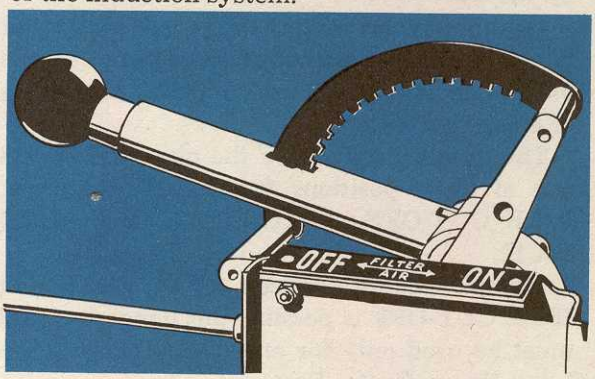
Normal maximum allowable carburetor air temperature is 38°C. When using water injection, temperatures up to 55°C are permitted.

If your carburetor air temperature goes up for no apparent reason, open the intercooler doors manually. The automatic mechanism may have failed.

**Air Filter**

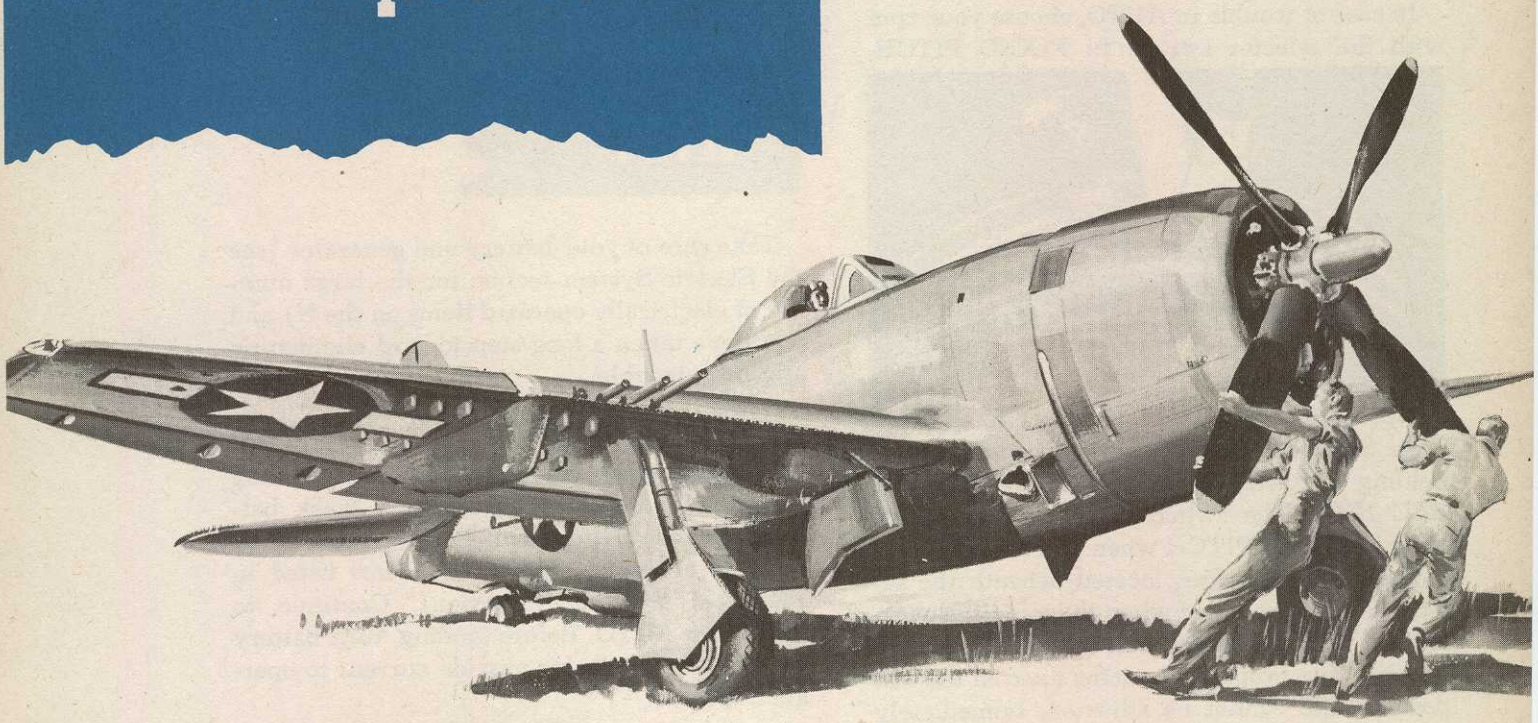
An air filter is located on the air intake duct near the supercharger. It is controlled by a lever on the floor to the left of the cockpit seat. OFF is to the rear; ON forward.

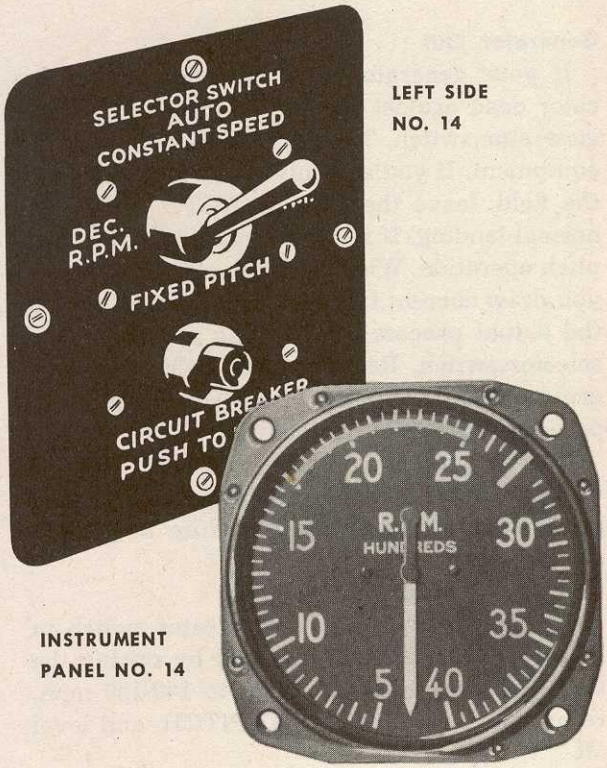
Use the filter on dusty days, particularly when on or near the ground, to keep dirt out of the induction system.




When the filter is closed, the carburetor-air temperature rises, so watch the gage closely. On takeoffs with the filter closed, it may be necessary to employ water injection to allow for the high temperatures. With the filter closed you will find that you get a slightly lower manifold pressure for any given throttle position. (See War Emergency Power Takeoff Section.)

# Propeller






LEFT SIDE
NO. 14

INSTRUMENT
PANEL NO. 14

These items are involved in the operation of the 4-blade paddle-type Curtiss Electric constant-speed propeller on the P-47N. The blades have a 13-foot diameter, largest on any fighter.

The tachometer is calibrated from 500 to 4000 rpm in increments of 50.

The rpm is adjusted either by the "P" control on the throttle quadrant or by the selector switch on the propeller panel.

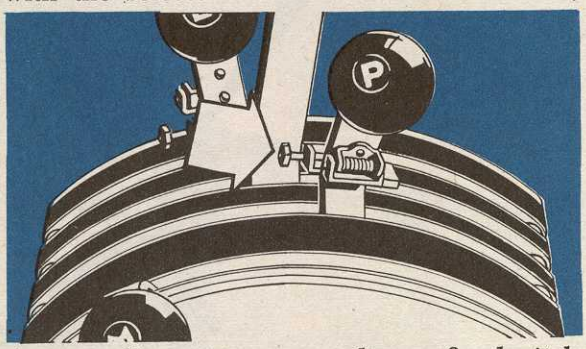
Although maximum allowable rpm is 2800, the propeller may be overspeeded up to 3120 rpm for 30 seconds without damaging the engine. Any time the propeller overspeeds to 3000 rpm, it's important to note on the Form 1-A the rpm and the duration so the engine may be checked.

During normal operations, leave the selector switch in AUTO and adjust the rpm with the "P" control. Push forward to increase and pull back to decrease rpm. The propeller governor holds the rpm you choose.

Note the spring-loaded latch extending from the "P" control in the path of the throttle. This

is to insure that you increase rpm ahead of manifold pressure when suddenly applying power.

In case of trouble in AUTO, choose your rpm with the selector switch. In FIXED PITCH,



the propeller acts as an ordinary fixed pitch prop. Set the rpm for fixed pitch operation by holding the selector switch in INC RPM or REC RPM. The switch is spring-loaded and seats in FIXED PITCH when you release it.

The circuit breaker, located beneath the selector switch, pops out when the circuit is overloaded. With the button out, the system gets no current. The propeller remains fixed in the last position and cannot be adjusted. Immediately reset the breaker. If the button stays down, leave the propeller in AUTO. If not, switch to manual operation and obtain the desired rpm with the selector switch. It may be necessary to hold the breaker in while making your manual adjustments. In this case, make a normal landing with fixed pitch operation as soon as feasible. Something is wrong with the system.

## Trouble

**Defective Governor**

The symptoms of a defective governor are simple. The prop over or underspeeds. The remedy is equally simple. Reduce or increase rpm, as the situation requires, with the selector switch and land in fixed pitch.

**Remember:**

**When landing in fixed pitch, set your rpm at 2500. This setting enables you to go around if necessary.**

Fixed pitch operation, though commonly referred to as an "emergency," actually isn't any sort of a crisis unless you make it one by getting flustered.

## Hint:

Take care of your battery and generator (see the Electric System section for the large number of electrically operated items on the N) and you have taken a long step toward eliminating any prop trouble.

**Weak Battery**

If you get a continuous high ammeter reading (around 60 amperes), disclosing a weak battery, turn the battery switch OFF. Turn off all possible electrical equipment (items listed in Electrical Equipment section). Continue to operate in AUTO. Before landing, turn battery switch ON. This helps provide current to operate the radio.

**Generator Out**

If your generator goes out (ammeter indicator dead against the zero stop), turn off the generator switch. Turn off all possible electric equipment. If you are only a few minutes from the field, leave the prop in AUTO and make normal landing. If farther away, resort to fixed pitch operation. When operating in this fashion, you draw current from the battery only during the actual process of changing rpm with the selector switch. Return to the field at normal cruising rpm, changing to 2500 rpm when approaching the field for landing.

If your prop is completely "OUT," that is, uncontrollable by either the prop handle or the selector switch, use this procedure to get the desired rpm:

To increase rpm:

Cut the throttle, hold the selector switch in INC RPM, and reduce airspeed by raising the nose. When your speed drops to 140-150 mph, return the switch to FIXED PITCH, and level off.

To decrease rpm:

Advance the throttle, hold the switch in DEC RPM, and go into a shallow dive. Release the switch and return to level flight.

**False "Runaway Prop"**

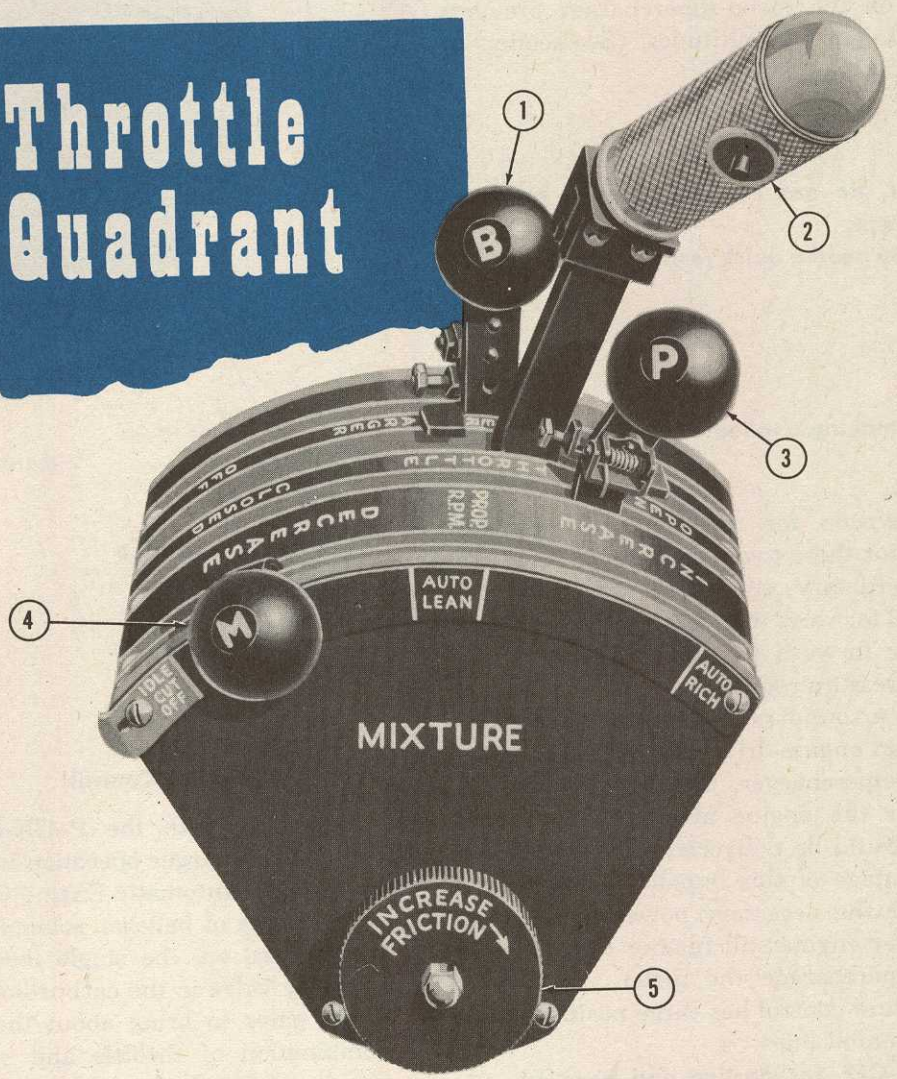
Anytime you believe you have a runaway prop, check your fuel pressure. You may simply be trying to operate your engine on an empty gas tank.

As a gas-starved engine loses power, the propeller blades decrease pitch in maintaining rpm. If this is the situation, merely switch to a new tank. The rpm will return to normal, probably after a brief period of overspeeding above the selected rpm until the governor takes hold.

Note: While making the check also make certain the propeller selector switch is in AUTO. A propeller inadvertently left in fixed pitch on takeoff usually overspeeds.

When cutting off an engine, always leave the "P" control full forward.

# Throttle Quadrant




1. "B"—boost, or turbo-supercharger control.
2. Throttle. The twist grip is used for ranging with the K-14 gunsight. The button turns on the radio microphone.
3. "P"—propeller control.
4. "M"—mixture control.
5. Tension knob. Turn clockwise to increase friction.

The boost control has a spring-loaded latch which provides for interconnected operation with the throttle. The propeller control has a similar latch, though with only one claw. The latch is used to keep the prop control ahead of the throttle when advancing power. Always leave the latch on the prop handle extended. The latch on the boost lever will be retracted for normal operation.

The turbo and throttle can be used interconnected from takeoff through all altitudes. A governor on the turbo-supercharger prevents overspeeding at high altitudes. (See section on Turbo-supercharger.)

**However, do not use the controls interconnected, except:**

**When you need a quick response of power,**

**or**

**You are making a takeoff with water injection.**

The provision for interconnected controls was made for these two purposes.

Under ordinary conditions advance your throttle full forward; then afterwards push your boost lever forward to supply the additional manifold pressure required.

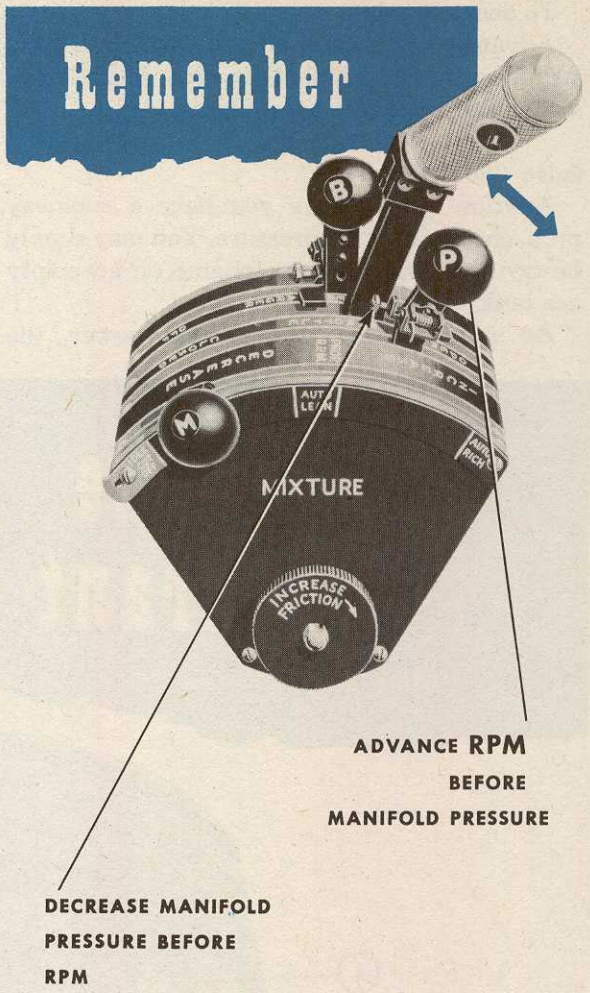
There is a sound reason for this procedure. You have an engine-driven impeller as well as the turbo-supercharger. Operation of the impeller costs the engine about 300 hp which otherwise could be delivered to the propeller. Take advantage of this impeller as long as it will deliver the necessary power without penalizing your engine still further by cutting in another supercharger—the turbo.

The mixture control has three positions indicated by painted lines:

**IDLE CUT-OFF—for starting and stopping.**

**AUTO LEAN—for normal operation.**

**AUTO RICH—for takeoff and use with high powers when the engine needs the cooling effects of a rich mixture.**



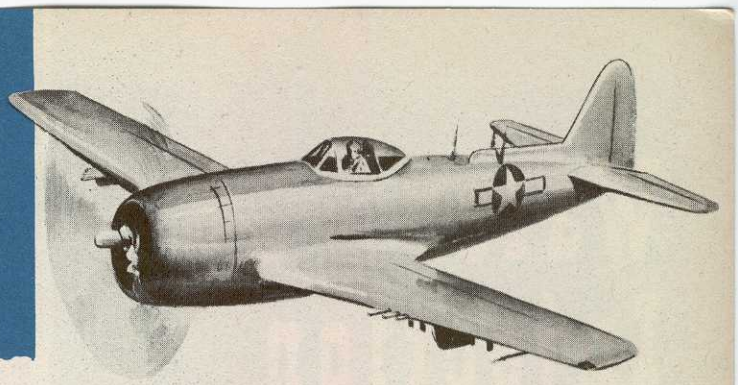

### Automatic Engine Control

Beginning with the P-47N-25, engine and turbo-supercharger operation will be regulated by a single Automatic Engine Control.

By means of bellows, solenoids, electric motors and so on, the single lever operates the butterfly valve in the carburetor and the turbo waste gates to bring about the most efficient combination of throttle and supercharger to obtain a desired manifold pressure.

The throttle quadrant on planes equipped with Automatic Engine Control is the same as on earlier series, except there is no "B" or turbo control lever.

# Power Settings



A power setting is any combination of manifold pressure and tachometer readings to meet a specific condition.

In selecting a given setting, a number of factors are considered: The power desired or necessary, the operating limits and the life of the engine, the different requirements for training and combat and so on.

For the purpose of preventing abuse of the engine and avoiding detonation, definite maximums have been established. On the P-47N, these maximums are:

| | | | |
|---|---|---|---|
| **War emergency power** | **2800 rpm** | **72″ Hg** | **5 minutes** |
| **Takeoff (military power)*** | **2800 rpm** | **54″ Hg** | **15 minutes** |
| **Maximum continuous (Normal rated power)** | **2600 rpm** | **43.5″ Hg** | **Unlimited** |

***Limited to 5 minutes on takeoff.**

Outside of combat, or authorized simulation of combat conditions, there is no necessity for drawing such powers or approaching them. To do so shortens the life of your engine and invariably has you skirting the edge of detonation.

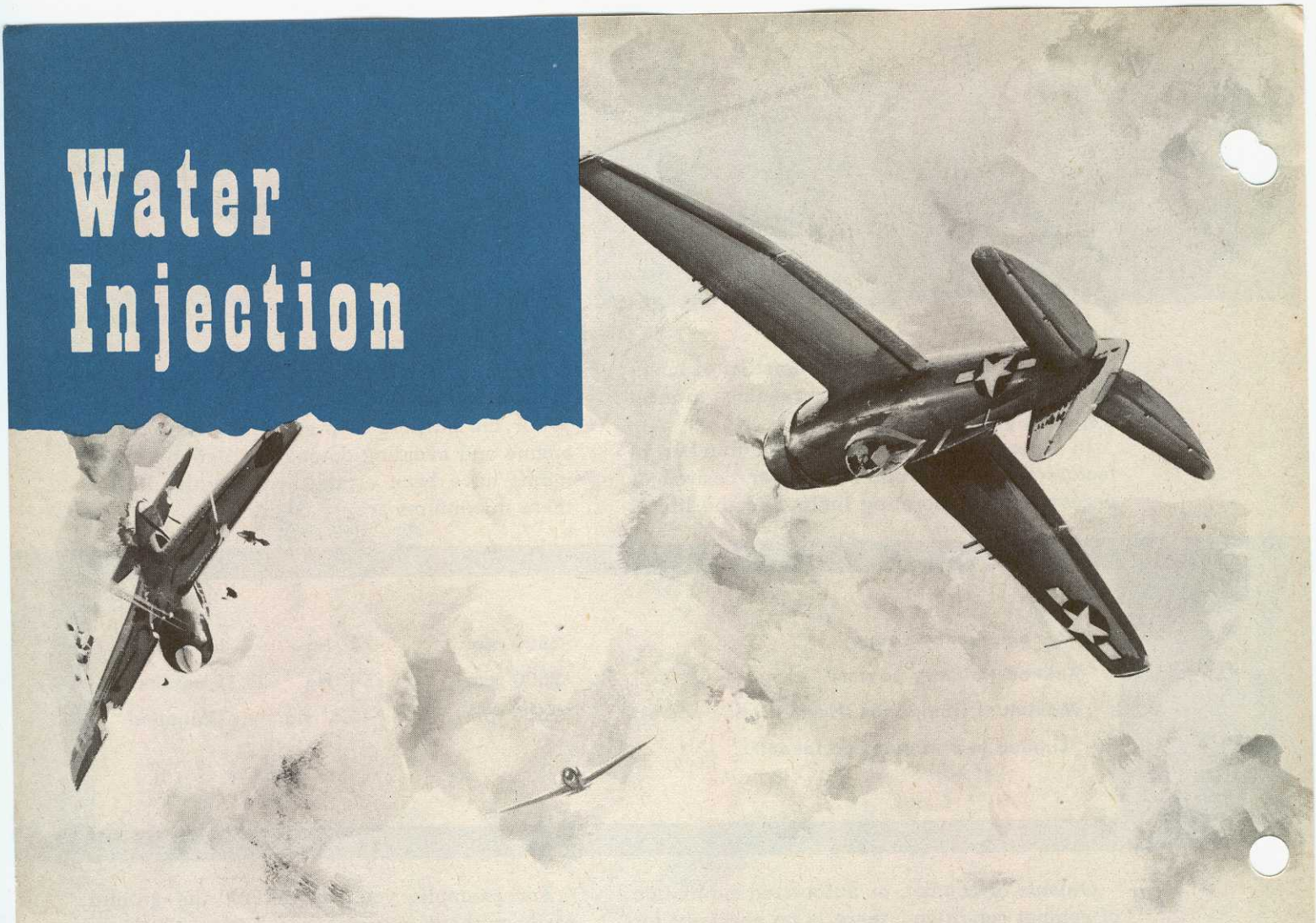
For example, you can get off the ground easily without external load with as little as 35″ Hg. Under more adverse conditions, with a full external load, it may be desirable to pull as much as 65″ Hg.

**The recommended setting for normal training operations with a clean airplane:**

| | | | |
|---|---|---|---|
| **Takeoff** | **2800 rpm** | **45″ Hg** | **AR** |
| **Climb** | **2500 rpm** | **42″ Hg** | **AR** |
| **Cruise** | **2250 rpm** | **32″ Hg** | **AL** |

When operating with these settings, you reduce the chance of engine trouble to a minimum. This is not to imply that maximum settings are dangerous. The engine is designed for them and you should be familiar with them. However, you should **not** abuse your engine needlessly or thoughtlessly.

# Water Injection



When using greater than 54.5″ Hg, you must employ water injection to avoid detonation.

Though commonly referred to as water, the solution actually used is a mixture of water and alcohol. The supply tank holds 30 gallons, or enough for 12 to 15 minutes.

When drawing 54.5″ Hg, the water consumption is 1.9 gallons per minute; using 72″ Hg, the consumption rises to 2.5 gallons per minute.

With the water injection switch in AUTO, the water flow starts automatically when you draw more than 54.5″ Hg. A warning light glows if you exceed this power with the water supply exhausted. The warning light has a switch for ground testing.

You may turn on the water at any manifold pressure by placing the water switch in MANUAL. Do not turn on the water when pulling less than 30″ Hg, or you will drown the carburetor.

It won't often be necessary to make a water injection takeoff. Ordinary power usually is sufficient. An exception, is when you must use your air filter during dusty conditions. Use of the filter may cause carburetor air temperatures that are allowable only when water is employed.

When the water cuts in, the engine coughs and you experience a momentary loss of power. For this reason a definite procedure is employed for a water injection, or War Emergency Power, takeoff. The procedure is explained in the War Emergency Power takeoff section. It involves turning on the water by means of the switch before starting your takeoff run.

When making a normal takeoff without water, do not draw more than 51″ Hg, or you might inadvertently get into the water range. Though the regulator is adjusted to turn on at 54.5″ Hg, it could be a little off, and you get an

increase in manifold pressure from air ram as you move down the runway.

On any flight in which you might use water injection, check your water and fuel pressure on the ground. Procedure for checking the water is to run up your engine to 30″ Hg, then turn on the water switch.

On planes prior to the N-5, you require the following pressure readings:

Water: 38-40 psi Fuel: 24-26 psi

On the N-5 and subsequent series, the readings should be:

Water: 35 psi Fuel: 17-19 psi

The later airplanes have an R-2800-73 engine containing a carburetor with a larger fuel nozzle allowing for lower pressures.

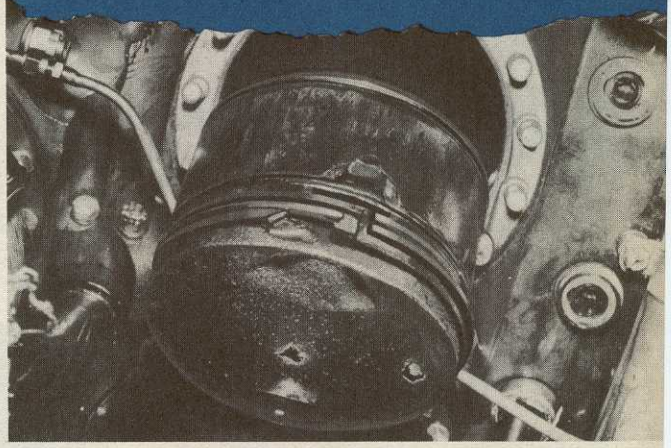
These readings will give you at least 1 lb.

INSTRUMENT PANEL NO. 27

greater water than fuel pressure at the carburetor at all altitudes. (Water pressure, being dependent partly on head pressure, experiences a big drop at altitude. Fuel pressure, resulting from positive pump action, remains fairly constant.) This condition is necessary to obtain a correct mixture.

Oddly enough, you consume less fuel when employing War Emergency Power than when using military power. That's because the water displaces some of the gas that ordinarily would flow into the carburetor.

# Detonation



Proper and efficient combustion of gasoline at high power settings is a continuing subject for research and study.

Octane rating higher than any dreamed of a few years ago, water injection, and better engine cooling are some of the results of this research. The primary object has been to make the fuel in the cylinder burn slowly enough to give the piston a firm, steady, **push,** rather than a sharp **blow.** This blow, which can be heard as a knock in your car, is detonation.

The noise of the air and exhaust drowns out this sound in a plane and there is no way to tell whether or not your engine is detonating until the cylinder-head temperature starts to rise and engine failure or partial failure has begun.

The following factors contribute to detonation:

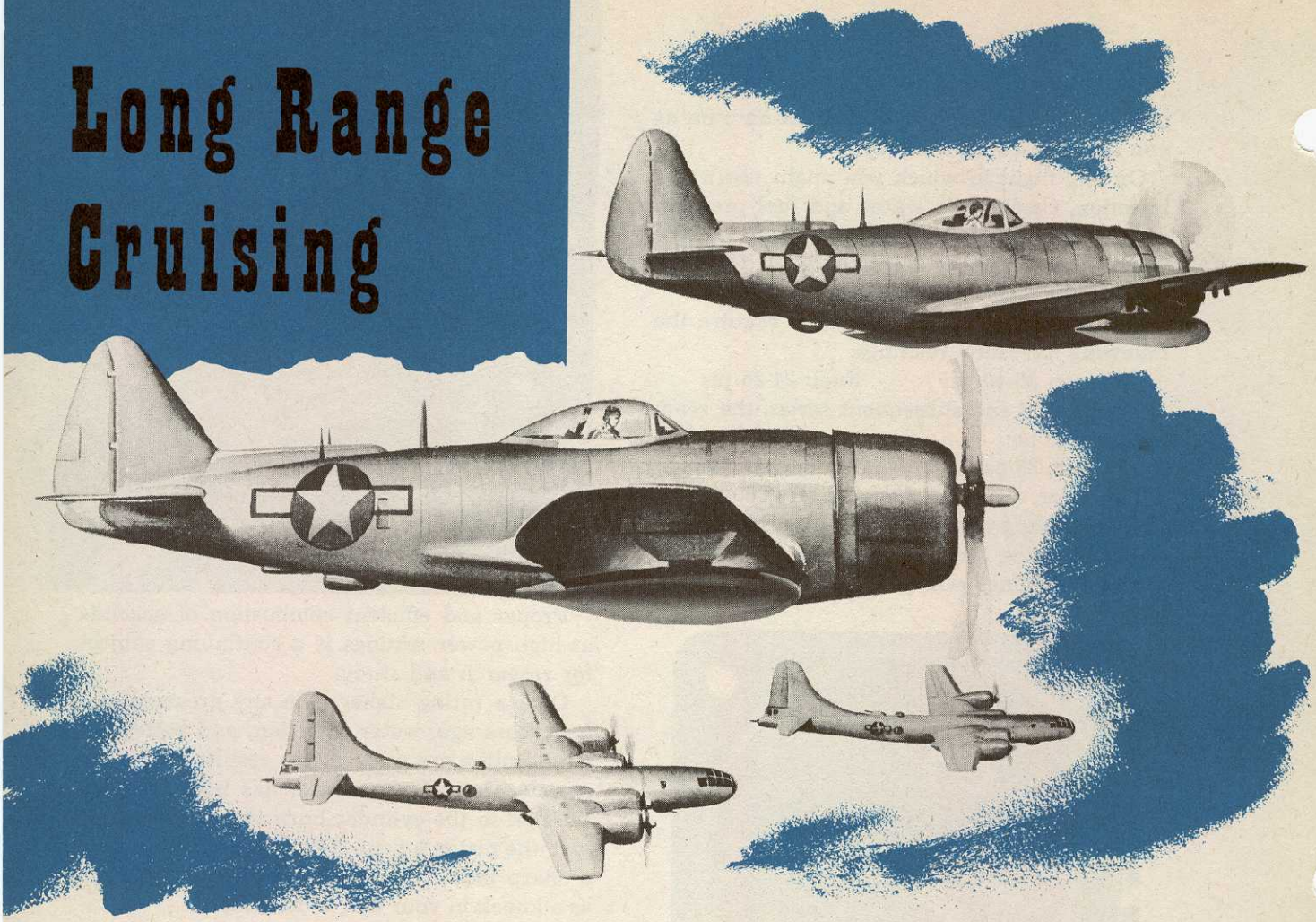
1. Excessive manifold pressure.
2. Insufficient cooling.
3. Too lean a mixture.
4. Excessive carburetor air temperatures.
5. Fuel of too low octane rating.
6. Malfunction of the ignition system.

Mild detonation may cause some minor damage to the engine which will pass unnoticed until aggravated on some future flight.

Don't kill your friends! Avoid detonation!

When the engine is operated within the specified limits, on the proper fuel, and with the carburetor and ignition system in normal condition, detonation will not occur.

# Long Range Cruising



The goal of long range cruising is to get the maximum miles per gallon of gas by regulating power and airspeed. To get the most range from the N, all of the skill and technique that you can acquire will be called into play.

Two facts:

With a clean airplane, your best altitude for range is around 15000 feet.

With external tanks attached, around 5000 feet.

In planning a long range flight, you must consider the following factors:

1. Type of climb (power settings and mixture).
2. Fuel to be spent in climb.
3. Fuel allocated for combat at high manifold pressures and rpm.
4. Fuel to be used in warm-up, taxiing, take-off, glide, and landing.

In combat you drop your external tanks after using the gas, thus reducing drag and improving your airspeed. Consequently you get more miles per gallon of fuel. (Obviously, you don't drop tanks in training.)

The normal combination of external tanks is two 165 gallon wing tanks. You also can carry a 110 gallon belly tank for extreme range.

Your best power setting while carrying two external wing tanks is 33.5″ Hg and 1950 rpm. This gives you as much as 900 miles from your wing tanks alone. Since you carry 330 gallons of gas in these tanks, it's clear that with this setting you are averaging almost 3 miles per gallon of gas.

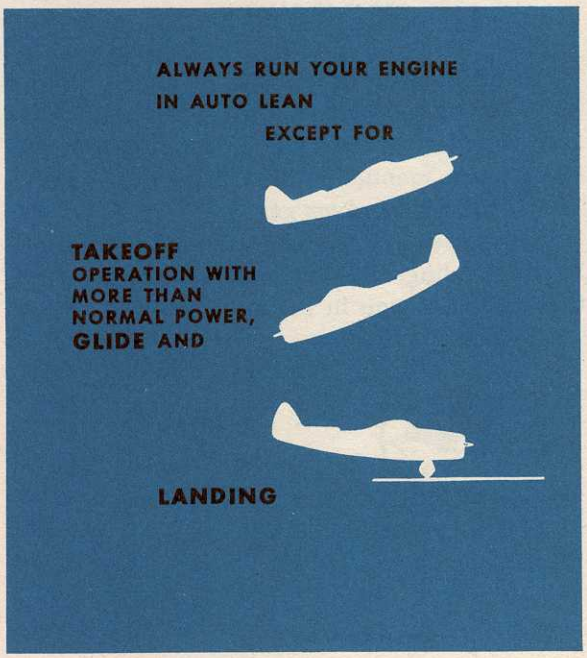
The belly tank, if carried, is used to reach cruising altitude and during the early stage of your cruise. Employing 33.5″ Hg and 2100 rpm, the belly tank will take you approximately 220

miles in level flight. Climbing at 43.5″ Hg and 2600 rpm, the tank will carry you around 150 miles.

After dropping external tanks, your internal gas load will take you approximately 1800 miles.

Unless you are trying for extreme range in an emergency, manual leaning should not be attempted. The carburetor is so adjusted that the fuel/air ratio falls off abruptly when you pull the control back of the AUTO LEAN position. Whether or not the advantage in increased range will be greater than the disadvantage of possible decrease in power and detonation varies between airplanes and climatic conditions.

If you do have to use manual leaning, this is the best way:




Put the prop in fixed pitch and ease the mixture control back a little at a time until you notice signs of roughness in the engine or a drop in rpm. Then move the control back toward the AUTO LEAN position until the engine smooths out or the rpm goes back to where it was. That is the manual lean position for that particular altitude and power setting. Return the prop to automatic.

## Tip:

On a muggy day you can save gas by manual leaning. This leaning compensates for the extra gas that is carried into the carburetor on the droplets of moisture in the air on damp days.

Remember when flying close to the deck over water that there's moisture in the air there too.

The trailing men in a formation use more gas than the leaders. That's inevitable. But you reduce the disadvantage of such a position by not jockeying the throttle. Stay in formation. Remember, if you need military power to get back in formation you are burning gas at that rate of consumption. In other words, don't straggle. The Japs will get you if lack of gas doesn't.

Here's a typical long range flight, conducted properly. (You must keep in mind the fact that combat requirements of speed, altitude, etc., will dictate the rules for planning flights when overseas.)

Loading: Two 165-gal. wing tanks and a 110-gal. belly tank.

Take off on MAIN, then switch to belly tank.

Climb at 500 feet a minute, using 43.5″ Hg and 2600 rpm, and 5000 feet. Mixture: AUTO LEAN. With this procedure, you reach 5000 feet in 10 minutes when 20 miles out. Gas consumption has been around 12 gallons, not counting the amount used for takeoff.

After leveling off, reset your power to 33.5″ Hg and 2100 rpm. Trim your ship to get maximum speed without altitude loss. Because of the external tanks, you must keep retrimming. Cruise at around 195 mph IAS, which is enough to keep up with any bomber. On a fighter strike, allow the airspeed to build up as the gas is consumed, retaining the same power settings.

When starting to cruise, the remaining gas in the belly tank should carry you around 160 miles. Your computer will show that in about 45 minutes you must keep a sharp watch on the fuel pressure gage to be ready to switch tanks when you notice any fluctuation. Switch to an external wing tank. (For procedure, see Fuel System section.) Drop the belly tank (in combat) to lessen drag.

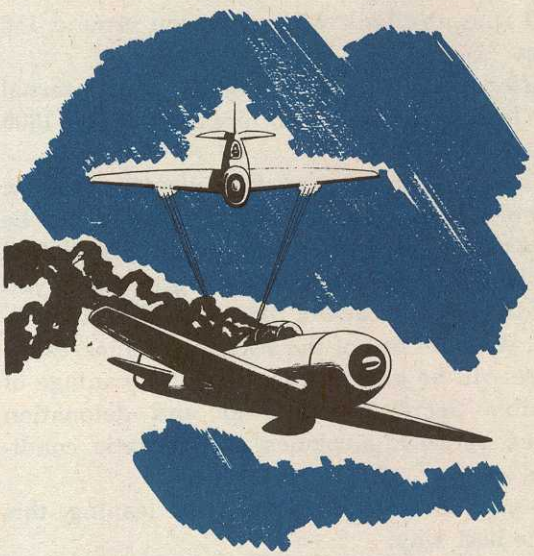
With the lighter load, pull the rpm back to 1950. Retrim. With the belly tank gone, the plane wants to gain altitude. Get on the step again to obtain the utmost possible speed. Remember that the 330 gallons in the wing tanks will take you around 900 miles only if the plane

**DROP BELLY TANK (IN COMBAT) RETRIM AND PULL RPM BACK TO 1950**

is kept in trim. Alternate between the 2 wing tanks to make trimming easier.

As the load decreases (remember, gasoline weighs about 6 lbs. per gallon) reduce the rpm to around 1800 to save more gas. Keep the manifold pressure at 33.5″ Hg. With this management, your external tanks should last about 4 hours and 30 minutes. When empty, drop the wing tanks (in combat).

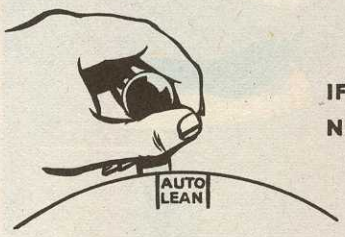
Twenty minutes of combat take about 90 gallons from the internal tanks. That leaves about 450 gallons of gas to get home. (Twenty gallons from the main tank were burned at the outset to allow for carburetor return.)



**20 MINUTES OF COMBAT USES ABOUT 90 GALLONS**

Return home at around 200 IAS. A setting of 33.5″ Hg and 1800 rpm with a clean airplane carries you more than 1400 miles. If speed is no object, lean manually and reduce your rpm to 1700. This really saves gas.

If it's necessary to stooge around the airfield before landing, use the lowest power settings that will keep you in the air.

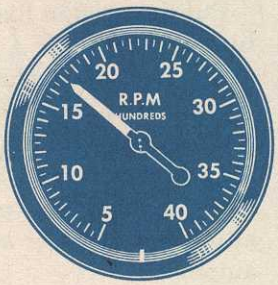



**IF SPEED IS NO OBJECT**

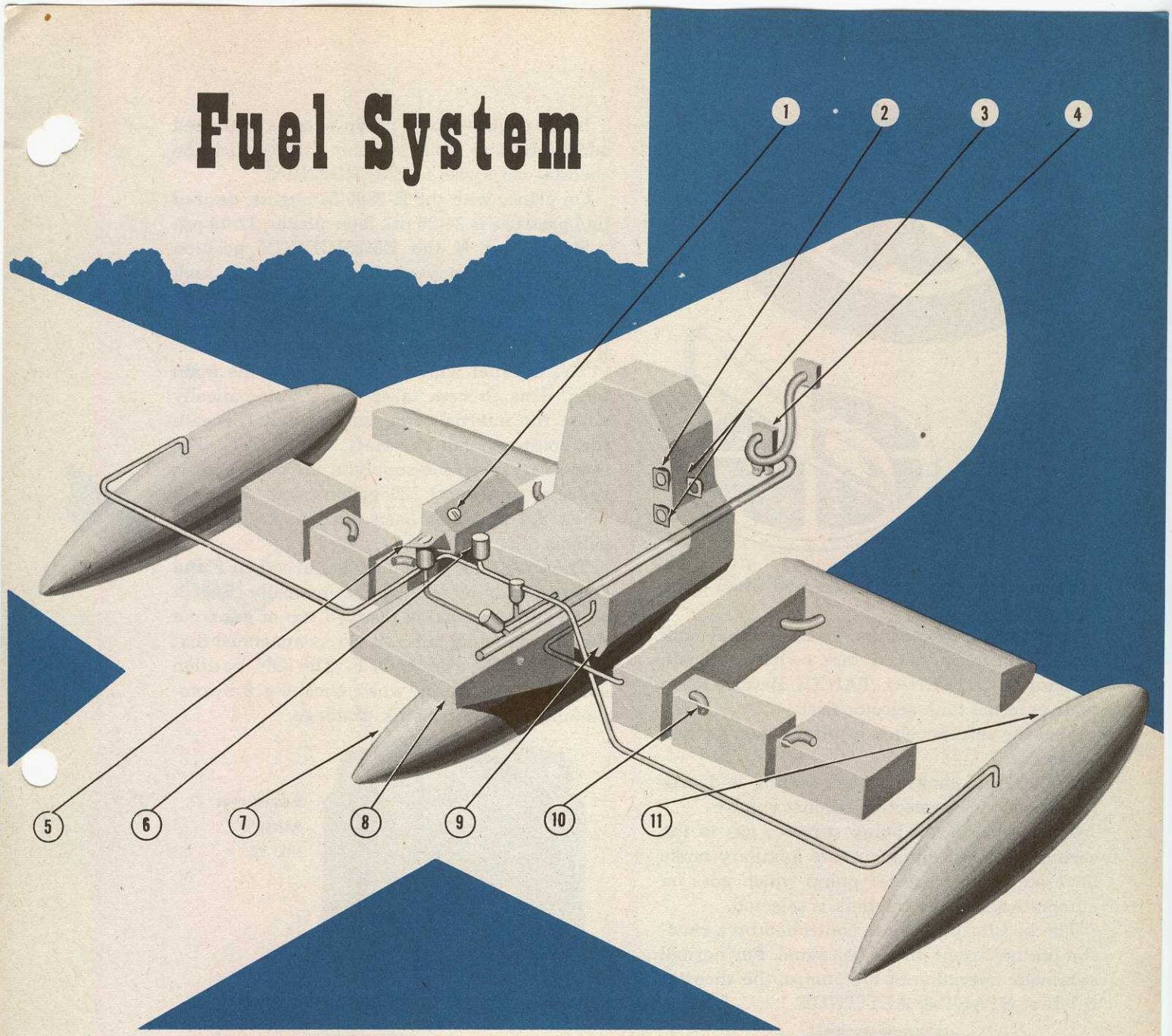
**LEAN MANUALLY**

**AND REDUCE RPM TO 1700**

**THIS REALLY SAVES GAS!**



# Fuel System

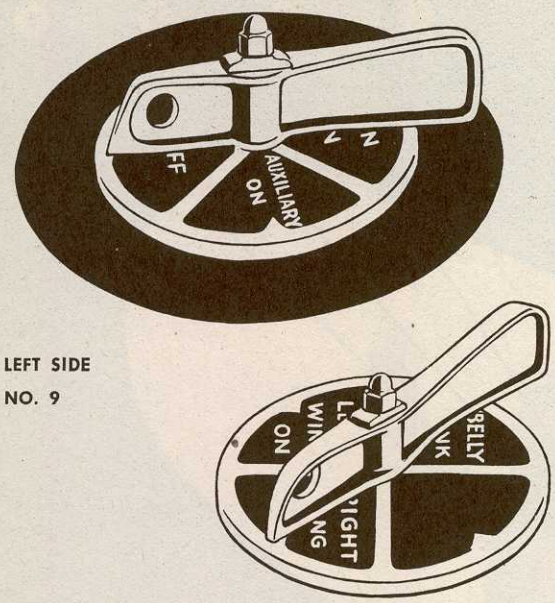



1. Booster Pump Emergency Switch
2. Fuel Level Gages
3. Fuel Pressure Gage
4. Main Fuel Pump
5. Main Fuel Selector Valve
6. External Fuel Selector Valve
7. Belly Tank
8. Auxiliary Fuel Tank
9. Main Fuel Tank
10. Internal Wing Tanks
11. External Wing Tank

The tanks hold:

| | Gallons |
|---|---|
| Main | 270 |
| Auxiliary | 100 |
| Internal wing tanks (90 gals. ea. wing) | 180 |
| External wing tanks (165 gals. ea.)* | 330 |
| Belly tank | 110 |
| Total | 990 Maximum gasoline load |

*Flights have been conducted with two 300-gal. external wing tanks.




LEFT SIDE
NO. 9

Set main selector to tank desired when using internal tanks.

When using drop tanks, place external tank selector on tank desired, then switch the main selector to EXTERNAL TANKS. Be sure to set your external tank selector first.

Feel the selector click in place when switching tanks.

All internal tanks are self-sealing and provide secondary protection against gunfire.

An engine-driven pump supplies gas to the carburetor. Both the main and auxiliary tanks have an electric booster pump which goes on automatically when the tank is selected.

The booster pumps are controlled by a rheostat on the circuit protectors panel. For normal automatic operation of the pumps, the rheostat is left at START & ALTITUDE.

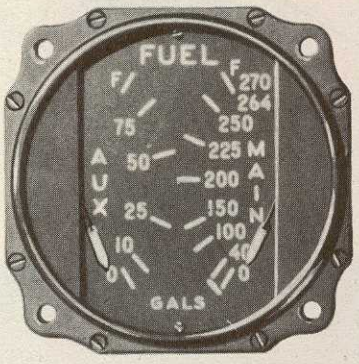
If the engine-driven pump fails, or you need added pressure while switching tanks, turn the rheostat clockwise to EMERGENCY.

On planes with the R-2800-57 engine, desired fuel pressure is 24-26 psi, later planes, 17-19 psi.

Remember: If the EMERGENCY position fails to maintain your fuel pressure at high altitude, retard your power until the pressure comes up. As you descend, retard the rheostat to keep the pressure from getting too high.

The internal wing tanks feed into the main tank. This process takes place automatically when the internal wing tank switch (beneath the booster pump rheostat) is in AUTO. The flow starts when the supply in the main tank is reduced to around 220 gallons, and shuts off when the tank has been filled to around 265 gallons.

The wing tank pump may be turned OFF and ON manually as well as automatically. Except when you are making planned use of gas from the internal wing tanks, it is recommended that you leave the switch OFF. The ON position should be used only when checking for complete internal wing tank drainage.




INSTRUMENT
PANEL
NO. 33

INSTRUMENT PANEL NO. 16

INSTRUMENT
PANEL
NO. 18

The vapor return line from the carburetor empties into the main tank. The maximum return is around 10 gallons an hour although it's usually less.

With your internal wing tank switch in AUTO, there is a danger that the main tank will overflow, resulting in the loss of gas overboard.

Fuel quantity gages for the main, auxiliary and internal wing tanks are on the instrument panel. The cockpit contains a 3-point correction card. The main tank also is equipped with a warning light that glows when the supply drops to 40 gallons.

The external tanks have no gages.

**Fuel Management**

1. Booster pump: START & ALTITUDE.
2. Internal wing tank pump: OFF.
3. Take off and fly 15 minutes on main tank.
4. Drain external tanks (if carried).
5. Drain auxiliary tank down to 25 gallons, leaving that supply as a known reserve.
6. Switch to main tank. After 10 minutes, turn internal wing tank pump to AUTO. When the internal wing tanks level gages indicate the tanks are nearly empty, turn the internal wing tank pump to ON to insure complete drainage. When the tanks are empty, turn the pump OFF.
7. Land on fullest tank—either main or auxiliary.

Note: The main tank is used for 15 minutes at the outset to provide space for the vapor return from other tanks.

**Regardless of the tank you are using, always keep an eye on the main tank gage. In brief:**

On planes prior to the N-20, there is no way to get the gasoline from the internal wing tanks in case of electrical failure or a breakdown of the internal wing tank pump. From the N-20 on, however, an alternate gravity feed to the engine driven pump is being installed.

This installation requires modified fuel cocks as shown.

If the internal wing tank pump fails—that is, the gages show that fuel is not being transferred—merely turn the main fuel selector to INTERNAL WING ALT. FEED. Otherwise you will drain the main tank before you want to.

To stop all fuel flow, when using these cocks, place the main selector on INTERNAL OFF EXTERNAL TANKS ON and the external tank selector to EXTERNAL OFF.

When using internal tanks during flight, leave the external tank selector on EXTERNAL OFF. This enables you to stop the fuel flow by turning the main selector only.

**External Tanks**

The external tanks are pressurized by exhaust from the vacuum pump.

The pressure is comparatively low, from 4 to 6 lbs., and in rare instances might be insufficient to force gas up to the engine-driven pump at high altitudes. If you should encounter this, try your external tanks again at around 10,000 feet before concluding they are useless.

It's important to drain your external tanks uniformly for the sake of your airplane's trim.

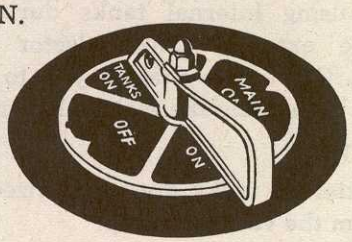
| TIME | TANK SELECTION |
|---|---|
| Takeoff | MAIN |
| TO + 0015 | External selector to RIGHT WING ON and main selector to EXTERNAL TANKS ON |
| TO + 0045 | External selector to LEFT WING ON |
| TO + 0115 | External selector to RIGHT WING ON |
| TO + 0145 | External selector to LEFT WING ON |
| TO + 0215 | External selector to RIGHT WING ON |
| TO + 0245 | External selector to LEFT WING ON |
| TO + 0315 | Alternate between external tanks every 15 minutes until emptied. |
| TO + 0415 | Main selector to AUX |
| TO + 0515 | Main selector to MAIN |
| TO + 0525 | Internal wing tank pump to AUTO approximately six hours of fuel remaining. |

As no external gages are provided, this presents a problem and calls for a definite system of fuel management. The following system is based on an average fuel consumption of 80 gallons an hour and for the use of two 165-gallon external wing tanks, the customary load.

(If the loading is different, work out a similar system based on the load carried.)

**Management of External Tanks:**

1. Turn external tank selector to RIGHT WING ON.




2. Turn main tank selector to EXTERNAL TANKS ON.

3. Burn for 30 minutes, then turn external tank selector to LEFT WING ON.

4. Alternate between the tanks at 30-minute intervals until each tank has been used for an hour and a half.

5. Start switching tanks at 15-minute intervals, while keeping an eye on the fuel pressure gage.

6. The instant the fuel pressure fluctuates, switch to an internal tank.

If your consumption is greater than 80 gallons an hour, naturally you start watching the fuel pressure gage earlier.

When you first turn on an external tank, you may get a fluctuation of fuel pressure. To eliminate this, turn the main fuel selector to MAIN until the gage is stabilized. You may have to repeat the process several times to "prime" the lines before the pressure remains constant on an external tank.

While checking tanks on the ground, leave the selector on each external tank long enough to stop fuel pressure fluctuation. The fluctuation occurs until air is worked out of the lines.

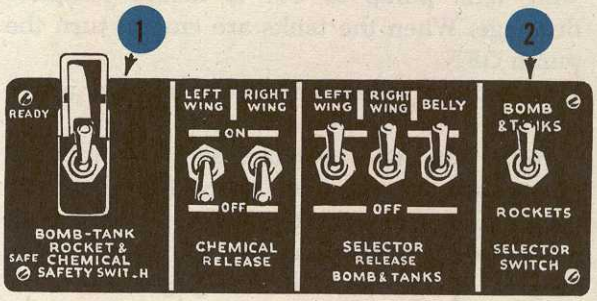
Do not switch tanks while pulling more than 35″ Hg. The momentary leaning during a high rate of fuel flow will cause dangerous backfiring.

**Jettisoning External Tanks**

Before taking off with external tanks, set your bomb and tank release switches so you can jettison the tanks instantly with the push button on the stick in case of engine failure.

Procedure:

1. Safety switch: ON (Ready).
2. Selector switch: BOMBS & TANKS.
3. Release switches: ON (For later series, SELECTIVE RELEASE).




After reaching a safe altitude, turn the selector release switches and safety switch OFF to avoid an accidental release of the tanks.

The tanks also may be jettisoned with the manual release handles.

Obviously, you should jettison external tanks before making a belly landing. They're a great fire hazard.

Also jettison your tanks before making a wheels down emergency landing. If you're in trouble, there's no point in adding to your problem with the drag and weight the external tanks provide.

After jettisoning tanks, pull up the bomb arming handles to retract the tank braces.

If a tank fails to release when jettisoned, yaw your plane until it falls free.

Note: With external tanks full, make no turns below 180 IAS. With the wing external tanks empty, make no turns below 150 IAS.

Remember that a full 165-gallon tank weighs almost as much as a 1,000-lb. bomb.

External wing tanks decrease stability around the vertical axis (yaw).

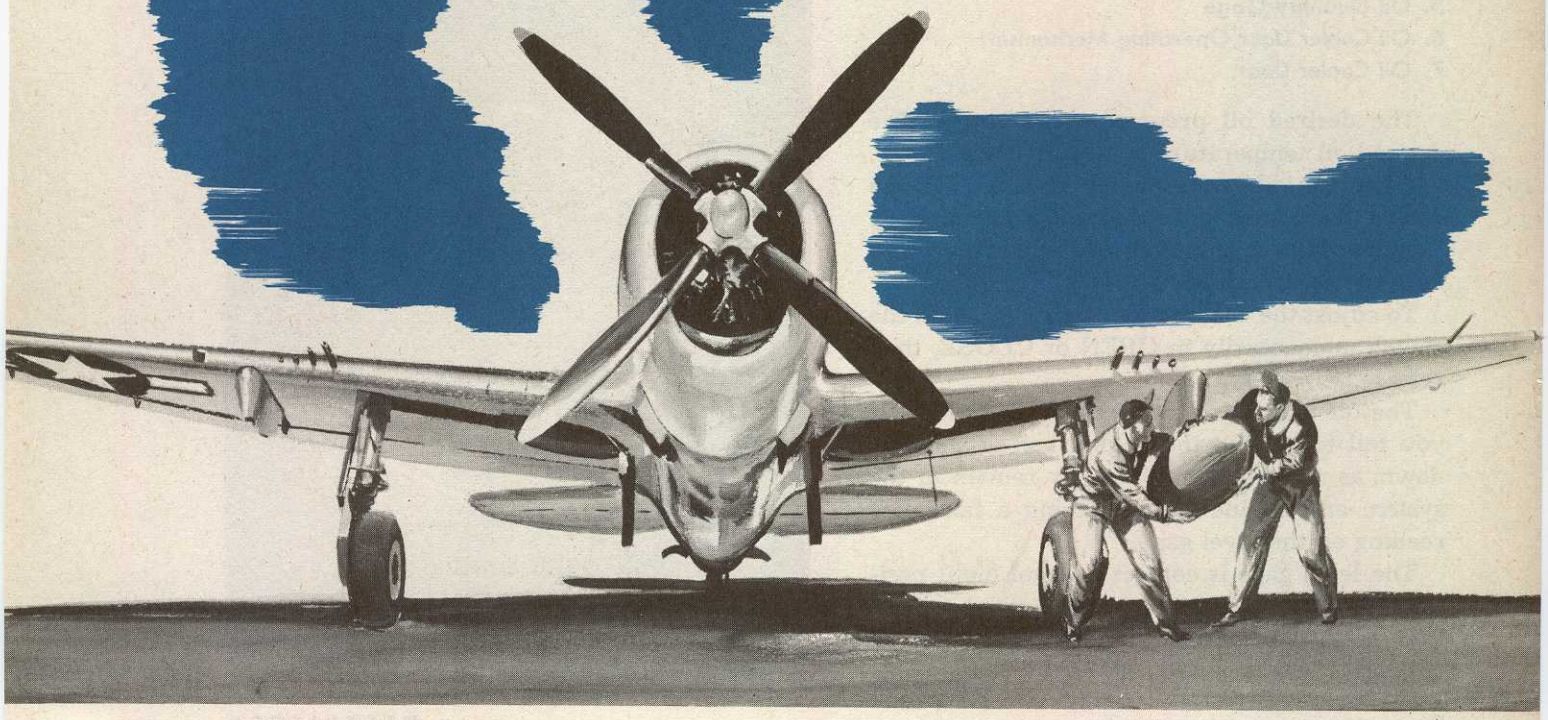
A full auxiliary tank decreases stability around the lateral axis (pitch).

Violent maneuvers, unauthorized practice landings, and high speed dives are prohibited when external loads are carried.

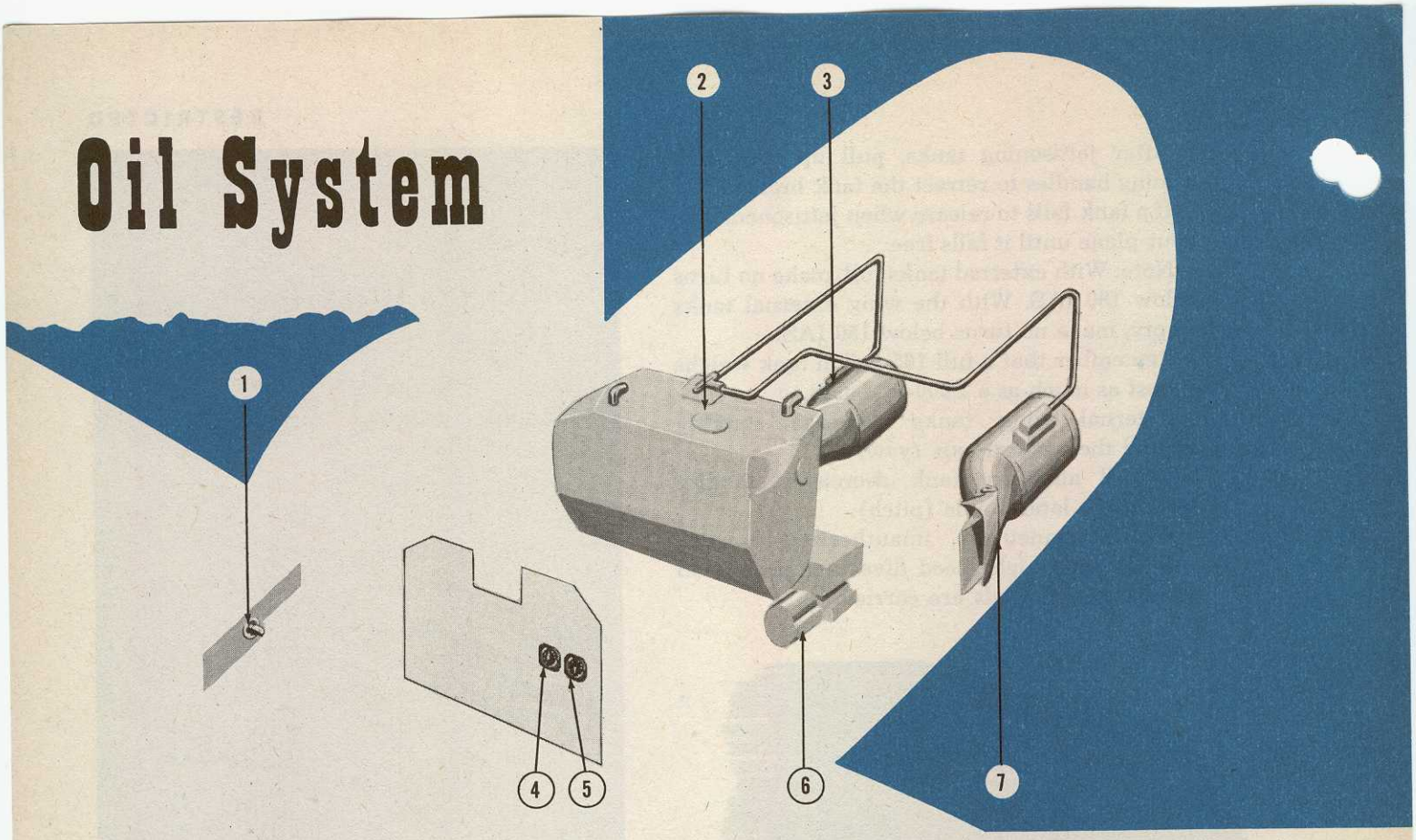
## IAS LIMITATIONS WITH EXTERNAL LOAD

| INSTALLATION | IAS LIMIT | VERTICAL ACCELERATION LIMIT |
|---|---|---|
| 75 US—(62.4 Imperial)—gallon belly tank | 350 IAS | 4.7g |
| 110 US—(92 Imperial)—gallon belly tank | 325 IAS | 4.00g |
| 110 US—(92 Imperial)—gallon wing tanks | 300 IAS | 4.00g |
| 165 US—(137.2 Imperial)—gallon wing tanks | 300 IAS | 4.00g |
| 300 US—(250 Imperial)—gallon wing tanks | 200 IAS | 3.00g |
| 1000 lb. wing bomb | 250 IAS | 3.7g |
| 500 lb. belly bomb | 300 IAS | 4.00g |

**Gas is your plane's life blood. Study the fuel system.**



# Oil System




1. Oil Cooler Control Switch
2. Oil Tank
3. Oil Cooler
4. Pressure and Temperature Gages
5. Oil Quantity Gage
6. Oil Cooler Door Operating Mechanism
7. Oil Cooler Door

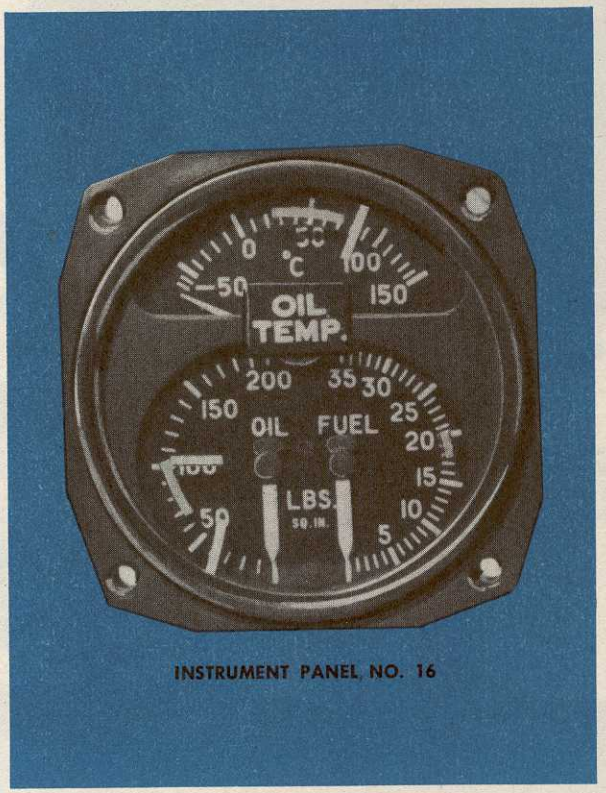
The desired oil pressure is 70-90 psi. The desired oil temperature is 40°C-100°C.

When the oil cooler switch is in AUTO, the cooler doors are governed automatically by thermal units to maintain the oil temperature between 88°C and 90°C.

To adjust the cooler doors manually, hold the switch momentarily in OPEN or CLOSE, then release.

The oil tank has a capacity of 40 gallons. If you fail to run up the engine before shutting down, as many as 8 gallons may remain in the system and engine sumps, giving a false low reading on the level gage.

The level gage is correct in level flight position. The cockpit contains a three-point correction card. Ordinarily you carry around 36 gallons.




INSTRUMENT PANEL NO. 16

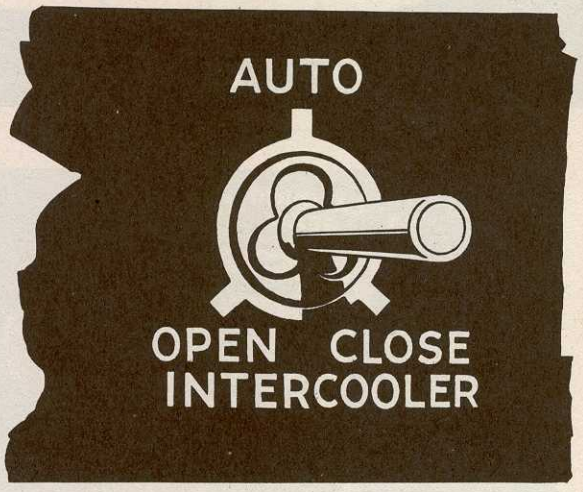
# Hydraulic System

INSTRUMENT PANEL NO. 18

Normal oil consumption is about two gallons an hour. As time is put on the engine, consumption increases, but it should never exceed seven gallons an hour.

A pendulum in the tank allows seven seconds of inverted flight.

At altitudes above 18,000 feet keep an eye on the oil temperature and if necessary regulate the oil cooler shutters manually to keep the needle in the green.

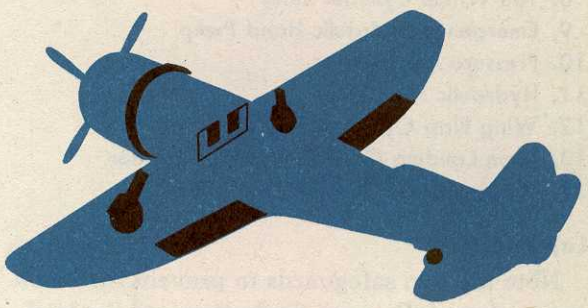


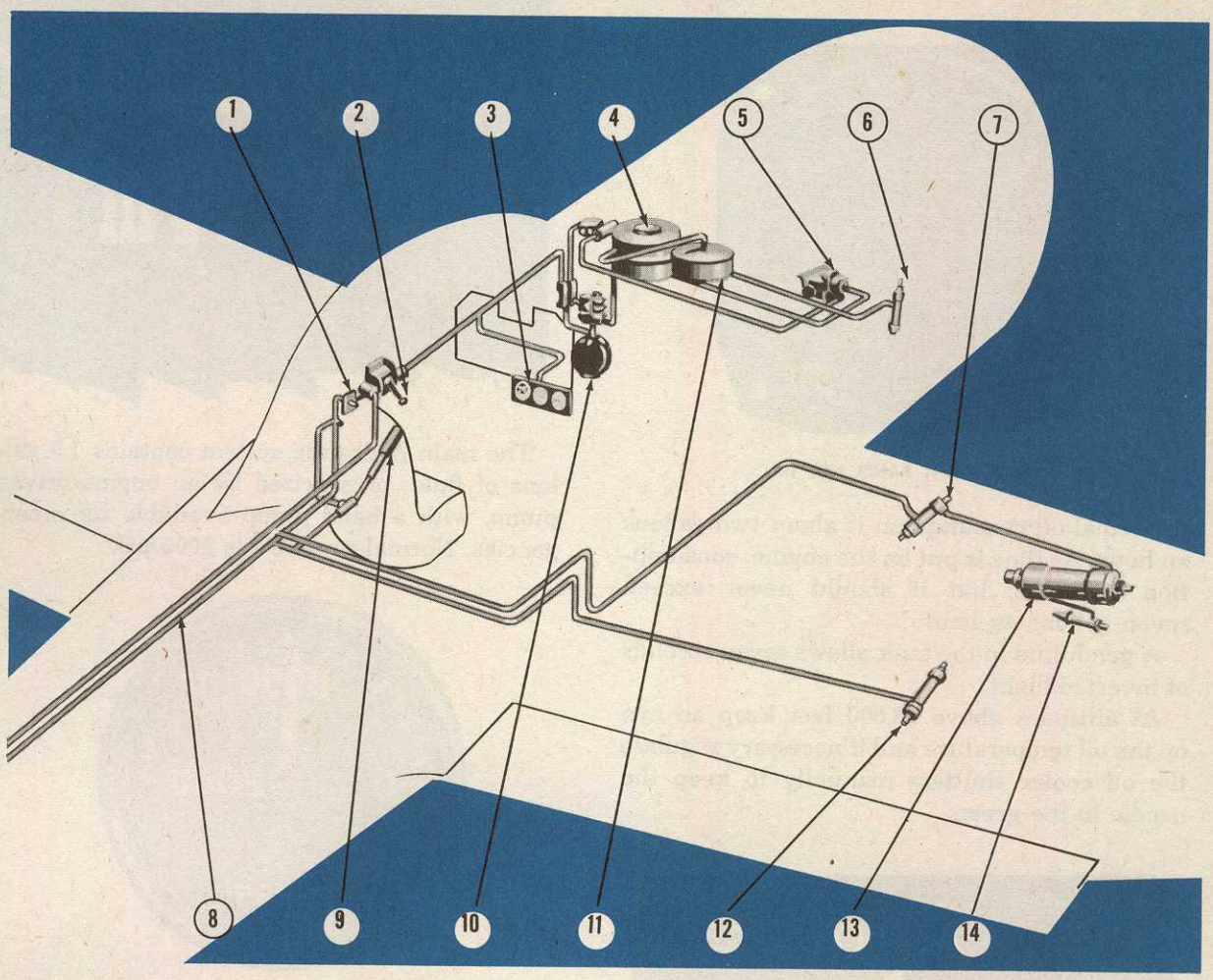

(See Extreme Weather Operation section for oil dilution procedure.)

Note: If oil temperatures continue to rise with the oil cooler shutters open, close shutters fully. The oil in the cooler may have congealed.

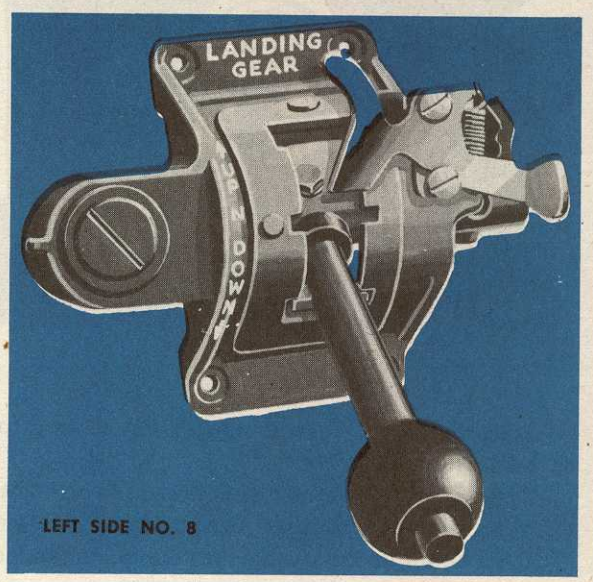
The main hydraulic system contains 1.9 gallons of fluid, pressurized by an engine-driven pump, with a hand pump available for emergencies. Normal pressure is 1000 psi.

The system operates:
Landing gear
Wing flaps
Cowl flaps
Automatic pilot
(The brakes have a separate system)






1. Wing Flaps Control
2. Landing Gear Control
3. Hydraulic Pressure Gage
4. Hydraulic Fluid Reservoir
5. Engine Driven Pump
6. Cowl Flap Cylinder
7. Wheel Well Door Cylinder
8. Tail Wheel Cylinder Lines
9. Emergency Hydraulic Hand Pump
10. Pressure Accumulator
11. Hydraulic Fluid Filter
12. Wing Flap Operating Cylinder
13. Main Landing Gear Retracting Cylinder
14. Landing Gear Downlock Cylinder



LEFT SIDE NO. 8

**Landing Gear**

Note the two safeguards to prevent inadvertent raising of the gear: the button and the latch.

The latch can cause you annoyance at first. Many new pilots forget to push it to one side and find they can't raise their gear. The lever positively will not go up with the latch in the way.

The "N," or neutral position, is used for only one purpose—that's for emergency use of your hydraulic pressure to lower your wing flaps.

The tailwheel retracts and lowers with the main gear.

The landing gear warning system consists of a horn and a red and green light.

With the gear down and locked, the green light burns.

While the gear is in motion, or in any unlocked position, the green light is out, but the red light burns. When the gear is up and locked, the red light goes out, and you have no light burning.

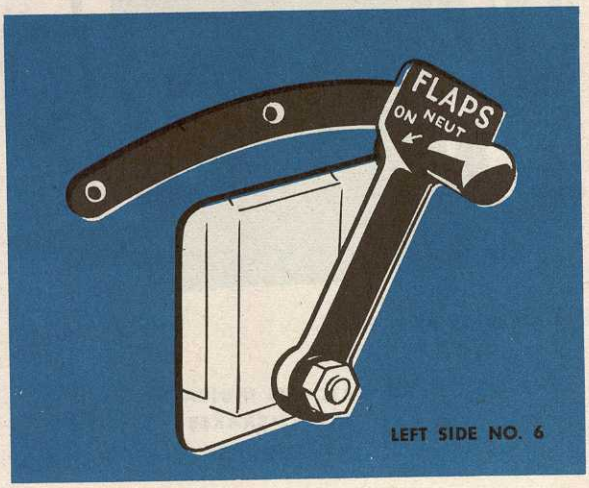
Anytime you pull back the throttle below minimum cruising, you get a red light and a squawking horn until the gear is down and locked. Then the green light comes on.

You can cut off the horn with the spring-loaded switch attached to the throttle linkage. The switch will snap back in place the next time you move the throttle forward.

Except in an emergency, don't interrupt the cycle of raising or lowering your wheels. This destroys the timing and may result in a crushed wheel well door.

### Wing Flaps

You can stop the movement of the flaps in any position by returning the control to NEUTRAL.




The flaps are marked off with lines from 0 to 40 degrees, in increments of 10 degrees, along their leading edges, to show you their exact position.

The cowl flaps and automatic pilot are explained elsewhere.

## Emergencies

### Hydraulic Pump Failure

Failure of hydraulic pump, as indicated by zero reading on the pressure gage:

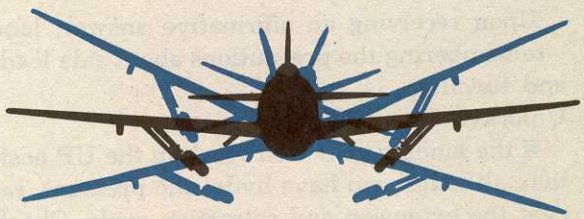
1. To retract landing gear: Move control to UP.

Operate the hand pump until warning system shows gear is up and locked (both lights out).

2. To extend gear: Move control to DOWN.

The gear will fall and probably lock in position. If you fail to get a locked signal (green light), rock your plane in an effort to snap the gear in place. If this doesn't work, place the flap handle in NEUTRAL and pump.

If you still fail to get a green light, have your wheels checked visually for being in the full



down position. Make a normal landing, being careful to keep side loads on the gear to a minimum.

a. Stop your plane at the end of the roll without turning. A turn may collapse the gear. Do not attempt to taxi. Call for a tug. Be sure to tell the tower what you are doing. They might be bringing someone else in right behind you.

b. Drop external tanks before landing, even though empty. The vapor in the empty tanks is a fire hazard in case the gear collapses.

3. To extend wing flaps:

After you have your landing gear down, place the landing gear control in NEUTRAL.

Operate hand pump to bring flaps down.

**Remember:**

When using the hand pump to operate either the gear or the flaps, place the other control in NEUTRAL. This keeps you from dissipating your pressure throughout both systems.

# Mechanical Trouble

Unlocked gear—DOWN.

If you fail to get a green light showing that your gear is locked down when you have full hydraulic pressure, retract and extend the gear a few times and the light may go on. Should you have plenty of time, repeat the operation through as many as 10 or 15 cycles. Meanwhile, replace your green light bulb with one that you know has been working.

If you can't get that magic green light, ask the tower or mobile control whether your gear appears to be down.

Upon receiving an affirmative answer, land —remembering the precautions about side loads and turning.

Unlocked Gear—UP.

If the landing gear won't lock in the UP position, although you have hydraulic pressure, repeat the extension and retraction cycle. Check the toggle switch for the red light in the throttle linkage. It may be stuck.

If the red light still burns, have the tower or another member of your flight check to see whether the wheels actually are in the wells. If so, proceed with your flight. (Don't perform any high speed dives and pullouts or a wheel might come out.)

It may be that the timing valve is defective, allowing the wheel well doors to retract ahead of the wheels and preventing complete retraction. In this case, lower your wheels (they'll come down all right) and make a landing.

If one or both of your wheels still fails to extend fully after trying the above steps—make a belly landing.

### Brakes

The N's brakes require pumping before you get brake action.

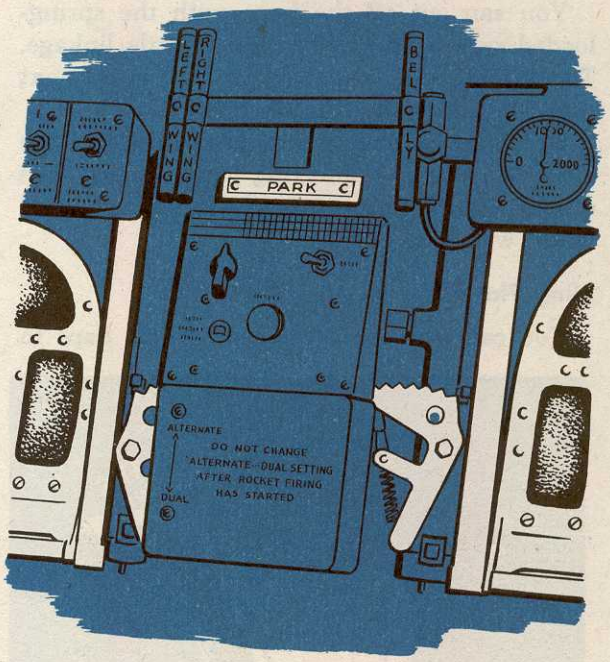
Pump up your brakes before the chocks are removed or while in the traffic pattern before landing. Not much pumping is needed.

Never brake your wheels after takeoff, or you may find the brakes locked when you land.

The brakes are the disc-type, metal against metal, and are inclined to stick when hot.

After taxiing, don't set your parking brake. Have the wheels chocked. If necessary, the crew chief will set the parking brake after the discs have cooled.

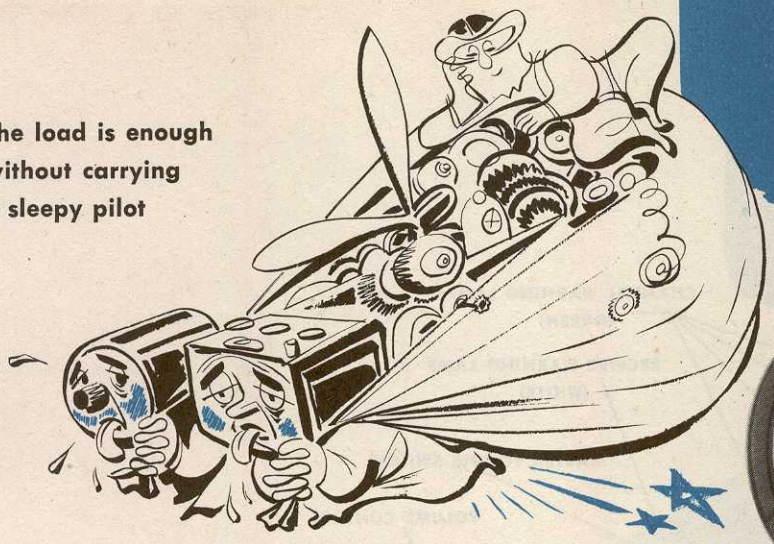
The parking brake handle is beneath the instrument panel. To set the brakes, depress the pedals, then pull out on the handle. Ratchets alongside the brake pedals show the extent to which the brakes have been engaged.

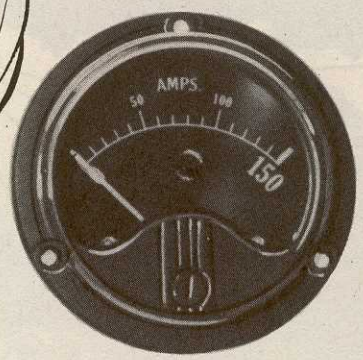



1. DEPRESS BRAKES
2. PULL HANDLE
3. RATCHETS INDICATE EXTENT BRAKES ARE ENGAGED

# Electrical System

**The load is enough without carrying a sleepy pilot**






INSTRUMENT PANEL NO. 1

The P-47N, as a casual inspection of the cockpit shows, is an electrified airplane. More than 50 items draw from the system. In addition to the Curtiss Electric prop, the usual lights, instruments and gages, the oil cooler and intercooler doors and the cowl flaps are regulated electrically. Therefore, proper regard for the electrical system is necessary to keep this airplane aloft.

The system is built around a 24-volt battery and a 100-ampere generator. Under ordinary conditions, the generator supplies all the current you need as well as keeping the battery charged. The usual drain is between 45 and 80 amperes. The generator is capable of 150 ampere output under brief overload conditions and at times this is needed. (During a night landing or takeoff, there may be a drain on the system of more than 147 amps.)

Your ammeter is the principal guide to your electrical system.

**Signs of trouble are a continuous reading of more than 60 amps, or the needle dead against the zero stop. The former reading indicates your battery is weak; the latter condition is a sure sign of a dead generator. The needle fluctuates when the generator is putting out.**

Your main problem under either of these circumstances is to preserve whatever electrical power you have for operation of the propeller. The procedures are described in the Propeller section.

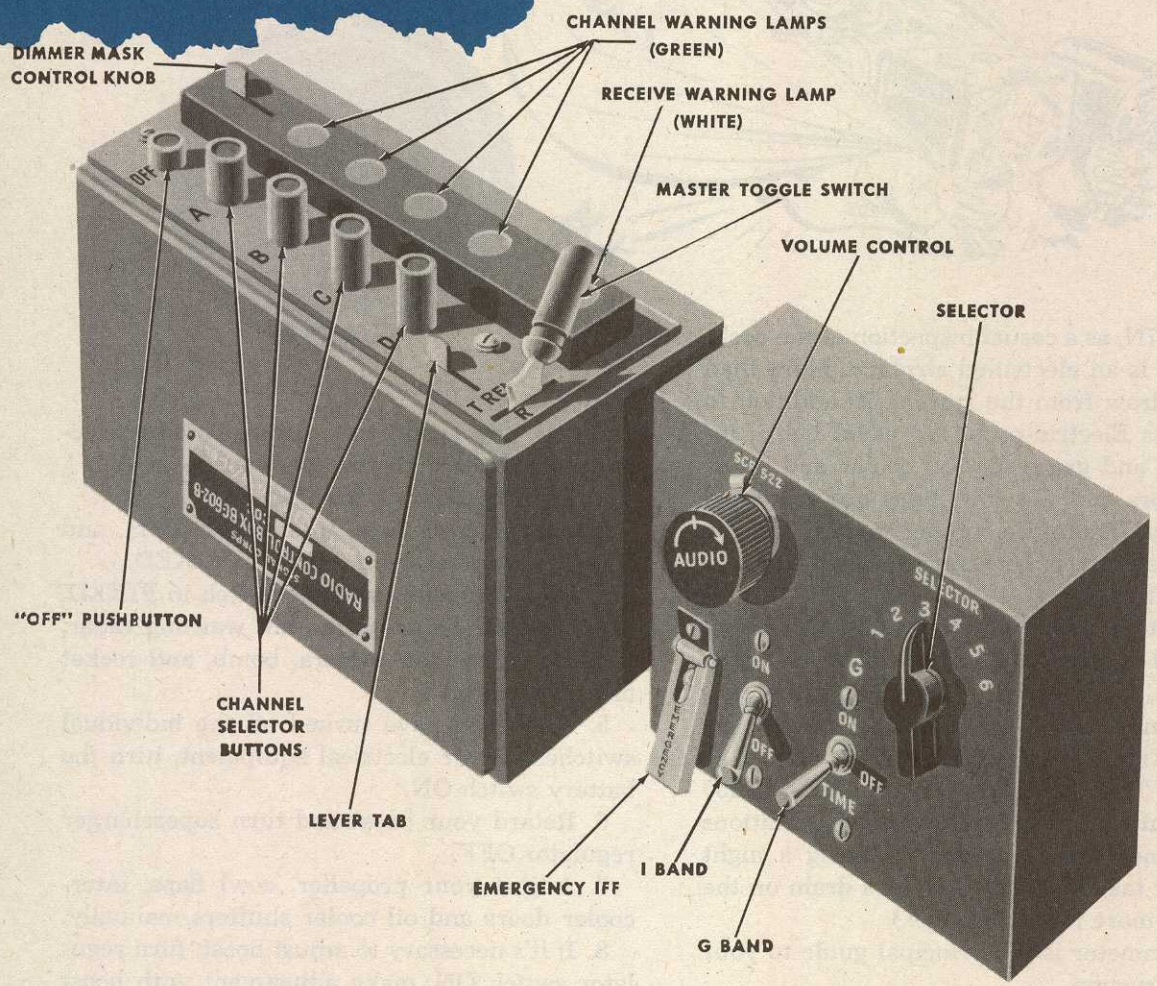
But in any event, turn off all possible electrical equipment. Here's how you do it:

1. Turn battery switch OFF.
2. Switch cowl flaps, intercooler doors, and oilcooler shutters from AUTO to FIXED.
3. Place propeller selector switch in FIXED.
4. Turn off lights, radio, tail warning radar, autopilot, gunsight, camera, bomb, and rocket firing switches.
5. After you have turned off the individual switches for the electrical equipment, turn the battery switch ON.
6. Retard your boost and turn supercharger regulator OFF.
7. Adjust your propeller, cowl flaps, intercooler doors and oil cooler shutters manually.
8. If it's necessary to adjust boost, turn regulator switch ON, make adjustment with boost lever, then turn switch OFF.

Each electrical unit is insured against overload by a circuit protector, located on the circuit protectors panel, or in the case of the prop, on the propeller panel.

If anything goes wrong with a unit, check the circuit protector. If it's out, reset it. Normally, it will stay in, because most trouble is due only to a momentary overload. If a protector will not stay in, hold it down while making an emergency adjustment.

# Radio Equipment



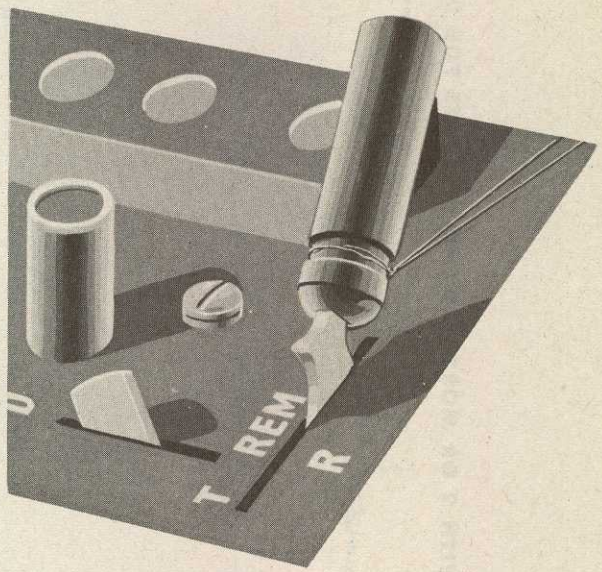

The P-47N has four radio sets: VHF (SCR 522), Detrola (SCR 438), IFF (SCR 695), and a VHF homing adapter (AN/ARA-8).

The VHF (very high frequency) unit is a command set for voice communication only. The range increases with altitude; for example, 35 miles at 1000 feet, 140 miles at 10,000 feet. Mountains or other obstructions in the line of transmission impede or cut out communication completely.

The set's controls are pictured below. The four channels, or frequencies, designated by letters, are tuned by radio men on the ground. To use a channel, push the appropriate button. When down, the adjacent green pilot light glows. Push the OFF button to break contact.

The toggle switch has three positions: T for transmit, R for receive, and REM for remote. Keep the switch in REM. In this position, you transmit by pressing the mike button on the throttle and are tuned to receive at all other times.

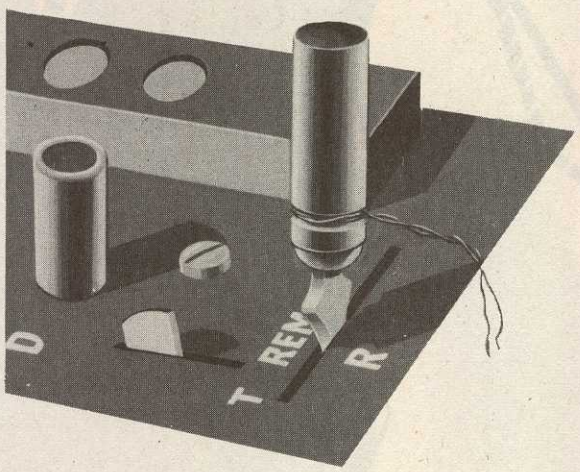
If the mike button is defective, transmit by holding the toggle in T (break the safety wire) and receive by holding it in R or REM. Do not leave the toggle in T or you transmit continuously and jam the channel. If you move the lever tab near the D channel button backward,

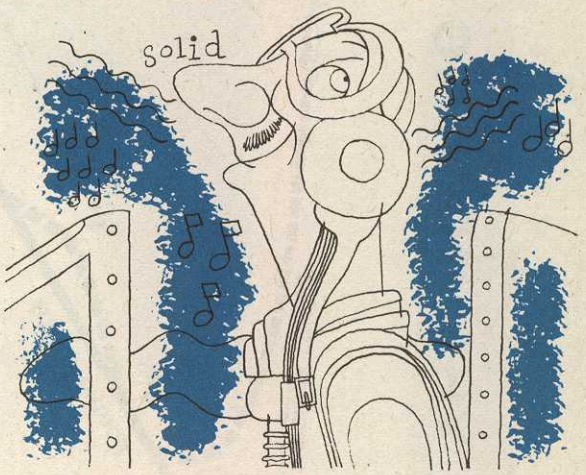



the toggle stays in T only while you hold it.

The receive warning lamp beside the toggle glows when the set can receive and goes out when you transmit.

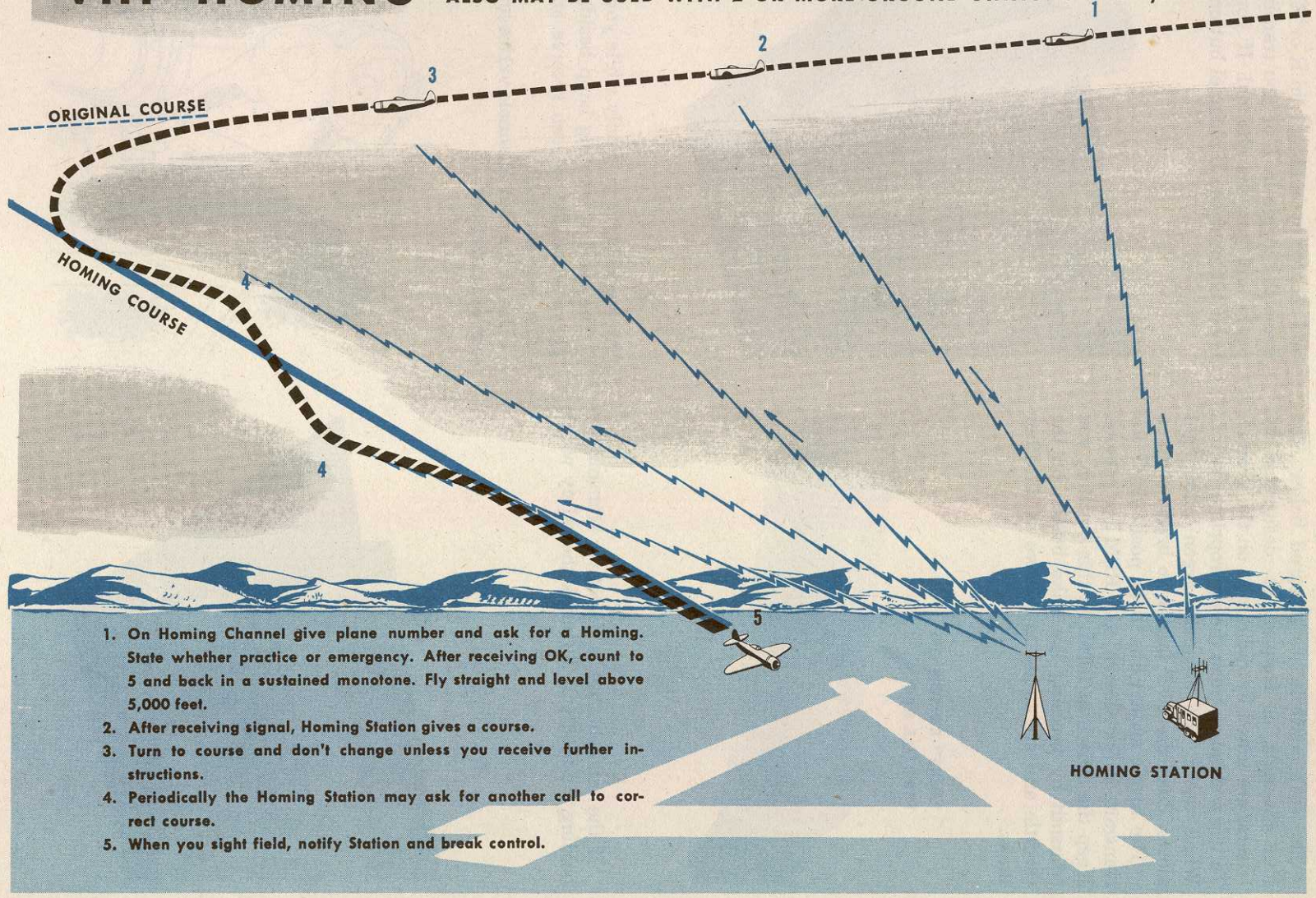
Use of the four channels varies among different organizations.



# VHF HOMING

## ALSO MAY BE USED WITH 2 OR MORE GROUND STATIONS FOR D/F FIXING




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 control.

**Detrola**

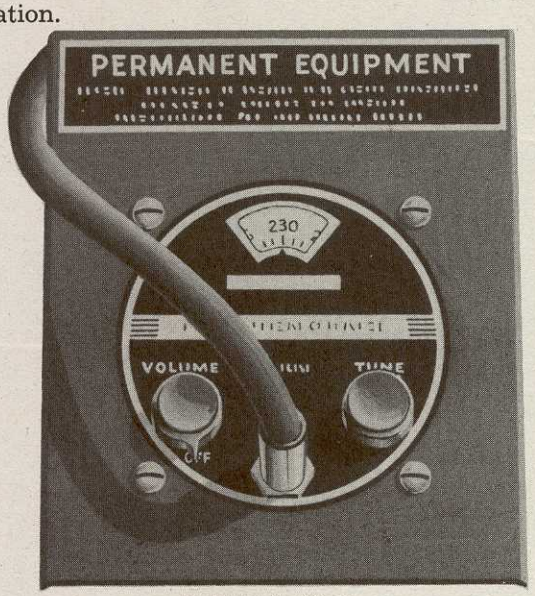
The Detrola, a receiver only, covers a range of 200 KC to 400 Kc. Most U. S. range stations operate within these limits.

The set is used:

1. To receive signals from radio range stations—for training, navigation, or orientation.

2. To receive transmission from control towers operating between 200-400 Kc. This may be necessary if your VHF is out of order or the tower doesn't contain VHF equipment.

The Detrola is located to the rear of the VHF set. It has its own switch and a tuning knob. To operate, turn ON; and with the tuning knob, adjust the dial to the frequency of the radio range or tower you desire to receive. Check the Detrola during each flight by tuning in on some station.




RIGHT SIDE NO. 5

**Homer**

The homer (AN/ARA-8) is an adapter for the regular VHF set. With it, you can either receive or transmit homing signals on any one of the four channels on the VHF radio.

The homer has 2 switches.

The 3-position switch selects:

HOMING—for receiving homing signals.

COMM—for normal operations of VHF set, with homer cut out.

TRANS—for transmitting a homing signal to another plane.

The other switch has 2 positions:

CW—for operation with unmodulated carrier wave.

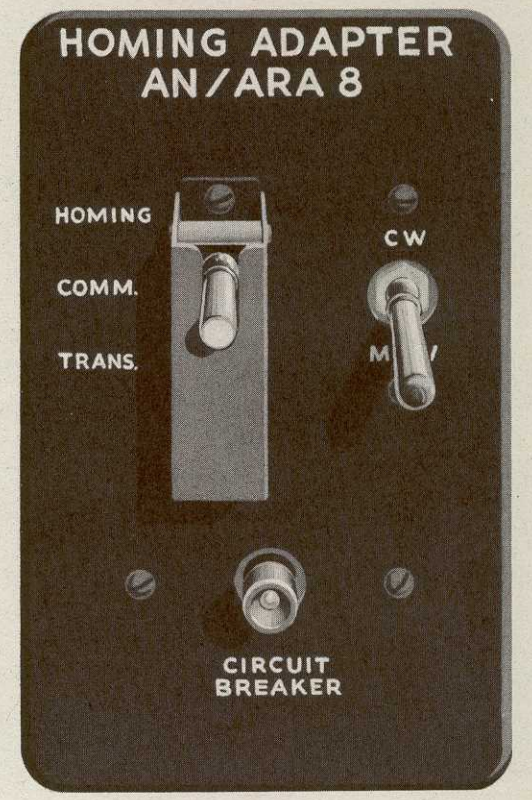
MCW—for operation with modulated carrier wave.

The selection of the type of wave to be used is made in briefing or when arrangements are made for a homing. The CW position gives better range, but MCW gives a clearer signal. Both transmitter and receiver must be set in the same position.

The homer utilizes the two aerial masts located just forward of the vertical stabilizer. By the use of two aerials, the homer converts the signal received to a D (-. .) or a U (. .-). When the transmitter is on your right, you receive a U, and when it's on your left you get a D.

When homing, if you receive a U, turn right. If you receive a D, turn left.

Once you are headed directly toward the transmitter, the two signals merge and you receive a steady hum.



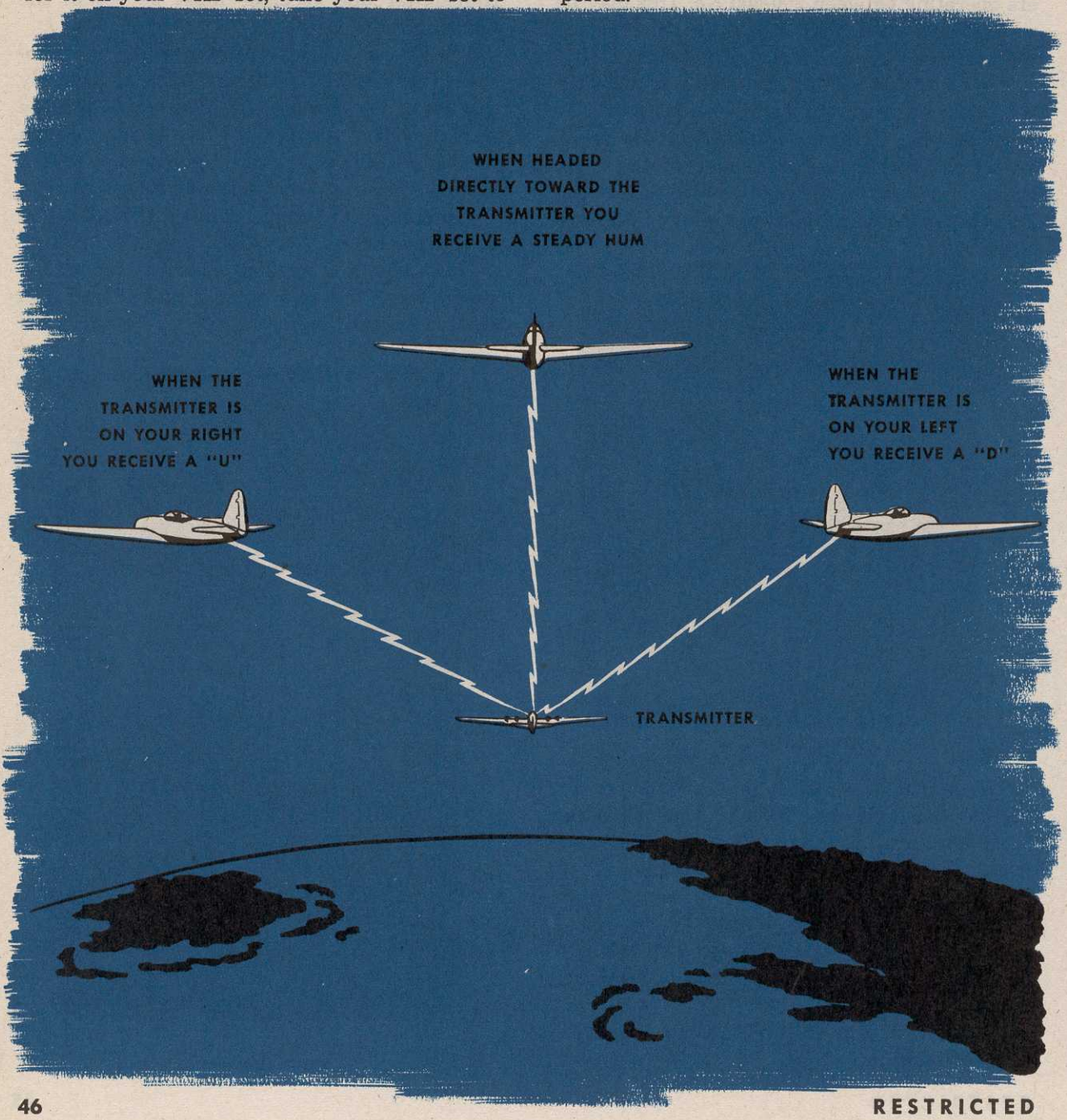

RIGHT SIDE NO. 11

### Air-to-Air Homing

When the homer is in use, normal voice communication is impossible. Therefore, agree upon details for homing before takeoff. These arrangements consist of selection of the channel, R/T procedure, and the period to be devoted to any one transmission.

To obtain a homing from another plane, ask for it on your VHF set, tune your VHF set to the agreed-upon channel, then turn your homing switch to HOMING. The usual transmission time is around three minutes. After you have placed yourself on course, return the switch to COMM, acknowledge via VHF, and arrange for another transmission if necessary.

When asked to give a homing, simply tune your VHF to the correct channel and set your switch to TRANS for the required transmission period.



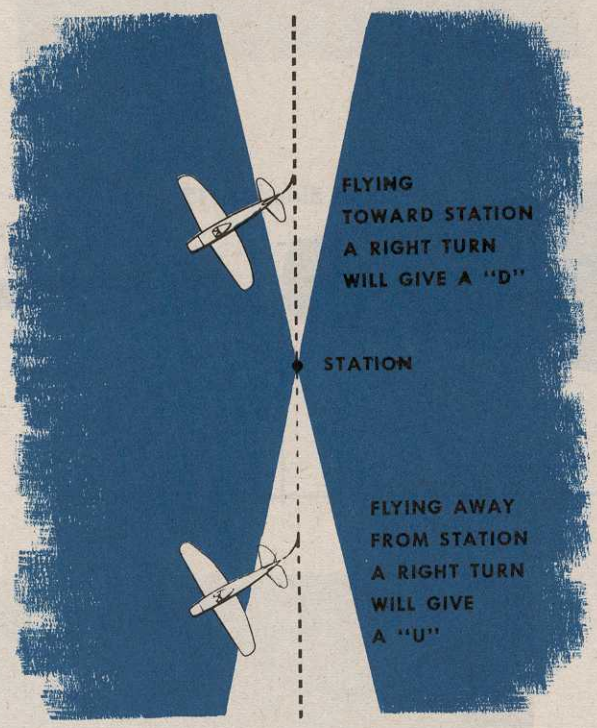
### Homing on a Ground Station

You tune in on the station equipped for VHF homing in the same way that you tune in on another airplane.

Since the system has no cone of silence, check the position of the transmitting station visually or use the following checks:

As long as you are approaching the station, if you turn right you get a D signal, left a U signal. If you are past the station, the signals are reversed.

Nearness to the station is indicated by an in-

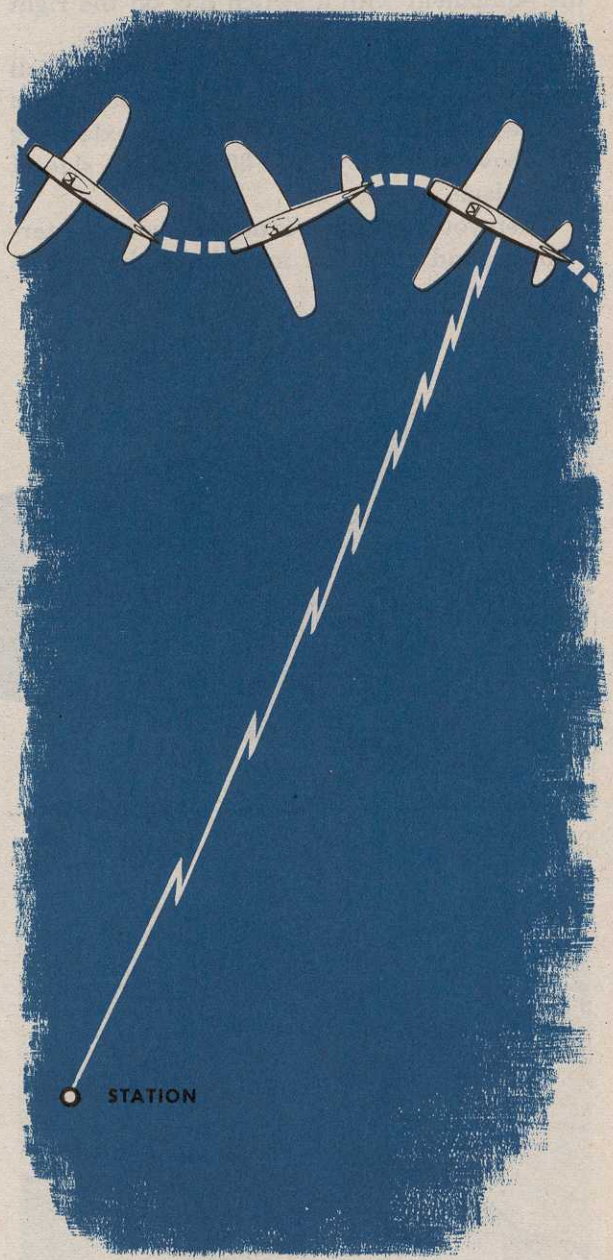



crease in signal strength, a narrowing of the on-course signal, and garbling when over the station.

### Additional Checks

Remember: If you suspect you are flying 180 degrees from the transmitter while receiving an on-course signal, check by turning your plane. If the normal position of the D and U signals are reversed you are indeed flying away from your objective.

If you should happen to be 90 degrees from the transmitter when you first pick up a homing signal, it is possible to receive a false on-course signal.



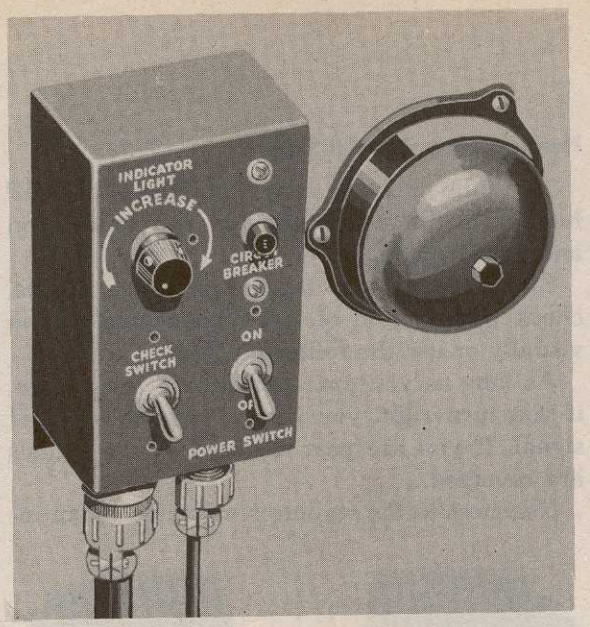

If you receive an on-course when you first tune in, check its authenticity by turning your plane to both sides. If it's false, you will receive the same letter signal, inasmuch as you are in the zone of that particular letter.

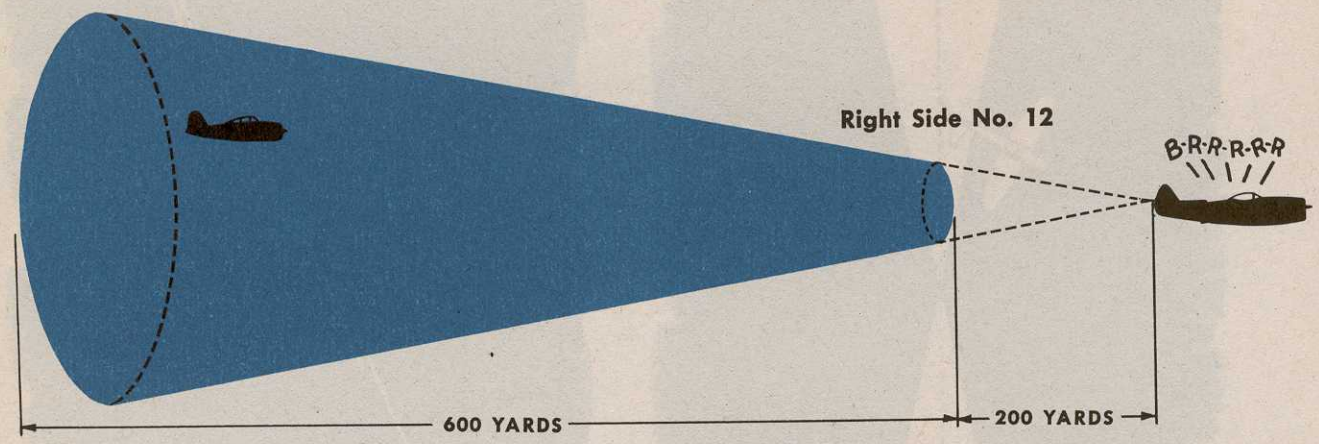
### Tail Warning Radar

From the N-5 on, the plane is equipped with a tail warning radar (AN/APS-13). Operate the equipment with a switch box on the right side of the cockpit.

With the radio on, a light burns and a bell rings in the cockpit if a plane approaches you from astern. The range is 800 yards, extending 45° above and below, and 30° on each side of your plane.

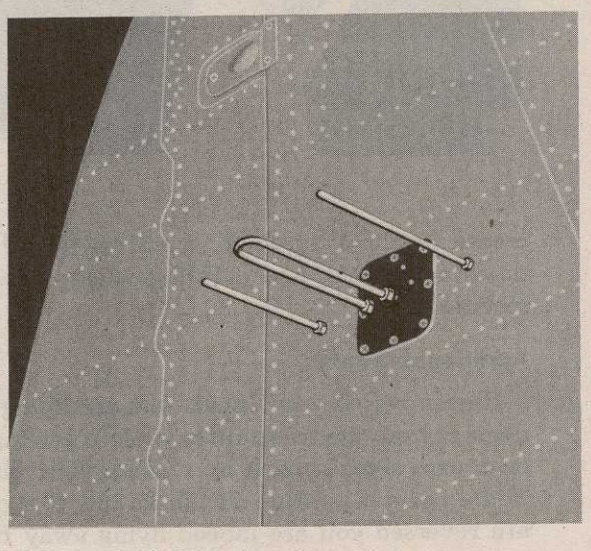
When you are 3100 feet or less above the terrain, ground reflection may make the signals continuous.




Right Side No. 12

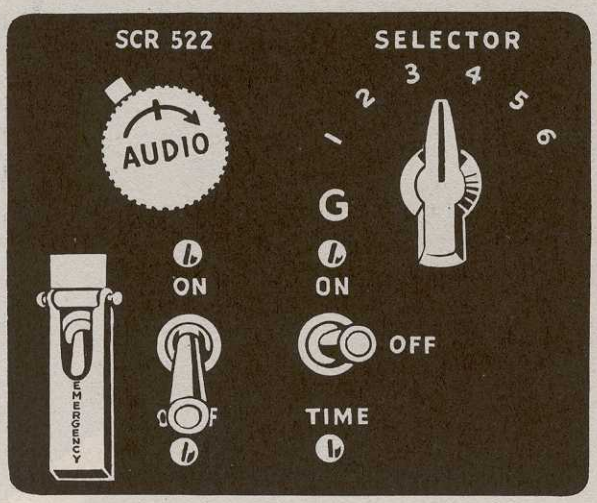
Tail Warning Light



Tail Warning Antenna

### IFF

Your plane is equipped with IFF, used to identify you to ground stations. The equipment is confidential and will be explained by the communications officer.




**Right Side No. 7**

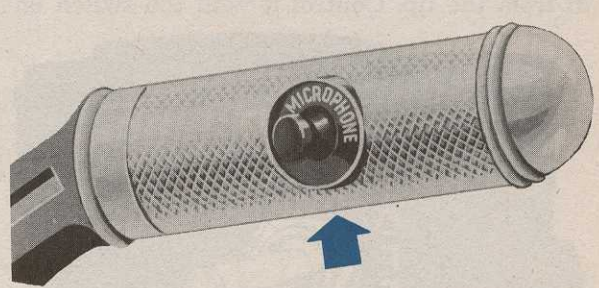
### Microphones

Two types of microphones are used:

1. The **throat mike** worn around the neck.

2. The **oxygen microphone** mounted in the oxygen mask.

Attach either mike to the radio set by connecting it to the proper lead on the right side of the cockpit.



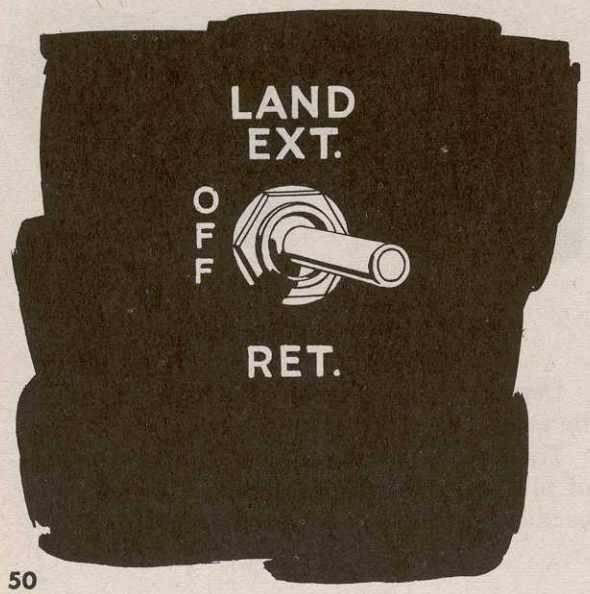

Depress the push-to-talk button on the throttle to talk.

The headset, used with both mikes, consists of phones placed in cups in the helmet over each ear, joined by connecting wires.

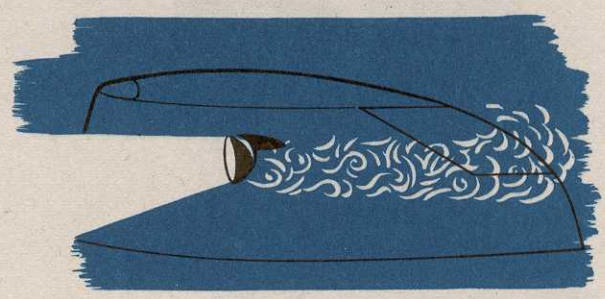
# Lighting System

The external lighting system on the P-47N consists of the landing light, recognition lights, and the three position lights.

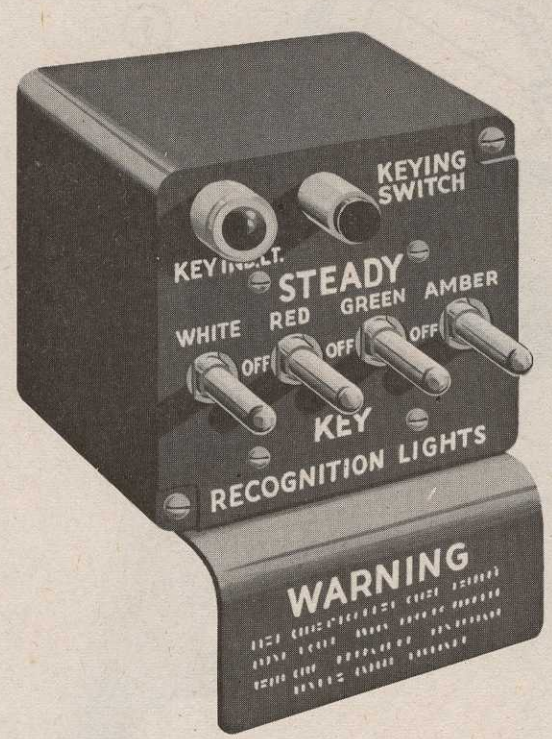
The landing light is flush-mounted in the lower surface of the left wing, about three feet in from the tip. Control it with the switch on the main panel using the three positions: EXT, OFF, and RET. The light comes on automatically when extended and goes off when retracted. Leave the switch in RET for a few seconds after the light goes out to insure that the light retracts fully into the wing.




If the light is even partially extended at speeds above 160 mph, it causes burbling under the aileron. If you should encounter this buffeting of the stick, particularly while gaining speed through 160 mph, check the position of the landing light.



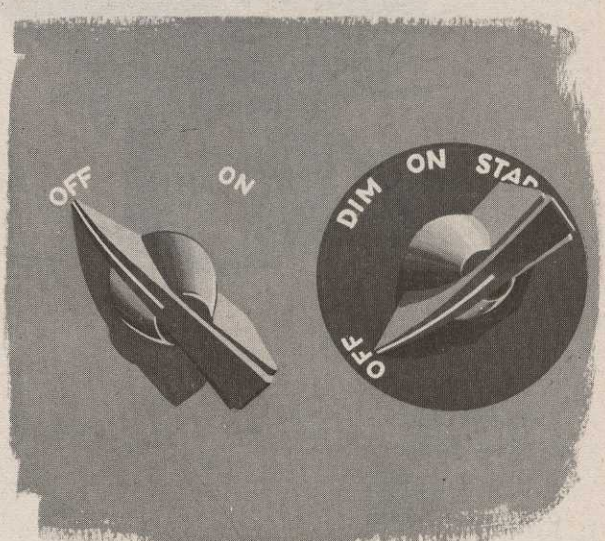
The recognition light control box is mounted on the right side of the cockpit. The lights are set in the lower surface of the right wing.




The wing position lights are set in the leading edges of the wing tips and the tail light is on the trailing edge of the rudder. There is a switch for the wing tip lights and another for the tail light. Each switch has three positions, BRIGHT, OFF, and DIM. Use the BRIGHT positions for the traffic pattern and the DIM for formation.

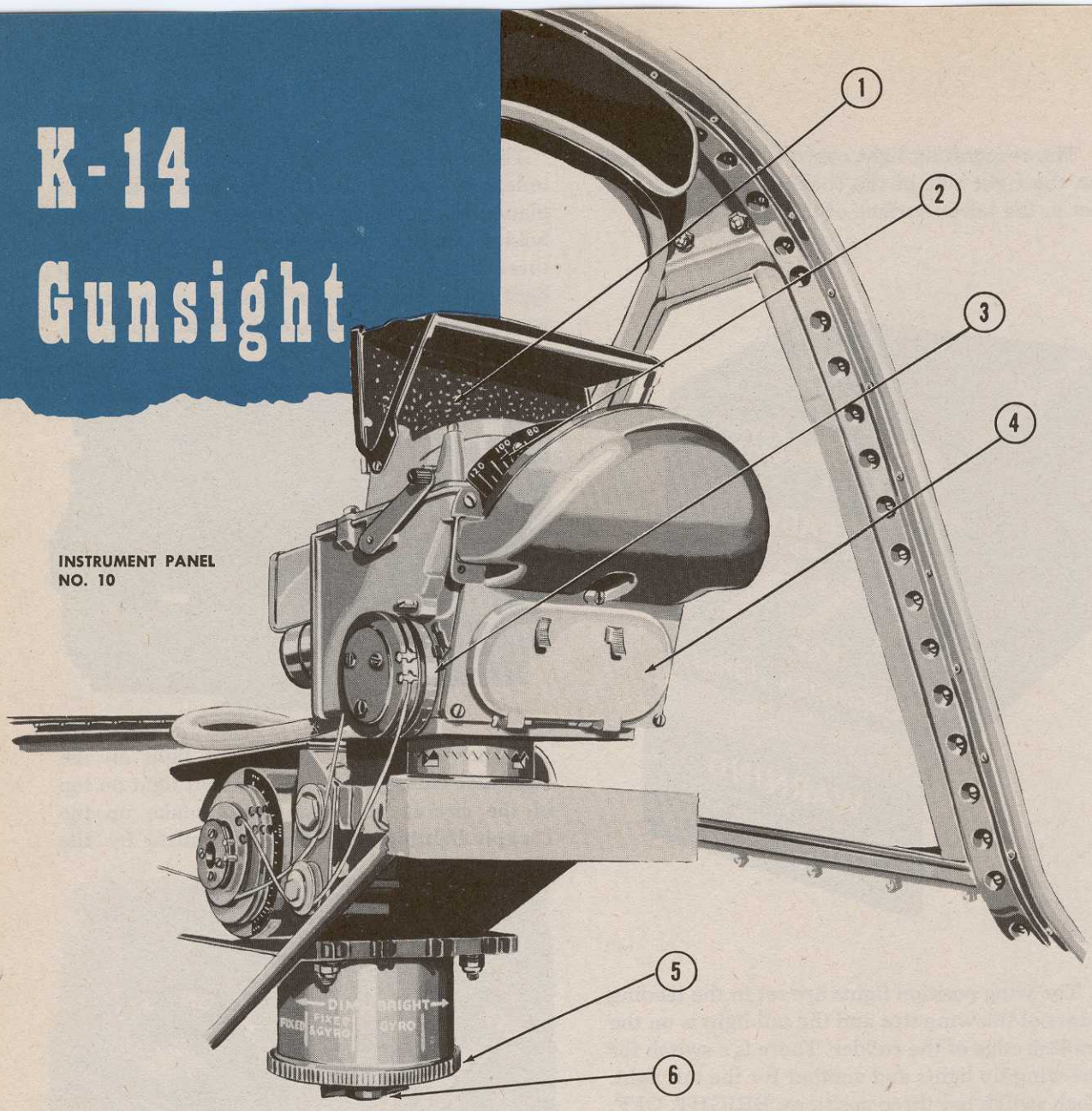
The wing lights are hard to see in formation unless you are well out to the side of the lead plane. When flying night formation, always hold a position which will enable you to see three lights on your leader's plane, the wing light on your side, the exhaust glow at the waste gate on your side, and the tail light.

A swivel-mounted fluorescent light on the right side canopy rail and a cockpit light on top of the circuit protectors panel make up the cockpit lighting. The rheostat control for the




fluorescent light is on the circuit protectors panel. There is a three-position switch on the main switch panel for the cockpit light, ON, OFF and a spring-loaded position, MOM, for momentary use. Adjust the hood on the cockpit light for different degrees of illumination.

# K-14 Gunsight




INSTRUMENT PANEL
NO. 10

1. Reflector Plate
2. Span Dial
3. Range Dial
4. Lamp Cover
5. Light Rheostat
6. Selector Switch

As you adjust the K-14 gyroscope gunsight, it automatically gives you the correct lead and shows you the range of the target. In other words, it's the answer to a poor deflection shooter's prayer.

Though exceedingly complicated internally, the sight is easy to operate with a little practice.

Actually, the K-14 contains 2 sights: The compensating sight, and an ordinary fixed electrical sight. In the fixed sight, a cross has been substituted for the pipper.

The fixed sight may be used alone, but ordinarily the cross is employed (with the ring extinguished) to show the amount of lead the gyro sight is allowing.

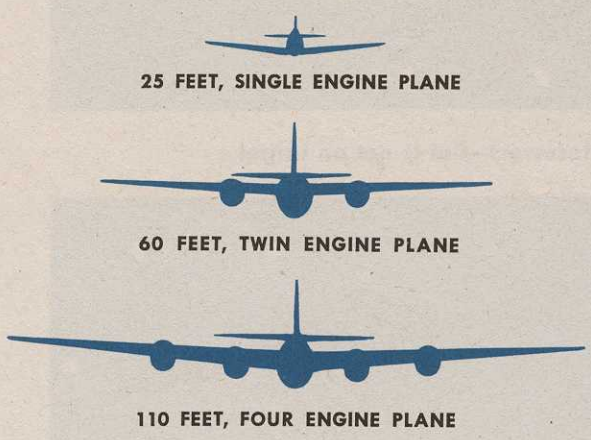
The gyro sight consists of a dot surrounded by six small diamonds. Your problem is to

place the dot squarely on an enemy plane by maneuvering your Thunderbolt, and keep him properly surrounded by the six diamonds until you shoot him down.

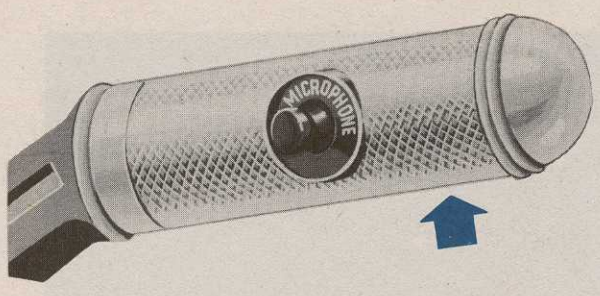
Here's how you do it:

On the front of the device is a span scale, reading 30 to 120 feet. Set this scale to the wing span of the enemy plane. It's a good idea to leave it set at the wing span of the enemy plane you're likely to encounter. This forethought might save a couple of seconds at a critical time.

In case your aircraft identification is feeble, set the wing span as follows:



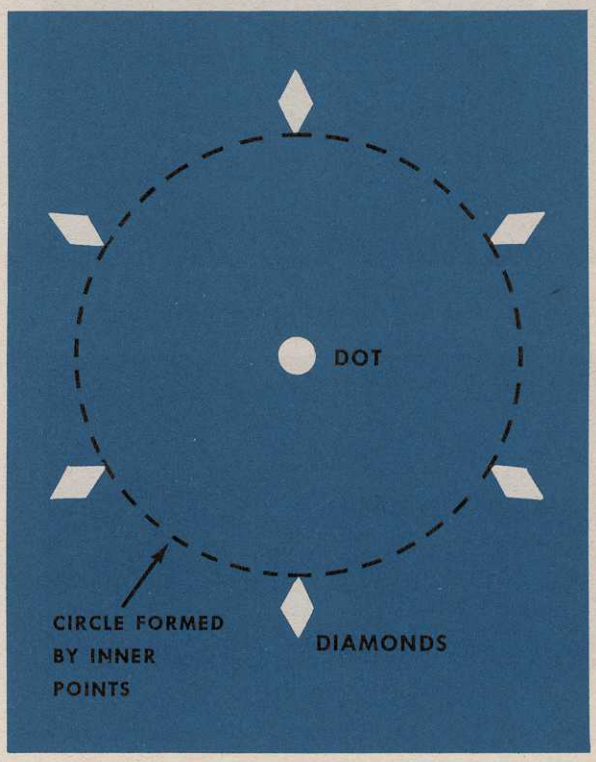

On your throttle is a twist grip. The grip is attached to the sight by cable and pulleys, ending with a range pulley containing a dial calibrated from 2400 to 600 feet.




When the twist grip is full counter-clockwise, the indicator points to 2400 feet on the dial. As you twist the grip clockwise, the indicator shows the range shortening.

As you maneuver to place and keep the dot on the enemy, use the twist grip to adjust the reticle of diamonds, so that the inner points surround him. You must keep the sight on the target for one second before firing to give the sight time to do its work. Fire a burst of at least two seconds.

You may have a tendency at first to use a hexagon formed by inner points of diamonds.



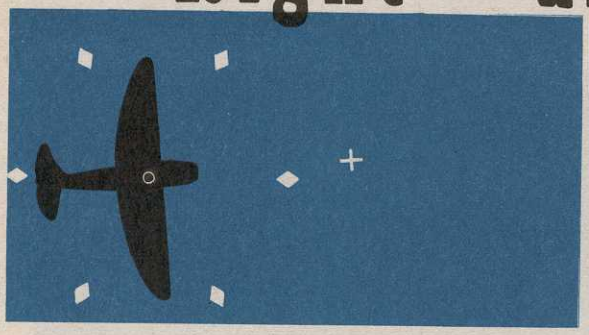

Curb it. Use a circle passing through the inner points.

When an encounter is likely, keep your twist grip on the minimum range of 600 feet. Also place it in that setting when shifting from one target to another.

Leave the grip in this position, until the dot is on or near the target, then twist the grip to get the proper frame. This procedure reduces over-ranging, prevents over-correction, and gets you set to fire quicker.

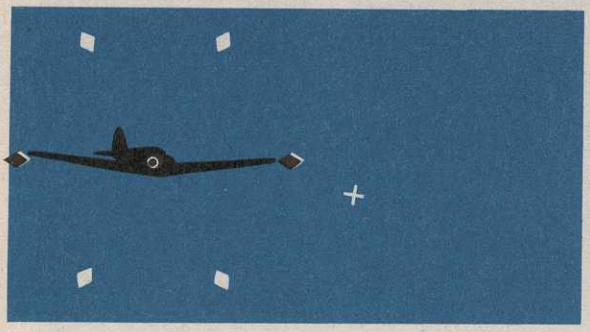
When a plane is at right angles from you—a 90° deflection shot—you can't use the diamonds to span the wings, even if the plane is banked. On most planes, the distance from the cockpit

# Target Pattern Right and Wrong

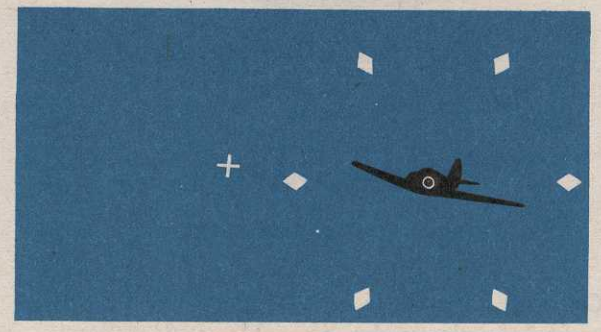


Correct—You have exact range now. Fire!

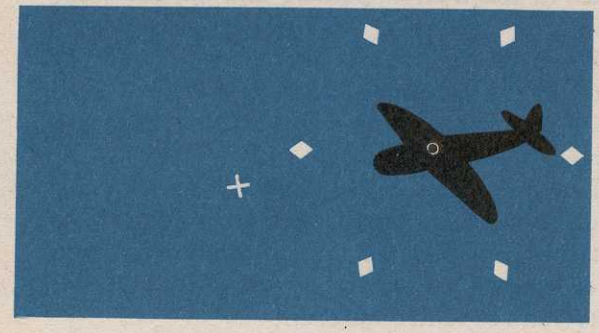
Incorrect—Dot is not on target.



Correct—Circle of diamonds corresponds to target's wing span.



Incorrect—Circle of diamonds is too large, making range and lead angle wrong.

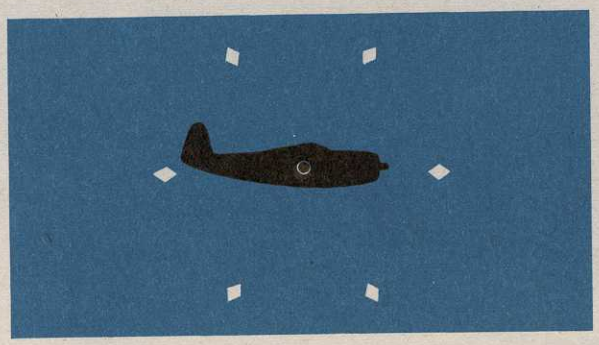


Correct—On broadside attacks the circle should be a trifle larger than length of fuselage, as wing span is greater than length.

Incorrect—Imaginary circle formed by inner tips of diamonds should correspond to target's wing span.

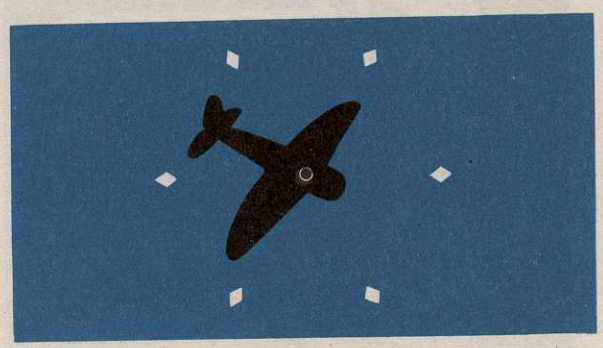
to the extreme end of tail is about half of the wing span. Therefore, place the dot on the cockpit with the imaginary circle touching the tail.

Note that circle is on extreme end of tail; not just in the assembly.



If neither the wings or fuselage are at right angles, make your imaginary circle slightly larger than the plane to compensate for the part you can't see.

If wings and fuselage are at 45°, allow 1/6 of the diameter, or 1/3 of the radius, on each side of target, ranging on the tip of the wing and the tip of the tail. This is the maximum allowance. One-tenth of the diameter of the reticle serves for most purposes.



When the separation of the fixed cross and the dot shows that a long lead, around 85 to 100 mils, is being allowed, any small ranging error is magnified by distance and makes long range firing unprofitable. When only a short lead is indicated, small ranging errors are unimportant. Fire at maximum range.

When closing in on a target at ranges of less than 600 feet, ignore the diamonds. Keep the dot on the target and you'll shoot it down.

Both the gyro and fixed sight are seen on a reflection plate. They are focused on infinity by means of collinator lenses. Parallex has been reduced to a minimum, allowing you to move your eyes without encountering an apparent shift in the relation of target and reticle images.

Operating instructions:

1. On any plane equipped with a K-14 gunsight, before starting the engine, place selector on FIXED and GYRO.
2. Place gun switch on GUNSIGHT and CAMERA.
3. Turn on battery or use outside power source to start gyro.

Note: To avoid damage, gyro must be running during every takeoff and landing. You turn it off only in the event of failure.

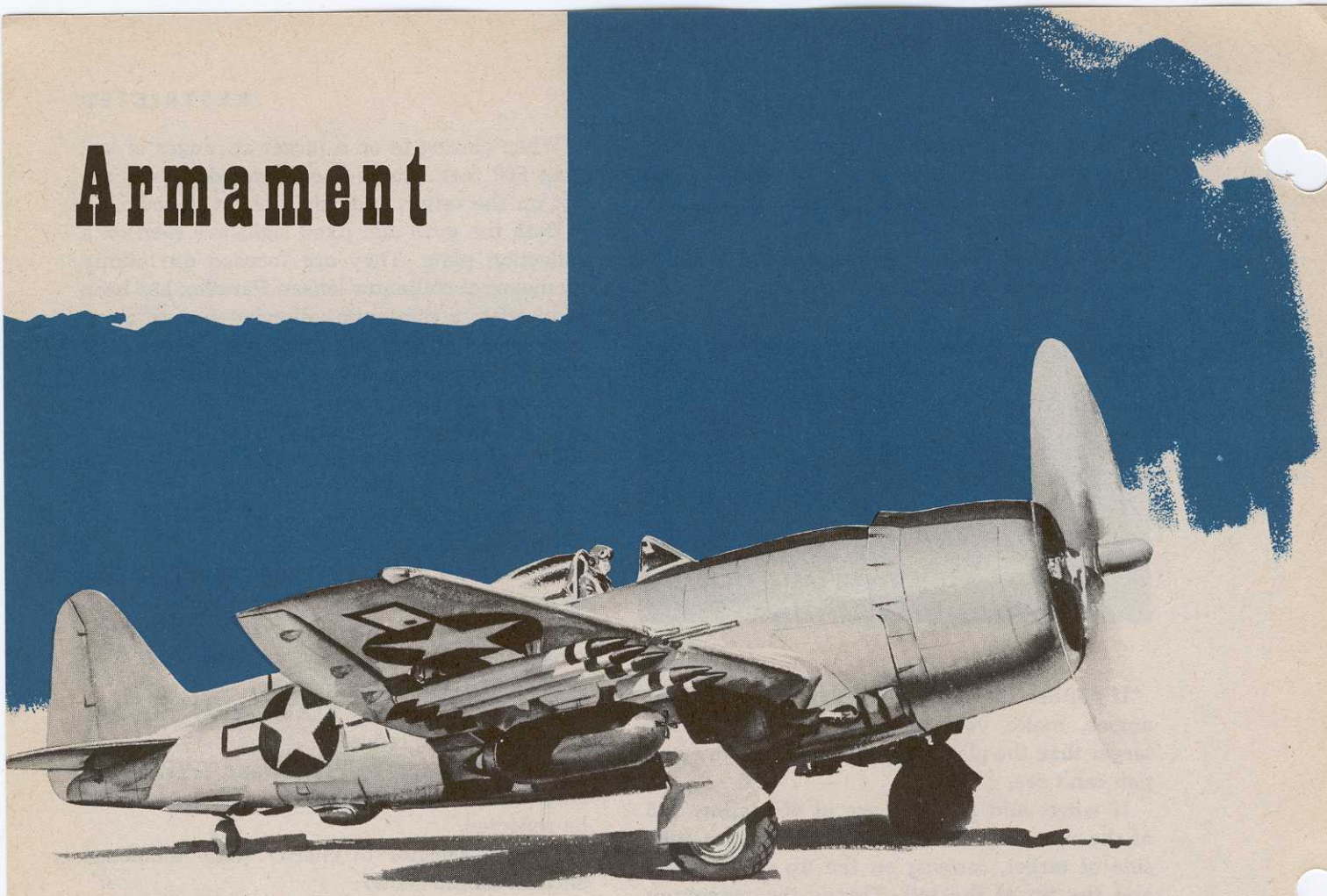
4. Turn selector to FIXED—Only ring and cross should be reflected.
5. Turn selector to FIXED and GYRO—The ring and cross, and diamonds and dots should be reflected.
6. Turn selector to GYRO (only diamonds and dot should show).

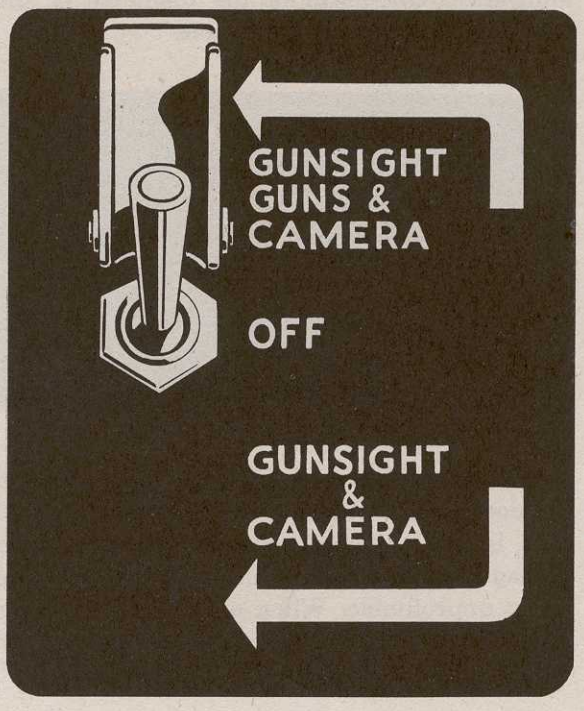
Note: Diamonds and dots should be clear and sharp.

7. Check that masking lever eliminates the fixed reticle.
8. Check dimmer control—for regulation of brightness of reticles.
9. Check twist grip. Full clockwise range dial reads 600 feet. Counter clockwise—2400 feet.
10. Check lamp bulbs in flight. Open lamp compartment. Feel bulbs. A cold bulb indicates bulb has not been burning.
11. In flight, adjust sun shades.

Operation of the gunsight gyros affects the magnetic compass. A separate compass correction card is mounted on the instrument panel for use when the gunsight is ON. Be sure to use the correct card.

# Armament






**Guns**

Much of the Thunderbolt's record is due to its devasting fire power. The plane carries 8 .50 calibre machine guns, 4 in each wing. This is 2 more guns than the design load, but pilots have uniformly found those 2 extra guns more than welcome.

The maximum load is 500 rounds per gun, but usually with 8 guns 267 rounds are carried. Find out how many you have before takeoff.

The guns can be charged only on the ground.

To fire:

Adjust gun switch on the main switch panel to GUNSIGHT, GUNS and CAMERA.

Press trigger on the stick.

The guns are boresighted and harmonized to obtain the proper pattern of fire as viewed through the sight. The harmonization used will vary under different conditions and in different

combat theaters. Determine the alignment of your guns before taking off on a firing mission.

To keep guns lined up:

1. Do not use gunsight as a handle.
2. Do not permit anyone to take hold of a blast tube when climbing on a wing.

**Gun Bay Heat Control**

LEFT SIDE NO. 3

When the handle is in normal, or down, gun heat is on. To stop gun heat, pull the handle upward. Leave the heat on except when firing on ground target. At altitude, you need the heat to keep the oil loose in the guns.

**Gun Camera**

The camera is located far out on the leading edge of the right wing.

The camera is turned on in conjunction with the gunsight by means of the switch on the switch panel and is activated by pressing the trigger on the stick.

The switch has three positions:
GUNSIGHT, GUNS & CAMERA
OFF
GUNSIGHT & CAMERA.

The last position is used for camera gunnery.

When practicing camera gunnery, assess your pictures as soon as possible after a mission. You'll get much more out of it if the events are fresh in your mind.

Take good care of your camera. Remember that most combat victories are allowed on the basis of pictures.

**Bombs**

The P-47N carries a maximum of two 1,000-lb. bombs (one under each wing) and a 500-lb. bomb under the belly. The bombs are mounted on the shackles that carry the external tanks.

The bombs ordinarily are released electrically by a button on top of the stick, but they can be dropped manually.

You arm the bombs with the three handles on the floor to your left.

LEFT SIDE NO. 2

Pull up and turn counterclockwise to arm. To return the bombs to safe, turn clockwise and push in. From the N-15 on, the bombs are armed electrically with the same toggles used to release chemical spray. (See Instrument Panel of N-15.)

To drop bombs:

Safety switch: READY

Selector switch: BOMBS & TANKS

Release switches: As desired.

Use the button on the stick to drop bombs.

If you don't drop your bombs, return the safety switch to SAFE. Turn the selective release switches OFF.

IMPORTANT: If you are carrying any type of load on the bomb shackles, make sure that the safety switch is SAFE before landing. Otherwise you might jar your load loose. This could be very embarrassing.

To release bombs manually:

Pull the manual release handles adjacent to the parking brake.

Before releasing bombs, be sure the arming handles are where you want them.

### Chemical Spray

To use chemical spray tanks:

Safety switch: READY

Selector switch: BOMBS & TANKS

To start the chemical spray flow, lift the toggle for the tank desired.

IMPORTANT: When using chemical spray, make certain that all of the bomb and tank release switches are off. With them on, if you should inadvertently press the button on your stick, you will drop the spray tanks.

### Rockets

From the P-47N-5 on, you can carry 10 rockets under the wings. You govern your fire with a rocket selector panel.

To use:

On armament selector switch panel: turn selector switch to ROCKETS. This sends current to the rocket selector panel.

Turn safety switch: READY

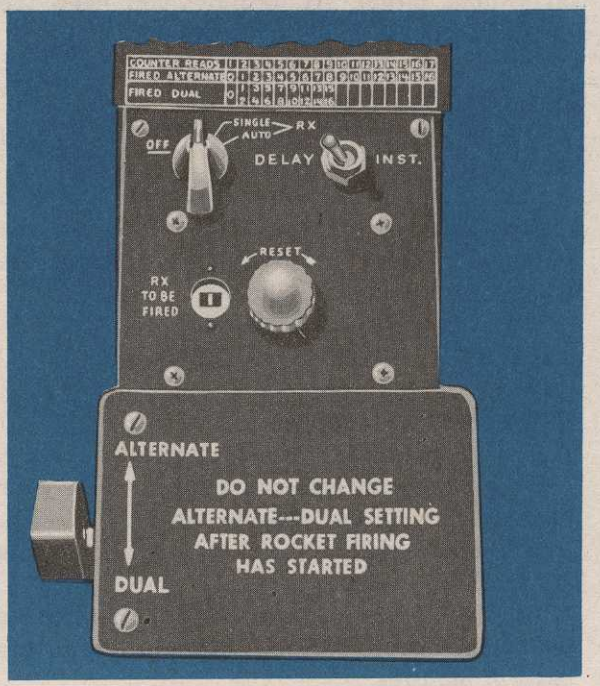
On rocket selector panel: Adjust ALTERNATE-DUAL switch.

When the switch is up, you fire rockets singly, alternating between wings.

When down, you fire two rockets at a time, one from each wing.

Place RX switch to SINGLE or AUTO as desired.

When on SINGLE you must press the button each time you fire. On AUTO the rockets are




INSTRUMENT PANEL NO. 26

released in train as long as you keep the firing button depressed.

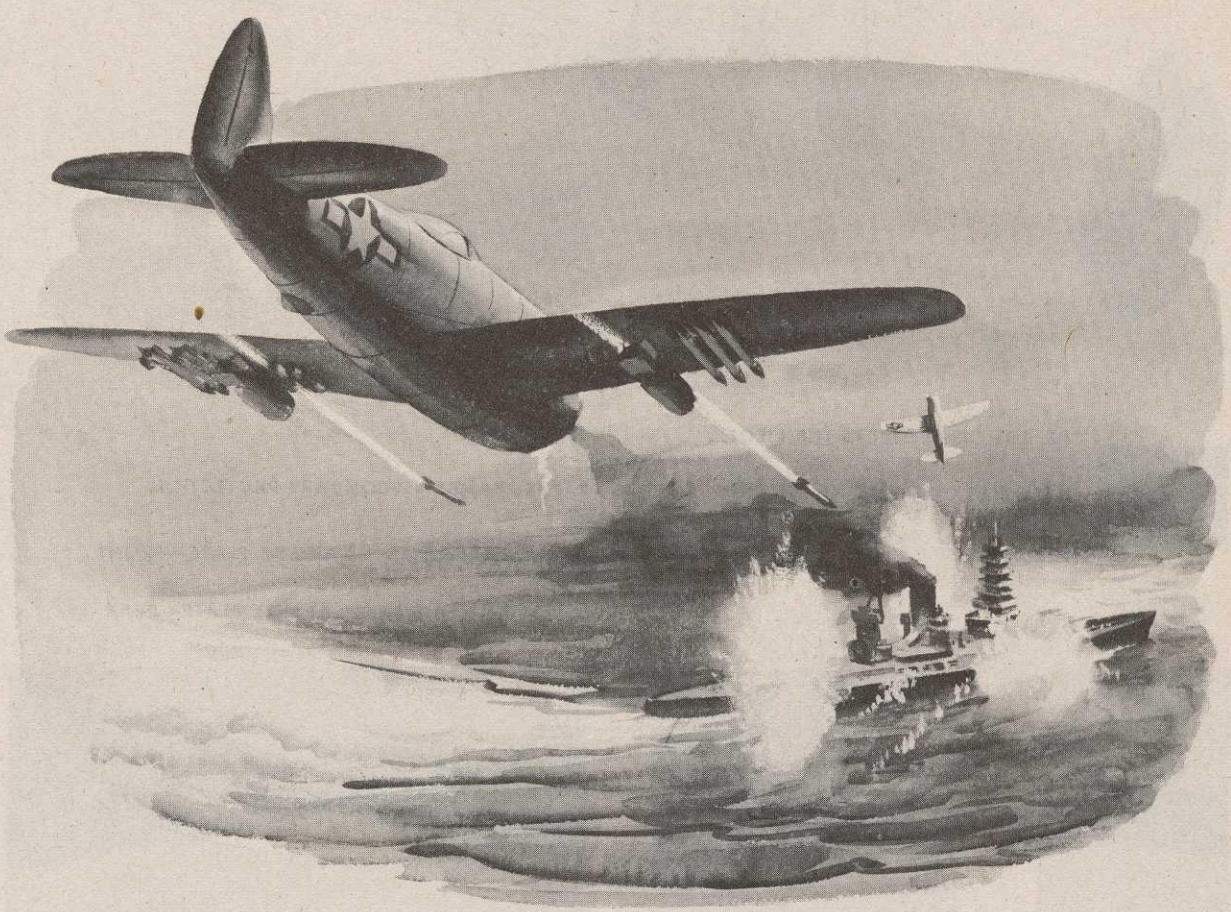
Set the number of the rocket to be fired in the counter window with the RESET knob. A counter chart above the panel enables you to keep track of the number of rockets already expended, whether firing in dual or alternate.

To keep the bookkeeping straight, you must stop firing and reset the number in the counter window when switching from ALTERNATE to DUAL or vice versa.

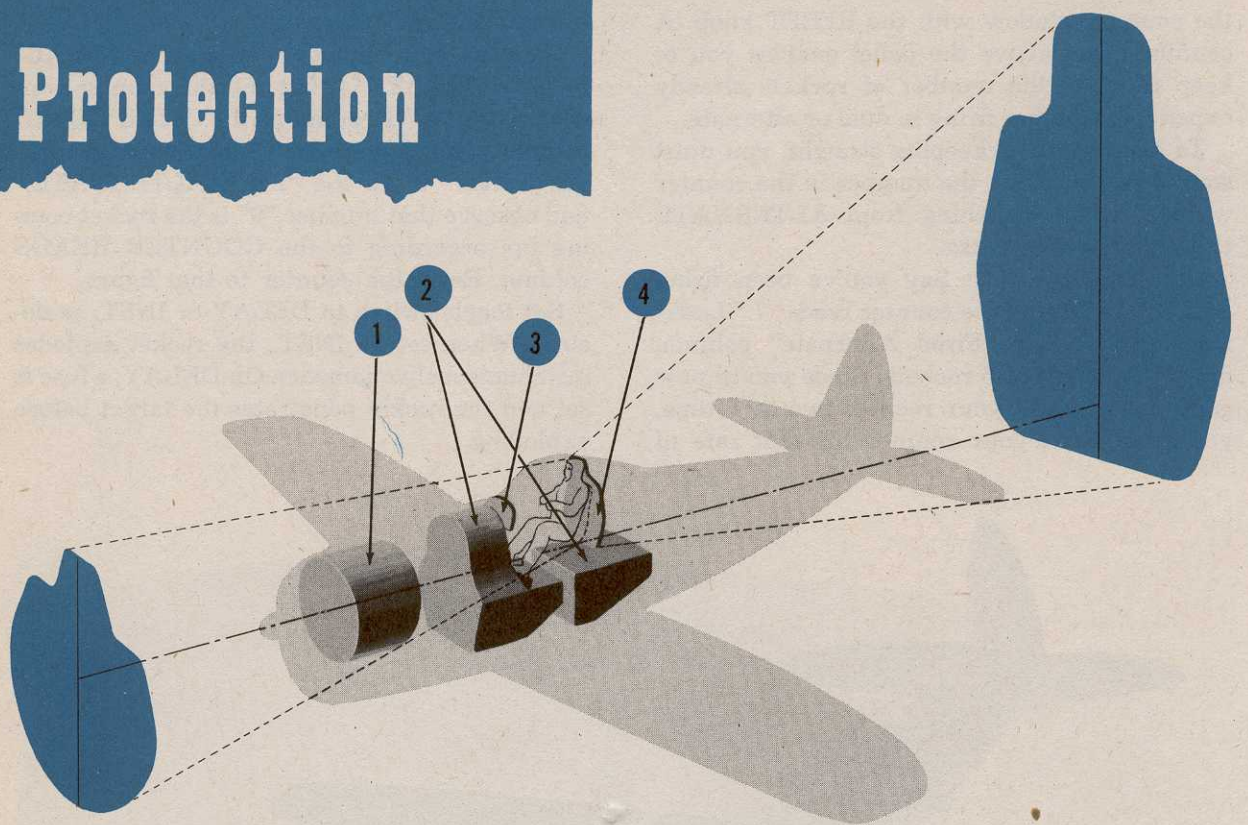
It's done like this: Say you've been firing ALTERNATE and the counter reads "7." Looking down to the "Fired Alternate" column, notice you've fired 6 rockets. Since you're now going to be firing your rockets two at a time, you must reset your counter for that rate of fire. Look in the "Fired Dual" column for the proper counter setting with 6 rockets gone. You'll find the counter reading is "4." Reset the counter to that figure.

Suppose you want to change from "DUAL" to "ALTERNATE" firing and the counter window reads "5." Reading in the "FIRE DUAL" column you'll notice you've discharged 8 rockets. Locate "8" in the "FIRE ALTERNATE," and observe that number "9" is the rocket coming up, according to the COUNTER READS column. Reset the counter to that figure.

Set toggle switch to DELAY or INST. as desired. When set on INST., the rocket explodes instantaneously on impact. On DELAY, a fuse is set and the rocket penetrates the target before exploding.

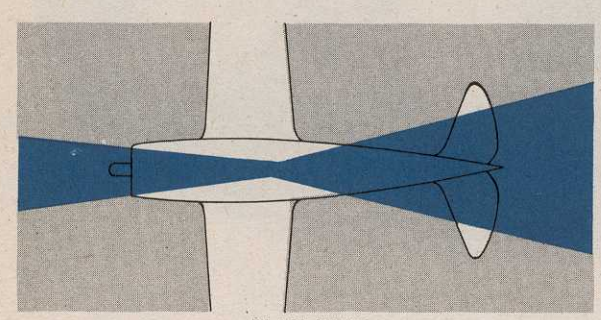


# Armor Protection

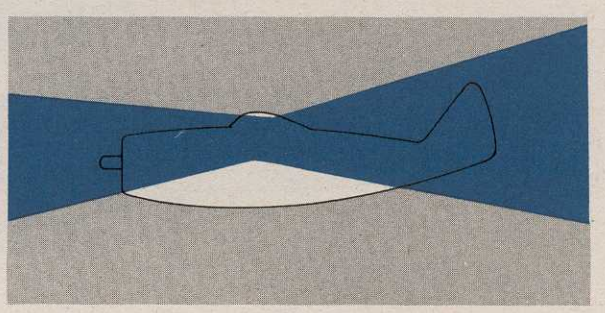



THE ARMOR PROTECTS THE PILOT FROM FIRE ORIGINATING WITHIN THIS AREA

1. ENGINE
2. FUEL TANKS—SECONDARY PROTECTION
3. FACE HARDENED ⅜" ARMOR PLATE—FRONT
4. FACE HARDENED ⅜" ARMOR PLATE—REAR



PLAN VIEW

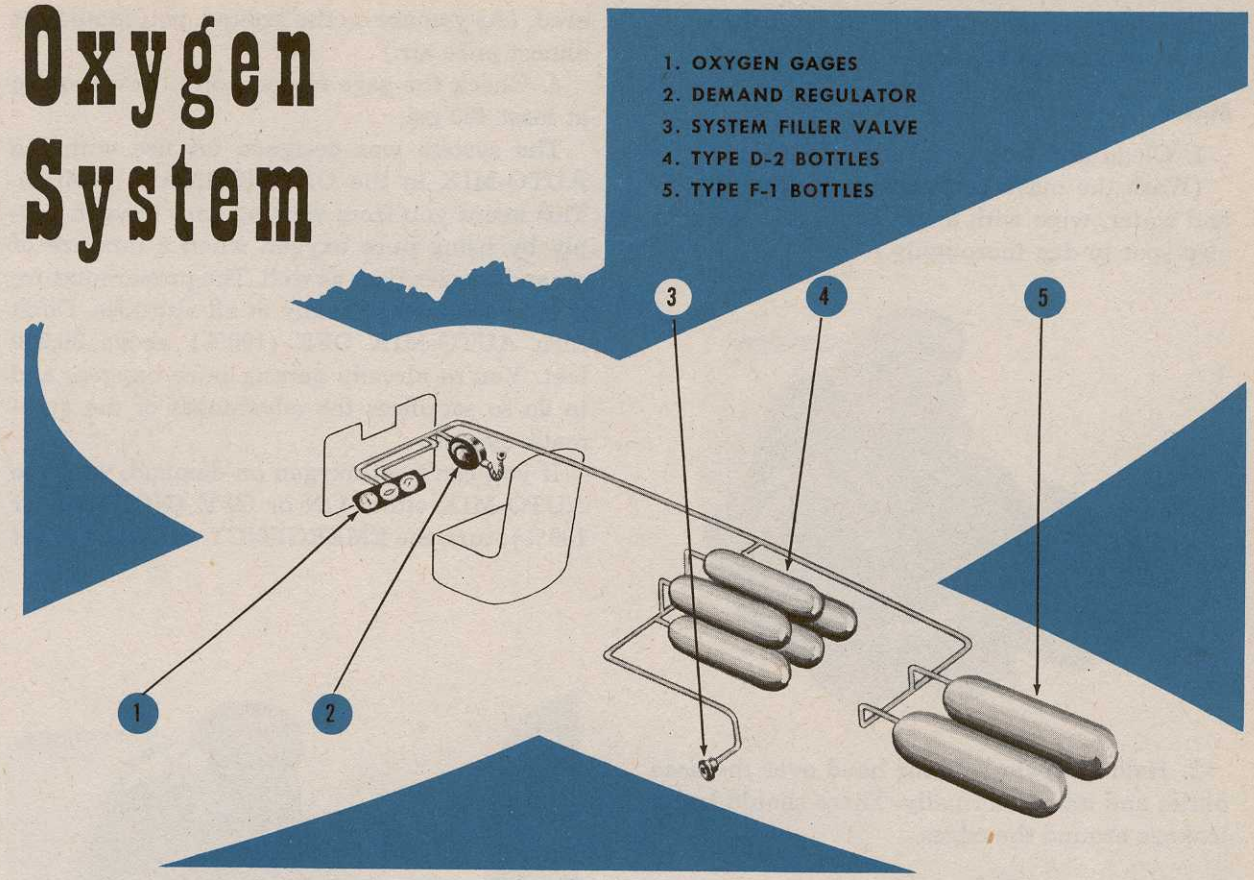


SIDE VIEW



RESTRICTED

# Oxygen System




Here is the N's demand-type oxygen system. It's used with the demand-type (A-14) mask.

Your mask will be fitted by the personal equipment officer. It must be sufficiently tight to allow not more than 5% leakage.

Join the mask to the regulator hose with the quick-disconnect fitting. The regulator has two valves. By turning the EMERGENCY valve ON, you get a large flow of oxygen under pressure. The position of the AUTO-MIX valve determines whether you get air and oxygen mixed in the proper proportion or pure oxygen, delivered on demand.

A gage on the panel shows you the amount of oxygen aboard. An adjacent blinker flow indicator keeps time with your breathing to show that oxygen is being delivered.

INSTRUMENT PANEL NO. 34

During your cockpit check, inspect the oxygen equipment as follows:

**Mask**

1. Clean and free of foreign matter.

(Wash the mask periodically with mild soap and water, wipe with a soft cloth, and leave in airy spot to dry thoroughly.)

2. Hold the palm of your hand over the hose outlet and inhale normally. There should be no leakage around the edges.

**Quick-disconnect Fitting**

1. Male end on the mask should fit snugly into the female end attached to the regulator hose. The connection should withstand about a 10-pound pull.

Note: Clip the hose to your shoulder harness, not your parachute harness. You might forget the clip in case of a bailout. When fixing the clip, see that there are no kinks in the hose or strain on the connection.

If at any time you aren't getting oxygen, always suspect a parted connection. Your body movements might bring it about.

**Demand Regulator**

1. See that the knurled collar holding the hose to the regulator is tight.

2. Turn AUTO-MIX valve OFF. (100%)

Note that the blinker operates.

3. Turn the AUTO-MIX valve ON. (NORMAL.) When you breathe normally, the blinker should show that little oxygen is being delivered. (As you are on the ground, you should get almost pure air.)

4. Check the gage for pressure. You require at least 400 psi.

The system was designed for use with the AUTO-MIX in the ON (NORMAL) position. This keeps you from wasting your oxygen supply by using pure oxygen when a mixture of air and oxygen does as well. The proper mixture is obtained automatically at all altitudes. Don't turn AUTO-MIX OFF (100%) above 30,000 feet. You're already getting pure oxygen, and to do so sacrifices the advantages of the automatic system.

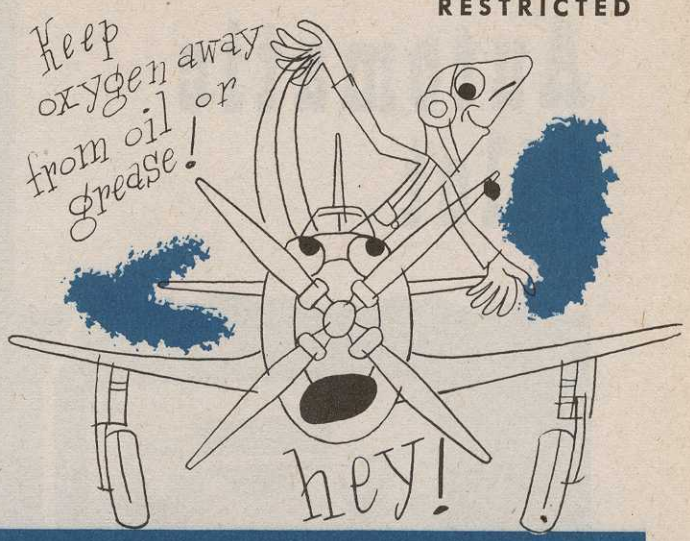
If you can't get oxygen on demand, with the AUTO-MIX either ON or OFF (NORMAL or 100%), turn the EMERGENCY valve ON to get a steady flow under pressure. If you detect fumes in the cockpit, turn the AUTO-MIX to OFF (100%) to shut out outside air. If you have become dizzy turn on the emergency flow a few moments to clear your lungs.

**Clip oxygen hose to shoulder harness, not parachute harness, to afford quick getaway**

When using your oxygen on EMERGENCY continuously you've got to get downstairs. The supply won't last long.

In extremely cold weather, when the temperature in the cockpit may be below freezing, squeeze the face piece occasionally to check on ice formation. If present, manipulate the mask to break it up.

The five small (D-2) oxygen bottles shown in the illustration each hold 500 cu. in. The two large bottles (F-1) hold 1000 cu. in. each. When used with the AUTO-MIX valve ON (NORMAL) the supply lasts approximately as follows, at various altitudes:



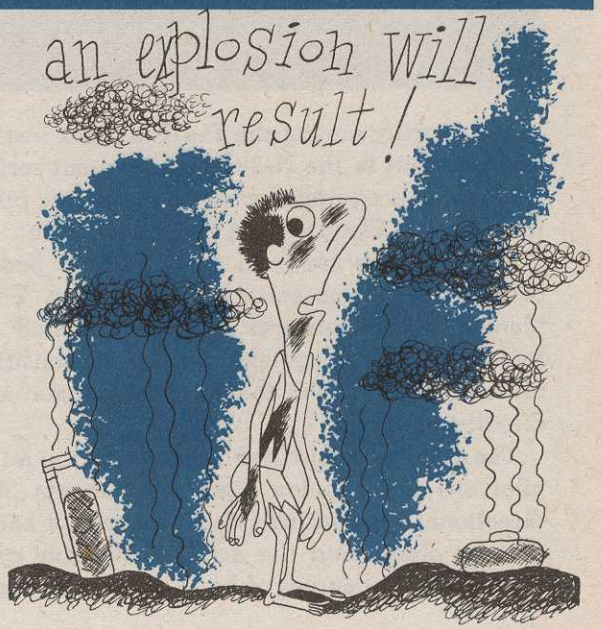

| ALTITUDE | DURATION |
|---|---|
| 15,000 feet | 12 hours |
| 20,000 feet | 10 hours |
| 25,000 feet | 8¼ hours |
| 30,000 feet | 9 hours |
| 35,000 feet | 13 hours |
| 40,000 feet | 17 hours |

**ALWAYS USE OXYGEN ABOVE 10,000 FEET**

Notice that the consumption of oxygen increases steadily up to 30,000 feet as the AUTO MIX uses more oxygen and less air to keep a proper mixture as the air becomes rarefied. Above 30,000 feet, the consumption starts to fall off and the supply lasts longer. This is because outside atmospheric pressure is not sufficient to force oxygen into the blood stream.

Thus, though the AUTO-MIX is metering you pure oxygen above 30,000 feet, your supply will last longer than it will at 25,000 feet.

Oxygen is literally your life in high altitude flying. Read your PIF and listen carefully to your personal equipment officer's explanation of anoxia, the proper use of oxygen, and all details pertaining to the system.



# Automatic Pilot

INSTRUMENT PANEL NOS. 8 AND 12

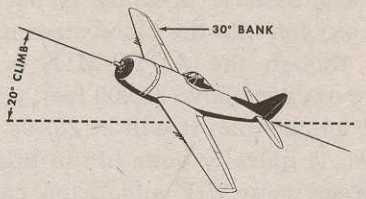
Noteworthy among the P-47N's flight instruments is that in the N-2 and subsequent series, the fighter is equipped with an automatic pilot, the General Electric type G-1 installation.

With George on, and your rudder pedals dropped back, you relax on long flights. Your plane's control surfaces will be adjusted by hydraulic servos regulated by electric sensitive units incorporated in the artificial horizon and directional gyros.

The two gyros also are used (with the autopilot off) as orthodox flight instruments. The directional gyro withstands 60 degrees of bank, dive or climb, and the artificial horizon gyro withstands 90 degrees of bank without spilling.

Cage the instruments before exceeding these limitations; leave them uncaged at all other times.

The autopilot is not effective in maintaining an attitude beyond approximately 30 degrees



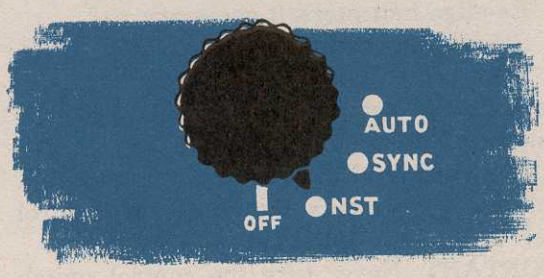

of bank and approximately 20 degrees of climb or dive. Any time you plan a more radical

change of attitude, turn off the autopilot and take over the controls.

You do not engage the autopilot before reaching at least 2,000 feet, but the gyro instruments are used from the ground up as ordinary flight instruments. Procedure:

Before takeoff.

1. Turn control switch on the artificial horizon gyro to "INST.," setting the gyros in mo-




tion. On the autopilot the gyros are electrically driven and required about three minutes to work up speed.

2. See that the artificial horizon gyro is uncaged.

3. With course setting knob on directional gyro adjust the dial until the heading corresponds with the magnetic compass heading.

4. Uncage the directional gyro.

In flight.

1. When flying level, place the miniature airplane and the horizon bar in alignment.

To use autopilot:

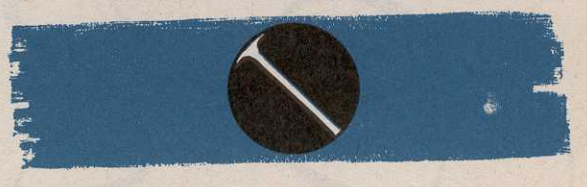
1. Gyros in operation as described above.

2. Trim the plane to fly hands off.

(Now is the time to trim the plane. Do not touch the trim tabs after the autopilot has been turned on.)

3. Set the three sensitivity controls to the left of vertical (between 9 and 11 o'clock).

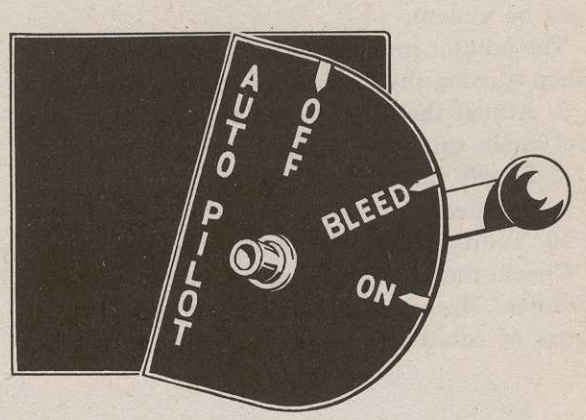
Bear in mind that these controls regulate the



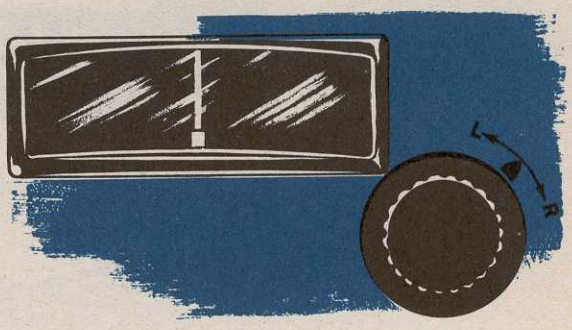
speed of your plane's response to correction by the autopilot. Don't adjust them near the ground (you may get a sudden change in attitude), and when you do make an adjustment to eliminate flutter of controls or a tendency of the plane to hunt, move the knobs slowly and cautiously. Never turn them fully clockwise or counterclockwise.

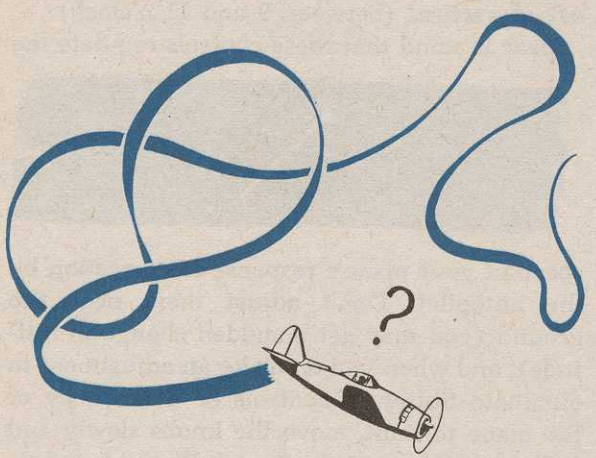
4. Turn control switch to "SYNC."

5. After one minute (to allow servo-amplifier tubes time to warm up), turn ON-OFF switch to "BLEED."




6. Turn the rudder trim control knob in one direction until the indicator moves in same direction, then align the indicators.






Remember: Once you turn the autopilot on, the indicators control the attitude of your plane. If they are not in adjustment when you turn the control on, your plane will immediately respond to their actual setting. The reaction may be violent.

The pointer must move in the **same** direction. Keep turning the knob until it does.

7. Adjust the aileron and elevator trim control knobs until the pointers are lined up.
8. Slowly turn ON-OFF control to ON.
9. Turn control switch to AUTO.
10. Trim plane with control knobs.

Check the directional gyro every 15 or 20 minutes. The gyro undergoes a small drift because of rotation of the earth and mechanical friction. Place your plane back on your magnetic heading with the rudder trim knob. To reset the directional gyro:

1. Turn control switch to SYNC.
2. Turn ON-OFF control OFF.
3. Turn airplane to correct magnetic compass heading.
4. Cage directional gyro, set to agree with compass heading, uncage.
5. Re-align indicators, if necessary.
6. Slowly turn ON-OFF control ON.
7. Turn control switch to AUTO.

To take the autopilot out of operation you simply turn the ON-OFF control to OFF and the control switch to INST. If you want to shut down the instruments too, turn the control switch OFF and cage the gyros.

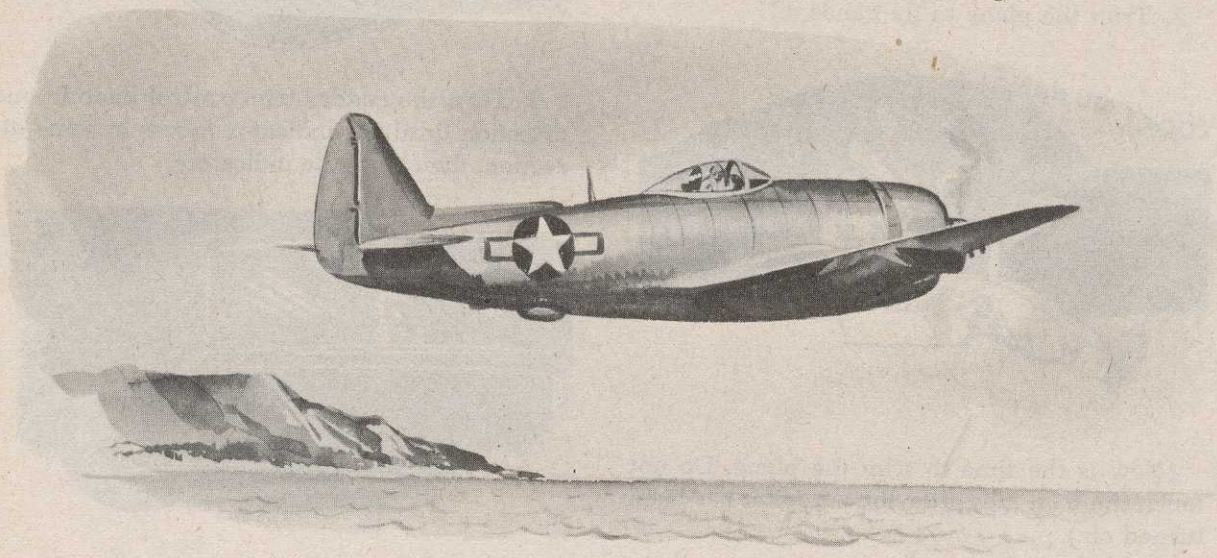
IMPORTANT: Never turn the control switch to INST before turning the on-off control OFF.

If you spill a gyro, quickly turn the on-off control OFF and right your plane manually. Cage both gyros to restore their equilibrium and then use as desired.

TIPS:

Thirty pounds pressure on the controls will overpower the autopilot. If you use the autopilot through a long climb or descent, disengage it every 10,000 or 15,000 feet, retrim the plane and engage again.

When ready to drop external tanks, take over the controls yourself, jettison the tanks, retrim, and turn it back over to George.



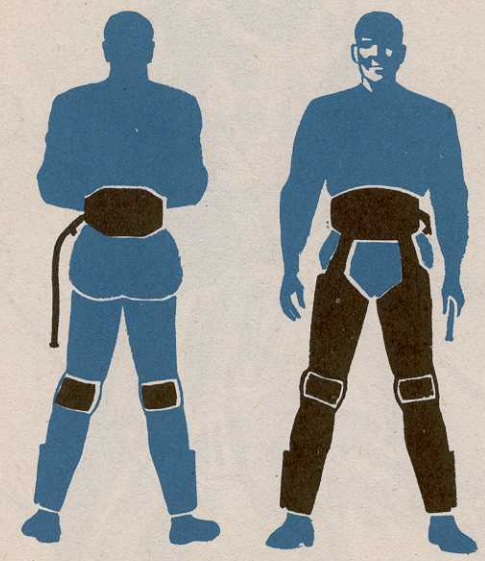
# Personal Equipment

On all flights, wear:

1. Helmet
2. Goggles
3. Gloves
4. Life vest
5. Parachute
6. Oxygen mask
7. First aid and emergency kit
8. One-man life raft (when flying over water)
9. Knife

The mask is worn on all flights to accustom you to it and to protect your face in case of fire. You wear gloves as a fire protection and to prevent skinned knuckles, which are inevitable without gloves. Use your goggles when needed. Do not wear commercial polaroid glasses. Use only government issue. The knife is carried to puncture your dinghy should it accidentally be inflated. It must be worn where it can be reached easily, preferably on the calf of your leg.

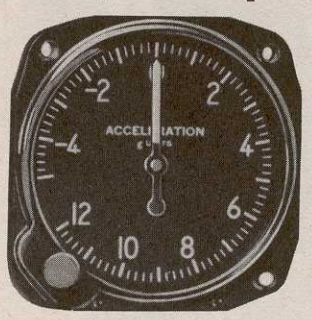
### Anti-G Suit



Planes from the N-5 on are equipped for use of the Anti-G suit. The suit, known officially as the Type G-3 Pilot's Pneumatic Pressure Suit, consists of five bladders spaced to exert pressure against your calves, thighs and abdomen to keep blood in the upper part of your body and reduce the likelihood of "blacking out."

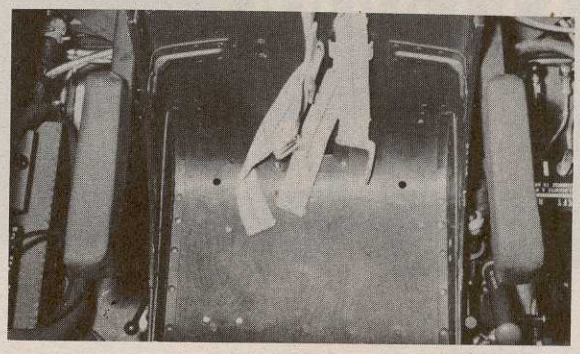
The bladders are inflated by exhaust from the vacuum pump. One pound of pressure is forced into the bladders for every G of pull out acceleration in excess of 2¾ G's. You fasten the suit to a quick disconnect valve on the left side of the seat.

The accelerometer on the instrument panel records the number of G's you pull on a maneuver. The instrument has a main pointer and two auxiliary pointers that remain fixed, until reset, at the maximum positive or negative reading attained by the main pointer.




INSTRUMENT PANEL NO. 22

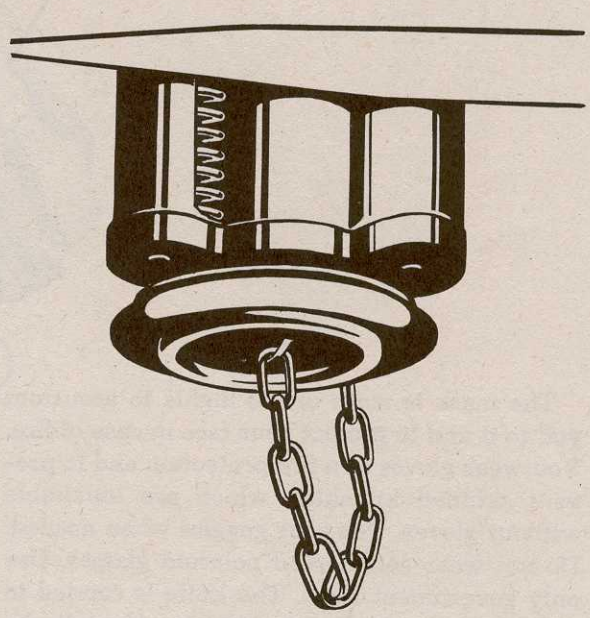
### Arm Rests



Planes from the N-15 on contain arm rests to reduce fatigue on long flights. Prevents that tired businessman feeling, in other words.

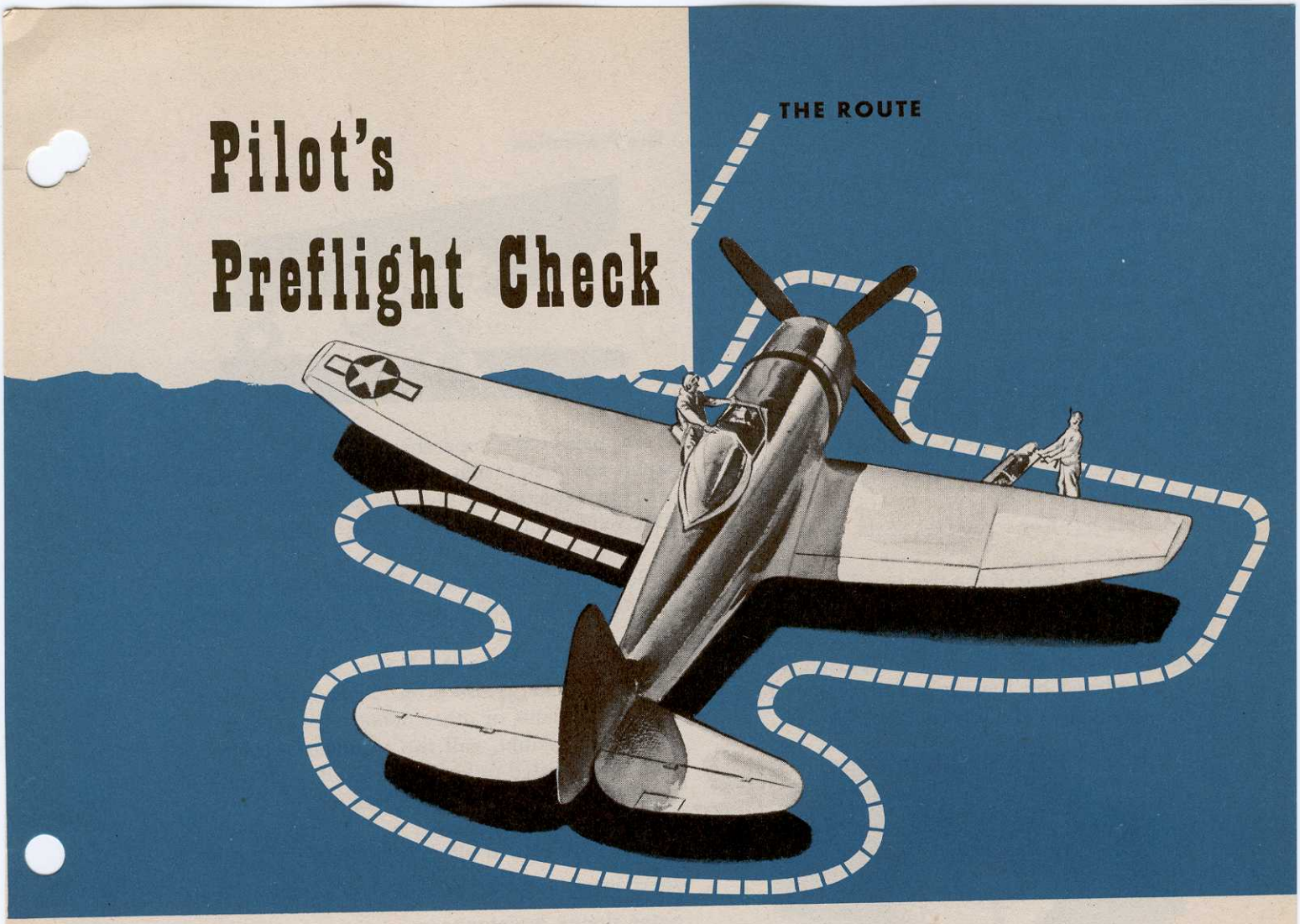
### Flare Gun Adapter

An opening in the right side of the cockpit is fitted to hold the muzzle of your Very pistol. To fire signal flares, remove the gun from the compartment to the rear of your map case, insert the muzzle in the adapter, and pull the trigger.



RIGHT SIDE NO. 5

# Pilot's Preflight Check




The preflight check starts before you reach your airplane. Survey the proposed taxiing route for any possible future obstruction, such as a fuel truck about to move. Study the ramp area for stray equipment or rubbish and rags that might be blown into the airscoop or tail assembly by prop blast.

See that a ground crewman is on hand with a fire extinguisher and portable battery cart.

If the plane has been standing for more than two hours, instruct the ground crew to pull the prop through four blades. Two complete revolutions of the engine are needed to clear the lower cylinders of oil.

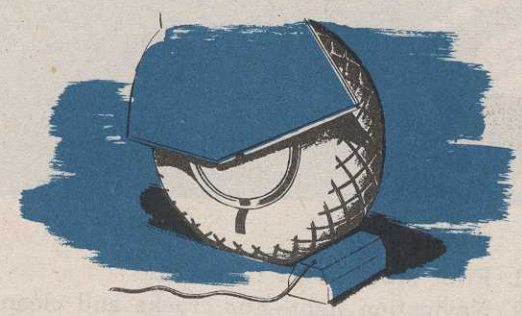
A complete circuit of the plane, starting at the left wingtip, is required to check the P-47N.

The sketch shows your route as you check the following items:

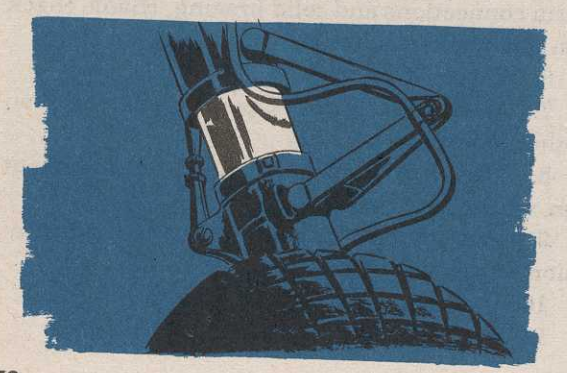
1. Pitot tube—Cover removed.
2. Navigation light—For cracks and cleanliness. (Same check on right wing.)
3. Landing light—For cracks and cleanliness.
4. Guns—Plugs inserted and blast tubes snug. (Same check on right wing.)
5. External wing tank (if carrying) — For firm connections and solid bracing. (Same check on other external tanks.)
6. Wheels—Chocked.
7. Turbo waste gates—Open. (Same check on other side.)
8. Tires—For proper inflation and alignment on wheels.
9. Oleo struts—For some extension. (Extension varies with loading.)
10. Inspection plates—All closed.
11. Propeller—For nicks.

12. Airscoops—For foreign objects.
13. Leading edge of wings—For dents.
14. Camera glass—For cracks, scars, or yellowed appearance.
15. Ailerons—For foreign objects.
16. Fuel drain cocks—Safetied.
17. Intercooler doors—Open. (Same check on other side.)
18. Radio antenna—For proper tension and security of mounting.
19. Tail surfaces—For damage or foreign objects.
20. Tailwheel—For proper extension.
21. Interior of supercharger flight hood—For accumulated oil or dirt.
22. Canopy—For scratches, scars, dirt, or oily film.

The outside bead of the tire tread, under normal loading, should just touch the ground. A line painted from the rim to the tire indicates proper alignment. If the line has parted, strain is being placed on the inner tube valve stem. Write up the lack of a line in Form-1A.



Lack of proper oleo extension to cushion a landing places a terrific strain on the tires and wings. A blowout or weakened wing structure may result. Any time the oleos are down, therefore, instruct the crew chief to check them.



**Fire Prevention**

To inspect the supercharger hood, you must squat and look inside. A film of oil doesn't matter, but wipe up any large drops or small pools. Hot exhaust gases ignite such accumulations every time.

See that all three drain holes in the hood are unstopped. The holes prevent oil from collecting.

As a pilot new to the N you may not know whether nicks in the prop, dents in the wing, oil on the plane, or other defects are serious. If you are in doubt, call the engineering officer. You are entitled to be satisfied with the condition of your plane before taking off.

**Here's a tip: If a plane is generally dirty, inspect it with utmost care. Such a condition denotes sloppy maintenance.**

The first pilot of the day has an additional check: The battery drain jar, reached by unfastening the cowling on the right side of the accessories section.

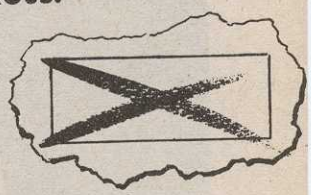
See that the inch-thick pad in the bottom is well saturated with neutralizing fluid—sodium bicarbonate and water. The fluid neutralizes battery acid that bubbles up during flight. It must be renewed every four to six flights.

Inspect tubes leading from the battery for kinks or bends. Battery acid causes these tubes to kink easily. See that the opening of the impact tube, protruding from the lower right side of the accessories section, faces to the front. The tube keeps the proper air pressure in the jar.

Unless the drain jar is properly maintained, excess acid creates combustible gases in the battery, or weakens other parts by corrosive action.

# Cockpit Check

**FORM 1A IS YOUR BIBLE.
NEVER FLY AN AIRPLANE THAT
IS CARRYING A RED CROSS.**



Enter the N from the left, using the built-in hand- and footholds. Don't step on the wing flap. Open the canopy using the release latch located below the canopy rail.

Unlock the controls and waggle for freedom of movement, then settle in the seat. Remove Form 1 and Form 1A from the data case. Form 1A is your bible on the plane's condition. If you don't understand what any red diagonal or red dash signifies, ask the crew chief or engineering officer to explain. Nobody has been killed yet for asking questions.

Never fly an airplane that is carrying a red cross.

Before signing an exceptional release, know what you are signing.

Unless the preflight box has been initialed, don't start the engine. The plane hasn't been preflighted.

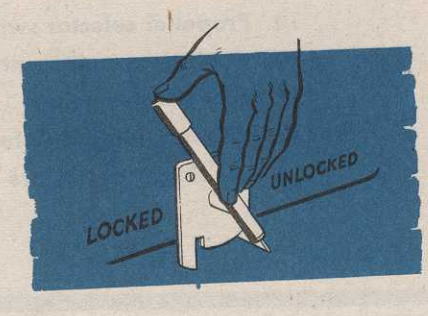
The servicing section shows the quantity of fuel aboard. Here is where you get the accurate information.

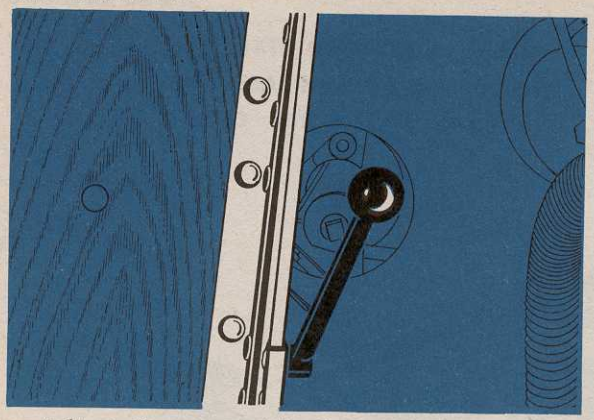
The "Remarks: Pilots and Mechanics" section contains the comments of the preceding pilot. Note what he says, and when in turn you make an entry be clear and concise. If necessary, elaborate on the trouble when talking with the crew chief, but do not omit any important point from the Form 1A.

When returning the forms, examine the case for the following publications:

Maps of the local flying area
Radio Facilities Charts
T. O. 01-65BD-1.

Fasten your safety belt and shoulder harness. Tighten the harness straps sufficiently to keep them on your shoulders during normal movements. A lever on the left side of the seat enables you to lock and unlock the harness. Lock the harness for the takeoff.





Adjust the seat with the lever on the right side, to maximum height, for taxiing. When ready to take off, readjust as desired.

Regulate the rudder pedals for equal extension and complete control at extreme positions.

Arrange the mirror for rear view.

Lock the brakes by pulling out the parking brake handle (on the lower center edge of the instrument panel), pump up the brakes and then depress the toe tread of each rudder pedal. Check the ratchet on the inside of each pedal to determine the extent that each brake has been engaged. Release the pedals and then the handle.

To release the brake, further depress the toe treads, disengaging the ratchet.

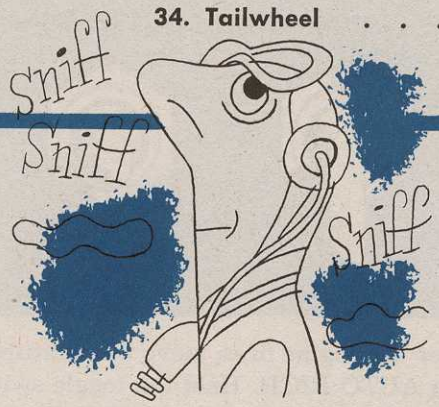
Make the cockpit check from left to right, performing it in the same manner each time until it becomes second nature.

# Check:

| | |
|---|---|
| 1. Carburetor air filter | OFF (unless needed). |
| 2. Trim tab controls | Set for takeoff: |
| Ailerons | N (neutral). |
| Rudder | TO (takeoff). |
| Elevator | N (neutral). |
| 3. Flap handle | UP (full forward). |
| 4. Landing gear handle | DOWN (with safety latch in place). |
| 5. Main fuel selector | MAIN. (On N-15 and subsequent series, also turn external selector cock to EXTERNAL OFF.) |
| 6. Supercharger control | OFF (full rear). |
| 7. Throttle | Cracked one inch. |
| 8. Propeller control | INCREASE RPM (full forward). |
| 9. Mixture control | IDLE CUT-OFF (full rear). |
| 10. Propeller selector switch | AUTO. |
| 11. Autopilot on-off control | OFF. |
| 12. Fuel booster pump | Start and Altitude. |
| 13. Internal wing tank fuel pump | OFF. |
| 14. All circuit protectors | IN. |

# Check:

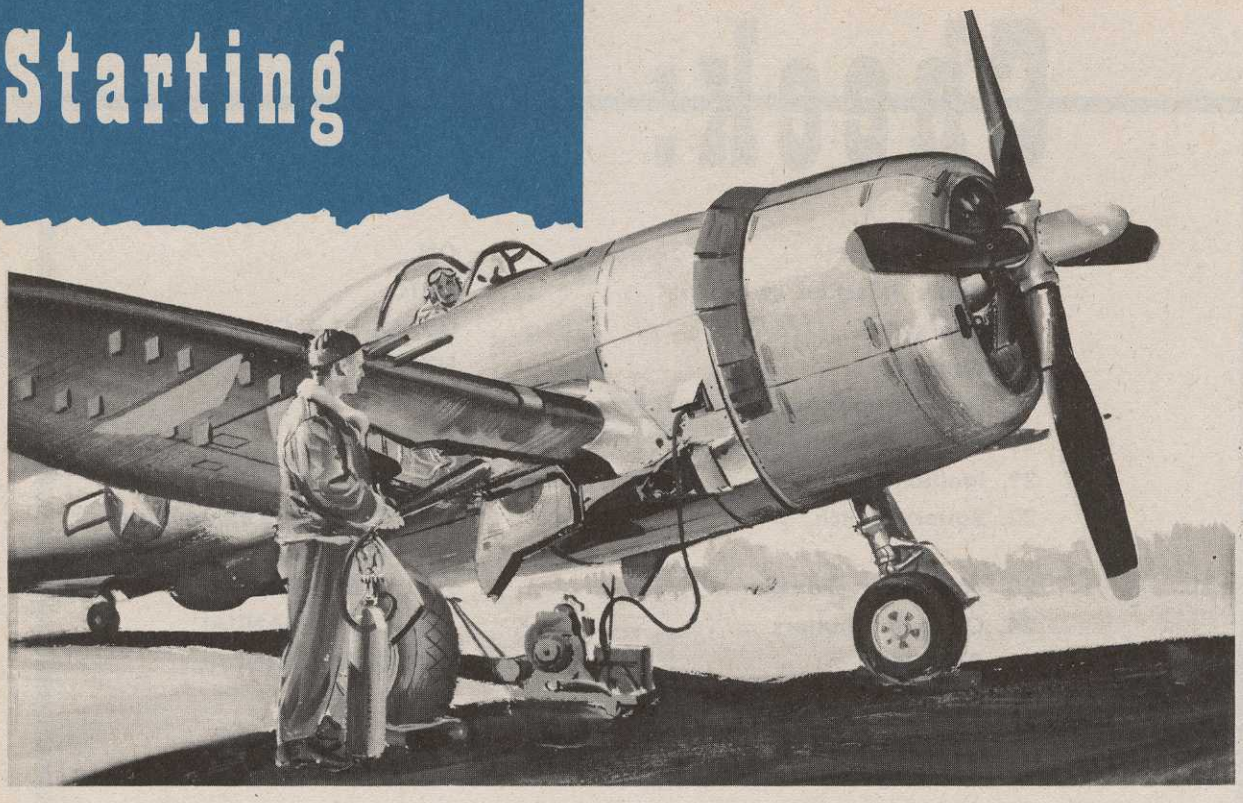
| | |
|---|---|
| 15. Generator | ON. |
| 16. Water injection switch | AUTO. |
| 17. Gun switch | GUNSIGHT & CAMERA. |
| 18. Gunsight | FIXED & GYRO. |
| 19. Supercharger regulator switch | ON. |
| 20. Armament switches | OFF. |
| 21. Ignition switch | OFF. |
| 22. Battery switch | ON (OFF if using external power source). |
| 23. Intercooler shutters | FULL OPEN—MANUAL. |
| 24. Oil cooler shutters | FULL OPEN—MANUAL. |
| 25. Cowl flaps | FULL OPEN—MANUAL. |
| 26. Altimeter | SET. |
| 27. Parking brake | SET. |
| 28. Gyro flight instruments | UNCAGE. |
| 29. Hydraulic pressure gage | Operate hand pump and note that pressure rises. |
| 30. Fuel | Check all internal tanks for quantity. |
| 31. Oil | Check for quantity. |
| 32. Oxygen pressure gage | 400-450 psi. |
| 33. Radios | OFF. |
| 34. Tailwheel | UNLOCKED. |




A cockpit check isn't an ironclad guarantee that everything is O.K. Use your eyes, ears, and nose to detect any unusual condition. Don't fly a plane with hydraulic fluid on the floor, a sure indication of a leak. Don't take off with gas fumes, or raw gasoline, in the cockpit. This is a fire or explosion hazard. While inspecting the cockpit, examine the fume boot at the base of the stick. A tear permits noxious gases to enter.

Check the landing gear warning light by turning the switch on the switch panel ON. If light doesn't glow, ask the crew chief to investigate. You need the light to tell when your gear is operating satisfactorily. Check the position of the push-pull controls of the ventilator and defroster for desired cockpit temperature.

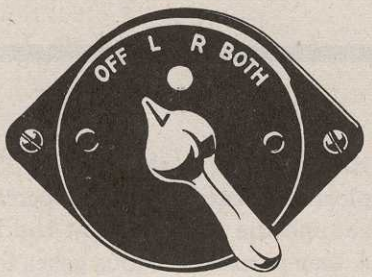
# Starting



To start the engine:

Shout "Clear!"

Get acknowledgment. The crew chief may be adjusting a chock, or he may have wandered off, leaving you no fire protection.



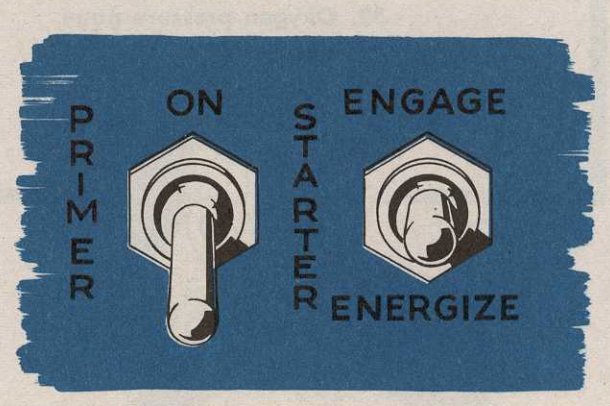

Turn ignition switch to BOTH.

Flick starter switch to ENGAGE, then OFF, to seat starter brushes on the commutator.

Energize for 15 to 20 seconds.

Engage the starter and prime simultaneously.

If the engine doesn't fire within a couple of seconds, release the priming toggle switch to avoid flooding the engine.




After the engine fires, move the mixture control to AUTO RICH. Hold the toggle switch in ENGAGE for a few seconds after the engine fires. This provides a hotter spark and is a starting aid.

Warm up the engine with the throttle set to produce 800 to 1000 rpm.

**If the oil pressure doesn't come up within 30 seconds, shut off the engine at once. Lack of lubrication will destroy an engine in a short time.**

If you are using an external power source, turn on the battery switch after the engine catches and signal the ground crewman to unplug the power unit.

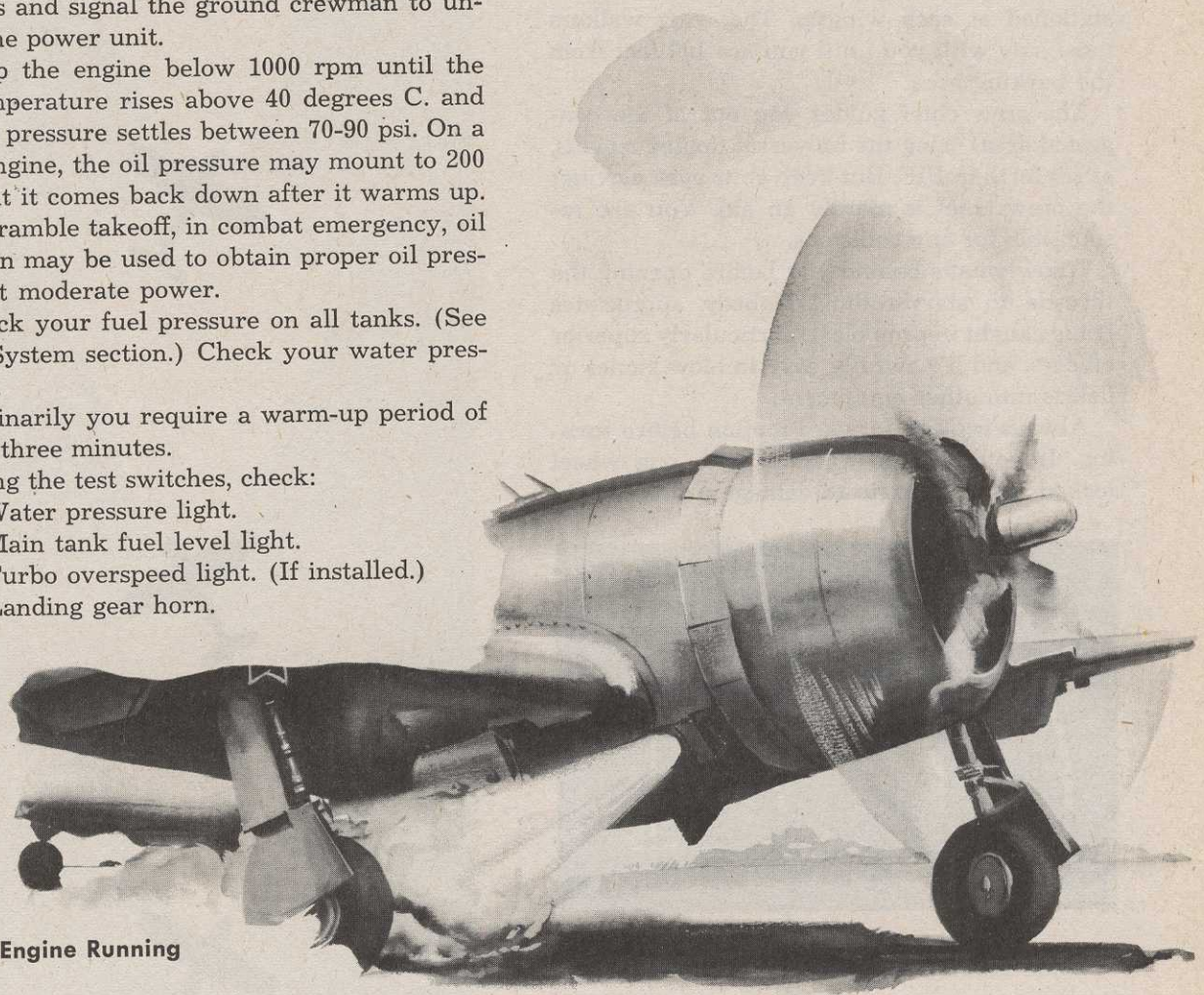
Keep the engine below 1000 rpm until the oil temperature rises above 40 degrees C. and the oil pressure settles between 70-90 psi. On a cold engine, the oil pressure may mount to 200 psi, but it comes back down after it warms up. For scramble takeoff, in combat emergency, oil dilution may be used to obtain proper oil pressure at moderate power.

Check your fuel pressure on all tanks. (See Fuel System section.) Check your water pressure.

Ordinarily you require a warm-up period of about three minutes.

Using the test switches, check:

1. Water pressure light.
2. Main tank fuel level light.
3. Turbo overspeed light. (If installed.)
4. Landing gear horn.



**Keep Engine Running**

Leave the plastic dimmer hoods open for daylight flights.

If plane is equipped with autopilot, turn gyro control switch to INST.

Turn on your radio and get taxi instructions from the tower.

Signal the crewman to remove the chocks.

If the engine quits, return the mixture control to IDLE CUT-OFF without delay. Raw fuel pouring into the engine, unless it's firing, creates a serious fire hazard. However, if the engine is taking hold but fire is noticed, persist in starting. Once the engine is running, it will blow out the flames. If necessary, advance the throttle to 2000 rpm to accomplish this. If the fire persists, return the mixture control to IDLE CUT-OFF and turn selector valve to OFF.

Don't hold the starter switch in ENGAGE longer than 30 seconds. Let the starter cool for one minute, then ENERGIZE again.

# Taxiing

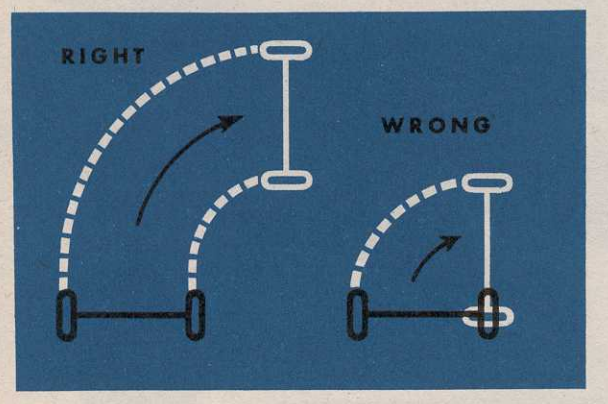
Release your brakes and pump them up while moving slowly forward.

If your N is parked in a congested area, as it is likely to be, don't start rolling until a man is stationed at each wingtip. The wing walkers must stay with you until you are 100 feet from the parking area.

The crew chief guides you out of the congested area, using the universal taxiing signals, as set forth in PIF. But keep your eyes moving; the crew chief is merely an aid. You are responsible for any collisions.

Know what's behind you before opening the throttle to start rolling. Nobody appreciates being caught in prop blast, particularly superior officers, and it's awfully easy to blow stones or debris into other equipment.

Always acquire forward motion before turning. If you turn on a dime, with one wheel locked, you're certain to damage a tire.




While taxiing, use only one brake at a time, applying pressure with a gentle pumping motion. You invite trouble by using both brakes simultaneously.

Use between 800 and 900 rpm. This keeps your speed down sufficiently to avoid having to jam on the brakes, and enables you to stop almost in place.

A FLIGHT TAXIING PROPERLY

Taxi as slowly as you like in the N. Simply run up the rpm every few minutes to keep the engine from loading up.

Keep far enough behind the plane ahead to avoid the necessity of slamming on the brakes. S in the opposite direction from that plane. This keeps it on your open side. In other words, zig when he zags. If you ever lose the plane, or there is doubt in your mind as to its exact position, stop. Cut off the engines and get out and look, if necessary.

Judge the location of your wheels on the taxi strip by referring to the inboard guns. The guns are approximately over the wheels. If you run off the strip, and 1000 rpm won't move your plane, don't try to blast clear. You probably couldn't control the plane after it broke out. Cut your throttle and call for a tug.

DON'T BLAST OUT

If it requires continuous pumping to get brake action, return to the ramp. Call a tug if you don't get pressure on either or both brakes, something is wrong with the hydraulic system—a leak, low fluid supply, or air in the line. Write up any brake trouble in Form 1A.

The P-47N handles easily on the ground because of its weight, widespread wheels, and centrally located CG. But it is a **blind** airplane. To see ahead you must S. Don't make the mistake of allowing your eyes to follow the course of your plane while S-ing. Look into the area opened up.

Keep both wheels rolling in a turn.

Keep your head and eyes out of the cockpit and constantly roving.

Do not taxi with the flaps extended or with the tailwheel locked.

If you slam on the brakes, you nose up, even if you are taxiing no faster than a man walks.

# Takeoff

When lining up for the takeoff check, park so that your prop blast won't affect other planes. Head upwind to keep dust from blowing back into your engine and to keep the engine cool.

Check your wing flaps, then run up the engine to 30″ Hg and 2400 rpm. If your brakes won't hold this power, return to the line, by tug if they're extremely weak.

The check:

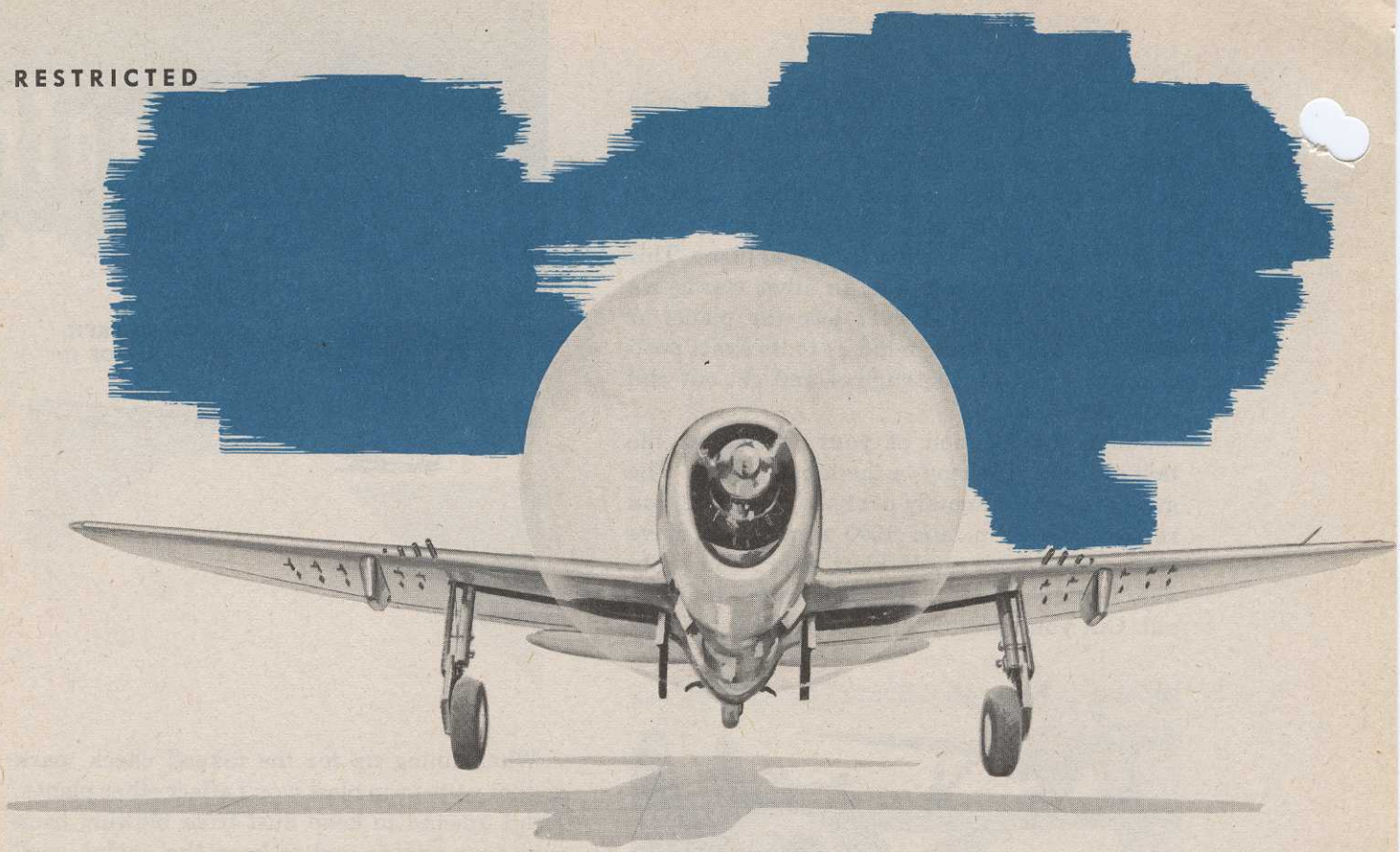
Turn the mag switch from BOTH to R (right), back to BOTH, then to L (left), then back to BOTH. The drop on each mag must be less than 100 rpm. The difference in the drop on the 2 mags should not exceed 40 rpm.

If you get a drop in excess of 100 rpm but the engine isn't running rough, continue the runup for a minute or so and try again. After you clear the engine, the mags may check OK. However, if you still get an excessive drop return to the line.

Check the ammeter to see that the generator is delivering electricity to the battery.

Check the propeller.

Make the manual check first. Hold the selector switch in DEC RPM until you get a drop of 400 rpm. Shift the switch to INC RPM until the rpm returns to 2400. Return the switch to AUTO.



**The "N" flies off the ground from a three point attitude.**

Pull back on the propeller control handle until you get a drop of 200 rpm. Leave for a moment to insure that the tachometer does not oscillate more than 100 rpm. Return the handle full forward.

If your prop check is unsatisfactory, return to the line.

Check the water pressure (if carrying water).

Check the oil pressure (70-90 psi) and oil temperature (40-100°C.).

Reduce power to around 800 rpm and repeat the cockpit check—all of it—plus:

Check hydraulic pressure—1000 psi.

Check canopy operation.

Place oil cooler and intercooler shutters in AUTO.

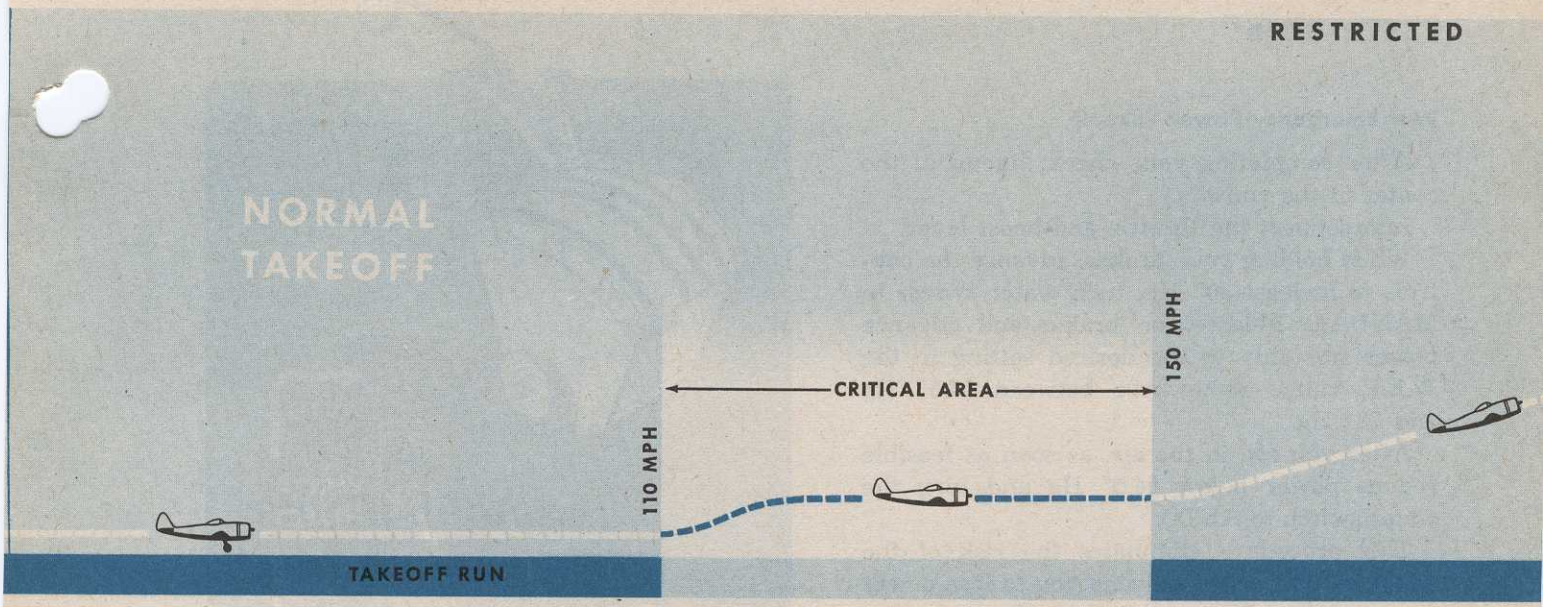
Set the friction control knob on the throttle quadrant.

If carrying external tanks, set release switches for instantaneous release. (For procedure see Fuel System section.)

Make certain the runway is clear, then line up in the center.

Open the canopy.

**Apply power smoothly to avoid excessive torque.**




Lock the tailwheel, after rolling straight ahead for a few feet, and raise the safety catch on the landing gear lever so you won't have to duck your head in the cockpit during the takeoff run.

Set cowl flaps one-half open manually and leave the switch in MANUAL.

Apply power smoothly to avoid excessive torque. Do not exceed 51″ Hg unless you are using water.

The N requires a longer run that you are used to. You may be tempted to exceed the red line to work up speed. Don't do it! Your plane gets off the ground OK using prescribed power limits. When you draw excessive power, you risk detonation and engine failure.

The N flies off the ground from a 3-point position at about 100 mph. However, raise the tail about 6 inches when it wants to lift off. Stay on the ground until reaching a speed of around 110 mph. Then lift the plane off the runway. The raised tail and added speed give much better rudder control.

Use rudder, not brakes, to correct for torque. Rudder is sufficient and it's brutal on the tires to use brakes.

Develop climbing speed before starting to climb. Be easy on the back pressure until you have at least 150 mph, then climb gently. The plane is sluggish before reaching a climbing speed of 170-180 mph. (The best rate of climb is obtained at 155 mph.)

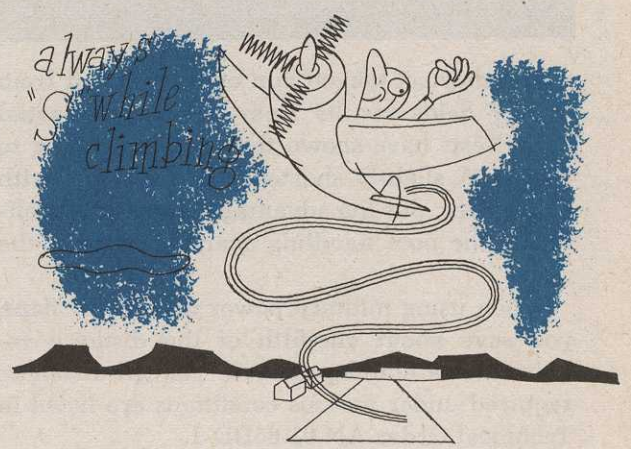
If not pushed, the N picks up climbing speed rapidly. You reach altitude in less time by getting climbing speed first than you do by having your plane labor in a climbing attitude with insufficient speed.

When definitely airborne, raise your wheels. Do not brake them.

Don't start your first turn until you have built up a safe airspeed.

After setting your power for climb, place the cowl flap switch in AUTO.

Always S while climbing or letting down. Any time you fly into the altitude of another plane, particularly a fast fighter, without scanning the sky, you run the risk of a collision. In any event, you need the training for combat where you must keep watch for hostile aircraft.



### War Emergency Power Takeoff

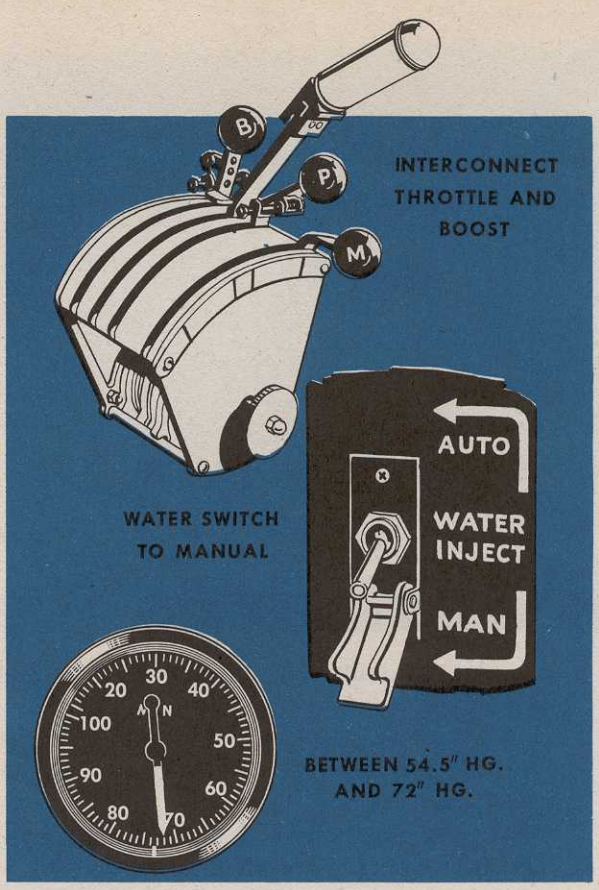
After completing your check, lineup in the center of the runway.

Interconnect the throttle and boost lever.

While holding your brakes, advance the controls to at least 30″ Hg, turn water switch to MANUAL. Release the brakes and advance power smoothly to the desired setting in the W.E.P. range—somewhere between 54.5″ Hg and 72″ Hg.

After you are in the air, as soon as feasible reduce power below 54.5″ Hg and turn the water switch to AUTO.

This procedure eliminates the risk of the water cutting in and causing you to lose power momentarily during the takeoff run. (See Water Injection section.)




### Maximum Performance Takeoff

The shortest takeoff run or best takeoff from muddy fields results from the use of partial flaps. Tests have shown the best flap setting to be 20°. A slightly shorter run is possible with 30° of flaps, but the advantage is more than offset by the poor handling characteristics of the plane.

When using military power and 20° of flaps, you save about one-fifth of the distance required for a non-flap takeoff. Takeoff distances required under various conditions are listed in Technical Order AN 01-65BD-1.

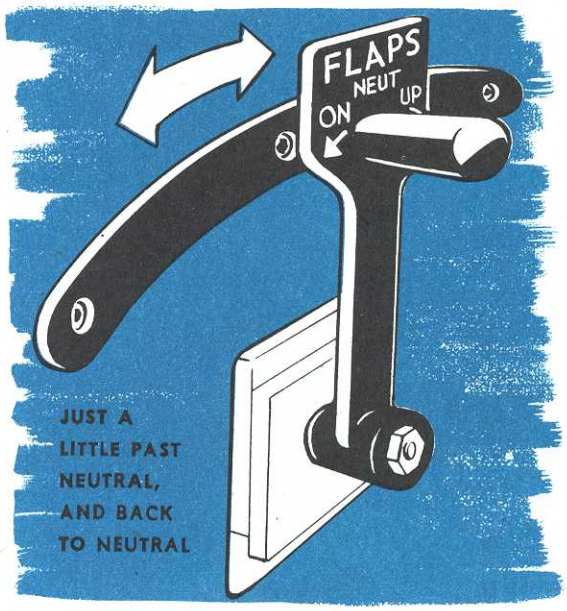
If you plan a takeoff with flaps, run the flaps all the way down, then return them to 20°. This procedure helps insure that the hydraulic pressure will remain steady against both flaps.

**It's not advisable to use flaps on takeoff unless the shorter run is absolutely necessary. It is strictly an emergency procedure, as there's always the possibility that one flap may come up, making the airplane difficult to control.**

# Emergencies

**Don't raise the flaps until you reach a minimum altitude of 800 feet . . .**

and 150 mph, then milk them up 5 to 10° at a time. Do this by snapping the flap handle a little forward of N (neutral), then back to N. If you




push the handle all the way forward to UP, the flaps will probably raise completely before you can get the handle back.

### Runaway Prop

If there's enough runway ahead, stop the takeoff. But if you are too far committed, continue the takeoff. Once airborne, place the prop selector switch in MANUAL and regulate for correct rpm. Circle the field and make a normal landing. There is no reason to get rattled. Regard flying in MANUAL as merely a different procedure. It's not an emergency unless you make it one.

### Blown-out Tire

Reduce power.

Fight to keep the plane straight on the runway by using opposite brake. Cut off the power as you gain control. Cut the switches if there is any possibility of nosing up or leaving the runway.

### Engine Trouble

If the engine misses, backfires, detonates or gives any evidence of supplying less than full power before the wheels are off the ground, cut the switches and return the mixture control to IDLE CUT-OFF. Apply the brakes by pumping. Hold the plane straight on the runway. In case you are running out of field, but your speed has been reduced to 70 mph or less, unlock the tailwheel, and groundloop by holding one brake. However, if your speed is too great, collapse the landing gear and skid to a stop. This is preferable to nosing over or colliding.

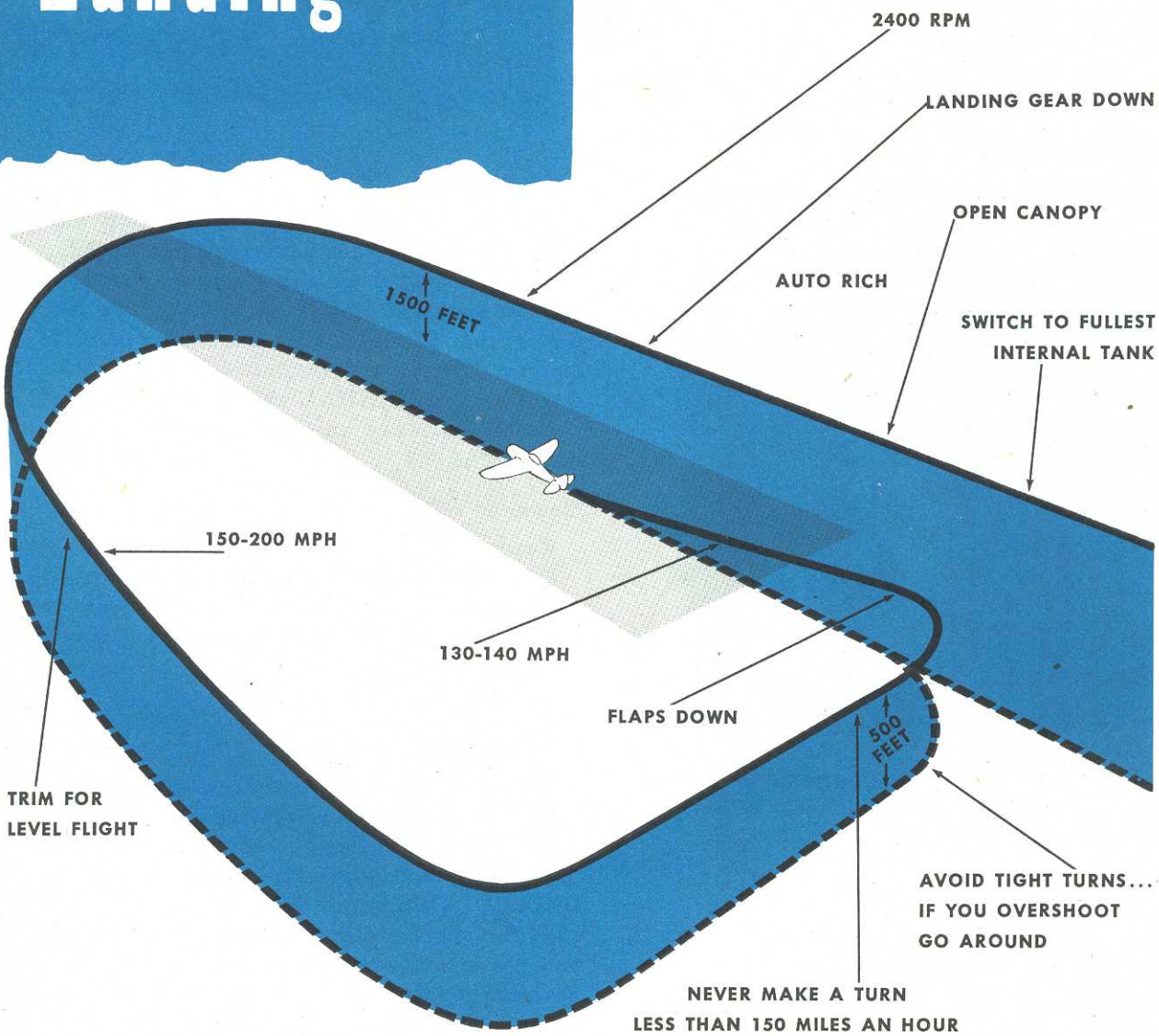
In case you are already airborne, retract the wheels and land straight ahead. Jettison your external load. Push the nose down to keep your airspeed up.

### DON'T STRETCH YOUR GLIDE

Don't try to turn. To do so is fatal.

(For procedure see Emergency Landing section.)

# Landing




On entering the landing pattern, contact the tower for instructions. Use the correct pattern and obey the tower unless you are in trouble. In that case you are the boss.

During your first few landings fly a fairly large pattern to avoid steep turns.

Never make a turn at less than 150 mph.

Switch to the fullest internal gas tank.

Check to insure that your mixture control is in AUTO RICH.

Landing gear lever DOWN.

While your gear is in motion, hydraulic pressure falls off sharply, but returns to 1000 psi when the operation is complete. This provides you with a check to supplement your landing gear lights check.

Trim your plane for level flight.

Advance propeller control to 2400 rpm.

Open the canopy.

Keep your head out of the cockpit, and keep your eyes moving except for the brief glances required to complete checks.

Fly your landing pattern at 150-190 mph.

Pump up your brakes on your downwind leg.

**Avoid tight turns. If you are overshooting when turning off of your base leg, don't try to reef the plane in. Go around!**

Do not advance your throttle while actually in a turn. It pulls the nose up and makes the turn too steep. If you need additional power, apply throttle before turning or after the turn has been completed.

After you've made a few landings and gotten the feel of the plane, keep your base leg in close. Stay above 1000 feet. Complete the last turn at 500 feet, or more. Hold an airspeed of 130-140 mph on the final approach.

Keep the nose down on the N until you start to break your glide.

Lower your wing flaps on the final approach and trim to relieve the resulting nose heaviness. You may observe pilots lowering their flaps earlier in the pattern, but remember they have more time in the plane than you have.

Carrying external tanks, even though empty, gives the plane unstable characteristics when you turn with flaps down.

The N was designed to land with full flaps. However, you may lock the flaps in any intermediate position by returning the flap control to NEUTRAL. Check the flaps visually for proper extension. Should the flaps come down unevenly, hold the plane with aileron until they even up.

Avoid a long, flat approach with power. Such approaches are dangerous in case of power failure and result in poor landings.

After you throttle back to start your glide, clear your engine at least once. This keeps the engine from cutting out if you need sudden power.

Try for a 3-point landing in the center of the runway. Land in the first 1000 feet. Do not level off too high. The N has no tendency to drop a wing when stalled out, but it settles fast when the speed drops below 110 mph. If you level off too high, add a little power and settle slowly.

There is no harm in a wheels landing, although a longer landing roll results.

When landing behind another plane, be on the lookout for prop wash.

Apply slight brake pressure early in the roll to insure that your brakes are working. Do not apply firmly enough actually to slow the plane, but only sufficiently to reassure you that the brakes are ready for use.

A crosswind landing in the P-47 is relatively easy. Apply the methods learned in flying school. It's easy to get your plane lined up with the center of the runway and to keep it there. Set your base leg a little higher and farther out to give yourself time to establish your approach angle.

After landing, place the cowl flaps in manual full open, raise the flaps (not to be confused with the landing gear) and when ready to turn off into the taxi strip, unlock tailwheel.

Clear the runway quickly, but if you have made a short landing, don't swing into an intermediate taxi strip unless you have received permission from the tower. Go to the end of the runway before turning off.

While preoccupied with landing or taxiing, don't go deaf. Remain conscious of your radio. The tower, at any moment, might have an urgent message for you.

Keep your eyes moving while returning to the parking area.

When parked, hold the brakes, run the engine up to 1000 rpm, move the mixture control to IDLE CUT-OFF. After the engine stops, turn off the ignition and main line battery switches. Shout, "Switch Off."

Turn the fuel selector cock to OFF.

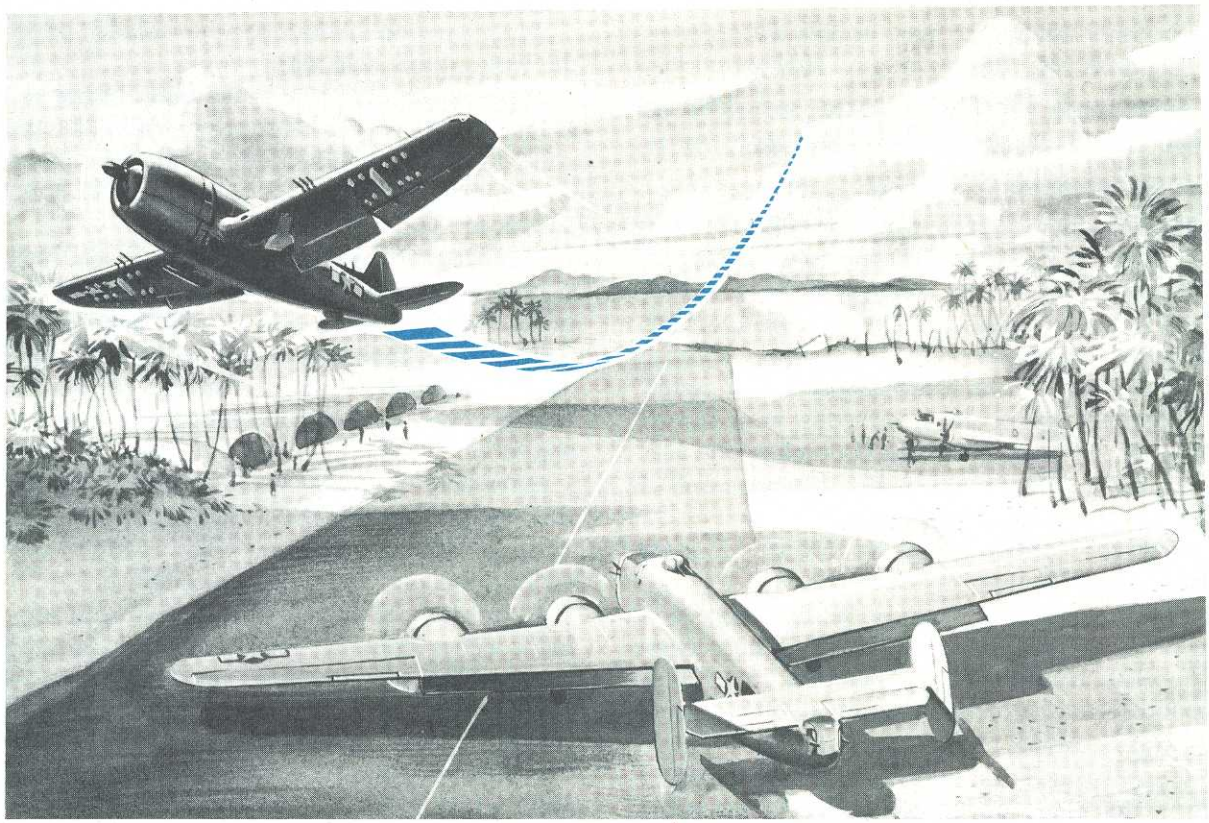
Run through the cockpit check to determine that the plane is set for the next flight.

In windy weather see that the controls are locked.

Don't set the brakes; have the crew chief chock the wheels. The brakes may stick if they're set while hot. Fill out Form 1.

A Pilot's Golden Rule:

**When filling out Form 1A, note all defects you observed. Don't undertake to judge whether any defect is important. The crew chief and engineering officer are on the field for that purpose.**



### Going Around

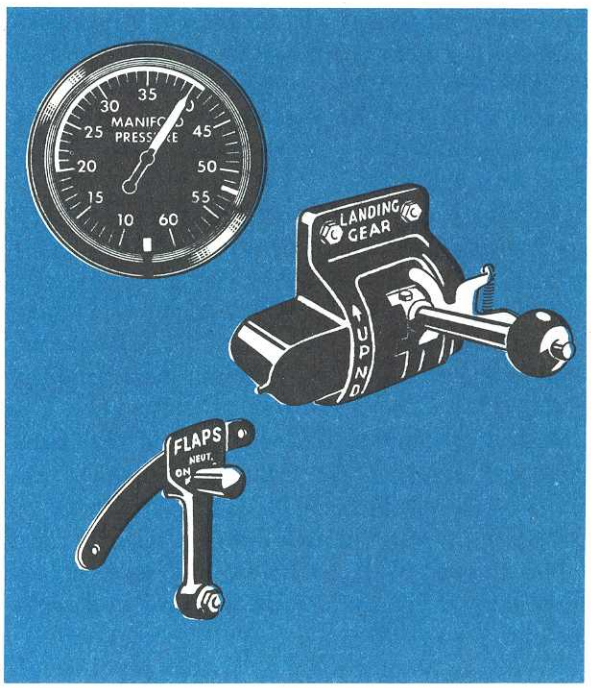
Bad landings in a P-47 almost always are man-made. If you're not sure your approach is 100% correct or that your gear is down and locked, go around. Give yourself a chance to work out your problem, or to discuss matters with mobile control or the tower.

When going around, apply power smoothly, remembering that the torque caused by a sudden surge of power causes your left wing to drop. Always be ready to apply the necessary right rudder.

Open the throttle smoothly to 40″ Hg and raise your wheels. Don't forget you must spring the safety latch before the landing gear lever will come up.

Don't pull up too steeply or you may lose control of the plane.

Acquire a safe airspeed, 150 mph, before starting to raise the flaps. Milk the flaps up slowly as described in the previous section. If you spill the flaps suddenly, the plane will mush dangerously.



# Flight Characteristics

The P-47N handles much like the AT-6. Some fighters are aileron planes. Others are handled mainly by the rudder. But the P-47N, like a trainer, requires coordination of the two controls to keep the ball centered.

Don't let the Thunderbolt's size give you the notion that it possesses any mysterious qualities. Once the wheels and flaps are up, the size and weight are not noticeable.

You'll be given prescribed missions for your transition. Don't short-change yourself by skimping any assignment. You must master the fundamentals before you can fly with your head out of the cockpit, or in other words, before you can call yourself a fighter pilot.

While performing the mild zooms and dives, Lazy 8's and level flight at varied power settings which make up the exercises, study your engine, airspeeds and the way the plane trims and handles.

### Stalls

Try a few partial stalls to identify the buffeting that precedes a stall. Recover when the plane starts to shudder. Perform the maneuver with power on and off, with wheels and flaps up, wheels down, and finally with wheels and flaps down. Execute the series in turns to the right and left.

In a full stall there is no tendency to spin. The nose, and usually the left wing, drops and the airplane will dive out.

### High-Speed Stalls

The approach to a high speed stall is the same as to a normal stall; the plane shudders. Such stalls are brought about most commonly by trying to make a turn too tight.

At high altitudes, high speed stalls result from using too much back pressure to recover from a dive. Light stick pressure has little effect and there is a tendency to overcontrol, resulting in a change of the angle of attack sufficient to break down the airflow.

(See Compressibility section.)

Do not dive faster than 225 IAS or make tight turns when the cowl flaps are open. You may run into tail buffeting.

### Spins

Never spin the P-47N intentionally. The wing loading and design of a modern fighter do not allow enough of a safety factor to play around with them. Furthermore, spin tests on the N have not yet been completed and specific recovery procedures are not available. Use the procedures outlined below until they are modified by a Technical Order or a revision of this manual.

Though dangerous, entry into an accidental spin does not mean that you can't get the plane out.

Recovery from a normal Spin:

1. Cut off the throttle and boost.
2. Apply full opposite rudder sharply.
3. Hold the elevator in neutral. (To do this in a spin you must hold a **slight** back pressure on the stick.)
4. Apply aileron against the spin.
5. As the rotation stops, "pop" the stick forward to break the stall. Move the stick only a few inches, because the weight of the engine is enough to get the nose down and full forward stick might put you in a dangerously steep dive after you get out of the spin.

Use of the throttle should not be necessary in a normal spin, though the torque will help to recover from a spin to the right if opposite rudder doesn't seem to be enough.

As spins wind up they are progressively harder to stop, so get on that opposite rudder at the first degree of turn.

If you get into a normal spin at medium or high altitudes, fight it down to 8000 or 10,000 feet, then bail out.

If you enter a spin between 6000 and 10,000 feet, make one thorough attempt at recovery and, if unsuccessful, get out.

### Flat Inverted Spin

There is only one way to get the N into this condition. That is by uncoordinated use of the rudder and ailerons while the plane is stalling on its back.

If you get into an inverted spin, you are in for a hard, violent tussle. Hold on to that stick. If it should be jerked from your hand it will give you quite a chase around the cockpit.

Recovery from an inverted spin:

1. Cut off the throttle and boost.
2. Kick hard opposite rudder.
3. Apply aileron in the direction that you appear to be turning.

4. As the rotation stops, the nose will drop. Stay on your back until you build up safe flying speed and then roll out, being careful to coordinate the controls. If you fall through into a normal spin, use the procedure outlined for that.

### Flat Spin

It is also possible to get the N into a spinning attitude where the nose stays near the horizon and the airplane seems to be making lazy, flat circles.

Recovery from a flat spin:

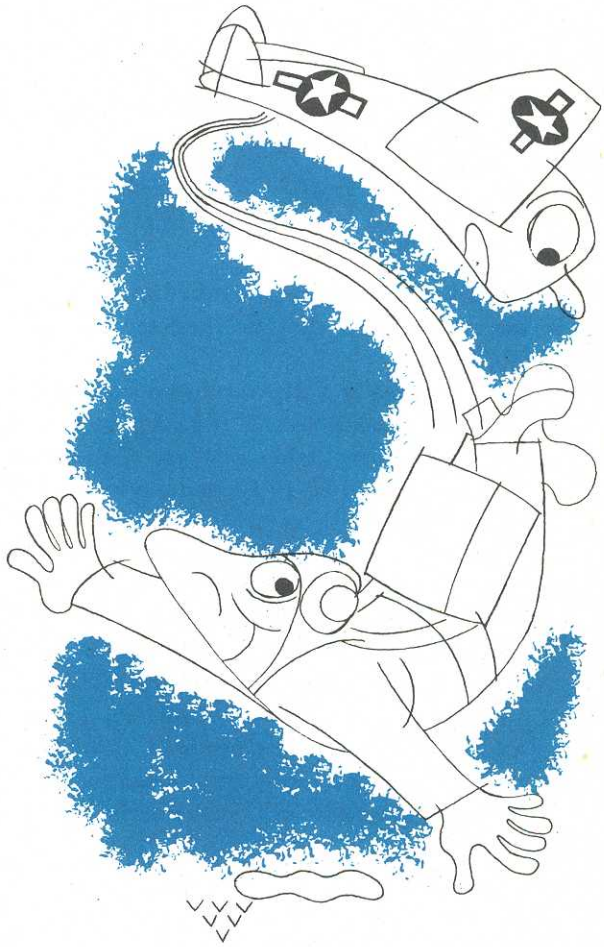
1. Cut off the throttle and boost.
2. Apply full opposite rudder.
3. Hold the elevator in neutral.
4. Apply the ailerons full against the spin.
5. Apply repeated bursts of power (50″ Hg and 2800 rpm for two or three seconds).

Either the rotation will stop and you can dive out or you will fall off into a normal spin.

Do not attempt recovery from either a flat spin or an inverted spin below 10,000 feet. Bail out.

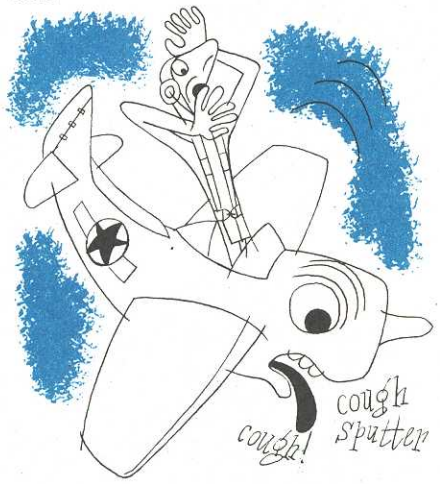
## *Remember*

**Any time your N goes out of control or is still out of control below 5000 feet, JUMP.**



The use of ailerons against the spin, as recommended here, is based on a maximum ammunition loading of approximately 250 rounds for each of your eight guns. If the loading in your plane is greater than this, use aileron with the spin for recovery. If you're not sure how much you're carrying, follow the normal procedure and if it doesn't work, repeat it, using aileron with the spin.

### Out of Gas




If your engine sputters, **immediately** switch gas tanks and turn the fuel booster pump to EMERGENCY.

If your trouble is a dry tank and you switch soon enough, the engine will regain power right away. If, by any outside chance, the engine does not re-start in 10-15 seconds, add the following procedure:

1. Check the selector and gages to see that you are on a tank with gas in it. (Leave the booster pump on EMERGENCY.)
2. Pull the throttle back to ¼ open.
3. Place mixture control in IDLE CUT-OFF.
4. As the fuel pressure comes up, let the engine windmill for a few seconds, to clean it out and stabilize the fuel pump operation.
5. Return the mixture control to AUTO RICH.
6. As the engine picks up, open the throttle and go on with your mission.

This procedure will cost you 1500 to 3000 feet of altitude, so don't waste time with it when close to the ground.

If you run a tank dry at high altitude and are unable to re-start, fly the plane down to 10,000 feet and try again before deciding to bail out or make a forced landing.

### Engine Failure

Internal engine failure is evidenced by loss of oil pressure, excessively high cylinder head temperature, violent vibration, or a combination of the three. This usually means that you must choose between making a forced landing and bailing out. Such a failure seldom results in fire. Reduce your power to try for smooth operation. See if you can hold altitude. If you can, you may be able to get back to the field or to some terrain better suited for a belly landing.

### Fire

Fire in the air remains the pilot's worst enemy. It is almost always best to bail out. If for any reason you can't or prefer not to, move the mixture to IDLE CUT-OFF, turn the selector OFF, and open the cowl flaps, then turn off switches. Make a dead stick landing.

### Collision

If a cable or control surface is useless, don't waste time trying to recover. If you can't right the airplane get out immediately. Loss of part of a control surface, a wing tip, or damage to a wing, is not necessarily reason for bailing out. Get to a safe altitude and simulate a landing, wheels down, and see where it stalls. If the stalling speed is slow enough, return to the field. If the plane is unsafe or unstable, bail out. Before landing warn the tower that you are making an emergency landing and will make an unconventional traffic pattern.

If you have partial control or if the cables are weak, the trim tabs will help.

### Cockpit Fumes

Vapor from a broken fuel line or defective primer is a hazard both as a possible fire or explosion and as a toxic agent on the pilot.

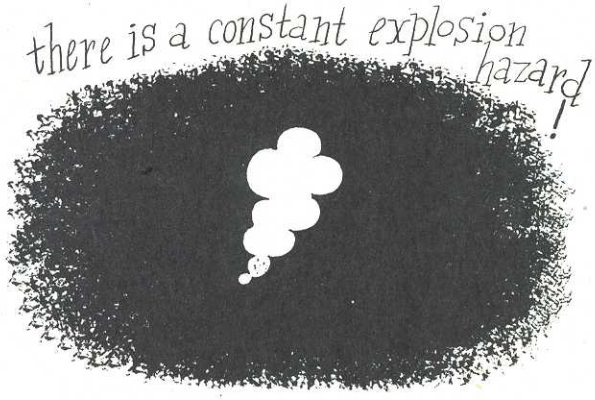
Put on your oxygen mask, take a few breaths from EMERGENCY, then turn to AUTO-MIX OFF (100% oxygen). Close the cockpit vent and leave the canopy closed.

Make a normal landing as soon as possible, at the nearest field. Don't pull the throttle all the way back during the final approach. A backfire or torching may ignite the fumes.

Never smoke in the P-47N.

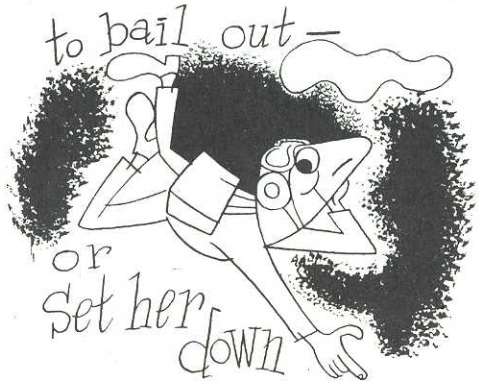
Carbon monoxide has much the same effect as anoxia. Any time you feel sleepy or your reactions are sluggish, breathe pure oxygen. If you don't feel better almost at once, go home.

THIS IS A CONSTANT EXPLOSION HAZARD




Experience and statistics dictate the following general policies:

1. If you are lost or running low on gas, pick out a good field and make a belly landing while you still have gas to go around.




2. In case of power failure but full control, make a belly landing if the terrain is favorable. (For procedure see Forced Landing section.)

3. "Favorable" terrain for a belly landing means flat or gently rolling land, no gullies, ditches, or power lines, free from buildings or large, scattered trees. Beaches, pastures, and cultivated farms are best.

4. If the airplane is out of control, bail out.

5. Don't attempt a forced landing at night. Bail out!

### Forced Landings

To get maximum glide, with no power, place your propeller manually in the full decrease rpm position. This presents the edge of the blade forward, reducing drag in the same manner that feathering a prop does on a multi-engine plane.

As long as your propeller is windmilling, keep your airspeed above 150 mph. If the engine should freeze, giving you a dead prop, increase your airspeed to above 170 mph to overcome the added drag. With a frozen engine, don't put your wheels and flaps down.

Unless you are on the way to a field of your choosing, with a definite plan of action in mind, bail out before you get as low as 3000 feet. Once you have decided on a course, stick to it, unless a new emergency, such as fire, causes you to reach a new decision.

For trouble developing below 4000 feet, make one quick check—if a solution isn't available instantly, bail out.

Make a forced landing with wheels up, unless you are positive that you can make a runway with gear down.

**THREE RULES FOR ANY FORCED LANDING**

**1. Don't Stall**

**2. Don't Ever Stall**

**3. Don't Never Ever Stall***

*Ungrammatical, but still true.