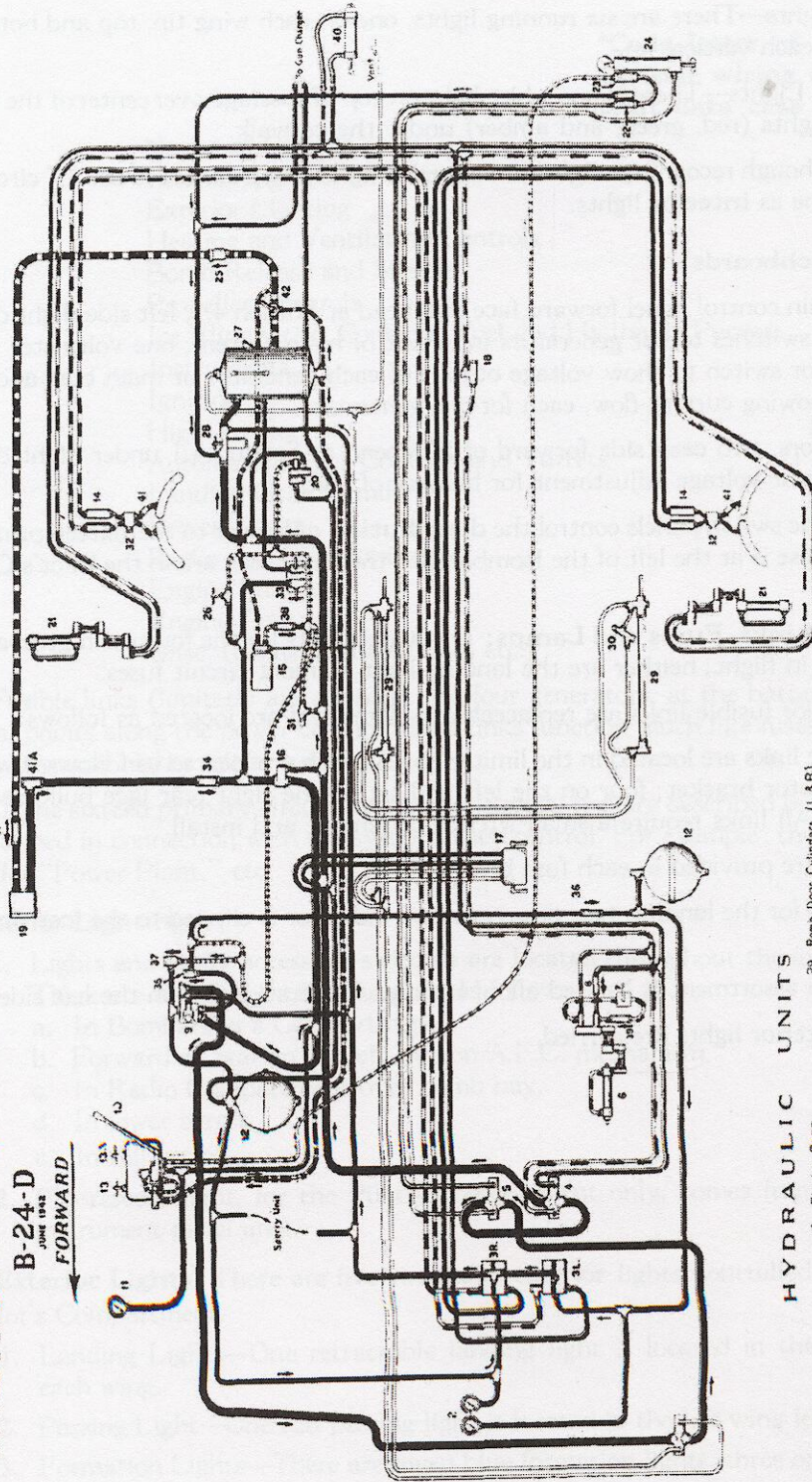


HYDRAULIC SYSTEM

B-24-D
JUNE 1942
FORWARD



HYDRAULIC UNITS

- | | | |
|--------------------------------|-------------------------------------|-----------------------------------|
| 1 Bomb Door Control Valve | 15 Electric Pump | 29 Bomb Door Cylinders (L & R) |
| 2 Brake Control Valves (L & R) | 16 Bomb Door Valve | 30 Relief Valve |
| 3 Landing Gear Control Valve | 17 Main Landing Gear Restrictor | 31 Brake Bleeder Valve |
| 4 Tail Wheel Control Valve | 18 Engine Driver Pump | 32 Test Stand |
| 5 Nose Wheel Control Valve | 19 Pressure Switch | 33 Engine Pump Check Valve |
| 6 Nose Wheel Restrictor | 20 Pressure Switch Cylinder (L & R) | 34 L Accumulator Check Valve |
| 7 Shutting Valve | 21 Relief Valve | 35 R Accumulator Check Valve |
| 8 Hydraulic Pressure G | 22 Shutting Valve | 36 Auxiliary Pump Check Valve |
| 9 Accumulators (L & R) | 23 Floor Cylinder | 37 Tail Wheel Overriding Cylinder |
| 10 Emergency Pump Valve | 24 Suction Valve | 38 Automatic Seal Coupling |
| 11 Brake Exhausters (L & R) | 25 Automatic Seal Coupling | 39 41A Automatic Seal Coupling |
| | 26 Filter | 42 Suction Valve |

LEGEND

- | | |
|------------------------|-------------------------|
| ——— MAIN PRESSURE | ——— LANDING GEAR DOWN |
| ——— AUXILIARY PRESSURE | ——— LANDING GEAR UP |
| ——— EMERGENCY PRESSURE | ——— FLAP DOWN |
| ——— RETURN | ——— FLAP EMERGENCY DOWN |
| ——— SUCTION | ——— FLAP UP |
| ——— VENT | ——— BRAKES LEFT |
| ——— BOMB DOOR OPEN | ——— BRAKES RIGHT |
| ——— BOMB DOOR CLOSED | |



CONSOLIDATED AIRCRAFT CORPORATION SAN DIEGO, CALIFORNIA

HYDRAULIC SYSTEMS

General:

1. The main hydraulic system operates the tricycle landing gear (including tail skid gear), wing flaps, bomb bay doors, power brake, and the gun-charging mechanism on the belly turret.
2. The hydraulic shock absorber units cushion the landing impact and taxiing loads on the tricycle landing gear.
3. The hydraulic nose wheel shimmy damper unit dampens the tendency of the nose wheel to turn or "shimmy" from side to side.
4. The hydraulic tail turret unit controls the rotation of the rear turret, the elevation of the guns, and the gun charging mechanism.

MAIN HYDRAULIC SYSTEM

General: The hydraulic system consists of a main open center system and a secondary accumulator system.

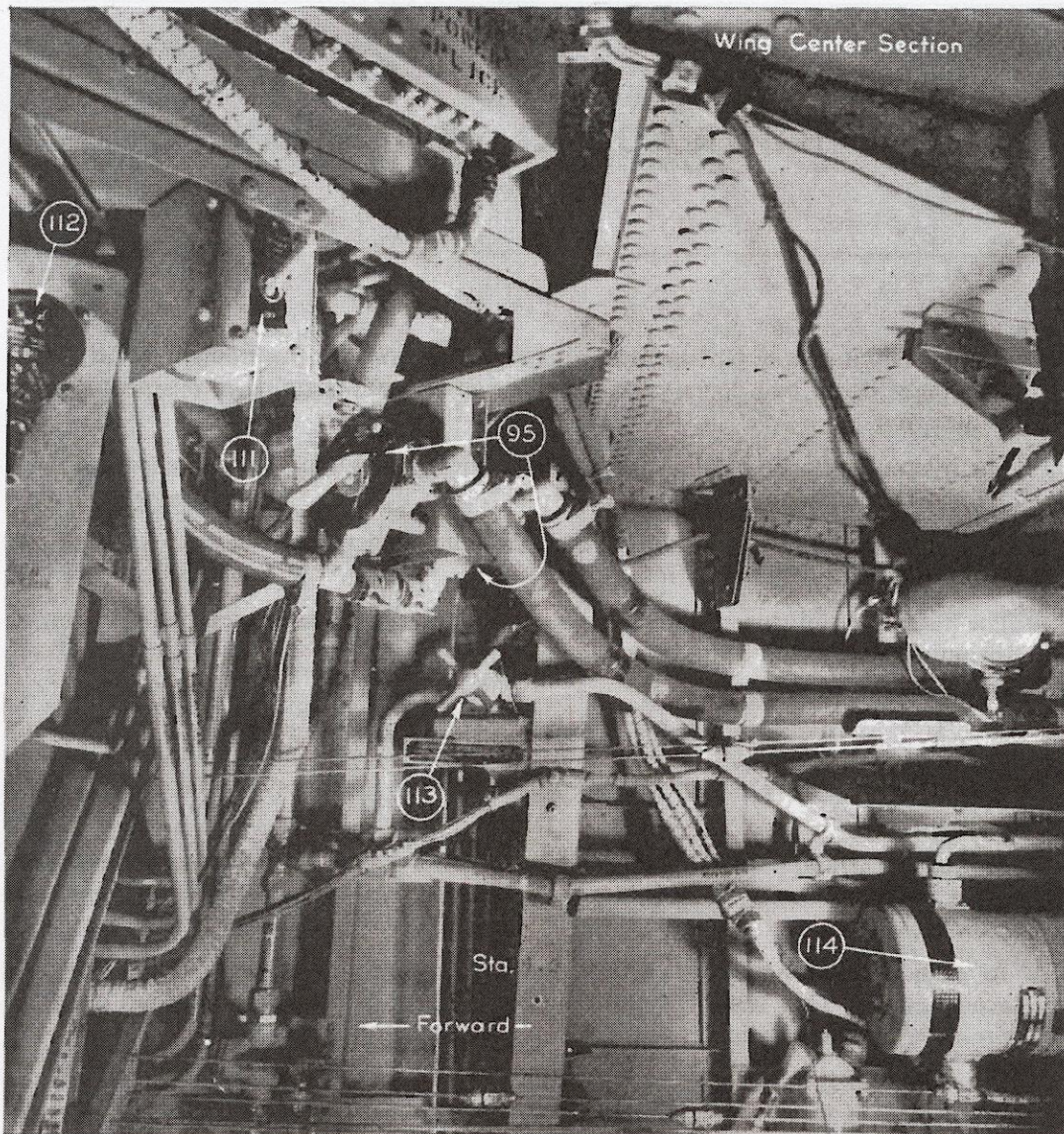
1. In the open center system the fluid circulates freely in a completely closed circuit when no hydraulic mechanisms are operating. It operates the Bomb Doors, Wing Flaps, and Landing Gear.
2. In the accumulator system the fluid is under constant high pressure, built up in two accumulators. This system is the sole source of brake operating and gun charging pressure, and an auxiliary source of bomb door operating pressure.

HYDRAULIC PUMPS

A Vickers positive displacement pump, driven by No. 3 Engine, supplies pressure for the main system. The pump normally floats on the line. When the flow is diverted to operate an hydraulic mechanism, by closing a valve, pressure builds up to that required to operate the mechanism.

This pump's secondary function is to maintain a charge in accumulator system. An automatic unloading valve in the engine-driven pump pressure line regulates this operation.

An auxiliary electrically-driven pump, located in the right side of the fuselage in the forward bomb bay, maintains accumulator pressure when the main pump is inoperative. An automatic pressure switch and a manual master switch control the pump motor.



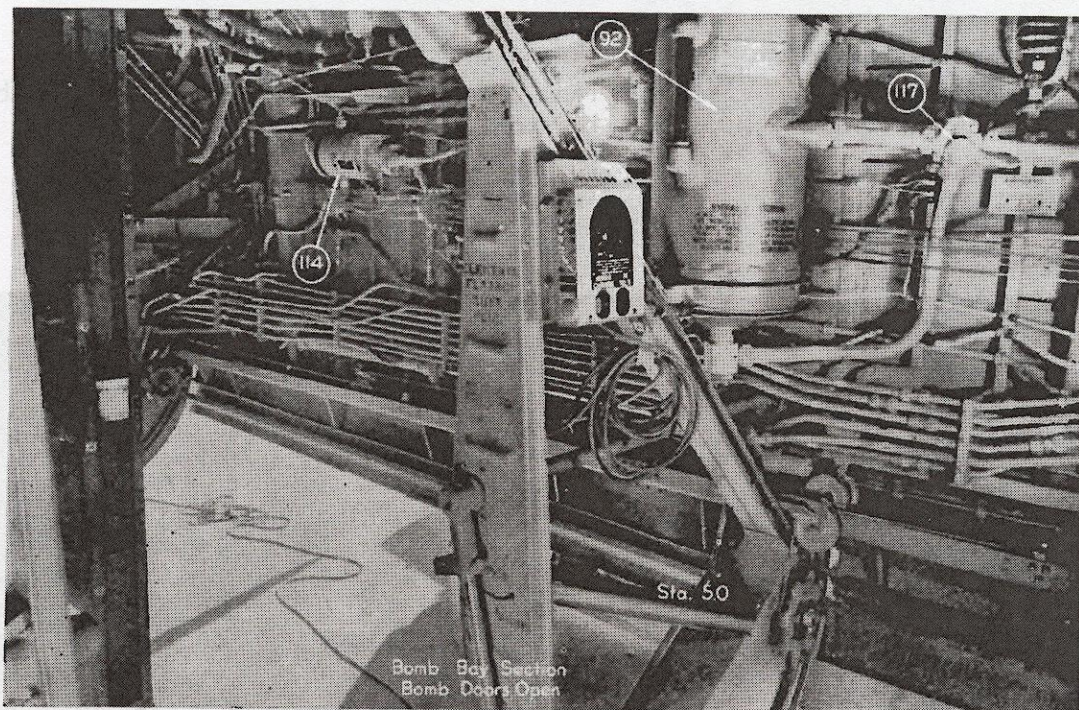
- | | |
|---|-------------------------------------|
| 95. Fuel Selector, Shut-off, and Cross-over Valve | 112. Typical Oxygen Outlet |
| 111. Electric Hydraulic Pump Switch | 113. Electric Pump Cross-over Valve |
| | 114. Electric Hydraulic Pump |

When the engine-driven pump fails, an emergency valve just above and forward of the electric motor may be turned on to connect the auxiliary pump into the main system.

The hydraulic hand pump is located outboard of the Co-Pilot's seat. This pump has a displacement of 2 cubic inches per cycle and can deliver 1000 pounds pressure to the line. It may be used to operate any hydraulic service in an emergency. It operates through a separate line to the wing flaps.

Reserve Fluid: In the event of low fluid, the engine-driven pump and the electrically-driven pump may be connected to the bottom of the reservoir by closing the valve provided in the reservoir outlet. **This should be done only after steps have been taken to insure that no further loss of fluid can take place.**

CAUTION: The landing gear, main bomb door and flap retracting systems cannot and must not be operated simultaneously.



92. Hydraulic Reservoir

114. Electric Hydraulic Pump

117. Hydraulic Suction Line Valve

OPERATING PRESSURES

The main system pressure gauge on the Instrument Panel should indicate approximately 50 pounds with no controls operating. With any system being used, this pressure should rise to between 100 and 1100 pounds.

The wing flaps should be operated before flight to allow the Pilot to check the system and also give the Co-Pilot a check on the operating pressures built up at the gauge. The brake pressure gauge should always show a pressure of approximately 850 to 1000 pounds per square inch.

RESTRICTED

HYDRAULIC SYSTEMS [Page 67

Location of Controls:

Landing Gear and Tail Bumper
Valve Handle
Electric Pump Cross-Over Valve

Electric Pump Master Switch
Hand Pump
Landing Gear Crank & Gear Box
Horn Interruption Switch
Suction Line Valve

Flap Control Valve
Valves to Main System and Wing

Left side of Pilot's Control Pedestal.

In forward right bomb bay, at pump. On airplanes equipped for bomb bay tanks—forward of pump near Station 4.1.

Aft of Station 4.1 to right of hatch opening.

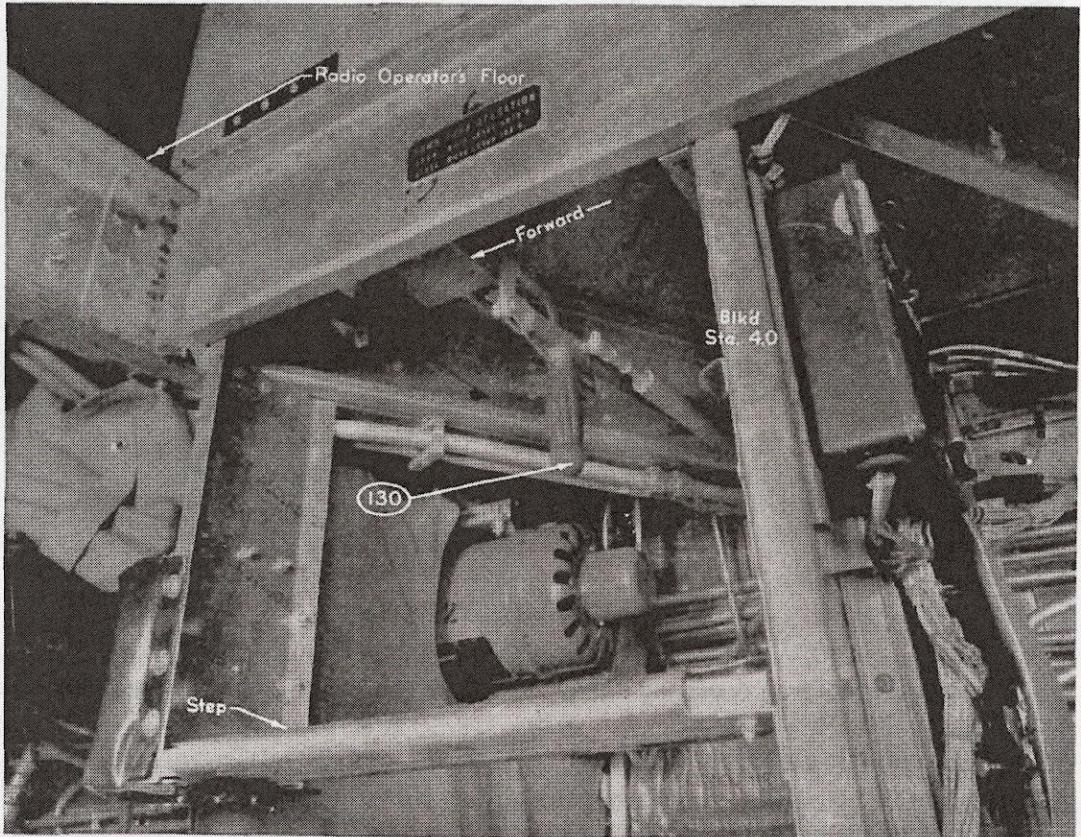
Outboard of Co-Pilot, on floor.

Centerline of front spar.

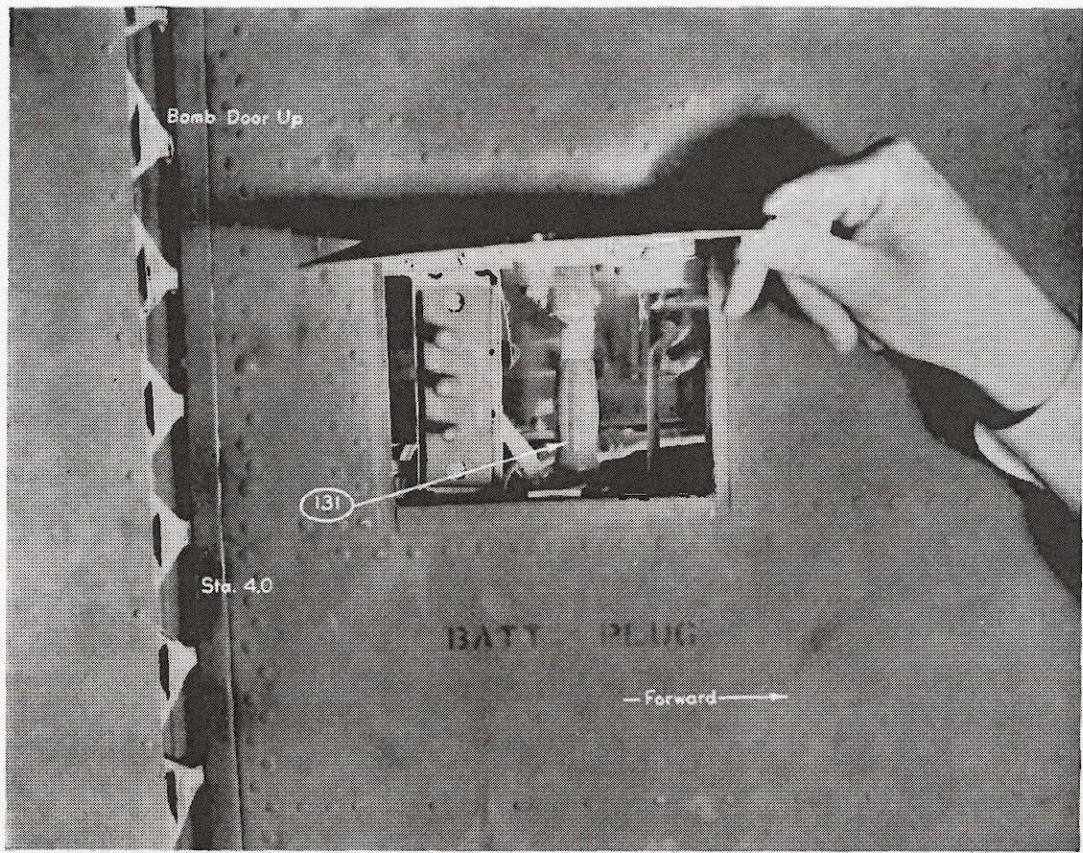
Pedestal Switch Panel.

Near the reservoir, middle of right side of bomb bay, under wing tanks.

Right side of Pilot's Control Pedestal.



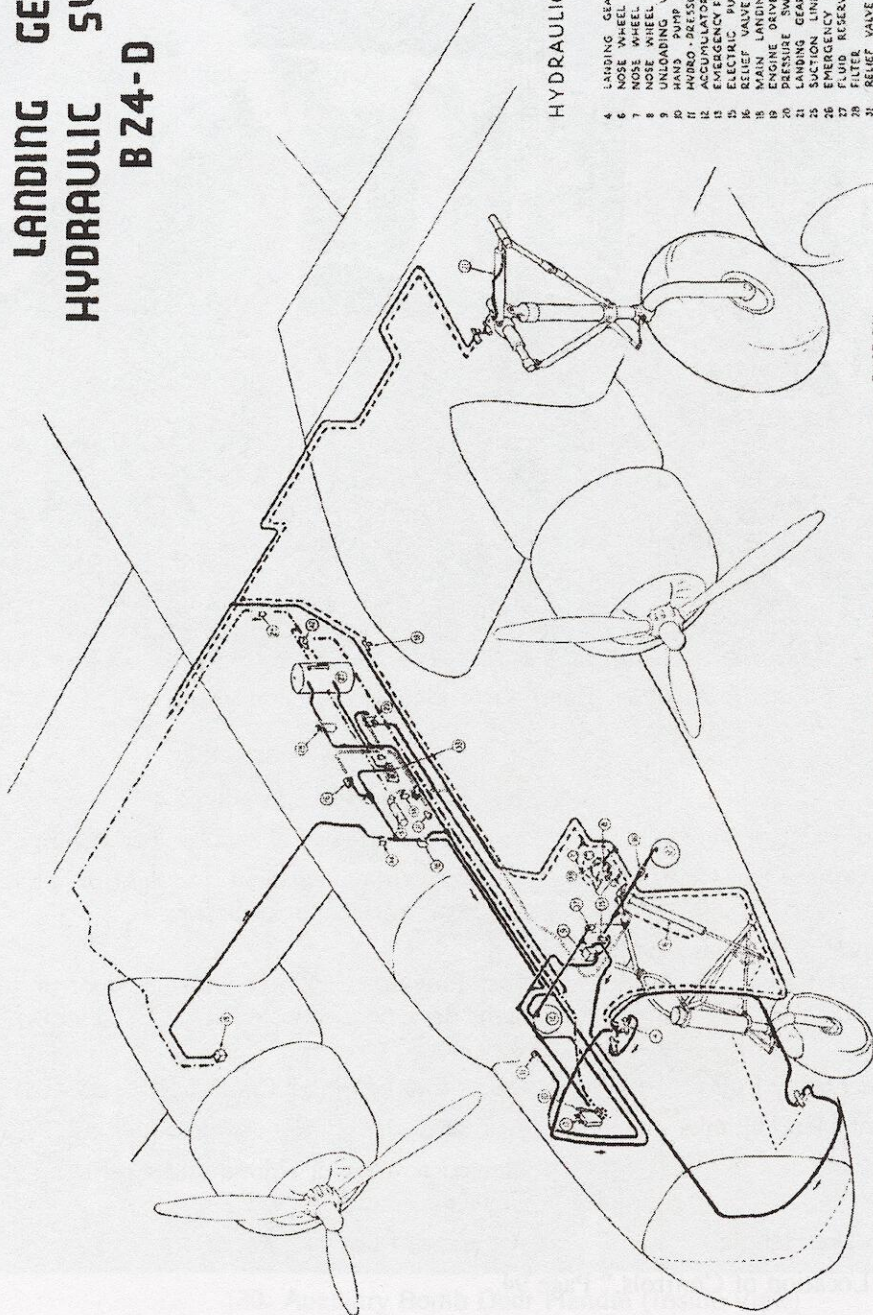
130. Auxiliary Bomb Door Handle (Inside View)



131. Auxiliary Bomb Door Handle (Outside View)

Flap Lines	Just outboard of hand pump.
Bomb Door Control Valve	Station 0.2, left side of Bombardier's Compartment
Auxiliary Bomb Door Control Valve	Just forward of Station 4.0 at right of hatch opening, and under flight deck floor.
Outside Lock to Auxiliary Bomb Door Control Valve	Just forward of right bomb bay door and under flight deck floor. Special Note: Use main entrance door key.
Pilot's Emergency Pull	On aft end of Pilot's Control Pedestal.
Bomb Door Hand Cranks	Just above bomb bay catwalk at Station 5.0.
Brake Pedals	Hinged to tops of Pilot's and Co-Pilot's Rudder Pedals.
Parking Brake Handle	Aft end of Pilot's Pedestal.
See also "Location of Controls," Page 94.	

LANDING GEAR HYDRAULIC SYSTEM BZ4-D



- | | | | |
|---|--------------------|---|-------------------|
| — | MAIN PRESSURE | — | SUCTION |
| — | AUXILIARY PRESSURE | — | LANDING GEAR DOWN |
| — | EMERGENCY PRESSURE | — | LANDING GEAR UP |
| — | RETURN | | |

HYDRAULIC UNITS

- 4 LANDING GEAR CONTROL VALVES
- 5 NOSE WHEEL DUMP VALVE
- 6 NOSE WHEEL RESTRICTOR
- 8 UNLOADING VALVE
- 10 HAND PUMP
- 11 HYDRO-PRESSURE GAUGE
- 12 ACCUMULATORS
- 13 EMERGENCY PUMP
- 14 RELIEF VALVE
- 15 MAIN LANDING GEAR RESTRICTOR
- 16 ENGINE DRIVEN PUMP
- 17 PRESSURE SWITCH
- 18 LANDING GEAR CYLINDER
- 20 SUCTION LINE CHECK VALVE
- 21 MAIN LANDING GEAR RESTRICTOR
- 22 FILTER RESERVOIR
- 23 RELIEF VALVE
- 24 TEST STAND
- 25 ENGINE PUMP CHECK VALVE
- 26 CHECK VALVE (UNLOADER)
- 27 LEFT ACCUMULATOR CHECK VALVE
- 28 RIGHT ACCUMULATOR CHECK VALVE
- 29 AUXILIARY PUMP CHECK VALVE
- 30 NOSE WHEEL CYLINDER CHECK VALVE
- 31 SUCTION VALVE
- 32 SUCTION VALVE

LANDING GEAR AND TAIL BUMPER HYDRAULIC SYSTEM

General—The landing gear, two main wheels, nose wheel, and the tail bumper gear are simultaneously operated under hydraulic control: The main control for extending and retracting the gear is located on the left side of the Pilot's Pedestal. Movement of the operating lever is restrained by an electric solenoid which is controlled by two switches in series. One switch is push button in the operating handle itself, the other a "micro switch" located on the left landing gear fairing. Extension of the landing gear strut after take-off, closes the "micro switch" and allows the circuit to be completed by pressing the button on the valve operating lever. The solenoid which latches the lever is located forward of the lever on the back of the pedestal, and restrains lever from "UP" position ONLY.

Movement of the selector valve to the "UP" position applies hydraulic pressure simultaneously to the side gear restrictor and to the nose wheel actuating cylinder. The side gear restrictor, restricts the flow of fluid to the main landing gear until the pressure reaches 800 p.s.i. This pressure is sufficient to house the nose gear. When pressure exceeds 800 p.s.i. the restrictor opens and allows fluid to go to the side gear cylinders.

On the lowering operation, pressure is applied to all three gear cylinders simultaneously.

In case of insufficient pressure in the hydraulic system, the hand pump may be used.

In case of complete failure of the hydraulic system, the tricycle landing gear may be manually lowered. See "Emergency" section, Page 86. No means of manual control is provided for the tail bumper gear.

MAIN LANDING GEAR

Each main landing gear mechanism operated by the main retracting cylinders through "over-rides" is equipped with two latches.

When the main gear is fully extended, a spring-loaded latch on the side brace knee holds the side brace rigid and locks the gear in place. Another latch on the side brace pivot in the wing, locks the gear in the retracted position.

The main gear down latch is painted yellow and can be seen for "down latch" check from the side window. It cannot be seen if flaps are lowered.

NOSE WHEEL GEAR

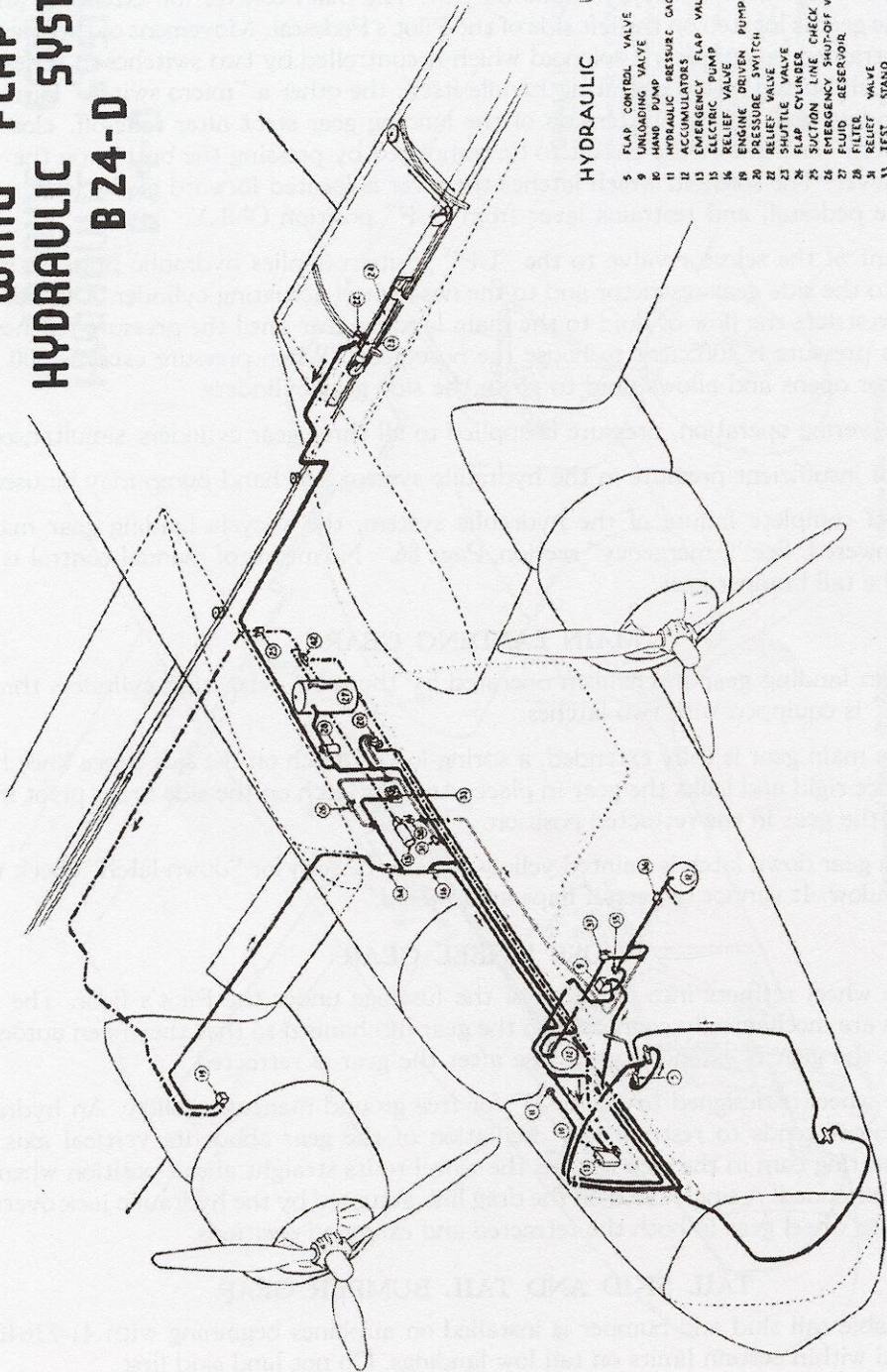
The nose wheel retracts into the nose of the fuselage under the Pilot's floor. The nose wheel doors are mechanically connected to the gear mechanism so that they open automatically before the gear is extended and close after the gear is retracted.

The nose wheel is designed to caster 45° for free ground maneuverability. An hydraulic shimmy damper tends to restrain any oscillation of the gear about its vertical axis. An internal centering cam in the oleo returns the wheel to its straight ahead position when the oleo is fully extended. A single latch on the drag link actuated by the hydraulic jack override, locks the nose wheel gear in both the retracted and extended positions.

TAIL SKID AND TAIL BUMPER GEAR

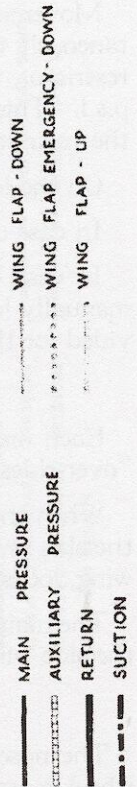
A retractable tail skid and bumper is installed on airplanes beginning with 41-23640. It may be used within certain limits on tail low landings. Do not land skid first.

WING FLAP HYDRAULIC SYSTEM B24-D



HYDRAULIC UNITS

- 5 FLAP CONTROL VALVE
- 9 UNLOADING VALVE
- 10 HAND PUMP
- 11 HYDRAULIC PRESSURE GAGE
- 12 ACCUMULATORS
- 13 ENGINE DRIVEN PUMP
- 14 CHECK VALVE
- 15 RELIEF VALVE
- 16 PRESSURE SWITCH
- 17 SHUTTLE VALVE
- 18 FLAP CYLINDER
- 19 SUCTION LINE CHECK VALVE
- 20 EMERGENCY SHUT-OFF VALVE
- 21 FLUID RESERVOIR
- 22 VALVE
- 23 RELIEF VALVE
- 24 TEST STAND
- 25 ENGINE PUMP
- 26 CHECK VALVE
- 27 UNLOADER
- 28 L ACCUMULATOR
- 29 B ACCUMULATOR
- 30 AUXILIARY PUMP
- 31 CHECK VALVE
- 32 EMERGENCY SHUT OFF VALVE



The tail bumper protects the bottom of the fuselage in case the airplane should accidentally tilt back.

WARNING SIGNAL AND LIGHT

A green light on Pilot's Instrument Panel is lighted whenever the landing gear is down and locked.

Further warning that the gear has not been extended is given by an electric horn connected to the throttle controls. When the throttles are moved backward to approximately three-fourths closed, and all landing wheels are not extended and locked, the horn will blow until the gear has been extended and locked or until the throttles are opened to higher engine speed. The horn may be silenced by pressing the Pilot's Interruption Switch on the Pilot's Electrical Switch Board. The horn will then remain silent until the throttles are moved again. This re-sets the horn relay so that another closing of the throttles would again actuate the horn. The horn interruption switch is provided in the event it is necessary to continue flight with one or more engines throttled.

On ships equipped with bottom turrets, this warning is also given when the turret has not been fully retracted.

NOTE: The green light indicator is wired through switches on all three landing gear units. On ships prior to 41-23750 the warning horn is wired through switches on the left main gear and the bottom turret. Starting with ship 41-23750, the horn is wired through switches on all three landing gear units.

WING FLAP HYDRAULIC SYSTEM

General—The Fowler type wing flaps are operated by a single hydraulic jack which lies along the left rear wing spar at Wing Station 3.0. The flaps move along tracks in the trailing edge and are extended and retracted by a lever on the right side of the Pilot's Pedestal. To raise flaps, move lever forward; to lower flaps, pull lever aft.

In the flap down position, excessive speeds in excess of 155 MPH will create a sufficient pressure on the flaps to open a relief valve at the operating cylinder and allow the flaps to retract automatically.

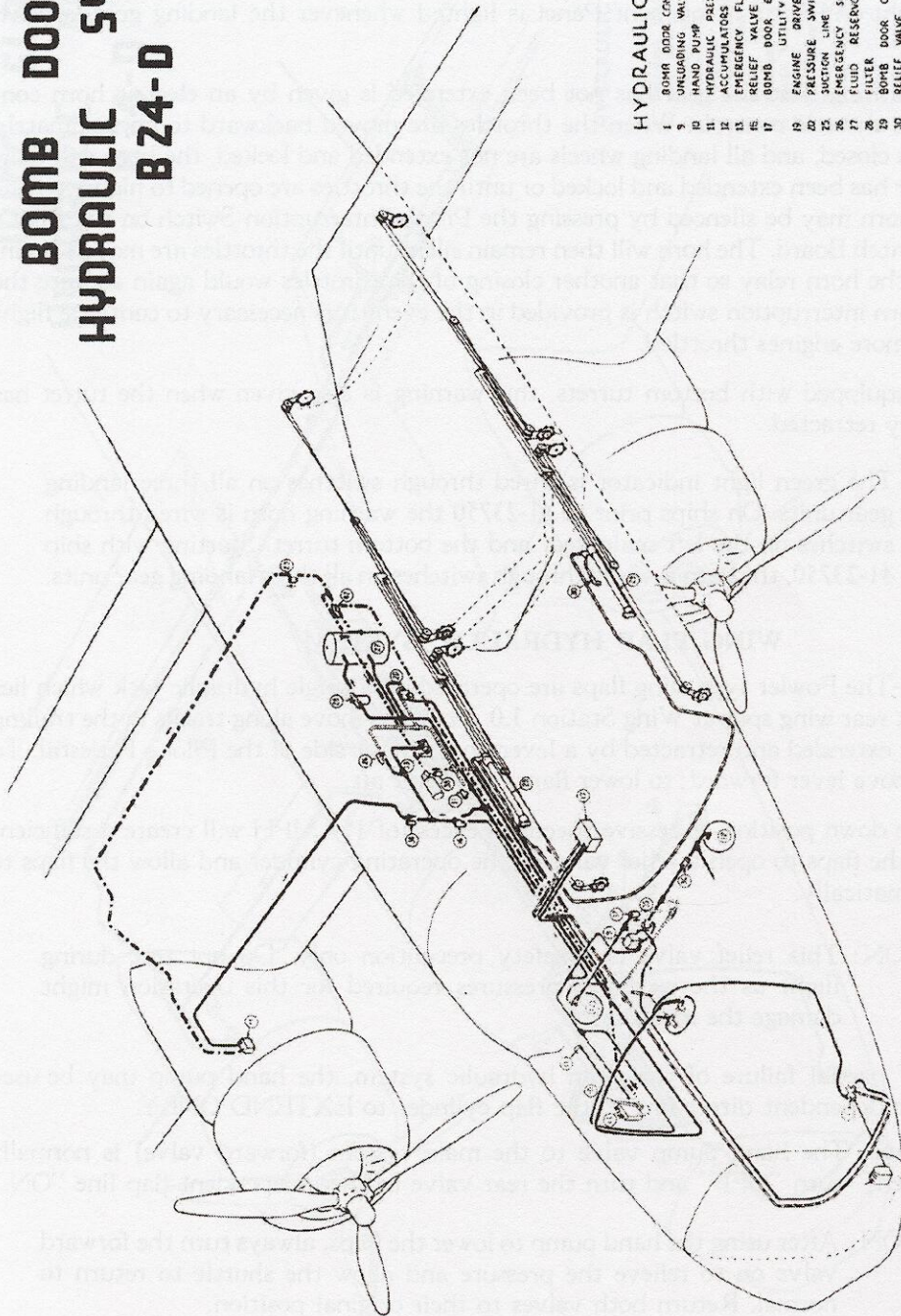
CAUTION: This relief valve is a safety precaution only. Do not test during flight as the excessive pressures required for this operation might damage the mechanism.

In case of partial failure of the main hydraulic system, the hand pump may be used through an independent direct line to the flap cylinder to **EXTEND ONLY**.

To Operate: The hand pump valve to the main system (forward valve) is normally safetied "open;" turn "OFF" and turn the rear valve to the independent flap line "ON."

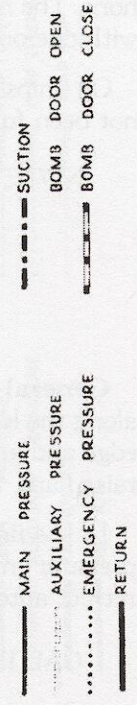
CAUTION: After using the hand pump to lower the flaps, always turn the forward valve on to relieve the pressure and allow the shuttle to return to normal. Return both valves to their original position.

BOMB DOOR HYDRAULIC SYSTEM B 24-D



HYDRAULIC UNITS

- 1 BOMB DOOR CONTROL VALVE
- 2 UNLOADING VALVE
- 3 HAND PUMP
- 4 HYDRAULIC PRESSURE GAGE
- 5 ACCUMULATORS I & R
- 6 EMERGENCY FLAP VALVES
- 7 RELIEF VALVE
- 8 BOMB DOOR EMERGENCY AND UTILITY CONTROL VALVE
- 9 ENGINE DRIVEN PUMP
- 10 PRESSURE SWITCH
- 11 INJECTION LINE
- 12 CHECK VALVE
- 13 EMERGENCY SHUT-OFF VALVE
- 14 FLUID RESERVOIR
- 15 FILTER
- 16 BOMB DOOR CYLINDERS
- 17 RELIEF VALVE
- 18 TEST STAND
- 19 ENGINE PUMP
- 20 CHECK VALVE
- 21 CHECK VALVE
- 22 ACCUMULATOR
- 23 ACCUMULATOR
- 24 CHECK VALVE
- 25 AUXILIARY PUMP
- 26 CHECK VALVE



In case of complete failure of the hydraulic system, no manually controlled system is provided for the wing flaps.

Flap Indicating System. See photo on Page 2.

A Selsyn type indicator on the Pilot's Panel shows the flap position at all times.

BOMB BAY DOORS' HYDRAULIC SYSTEM

Each side (2 units) of the bomb bay doors is actuated by an individual hydraulic jack.

The system is hydraulically controlled from any one of four positions:

1. Bombardier's Compartment Main control valve
2. Under Radio Operator's floor at hatch opening. Auxiliary control valve
3. On the ground from access door on right side forward of bomb door. Auxiliary control valve
4. Pilot's Compartment Emergency operation of auxiliary valve. Doors may be opened but not closed until pull line is reset.

CAUTION: The Pilot's emergency pull line to the auxiliary valve cam (see No. 4 control in above paragraph) must be re-set by hand or hydraulic system will by-pass through the bomb jack relief valve thus affecting the entire hydraulic system.

Under military operating conditions the main control valve is used to control the operation of the doors.

The auxiliary valve, in the accumulator system, is generally used for local flight operations.

In case of complete failure of the hydraulic system, the doors may be manually operated by hand cranks accessible from the catwalk at the center of the bomb bay.

Bomb Bay Door Indicating System:

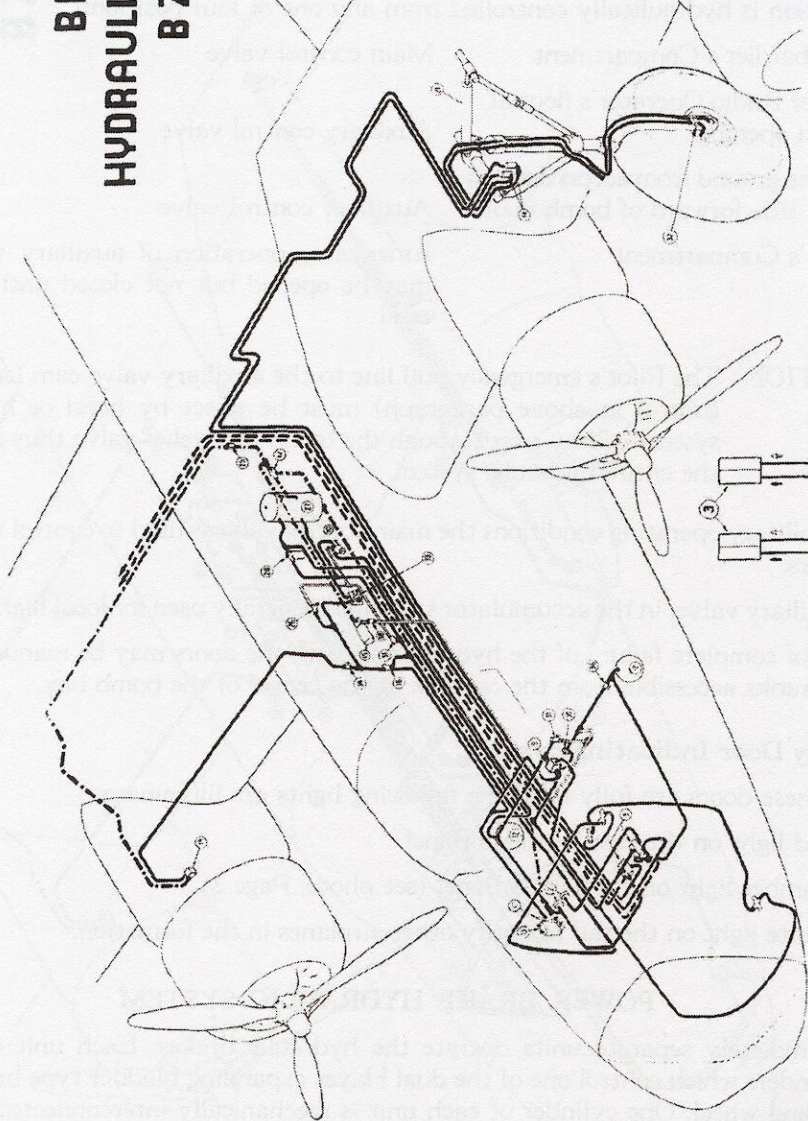
When these doors are fully open the following lights are illuminated:

1. A red light on the Bombardier's Panel.
2. An amber light on the Pilot's Panel (see photo, Page 2).
3. A white light on the tail to notify other airplanes in the formation.

POWER BRAKE HYDRAULIC SYSTEM

Two completely separate units operate the hydraulic brakes. Each unit contains two brake cylinders which control one of the dual Hayes expanding bladder type brakes on each main landing wheel. One cylinder of each unit is mechanically interconnected to the right hand brake pedal of both Pilot and Co-Pilot; the other cylinder of each unit is similarly connected to both left hand brake pedals.

BRAKE SYSTEM HYDRAULIC SYSTEM B Z 4-D



HYDRAULIC UNITS

- 2 BRAKE PRESSURE GAGES
- 3 BRAKE CONTROL VALVES (L & R)
- 5 UNLOADING VALVE
- 10 HAND PUMP
- 12 ACCUMULATORS
- 13 CHECK VALVES
- 14 BRAKE DEBOOSTERS (L & R)
- 15 ELECTRIC PUMP
- 16 RELIEF VALVE
- 19 ENGINE DRIVEN PUMP
- 20 PRESSURE SWITCH
- 21 MAINLINE GEAR PULUNNER
- 22 SUCTION VALVE
- 23 EMERGENCY SHUT OFF VALVE
- 27 FLUID RESERVOIR
- 28 FILTER
- 31 RELIEF VALVE
- 32 BRAKE BLEEDER VALVES (L & R)
- 33 ENGINE PUMP
- 34 CHECK VALVE
- 35 ENGINE PUMP CHECK VALVE
- 36 L ACCUMULATOR CHECK VALVE
- 37 R ACCUMULATOR CHECK VALVE
- 38 AUXILIARY PUMP CHECK VALVE
- 42 SUCTION VALVE

- MAIN PRESSURE
- AUXILIARY PRESSURE
- EMERGENCY PRESSURE
- RETURN
- SUCTION
- LEFT BRAKE
- RIGHT BRAKE

Each unit takes its pressure directly from a different one of the two main accumulators which are isolated from each other by check valves so that failure of one accumulator does not affect the other. Failure of one complete unit leaves one-half braking power available.

Parking Brake:

To Set: A lever on the left rear corner of the Pilot's Pedestal is raised to engage locking cam while brakes are held on.

To Unlock: Press brake pedals.

Brake Indicating System (See photo, Page 2).

Two pressure gauges on the instrument panel indicate the pressure in each brake system.

NOSE WHEEL SHIMMY DAMPER HYDRAULIC SYSTEM

An independent system, located on the nose gear strut, dampens out nose wheel shimmy by means of an accumulator connected to two hydraulic damper rams which act in opposite directions. A pressure gauge is attached to the accumulator. The pressure must be maintained at 150 to 250 p.s.i. When the pressure falls below 150 each of the two cam slots in the damper may be chocked with a piece of metal.

CAUTION: This emergency "jamming" will eliminate the wheel vibration, but will also fix the nose wheel in straight travel, non-steerable. Therefore, this procedure must only be used in an emergency as it will injure the wheel and damper mechanisms.

NOTE: An emergency positive type nose wheel lock is to be provided in the near future. They will be furnished for all delivered airplanes.