

DIRECTED STUDY PROGRAM

C-47

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REF: 1080-7

EMERGENCY SYSTEMS AND PROCEDURES

PREFACE

In an emergency, notify the ground station as soon as possible. Also, when appropriate, alert the other crew members; if emergency landing is planned, direct other crew members to take necessary preparatory action.

PROCEDURES

All procedures in this section are written to conform with the latest approved methods for handling each emergency. Crew duties have been assigned so that all crew members may become familiar and proficient with their duties and the sequence in which they should normally be performed. It is important that these standardized procedures be followed in training so that maximum efficiency may be obtained in any emergency, regardless of changes in crew pairings. It is the duty of the Captain to assign or carry out the duties of the other crew when only a two-man pilot crew is assigned.

In case of smoke, fire, or fire warning as indicated visually or by warning light, immediately carry out the appropriate procedure in the sequence indicated and head for the nearest suitable landing area.

In most cases procedures have been divided into "Immediate Action Items" and "Secondary Action Items". It is expected that all crew members will commit to memory the entire "Immediate Action Items" portion of the procedure. Secondary Action Items should be accomplished promptly after completion of "Immediate Action Items" using the appropriate check list.

A copy of the actual "Fuselage Smoke and Fire Fighting" check list installed in the airplane is included in this section. The "Engine Failure or Fire" and "Propeller Unfeathering" check lists are a part of the cockpit check list installed in the airplane, a facsimile of which is included in the "Normal Operating Procedures" section of this manual.

EMERGENCY LANDINGS

Due to the potential fire hazard attending emergency landings, the airplane should be evacuated as rapidly as possible after coming to a complete stop. In extreme emergencies, such as uncontrolled inflight fires, the Captain should consider the advisability of belly landing in order to expedite rapid evacuation.

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- | | |
|---|------------------------------------|
| 1. In any emergency, notify the _____ and _____ as soon as possible on 119.1 or other suitable frequency. | |
| 2. Alert the _____ appropriately. | ground station other aircraft |
| 3. If emergency landing is planned, direct the other crew members to take _____ action. | other crew members |
| 4. All emergency procedures must be understood and memorized by _____, so that each crew member is informed of the responsibilities _____ as well as his own. | necessary and appropriate |
| 5. It is important that all standardized procedures be followed in training as well as in actual emergency, to attain _____ and to avert confusion that might result from changes in _____. | all crew members of others |
| 6. It is the duty of the Captain to assign or carry out the duties of other crew when only a _____ crew is aboard. | maximum efficiency |
| 7. In case of smoke, fire, or fire warning immediately carry out the appropriate procedure in proper sequence and head for the nearest _____. | two-man pilot |
| 8. Emergency procedures are divided into _____ and _____ action items, all crew members must memorize and be able to recite properly the immediate action items. | suitable landing strip |
| 9. A copy of all emergency procedures and check lists can be found in _____ and also in the _____. | immediate action secondary |
| 10. After an emergency landing, the A/C should be _____ as rapidly as possible because of possible _____ hazard. | all aircraft A/C flight manuals |
| 11. In extreme emergency, such as an uncontrolled in-flight fire, the Captain should consider the advisability of a _____ to expedite rapid evacuation. | evacuated fire |
| | belly landing |

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If failure or fire occurs before coming airborne, the Captain will check airspeed and decide whether take-off shall be interrupted or continued. If engine failure or fire occurs at speeds below Vmc both engines should be throttled back and the airplane stopped. If the speed is above Vmc (76K) the take-off may be carried through; however, the Captain may elect to stop if necessary runway or runout is known to exist.

The pilot in control during the take-off shall normally continue to control the airplane.

The other pilot will raise the landing gear and wing flaps.

CAUTION: Safe Single-Engine Speed is never less than 110 per cent Vmc (84 knots) or 110 per cent of Power-Off Stall Speed (clean configuration) for the given gross weight, WHICHEVER AIRSPEED IS THE GREATER.

Hold airplane on ground until reaching safe Single Engine Speed, climbing at Safe Single Engine Speed, or higher. If obstacle clearance is critical, climb out at Safe Single Engine Speed.

Do not restart engine in which fire (or fire warning) has occurred.

If fire is not under control, land as soon as possible. If fire is out, land as soon as practicable.

With a full fledged engine fire that is uncontrollable, past experience has shown that the wing can burn through in approximately 1½ minutes. However, this may be delayed by violently slipping the aircraft away from the fire in the emergency descent.

| | |
|---|--------------------|
| 1. If failure or fire occurs before becoming airborne, an _____ should be made if possible. | |
| 2. Do not _____ an engine in which a fire or fire warning has occurred. | aborted take-off. |
| 3. If a fire is uncontrollable, _____ as soon as possible. | restart |
| 4. In case of an uncontrollable engine fire, _____ the A/C away from the fire in an emergency descent may delay serious damage to the wing structure. | land |
| | violently slipping |

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ENGINE OVERSPEEDING

Captain

First Officer

Close throttles
Prop Control High PITCH
Zoom aircraft to reduce speed
(not below Safe Single Engine Speed)
Intermittently push the feathering
button in. Pull out when RPM drops
below 2700 RPM. If the governor
doesn't hold after two or three
attempts, feather the propeller.
Gear, flaps and power ——— CHECK

Stands by for any orders from Captain

Gear, flaps and power ——— CHECK

SECONDARY ACTION ITEMS

If governor fails to control and engine is feathered, complete ENGINE FAILURE AND FIRE CHECK LIST. Make visual check of engine from cabin.

- NOTES:
1. WHEN POWER REQUIREMENTS PERMIT, CLOSE THROTTLES OF BOTH ENGINES IN ORDER TO HELP REDUCE AIRSPEED. If overspeed occurs on take-off or initial climb, close throttle on affected engine only.
 2. Speed may be resumed after overspeeding stops.
 3. If propeller will not feather, reduce airspeed to attain a windmilling RPM not exceeding normal cruise RPM. In a high RPM windmilling condition, passengers should be moved aft of the plane of propeller rotation. A high RPM windmilling condition may be partially restored to normal by descending to a lower altitude, inasmuch as the propeller windmilling characteristics are a function of true airspeed.
 4. If engine RPM exceeds 3000, runaway engine should not be restarted except for emergency use.

If restarted under these conditions, use reduced power whenever possible
 5. If engine overspeeds beyond 3050 RPM the engine must be removed for shops inspection (Ref. MM08.01-02).

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EMERGENCY DESCENT

Airplane Configuration

Descent Airspeed

- | <u>Airplane Configuration</u> | <u>Descent Airspeed</u> |
|-------------------------------|-------------------------|
| 1. Gear and flaps up | Descent at 180 kts |
| 2. Gear and flaps full down | Descent at 85 kts |

SMOKE EVACUATION

Under no circumstances should any hatch or door other than the clear vision windows and the main cabin door be opened during an inflight fire for smoke evacuation.

NOTE: THE PILOT'S AND CO-PILOT'S CLEAR VISION WINDOWS MUST BE OPENED BEFORE OPENING THE MAIN CABIN DOOR TO REDUCE SMOKE AND FLAME INDUCTION.

| | |
|---|---|
| 1. If a runaway propeller exceeds _____ RPM the engine should be shut down and not restarted except for _____. | |
| 2. Engine overspeeds beyond _____ RPM call for a _____. | 3000; emergency use |
| 3. Emergency descent with gear and flaps up is made at a maximum speed of _____ knots. | 3050 mandatory engine change |
| 4. Emergency descent with gear down and full flaps is made at a speed not in excess of _____ knots. | 180 |
| 5. Smoke evacuation (after fire has been extinguished) is accomplished by first opening pilots and copilots _____, blocking open the _____ door, and then opening the _____ door. | 85 |
| 6. This procedure will ensure smoke clearance beginning with _____. | clear vision windows; cockpit to cabin; main cabin entrance |
| | the cockpit |

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ELECTRICAL SYSTEM MALFUNCTIONING

In the event of complete loss of DC electrical power or other malfunctions which would render inoperative any fire detector system, land at the next suitable airport where maintenance is available.

Static Discharge Inspection

When an airplane is subjected to a static discharge an immediate inspection should be made to determine what damage, if any, was sustained. The following equipment should be checked for proper operation as soon as operating conditions permit:

- A. All communication and radio navigation equipment.
- B. Airplane compasses:
 1. Check the magnetic compass (on multiple headings if practicable) against other cockpit indications such as radio magnetic bearings, gyrosyn compass or known headings.
- C. All electrical instruments should be monitored for sluggish, erratic or erroneous indication.
- D. The co-pilot will make an inspection of aircraft exterior in flight in so far as practical.

Upon landing, a visual inspection of the airplane exterior shall be made particularly noting radio antenna, pitot tubes, and the aft area of all airfoil sections for holes. Report finding in the airplane log book.

| | |
|--|--|
| 1. In case of complete loss of DC power or other malfunction that would inactivate the _____ system, land at the next suitable airport where maintenance is available. | |
| 2. If an A/C is struck with lightning an immediate inspection should be made to _____ if any. | fire detection |
| 3. The inspection should include radio and radar equipment, magnetic compass, all electrical instruments, and an in flight inspection of _____ insofar as practical. | assess the damage |
| 4. Upon landing, you should make a visual inspection of the A/C exterior including _____, _____, and the _____ area of all aerofoil section for holes. | A/C exterior |
| | radio antenna pitot tubes trailing |

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HYDRAULIC SYSTEM MALFUNCTIONING

Unable to Obtain Normal System Pressure

Hydraulic Fluid Quantity Normal (internal leak indicated)

1. Operate all units (auto pilot excepted) with emergency hydraulic hand pump.

Hydraulic Fluid Quantity Low - immediately isolate all units as follows:

1. Landing gear handle in neutral position.
2. Wing flap handle in neutral.
3. Brakes off.
4. Windshield wiper off.

Emergency Landing Gear Extension

1. Landing gear lever DOWN.
2. Operate the hydraulic hand pump until the gear is down and spring locked. Visually observe the gear position.
3. Landing gear lever in NEUTRAL.

CAUTION: Place latch lever in positive lock position only after the gear is fully extended and normal pressure is indicated, since the spring lock action catch is locked closed in the positive lock position.

4. Check landing gear warning lights, green lights ON and red light OFF.
5. Landing gear latch lever in POSITIVE LOCK position.
6. Check landing gear warning horn for gear down and locked indication by retarding a throttle.

Emergency Wing Flap Operation

Move the wing flap lever to the desired position, actuate the hydraulic hand pump, then return the flap lever to neutral.

Landing Gear Hydraulic Line Failure

In the event of a complete line failure, the gear can be snapped down so that the latches will engage. Return the landing gear lever to NEUTRAL as soon as it is certain that the safety latches have engaged, so as to conserve all the fluid and pressure possible for wing flap and brake operation. If the above condition exists, the green landing gear warning light will go on when the lever is returned to NEUTRAL, but the pressure shown on the landing gear system pressure gage may fall rapidly to zero.

Landing Gear Safety Latch Failure

The aircraft may be safely landed whether or not the landing gear safety latches are engaged, providing the landing gear is fully down, the hydraulic system pressure is 850 - 900 psi and the landing gear lever is in the down position.

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Pressure in the landing gear actuating struts is indicated on the landing gear pressure gage. The horn will continue to sound and the red light will stay on, since the switches are connected to the safety latch and landing gear lever. When landing under these conditions, the gear is held in the extended position by the pressure of the hydraulic fluid against the retracting strut pistons. When the brakes are applied, the resulting rotative force will have a tendency to cause the gear to retract, moving the pistons up in the struts and resulting in an increased pressure in the landing gear downlines. To eliminate the possibility of a line failure due to the excessive rise in pressure caused by the pistons moving up in the strut, the brakes should be used only if absolutely necessary. If the length of the runway necessitates the use of the brakes, apply them as lightly as possible and, in any event, limit the pressure applied to the brakes so that the pressure indicated on the landing gear pressure gage does not exceed 1500 psi.

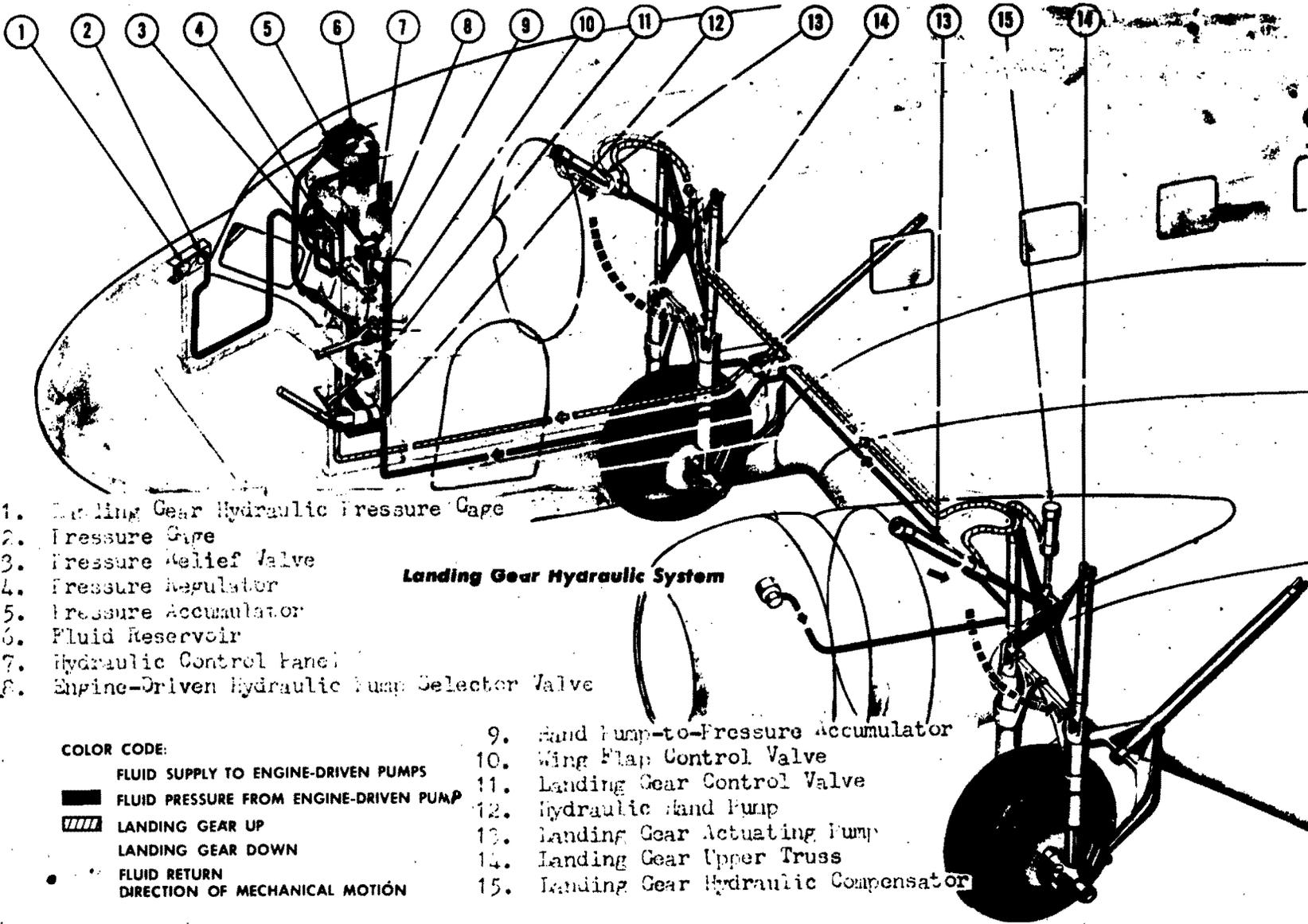
Landing Without Hydraulic System Pressure

A landing without fluid pressure would be necessary in case of failure in the lines from the hand pump to the retracting struts. In this case, the landing gear down position latches will hold the gear in place, and a safe landing can be made. Move the landing gear lever to the down position to allow as much fluid as possible to get into the actuating strut, and then zoom the aircraft as required to snap down the gear and engage the latches. Return the control handle to neutral. If the warning light is green, it indicates that the latches have engaged and a normal landing can be made.

NOTE: If any doubt should exist that the gear is not in positive lock, the interlock rod between latch lever and gear handle can be removed and an attempt made to raise the gear.

Brake System Failure

If the pressure gage reads below 600 psi carry out the hydraulic braking with the aid of the hydraulic hand pump. The co-pilot should operate the hydraulic hand pump to supply pressure to the brakes. The pump handle will move each time the brakes are applied. About 50 pounds pull should be exerted on the pump handle continuously until the brakes are no longer required. When the brakes are hand operated in this manner, no pressure will show on the gage. Apply the brakes with one steady application.



1. Landing Gear Hydraulic Pressure Gauge
2. Pressure Gauge
3. Pressure Relief Valve
4. Pressure Regulator
5. Pressure Accumulator
6. Fluid Reservoir
7. Hydraulic Control Panel
8. Engine-Driven Hydraulic Pump Selector Valve

9. Hand Pump-to-Pressure Accumulator
10. Wing Flap Control Valve
11. Landing Gear Control Valve
12. Hydraulic Hand Pump
13. Landing Gear Actuating Pump
14. Landing Gear Upper Truss
15. Landing Gear Hydraulic Compensator

COLOR CODE:

- FLUID SUPPLY TO ENGINE-DRIVEN PUMPS
- FLUID PRESSURE FROM ENGINE-DRIVEN PUMP
- LANDING GEAR UP
- LANDING GEAR DOWN
- FLUID RETURN
- DIRECTION OF MECHANICAL MOTION

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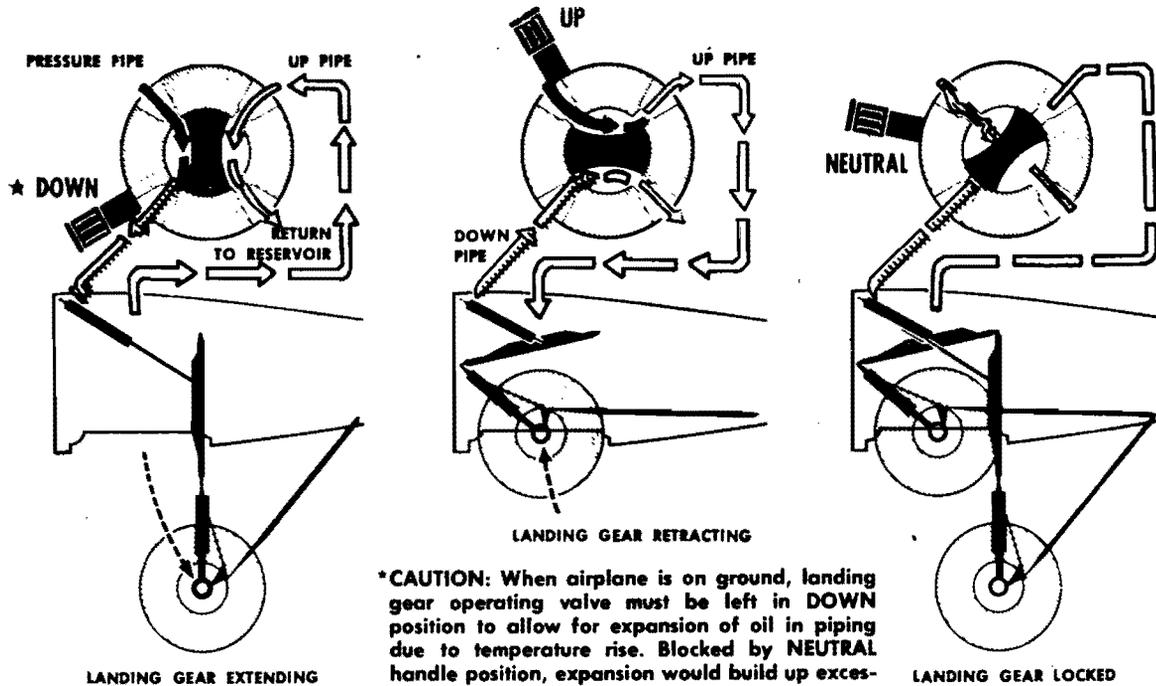
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LANDING GEAR CONTROL VALVE



***CAUTION:** When airplane is on ground, landing gear operating valve must be left in DOWN position to allow for expansion of oil in piping due to temperature rise. Blocked by NEUTRAL handle position, expansion would build up excessive oil pressure and damage the landing gear pressure gage.

Operation of Landing Gear

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MECHANICAL SAFETY LATCH SYSTEM

A spring-loaded mechanical safety latch installed in each nacelle on the forward side of the wing front spar, automatically latches when the landing gear is fully extended, by engaging a slot in the lower end of the actuating cylinder piston rod. Latches for both gears are controlled simultaneously by cables connected to the single control handle located on the floor to the right of the pilot's seat. The control handle has three positions: LATCH RAISED, which releases the landing gear for retraction; SPRING LOCK, which receives and latches the landing gear actuating cylinder hook (landing gear extended); and POSITIVE LOCK, for locking the actuating cylinder piston rod hook when the gear is completely extended. The control handle is connected by linkage to a catch and dog on the landing gear control valve.

The catch and dog prevent the control valve from being moved into the UP position if the mechanical safety latch is in the POSITIVE LOCK or SPRING LOCK position.

| | |
|---|--|
| 1. The mechanical safety latch system _____ when the landing gear is fully _____. | |
| 2. Latches for both gears are controlled _____. | automatically latches, extended |
| 3. _____, _____ and _____ are the three positions of the control handle. | simultaneously |
| | latch raised, spring lock, positive lock |

BUNGEE

The bungee, used on earlier airplanes, consists of six loops of elastic shock cord mounted on a forward yoke connected to the upper truss by a rod and an aft yoke mounted in the rear of the nacelle. The bungee cords are stretched by the extension of the landing gear and aid in balancing the weight of the landing gear. The bungee also assists the landing gear actuating cylinder to retract the landing gear.

HYDRAULIC COMPENSATOR

On later airplanes, the landing gear bungee has been replaced by a hydraulic compensator to provide faster retraction of the landing gear. The compensator is a hydraulic cylinder, bolted to a bracket located on the wing front spar, with the cylinder piston rod attached to the landing gear upper truss. A flexible hose connects the lower end of the compensator to the landing gear hydraulic UP piping.

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1. Earlier aircraft used bungee cords to aid in _____ the weight of the gear and to assist in _____ of the gear.

2. On later aircraft the bungee was replaced by a _____

balancing,
retraction

hydraulic,
compensator

LANDING GEAR CONTROL VALVE

The landing gear control valve, located on the hydraulic panel above the hydraulic hand pump, controls the flow of hydraulic fluid to the landing gear actuating cylinders.

The valves are constructed so that fluid pressure from the system pressure manifold can be directed to either end of the landing gear actuating cylinder, or the fluid flow to the actuating cylinders can be blocked off.

When the control valve handle is placed in the NEUTRAL position, both ports to the actuating cylinders are closed and the fluid flow either to or from the actuating cylinders is blocked off.

The control valve handle operates in a notched quadrant and it is necessary to lift the handle slightly to move it from one position to another.

The landing gear mechanical latch is connected to the landing gear control valve by a rod.

The catch and shoe mechanism on the control valve is designed so that the landing gear mechanical latch control handle, located on the floor of the flight compartment, must be raised to the LATCH RAISED position before the landing gear control valve handle can be moved to the UP position for retracting the landing gear.

No provision is made for thermal expansion of the fluid in the landing gear hydraulic system.

The landing gear control valve will always remain in the DOWN position when the airplane is on the ground.

This position connects the landing gear hydraulic system to the pressure and return manifolds, and any excess fluid pressure in the landing gear DOWN pipe is relieved through the bleed hole located in the hand pump shutoff valve.

1. The landing gear control valve is located above the _____

2. When the control handle is in NEUTRAL, fluid flow _____ or _____ the actuating cylinders is blocked off.

hydraulic hand pump

3. The landing gear latch control handle must be in the _____ position before the _____ position can be selected.

to-from

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4. When on the ground, the landing gear control valve must be in the _____ position.

latch raised,
up

down

LANDING GEAR INDICATOR LIGHTS

The landing gear indicator lights are located on the right side of the main instrument panel.

The green light will illuminate when both main landing gears are down and locked and the control lever is in the NEUTRAL position. The red light will illuminate when the gear or control lever is in any other position.

LANDING GEAR WARNING HORN

The landing gear warning horn, located in the flight compartment to the left of the pilot's seat, will sound when one or both throttles are positioned less than approximately one-quarter open and the gear is not down and locked.

1. The green light comes on when both main gears are _____ and _____ and gear selector is in _____ position.

2. The warning horn will blow when either throttle is retarded to _____ if the gear is not _____ and _____.

down, locked,
neutral

one-quarter,
down, locked

FLIGHT WHEEL BRAKE

A flight wheel brake is secured to the lower rear face of the firewall in each nacelle and consists of a length of heavy flexible belting faced with small steel plates.

As the landing gear is retracted into the nacelle, the flexible brake contacts the tire tread and stops the rotation of the wheel.

1. A flight wheel brake is installed in each _____ to _____ the rotation of the wheel after gear retraction.

nacelle,
stop

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TAIL WHEEL GEAR

A fully swiveling, non-retracting tail wheel is installed on the airplane. Major components of the tail wheel gear consist of the wheel and axle assembly, tire, oleopneumatic strut, fork, spindle, and tail wheel locking device.

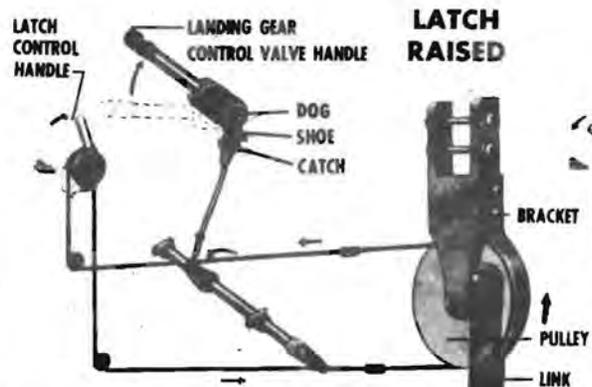
TAIL WHEEL SHOCK ABSORBER STRUT

The tail wheel shock absorber strut is attached at the upper end to the spindle and at the lower end to the tail wheel fork. Impact loads on the tail wheel strut are absorbed by forcing the hydraulic fluid present in the strut assembly through a restricted opening in the strut piston. Taxiing loads are absorbed by the compression of the air present in the upper chamber of the strut.

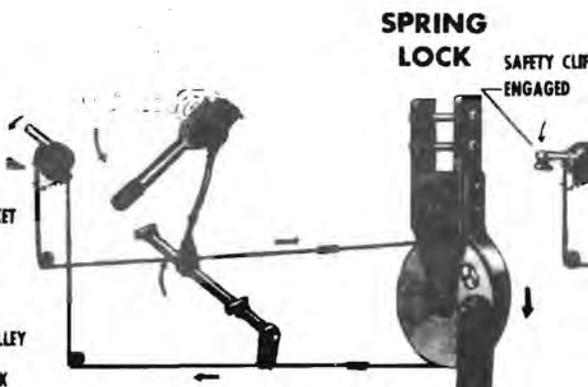
TAIL WHEEL LOCKING MECHANISM

The spring-operated lock at the tail wheel consists of a key and slot mechanism with the slot located on the spindle and the key hinged to the fuselage structure. The key is released from the slot by the control cable connected to the control handle located on the control pedestal, allowing the tail wheel to turn freely for towing or taxiing the airplane.

| | |
|--|--------------------------------|
| 1. The tail wheel gear is _____. | |
| 2. The tail wheel gear has a _____ strut to help absorb _____ loads and _____ loads. | full swiveling non-retractable |
| 3. A _____ lock is incorporated on the tail wheel spindle. | shock absorber, impact, taxi |
| 4. A control handle on the _____ is used to _____ and _____ the lock. | spring operated |
| | pedestal, lock, unlock |



When latch control handle is pulled back to "LATCH RAISED" position, valve catch is pulled down by the connecting rod. The dog springs into position to hold catch down. The latches are raised clear of the actuating cylinder hooks. Control valve handle can be moved to the "UP" position as the shoe assembly displaces the dog and slides on catch. Landing gear is retracted.

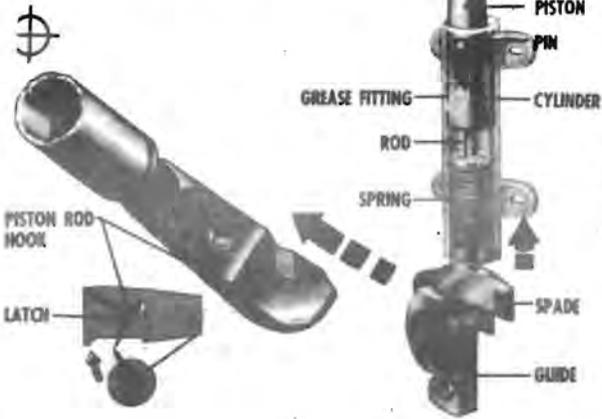


When the control valve handle is moved to "NEUTRAL" position after retraction, the latches automatically assume the "SPRING LOCK" position. The latches are spring loaded in the guides to automatically latch the landing gear when fully extended. Control valve handle always can be moved to the "DOWN" position.



After the landing gear is extended and latched, the latch handle is moved to "POSITIVE LOCK" position. The latches are held securely in the guides. Move the control valve handle to "DOWN" if airplane is to stand on ground.

CAUTION
Place latch handle in "POSITIVE LOCK" only after landing gear is fully extended and latched.



Operation of Mechanical Safety Latch

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BRAKE HYDRAULIC SYSTEM

GENERAL DESCRIPTION

The main landing gear wheel brakes can be applied independently by means of two brake control valves contained in a single housing and linked to the rudder-brake pedals.

Application of toe pressure on the rudder-brake pedals allows hydraulic fluid under pressure to flow through the brake control valves and the brake operating pipes, to the brake actuating cylinders.

The brake actuating pistons are forced outward to pressure the brake shoes against the brake drums.

When the rudder-brake pedal is released, springs return the brake shoes to the OFF position, forcing the brake actuating pistons inward, and the excess hydraulic fluid flows through the brake-operating pipes to the brake control valve, and into the return pipe to the hydraulic reservoir.

A parking brake mechanism is provided to secure the rudder-brake pedals in the ON position.

1. The wheel brakes can be applied _____ by means of two _____.

2. _____ on the rudder-brake pedals provides the initial pressure flow to the _____ cylinders.

3. When brake pedals are released, _____ return the brake shoes to the _____ position.

4. A parking brake mechanism is provided to secure the rudder-brake pedals in the _____.

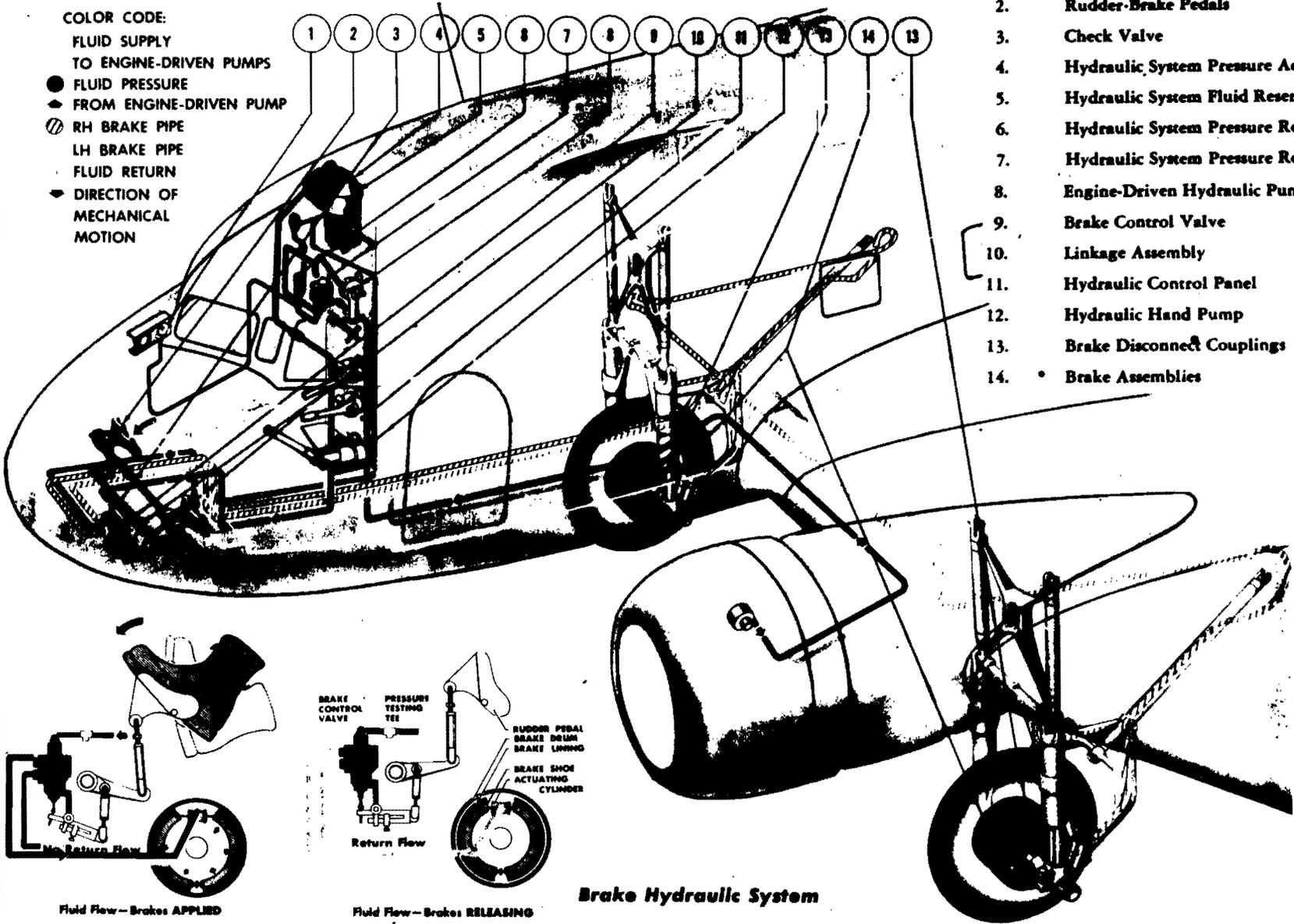
independently,
brake control valves

toe pressure,
brake actuating

springs,
OFF

on position

COLOR CODE:
 FLUID SUPPLY TO ENGINE-DRIVEN PUMPS
 ● FLUID PRESSURE
 ● FROM ENGINE-DRIVEN PUMP
 ⊘ RH BRAKE PIPE
 ⊘ LH BRAKE PIPE
 ⊘ FLUID RETURN
 ▾ DIRECTION OF MECHANICAL MOTION



1. Hydraulic System Pressure Gage
2. Rudder-Brake Pedals
3. Check Valve
4. Hydraulic System Pressure Accumulator
5. Hydraulic System Fluid Reservoir
6. Hydraulic System Pressure Relief Valve
7. Hydraulic System Pressure Regulator
8. Engine-Driven Hydraulic Pump Selector
9. Brake Control Valve
10. Linkage Assembly
11. Hydraulic Control Panel
12. Hydraulic Hand Pump
13. Brake Disconnect Couplings
14. Brake Assemblies

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Brake Hydraulic System

Fluid Flow - Brakes APPLIED
 Fluid flows to brake cylinders only until fluid pressure in piping equals pedal pressure

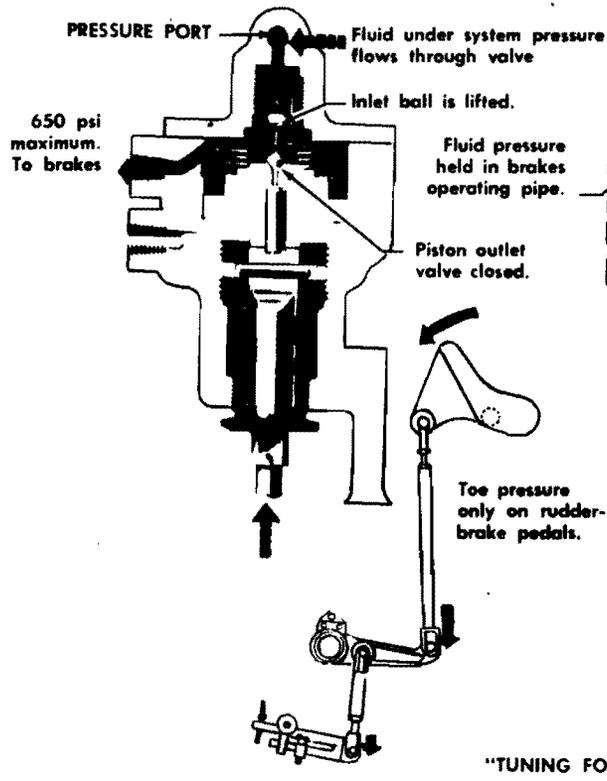
Fluid Flow - Brakes RELASING
 Fluid flows from brake cylinders only until fluid pressure is relieved

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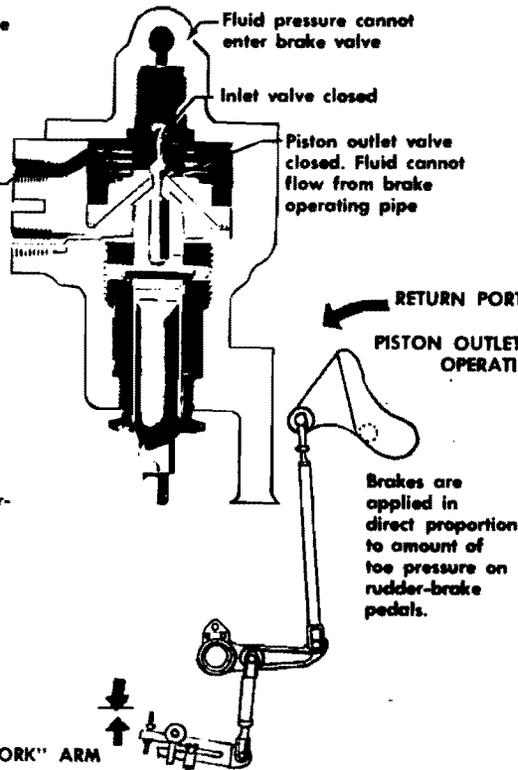
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1. BRAKES APPLIED



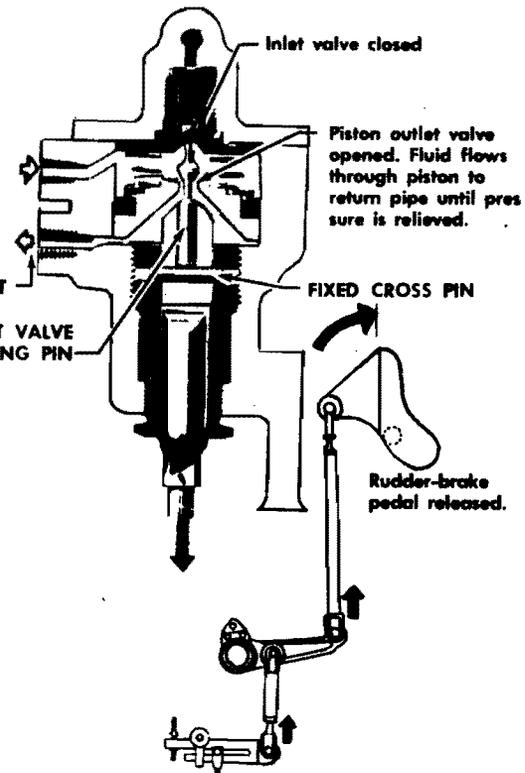
TOE PRESSURE APPLIED TO RUDDER-BRAKE PEDAL FORCES BRAKE VALVE PISTON UP, UNSEATING BALL AND OPENING INLET VALVE AND CLOSING PISTON OUTLET VALVE. HYDRAULIC FLUID FLOWS FROM PRESSURE PIPE THROUGH BRAKE VALVE TO BRAKE OPERATING PIPE. BRAKE ACTUATING CYLINDERS BEGIN TO APPLY BRAKES. DEFLECTION OF THE "TUNING FORK" ARM LIMITS PRESSURE IN THE BRAKE OPERATING PIPE TO A MAXIMUM OF 650 PSI.

2. BRAKES HELD



TOE PRESSURE IS STILL APPLIED. FLUID PRESSURE FORCES PISTON DOWN, CLOSING INLET VALVE; PISTON THRUST IS TAKEN UP THROUGH DEFLECTION OF "TUNING FORK." THIS DEFLECTION INCREASES UNTIL FORCE EXERTED BY FLUID PRESSURE ON PISTON EQUALS FORCE EXERTED ON PISTON BY PEDAL PRESSURE. FLUID PRESSURE IS FELT AT PEDAL. BRAKES ARE APPLIED TO A DEGREE DEPENDING ON AMOUNT OF PEDAL PRESSURE.

3. BRAKES RELEASED



TOE PRESSURE ON RUDDER-BRAKE PEDAL IS RELEASED. PISTON IS FORCED DOWN TO NONOPERATING POSITION BY BRAKE ACTUATING CYLINDERS RETURN SPRINGS AND FLUID PRESSURE; PISTON VALVE OPERATING PIN IN PISTON IS STOPPED BY FIXED CROSS PIN AND PISTON OUTLET VALVE IS OPENED. EXCESS FLUID IN BRAKE OPERATING PIPE FLOWS THROUGH TWO HOLES IN PISTON INTO THE RETURN PIPE TO RESERVOIR. BRAKE VALVE ALSO ACTS AS AUTOMATIC UNLOADING VALVE TO MAINTAIN CONSTANT PRESSURE IN BRAKE OPERATING PIPE, REGARDLESS OF THERMAL EXPANSION OR CONTRACTION OF THE FLUID.

Operation of Brake Control Valve

COLOR CODE: ■ FLUID PRESSURE ■ FLUID PRESSURE FLOW

FLUID RETURN

FLUID RETURN FLOW

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FIRE CONTROL

The C-47 airplanes are equipped to extinguish engine fires instantaneously while in flight or on the ground.

A fire in either the left or right engine area can be extinguished from the pilot's compartment by means of a bromochloromethane (CB) fire extinguisher cylinder assembly, located on the outboard side of each nacelle at station 187, which is connected by pipes to the spray ring located on each engine.

To operate the CB fire extinguisher system set the selector switch for the engine affected in the UP position and the discharge switch in the ON position.

The engine fire extinguishing agent is discharged by an electrically detonated explosive cartridge which forces a firing pin into the neck of the cylinder. The firing pin when actuated, ruptures the CB cylinder sealing plug and allows the extinguishing agent to be released under pressure to the spray ring located around the rear power section of the engine and the intake throat of the carburetor.

| | |
|---|------------------------|
| 1. The fire extinguishing agent used on Co. A/C is _____. | |
| 2. The CB cylinders are located on the _____ of each _____. | bromochloromethane |
| 3. To operate the system, place the selector switch to the _____ position and the discharge switch to the _____ position. | outboard side, nacelle |
| 4. CB is discharged by an _____ detonated explosive cartridge and firing pin. | up, on |
| 5. CB when released flows under pressure to the _____ around the rear power section and the intake throat of the _____. | electrically |
| | spray ring, carburetor |

Two fire detection warning lights are installed on the pilot's instrument panel to indicate a fire in the right or left engine. A test-button switch, located adjacent to the warning lights, tests the two engine detector circuit consists of 15 thermocouple units connected in series by asbestos-insulated fire-zone wire which are installed forward of the firewall in the accessory section of each nacelle. When a fire occurs or there is an abnormal rise in temperature, the thermocouple generates an electrical signal which actuates the fire detector relay box (located on the radio equipment rack), which in turn illuminates the corresponding warning light.

The circuit receives 24-volt dc power through a 5-ampere circuit breaker located in the main junction box.

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1. _____ fire detection warning lights on the _____ instrument panel, indicate a fire in the _____ or _____ engines.

2. _____ thermocouple units connected in _____ are located forward of the firewall in _____ nacelle.

two, pilot's,
left, right

3. A _____ or abnormal rise in _____ actuates a fire detector relay.

15, series,
each

4. The circuit is _____ and is protected by a _____ circuit breaker.

fire,
temperature

24-volt dc,
5-ampere

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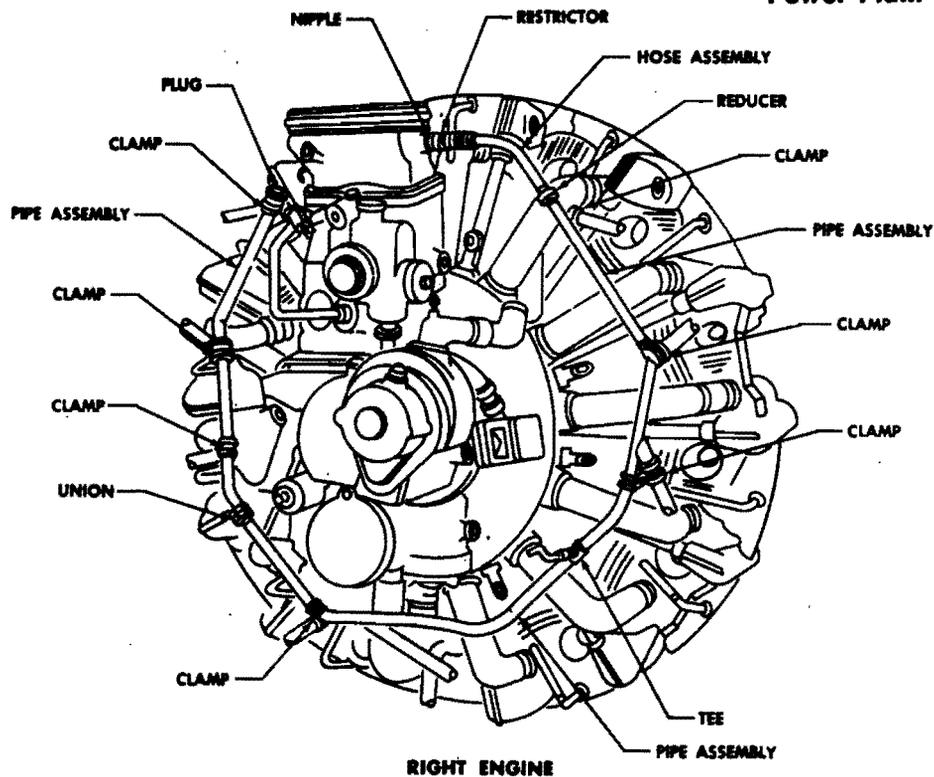
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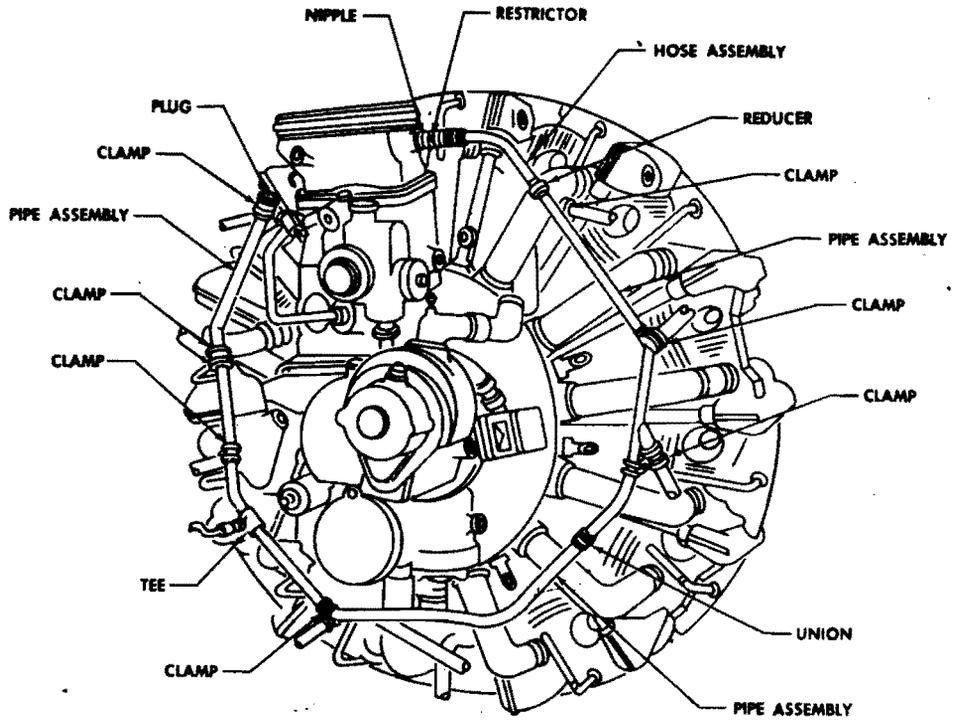
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Power Plant CB Fire Extinguisher Spray Ring



RIGHT ENGINE



LEFT ENGINE

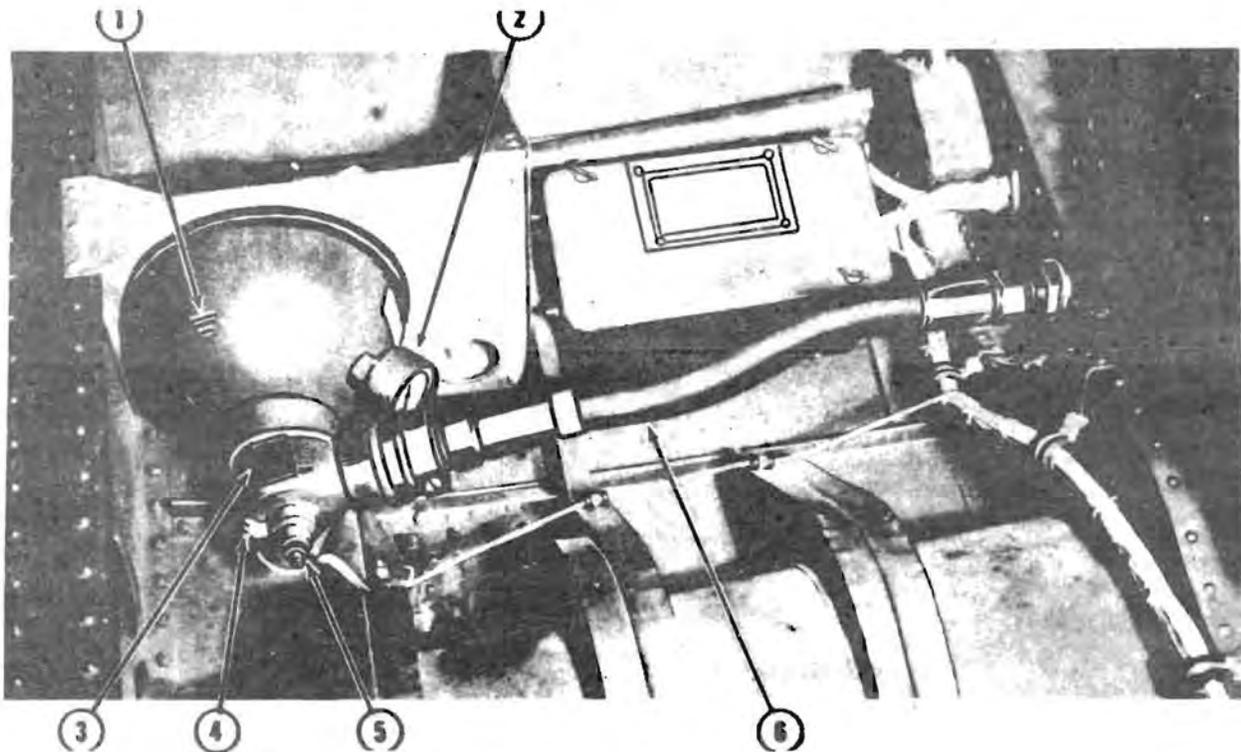
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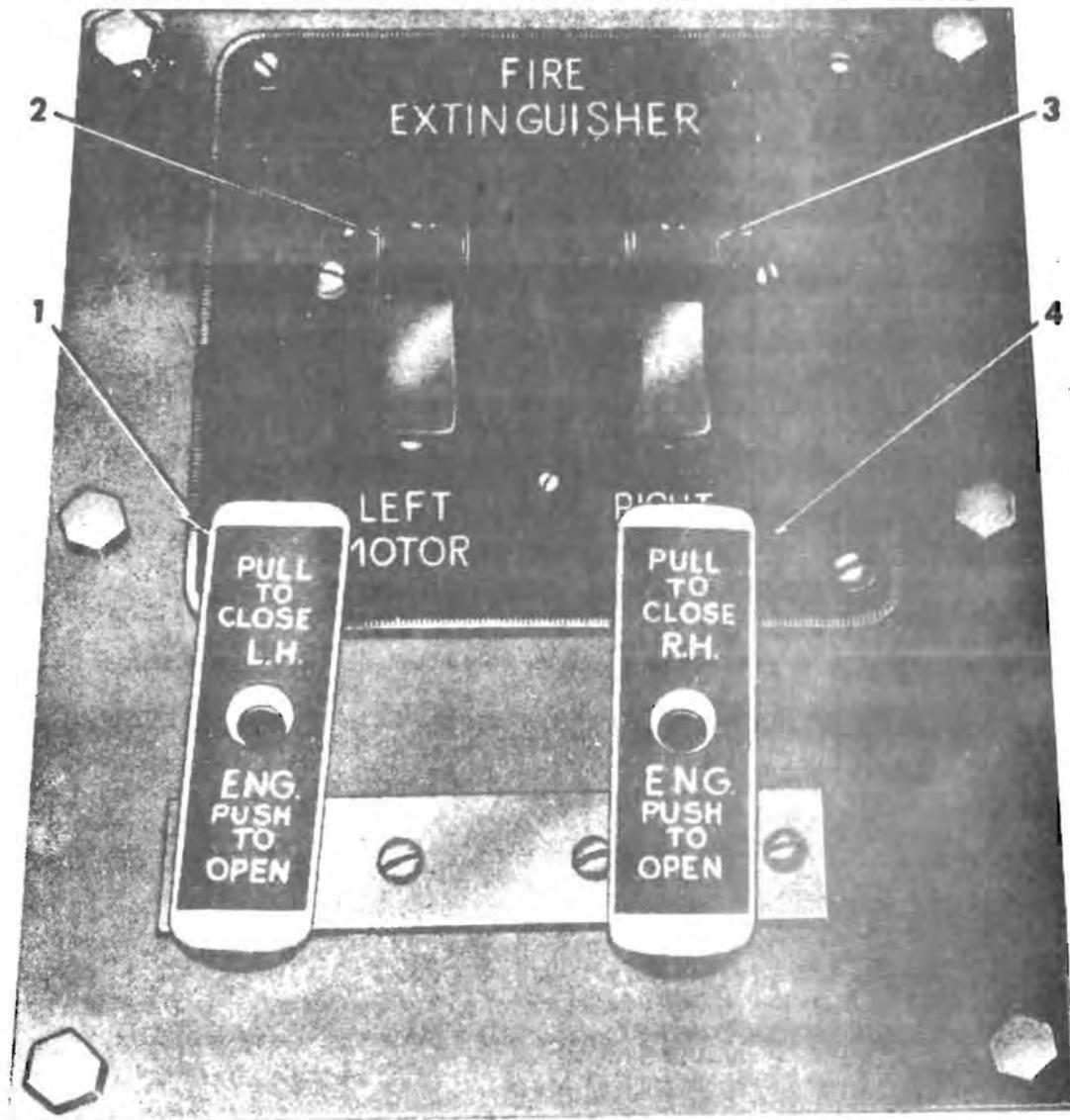


- | | | | |
|----|--------------------------------|----|-----------------------------------|
| 1. | CB Fire Extinguisher Container | 4. | Bonnet Ground Terminal |
| 2. | Pressure Gage | 5. | Bonnet Electrical Terminal |
| 3. | Bonnet | 6. | Hose From Container to Spray Ring |

CB Fire Extinguisher Unit — Nacelle Piping and Wiring

ENGINE FIRE EXTINGUISHER CONTROLS

LOCATED: COCKPIT FLOOR BETWEEN PILOTS' SEATS



1. LEFT ENGINE FIREWALL SHUTOFF VALVE HANDLE
2. LEFT ENGINE FIRE EXTINGUISHER DISCHARGE SWITCH
3. RIGHT ENGINE FIRE EXTINGUISHER DISCHARGE SWITCH
4. RIGHT ENGINE FIREWALL SHUTOFF VALVE HANDLE

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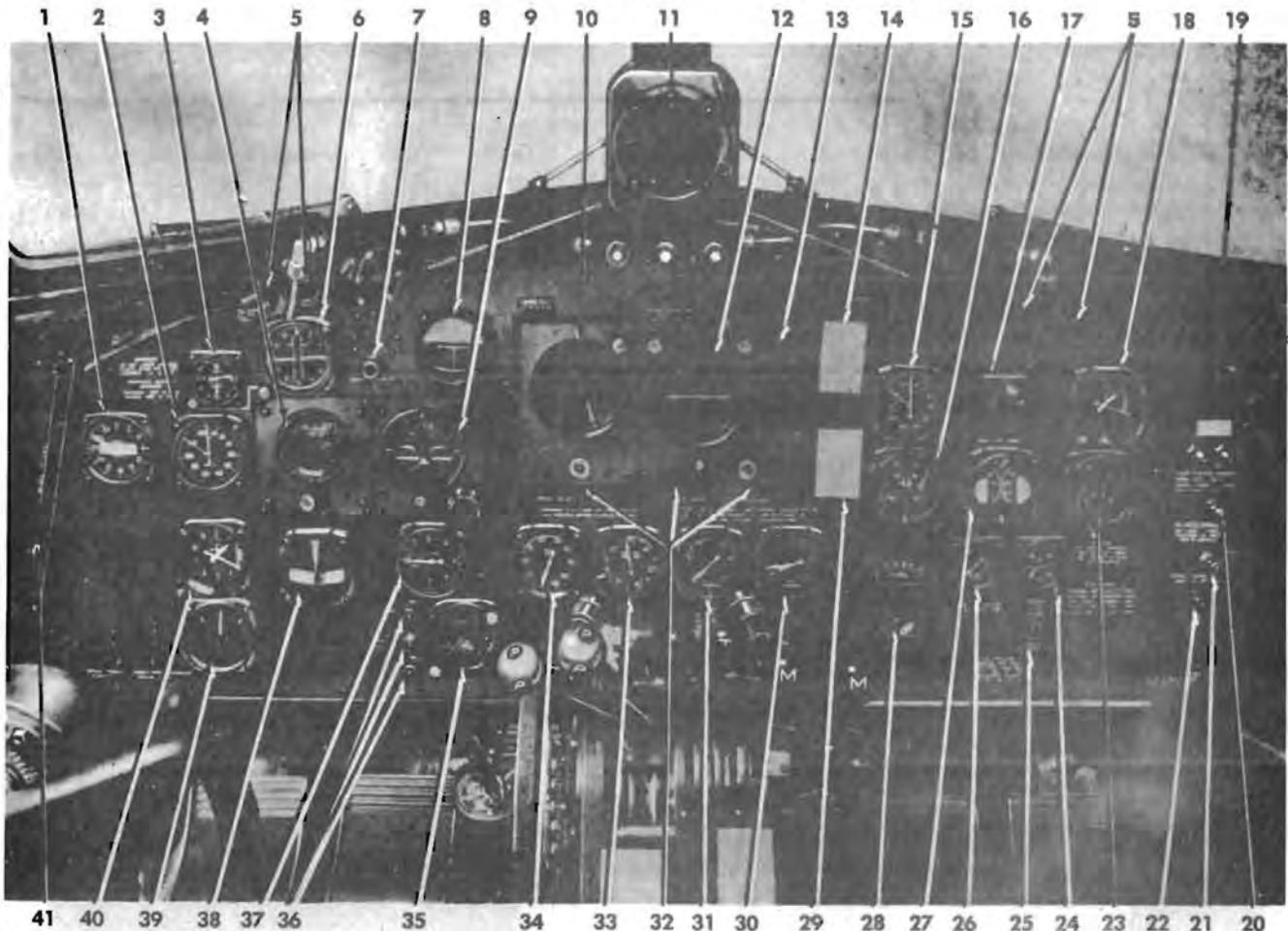
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MAIN INSTRUMENT PANEL—TYPICAL



1. RADIO MAGNETIC INDICATOR (RMI)
2. AIRSPEED INDICATOR (PILOT'S)
3. CLOCK
4. DIRECTIONAL INDICATOR
5. FLUORESCENT LIGHT SWITCHES
6. REMOTE COMPASS INDICATOR
7. MARKER BEACON INDICATOR LIGHT
8. GLIDE SLOPE AND COURSE INDICATOR
9. ALTITUDE INDICATOR
10. AUTOPILOT DIRECTIONAL INDICATOR
11. MAGNETIC (STANDBY) COMPASS
12. AUTOPILOT ATTITUDE INDICATOR
13. AUTOPILOT VACUUM GAGE
14. COMPASS CORRECTION CARD
15. AIRSPEED INDICATOR (CO-PILOT'S)
16. OIL TEMPERATURE INDICATOR (DUAL)
17. FREE AIR TEMPERATURE INDICATOR

18. ALTIMETER (CO-PILOT'S)
19. CRITICAL TEMPERATURE WARNING LIGHTS
20. LANDING GEAR INDICATOR LIGHT (RED)
21. LANDING GEAR INDICATOR LIGHT (GREEN)
22. DOOR-OPEN WARNING LIGHT
23. CARBURETOR AIR TEMPERATURE INDICATOR (DUAL)
24. AUTOPILOT OIL PRESSURE GAGE
25. STATIC PRESSURE SELECTOR VALVE SWITCH
26. DE-ICING SYSTEM PRESSURE GAGE
27. CYLINDER HEAD TEMPERATURE INDICATOR (DUAL)

28. FUEL QUANTITY INDICATOR
29. REMOTE COMPASS CORRECTION CARD
30. FUEL PRESSURE GAGE (DUAL)
31. OIL PRESSURE GAGE (DUAL)
32. AUTOPILOT SPEED CONTROL VALVE KNOBS
33. MANIFOLD PRESSURE GAGE (DUAL)
34. TACHOMETER (DUAL)
35. RADIO ALTIMETER
36. ALTITUDE LIMIT INDICATOR LIGHTS
37. VERTICAL VELOCITY INDICATOR
38. TURN-AND-SLIP INDICATOR
39. ALTITUDE LIMIT INDICATOR
40. ALTIMETER (PILOT'S)
41. WING FLAP POSITION INDICATOR

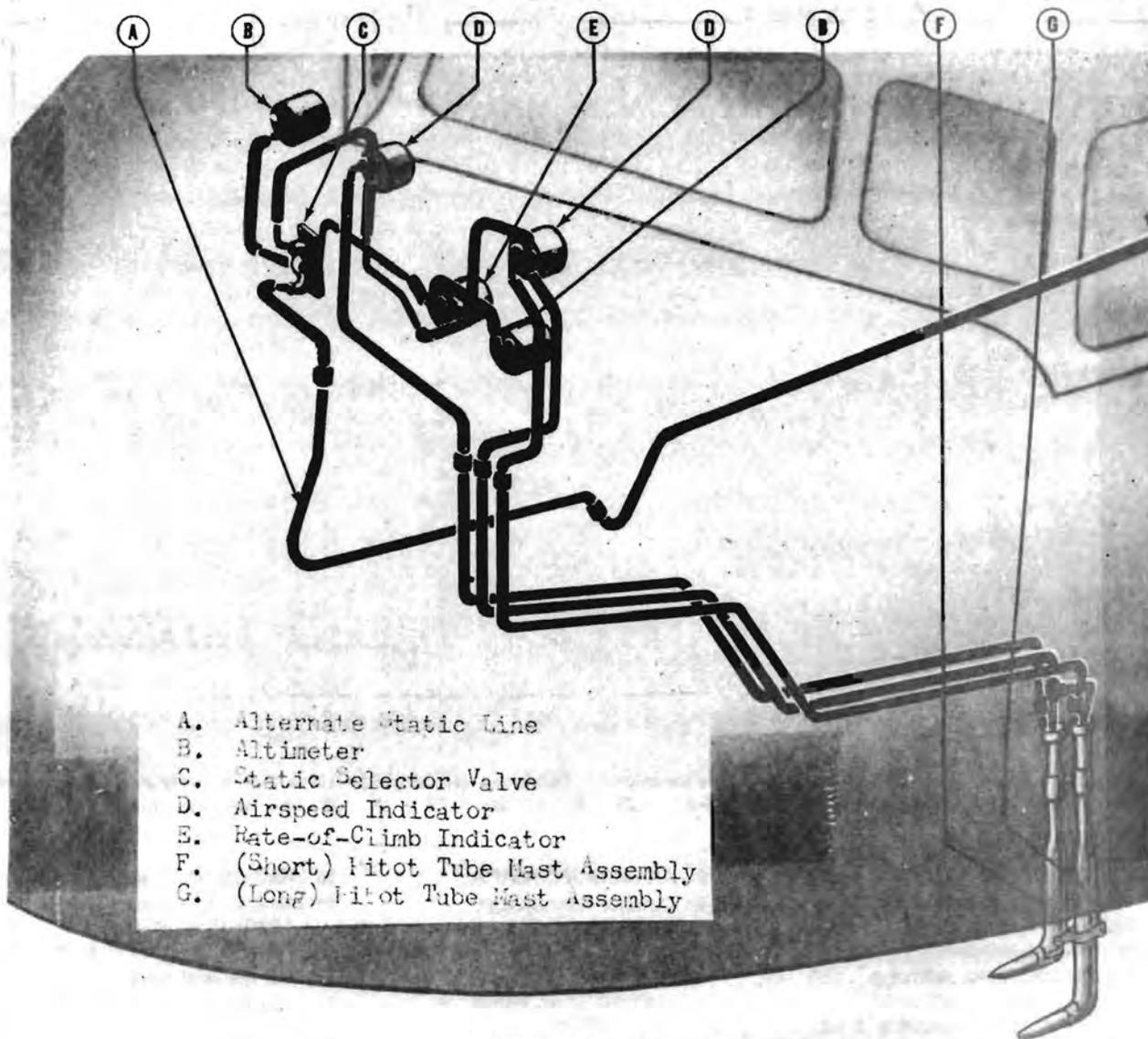
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- A. Alternate Static Line
- B. Altimeter
- C. Static Selector Valve
- D. Airspeed Indicator
- E. Rate-of-Climb Indicator
- F. (Short) Pitot Tube Mast Assembly
- G. (Long) Pitot Tube Mast Assembly

Pitot-Static Instrument System

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FLIGHT CONTROLS

GENERAL

The airplane is controlled manually by the pilot and/or copilot in flight by means of conventionally operated ailerons, elevators, and rudder aided by trim tabs for manual trimming.

The rudder is controlled by means of pedals hinged beneath the floor and provided with the toe pads which have a fore and aft adjustment of 4 inches. The toe pedals also function as brake pedals. The elevators are controlled by means of the forward and aft movement of the control column, whereas the ailerons are controlled by means of the control wheel mounted on the control column. All controls are duplicated on the co-pilot's side of the cockpit, except that the parking brake cannot be operated from the right side.

All the control surfaces are constructed from metal frames covered with doped fabric. Fabric covering is used to minimize the possibility of control surface flutter. All control surfaces are aerodynamically balanced to reduce the control loads. The elevators are further balanced by the addition of an 8 pound bobweight. Ailerons are "Drooped" $1-1/2^{\circ}$ to improve low speed control.

| | |
|---|--------------------------------|
| 1. The controls are conventional and manually operated, with _____ controllable from the cockpit. | |
| 2. All control surfaces are of _____ frame and _____ covered except the _____. | trim tabs |
| 3. Fabric covering is used to minimize _____. | metal; doped fabric wing flaps |
| 4. All control surfaces are _____ balanced to reduce the _____. | control surface flutter |
| 5. The elevators are _____ balanced by the addition of an 8-lbs. _____. | aerodynamically control loads |
| 6. The ailerons are _____ $1\frac{1}{2}$ degrees to improve _____ control. | statically bobweight |
| | drooped low speed |

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The maximum deflection of the control surfaces is:

RUDDER 30 degrees each way from neutral
 ELEVATORS 30 degrees UP and 20 degrees DOWN
 AILERONS 27 degrees UP and 18 degrees DOWN

TRIM TABS

Trim tabs are provided on both elevators, the rudder, and the right hand aileron. These trim tabs are controllable from the cockpit and are for the purpose of trimming the airplane so that it will fly "hands-off" under various conditions of speed, power, and load. The maximum movement provided on the rudder and elevator is 12 degrees either way from neutral; the aileron 13 degrees either way from neutral.

1. Max control surface deflection is rudder _____ R or L, elevators _____ up and _____ down, ailerons _____ up and _____ down.

2. Trim tabs are provided on _____, _____, and _____.

30°; 30°; 20°;
 27°; 18°;

3. All trim tabs are controlled from the _____.

both elevators
 rudder
 right aileron

4. Max trim tab movement on rudder and elevator is _____ either way from neutral, on ailerons _____ either way from neutral.

cockpit

12°
 13°

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OPERATION

Primary Controls

In flight, operate primary controls with a steady even movement. Any rapid movement of the flight controls results in a whipping action of the airplane and places unnecessary strain on the airplane structure.

Trim Tabs

Operate tab controls in conventional manner.

Gust Lock

The Company C-47s do not have control locks operable from the cockpit. The locking system used in Company aircraft consist of ailerons, rudder, and elevator stops that are applied on the ground from the outside of the plane.

LIMITATIONS

During ground operation in gusty wind conditions, any tendency for the control wheel to move should be resisted by holding the wheel in neutral. Restraint should not be applied by holding the wheel against the stops.

1. The control surfaces gust locks are applied from the _____ and are _____ from the cockpit.

2. All flight controls should be checked _____ to ensure that the locks have been removed.

ground
not operable

3. During ground operations in gusty wind conditions, the control wheel should be held _____ and not _____ in either direction.

prior to leaving the
ramp

in neutral
against the stops

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LANDING GEAR AND BRAKES

GENERAL DESCRIPTION

The landing gear consists of three units: two retractable main gears with single wheels and dual brakes; and a tail wheel gear which is not retractable, but is full swiveling.

Extension and retraction of the main gear is accomplished by hydraulic actuating struts which are controlled by the landing gear control lever on the hydraulic control panel.

1. The three units of the landing gear are _____ and _____.

two retractable main gears, non retracting tail gear

MAIN GEAR

The main single-wheel landing gear retracts forward and up into the nacelle of each wing.

Each main gear consists of two oleopneumatic shock struts, trusses, links, yoke, rear brace strut, hydraulic actuating cylinder, bungee or compensator, safety latch, warning light switches, wheel, and brakes.

When the gear is fully retracted, the projecting ends of the axles are held against rubber bumpers installed in the sides of the nacelles leaving a small portion of the tire projecting below the lower contour of the nacelle.

1. The main gear retracts _____.

2. When the gear is fully retracted, a small portion of the _____ protudes below the _____.

forward

tire, nacelle

MAIN GEAR SHOCK STRUT

Each main gear wheel is mounted between two pneumatic-hydraulic shock absorber struts which absorb the landing and taxiing loads imposed on the airplane.

Landing loads are absorbed mainly by forcing the hydraulic fluid in the strut through an orifice located in the lower cylinder of the strut.

Taxiing loads are absorbed principally by the compression of the air in the upper chamber of the strut.

Piping between the two struts aids in balancing the air pressure.

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1. Each main gear is mounted between two _____

2. Landing loads are absorbed mainly by _____.

pneumatic-hydraulic
shock absorber struts

3. Taxiing loads are absorbed by _____ of air.

hydraulic fluid

compression

LANDING GEAR ACTUATING CYLINDER

The landing gear actuating cylinder, attached to the nacelles structure aft of the firewall, extends through an indentation in the oil tank, and is bolted to the upper truss of the landing gear.

When hydraulic fluid under pressure is directed to the upper end of the actuating cylinder, the piston rod extends and lowers the landing gear.

When hydraulic fluid under pressure is directed to the lower end of the actuating cylinder, the piston rod retracts, pulling the landing gear up into the nacelle.

The actuating cylinder mechanism includes a dashpot which serves as a shock absorber so that the actuating cylinder piston comes to rest slowly at the end of the retracting stroke without damage to the attaching structure.

The dashpot traps some of the hydraulic fluid at the end of the retracting stroke and the fluid is forced through a hole in the dashpot, absorbing the energy and converting it into heat in the same manner as a shock absorbing unit.

1. The landing gear actuator is bolted to the _____
_____ of the gear.

bolted

2. Hydraulic pressure directed to the _____ end of the
actuator _____ the gear.

upper,
extends

3. Hydraulic pressure directed to the _____ end of the
actuator _____ the gear.

lower,
retracts

4. The actuator mechanism includes a _____ which acts
as a _____.

dashpot,
shock absorber

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| | |
|--|--|
| 1. If hydraulic system pressure falls below normal but the hydraulic fluid lever remains constant, _____ hydraulic leak is indicated. | |
| 2. In this case, turn off the auto pilot and operate all hydraulic units with the _____. | internal |
| 3. If the hydraulic fluid quantity at the sight gage indicates an increasing loss of fluid an _____ leak is indicated. | emergency hand aux pump |
| 4. In this case, isolate all units by _____ the valves and turning off the auto pilot by the _____ valve. | external |
| 5. A leaking unit may then be determined by turning on each unit, _____, and observing the _____. | closing; emergency autopilot shutoff |
| 6. Emergency landing gear extension is accomplished by start valve _____, gear lever _____, hand pump until gear is down and _____ and _____ checked from the cockpit. | one at a time hydraulic fluid level |
| 7. The gear selector lever is then _____, and the latch lever put in the _____ position. | CLOSED; DOWN; spring locked visually |
| 8. Then check the _____ lights ON and the _____ light OFF. | returned to neutral positive lock |
| 9. Check landing warning horn for gear down and locked by _____. | green red |
| 10. For emergency wing flap operation, star valve _____, flap lever in desired position, hand pump until flaps in _____ position, then flap lever to _____. | retarding a throttle |
| | CLOSED desired NEUTRAL |

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| | |
|---|---|
| <p>11. In case of complete loss of hydraulic fluid or a landing gear hydraulic failure, the gear can be extended by _____ to the down and latched position.</p> | |
| <p>12. It must be remembered that the landing gear is held in its UP position by _____ in the up line, as long as the gear lever remains in _____.</p> | <p>free fall</p> |
| <p>13. When the gear lever is put in the down position, this trapped fluid in the up line is _____ to the hydraulic _____, allowing the gear to _____.</p> | <p>trapped hydraulic fluid;</p> |
| <p>14. In case the gear is extended by the aux hand pump, the gear down line pressure gage shows _____ pressure as soon as pressure on the _____ is released, or the lever is returned to _____.</p> | <p>bypassed return line free fall</p> |
| <p>15. In this case a safe landing can be made providing the _____ comes on when the gear handle is returned to neutral and the latch is in _____.</p> | <p>zero hand pump</p> |
| <p>16. The A/C may be safely landed in case of safety latch failure, if the landing gear is _____ and the system pressure is _____ psi, and the landing gear lever is left in the _____ position.</p> | <p>green light POSITIVE LOCK</p> |
| <p>17. In this case, pressure in the gear actuator down line is indicated on the _____ gage.</p> | <p>fully down; 850-900; down</p> |
| <p>18. The horn in this case _____ and the red light will _____, since the switches are connected to the safety latch and landing gear lever.</p> | <p>landing gear down line</p> |
| <p>19. Upon landing under these conditions, brakes should _____ or used _____.</p> | <p>will continue to sound; stay on</p> |
| <p>20. In landing without fluid pressure, because of failure in the lines between the hand pump and the gear actuator, the _____ will hold the gear for a safe landing.</p> | <p>not be used; lightly as possible</p> |
| | <p>gear down latches</p> |

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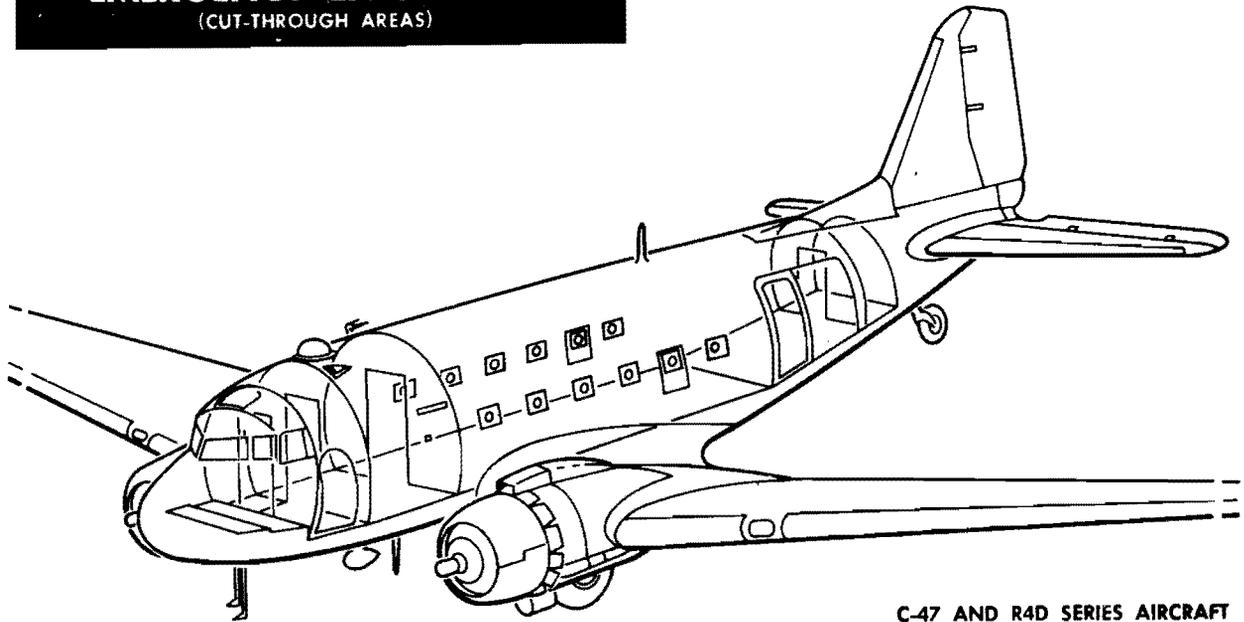
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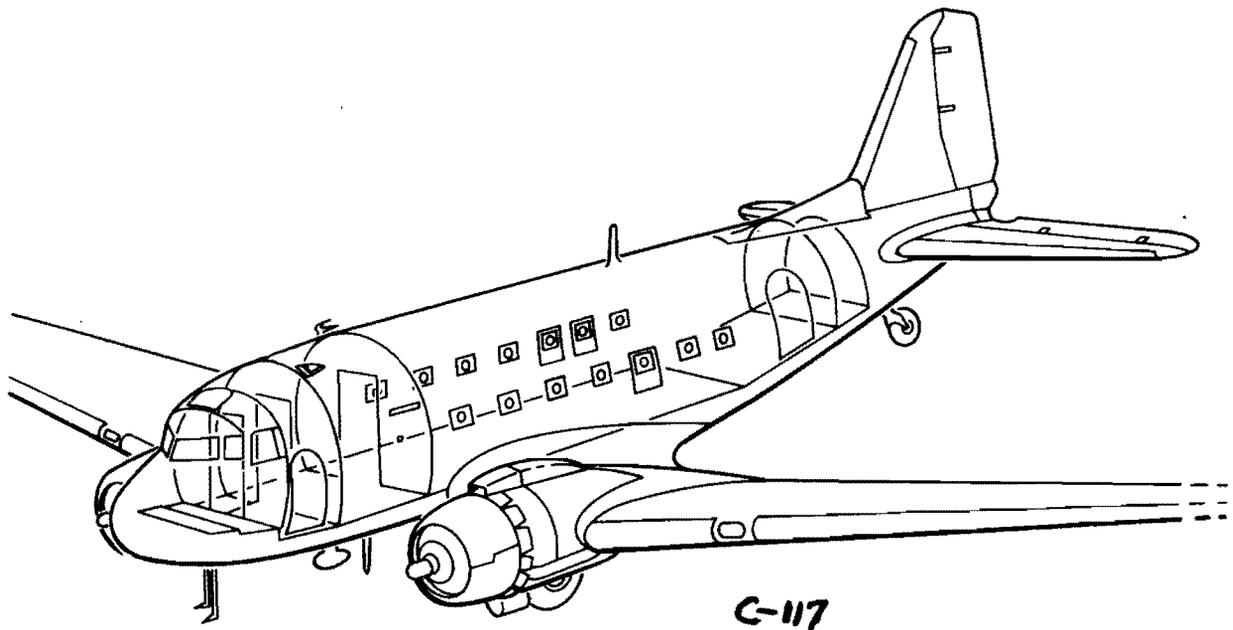
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EMERGENCY ENTRANCES (CUT-THROUGH AREAS)



C-47 AND R4D SERIES AIRCRAFT



C-117

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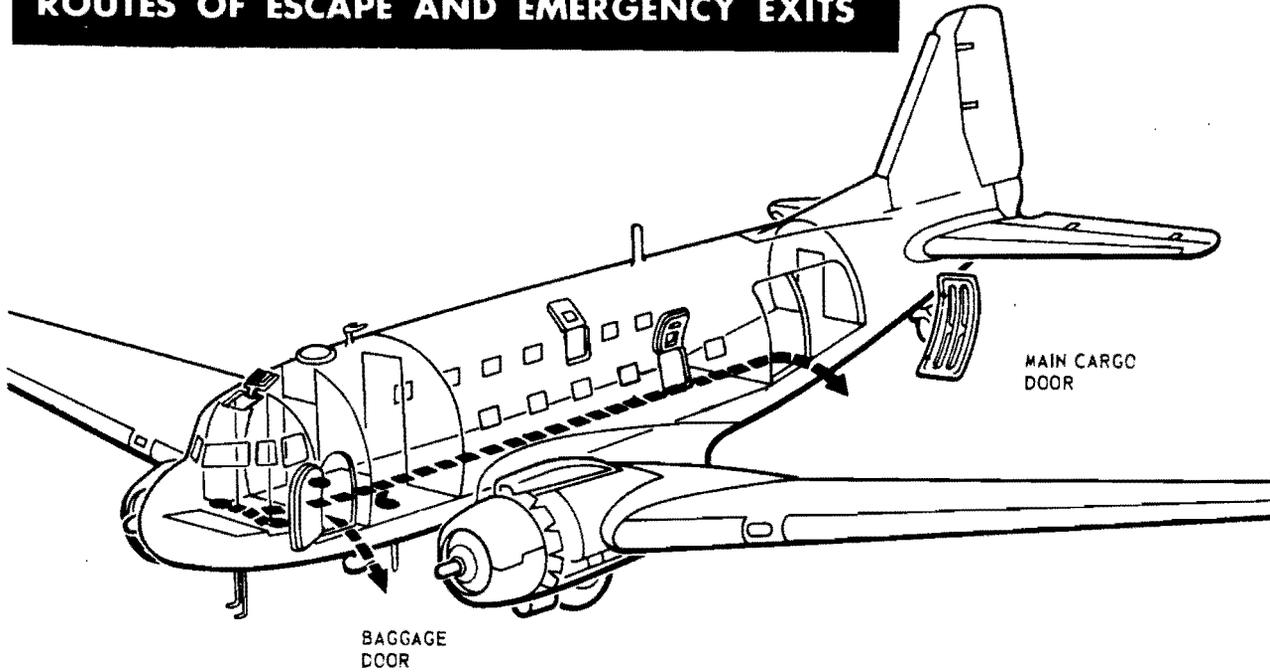
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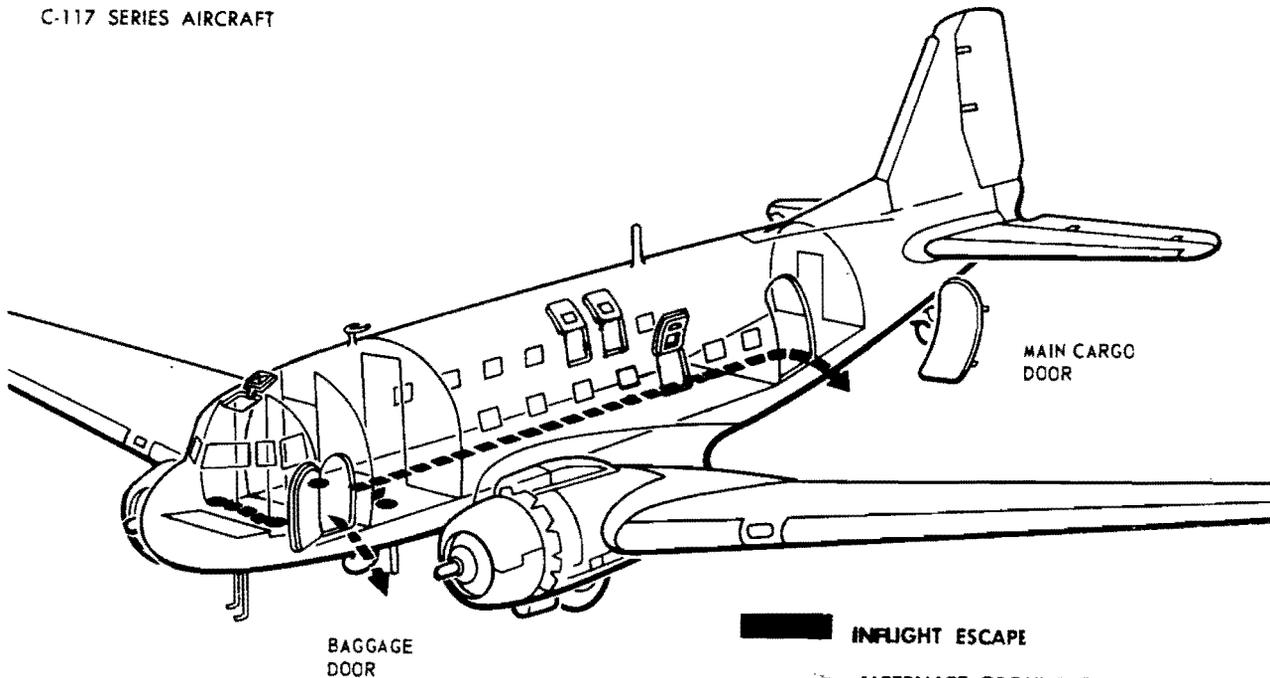
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ROUTES OF ESCAPE AND EMERGENCY EXITS



C-47 AND R4D SERIES AIRCRAFT

C-117 SERIES AIRCRAFT



-  INFLIGHT ESCAPE
-  ALTERNATE GROUND ESCAPE
-  FOR GROUND ESCAPE
ENGINE NOT OPERATING

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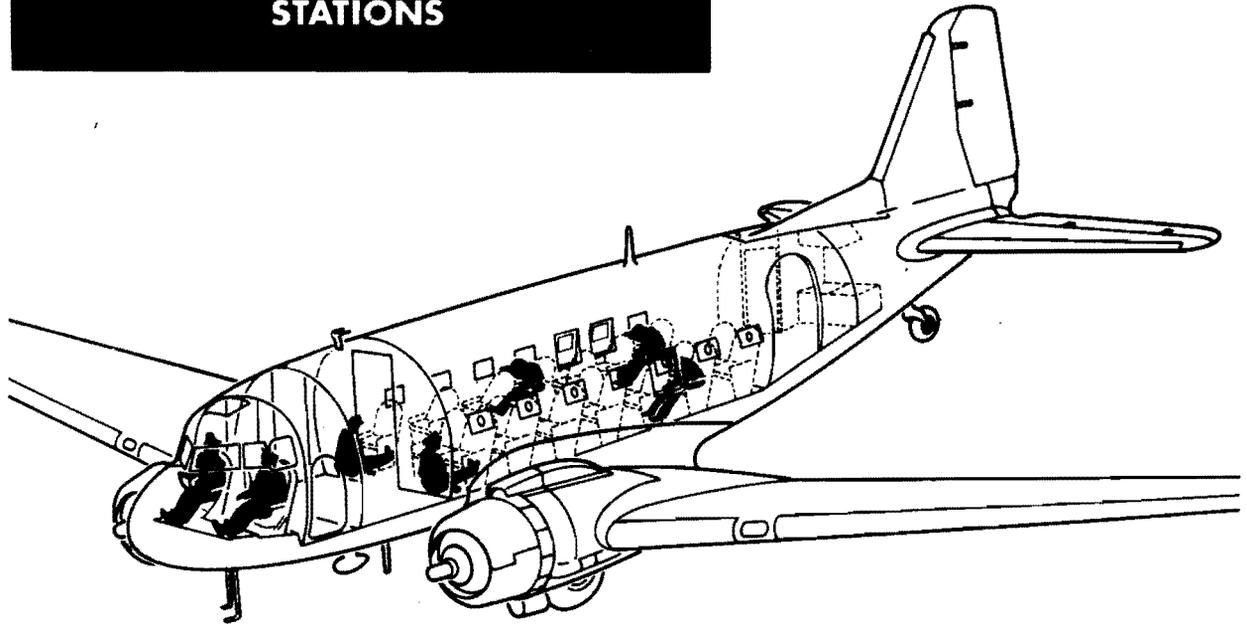
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DITCHING AND CRASH LANDING STATIONS



CREW POSITIONS PRIOR TO DITCHING



BOARDING THE LIFE RAFTS