

Boeing 707

Brakes

Training manual

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1. GENERAL.

The hydraulic brake control system includes linkage and cables running from the rudder pedals (brake pedals) in the control cabin to metering valves located in the main wheel wells. A parking brake handle on the pilot's control stand, operates linkage to hold brakes on when brake pedals are released. Pressure for brake operation is provided by one hydraulic accumulator. Metering valves, one for each main landing gear, control the pressure applied to the brakes. Lockout-deboost valves limit the pressure entering the brakes and limit fluid loss if leakage occurs between the lockout-deboost valves and the brakes. Automatic brake actuation is provided to apply brakes when the main landing gear is retracted. An anti-skid system prevents locked or skidding wheels when brakes are applied on any landing surface.

Brakes are multiple disc type, with full circle sintered lining. Eight brakes are provided, one on each main landing gear wheel. Brakes have automatic adjustment for lining wear.

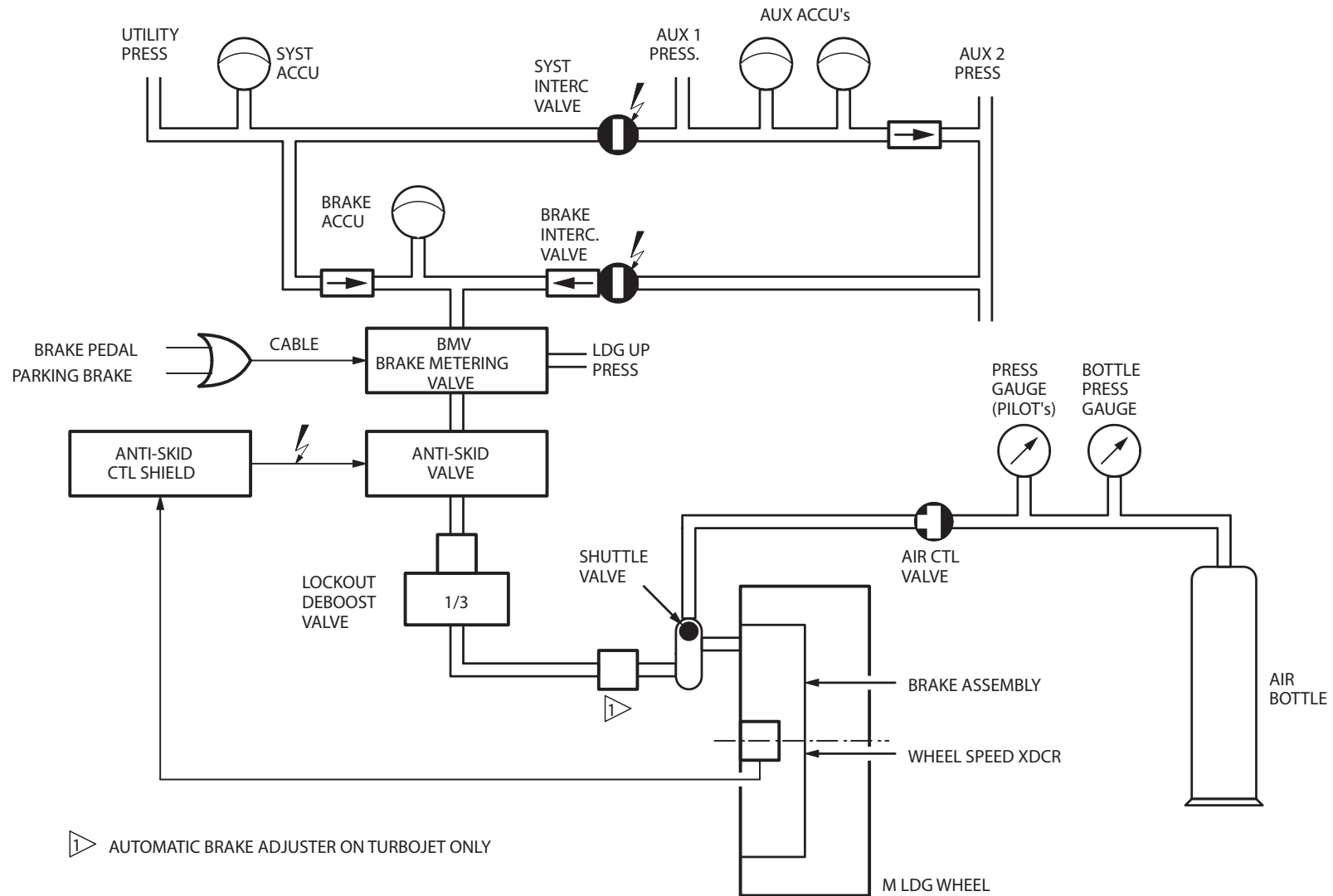
Anti-Skid.

Anti-skid protection is provided to increase-braking effectiveness and prevent excessive skidding during heavy braking. The maximum braking efficiency is obtained when all wheels are in a slight skid or at a maximum rate of deceleration short of a skidding wheel. Anti-skid also provides locked wheel protection.

Emergency Air Brakes.

Emergency-air brakes are installed for emergency use only.

The air brakes should be used only when there is insufficient hydraulic brake pressure to stop the aircraft. No differential braking is available with the emergency air brakes. Directional control must be maintained by other means such as flight controls, reverse thrust and nose wheel steering. The anti-skid system and the parking brake do not function with air brakes.



BRAKE SYSTEM - GENERAL

2. CONTROL AND INDICATION.

BRAKE PRESSURE Indicator.

Indicates pressure output in thousands of psi (with subdivisions in hundreds), Normal pressure is 3000 psi. When the system is depressurized it gives accumulators precharge. Normal precharge is 750 psi at 21°C.

INTERCONNECT VALVE Switch.

This switch operates the system interconnect valves. When set to position BRAKE it connects the auxiliary system to brakes (both pumps).

When set to SYSTEM it opens the interconnect valve if the aircraft is powered by EXT. POWER or APU with ext. power contactor closed. Only aux pump No. 1 can supply the utility system.

In the OFF position both interconnect valves close.

BRAKES REL Indicator

Comes on when either or both of a pair (front and rear) of brakes is released by antiskid system action on ground, or when gear is down and locked in flight and antiskid system ON.

Antiskid TEST Switch.

When set to OUTBD or INBD, simulates a spin up condition on selected wheels. The set of wheels selected shows blank in REL indicator. The other set senses its non-rotation as a skid and shows a release (REL) indication. Switch is spring-loaded OFF. When switch is released, all REL lights illuminate momentarily.

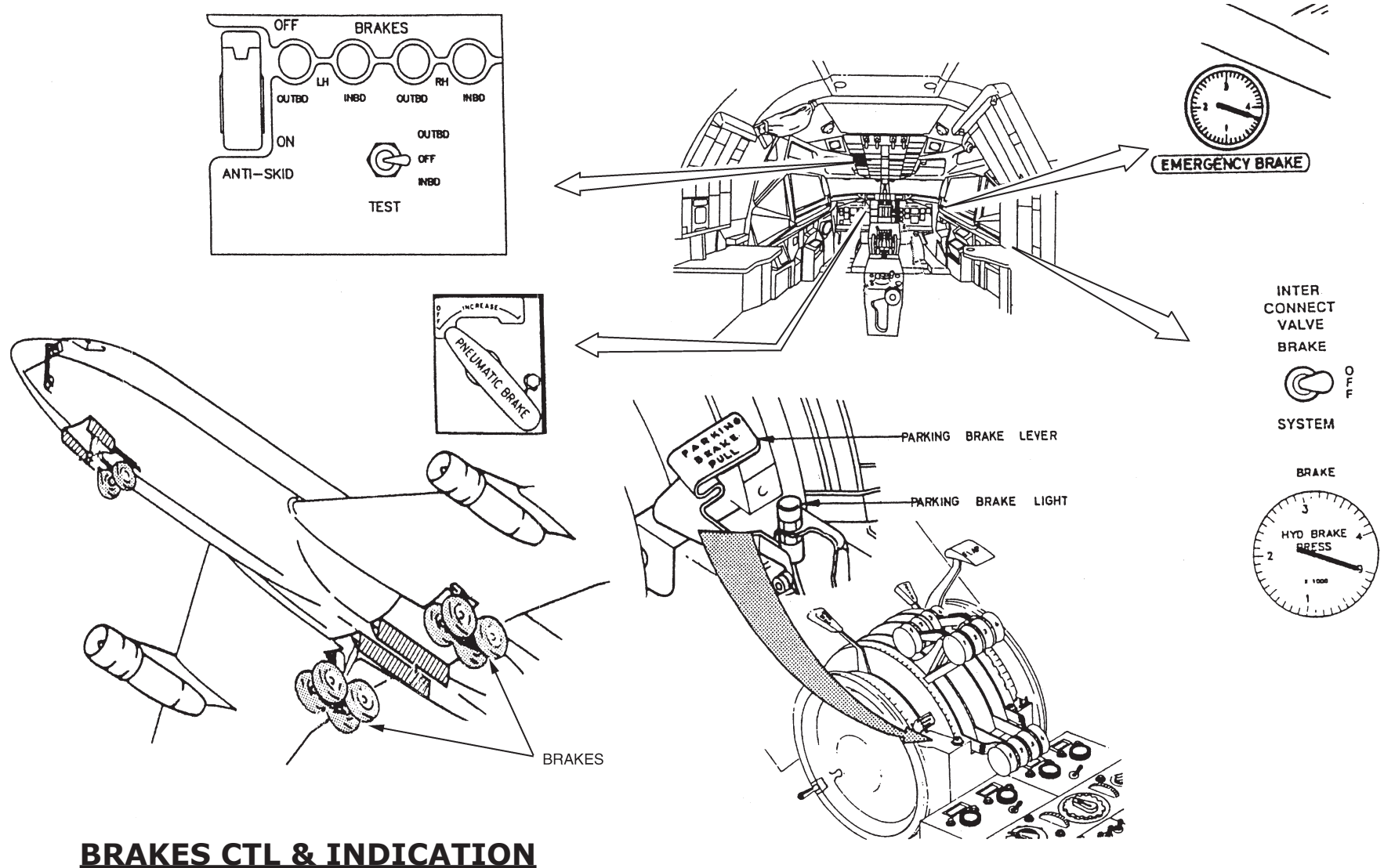
ANTI-SKID Control Switch (Guarded On).

In ON position, energizes antiskid system in OFF position, de-energizes antiskid system.

Parking Brake.

The parking brake lever is on the, aft left corner of the throttle quadrant. Either pilot may park the brakes by applying pressure to the brake pedals, pulling up of the lever and then releasing the pedals. To release the parking brakes, the pilot need only depress the brake pedals fully and then release.

A red light on the pedestal near the parking brake lever will be on any time the parking brake lever is set.



BRAKES CTL & INDICATION

3. SYSTEM DESCRIPTION.

3.1. Hydraulic Pressure Supply.

The brake system is normally pressurized by the utility system. Eventually, it may be pressurized by the auxiliary pumps after opening of the brake interconnect valve.

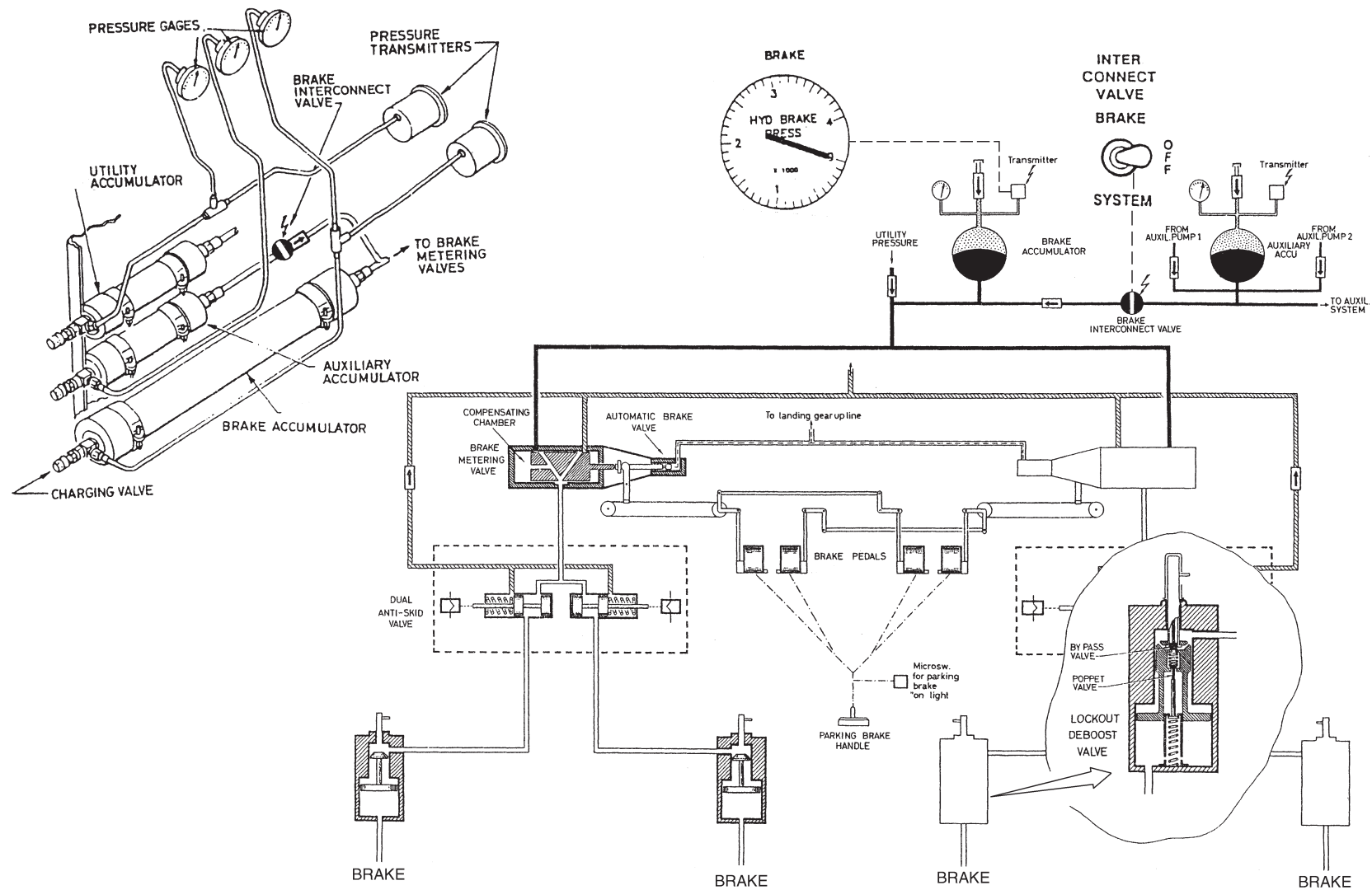
A brake accumulator stores hydraulic fluid under pressure instantaneously available to the brakes. A check valve prevents the accumulator from discharging in a system other than the brakes. When the accumulator is charged up to 3000 psi, it contains sufficient fluid for approximately 10 brake applications. The accumulator precharge pressure is 750 psi. This pressure may be checked after complete depressurization of the brake circuit by a direct reading gage installed in the right wing fillet near the accumulator. The nitrogen pressure is also electrically transmitted to a brake pressure indicator installed in the cockpit on the copilot's instrument panel. The accumulator charging valve is mounted directly on the accumulator.

Brake Pressure Control Circuit.

Pressure delivered to the left and right gear brakes is controlled by two independent brake metering valves separately actuated by the left or right brake pedals. Each metering valve feeds two identical but separate systems which supply pressure to two brakes of a same tandem of wheels (front and aft).

Each system includes :

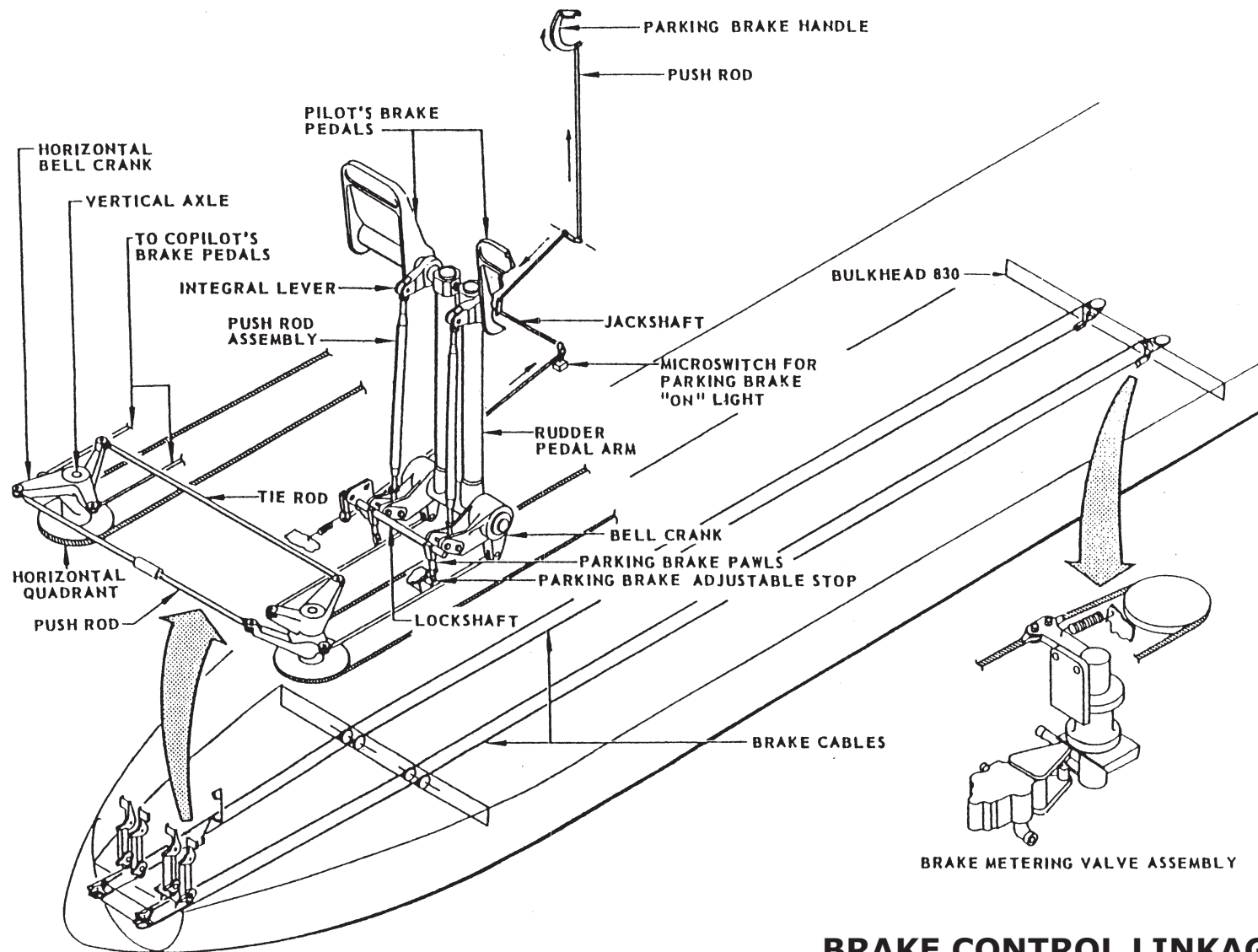
- Two antiskid valves electrically controlled by the antiskid system. They automatically release pressure from the corresponding brakes in case one or the other wheel tends to skid (see "ANTISKID SYSTEM").
The two antiskid valves of a same tandem are contained in a common housing located in the wheel well. They form a dual antiskid valve.
- Two lockout deboost valves which prevent complete loss of fluid in case a leak occurs in the downstream circuit, and reduces pressure delivered by the metering valve by a constant ratio of 2,9 to 1.



HYDRAULIC PWR SUPPLY

Brake Pedals.

The brake metering valves are controlled by the brake pedals. A mechanical linkage interconnects pilot and copilot pedals. The pedals are adjustable by a crank. Left pilot and copilot pedals actuate the left brake metering valve while the right valve is actuated by the right pedals. The brake control mechanism is designed to maintain the pedals within $\pm 5^\circ$ of normal position when rudder pedals move over full range of travel.



BRAKE CONTROL LINKAGE

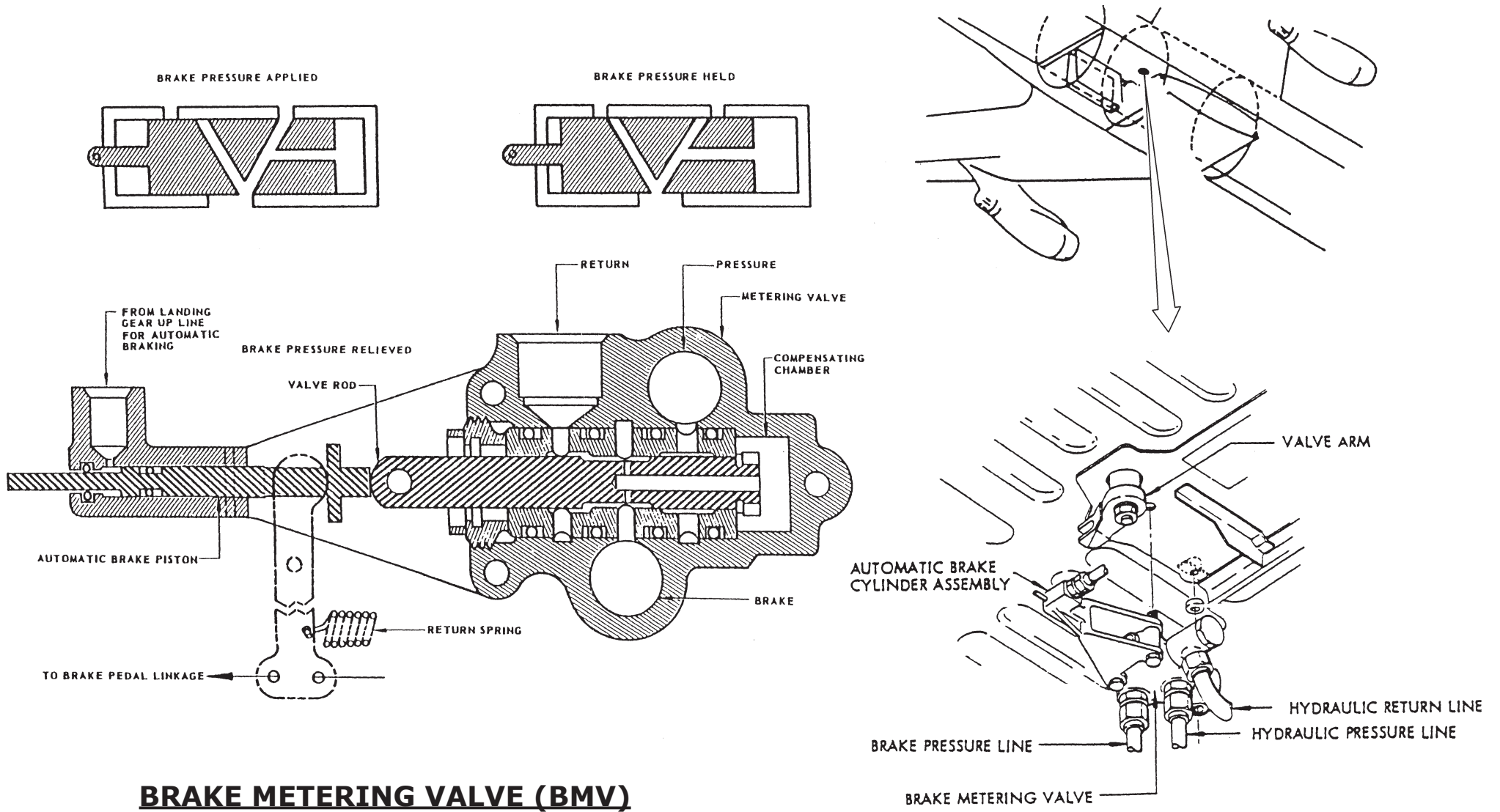
3.2. Brake Metering Valves.

The brake metering valves are located in the main wheel wells. They are connected to the brake pedals through cables and mechanical linkage.

They deliver a pressure proportional to the brake pedals displacement.

The return force developed by the brake pressure is transmitted by the control cables to the pedals and must be balanced by the pilot action.

So pressure delivered to the brakes will be felt by the pilot on the pedals. When the brake pedals are released, the metering valves connect the brake circuit with the return line. The brake metering valve is automatically actuated during gear retraction by a small cylinder (automatic brake piston) connected to the landing gear up line. This automatic brake piston partially applies the brakes to stop wheel spinning during gear retraction.



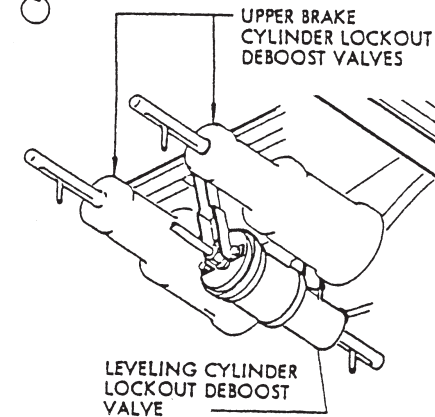
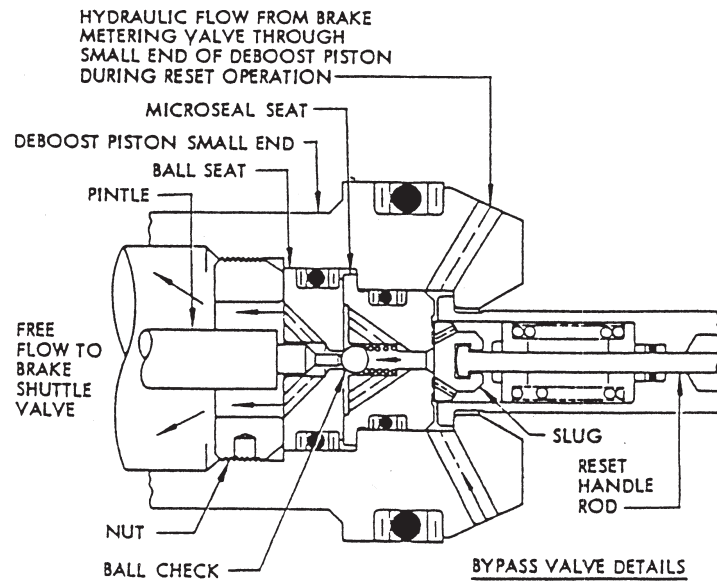
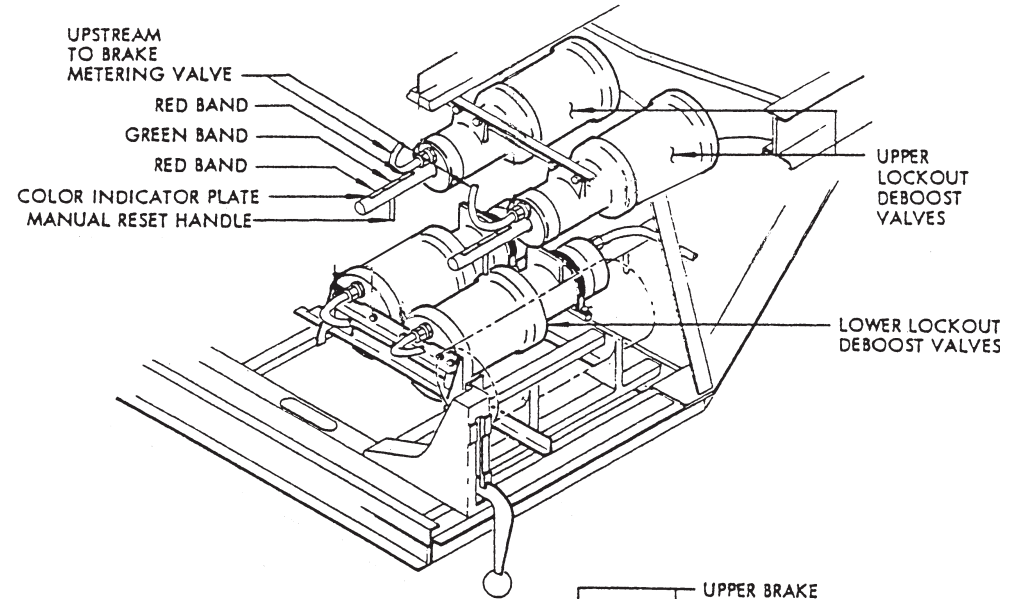
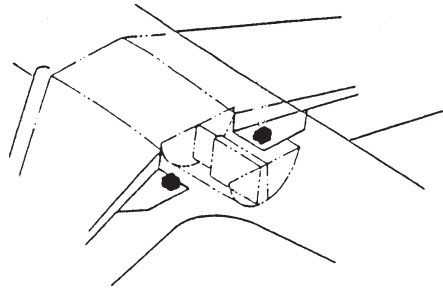
BRAKE METERING VALVE (BMV)

3.3. Lockout Deboost Valves.

The brake lockout deboost valves consist of a stepped cylinder housing and a double piston.

A manually operated by-pass valve permits fluid to pass through the piston when it is required to charge the brake side and raise the piston in the deboost valve. An indicator provided with a green band and two red bands shows the position of the manual reset handle and consequently indicates the fluid level in the brake side of the valve. If a leak occurs downstream of the deboost valve, fluid loss is limited to the fluid in the line from the deboost valve to the brakes. When brakes are set, the reset handle should be in the green band. The brake lockout deboost valves are installed in the wing fillets.

WARNING: WITH BRAKES ON, RESET HANDLE MUST BE IN GREEN RANGE.
IF RESET HANDLE IS IN INNER RED RANGE, PULL HANDLE OUT TO REPLENISH BRAKE LINES. IF HANDLE IS IN OUTER RED RANGE, VALVE MUST BE REPLACED.
AIRPLANE WILL NOT BE TAXIED.



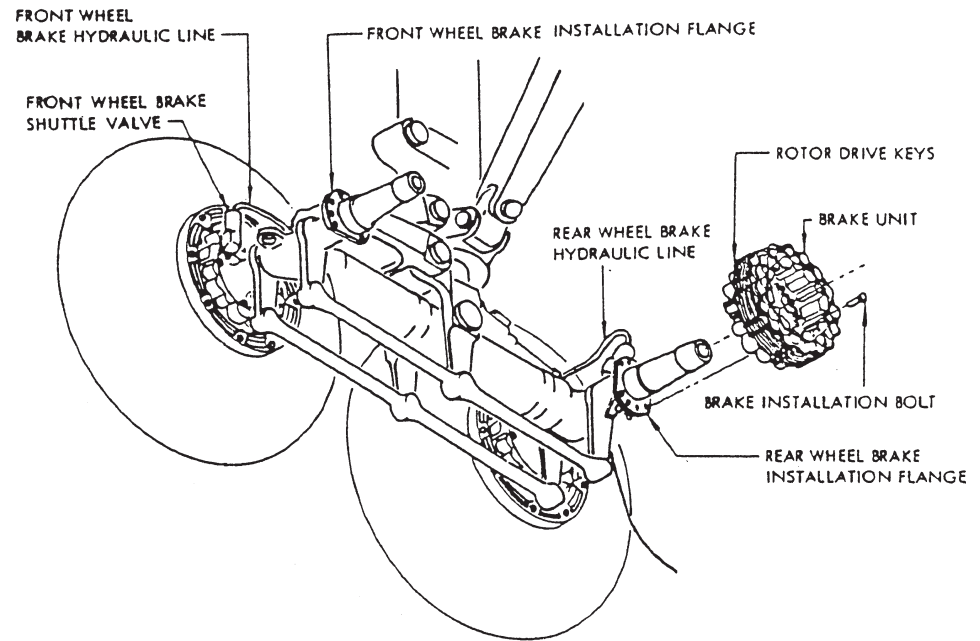
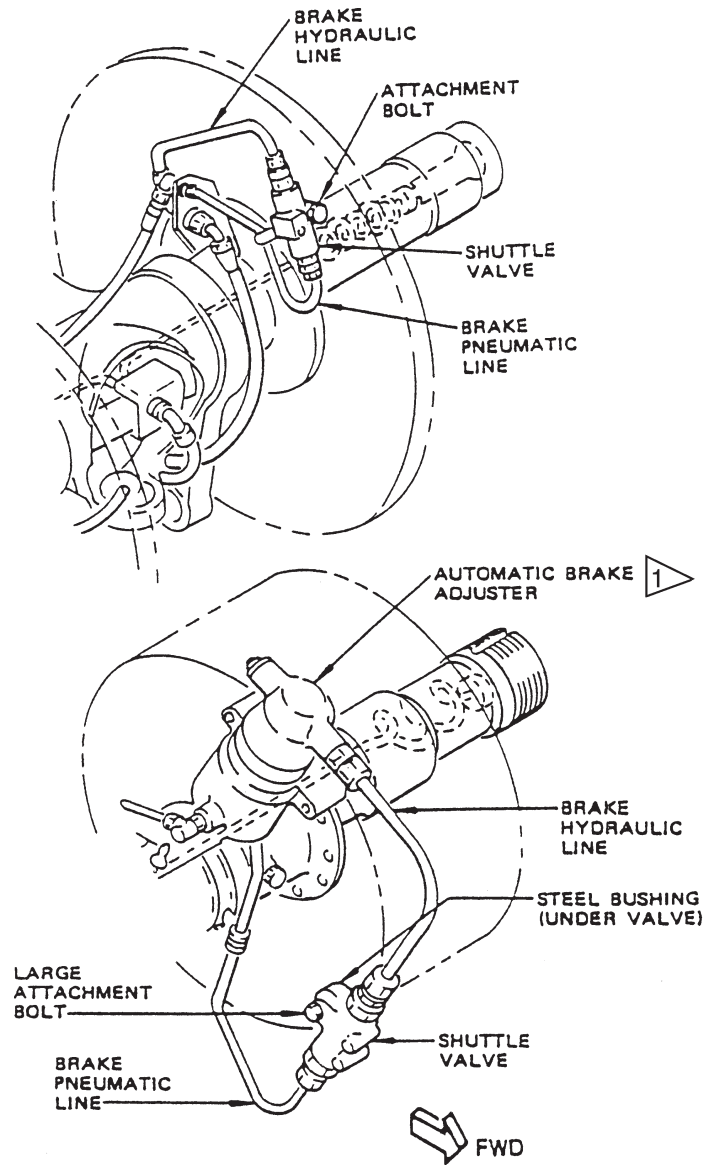
LOCKOUT DEBOOST VALVES

3.4. Brake Shuttle Valve.

One brake shuttle valve is mounted on each brake unit. The brake hydraulic line, and the emergency brake air line are both connected to the shuttle valve.

During normal brake operation, the shuttle valve seals off the emergency brake line.

During emergency braking, the valve operates to seal off the hydraulic line and open the emergency brake line to the brakes.



1 ON SOME AIRPLANES

BRAKE / SHUTTLE VALVE

3.5. Brakes.

The landing gear brakes consist of :

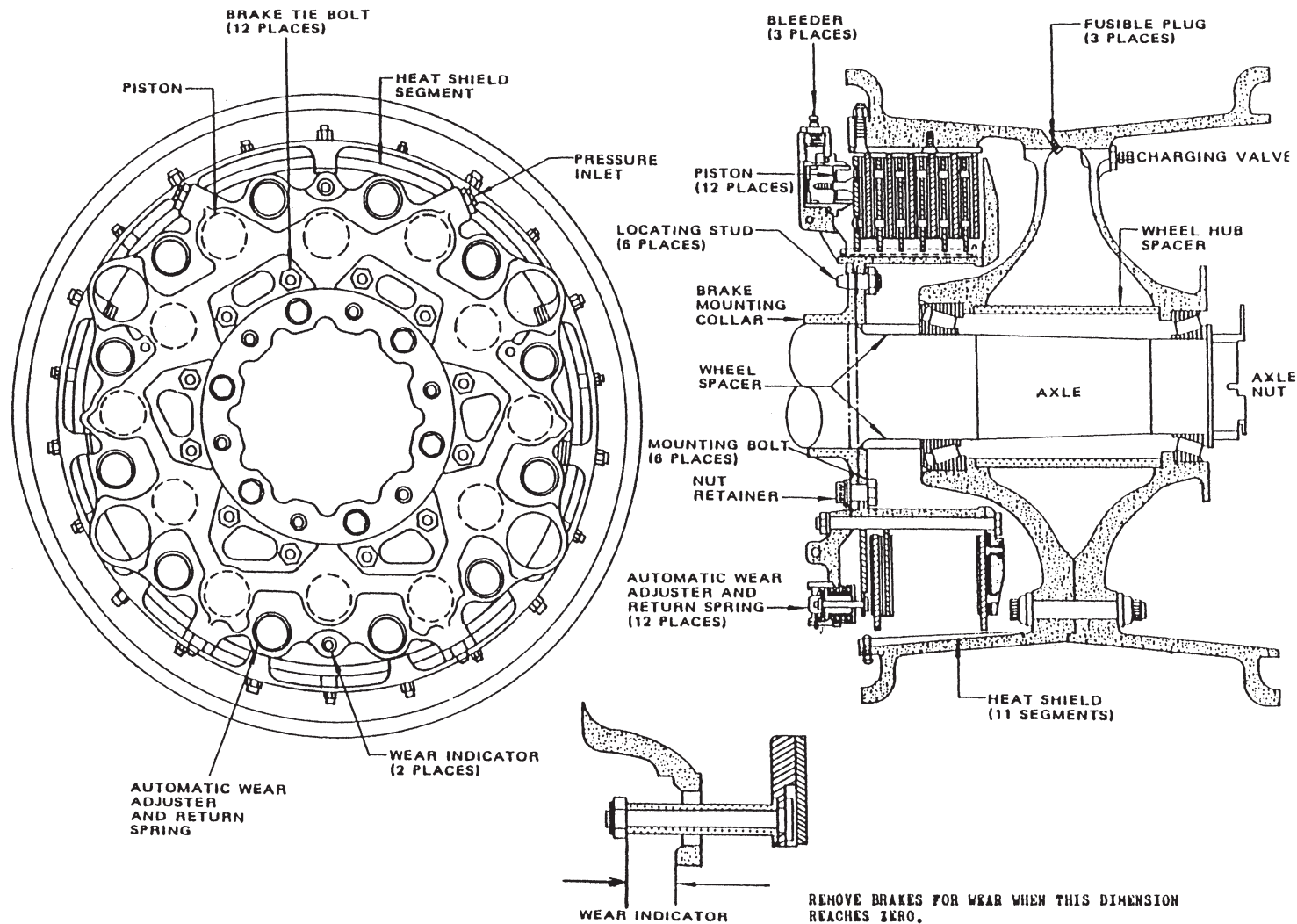
- Six rotating discs keyed into the wheel and provided with bronze lining on both sides,
- Five stationary discs keyed to the brake torque plate,
- A pressure plate and a back pressure plate,
- 12 actuating pistons,
- 12 return springs.

Brakes are applied by the pistons acting on the pressure plate, pressing all discs together and against the back pressure plate. Friction between the discs provides the required braking. When hydraulic brake pressure is released, the return springs return the brake pressure plate towards the brake released position by pulling on grip collars fixed to the return pins by friction.

At this time, rotary and stationary discs separate and the wheel can rotate freely. If wear lining exceeds a predetermined value, when pressure is applied, the grips contact the return spring housings before the brake discs are pressed together. At this time, the pins are forced through the grip collars. As the tightness of the collars around the pins cannot be overcome by the return springs, the excessive clearance between the discs is automatically reduced.

NOTE: A bleed hole is provided in the automatic brake adjuster housing to drain fluid seeping between piston and cylinder, leaking may be considered as normal.

Two wear indicators allow to appreciate the lining wear. When dimension "L" is zero with brake applied, the brake has to be replaced. The brake wear has to be measured from the pin nut outside face.



BRAKE AND WHEEL ASSEMBLY

4. PARKING BRAKE.

The parking brake is applied by latching the brake pedals in the depressed position mechanically by pulling the parking brake lever up and by closing the return side of the antiskid valves electrically. A loss of electric power to the antiskid valves can result in a gradual loss of pressure in the brakes.

The parking brake lever position pawls in the brake pedal linkage.

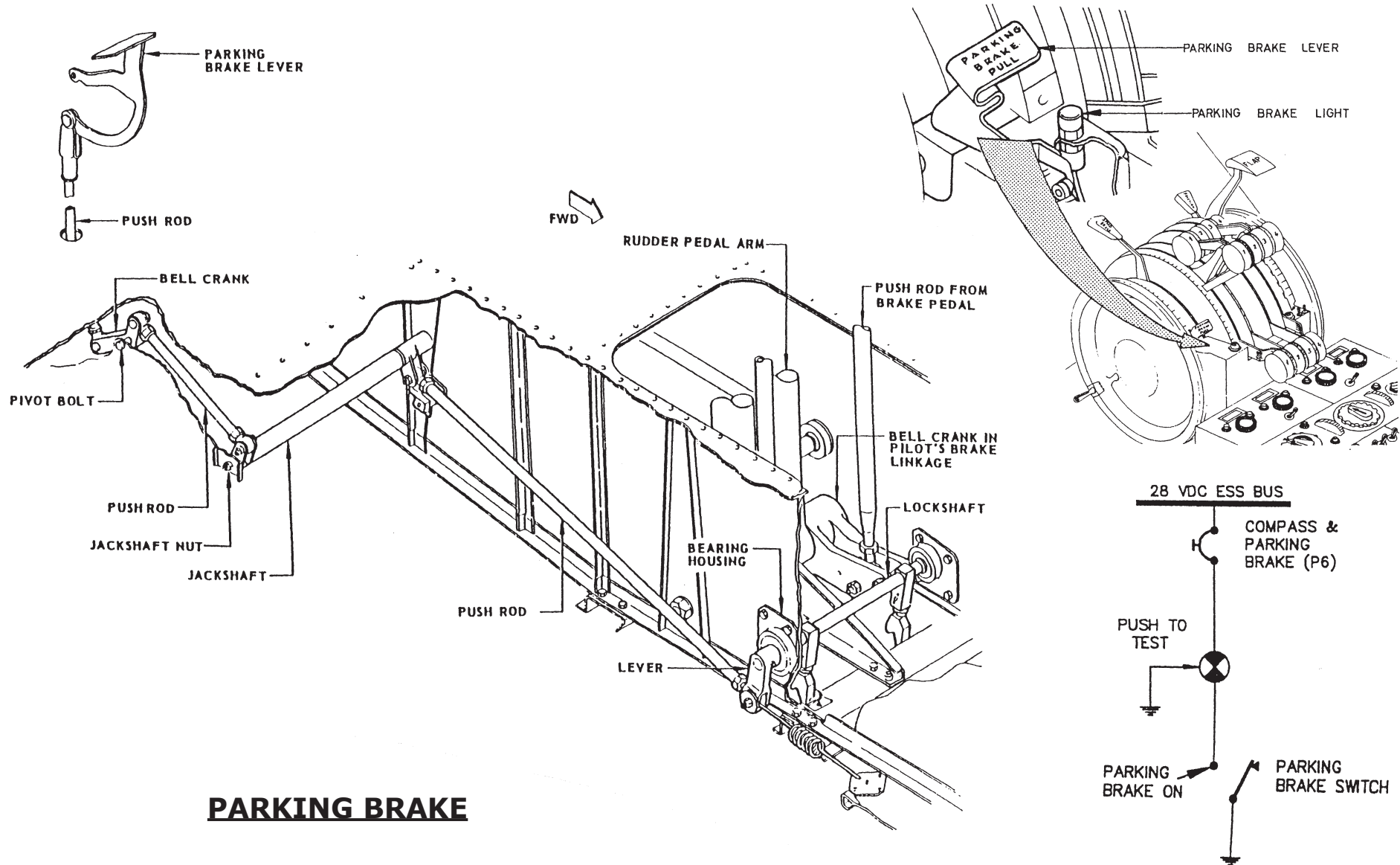
These pawls prevent brake pedals from returning into off position when released so that an intermediate pressure of about 925 psi is maintained on the brakes. Parking brake will be automatically released by fully depressing brake pedals. A return spring disengages the pawls which allows the brake pedals to come back to brakes released position. The parking brake lever is installed on the aisle control stand. A warning light near the parking brake lever illuminates when the parking lever is in on position. Power for the light is 28 VDC from the essential TR bus.

CAUTION: THE PARKING BRAKE MECHANICAL LINKAGE IS SUCH THAT THE BRAKE COULD BE APPLIED ON ONE SIDE ONLY. WHEN ONLY ONE BRAKE PEDAL IS DEPRESSED (LH OR RH) AND THEN THE PARKING LEVER IS PULLED, THE PAWLS LOCK THE BRAKE CONTROL MECHANISM IN ENGAGED POSITION FOR THIS SIDE ONLY.

PARKING BRAKE IS NOT RELIABLE IF ANTISKID SYSTEM IS INOPERATIVE.

Parking.

For parking, stop the airplane with the nose gear straight, so no eccentric forces stress the main landing gear shock struts, which might damage O-rings. To eliminate such forces, it is recommended to center the nose gear, then taxi a short distance straight ahead before stopping. Never apply parking brakes immediately after heavy braking. Always allow brake cooling, and thus prevent fusible plugs melting and tire fire. Maximum parking pressure will be delivered to the brakes provided that brake pressure is at least 2700 psi. Brake pressure at the end of an 8 hour parking period may decrease to 75% of the original pressure.



5. EMERGENCY BRAKE SYSTEM.

The pneumatic brake system provides an emergency means of applying the wheel brakes in case of hydraulic system failure and complete depletion of the accumulator precharge pressure. Pressure is modulated by a handle on the pilot's instrument panel. Pneumatic pressure acts on hydraulic fluid in a transfer tube applying hydraulic pressure equally to all brakes through a shuttle valve on each brake. An overboard vent line prevents brake application due to thermal expansion of the hydraulic fluid. No differential braking or antiskid protection is available with pneumatic braking.

Pneumatic Air Bottle.

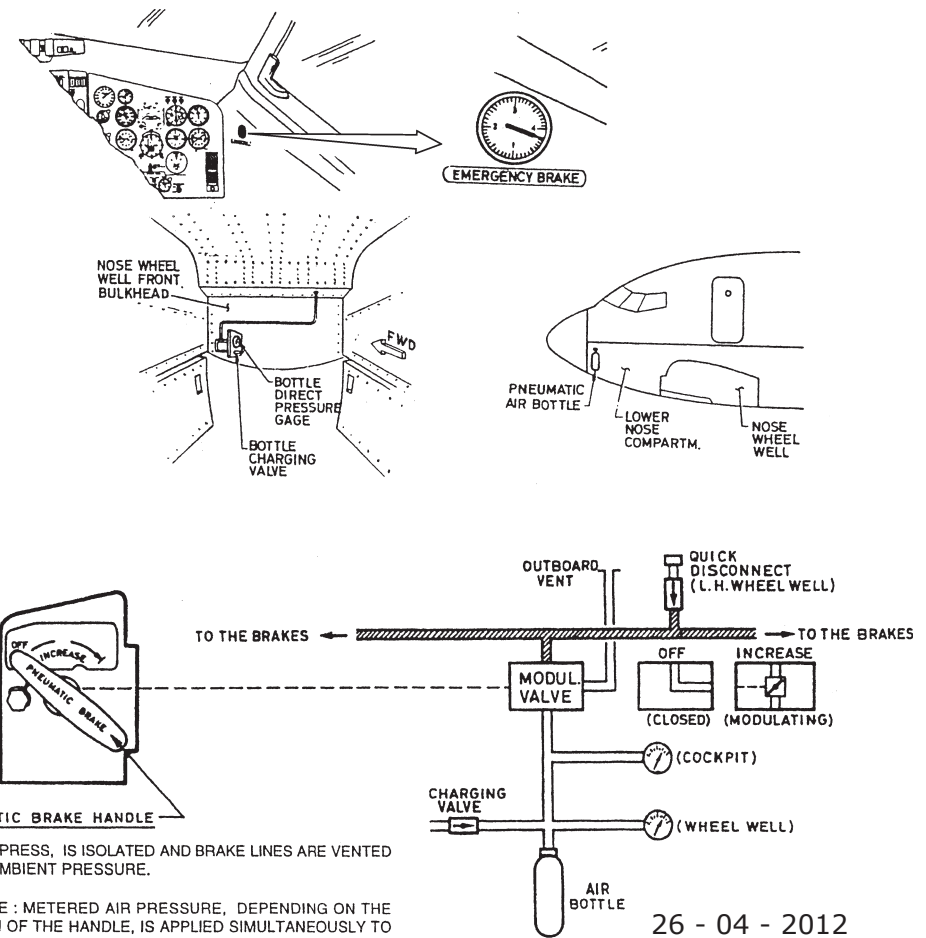
The bottle is installed in the nose gear wheel well. A charging valve and a direct reading pressure gage installed in the nose wheel well allow bottle servicing.

A second direct reading pressure indicator is installed on the copilot's side wall in the cockpit. The nominal pressure is 1200 psi.

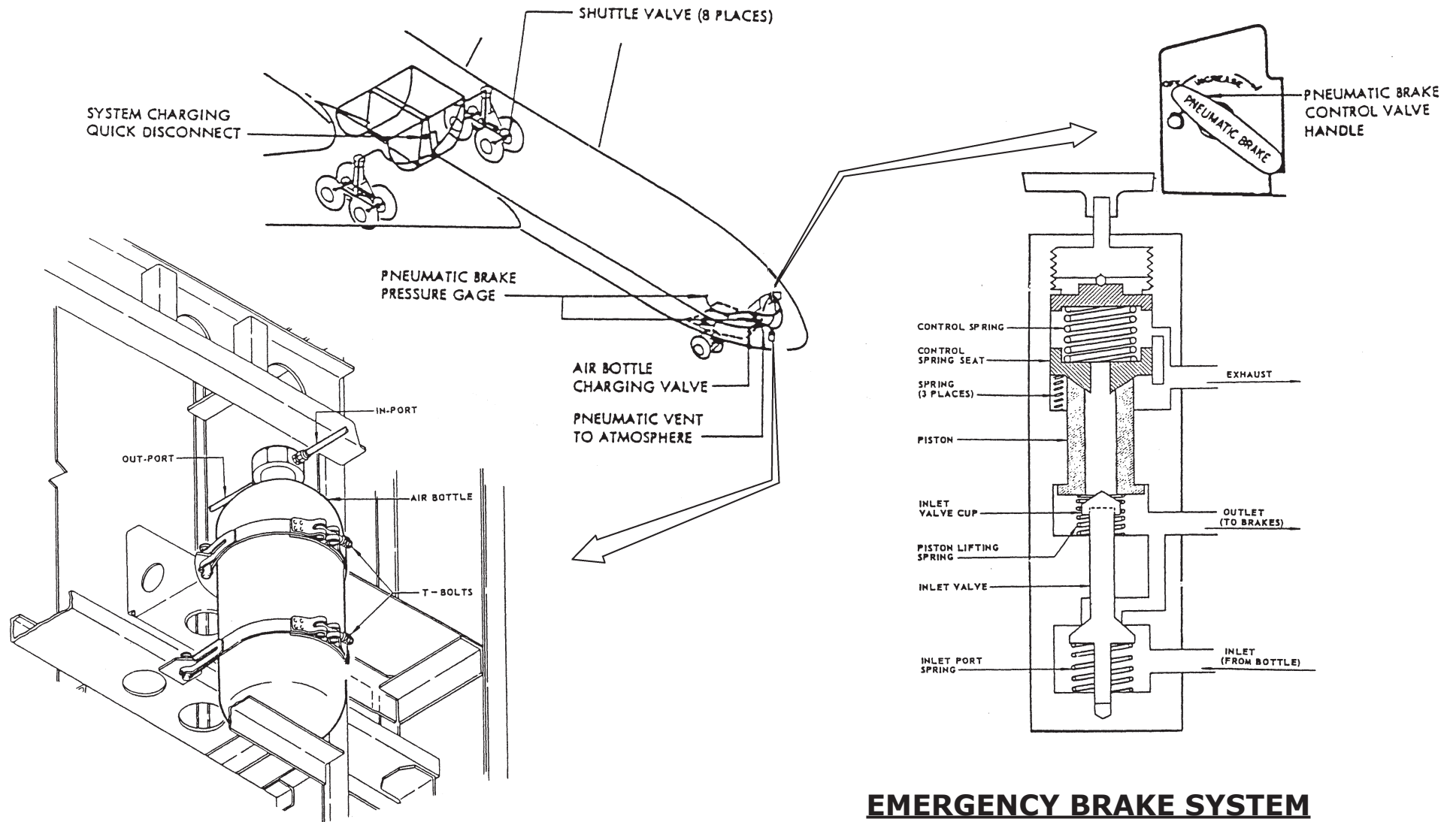
Pneumatic Brake Control Valve.

The valve is a modulating type valve. It is manually operated by a handle located on the pilot instrument panel. Pneumatic braking is applied by rotating the control handle to obtain the desired effect. Rotation of the handle allows selecting braking pressure from 0 to a maximum of approximately 850 psi.

A quick disconnect and a check valve have been installed in the LH wheel well for SKYDROL filling after use of the emergency brake. Filling does not need bleeding of the brake lines.



- OFF : AIR PRESS. IS ISOLATED AND BRAKE LINES ARE VENTED TO THE AMBIENT PRESSURE.
- INCREASE : METERED AIR PRESSURE, DEPENDING ON THE POSITION OF THE HANDLE, IS APPLIED SIMULTANEOUSLY TO ALL MAIN GEAR WHEEL BRAKES.



EMERGENCY BRAKE SYSTEM

6. ANTISKID SYSTEM.

The antiskid system prevents the wheels from skidding during brake operation by releasing and reapplying brake pressure in response to a wheel speed transducer installed in each main wheel. It also prevents brake application before landing. The antiskid system is a fully modulating type. The system consists of three basic elements :

- A wheel speed transducer in each wheel,
- A control shield which processes signals from the speed transducers and provides an appropriated correction signal
- An antiskid valve for each wheel which modulates hydraulic pressure applied to the brakes in accordance with correction signals received from the antiskid control shield.

Antiskid system operation is controlled by an antiskid switch located on the overhead panel. Four flag type indicators, corresponding to the four dual antiskid valves, are installed near the antiskid switch. They receive signals simultaneously from the corresponding dual antiskid valve. When energized they indicate "REL" (brake released). Otherwise the flags are blank.

Antiskid System Arming.

Power is available to the antiskid control system when :

- The ANTI-SKID switch is ON,
- LH gear down and locked (inbd. wheels control),
- RH gear down and locked (outbd. wheels control).

When the airplane is in flight, both LH and RH safety switches (squat switches) supply power to the logic circuits, replacing for each wheel the speed signal from the three others of the same group (the wheel being stopped, the logic circuits hold the brakes released). This circuit called "inflight arming" prevents landing with brakes applied. After touchdown, the control signals disappear progressively and the antiskid valves are controlled by the wheel speed

Antiskid Control Shield.

The control shield is located in the left main gear wheel well. It includes for each wheel:

- A control channel,
- A locked wheel channel.

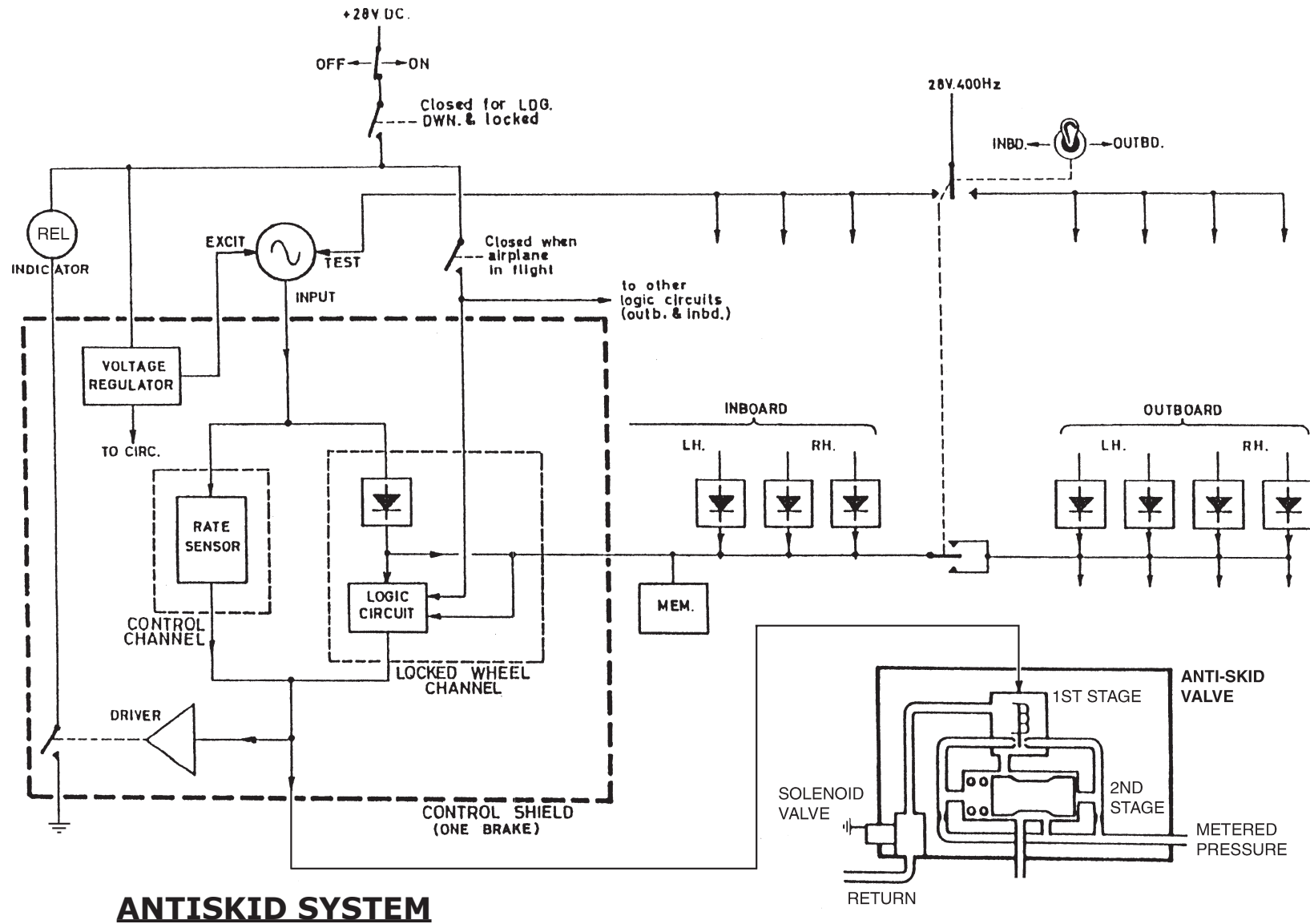
Control channel.

The control channel supplies a control signal to the antiskid valve when the deceleration rate exceeds a given value. When the wheel ceases to decelerate excessively, the control signal is not cancelled, but reduced to a value depending on the amplitude and the duration of the last skids. This provides the mean pressure level usable by the brake and permits the skid control system to operate about this mean. In the absence of a skid signal, the control signal will decrease progressively according to a predetermined time characteristic. In this manner, over a period of time, pressure is increased to the full metered pressure or until another skid causes a pressure reduction.

Locked wheel channel.

The locked wheel channel automatically releases brake pressure when a wheel stops completely while the other ones are still rotating. The system includes two identical wheel speed comparison and memory circuits, one for the inboard wheels and one for the outboard wheels. The speed signal delivered by the wheel speed transducer is applied to a logic circuit. The logic circuit of the considered wheel also receives the speed signal from the three other wheels of the same group. If the four wheels are rotating, the logic circuit is ineffective. If a wheel stops while the others are rotating, the logic circuit triggers a signal strong enough to overdrive the appropriate antiskid valve and to assure full brake pressure release. When a wheel is reaccelerating, its speed signal reappears. However, the valve control signal will remain maximum until initial wheel speed is recovered. Since then, the control signal supplied by the logic circuit decreases, and the brake is progressively reapplied. A memory circuit provides a reference speed signal in case of the four wheels lock simultaneously.

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ANTISKID SYSTEM

6.1. Wheel Speed Transducer.

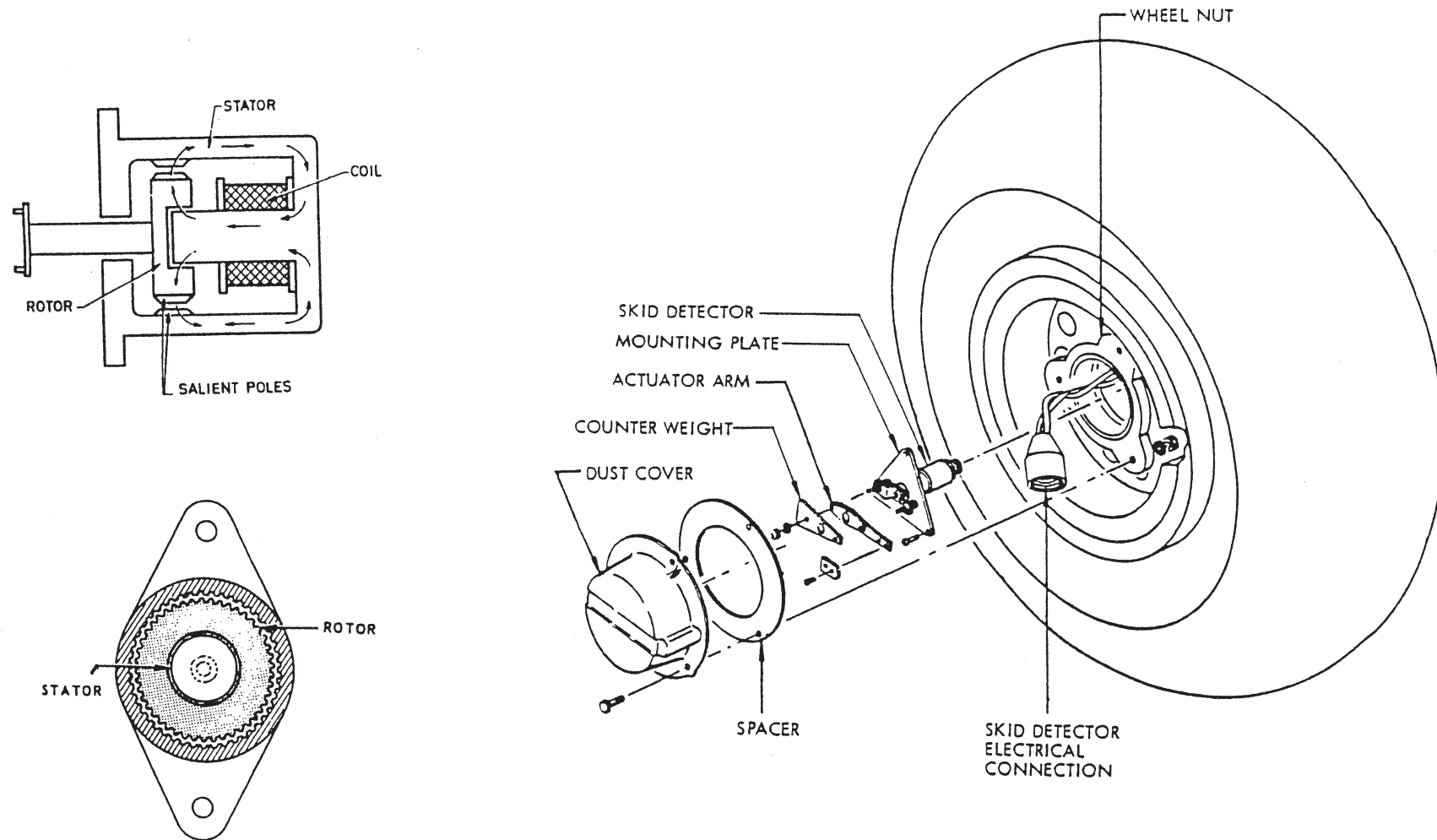
The wheel speed transducer consists of:

- A stator attached to the wheel axle and equipped with a coil which is normally energized by a DC voltage,
- A rotor attached to the wheel.

The skid detector is a speed sensing device. It contains only one moving part, a rotor which rotates inside a fixed stator.

The stator is firmly attached to the axle of each main gear wheel. The rotor is attached to the wheel. The rotor has 50 salient poles, or lobes, extend outward from its outer circumference. The stator has an equal number of salient poles extending inward. The stator also has a coil around it, which is connected to a controlled source of dc power. When the stator coil is energized, the stator becomes an electromagnet. When the wheel, and thus the rotor, is turning the lobes on the rotor, first approach and then recede from the lobes on the stator, thus changing the distance between them.

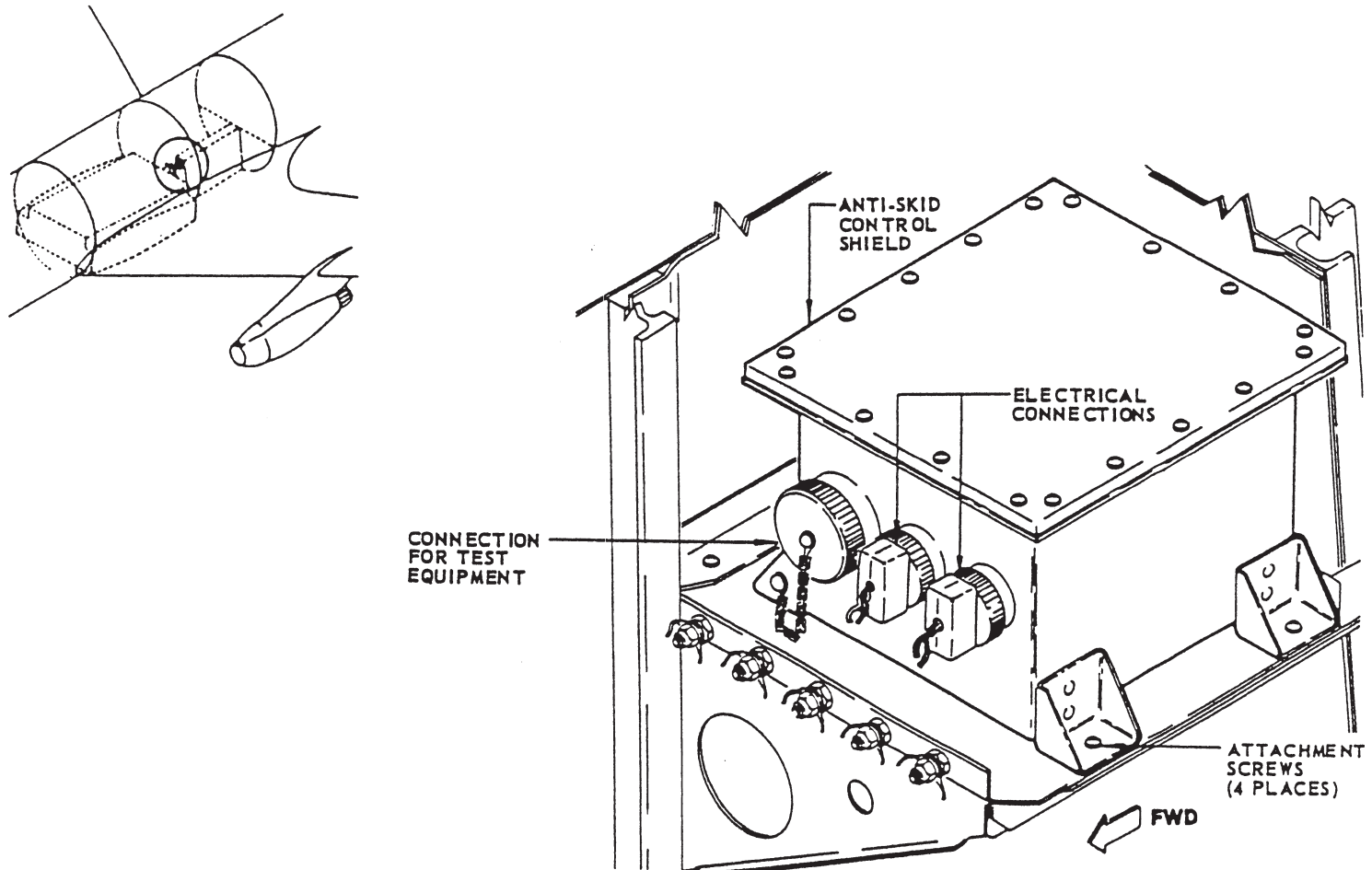
The change in distance causes a change in the magnetic field of the stator because of the variation in magnetic coupling (magnetic reluctance) between the stator and rotor. This change in magnetic field generates in the stator coil an ac voltage which is superimposed on the controlled dc energizing voltage. The frequency of the generated voltage is directly proportional to the rotational speed of the wheel. This ac signal is fed to the antiskid control shield.



WHEEL SPEED TRANSDUCER

6.2. Antiskid Control Shield.

The antiskid control shield contains of the necessary circuits for control of the antiskid system. The component circuits are: one control circuit, a voltage regulator circuit, and a valve drive circuit for each wheel, and two memory circuits, each common to four wheels.



ANTISKID CONTROL SHIELD

6.3. Antiskid Control Valve.

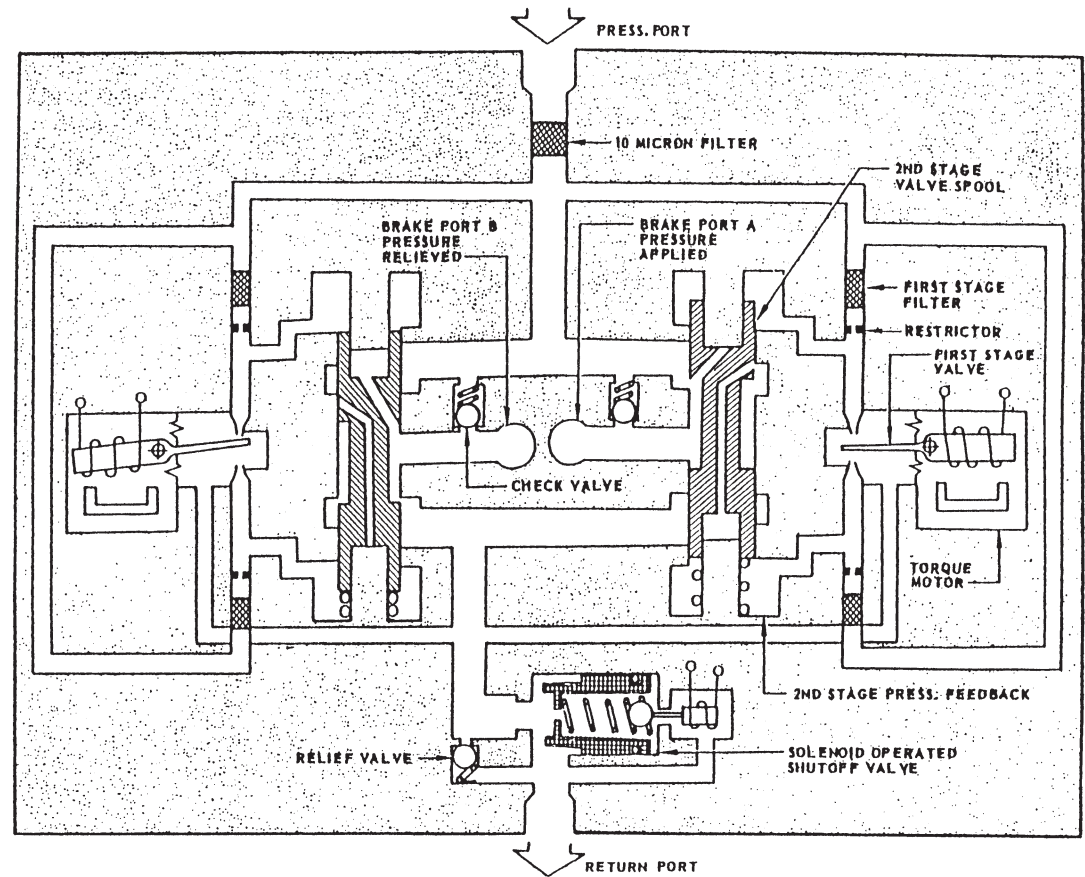
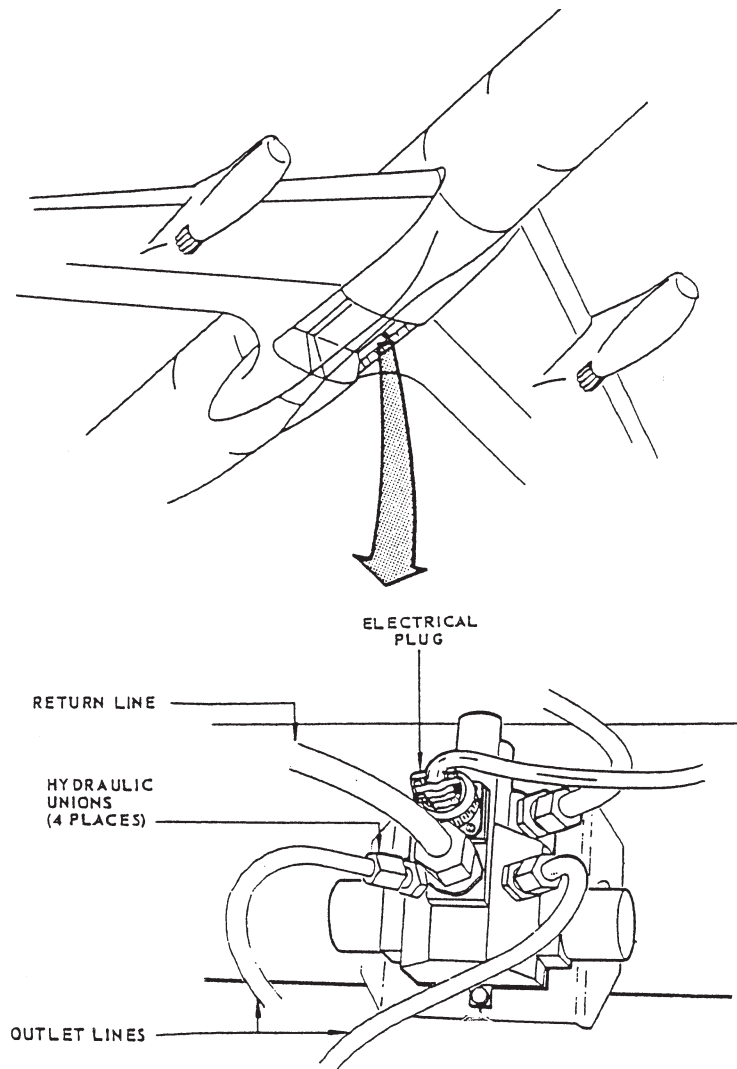
The antiskid control valve is an electrically controlled hydraulic valve which modulates hydraulic pressure applied to the brake lockout deboost valves in accordance with signals received from the antiskid control shield. Each valve assembly consists of two complete modulating valves in a common housing. Each of the modulating valves, in turn, consists of an electrically controlled first stage or servo valve, and a hydraulically controlled second stage valve. Each of the modulating valves in the dual assembly operates independently of the other.

When the pilot's brake metering valves are depressed, hydraulic fluid under pressure is metered to the antiskid control valves. Fluid flows into the pressure port, past the ends of the second stage valve spools, and then to brake pressure ports A and B. Fluid also flows through restrictors and ports on each side of the first stage valves, and then to the return port. When the first stage valve is in a neutral position. (antiskid off or no skid signal) the pressure drops, caused by flow through the restrictors, on each side of the valve are equal. The reduced pressures on each side of the first stage valve are applied to the ends of the second stage valve spool. As long as the pressures sensed at each end of the second stage valve spool are equal, spring pressure holds the spool in the "open" position, allowing free flow of pressure to the brake port. When a skid signal is received

from the control shield, it is applied to the first stage valve which moves to restrict the flow of fluid through the control port. Since this imposes an additional, restriction to fluid flow, the pressure at this port increases. This increased pressure is sensed at the end of the second stage valve spool, which moves from the "open" position. Displacement of the second stage valve spool from the open position reduces the pressure available at the brake port. Differences in control pressures are balanced by differences between supply and brake pressures. Since the movement of the first stage valve, and hence that of the second stage valve, is proportional to the strength of the correction signal received, the antiskid control valve can modulate brake pressure from essentially zero to the full pressure available from the brake metering valves, thus permitting skidding of modest frequency and severity and thereby attaining optimum braking efficiency.

Parking Brake Set.

Since the design of the antiskid control valve is such that there is a continuous bypass of fluid, a solenoid operated shutoff valve is incorporated in the return port of the antiskid control valve. The purpose of the shutoff valve is to close the return line when parking brakes are applied, and thus prevent bleeding off pressure through the ports of the antiskid control valve while the airplane is parked.



ANTISKID VALVE

6.4. Antiskid System Operation.

In flight, with wheel rotation stopped and landing gear down, the "squat" switches cause the antiskid valves to open, releasing pressure in all brakes. The REL indicators illuminate, and brakes cannot be applied until the weight of the airplane is on the landing gear, closing the "squat" switches.

When brakes are applied, full metered brake pressure is applied to all brakes until wheel deceleration exceeds a preset limit. When this limit is exceeded, pressure to that brake is reduced until the wheel speed increases to match the other wheels. The "locked wheel" circuit compares wheel speeds and, if one wheel is rotating much slower than the others, releases brake pressure completely to that wheel until the wheel is rotating at the same speed as the other wheels. The locked wheel circuit is disabled below a wheel rotating speed equal to about 17 knots, so that brakes do not release when applied during taxiing. Therefore, antiskid does not have to be shut off for taxiing.

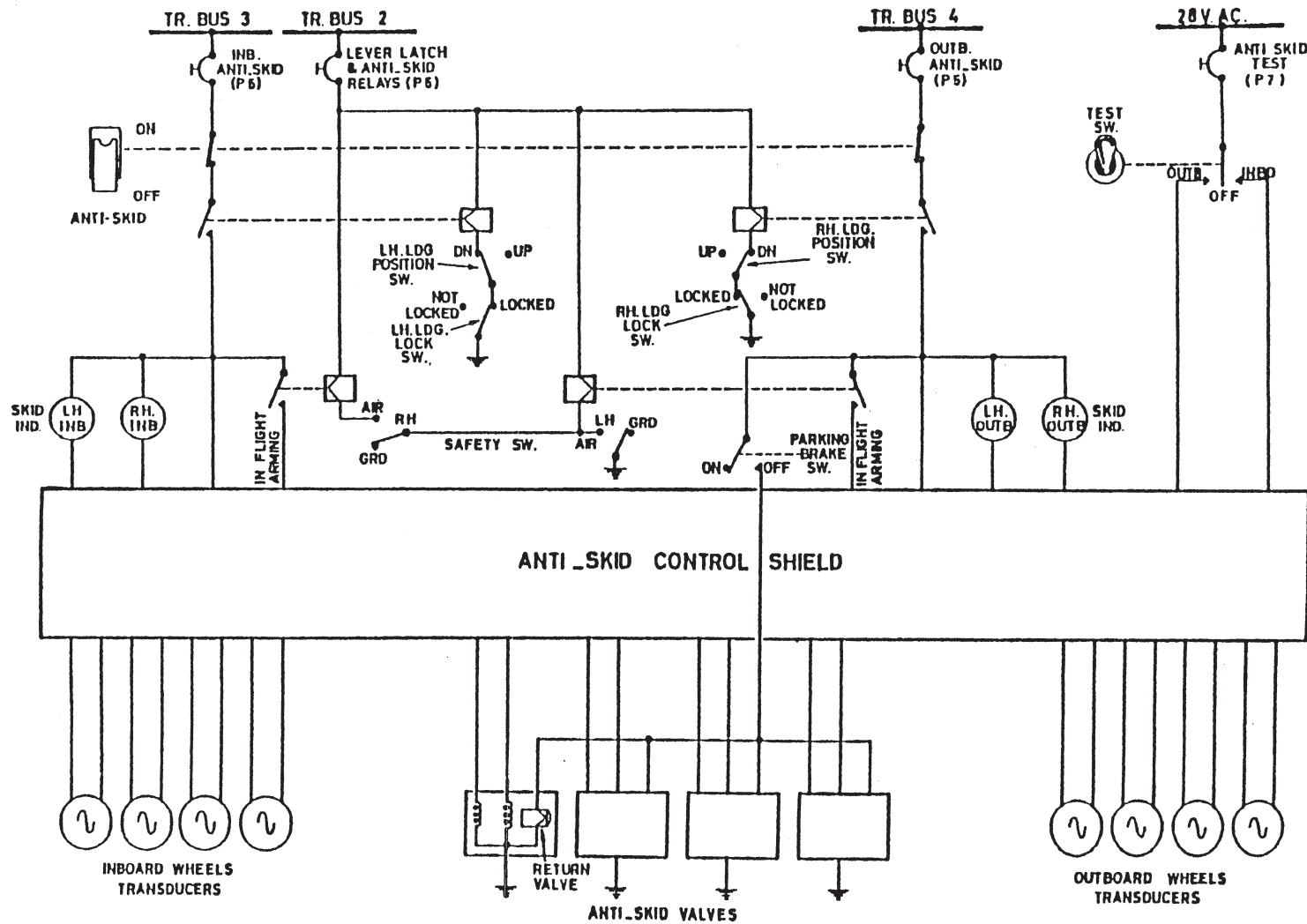
CAUTION: IF "SQUAT" SWITCH DOES NOT OPERATE ON LANDING, BRAKES DO NOT PRESSURIZE UNTIL WHEELS SPINUP TO A WHEEL SPEED CORRESPONDING TO ABOUT 17 KNOTS GROUND SPEED.

IF ANY LANDING GEAR DOWN LIGHT (GREEN) DOES NOT ILLUMINATE WHEN GEAR IS DOWN AND LOCKED, OR IF ONE OR MORE REL INDICATORS DO NOT ILLUMINATE ON PREFLIGHT OR DURING BEFORE LANDING CHECK, USE ANTISKID INOPERATIVE DATA IN SECTION IX "PERFORMANCE DATA". REFER TO "TAKE OFF WITH ANTISKID MALFUNCTIONS", SECTION II, AND "ANTISKID INOPERATIVE BRAKING" IN SECTION III

DO NOT OPERATE TEST SWITCH WHILE TAXIING. IF BRAKES ARE IN USE, TEST SWITCH CAN RELEASE ONE SET OF BRAKES.

REL Indicators.

The normally blank skid indicators on the overhead panel show "REL" whenever a full release signal is applied to the antiskid valves (signal from the locked wheel channel).



ANTISKID SYSTEM OPERATION

6.5. Test Switch.

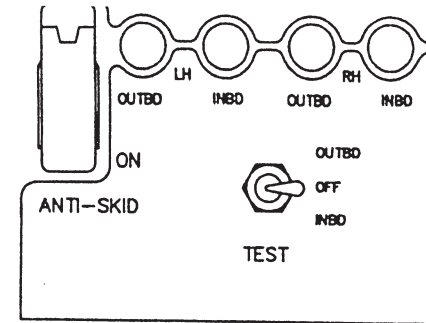
The test circuit is operated by the test switch on the pilot's overhead panel. When the airplane is on the ground, and all circuits energized, all four antiskid indicators will be blank. Movement of the test switch to the "OUTBD" position electrically simulates rotation of the outboard wheels.

The antiskid control shield will interpret this as locked inboard wheels, and thus show a "REL" indication on the inboard indicators. Movement of the test switch to the "INBD" position will have the opposite effect.

While the airplane is in flight, and the gear is down and locked, all indicators will show "REL". Movement of the test switch to the "OUTBD" position will cause the outboard indicators to be blank. Movement of the switch to the "INBD" position will cause the inboard indicators to be blank.

NOTE: If the parking brake is set, the test remains effective but does not control the release of the brakes, due to the fact that the solenoid valve included in the antiskid valve return line being closed.

A/S SWITCH	CONDITION	ANTISKID INDICATORS
OFF	ANY	○ ○ ○ ○
ON	FLIGHT GEAR UP	○ ○ ○ ○
	FLIGHT GEAR DOWN & LOCKED	BEFORE LANDING (WHEELS STOPPED) REL ○ REL ○ REL ○ REL ○
		AFTER TAKE OFF (WHEELS STOPPED) ○ ○ ○ ○ THEN REL ○ REL ○ REL ○ REL ○ AFTER WHEELS SLOW DOWN TIME
	GROUND -NO BRAKING -BRAKING WITHOUT SKIDDING	○ ○ ○ ○
GROUND BRAKING (EXAMPLE) -ABNORMAL DECELERATION ONE OF THE LH INBD. TANDEM WHEELS -ONE OF LH INBD. WHEELS TURNING SLOWER THAN OTHER INBD. WHEELS	○ REL ○ ○ ○ ○ BRAKES OF BOTH WHEELS OF LH INBD. TANDEM RELEASED	



TEST SWITCH	AIRPLANE CONDITIONS	ANTI SKID IND.
OFF	IN FLIGHT GEAR UP	○ ○ ○ ○
	IN FLIGHT GEAR LOCKED DOWN (ARMING)	REL ○ REL ○ REL ○ REL ○
INBOARD	WHEELS STOPPED	REL ○ ○ ○ REL ○
OUTBOARD	WHEELS STOPPED	○ REL ○ REL ○ ○

ANTI SKID TEST

7. ABNORMAL OPERATION.

Braking in case of utility system failure.

1. USE OF THE BRAKE INTERCONNECT VALVE

- Brake pressure gage indicates 3000 psi (leak not located in the brake system):
 - Set INTERCONNECT VALVE switch to BRAKE. The braking capability will not be affected.
 - Shortly before touch down, set utility pumps ON.
- Brake pressure gage indicates zero (leak located in the brake system) :
 - At touch down, set INTERCONNECT VALVE switch to BRAKE and utility pumps ON.
 - Use pneumatic brakes if necessary.

In both cases :

- Do not pump brake pedals !
Pumping brake pedals rapidly depletes the fluid stored in the brake accumulator and in the two auxiliary reservoirs.

NOTE: In case of complete hydraulic failure (utility and auxiliary), hydraulic pressure is only available from brake accumulator. The number of pedal applications available in this case depends upon accumulator pressure.

- Leave antiskid system on, but adjust pedal pressure to avoid excessive antiskid cycling (not more than 1 cycle per second).

NOTE: Brake accumulator stores enough fluid to support many antiskid cycles, the exact number depending on the amount of pedal pressure. Turning off the antiskid system would increase the hazard of blown tires and subsequent loss of directional control.

Good braking is achieved if enough brake pressure is supplied to feel a slight deceleration at high speed, and if the same pressure is continuously held until aircraft stops. After slowing down to taxi speed use differential forward thrust to steer the airplane.

2. USE OF PNEUMATIC BRAKES

(see also section III "EMERGENCY PROCEDURES")

Pneumatic brakes should be used only as a last resource because :

- Hydraulic brake system must be bled following use of emergency air braking.
- Antiskid capability is not available. The tendency is to apply excessive pressure. As a result, a number of blown tires and an uncontrolled skid might occur.
- The pneumatic brake system does not provide for maneuvering with differential braking which means that different brakes and tires conditions on one truck could induce airplane skidding on one side.

The control handle is normally lockwired in OFF position. If pneumatic brakes have to be used, the lockwire should be broken during approach to avoid a possible delay in applying the brakes during landing roll. Before attempting to tow the airplane, turn the handle to OFF and allow the system to bleed down (10-20 seconds may elapse before the pressure drops significantly).

WARNING: DO NOT USE BRAKE PEDALS WHEN APPLYING EMERGENCY BRAKES. DEPRESSING THE BRAKE PEDALS WHEN USING PNEUMATIC BRAKES COULD RESULT IN BLOCKED BRAKES, BLOWN TIRES, OR POSSIBLE DAMAGE TO OTHER PARTS OF THE AIRPLANE, OR EVEN PREVENT BRAKING AT ALL.

Hydraulic and pneumatic brake systems are isolated by shuttle valves.

A differential pressure of about 50 psi is sufficient to open the valve to the high pressure side. Residual hydraulic pressure may be sufficient to open the shuttle valve even if the pressure gage indicates only preload pressure.

Should this condition exist during emergency braking, stepping on the brake pedals would trap air in the hydraulic system. When pressure on the brake pedals is released the trapped air might prevent release of the brakes.

Braking under wet or icy runway conditions.

Under wet or icy runway conditions, relatively light pedal pressure can produce excessive antiskid cycling. The most efficient braking under these conditions is obtained by adjusting pedal pressure to keep the cycling rate down to 2-3 per second.

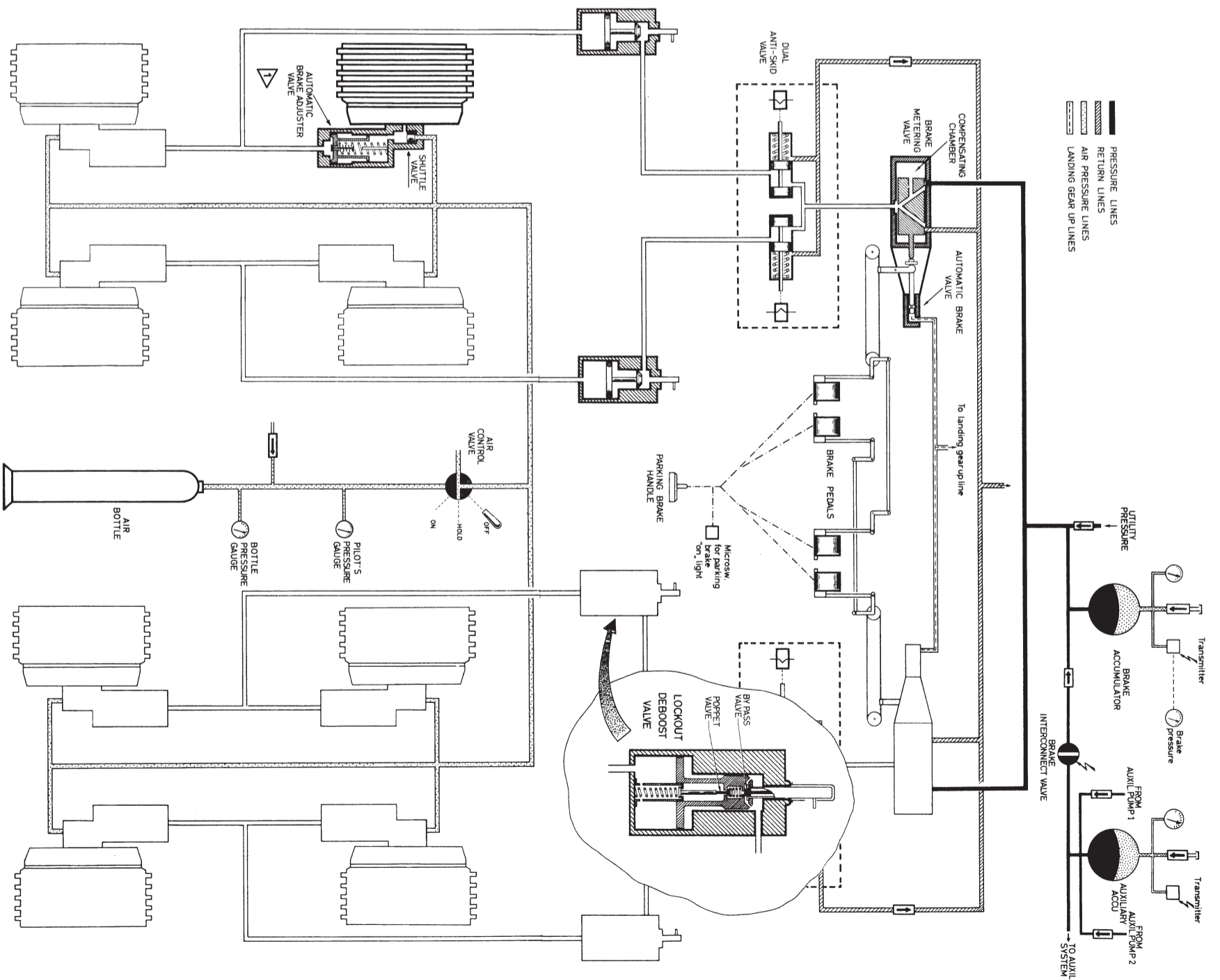
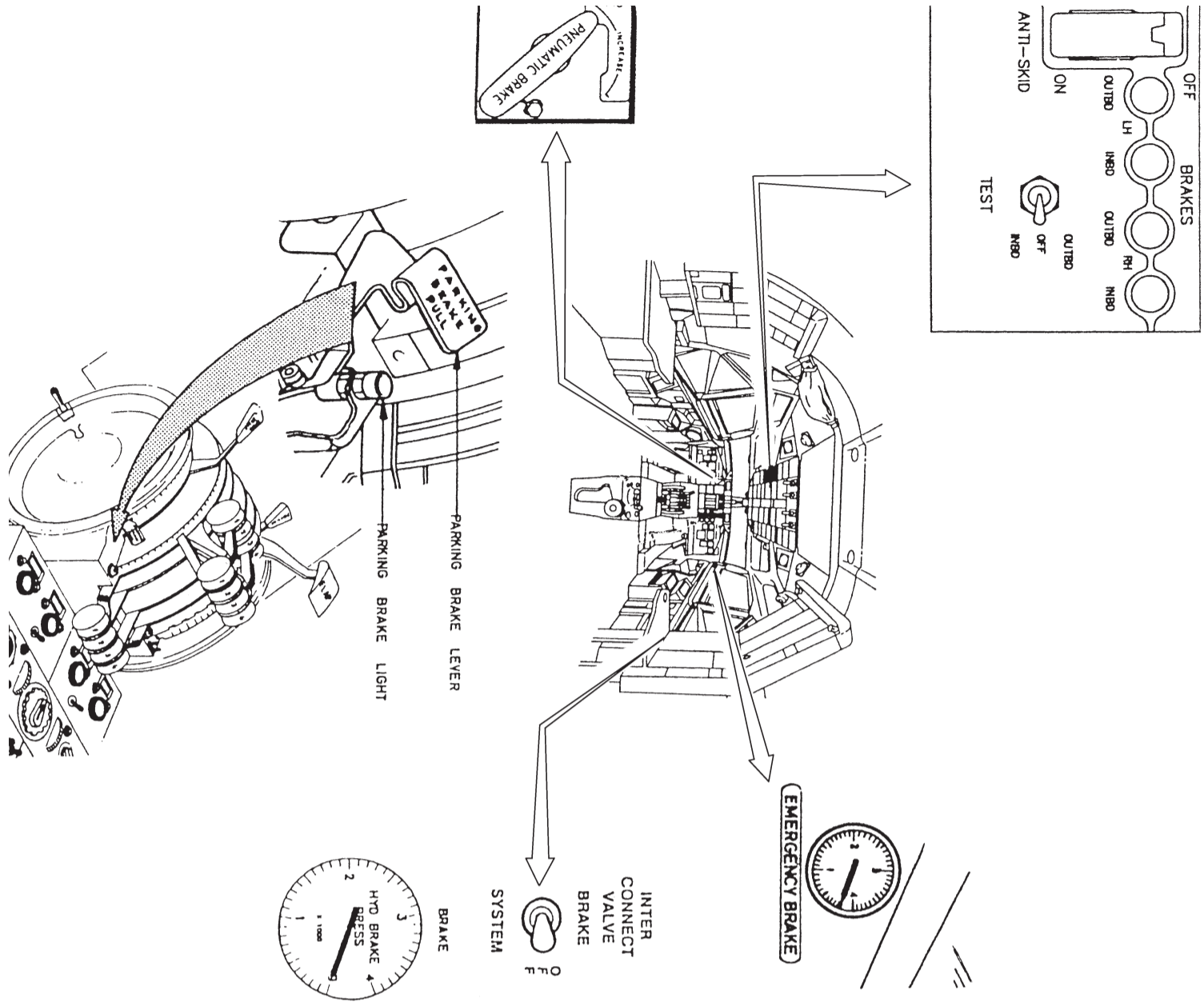
NOTE: During skid the wheel braking effort is considerably less than when the wheel is turning but being braked to the point just before starting to skid. Excessive cycling of the antiskid system reduces total braking force roughly in proportion with the cycling rate.

Wheel and brake fire after landing

Dry chemical fire extinguishing powder is recommended for controlling wheel fires because it is less likely to chill the wheel steel parts. If CO₂ or water is used, some parts of the wheel might be cooled too quickly, and differential contraction could cause cracks in the metal. Any time wheels have been subjected to the thermal shock because of rapid cooling from high temperatures by CO₂ or water, the wheels have to be scrapped.

WARNING: USE OF CO₂ OR WATER TO EXTINGUISH A WHEEL FIRE ALSO PRESENTS A DANGER FOR THE PERSONNEL, ESPECIALLY WHEN ONE OR MORE TIRES REMAIN INFLATED. IF A WHEEL IS UNDER TIRE PRESSURE, CRACKS RESULTING FROM A RAPID COOLING CAN LEAD TO SEPARATION OF THE WHEEL. IN THIS CASE WHEEL PARTS ARE MOST LIKELY TO HAVE OUTBOARD OR INBOARD RATHER THAN FORWARD OR TO THE REAR. THEREFORE PERSONNEL SHOULD APPROACH THE LANDING GEAR TRUCK EITHER FROM THE FRONT OR FROM THE REAR.

If all tires have deflated by melting of the fusible plugs, using of a fine spray of CO₂ or water as extinguishing agent is not dangerous for the personnel.



▷ ON SOME AIRCRAFTS (TURBOJET)

BRAKE SYSTEM

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