Aviation Competence Centre
First Class Education

Boeing 707

Landing Gear

Training manual

ATA 32

Contact address for

course registrations
course schedule information

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1. GENERAL.

The tricycle landing gear has two 4-four-wheel main gear trucks and a steerable, dual-wheel nose gear. All three gears are actuated simultaneously by the landing gear lever on the pilot's center instrument panel.
The gear is normally powered by the utility hydraulic system.

The main gear retracts inboard into the wheel well areas of the fuselage which are faired by doors hinged to the keel beam. The nose gear retracts forward into a nose wheel well, faired by clam shell type doors.

A lever lock solenoid, when de-energized, prevents the pilot from inadvertently placing the landing gear lever in the up position.
Landing gear down and locked position lights, landing gear and door warning lights, and a truck unlevel light are provided.
A warning horn which sounds due to various unsafe condition is also provided.

LANDING GEAR Lever.
Lever has three detent positions: UP - OFF - DN (Push lever into detent when operating). Refer to LANDING GEAR OPERATION.

UP.
Mechanically positions landing gear control valve to open doors, raise gear, and close doors in retraction sequence.

OFF.
Mechanically positions landing gear selector valve to cause pressure to be blocked in up and down lines depressurize brakes and landing gear systems. Normal flight position.

DN.
Mechanically positions landing gear selector valve to open doors, drop gear, and close doors in the extension sequence. Refer to LANDING GEAR OPERATION.

CAUTION: DO NOT SET GEAR LEVER TO OFF ON GROUND. COLLAPSE OF NOSE GEAR CAN RESULT.

LOCK OVERRIDE Trigger.
When pulled, overrides gear lever solenoid lock and allows gear retraction. Solenoid lock prevents raising gear lever until either main landing gear strut is extended and both trucks have been levelled (rotated perpendicular to gear strut) after takeoff.

CAUTION: USE LOCK OVERRIDE ONLY IN EXTREME EMERGENCIES.
GEAR RETRACTS WHETHER IN CORRECT POSITION OR NOT.
GEAR COULD HIT DOORS OR STRUCTURE, CAUSING DAMAGE.

Gear Door Warning.
A red light on the pilot's center instrument panel will illuminate when any landing gear door is not closed and locked.

Landing Gear Warning.
A red light on the pilot's center instrumentpanel will illuminate when any landing gear is not locked. This light will also illuminate on the ground if the. gear lever is pulled out of the down detent.

Gear Down/Locked Lights.
Each gear has a green down and locked light on the pilot's center instrument panel. These lights will illuminate only when the specified gear is down and locked.
A switch directly below the lights allows the pilot to dim the lights.

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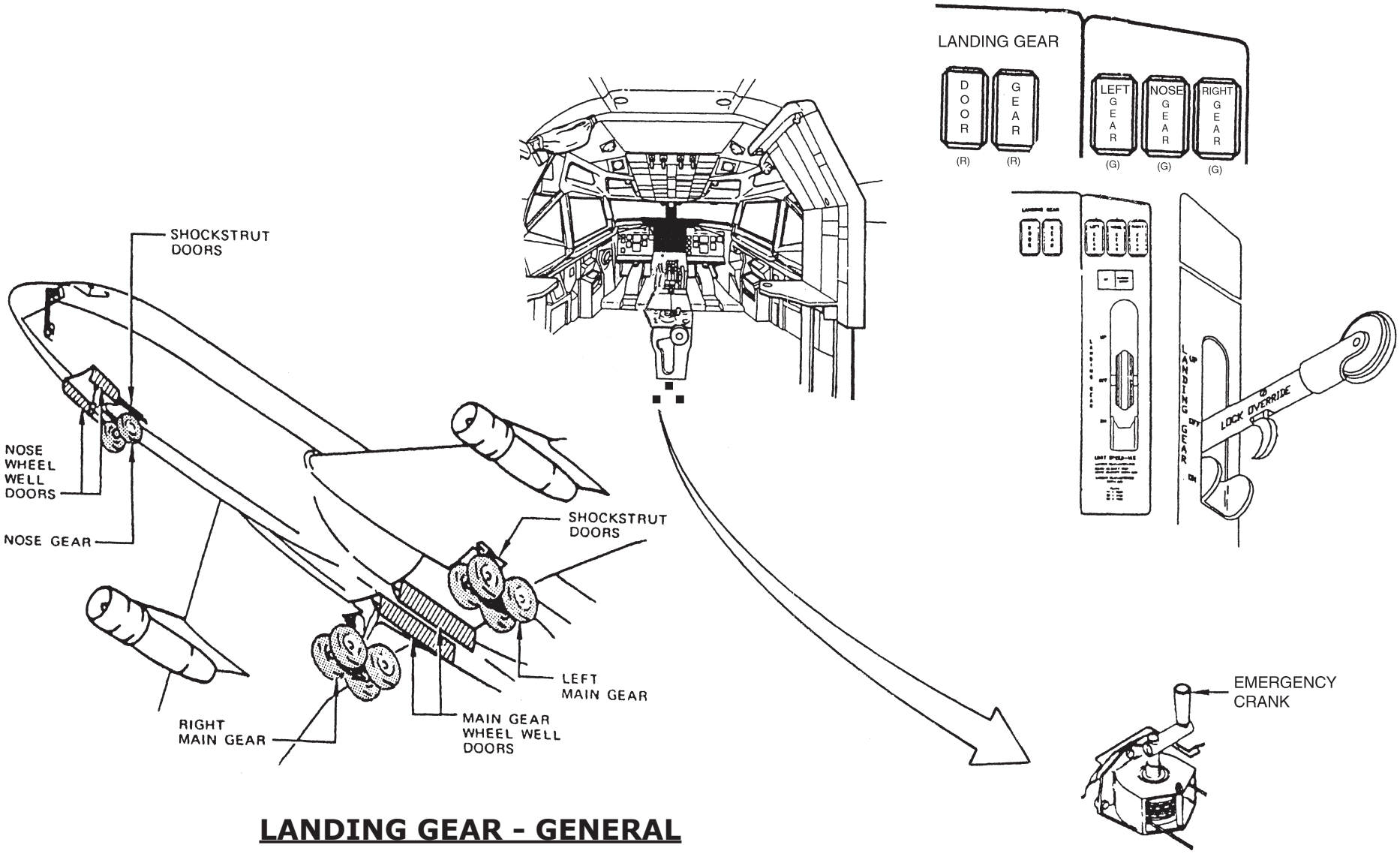


LANDING GEAR - GENERAL

Emergency Extension System.
The landing gear manual extension system provides a means for extending the gear independent of the normal hydraulic controls. Crank operated cable systems for each gear control the emergency extension. Any of the gear, when unlocked, will free fall to the extended position. This makes cranking necessary only to release the doors and unlock the gear from the up position, and to lock the gear in the down position.

The controls for manual gear extension are in the floor of the cockpit. Three hand-crank drums, one for each gear are accessible through doors in the cockpit floor. A crank, stowed on the cockpit side of the 302 bulkhead, is used to turn the drums.
The hand-crank drums are rotated one way to unlock the wheel well doors and unlock the gear, and rotated in the opposite direction to lock the gear in the down position.

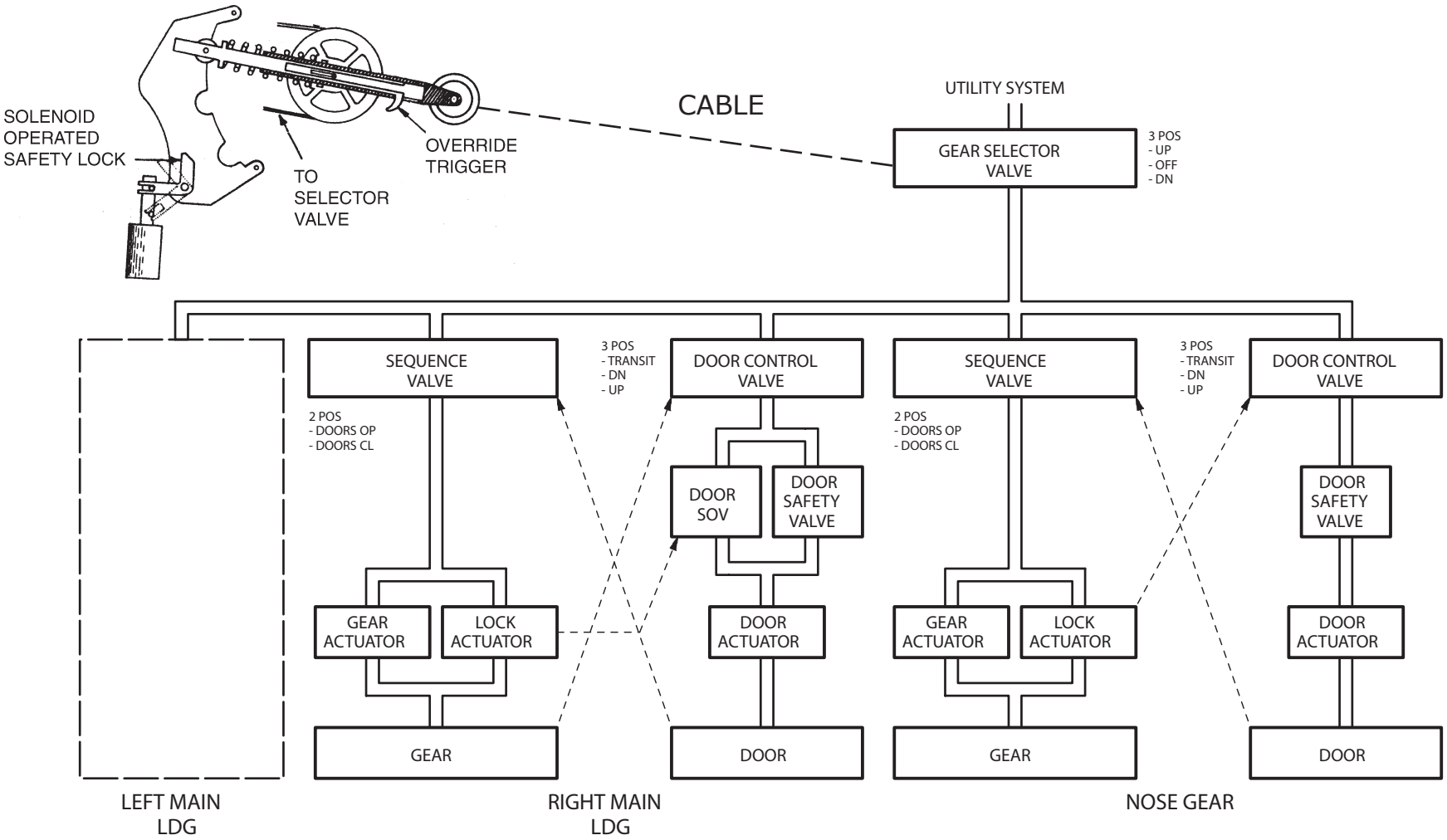
Landing Gear and Gear Door Control System.

The landing gear and door control system controls the retraction and extension of the main and nose gear, and the main and nose gear doors.
The doors are sequenced to close after each retraction or extension of the landing gear.

The control system consists of a control handle, control cable system, a selector valve, door control valves, sequence valves, door safety valves, door shutoff valve, restrictors, a pressure relief and various check valves.

When the landing gear control handle is positioned to actuate the gear, the wheel well doors will open first. As the doors reach open position, hydraulic pressure is directed to unlock the gear. Pressure is also directed to the landing gear actuators to retract or extend the gear) depending on the position of the control handle. As the geax reaches retracted or extended position, hydraulic pressure is directed to close the wheel well doors.

CAUTION: IF THE LANDING GEAR SELECTOR HANDLE IS MOVED FROM “DOWN” TO “OFF” WHILE THE AIRPLANE IS ON THE GROUND, COLLAPSE OF THE NOSE GEAR CAN RESULT IF THE CABLE RIGGING TO THE LANDING GEAR SELECTOR IS MARGINAL OR INCORRECT, AND THE LANDING GEAR GROUND LOCKS ARE NOT INSTALLED. THEREFORE, AVOID PLACING LANDING GEAR SELECTOR SWITCH IN “OFF” POSITION WHEN ON THE GROUND.



LANDING GEAR - GENERAL

2. MAIN LANDING GEARS.

2.1. Main Gear Assembly.

Each main gear includes:

- Four wheels mounted on a truck,
- A shock strut which transmits fuselage and wing loads to the truck when the airplane is on the ground and absorbs shock loads on landing and during taxi,
- A trunnion which attaches the gear to the airplane structure and allows its extension and its retraction,
- A drag strut and an articulated side strut which respectively transmit longitudinal and lateral loads, applied on the wheels, to the airplane structure,
- A main actuator which rotates the trunnion to retract or extend the gear,
- A single lock mechanism which locks the gear in UP and DOWN position.

Truck Assembly.
The truck consists mainly of a beam attached by a pivot axle to a yoke at the lower end of the shock strut. The truck is equipped with:

- A leveling cylinder which keeps the truck beam perpendicular to the shockstrut during gear retraction and extension
- A snubber which dampens rapid truck beam pitchings
- Four brake equalizing rods which balance braking between front and rear wheels (see Brake Systems).
- A leveling switch attached to the aft inboard side of the truck beam, and actuated by a link connected to the shock strut yoke, senses whether the truck is tilted.

Jacking points are provided under each landing axle for removal of wheel and tire or brake assembly.

CAUTION: JACKING AIRPLANE UNDER ANY PART OF TRUCK OTHER THAN JACK PADS MAY DAMAGE THE BEAM BECAUSE OF SENSIBILITY OF THE HIGH STRENGTH STEEL TO NOTCHES OR MICROCRACKS WHICH WILL ULTIMATELY CAUSE TRUCK FAILURE.

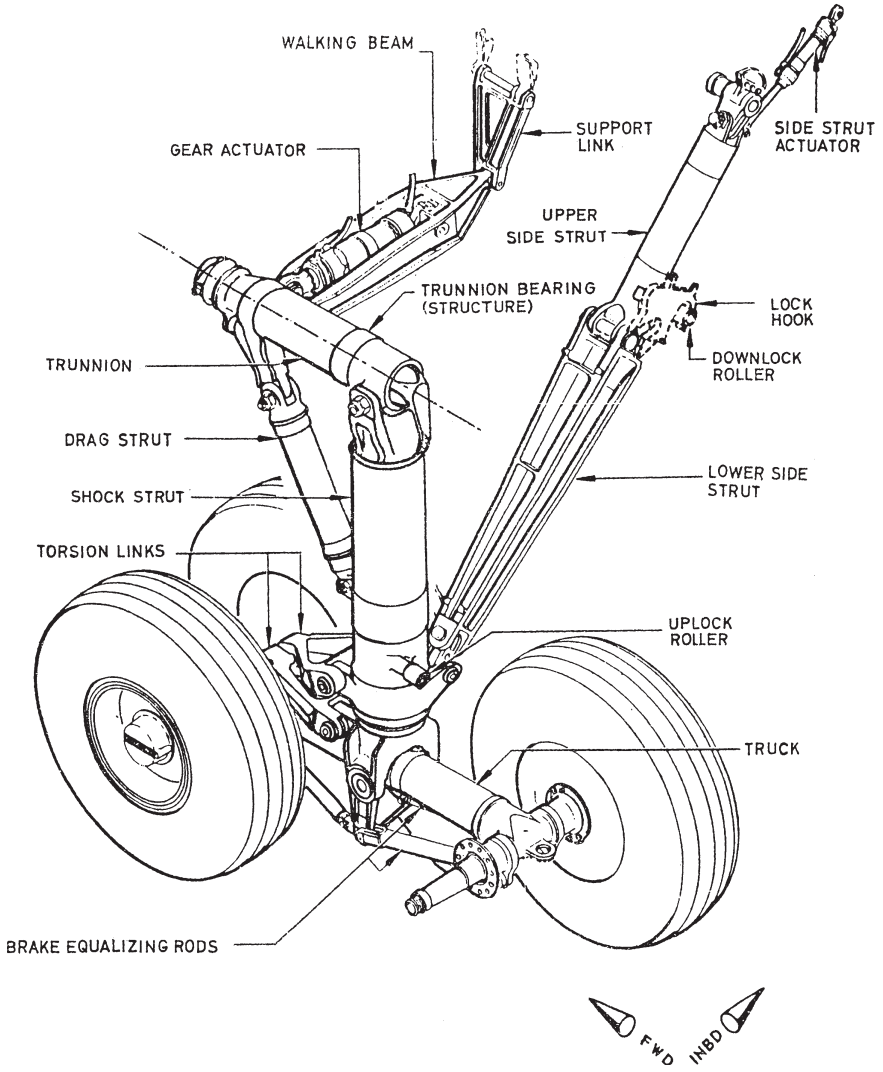
Main Gear Actuator.
The main gear actuator provides the power required to retract and extend the main landing gear. The actuator is a hydraulic piston type, with snubbing action to slow its movement when limits of travel are approached. The cylinder end of the actuator is attached to the walking beam, and the piston rod end is attached to trunnion arm. One end of the walking beam is attached to structure and the opposite end pivots on a second trunnion arm. The actuator and walking beam are located in the wing trailing edge just inboard of the trunnion, and forward of the main gear side strut.

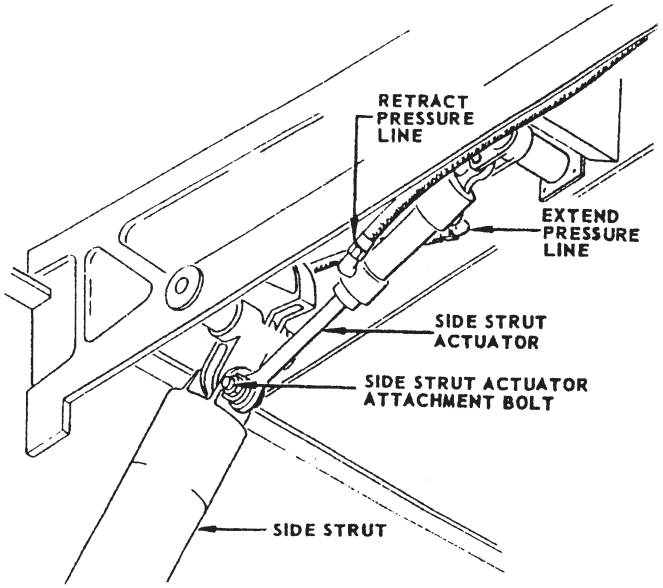
Main Gear Actuator "Walking Beam".
The main gear actuator walking beam works in conjunction with the main gear actuator, to retract and extend the main gear assembly. The walking beam serves to reduce the reaction force going into the airplane structure from the main landing gear actuator. This is accomplished by taking the reaction force of the main gear actuator back to the trunnion through the walking beam. The beam is attached to the lower of two lugs at the forward end of the trunnion. The inboard end is attached to a beam support, hinged to the airplane structure. One end of the main gear actuator pivots in the beam, the piston-rod end is attached to an upper lug on the trunnion.

With the main gear down and locked, the walking beam trunnion attachment lug is below and slightly outboard of the trunnion centerline.
The actuator attachment to trunnion is just slightly below a point directly inboard of the trunnion centerline.

Main Gear Side Strut Actuator.

The main gear side strut actuator extends to push the side strut overcenter into locked position as the main gear fully extends. On initial retraction the actuator pulls the side strut back from overcenter and out of locked position. The actuator is a hydraulic piston type and is located between the side strut upper universal and structure.





MAIN GEAR ASSEMBLY

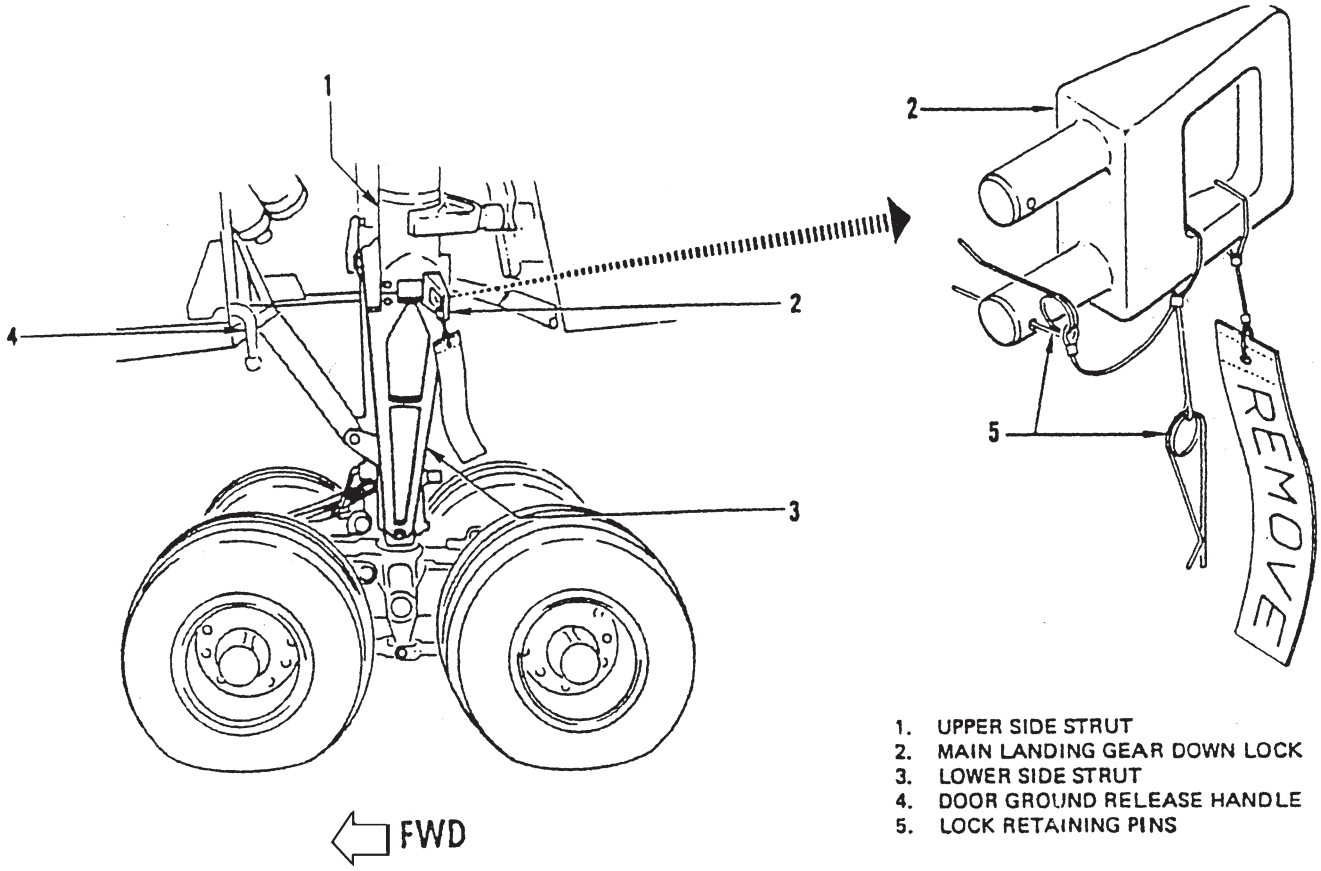
2.2. Main Gear Ground Locks.

Two locks act as safety aids for ground maintenance. The main landing gear cannot retract with the weight of the airplane on the gear. The locks are u-type pins, which are pushed through the hinges of the main gear side struts, and must be removed before flight, or the main gear cannot retract. Red warning streamers are attached to the ground locks.

The gear safety pins have to be used :

1. When towing the airplane,
2. During work on a gear,
3. When the airplane is parked without surveillance.

CAUTION: THE GEAR SAFETY PINS HAVE TO BE REMOVED BEFORE FLIGHT. OTHERWISE GEAR RETRACTION WILL NOT BE POSSIBLE.



MLDG - GROUNDS LOCKS

2.3. Main Gear Truck.

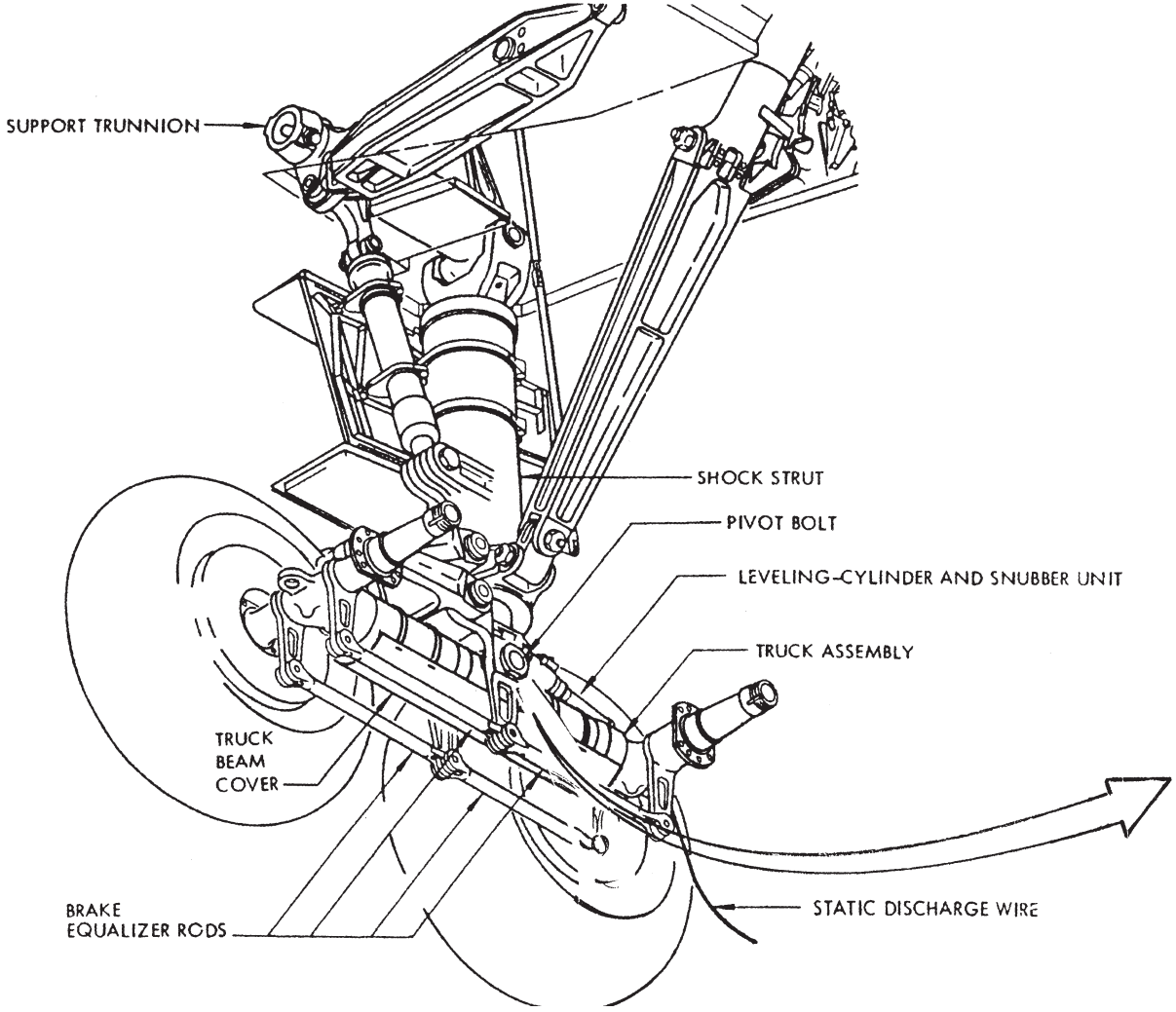
The majority of fuselage and wing loads (with airplane on ground) are transmitt ed through the main gear support trunnion, drag strut and side strut, int o the main gear shock strut. Loads in the main gear shock strut are transmitted through the main gear trucks into the four wheels of each main gear. The main gear truck is a T-shaped tubular steel beam to which the forward and aft axles are attached. A jacking pad and a towing eye are formed on front and aft ends of the truck beam.

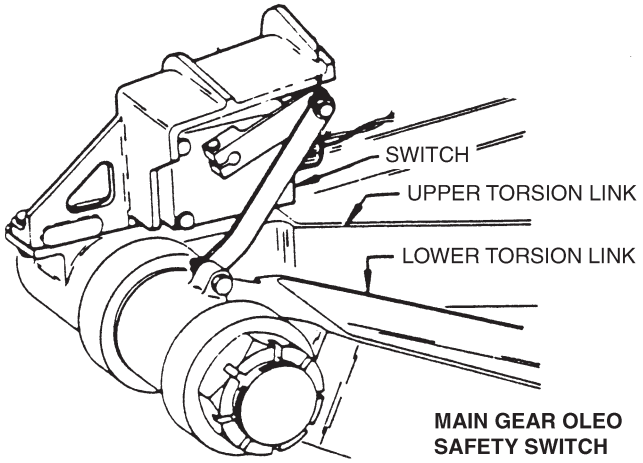
The forward horizontal arms of the truck beam carry the two piece forward axle. One axle stub is secured in each horizontal arm by a single bolt. The one piece aft axle is installed through the aft end of the truck beam and locked in position by two retaining plates. Both retaining plates are bolted to the center or the axle inside the-truck beam. Axles are machined on each side of the truck be to support movable collars. Each movable collar carries a brake assembly and provides an attachment lug for a brake equalizer rod. Brake equalizer rods link the movable collars with the lower terminal of the shock strut inner cylinder. This arrangement prevents porpoising (raising of rear wheels) as brakes are applied on landing or taxi-roll. The center portion of the truck beam is machined and drilled to mate with the yoke at the lower end of the shock strut inner cylinder.

One large bolt attaches the strut to shock strut. Hydraulic and pneumatic tubing, electric wiring and a truck leveling switch are attached or bracketed to the truck. The static ground wire is attached to the aft end of truck beam. A cover is installed under the truck beam to protect truck from damage.

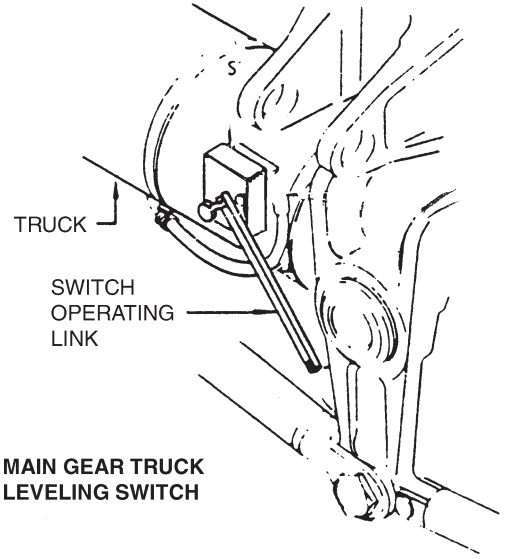
Main Gear Oleo Safety Switch.
The main gear oleo safety switch prevents landing gear retraction when the weight of the airplane is on the landing gear. One safety switch is mounted on a cast bracket on the upper torsion links of each main gear. The assembly consists of a low travel microswitch, a switch bracket and linkage. The switch is closed when the shock strut is extended and open when the airplane is on the ground with the shock strut compressed. Actuation of the switch is through the linkage from the lower torsion links.

Main Gear Truck Leveling Switch.
The main gear truck leveling switch prevents landing gear retraction when the truck is not perpendicular to the shock strut. One leveling switch is attached to the right side of each main gear truck beam. The assembly includes a low travel microswitch and an operating link connecting the switch actuating arm to the lower terminal of the shock strut outer cylinder.
The switch opens when the trucks are tilted to an extent that is unsafe for gear retraction.





MAIN GEAR OLEO SAFETY SWITCH



MAIN GEAR TRUCK LEVELING SWITCH

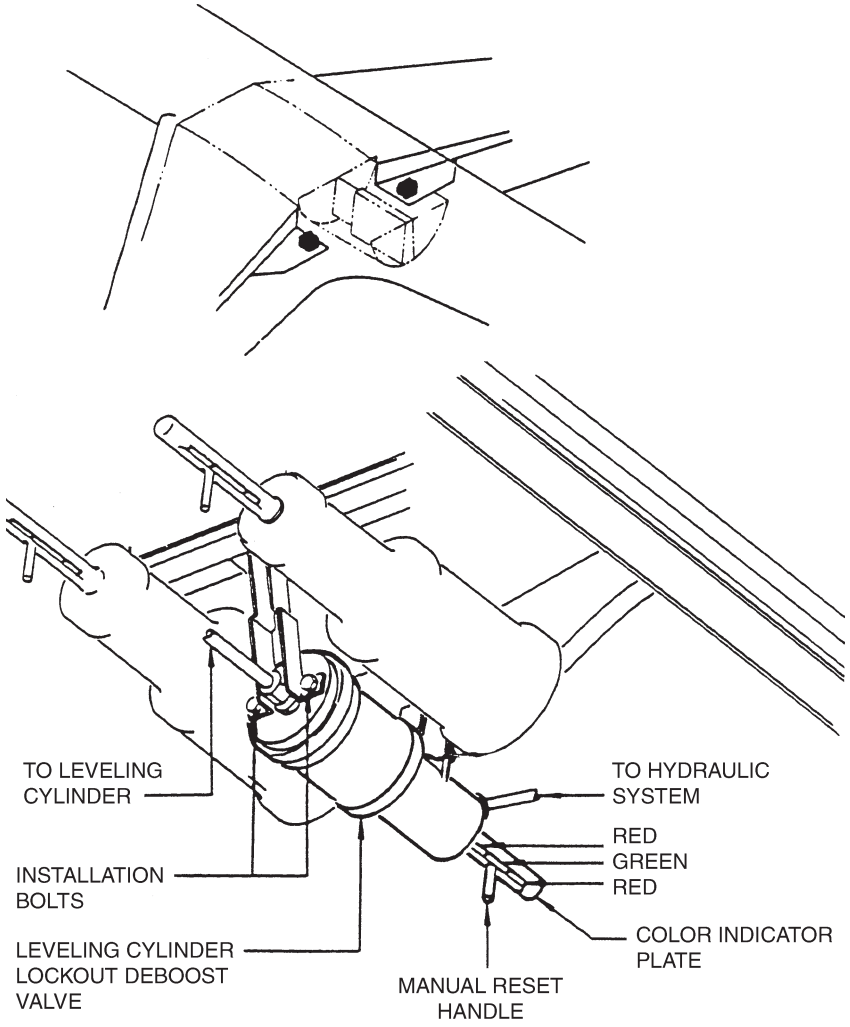
MLDG - TRUCK

2.4. Leveling Cylinder and Snubber Unit.

The leveling cylinder and snubber unit is mounted at the rear of the truck between the truck and the shock strut piston. The leveling cylinder maintains the truck beam perpendicular to the strut and acts as a snubber as the truck rotates to perpendicular after liftoff. The truck beam operates a leveling switch to unlock the landing gear lever lock and allow the landing gear to retract.

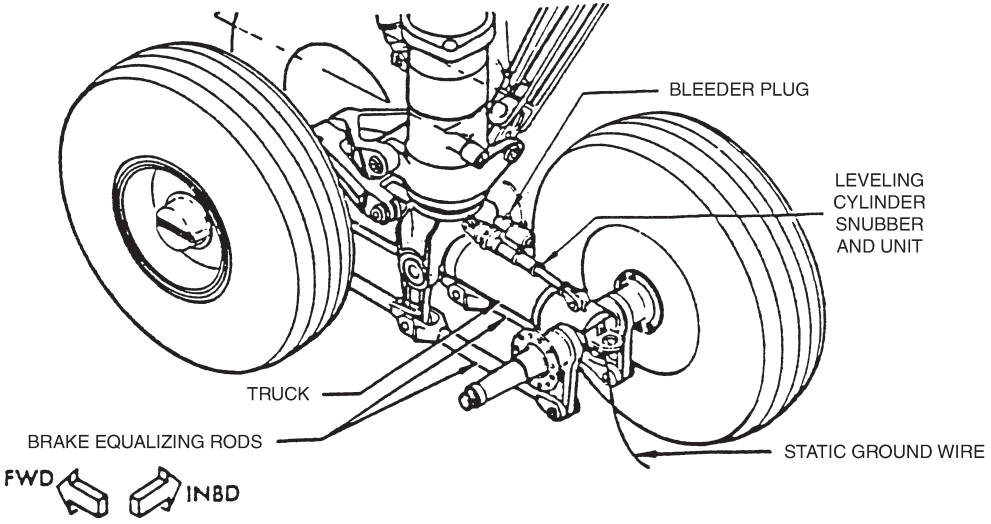
The unit is pressurized by the utility system through a lockout deboost valve and a priority valve. Pressure in the unit tends to maintain its length constant and so to maintain the truck beam perpendicular to the shock strut. Fluid is admitted into the unit through a restrictor which dampens rapid truck pitching. An incorporated relief valve limits the load supported by the unit.

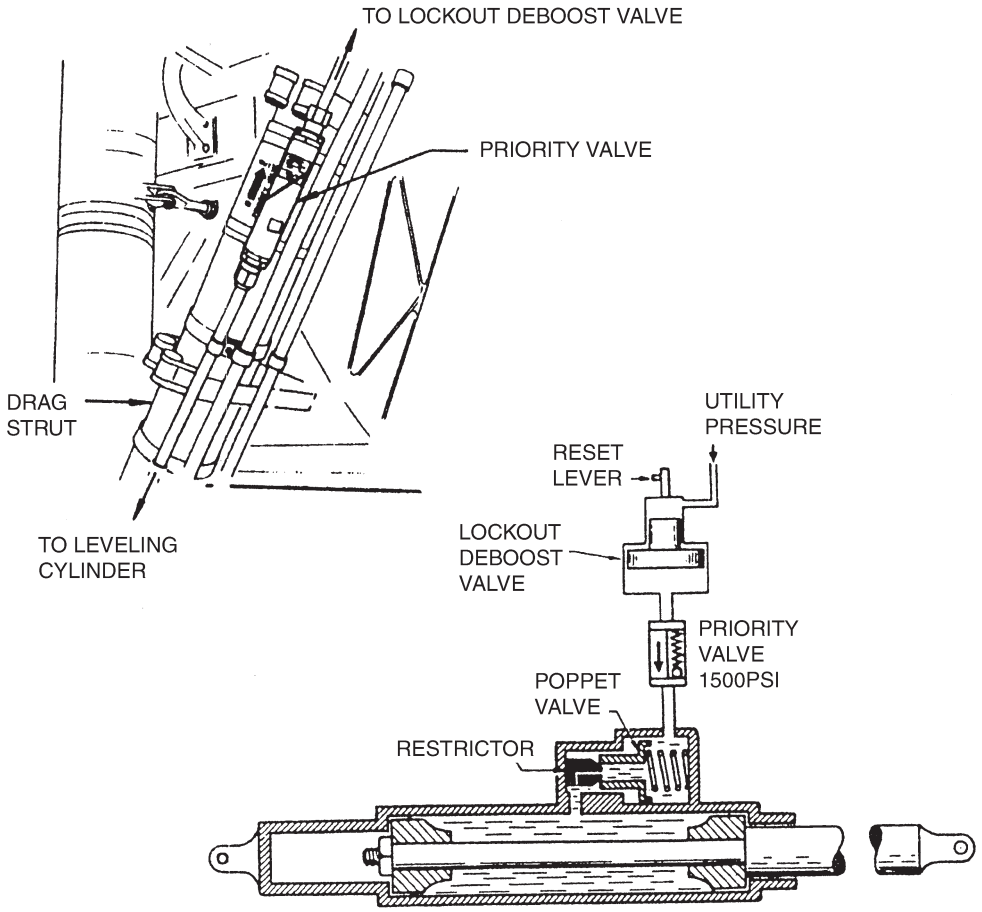
The lockout deboost valve reduces system pressure in the line leading to the cylinder and isolates the system from the cylinder. If a leak occurs downstream of the valve, fluid loss is limited to the fluid in the line and cylinder. The valve is color coded (red-green-red bands) to indicate proper fluid level and also has a reset handle (deboost valve handle).


TO LEVELING CYLINDER
INSTALLATION BOLTS
LEVELING CYLINDER LOCKOUT DEBOOST VALVE
MANUAL RESET HANDLE
TO HYDRAULIC SYSTEM
RED
GREEN
RED
COLOR INDICATOR PLATE

CAUTION: ON PREFLIGHT INSPECTION THE RESET HANDLE MUST BE IN THE GREEN BAND IF THE SYSTEM IS PRESSURIZED. IF THE HANDLE IS IN THE INNER RED BAND, REPLENISH THE FLUID BY PULLING OUT ON THE HANDLE. IF THE HANDLE CANNOT BE RESET TO THE GREEN BAND, CHECK THE SYSTEM FOR LEAKS. IF THE HANDLE IS IN THE OUTER RED BAND, THE VALVE IS DEFECTIVE. VALVE WILL BE REPLACED BEFORE FLIGHT.

The priority valve prevents a pressure drop in the unit when utility pressure decreases, namely during gear retraction. It consists of a relief valve and a check valve in a same housing. The check valve allows the free flow of fluid to the unit and traps fluid in the unit. Backflow from the unit to the system is possible only through the relief valve when pressure in the unit exceeds utility pressure of 1500 psi.



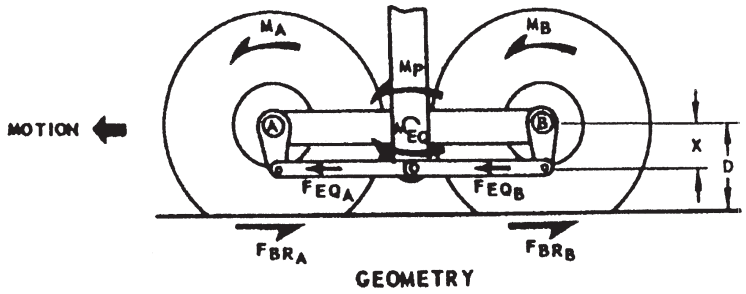


NEUTRAL CONDITION (TRUCK LEVEL)

MLDG - TRUCK LEVELING CYLINDER - GENERAL

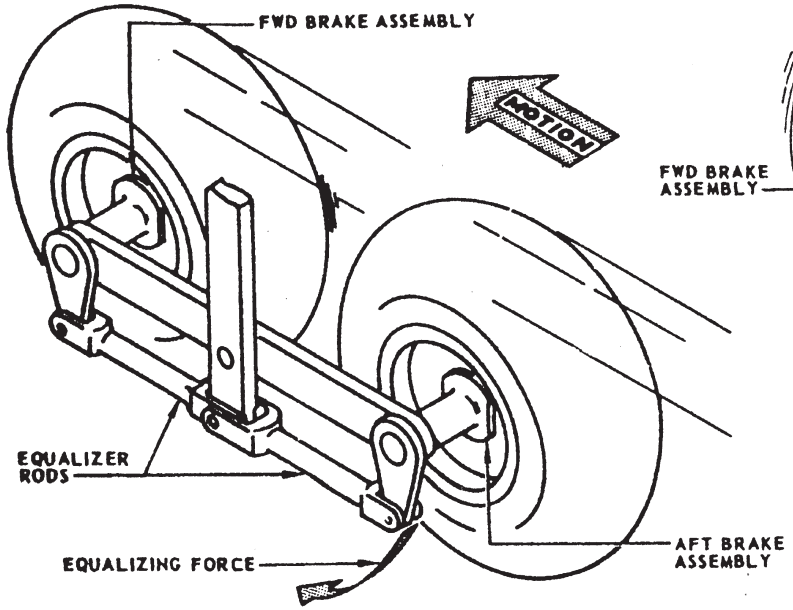
2.5. Brake Equalizer Rods.

The main gear brake equalizer rods are fixed length rigid units arranged to cause braking torque to depress aft end of wheel truck. This keeps weight on the rear wheels for more efficient and balanced braking. Each rod is mounted between a lug on the brake support collar ,and the shock strut inner cylinder lower terminal.

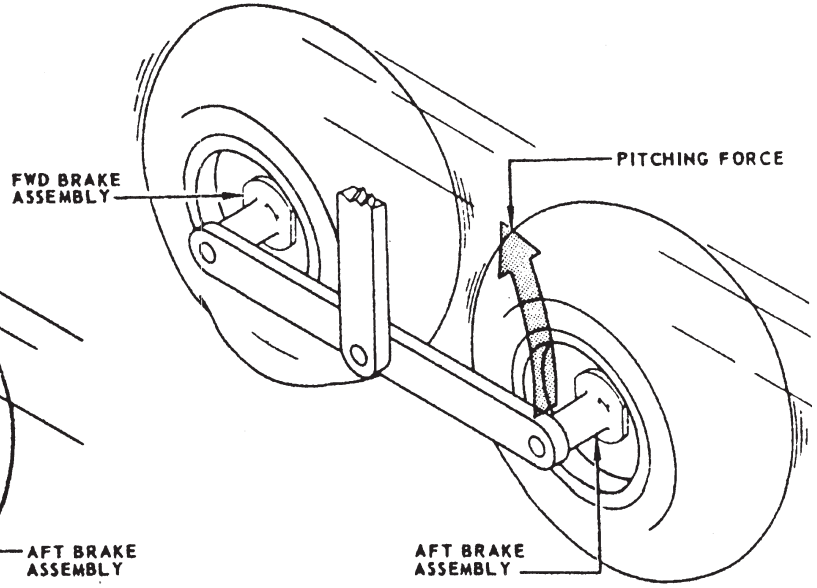


GEOMETRY

MP – PITCHING MOMENT
MEQ – EQUALIZING MOMENT
FBR – FORCE OF RUNWAY ON TIRES DURING BRAKING
FEQ – FORCE ABSORBED BY EQUALIZER RODS



CONDITION 2 GEAR WITH EQUALIZER
BRAKE ASSEMBLY IS BEARING MOUNTED



CONDITION 1 GEAR WITHOUT EQUALIZER
BOTH BRAKE ASSEMBLIES SECURED TO TRUCK

MLDG - BRAKE EQUALIZER

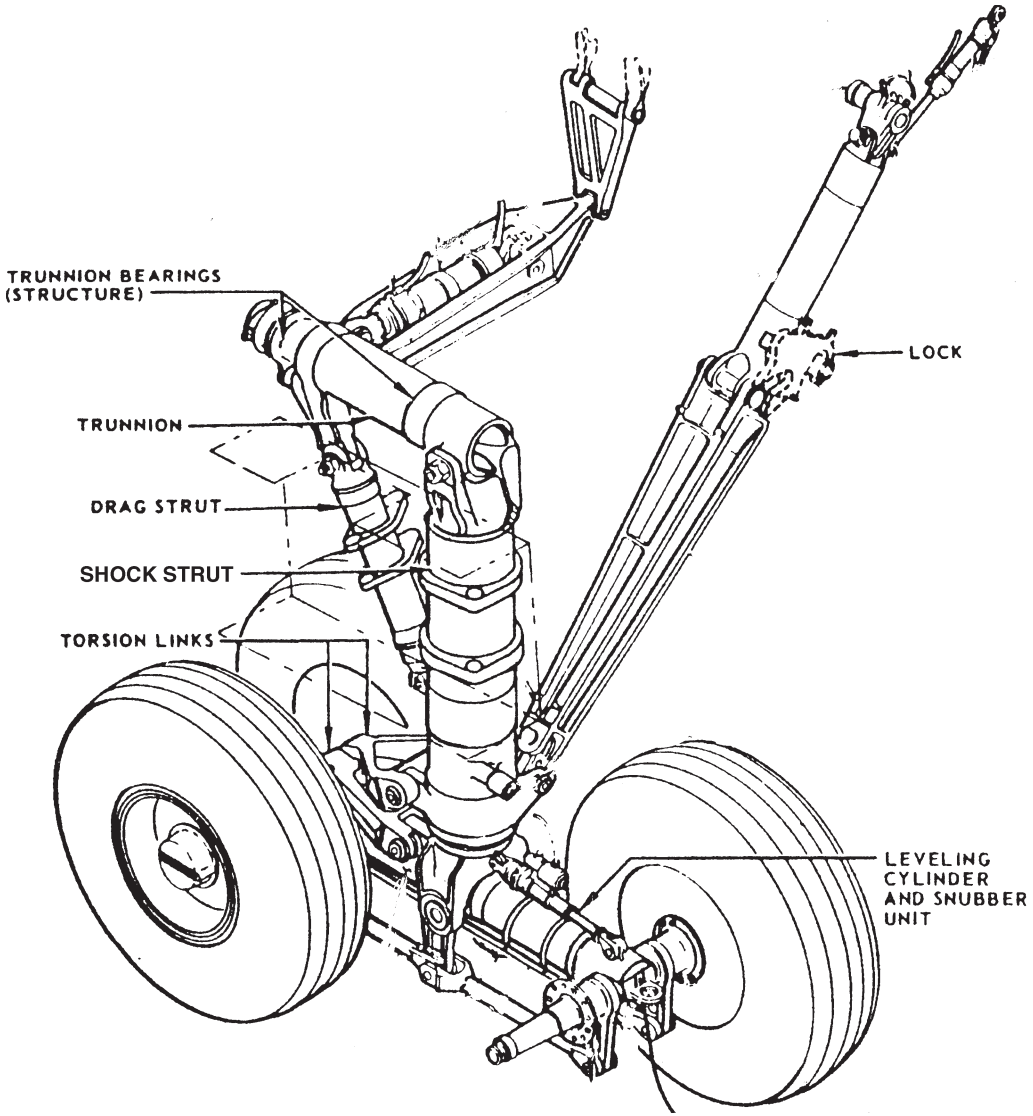
2.6. Shock Strut.

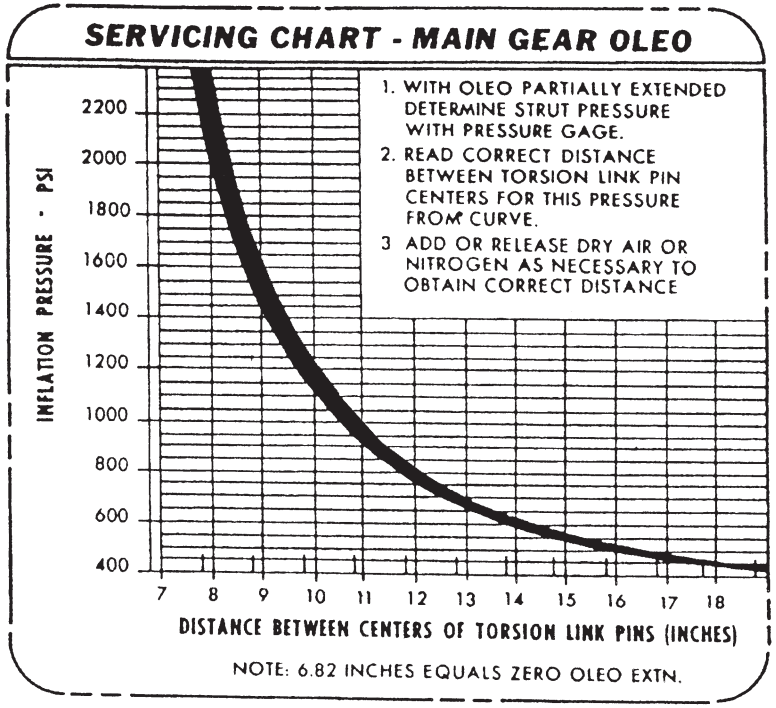
The main gear shock strut transmits fuselage and wing loads to the wheels when the airplane is on the ground and absorbs shock, loads on landing and during tayi. Shock absorption is accomplished by flow of hydraulic fluid through a variable orifice.

Shocks are also cushioned by compressing a volume of nitrogen in the upper end of the cylinder. A torsion link prevents any piston rotation.
A charging valve mounted on the top of the outer cylinder allows fluid and nitrogen servicing. The shock strut is filled with the same type of hydraulic fluid as used in the leveling cylinder. Shock strut re-inflation is necessary when the visible part of the piston at the bottom end of the shock strut is less than 3 fingers. The normal shock strut elongation is limited between 3 and 6 fingers, depending on the airplane weight.

Main Gear Shock Strut (Oleo).
The main gear shock strut, transmits fuselage and wing loads to the main gear wheels when the airplane is on the ground. The shock strut is made of steel and consists of an outer and inner.cylinder, a piston attached to the upper inner side of the outer cylinder, and an orifice rod attached to the inner cylinder. The shock strut is filled with hydraulic fluid and charged with compressed air to absorb landing and taxi shock loads. Shock absorbtion is accomplished by flow of hydraulic fluid through a variable orifice formed by the tapered orifice rod through an opening in the piston, and by flow of hydraulic fluid through openings in the piston rod. As the shock strut is- compressed, the tapered orifice rod permits a diminishing rate of hydraulic fluid passage from inner cylinder chamber to the upper side of the piston. Landing and taxi shocks are also cushioned by the increasing volume of hydraulic fluid above the piston further compressing a volume of air in the upper end of the outer cylinder. The shock strut is serviced with hydraulic fluid through an air valve in the upper inboard side of outer cylinder. The shock strut is serviced with clean dry air through air valve to shock strut extension as specified on a servicing chart on the keel beam in the left wheel well.

MLDG - SHOCK STRUT - GENERAL

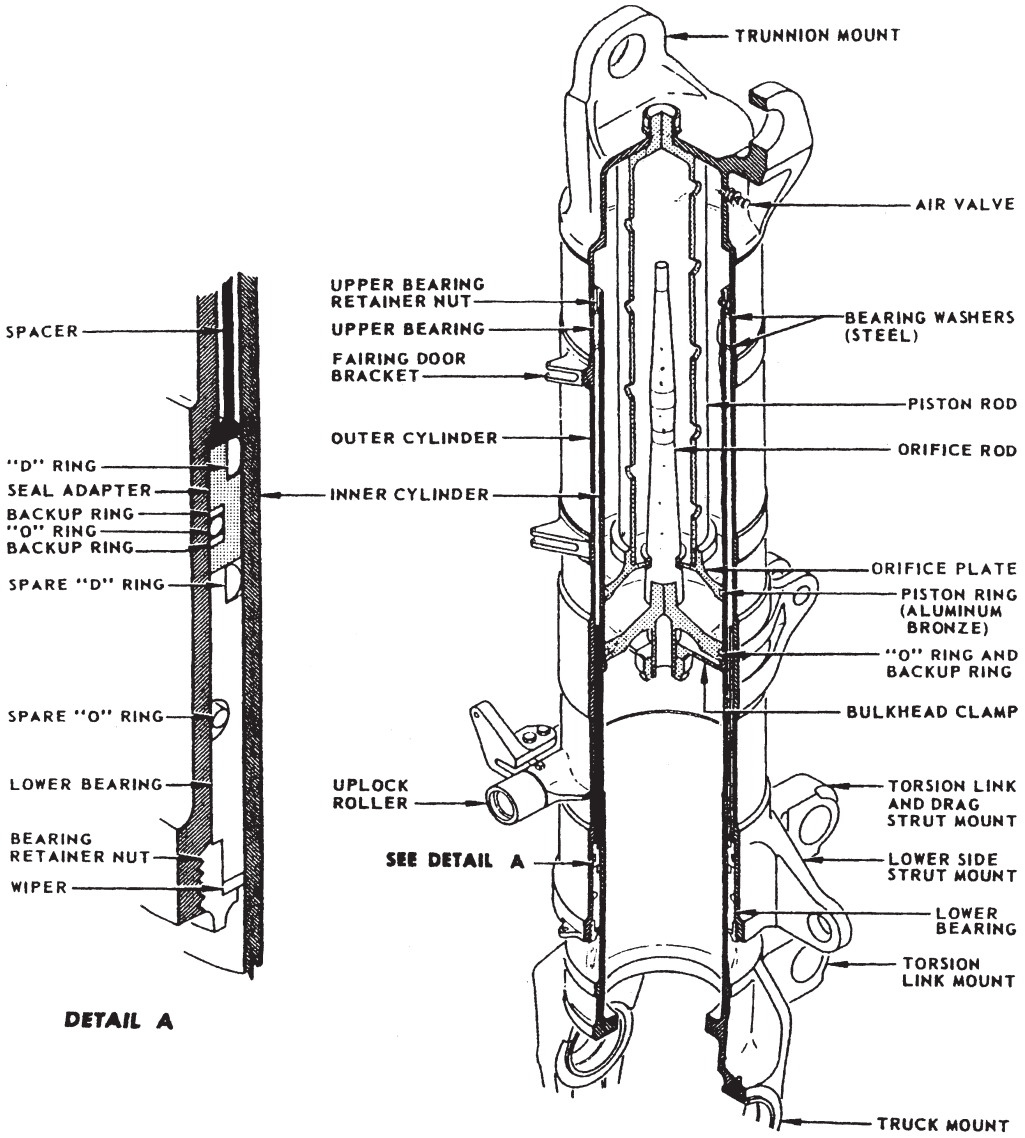


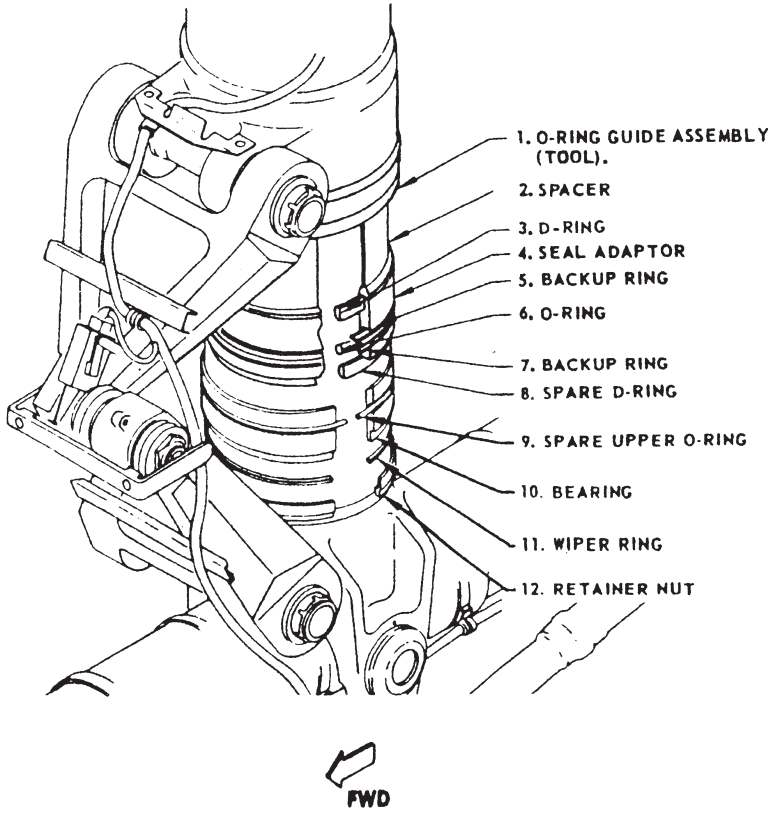


Upper and lower bearings provide sliding surfaces and an air-oil seal between inner and outer cylinders. Between the lower bearing and the spacer, a seal adapter with annular grooves is installed. A D-ring and and 0-ring with back-up rings are inserted in the grooves to provide an air-oil seal between cylinders. Shock struts have annular grooves in the lower bearing for storage of spare D-and 0-rings. The spare seals can be used to replace the working seals without complete disassembly of shock strut.

Lugs are provided.on the forward side of outer and inner cylinders for attachment of torsion links to keep the inner cylinder (which is attached to main gear wheel truck) from turning within the outer cylinder. Another lug on the forward side of the outer cylinder, just above the torsion link lug, is provided for drag strut attachment. A lug on the lower inboard side of the outer cylinder is provided for attachment of the lower strut segment universal fitting. Shock strut doors are attached to the outer cylinder.

MLDG - SHOCK STRUT - DETAILED





2.7. Locking Mechanism.

Main Gear Down-Locking.
When the gear extends, the side strut segments unfold. When the side strut is completely extended, the shock strut moves slightly beyond the vertical position (STEP II). To complete the gear extension, the side strut is pushed by a side strut actuator or by the emergency mechanism in an overcenter position until side strut stops contact (STEP III).

At the same time, the down-lock roller engages the corresponding groove of the hook and forces the hook to rotate from the unlock to the lock position. If hydraulic pressure is available, this movement is assisted by the lock actuator.

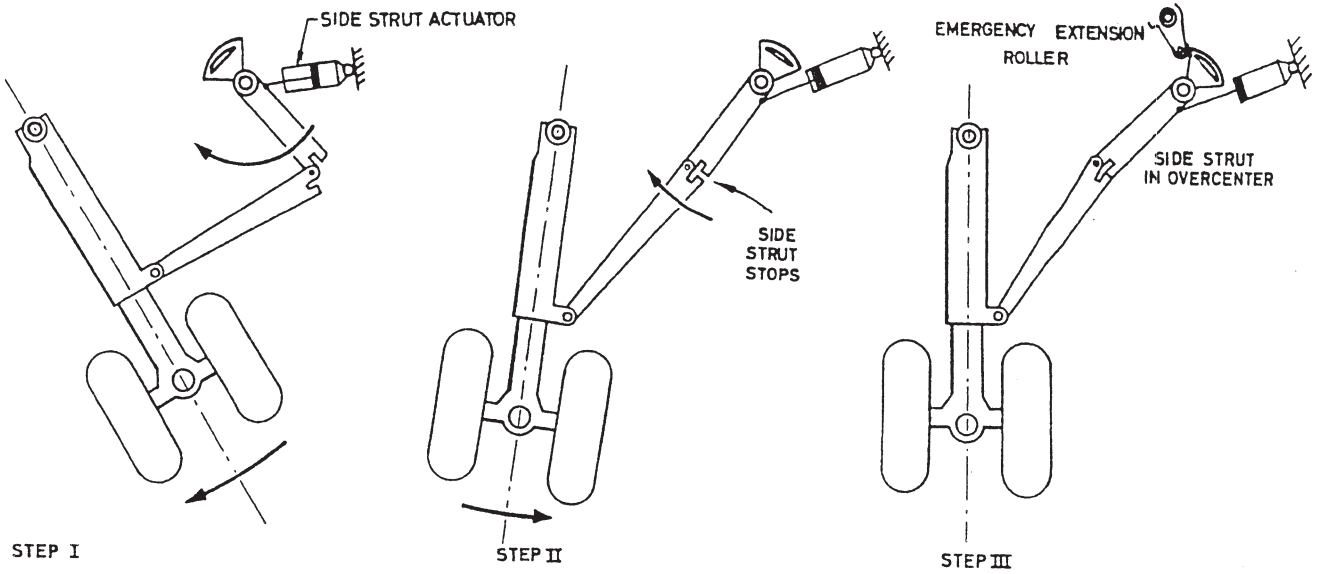
Main Gear Up-locking.
When the retraction mechanism pushes the up-lock roller into the hook groove, it forces the hook to rotate into the lock position, same as for the down-locking.

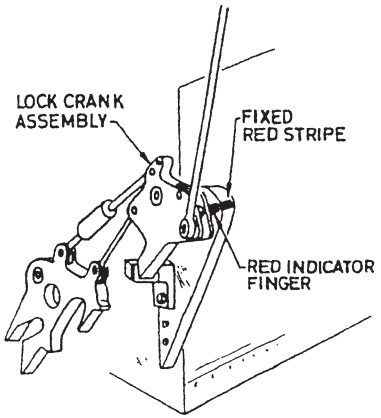
Main Gears Downlock Inspection Windows.
Red stripes painted on the lock crank assembly and on a fixed mount in the wheel well indicate, when aligned, that the hook is in lock position.
They are visible through inspection windows located in the cabin floor approximately 9 feet aft of centerline of the aft emergency exit hatch.

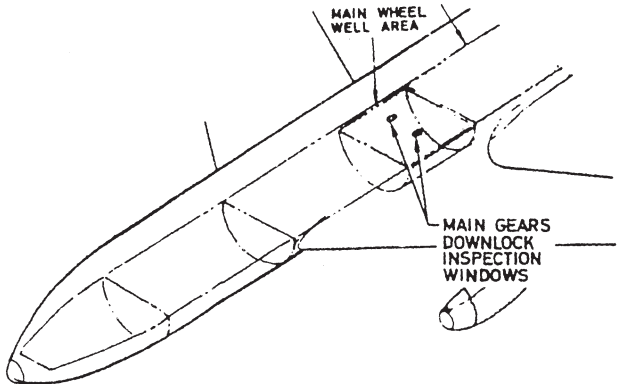
Main Gear Lock System.
The lock mechanism consists essentially of one spring loaded hoox installed in the wheel well and two lock rollers (up and down) mounted on the gear.
The up lock roller is mounted on the upper side strut segment. The down lock roller is mounted at the bottom of the shock strut. The hook is secured in both, lock and unlock, positions by a bungee and an overcenter mechanism.

In the lock position, the bungee keeps the crank assembly against the stop and the connecting link between the hook and the crank assembly in an overcenter position (C above BD). Any hook rotation towards the unlock position is impossible as long as the link is in overcenter. The link can be removed from the overcenter by means of a lock actuator or by means of an emergency extension unlock rod. In the unlock position, the bungee holds the hook against the limit stop while the connecting link passes in an overcenter position above the hook pivot point (B above AC).

Main Gear Unlocking.
The gear unlocking is accomplished by rotating the crank assembly counter-clockwise by means of the lock actuator or by the emergency unlock rod. Rotation of the crank assembly removes the connecting link overcenter and allows the hook to rotate into unlock position against the limit stop.







MLDG - SIDE STRUT LOCK / INDICATION

Main Gear Lock Warning Switch.
The crank assembly of each lock mechanism actuates a lock switch used to operate green and red warning lights installed on the center instrument panel.

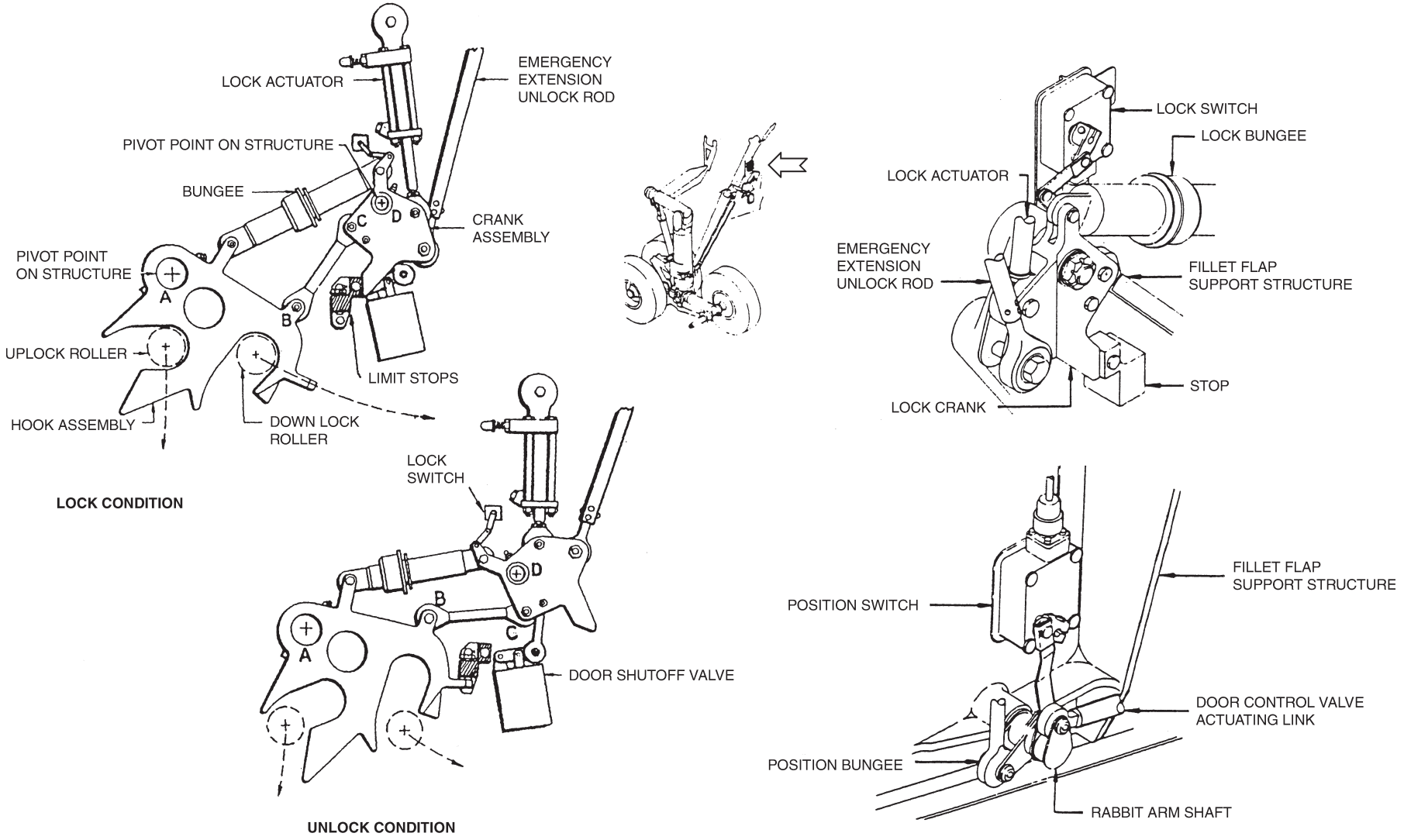
Gear Position Switch.
In conjunction with the closed lock switch it illuminates the green indicator lights and energizes LDG warning relays when the LDG is DN

Position swithces are operated the lock rollers contacting rabbit ears on the main gear.

2.8. Landing Gear Mechanical Indicating System.

The landing gear mechanical indicating system consists of a pair of mechanically actuated flag signals which provide a colored visual indication of the condition of each main landing gear and its lock when a load of cargo prevents the use of the -landing gear inspection windows in the cabin floor.

Two pairs of shafts, each pair actuated by the landing gear mechanism on one side of the airplane, extend upwards into the lower sidewall on each side of the fuselage at approximately BS 885. The upper ends of each pair of shafts terminate in a box set into the sidewall dado panel about 15 inches above floor level and concealed by a hinged cover plate. When the indication system is activated the cover plate of each indicator box is hinged down,
a metal flag installed to the top of each shaft and a sheet rubber tab installed on the aft face of the indicator box so that it projects inboard of the dado panel. The two flags of each indicator are provided with patches of orange reflective tape on the side which faces forward when the flags rotate inboard. The upper flag has a round orange patch and the lower flag has a square one. The upper flag of each indicator is actuated by the position of its landing gear and is rotated inboard when the langing gear is retracted.



MLDG - UP/DN LOCK MECHANISM

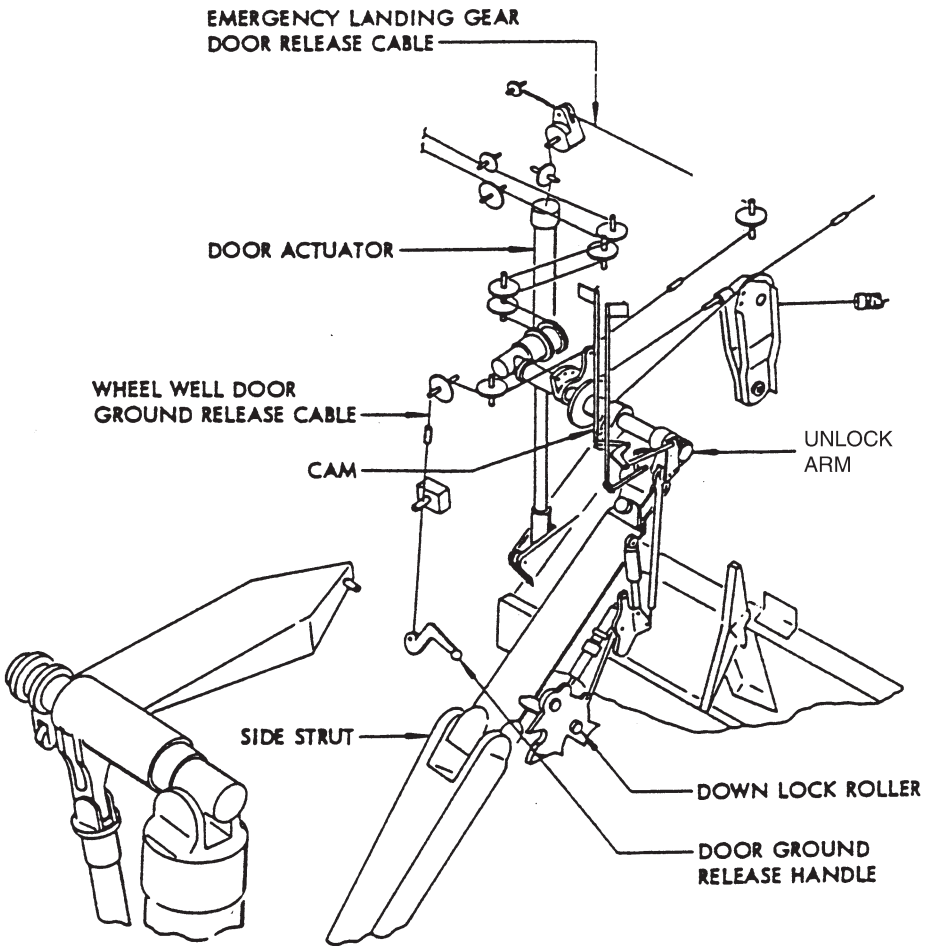
The lower flag is actuated by the landing gear lock and is rotated inboard when the lock is disengaged. The forward face of the rubber backing tab of each indicator is provided with two patches of green reflective tape: one round patch above one square patch. These green patches are so positioned that they are obscured by the corresponding orange ones when the flags are rotated. Both indicators are designed to be viewed from the forward end of the cabin. When the cabin is loaded with cargo, and therefore in darkness, inspection is made by shining a flashlight aft along each side of the cabin, and observing the colored signals reflected by each indicator.

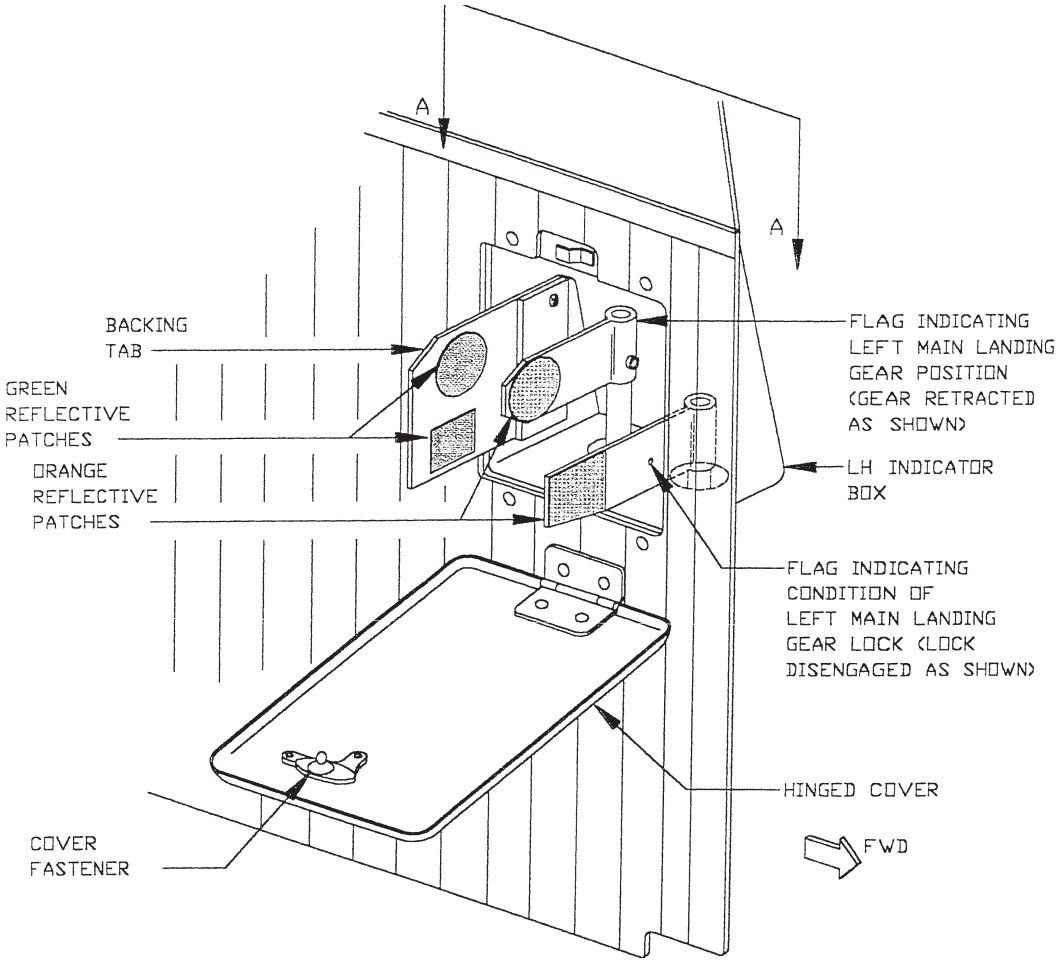
Main Gear Lock Mechanical Indicators.
Mechanical indicators located in the cabin sidewalls permit checking the position and the locking of the main gears when cargo prevents access to the inspection windows in the cabin floor. They consist of two mechanically actuated orange-coloured flags. One of them, which is provided with a square patch, is linked to the unlock rod of the lock mechanism, and indicates the unlocking of the gear. The other one provided with a round patch, is linked to the side strut upper sector, and indicates the main landing gear position.

In passenger configuration, the flags and tabs may be easily removed, and the housing is closed by a cover plate. In cargo configuration, the mechanical indicators must be installed before loading of the pallets.

The following indications are possible:

Indication	Meaning
1. - Two green patches visible - All flags retracted	Gear down and locked
2. - Round orange spot visible - Square green spot visible	Gear up and locked
3. - Round green spot visible - Square orange spot visible	Gear down but not locked
4. - Round orange spot visible - Square orange spot visible	Gear up but not locked





LANDING GEAR MECHANICAL INDICATORS

3. MAIN GEAR DOORS.

Two types of doors are used to close the main gears compartment :

- Shock strut doors,
- Wheel well doors.

Shock Strut Doors.
The shock strut doors close the compartment provided in the wing for the shock strut and the drag strut. They consist of four panels actuated by direct attachment to the shock strut or by linkage from the main gear. These doors close only when the gear is retracted. No special locking device is provided.

Wheel Well Doors.
The wheel well doorsclose the fuselage compartments which receive the truck assemblies. The wheel wells are separated by the keel beam.
They consist of two panels. The inboard panel is hinged to the keel beam; the outboard panel is hinged to the inboard panel. The wheel well doors close whenever the gear is locked in up or down position. They are normally operated by a hydraulic actuator attached. to the keel beam. This actuator is provided with an internal mechanism which mechanically locks the actuator when fully retracted, i.e. when the doors are closed.

Door-locking in open position is obtained by hydraulically locking the actuator (see "Main gear hydraulic system").

To open the doors, the lock mechanism is normally released by the hydraulic pressure at the actuator open port. In case of hydraulic system failure, it can be mechanically released by an emergency door release cable (see "Landing gear emergency extension mechanism"). The lock mechanism is also controlled by a ground release handle used to open the doors on the ground.

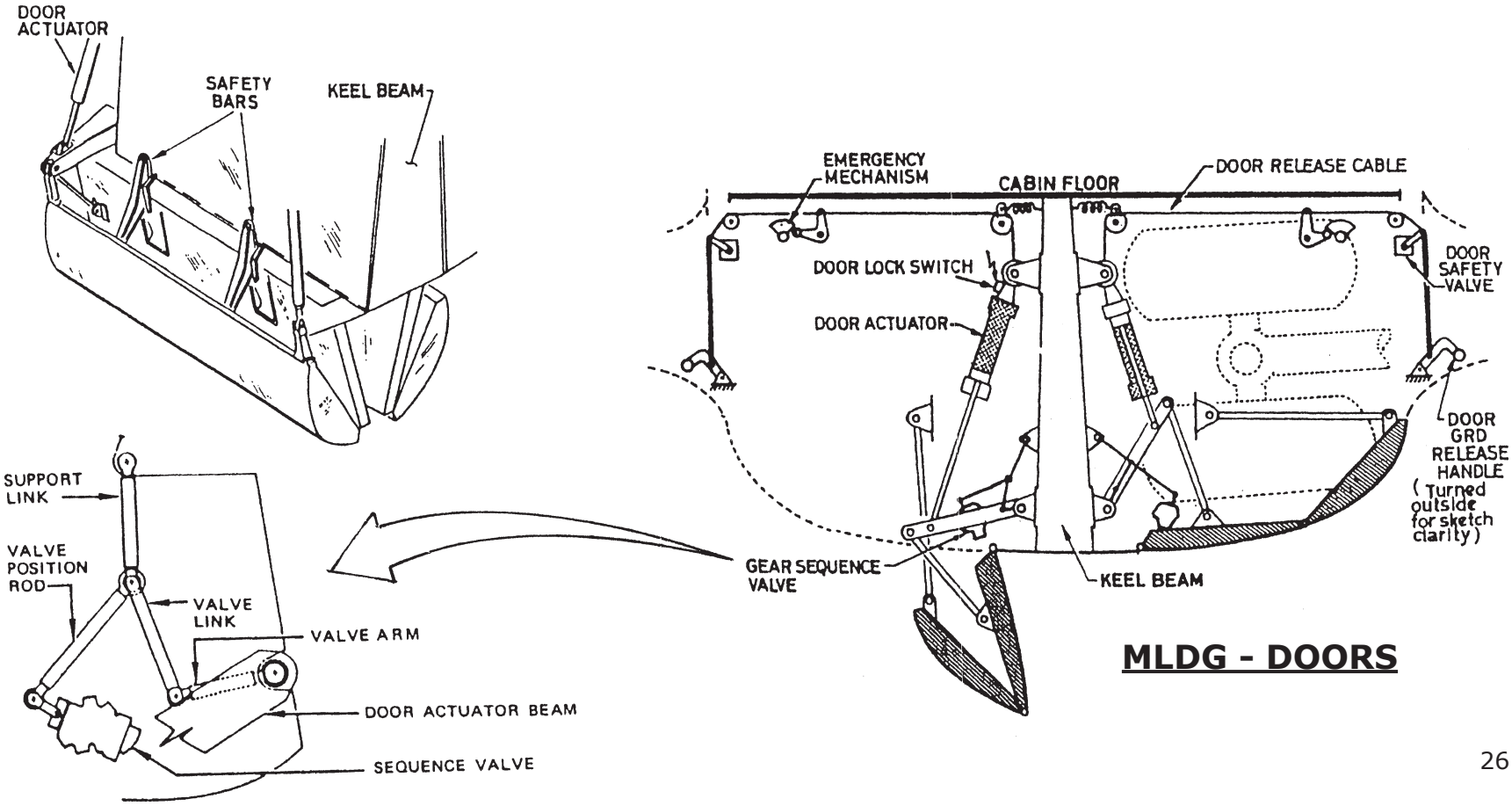
NOTE: Two safety bars are attached to the inboard panel of the doors. If a door is not fully open when the gear extends, the wheels contact the safety bars and force the doors to open completely.

Wheel Well Door Lock Warning Switch.
The door lock warning switch is mounted at the top of the door actuator.
It is operated by the actuator internal lock mechanism and is used to illuminate the door lock warning light in the cockpit.

Wheel Well Fire Detector.

A fire detection circuit is provided in the main wheel wells to detect overheated wheels and brakes. Operation of the unit is similar to the engine fire detector. An overheat fire in the wheel well causes the fire warning light on the overhead panel to illuminate, rings the fire bell, and illuminates the master fire warning lights on the glare shield panel.

Pressing the master fire warning light silences the bell and resets the system. There is no fire extinguishing system for the wheel well. In case of wheel well fire warning refer to "EMERGENCY PROCEDURES".



MLDG - DOORS

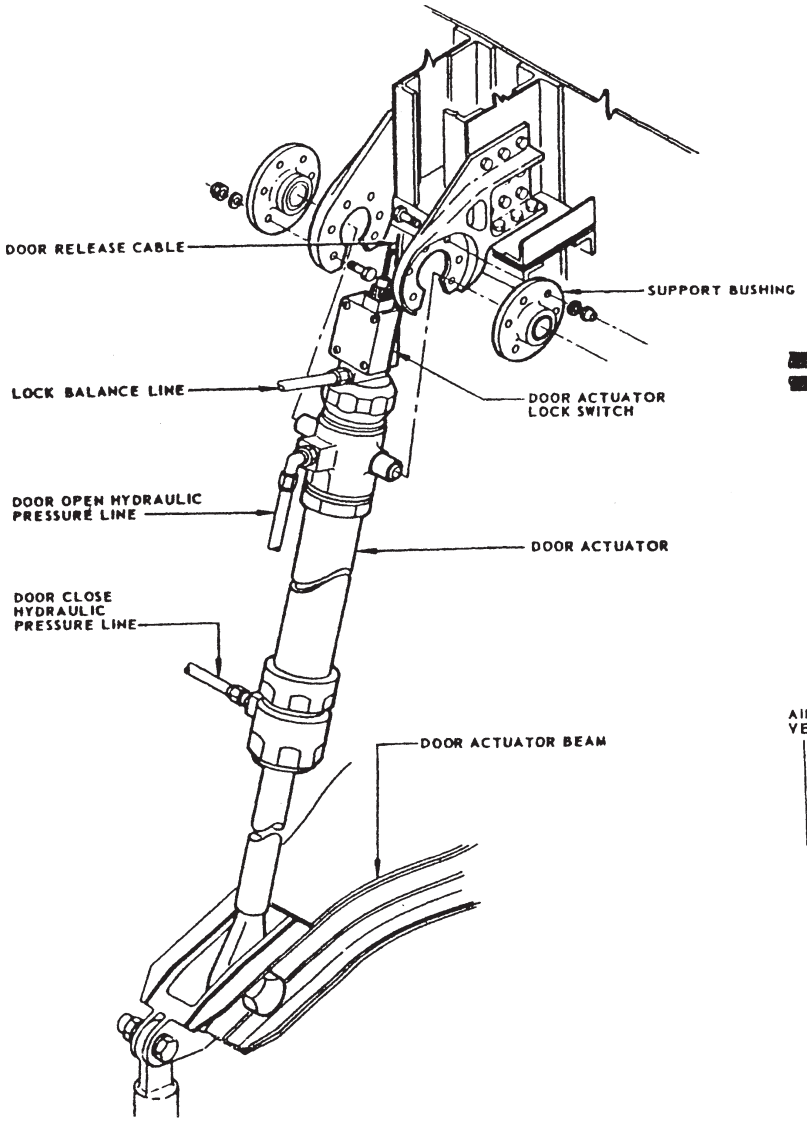
3.1. Main Gear Door Actuator.

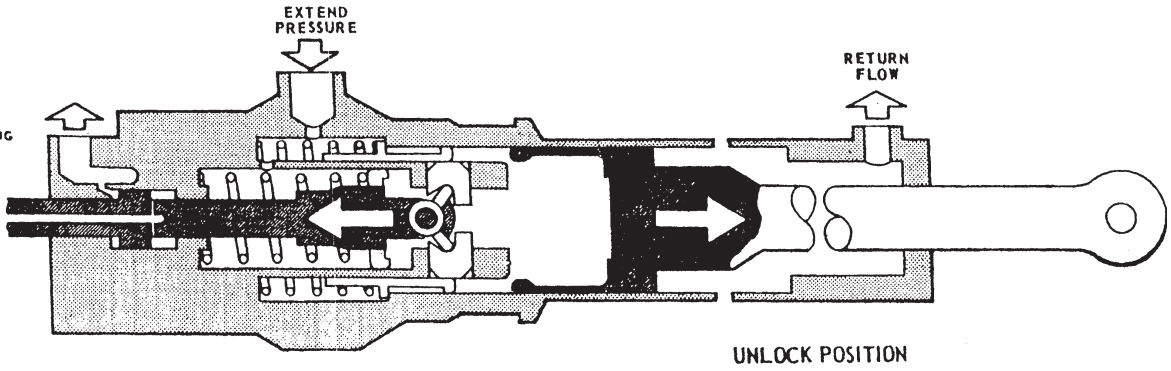
The main gear wheel well doors are opreated by a hydraulic piston t ype actuator located at the forward inboard end of each main wheel well.
The cylinder end of the actuator is trunnion mounted to the upper side of keel beam web. The actuator rod end is attached to a jig located nonadjustable actuator beam pivoted on the keel beam. A mechanical lock at the cylinder end of the actuator locks doors in the closed position. The open or close cycle is completed in approximately 1 second with actuator bottoming at each end of actuation.

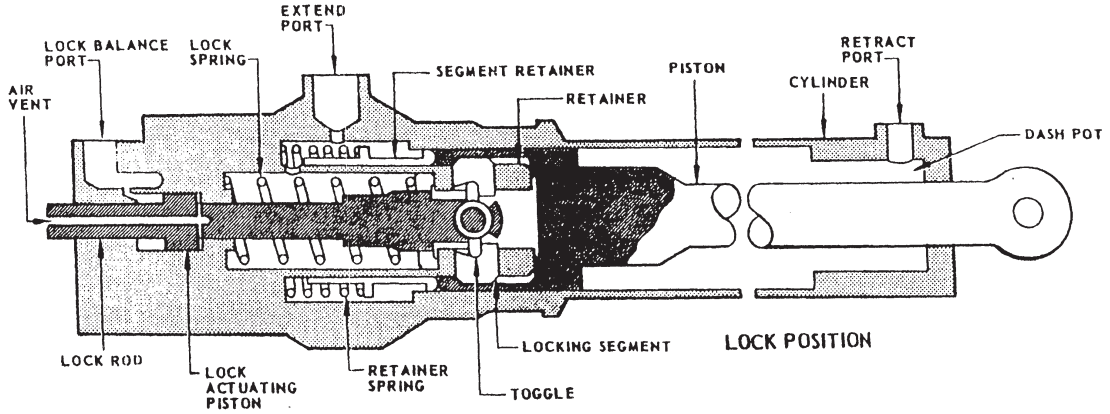
Door Actuator Operation.
The actuator lock mechanism consists of a lock rod extending out through the cylinder end of the actuator. The lock rod incorporates a pair of folding toggles on the inner end. The toggles actuate two diametrically opposed bronze lock segment blocks. The blocks are supported in broached holes in a steel retainer cylinder, and seat behind a flange on the bnd of the actuator piston rod. This locks the piston rod in the retracted position (doors closed). The lock rod is loaded towards locked position by a compression spring and a spring seat that is secured to the locks rod by a lockring. System pressure applied at the cylinder end of the actuator to open doors, forces the lock rod upward against the spring pressure.

As the lock rod moves up, the toggles fold inward allowing the piston to push lock segment blocks inward to free actuator piston. As the actuator extends to open the doors, a spring-loaded retainer segment follows the piston The retainer segment blocks. This keeps the blocks pushed in for return of the piston on actuator retraction. As the actuator extends, displaced fluid returns to the hydraulic system through a restricted passage in the piston rod bearing. The restriction of displaced fluid provides a snubbing action to slow piston movement near the end of the stroke. With hydraulic pressure applied at the rod end of the actuator,
the piston is retracted to close the dors. As the piston retracts it pushes the retainer segment back over the lock segment blocks. With the piston bottomed and the door closed, the spring loaded lock rod is pushed down. This causes toggles to expand, pushing lock segment blocks out ot lock the actuator in the retracted position. A lock balance port at the cylinder end of the actuator prevents surge pressure in the hydraulic return line to the cylinder end of the actuator from releasing the lock. The lock rod extension protruding through the cylinder end of the actuator is attached to the door release cable from the emergency extension system. The lock rod extension also operates a microswitch for the door unlocked warning light.

MLDG - DOOR ACTUATOR







3.2. Wheel Well Doors Ground Opening.

Two door ground release handles allow to open the wheelwell doors by gravity. They are located in the wing fillet areas, just forward of the side struts. When a handle is pulled down, it simultaneously unlocks the door actuator and operates a door safety valve. The safety valve cuts off any pressure supply to the door actuator and connects both actuator ports to the return line. At this time, the door is lowered by gravity.

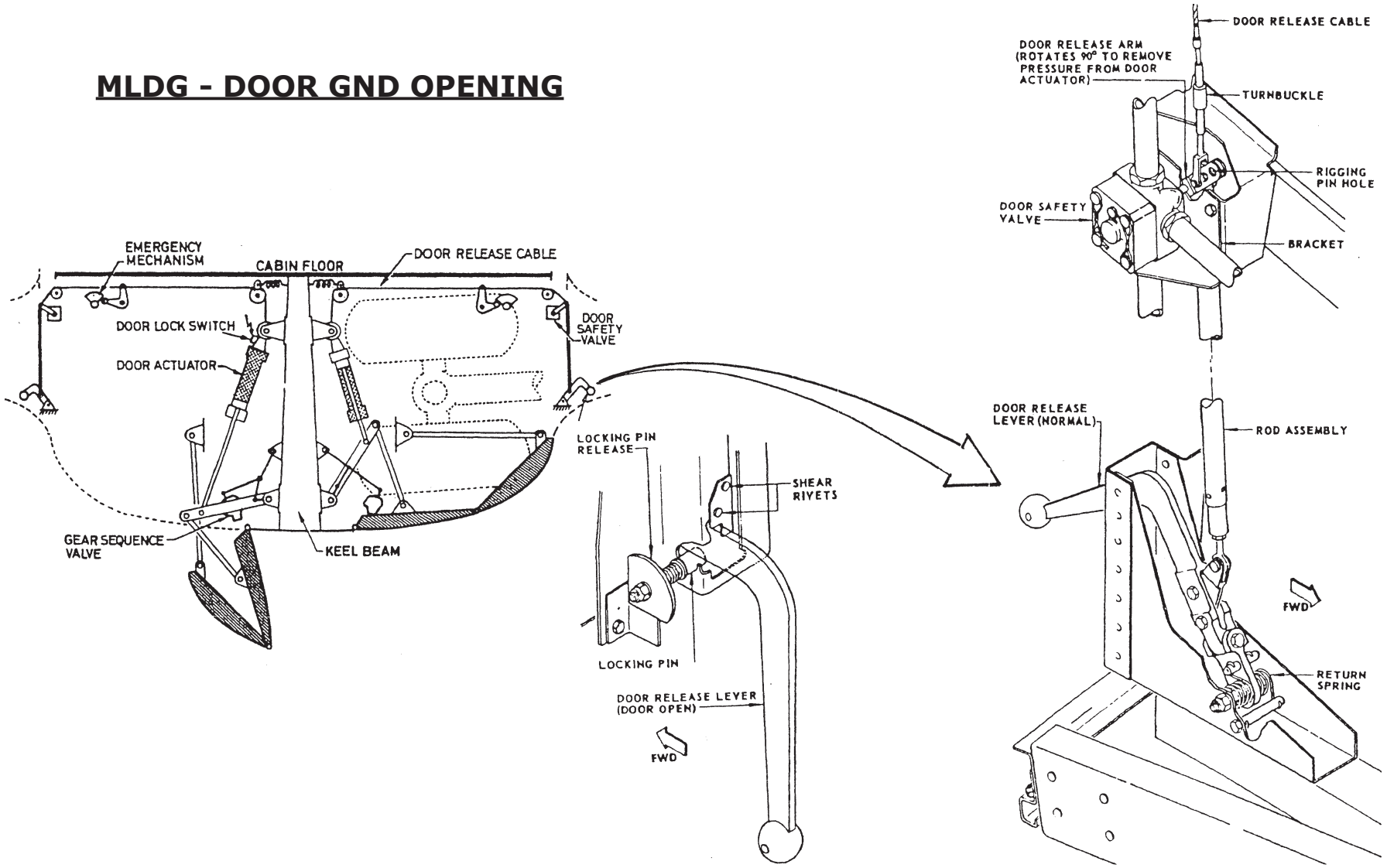
WARNING: PRIOR TO ENTERING, OR AT ANYTIME PERSONNEL ARE IN WHEEL WELL, ENSURE MANUAL DOOR RELEASE HANDLES ARE DOWN AND LATCHED. A LOCKING PIN IS PROVIDED TO PREVENT UNLATCHING OF THE HANDLE. THIS LOCKING PIN HAS TO BE PULLED OUTBOARD TO ALLOW POSITIONING THE HANDLE UP. HYDRAULIC PRESSURE WILL CLOSE DOORS RAPIDLY IF APPLIED WITH HANDLE UP. VERIFY WHEEL WELL AREAS ARE CLEAR BEFORE SETTING DOOR HANDLE TO CLOSE OR PRESSURIZING HYDRAULIC SYSTEM.

NOTE: In case of takeoff with the handle in DOWN position, when retracting the gear, the strut doors will shear off the detent plate shear rivets and push the handle up, allowing the doors to close.

Main Gear Door Safety Valve.

The main gear wheel well door safety valve, prevents inadvertant closing of doors during maintenance operations in the wheel well. The safety valve is operated through a linkage from the door ground release handle. When the handle is pulled down the valve is positioned to cut off door closed hydraulic pressure, and to open the door closed actuator port to return. If hydraulic pressure is directed to the door actuator by moving the landing gear control handle, pressure loss is prevented by the door safety valve and the piston in the fully extended actuator. Prevention of pressure loss permits full hydraulic operation of all other hydraulic components with the door control handle down and latched.

MLDG - DOOR GND OPENING



4. MAIN LANDING OPERATION.

4.1. Landing Gear Control Handle.

The landing gear control handle is the pilot's control for selecting the desired position of the landing gear. The control handle and control handle drum are located on the pilot's engine instrument panel. Cables attached to the control handle drum, extend down and back to the landing gear selector valve.
The control handle rides in a guide as the handle is moved up and down. The guide has three detent positions for the control handle to stop in.
The three positions for the control handle are; UP, DOWN and OFF.

A solenoid-operated lock mechanism prevents the control handle from being moved to the UP position if the landing gear cannot be safely retracted.
An override trigger on the control handle releases the lock mechanism to allow the control handle to be moved to the UP position.

Two position switches, mounted on the back side of the control handle, are actuated vhen the control handle is moved to UP or DOWN position.

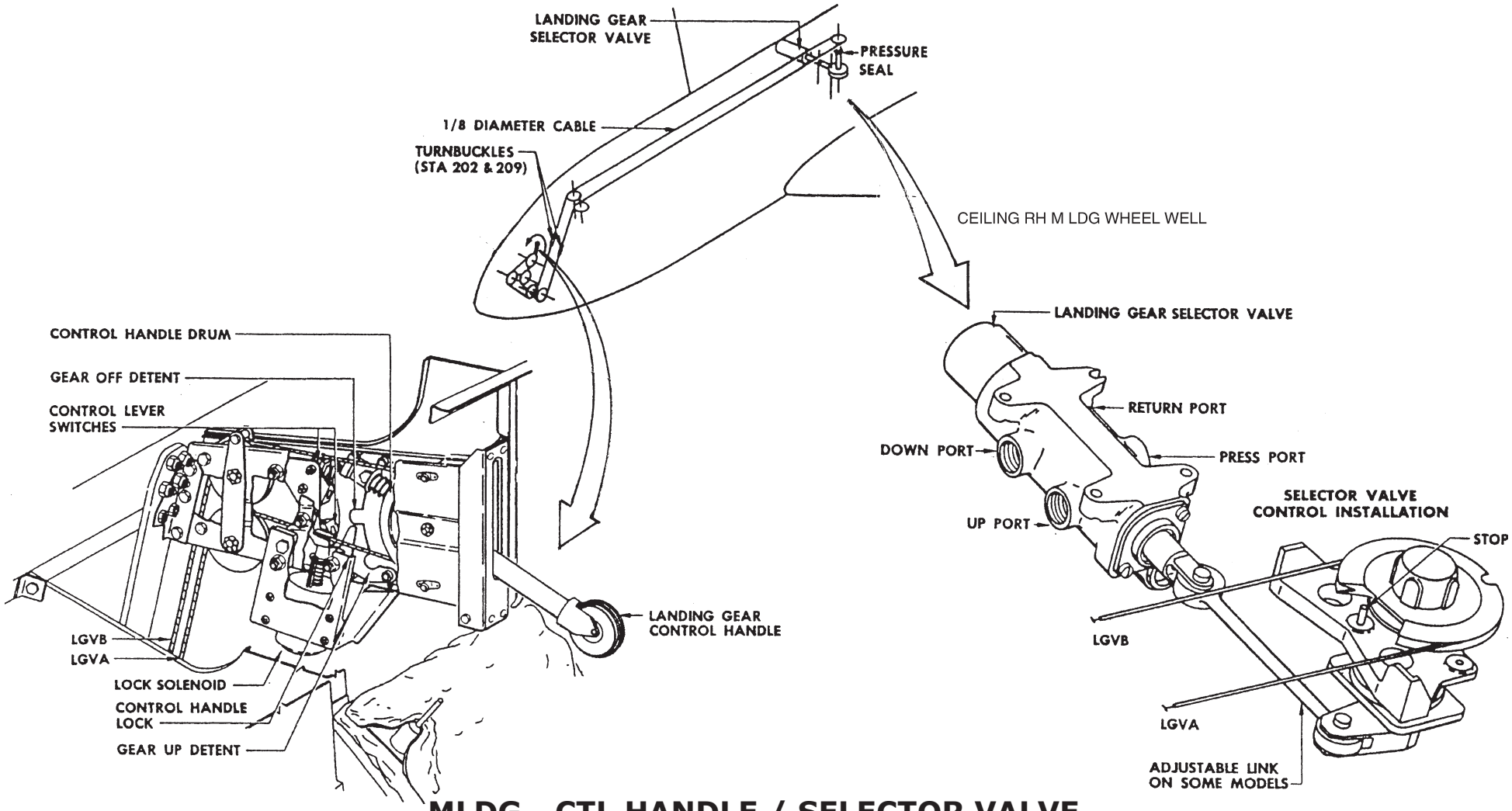
4.2. Landing Gear Selector Valve.

The landing gear selector valve is bolted to the front part of the RH wheel well ceiling. It is cable- controlled by a selector handle installed on the center instrument panel. The selector handle allows to place the valve into three positions :

- UP position : The valve directs pressure to the up lines and connects the down lines to the return line.

- OFF position : The valve shuts off pressure supply and interconnects both up and down lines to the return line.

- DOWN position : The valve directs pressure to the down lines and connects the up lines to the return line.



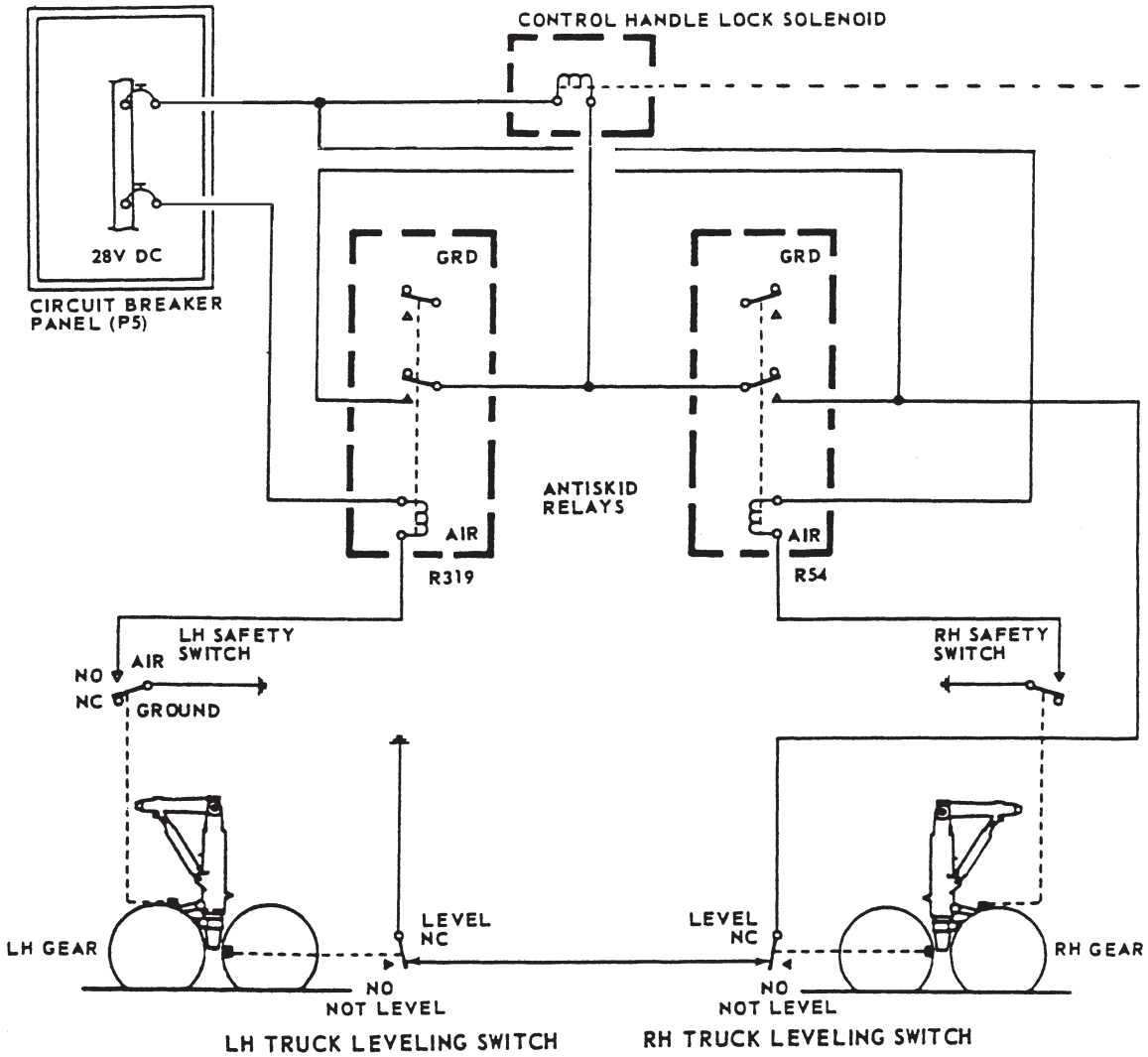
MLDG - CTL HANDLE / SELECTOR VALVE

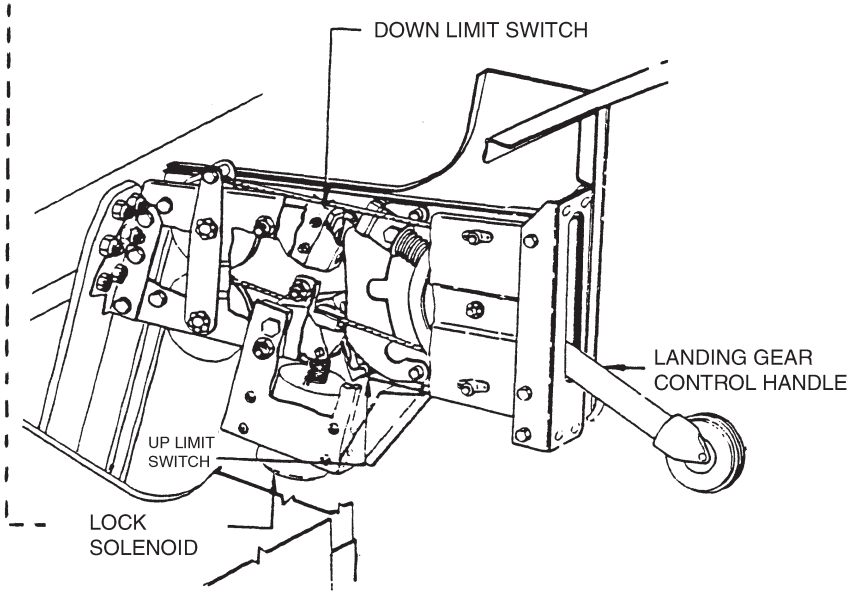
A solenoid-operated safety lock prevents the gear lever from being moved from OFF to UP unless following conditions are satisfied :

1. One of the shock struts extended (airplane airborne)
2. Main gear trucks perpendicular to the shock struts.

An override trigger is incorporated into the gear lever which allows the pilot to by-pass the lock solenoid.

With shock struts extended and wheel trucks perpendicular to shock struts, safety and leveling switches are closed. When either safety switch and both leveling switches are closed the control handle lock solenoid is energized.
The energized lock solenoid rotates the lock crank in a forward direction, clear of the inner end of the control handle. The control handle can then be moved into UP position. If one leveling switch, ot both safety switches are opened through their respective linkage, the lock solenoid is de-energized.
The lock crank then rotates to prevent the control handle from entering UP position. When the lock crank is in locked position, the control handle can be moved into UP position by using the lock override trigger to pull back the inner end of the control handle until it clears the lock crank.





LDG CTL HANDLE LOCK SOLENOID

4.3. Main Gear Sequence Valves.

The main gear sequence valves are actuated by linkage from the wheel well doors They prevent gear unlocking and motion as long as the wheel well doors are not open. The gear sequence valves direct pressure to the main actuators, the side strut actuators and the unlock port of the lock actuators. Restrictions in the side strut actuator supply lines synchronize movement of both side strut and main actuators. A relief valve by-passing one restriction permits rapid fluid flow during lowering of the gear. The sequence valves are open when the corresponding wheel well doors are open. When the wheel well doors are not fully open, the sequence valves shut off pressure supply and connect the up, down and unlock ports of the actuators to the utility return.

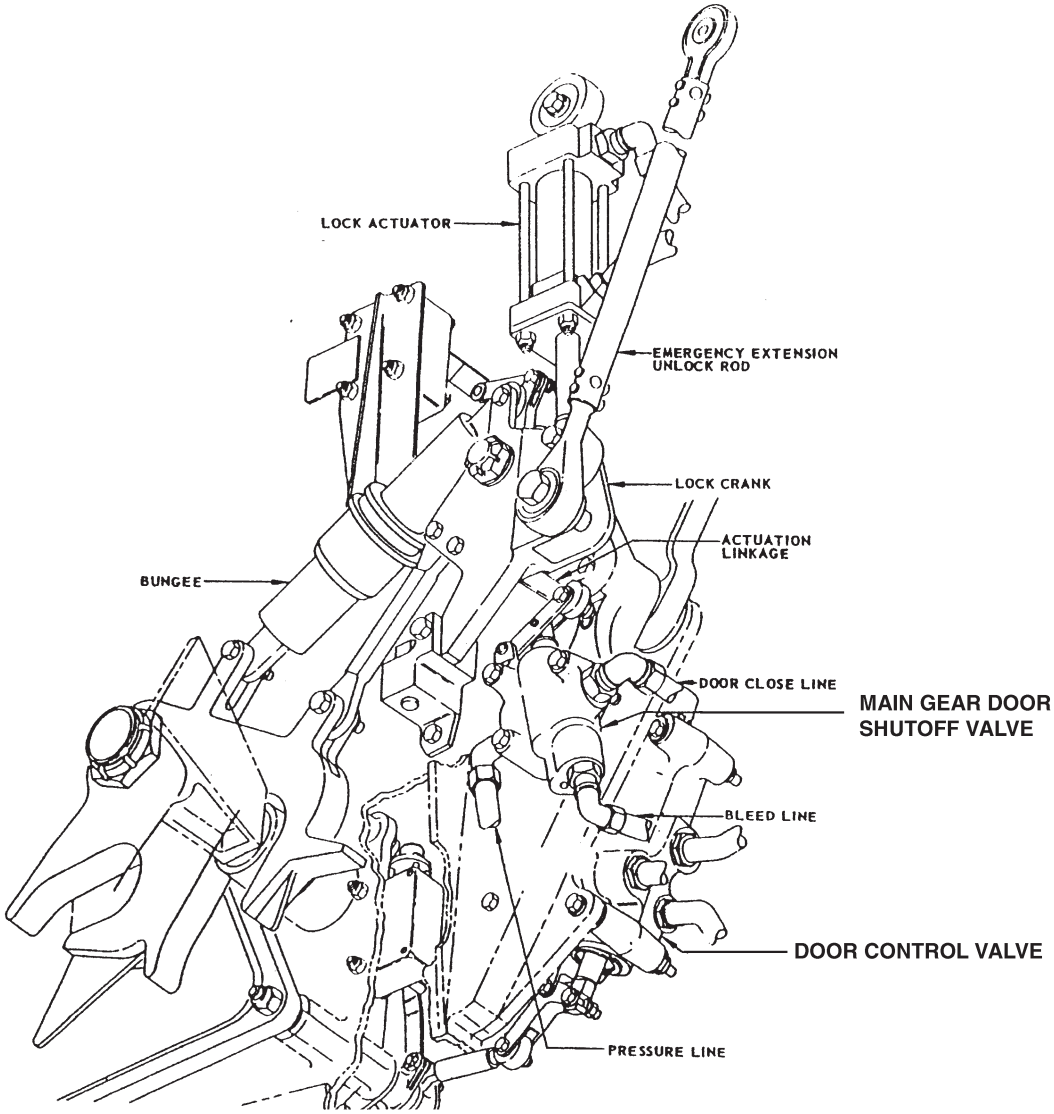
Main Gear Door Shutoff Valve.
The main gear door shutoff valve hydraulically locks the door in open position as long as the gear is not fully locked in either up or down position.
It is installed into the door actuator open line and is controlled by the lock crank assembly. When the latter is not in lock position, the shutoff valve is closed.

Main Gear Door Control Valves.
The main gear door control valve controls

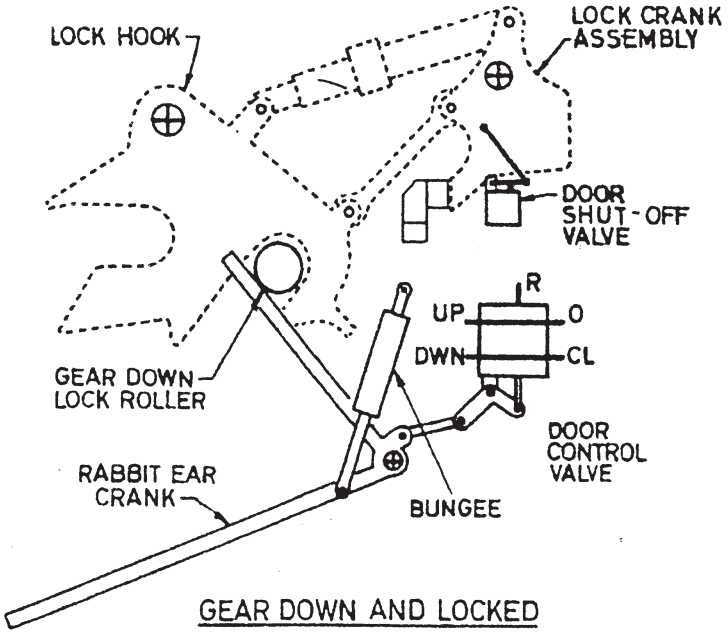
- -The door opening before gear extension or retraction,
- -The door actuator depressurization during gear transit by connecting the door close line to the return line and closing the open line,
- - The door closing after gear extension or retraction.

It also supplies hydraulic pressure to the lock port of the lock actuator to help gear locking and to maintain the lock hook in lock position after sequence completion. The main gear door control valve is operated by a rabbit ear crank which is positioned by the gear lock rollers (up and down) when they engage the gear lock hook, or by a bungee when the gear is in transit.

The rabbit ear crank also actuates a position switch, which senses whether the gear is up, down or in transit.



MLDG - SEQUENCE VALVES



GEAR DOWN AND LOCKED

4.4. Main Gear Hydraulic System Operation.

A. Gear Extension (page 45).

Initial conditions :
- Gear up and locked
- Doors closed and locked
- Landing gear selector handle in OFF position.

In these conditions, the up and down lines are connected with the return line. The landing gear hydraulic system is entirely depressurized.

Selector Valve Positioning.
To extend the gear, the selector handle is placed into the DOWN detent.
The selector valve directs utility pressure to the down line and connects the up line to the return line. Pressure is simultaneously sent to the sequence valve and to the door control valve. The sequence valve is closed, since the wheel well doors are closed. The door control valve is held in up position by the gear up lock roller and the rabbit ear crank.

Door Opening.
With the door control valve in up position, the door system open line receives pressure from the down line while the close line is connected to the return line. Hydraulic pressure passes simultaneously through the door shutoff valve and through its by-pass check valve to the door actuator open port.
The door actuator first unlocks and then extends and opens the doors.

Gear Unlocking.
When the doors reach their full open position, the gear sequence valve opens. Pressure is sent to the down port of the main and the side strut actuator and through internal shuttle valve to the unlock port of the lock actuator. The lock actuator lock port being connected to the door closed line is not pressurized and, consequently, the lock actuator rotates the lock hook into unlock position. At the same time, the door shutoff valve closes and so, hydraulically, locks the doors in open position.

Gear Transit.
Both main and side strut actuators push the gear downwards.
When the up-lock roller leaves the lock hook, the door control valve operator bungee positions the rabbit ear crank and the door control valve in transit position. The door control valve prev ents pressurization of the door actuator close line and, consequently, prevents the lock actuator from returning the hook assembly in lock position before the gear down-lock roller engages the hook.

Gear Locking in Down Position.
When the gear approaches full down position, the side strut pushes the side strut knuckle into overcenter, and the down-lock roller, engaging the lock hook, forces the hook to rotate into the lock position. When the roller engages the hook, the roller rotates the rabbit ear crank which moves the door control valve into down position. At this time, pressure is admitted through the door close line to the lock actuator lock port.

NOTE: Although the door close line is pressurized, the doors do not close because the door shutoff valve is still closed.

Pressure exists on both sides of the lock actuator piston; but, due to the piston rod, a resultant force on the crank assembly tends to rotate the hook into lock position.

Doors Closing.
When the gear is locked, the door shutoff valve opens and the doors close immediately. The piston automatically locks at the end of its stroke.

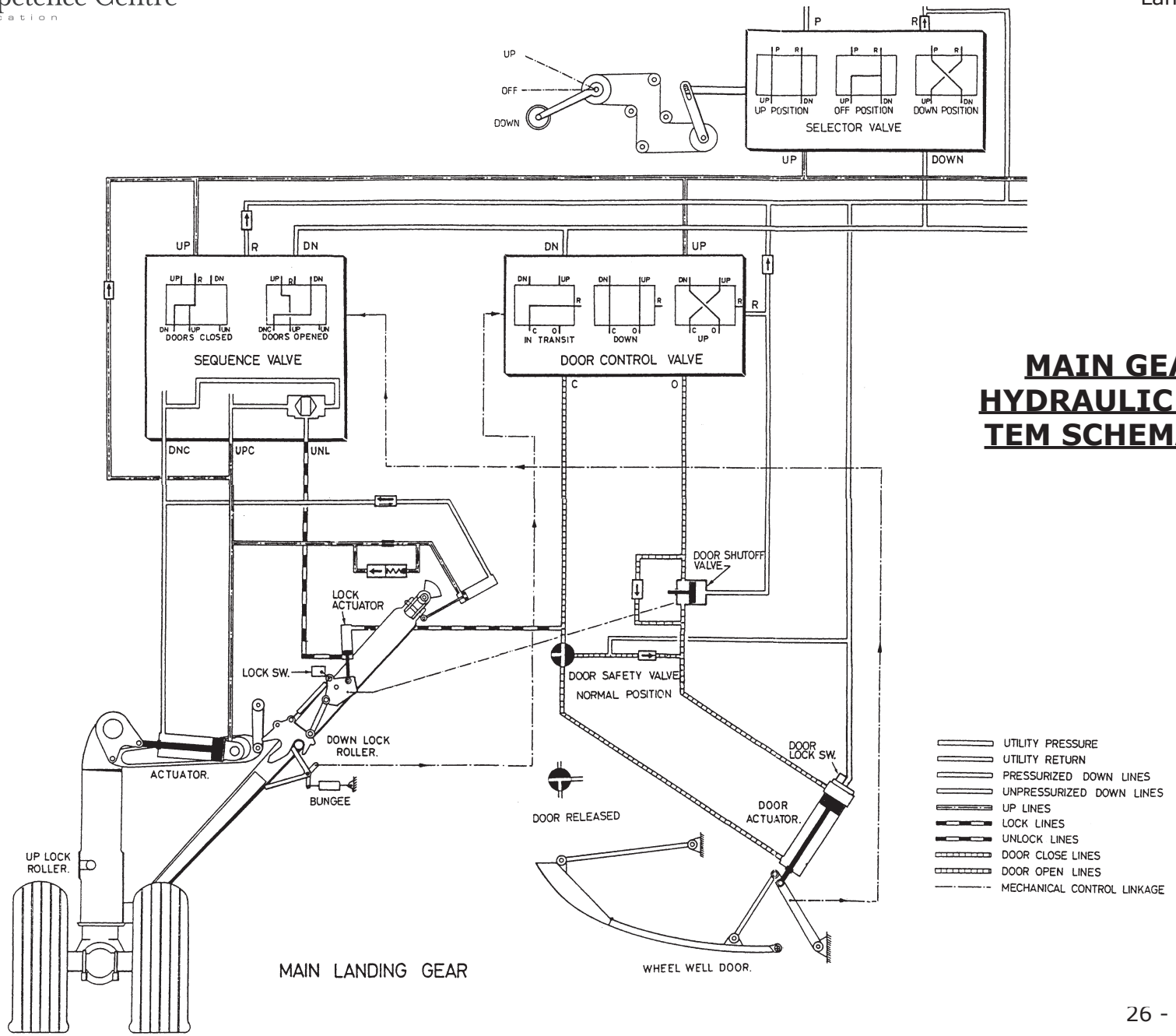
Final Conditions.
As soon as the doors are closed, the gear sequence valve closes and depressurizes the main actuator, the side strut actuator and the unlock port of the lock actuator. Pressure is maintained on the lock side of the lock actuator as long as the selector handle is held in down position.

B. Gear Retraction.

When either safety switch and both level switches are closed, the landing gear lever lock solenoid is energized and the gear lever can be set to UP. Doors and gear operate in the same sequence as during extension, i.e.:

- Doors unlock and open
- Gear unlocks and, at the same time, the doors lock by closure at the door shutoff valve.
- The side strut actuator breaks thezide strut overcenter, and then both main and side strut actuators retract the gear.
- When the down-lock roller leaves the hook, the door control valve moves into transit position which prevents any inadvertent operation of the lock actuator during gear transit.
- When the gear reaches the retracted position, the uplock roller engages the lock hook and moves the door control valve into the up position. Pressure is directed to the door close line and to the lock actuator lock port. The up-lock roller forces the lock hook to rotate into lock position by means of the lock actuator.
- When the gear locks, the door shutoff valve opens, and the door closes. The door actuator automatically locks in fully retracted position.
- The gear sequence valve closes and depressurizes all the gear actuators. However, the lock actuator lock port remains pressurized by the door close line.

MAIN GEAR HYDRAULIC SYSTEM SCHEMATIC



5. NOSE GEAR.

5.1. Nose Gear Assembly.

The nose gear assembly includes :

- -Two steerable wheels,
- -A shock strut which absorbs taxi and landing loads,
- -A trunnion which attaches the shock strut to the airplane structure and around which the gear can rotate to extend or retract,
- -An articulated drag brace designed to transmit fore and aft loads to the airplane structure and to hold the gear in up or down locked position,
- -A gear actuator used to extend or retract the gear,
- -A single lock mechanism to lock the gear in up or down position,
- -Two steering actuators providing directional control of the airplane on the ground.

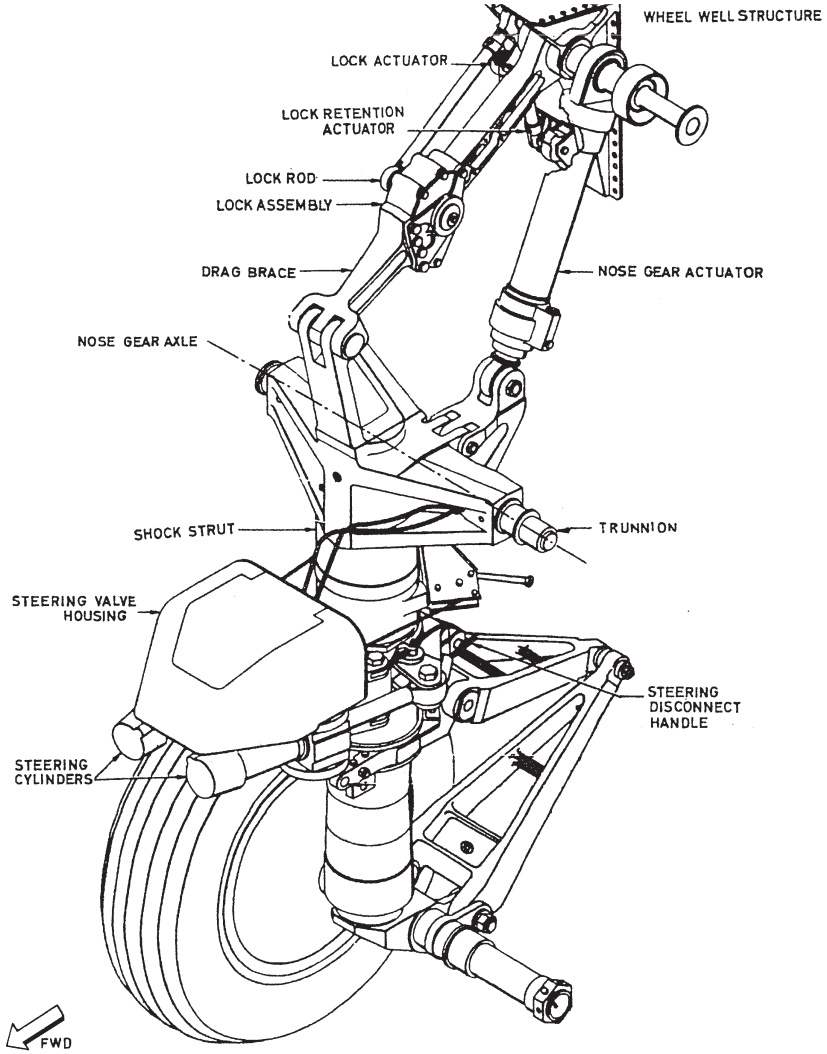
Gear Actuator.
The gear actuator is attached to a support shaft in the upper aft side of the wheel well and to the shock strut. Orifices in the hydraulic ports limit the rate of extension and retraction. An additional snubbing action is provided by an incorporated valve in the vicinity of the fully extended position of the piston (gear retracted).

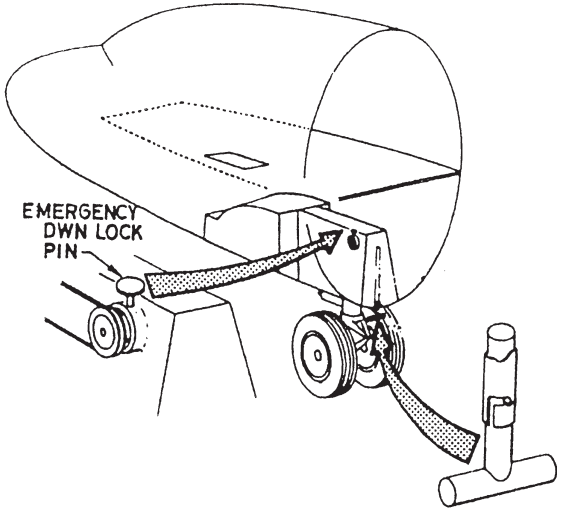
Ground Locks.

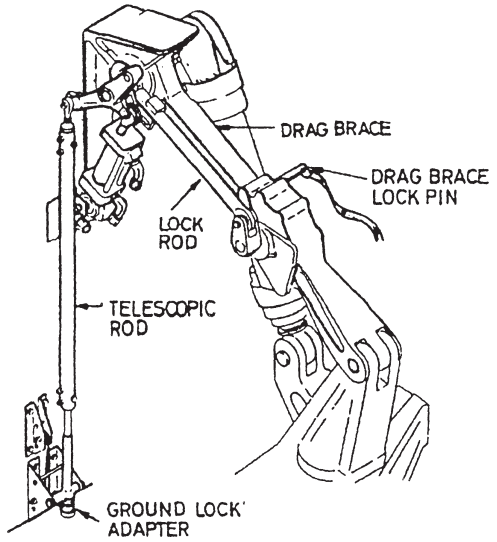
Ground Lock Handle.
When the airplane is on the ground, the lock mechanism can be secured in lock position by inserting a ground lock handlethrough a hole in the wheel well aft fairing. Pushing the handle upward compresses the spring of a telescopic rod attached to the Y-type lock crank. Subsequent handle rotation causes the shaft pins to enter grooves which lock the handle in position. With the handle in this position, any down movement of the telescopic rod is prevented which locks the nose gear Ytype lock crank and keeps the nose gear from unlocking. A portion of the down-lock shaft is chrome plated. This portion is not visible below the fairing when the lock is fully engaged.

Drag Brace Lock Pin (Nose Gear Maintenance Downlock)
The drag brace lock pin , is mainly used to ensure positive safety during maintenance work. The lock pin is inserted through the drag brace. It prevents relative movement between upper and lower segments. This lock pin is provided with a red warning streamer.

CAUTION: GROUND LOCKS HAVE TO REMOVED PRIOR FLIGHT



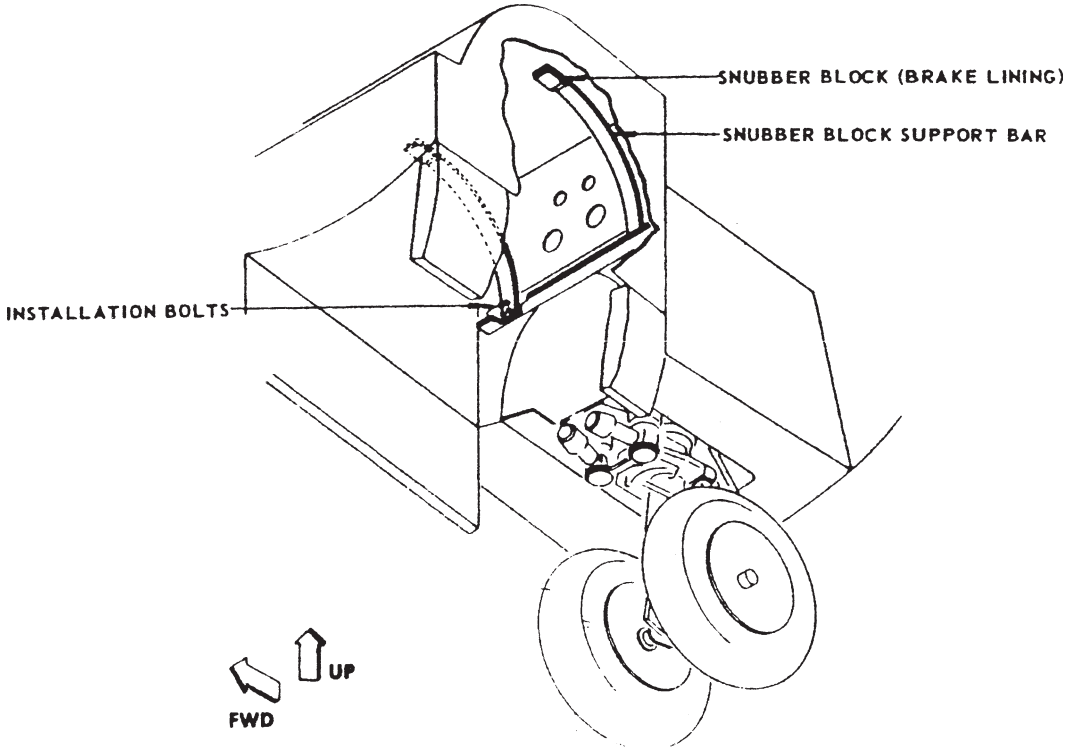




NOSE GEAR - GENERAL

5.2. Nose Wheel Snubber (Spin Brake).

To stop nose gear wheel rotation and the related noises, a wheel snubber for each nose wheel is installed in the upper side of nose wheel well. When the nose gear is retracted after a takeoff, nose wheel rotation is stopped by wheel contact with the snubbers. Each snubber consists of a spring bar attached to wheel well structure with a snubbing block if brake lining bolted to the upper (contact) end of the bar.



NOSE GEAR WHEEL SNUBBER

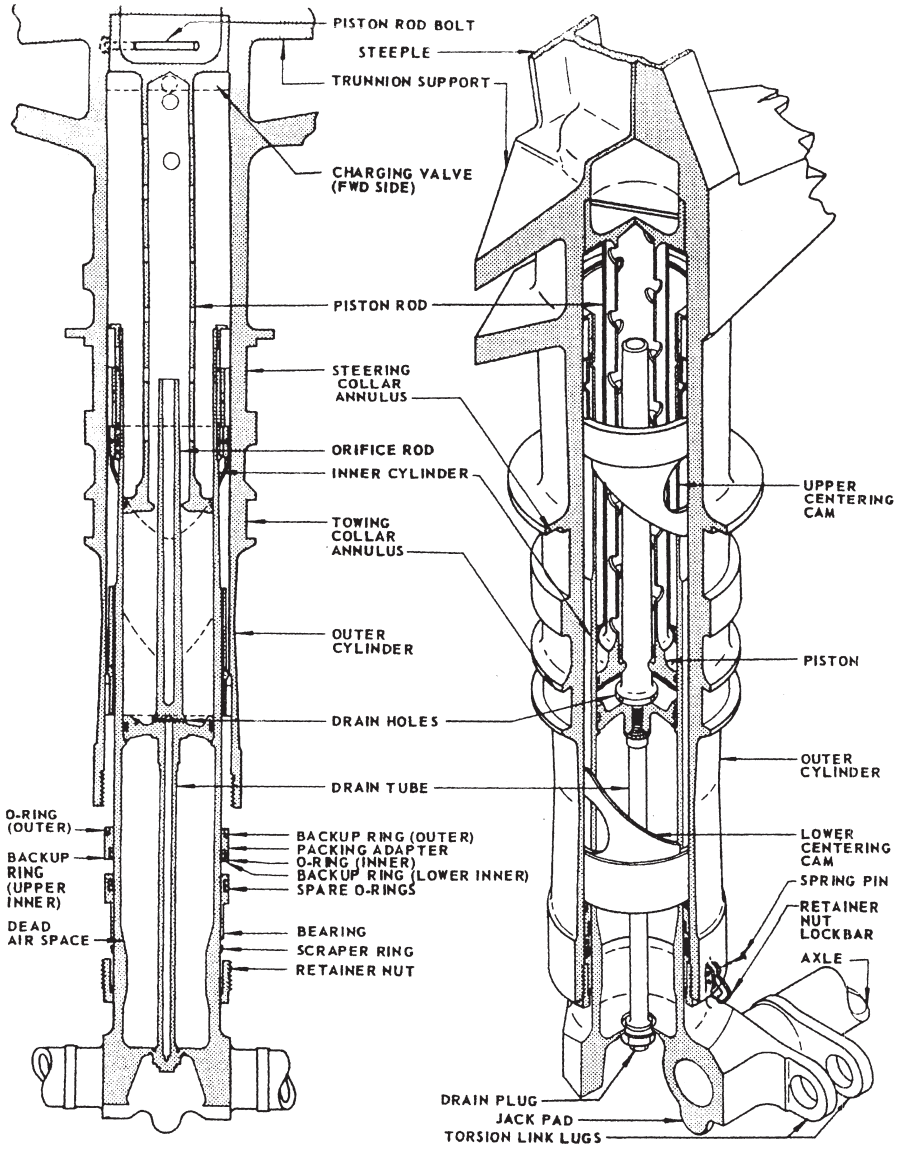
5.3. Shock Strut.

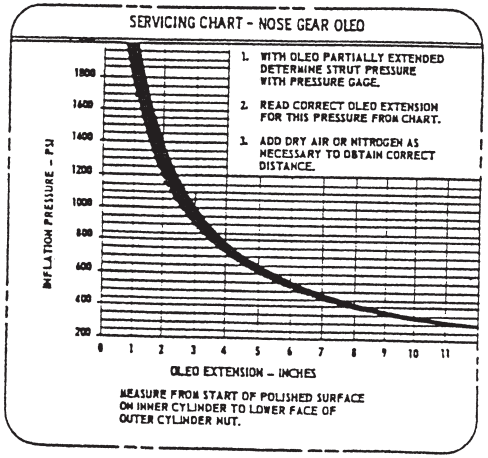
The nose gear shock strut operates in the same way as the main gear shock strut. However, the torsion links do not connect the shock strut inner cylinder to the outer cylinder but to a rotating towing collar enabling nose gear steering. The shock strut incorporates two centering cams which mate together and align the wheels with the fuselage axis when the shock strut extends at takeoff. The shock strut is serviced with hydraulic fluid and charged with nitrogen through a charging valve mounted on top of the outer cylinder. A servicing chart in the nose wheel well informs about the required respectively allowable strut extension (normally 3-6 fingers) according to the nitrogen pressure. A drain plug is provided at the bottom of the inner cylinder.

Maintenance.
With the shock strut assembled, compressed, and serviced with fluid to the filler point, the outer cylinder will contain fluid all around the piston rod and in the space between the inner and outer cylinders. After the shock strut is serviced with fluid, clean dry air is introduced through the servicing port until the shock strut has reached the extension point per placard in wheel well.

CAUTION: DO NOT EXCEED THE INFLATION LIMITS CALLED OUT ON THE WHEEL WELL PLACARD. TOWING OR TAXIING WITH EXCESSIVE NOSE GEAR STRUT EXTENSION COULD RESULT IN DAMAGE TO THE NOSE GEAR CENTERING CAMS. WITH GEAR CENTERED, MAXIMUM EX-TENSION IS 16 INCHES, BUT MAXIMUM SAFE EXTENSION OF SHOCK STRUT IS 12 INCHES WHILE TOWING OR TAXIING, REGARDLESS OF STEERING ANGLE. IF EXTENSION APPROXIMATE 12 INCHES, CHECK FOR PROPER INFLATION OF STRUT OR LOADED C.G. OF AIRCRAFT OR BOTH. NOSE GEAR LOCK SYSTEM

NOSE GEAR SHOCK STRUT





5.4. Locking Mechanism.

The lock mechanism prevents gear retraction or extension by pushing the drag brace knuckle against stops into an overcenter position and then locking the knuckle by means of a lock roller. The lock mechanism is normally operated by a hydraulic lock actuator and, in case of hydraulic system failure, mechanically by an emergency control drum (see "NOSE GEAR EMERGENCY EXTENSION"). Both lock actuator and emergency control drum actuate the lock roller by a Y-type lock crank and a lock rod. The Y-type lock crank is independent of the drag brace upper segment.

Gear Down-Locking.
During gear transit, the drag brace folds, and then the upper and lower segments progressively align. When both segments are in a straight line, the detents of the drag brace segments are not yet opposite each other. So the lock roller prevents any rotation of the Y-type lock crank with respect to the drag brace upper segment. The lock actuator, rotating the Y-type lock crank, forces the upper segment to continue rotating until stops contact. At this time the drag brace knuckle is slightly in overcenter, and any tendency of the gear to retract again will push the stops more against each other. When the drag brace knuckle is in overcenter, the lock actuator pushes the lock roller into the lower drag brace detent. However, the roller still remains partially engaged in the detent of the upper segment; so any relative movement between the two segments becomes impossible.

The lock roller is kept in this lock position by the retention actuator (see "NOSE GEAR HYDRAULIC SYSTEM" or by a down-lock pin (see "NOSE GEAR EMERGENCY EXTENSION"). The roller is also maintained in the lock position by a lock spring incorporated to the brace knuckle.

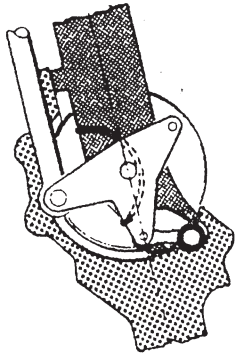
Gear Unlocking.
When unlocking the gear, the lock actuator :

- Pulls the lock roller inside the detent of the upper segment,
- Rotates the drag brace to break the knuckle overcenter.

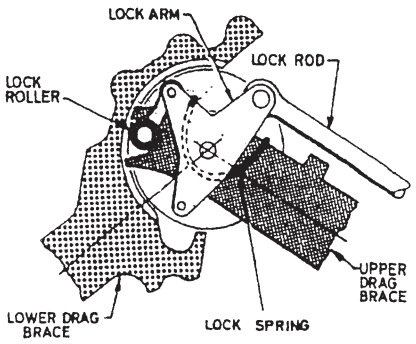
Since then the main actuator can move the gear.

Gear Uplocking.
The gear locking in up position is accomplished by the lock actuator similar to the down-locking.

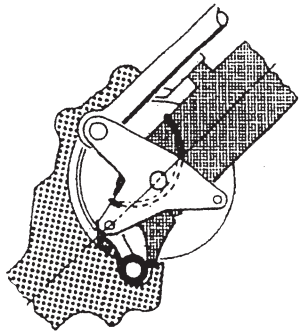
Nose Gear Lock and Position Warning Switches.
The lock warning switch attached to the drag brace upper segment and is actuated by the lock rod. It senses whether the gear is locked or not. The position switch is mounted on the wheel well structure and actuated by a linkage attached to the drag brace upper segment. It senses whether the gear is up or down.



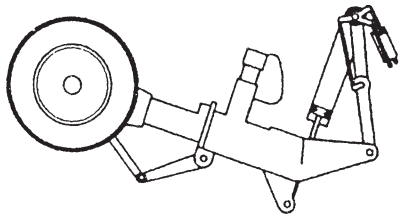
GEAR UP AND LOCKED

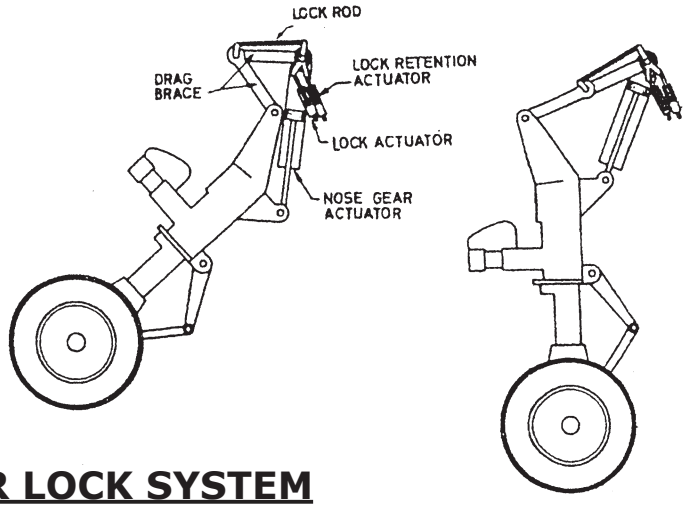


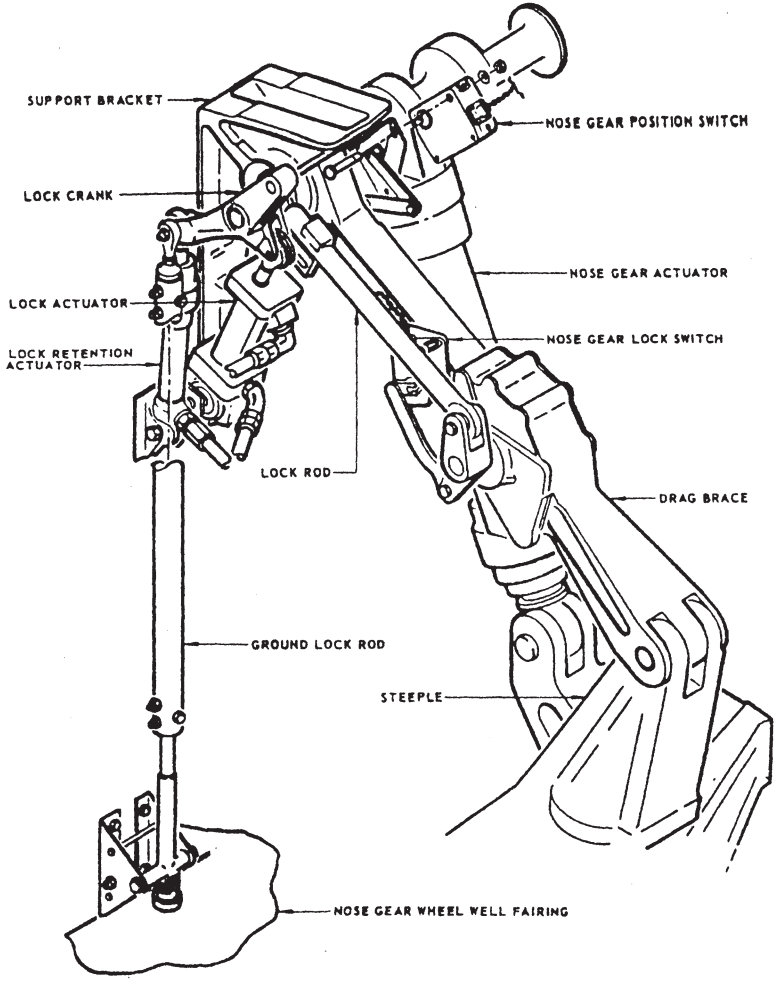
GEAR IN TRANSIT



GEAR DOWN AND LOCKED





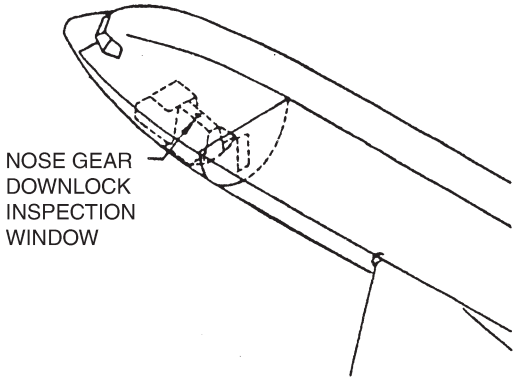


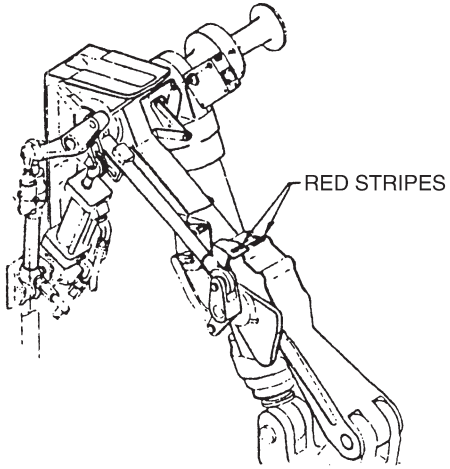
NOSE GEAR LOCK SYSTEM

5.5. Nose Gear Downlock Inspection Window.

Red stripes painted on the lock rod and on the lock housing indicate, when aligned, that the gear is locked. When the gear is down, they are visible in a mirror through a window in the lower nose compartment near the nose wheel well.

CAUTION: THESE RED STRIPES ARE ALSO ALIGNED AND VISIBLE UNDER A DIFFERENT VIEW ANGLE WHEN THE GEAR IS LOCKED IN UP POSITION. HOWEVER, IN THIS CASE, THE MIRROR ALSO REFLECTS THE STEERING CYLINDERS. NOSE GEAR DOORS





NOSE GEAR MECHANICAL INDICATION

6. NOSE LANDING GEAR DOORS.

6.1. Doors Mechanism.

The shock strut housing as well as the wheel well are closed by clamshell type doors.

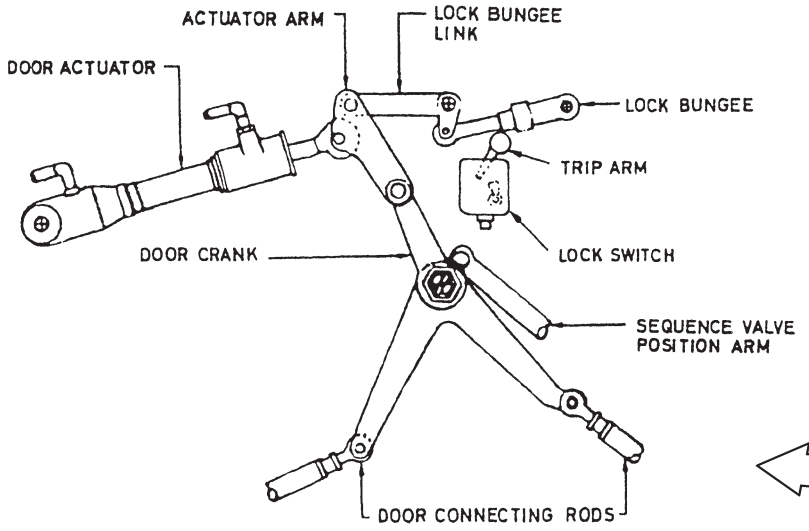
Shock Strut Doors.
A pair of clamshell type doors is mechanically controlled by the trunnion. They remain open when the gear is down and lower vibrations as well as noise level.

Wheel Well Doors.
The wheel well doors are normally operated by a hydraulic door actuator through a linkage (door actuation rods) mounted to the wheel well forward bulkhead. The door actuation rods are attached to the doors by quick disconnect pins. In the closed position the door actuator is fully extended, and the doors are mechanically locked by a lock bungee which maintains the door actuation linkage in an overcentered position. To open the doors the door actuator retracts, releasing the overcenter. The lock bungee will then relax. In case of hydraulic failure the emergency extension system releases the doors, by rotating a trip arm, which fall open by gravity. On ground the doors can be opened by actuation of the ground release handle.

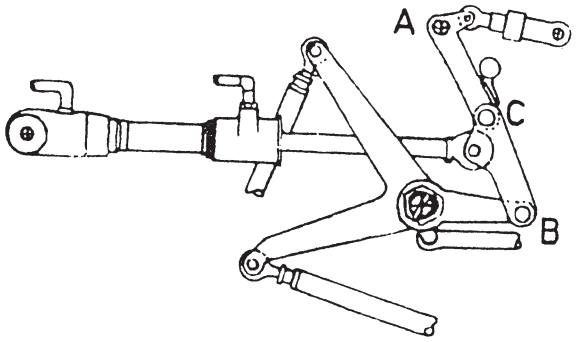
Nose Gear Door Lock Bungee.
The nose wheel well door lock mechanism incorporates a spring loaded lock bungee that exerts a force of ±66 pounds to hold the door linkage mechanism in a door closed and over center locked position. In the door open position, the bungee is freely extended with no loads exerted. One end of the bungee is attached to a support bracket and the other end is attached to a door linkage arm.

Wheel Well Doors Lock Warning Switch.
A microswitch mounted on the wheel well forward bulkhead is used to control a door lock warning light in the cockpit. The switch is actuated by the door control linkage.

NOSE GEAR DOORS

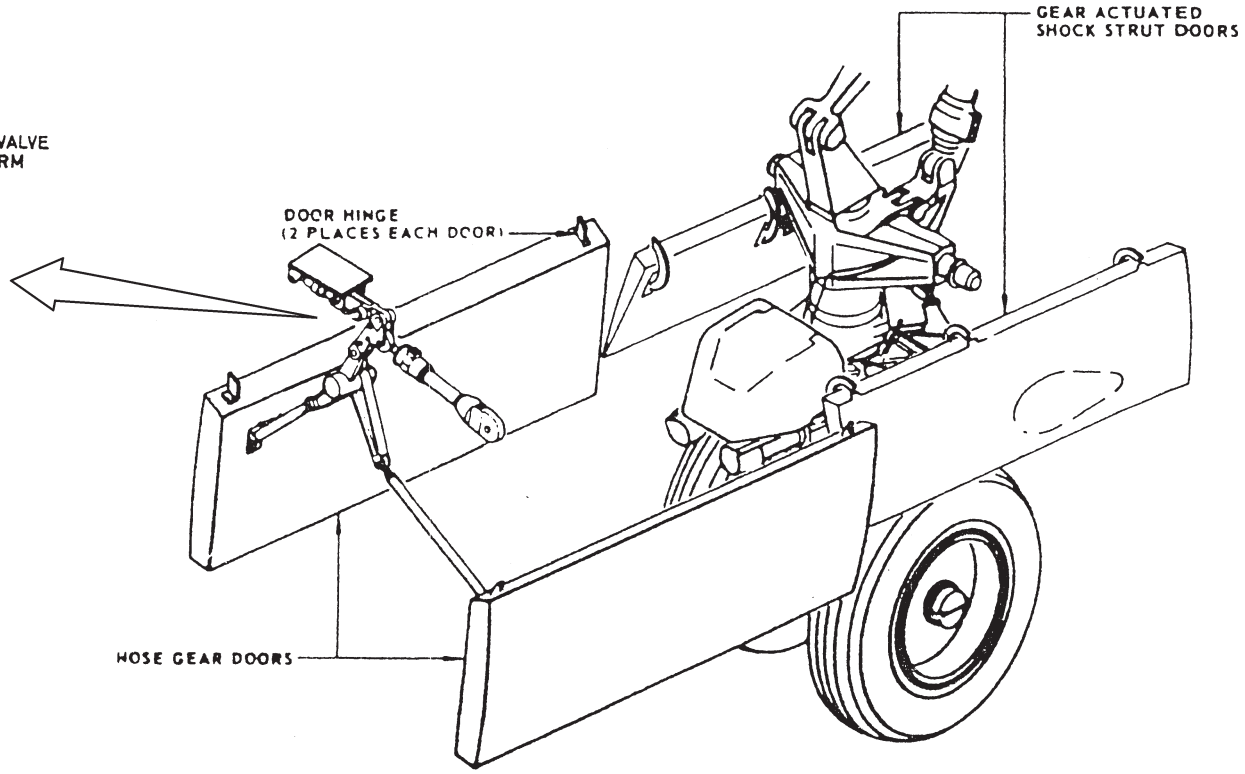


OPEN POSITION



C IS IN AN OVERCENTER POSITION WITH RESPECT TO LINE AB

CLOSED POSITION



6.2. Wheel Well Doors Ground Opening.

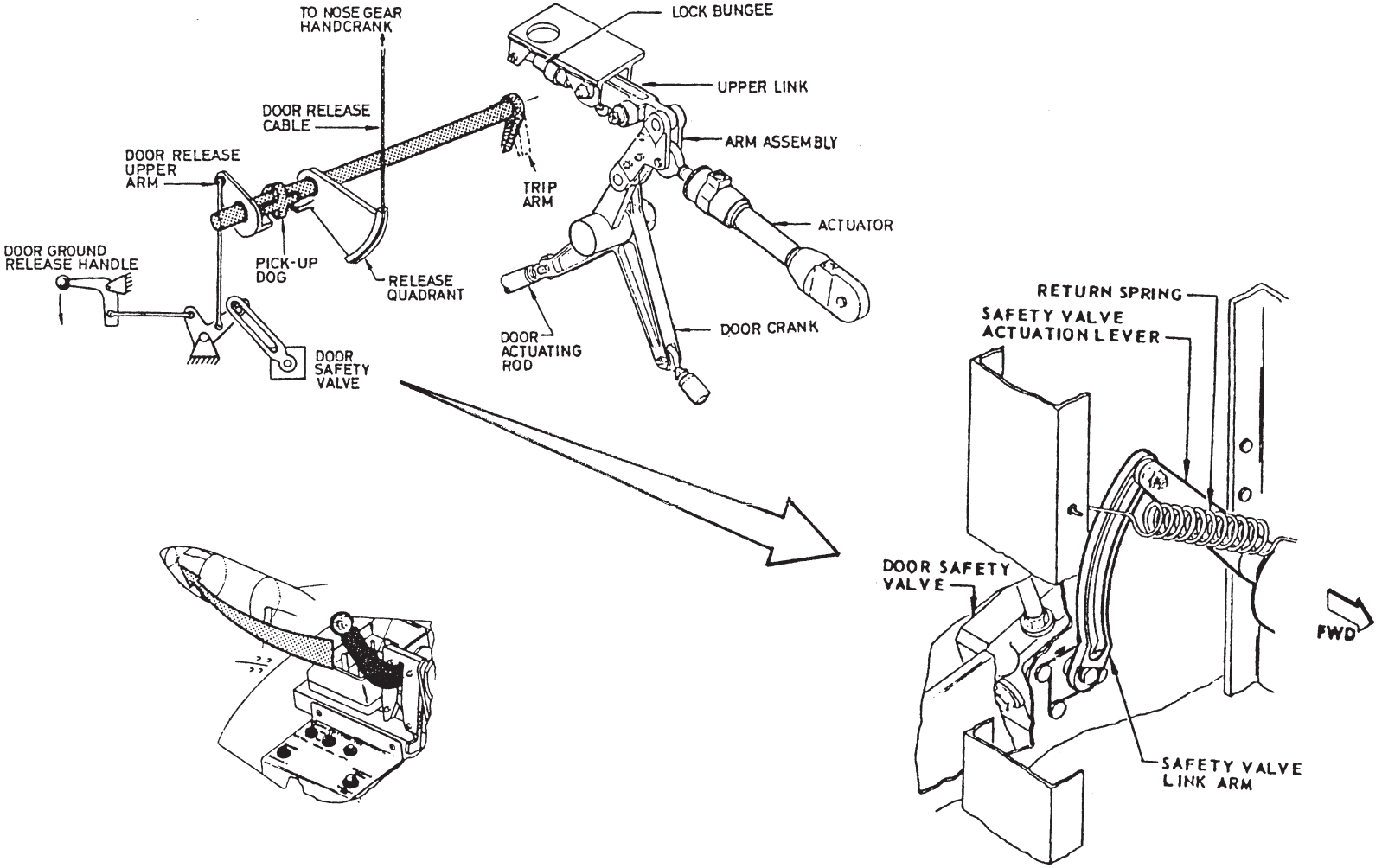
When the airplane is on the ground, the nose wheel well doors can be. unlocked and opened by pulling downwards a door ground release handle located near the external power receptacle on the right side of the fuselage.

When the door ground release handle is pulled down, the initial movement rotates the safety valve to block off hydraulic pressure to the door actuator port and to connect both close and open port to the return line allowing hydraulic fluid to flow from one end of the actuator to the other.
Further movement rotates the door release upper arm until it contacts a pick-up dog bolted to the trip ann shaft. Force is then applied by the trip arm on the bungee linkage to unlock the doors. After that, the doors open by gravity.

WARNING: PRIOR TO ENTERING, OR AT ANY TIME PERSONNEL ARE IN WHEEL WELL, ENSURE DOOR GROUND RELEASE HANDLE IS DOWN AND LATCHED, TO PREVENT INADVERTENT DOOR CLOSING DURING WHEEL WELL ACCESS. VERIFY WHEEL WELL AREA IS CLEAR BEFORE SETTING DOOR GROUND RELEASE HANDLE TO CLOSE, OR PRESSURIZING HYDRAULIC SYSTEM.

NOTE: The extemal power receptacle access door cannot be closed when the nose gear door ground release handle is pulled down.

When closing the nose gear doors before flight, the door ground release handle must be firmly pushed against its up stop to properly position the safety valve. Any intermediate position of the safety valve would prevent gear retraction at the next takeoff.



NOSE GEAR DOORS GROUND OPENING

7. NOSE GEAR HYDRAULIC SYSTEM OPERATION.

For gear extensionthe sequence valve and the door control valve distribute down line pressure to the actuators in the following sequence :

- Pressure is directed by the door control valve to the door actuator open port. The closed port is connected with the return line through the up line and the selector valve. The door actuator slightly compresses the bungee to unlock the door linkage and then opens the doors.
  The bungee extends completely. The sequence valve opens when the doors are full open.
- The sequence valve directs pressure to the down control line of the main and the lock actuators. The up control line is connected with the up line, i.e. with the return line.

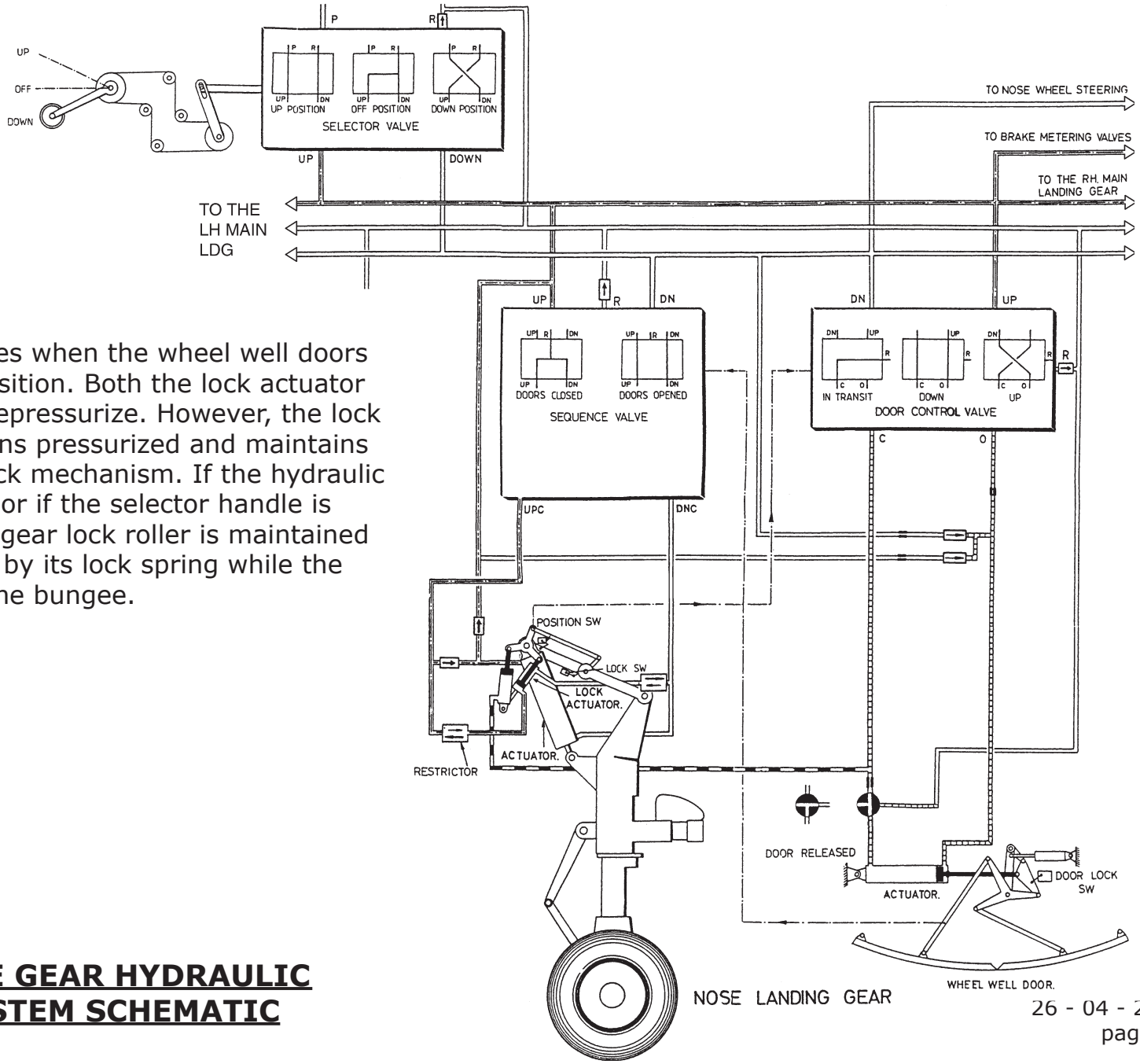
Gear Unlocking.
The lock actuator rotates the Y-type lock crank counterclockwise.
The lock retention actuator being connected to the door close line is depressurized and thus does not oppose against the lock crank rotation.
The lock roller disengages from the lower detent. Then the lock actuator breaks down the drag brace overcenter.

Gear Transit.
Once the gear is unlocked, the main actuator extends the gear. As the gear extends, the upper drag brace rotates upwards. Rotation of the drag brace also rotates the Y-type lock crank to which the door control valve and the lock actuator are attached. The door control valve is positioned in transit. The door actuator close port is thus depressurized while the open port is closed. Wheel well doors are consequently hydraulically locked in open position. During gear transit, pressure remains on the lock actuator but is bypassed through built-in passages until the gear reaches the full down position. Fluid leak through the actuator is limited by a variable restrictor.

Gear Downlocking.
At the down position, the lock actuator inner passages close, and the lock actuator retracts in order to push the drag brace into overcenter and then engage the lock roller in the down detent. Simultaneously the door control valve moves into down position.

The door control valve directs pressure to the close port of the door actuator and to the lock retention actuator. The door closes and, once fully closed, the door actuator pushes the door linkage into overcenter to lock the door. The bungee is fully compressed and maintains the lock engaged.

The sequence valve closes when the wheel well doors reach the fully closed position. Both the lock actuator and the main actuator depressurize. However, the lock retention actuator remains pressurized and maintains a locking force on the lock mechanism. If the hydraulic system is depressurized or if the selector handle is set into off position, the gear lock roller is maintained engaged in lock position by its lock spring while the door locking is kept by the bungee.



NOSE GEAR HYDRAULIC SYSTEM SCHEMATIC

8. EMERGENCY EXTENSION CONTROLS.

8.1. General - MLDG.

The landing gear emergency system provides a means of gear extension which is independent of the normal hydraulic controls. Crank operated cable systems for each gear control the emergency extension.
Any of the gear, when unlocked, will free fall to the extended position.
This makes cranking necessary only to release the doors and unlock the gear fro m the up position, and to lock the gear in the down position.
When released, the doors drop down to the open position and remain open.

The controls for emergency landing gear extension are in the floor of the control cabin. Three hand crank drums (one for each gear) are accessible through doors in the cabin floor. A crank, stawed in the emergency equipment rack, is used to turn the drums. The handcrank drums are rotated one way to unlock the wheel well doors and unlock the gear. Rotation in the opposite direction locks the gear down.

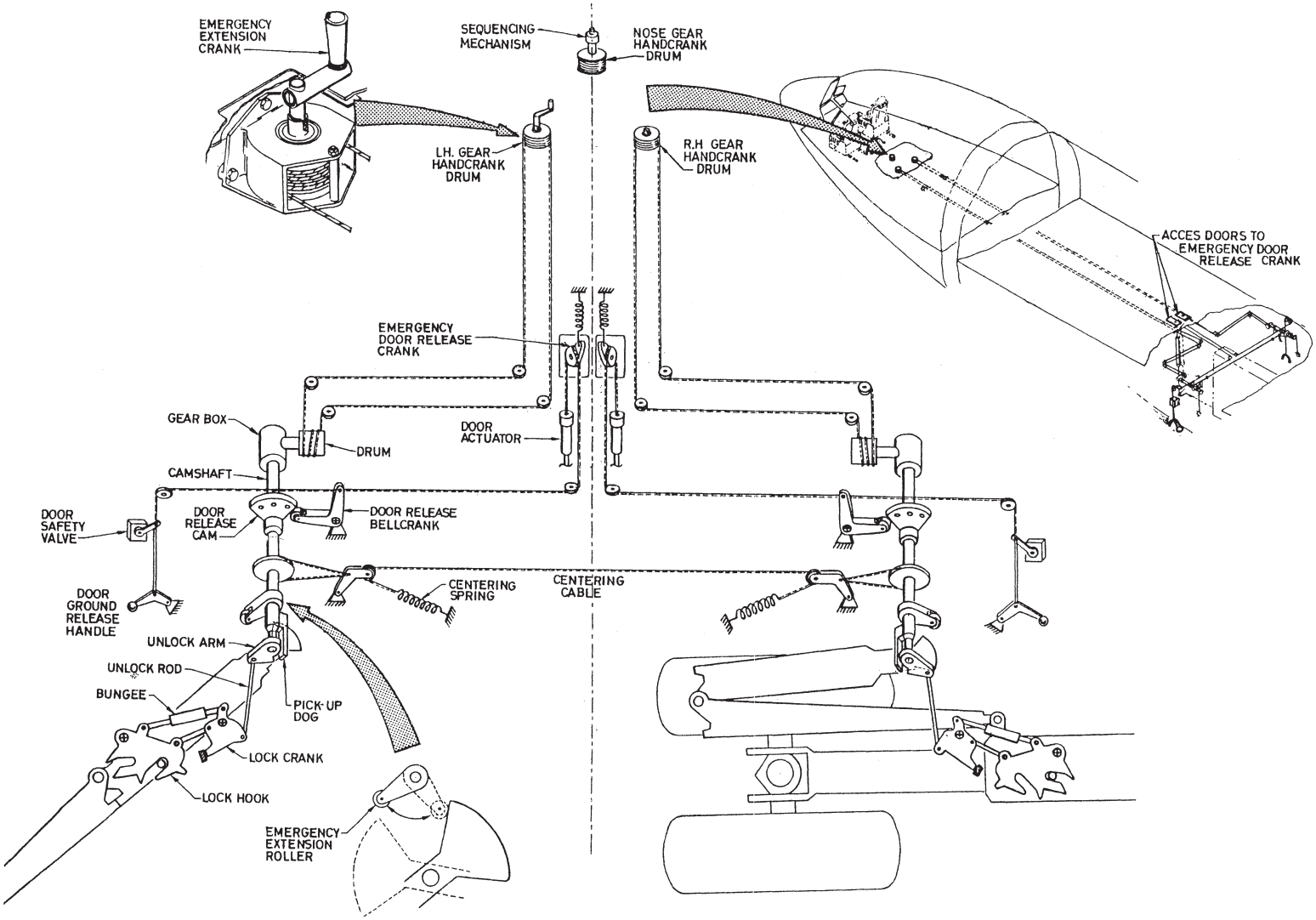
The emergency extension system should not be used to open wheel well doors for ground maintenance for the following reasons :

- During nose gear emergency extension the airplane must be on jacks as the gear will retract if unlocked with airplane weight on the nose gear.

CAUTION: DO NOT OPERATE LANDING GEAR EMERGENCY EXTENSION SYSTEM WITH AIRPLANE WEIGHT ON THE NOSE GEAR AS THE NOSE GEAR WILL RETRACT IF UNLOCKED.

- In main gear door emergency extension operation during ground maintenance the door safety valve is not actuated unless the door ground release handle is also moved to the down and latched position.

WARNING: APPLICATION OF HYDRAULIC PRESSURE TO LANDING GEAR SYSTEM WITH DOORS OPEN AND RELEASE HANDLE NOT DOWN AND LATCHED COULD CLOSE THE DOORS AND INJURE PERSONNEL.



MAIN GEAR EMERGENCY EXTENSION SYSTEM

8.2. Nose Gear Emergency Extension.

The emergency extension mechanism, allows to open the doors and to extend the gear when hydraulic power is not available. It operates the doors and the gear in the same sequence as when they are hydraulically operated except that the doors do not close again after gear extension. Similar to the main gear, the system is cable controlled from a hand crank drum installed in the cockpit floor. A cable driven by the hand crank drum is attached to the door release quadrant, and two other cables are wrapped on the gear release drum.

NOTE: When extending the nose gear with the emergency hand crank, be sure the adjustable hand crank is extended to its maximum length. This will assure proper leverage to release the uplock mechanism.

The instructions placarded on the hand crank adapter cover,read :

- Rotate 3/4 turn clockwise.
- Rotate 1 turn counterclockwise.

Doors Unlocking

The door release cable pulls the door release quadrant upwards. This quadrant is mounted freely on the trip arm shaft. However, when the release cable is pulled upwards, the quadrant contacts a pick-up dog fitted to the trip arm shaft and drives the trip arm. The trip arm pushes against the door release roller. The door mechanism unlocks and the doors lower by gravity.

NOTE: The emergency control mechanism does not control the door safety valve because the door release upper arm is mounted free on the trip arm shaft. Consequently, the gear selector valve must be placed into off position, to allow hydraulic fluid contained in the door actuator to transfer from one side to the other side.

CAUTION: WHEN THE EMERGENCY MECHANISM IS USED TO OPEN THE NOSE WHEEL WELL DOORS, THE DOOR ACTUATOR MUST BE ENTIRELY DEPRESSURIZED. INDEED, WHEN THE TRIP ARM ROTATES TO UNLOCK THE DOOR MECHANISM, IT MUST RETRACT THE DOOR ACTUATOR TO A CERTAIN EXTENT THAT THE DOOR MECHANISM OVERCENTER IS OVERCOME.
THIS ACTION WILL BE IMPOSSIBLE IN CASE HYDRAULIC PRESSURE IS MAINTAINED ON THE DOOR ACTUATOR. EXCESSIVE LOADS WILL DAMAGE THE MECHANISM.

Gear Unlocking.
While the door release quadrant rotates to unlock the doors, the gear release drum rotates clockwise. The gear release drum is mounted on a tubular shaft (outer shaft) concentric with the Y-type lock crank shaft. Both shafts can rotate independently until the pick-up dog contacts. The pick-up dog contacts only after unlocking doors. Since then, while continuing to rotate the hand crank clockwise, the gear release drum rotates the Y-type lock crank shaft. The lock roller is pulled out of the lower drag brace detent. Then the Y-type lock crank pulls the drag brace knuckle out of overcenter - this action requires a force on the hand crank of up to 80 pounds - and the gear lowers by gravity. Fluid contained in the gear actuators transfers from one side to the other through the gear selector valve (selector valve in off position).

Gear Extension.
The groove in the lock crank shaft is such that, during gear lowering, the Y-type lock crank shaft rotates with the upper drag brace segment without driving the release drum.

In that event :

- Remove the down lock pin,
- Proceed with the gear extension by means of the Johnson Bar.

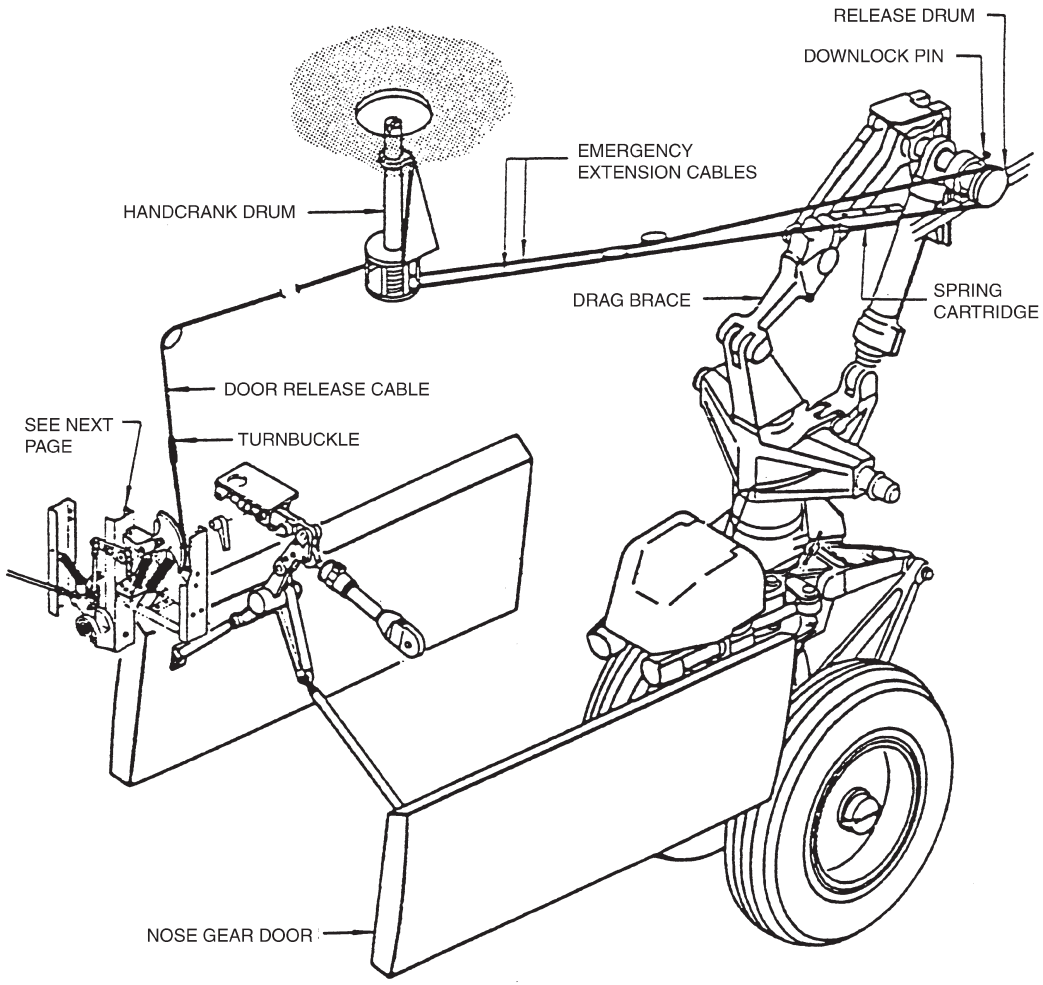
Observe that there is no force limit at the Johnson Bar. It actuates the nose gear extension and lock mechanism directly.

When rotating the hand crank clockwise (3/4 turn) two hard spots will be felt, the first is the nose gear door opening, the second, which requires high forces input, is the release of the uplock mechanism.

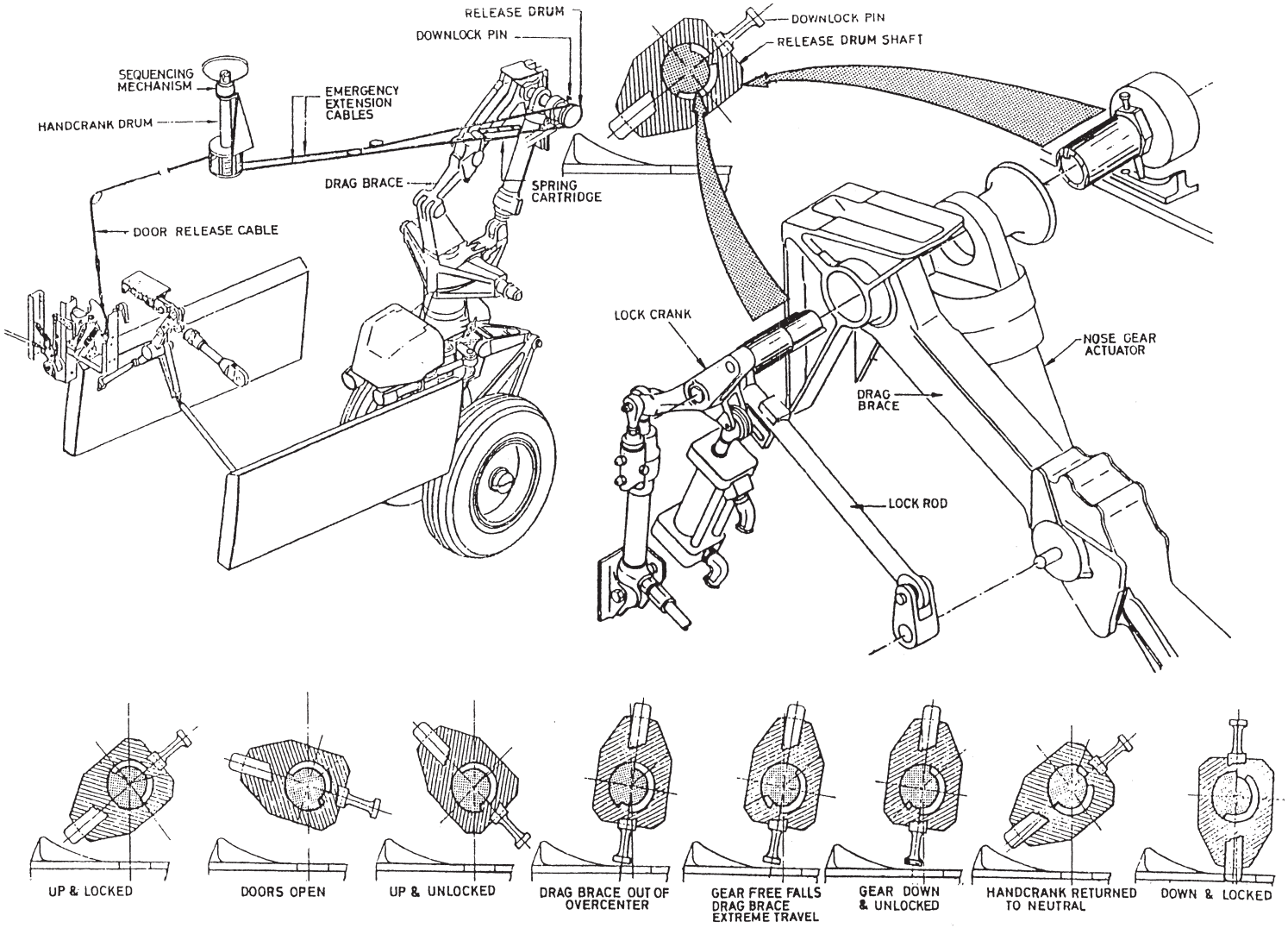
Rotate the hand crank clockwise full travel to its mechanical stop and hold 5 seconds minimum before vroceeding with step 2.

Gear Looking.
The first 3/4 turn brings the release drum back to its neutral position. A- little later, the outer shaft pick-up dog contacts the inner shaft. The Y-type lock crank rotates counterclockwise with the release drum which pushes the drag brace knuckle into overcenter and then engages the lock roller in the detent. At this time a spring-loaded down lock pin installed on the gear release drum drops into a detent. This nose gear downlock sets the gear lock mechanism into lock position. It accomplishes the same functions as the retention actuator during normal hydraulic operation.

NOTE: Extending the nose gear after the hand crank has been rotated into counter clockwise direction to the down lock stop, if the force is removed and the crank turns back into clockwise direction, the nose gear downlock pin has not engaged. In this event, all steps of the nose gear extension sequence must be repeated.
If still unsatisfactory, proceed with the Johnson Bar extension procedure. Under certain circumstances while completing the manual extension sequence, it is possible to engage the down lock pin with the nose gear still locked up. This is evidenced by the down lock pin engaged and no nose gear green light.



NOSE GEAR EMERGENCY EXTENSION SYSTEM



NOSE GEAR EMERGENCY EXTENSION SYSTEM

8.3. Emergency Mechanism Rearming.

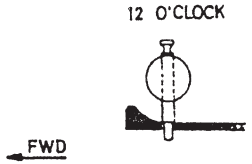
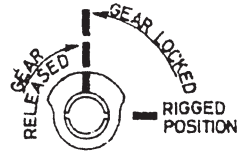
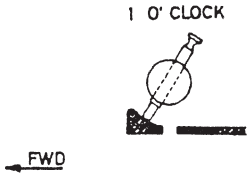
The emergency mechanism and the hand crank drum can return to their neutral position only after releasing of the down lock pin. This pin is accessible in the lower nose compartment on the left side of the nose wheel well. It is painted red.

NOTE: When the down lock pin is disengaged from the detent, the whole emergency mechanism automatically is reset into neutral position by a spring cartridge. The spring cartridge is installed on the left side of the wheel well.

CAUTION: THE NOSE GEAR CANNOT BE RETRACTED WITH THE DOWN LOCK PIN ENGAGED. AN ATTEMPT TO RETRACT THE GEAR WITH NOSE GEAR DOWNLOTK PIN ENGAGED COULD CAUSE BENDING OF THE PIN.

WARNING: USE CARE WHEN REMOVING THE NOSE GEAR DOWN LOCK PIN. SPRING LOAD TENDS TO ROTATE SPRING RAPIDLY TO UNLOCKED POSITION.

DO NOT RELEASE MANUAL GEAR EXTENSION HAND CRANK UNTIL UNLOCKING/ LOCKING CYCLE IS COMPLETED.
CABLE LOADS CAN CAUSE CRANK TO ROTATE AND CAUSE INJURY.

DOWN LOCK PIN POSITION	HANDCRANK ADAPTER POSITION	
		Gear emergency locked in down position.
		Emergency extension system in neutral position.

EMERGENCY SYSTEM REARMING

9. WARNINGS.

9.1. General.

DOOR Warning Light (Red).
Illuminates if any gear door not closed and locked.

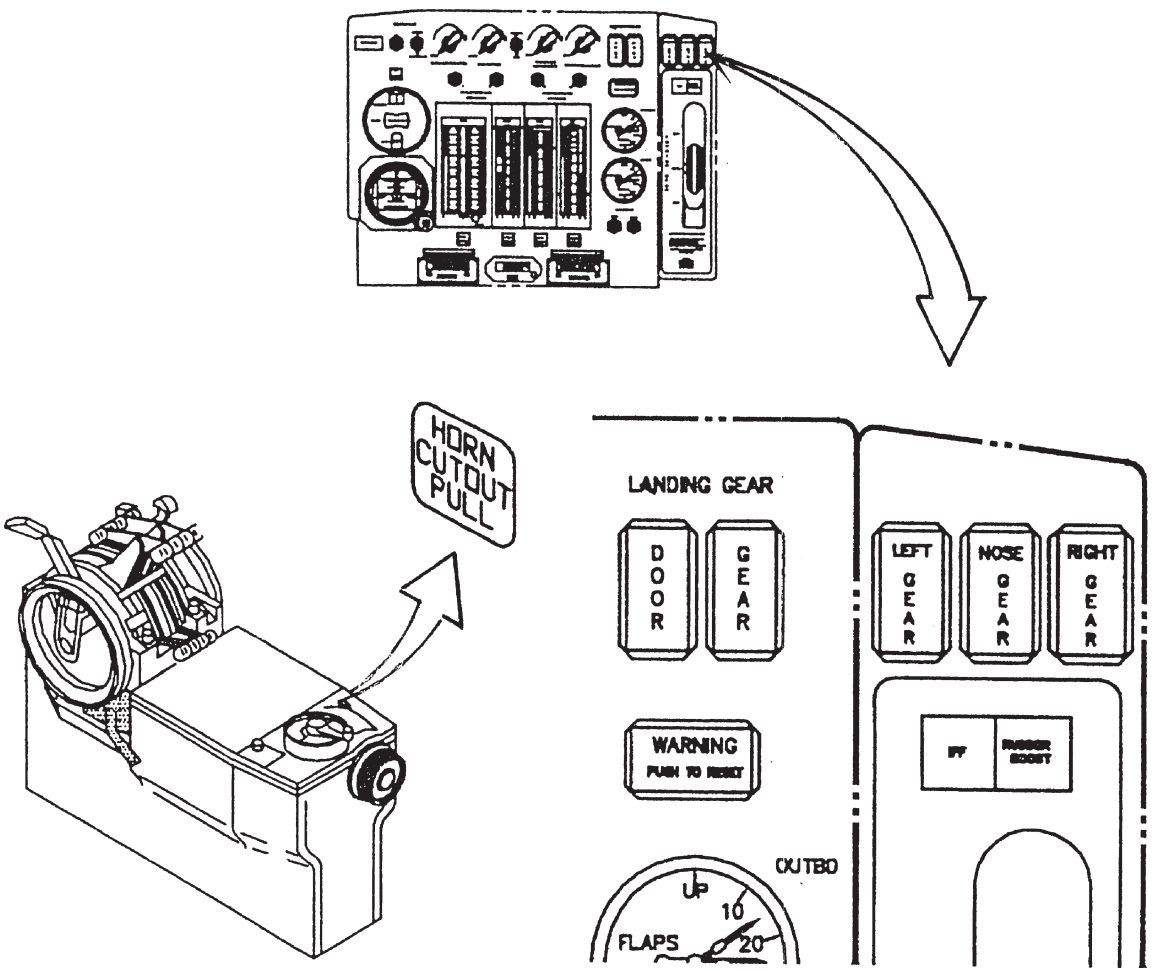
GEAR Warning Light (Red).
Illuminates when any gear is unlocked (regardless of landing gear lever position) or any gear is not in position indicated by landing gear lever or any gear not down and locked and any throttle retarded near idle (can be extinguished pulling HORN CUTOUT lever).

LANDING GEAR Down Indicator Lights (Green).
LEFT GEAR, NO,STE GEAR, RIGHT GEAR, each illuminate when corresponding gear is down and locked. Inoperative if landing gear position relays. malfunction.

HORN CUTOUT Lever (see page 77-78).
When pulled, mechanically resets throttle operated switches to silence warning horn. When landing gear lever is OFF and any gear is not down and locked, also shuts off GEAR Warning light. A warning horn will sound steadily for landing gear unsafe conditions :

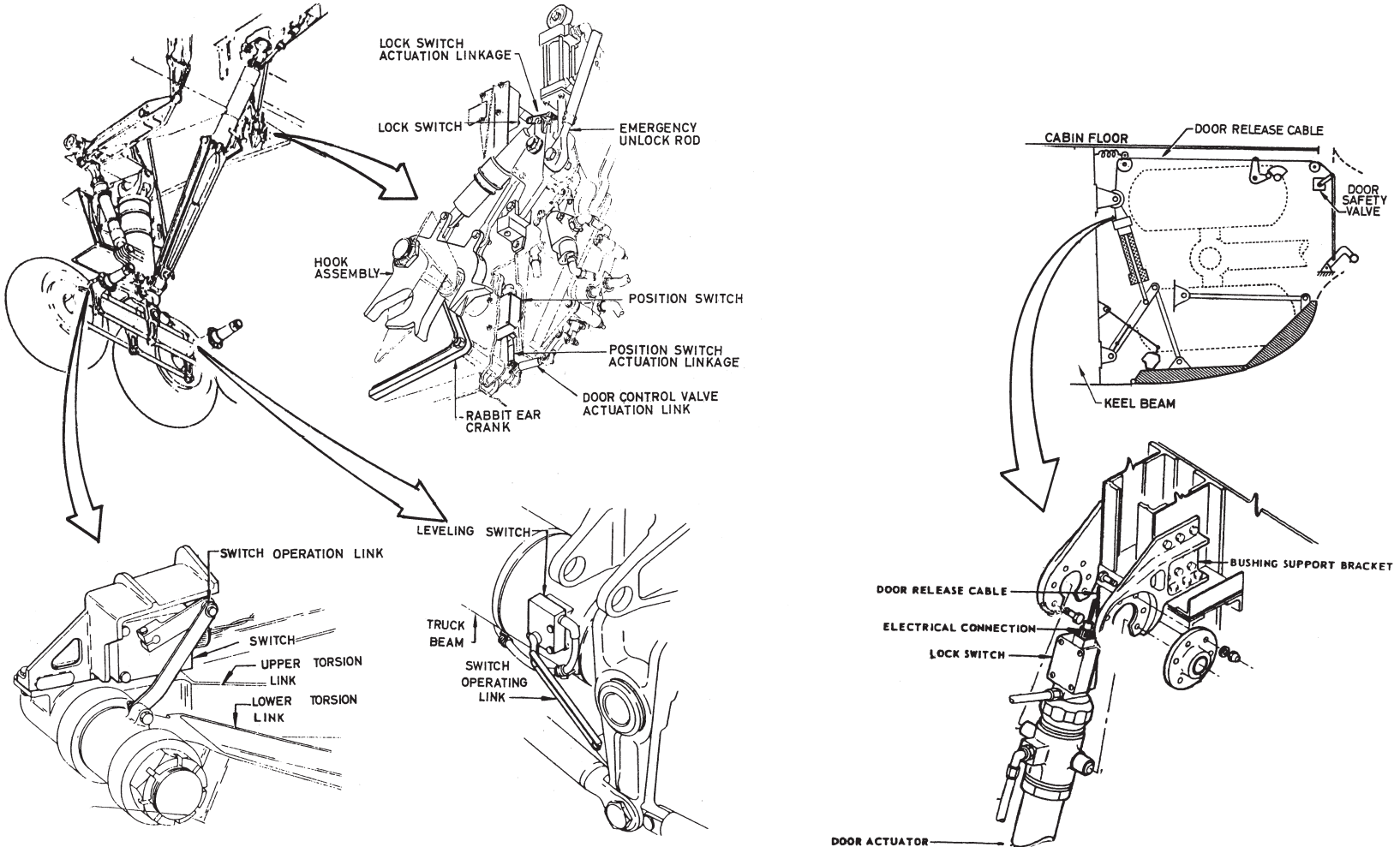
- If a thrust lever is retarded while the three gears are not down and locked. The horn may be silenced by momentarily pulling the horn silence (cut-out lever on top of the pedestal. The thrust lever switches are reset by advancing the thrust levers,
- If flaps are lowered more than 33° while the three gears are not down and locked. The horn cannot be silenced.

The warning lights and the dimming switch are the center instrument located on center instrument panel above the landing gear selector handle.

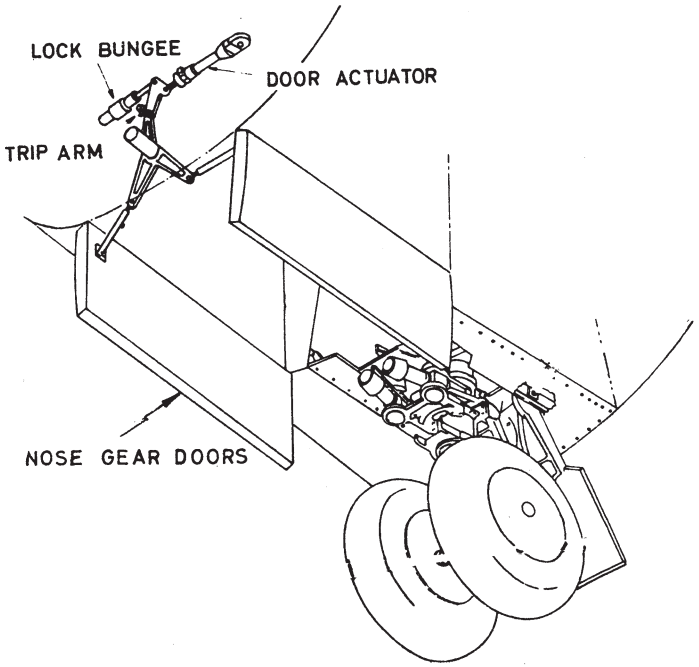


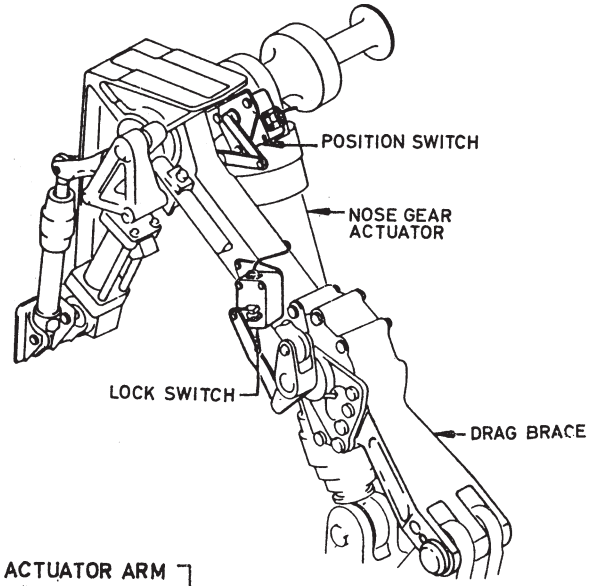
LANDING GEAR WARNING

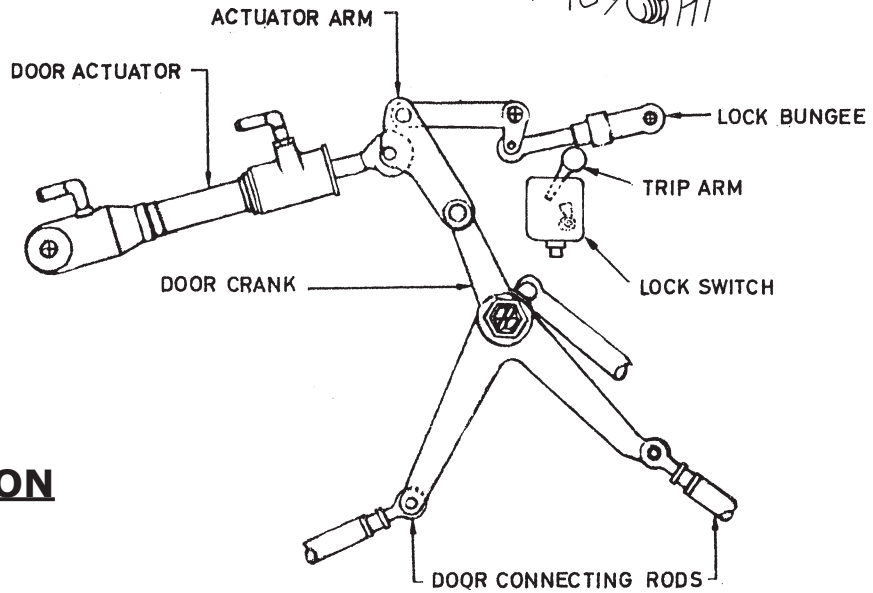
9.3. Warning Switches.



MLDG - WARNING SWITCHES LOCATION







NOSE GEAR WARNING SWITCHES LOCATION

9.3. Abnormal Operation.

Impossibility to move the gear lever into UP detent after airborne.
Check CB "LEVER LATCH AND ANTISKID RELAYS" on P5 panel

If this breaker is in, the possible causes are :

- Stuck latching mechanism or faulty solenoid, or
- Leveling switches not "'level" (due to abnormal gear truck position or switch failure), or
- One or both landing gear safety switches remaining in "on ground" position.

CAUTION: DO NOT USE THE OVERRIDE TRIGGER TO RAISE THE GEAR WITHOUT HAVING ASCERTAINED THAT ALL GEARS ARE IN SAFE POSITION TO RETRACT.

Try at first to level the trucks by lowering full flaps.

In order to check if trucks are level, open the landing gear doors by pulling the trigger and momentarily setting the gear lever into UP position.

CAUTION: THE GEAR LEVER HAS TO BE RESET INTO OFF POSITION AS SOON AS THE RED DOOR WARNING LIGHT IS ILLUMINATED.

The flight engineer will check if the trucks are level through the inspection windows. During night time the wheel well lights will be switched on.

The red door warning light illuminates during flight.
(Failure of the door warning system or non-locking of a wheel well door)

- Gear lever - UP
- DOOR warning light - OBSERVE

If light extinguishes :

- Gear lever - OFF

If light remains illuminated :

- Gear lever - REMAIN UP, INSPECT WHEEL WELL, CONSIDER MLO, VLO, AND PERFORMANCE

Indication	Malfunction
One green light remains OFF Red GEAR and DOOR warning lights OFF	Probable failure of the warning circuit. If the gear is actually not down and locked, both GEAR and DOOR red warning lights would remain ON. CORRECTIVE ACTION : - Visually check gear locking
One green light remains OFF Both red warning lights ON	Gear corresponding to the green light OFF is not locked in down position. Corresponding wheel well doors are open. CORRECTIVE ACTION : - Attempt to lock the gear by moving the gear lever to UP and DOWN again. - After second attempt extend and lock the respective gear by means of the emergency extension mechanism. **NOTE :** This trouble may be caused by icing of the lock mechanism, mainly for the nose gear. If this occurs for the nose gear, and if wanner regions are not in range, de-icin)-Z of the lock mechanisni may be attempted by breaking the nose gear down lock inspection window. This will allow a flow of warm air from the cabin around the lock mechanism. Cabin has to be depressurized for this procedure.
One green light remains OFF Red GEAR warning light ON Red DOOR warning light OFF	Failure of the gear warning circuit; or wheel well doors of the gear corresponding to the green light OFF have not opened, corresponding gear is up. CORRECTIVE ACTION : - Visually check the Position and the locking of the respective gear, - Main gears down locking is also indicated by the antiskid indicators; if the ANTI-SKID switch is ON, they must show -REL-. - If the gear is not down and locked, use the emergency extension mechanism.
Green lights ON Red GEAR warning light OFF Red DOOR waming light ON	Failure of the door warning circuit; or one door is not locked. CORRECTIVE ACTION : - None available **CAUTION :** Do not cycle the gear. If a door is partially damaged, gear extension could become impossible.
Green lights ON Red GEAR warning light ON Red DOOR warning light OFF	Probable failure of the gear warning circuit. The green lights indicate that the gears are down and locked, The wheel well doors are closed and locked. CORRECTIVE ACTION : - Check main gear locking visually and arith the anti-skid indicators, - Visually check nose gear locking

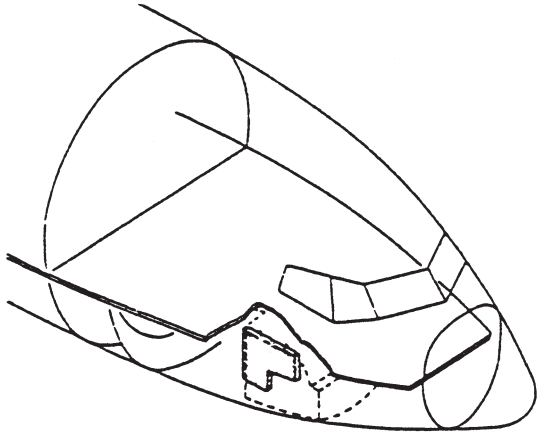
CAUTION: DO NOT TRY TO LOCK THE DOORS BY SELECTING GEAR DOWN AND UP AGAIN. IF THE INVOLDED WHEEL WELL DOOR DOES NOT FUNCTION PROPERLY, DIFFICULTIES COULD BE ENCOUNTERED WHEN EXTENDING THE GEAR PRIOR TO THE NEXT LANDING. INSPECT THE WHEEL WELL TO CHECK THE POSITION OF THE DOOR. IF THE DOOR IS NOT LOCKED OBSERVE SPEED LIMITS.

Landing Gear Safety Switches Malfunction.
In case of doubt about safety switches operation, the antiskid release indicators may be used to locate a faulty switch.
Conditions : ANTI-SKID switch ON, wheels stopped, landing gear down and locked.

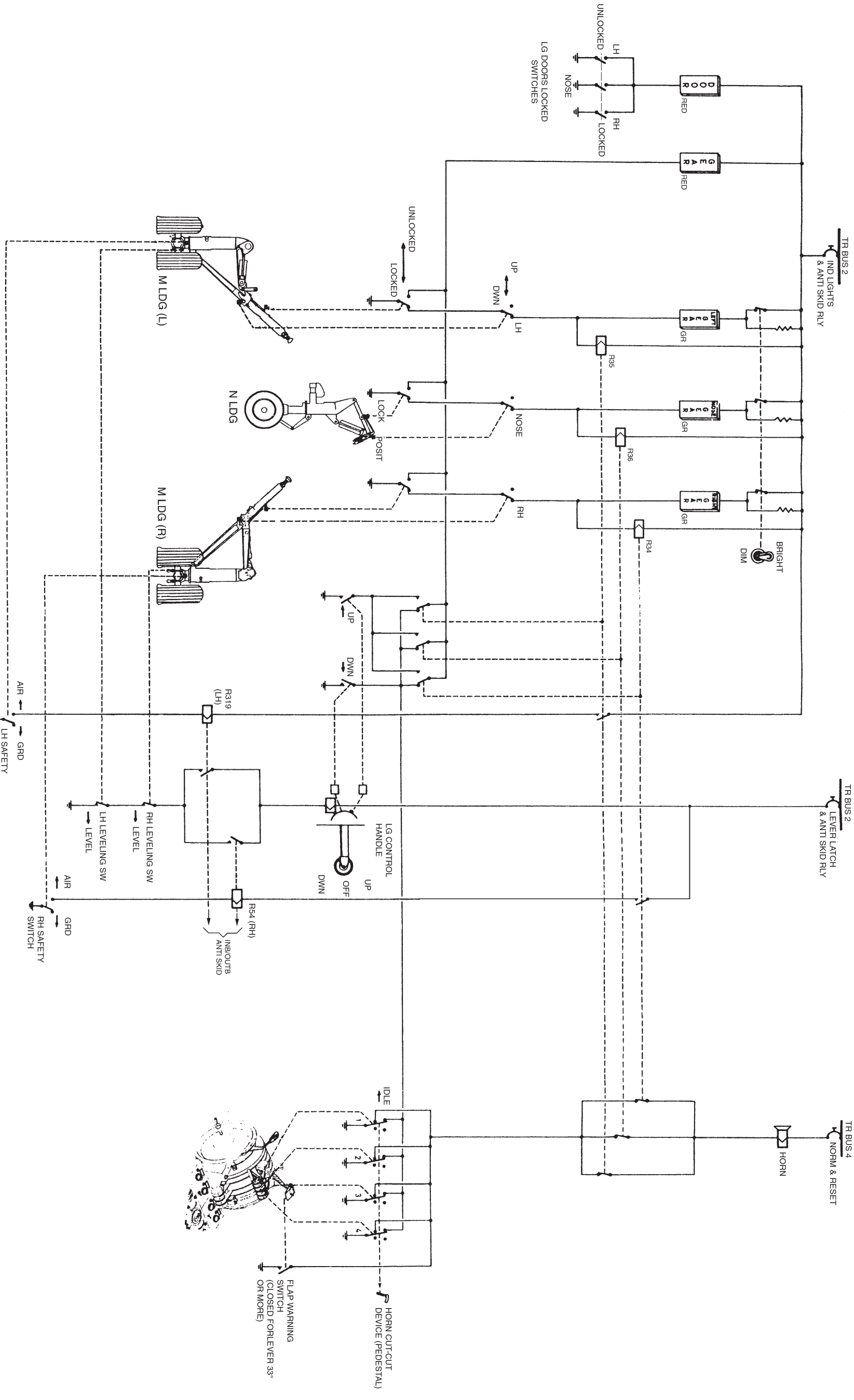
Manual Landing Gear Extension.
See "EMERGENCY PROCEDURES" and this sub-section, "MAIN GEAR EMERGENCY EXTENSION' and "NOSE GEAR EMERGENCY EXTENSION".

Abnormal indications during gear extension.
Landing Gear Warning Relays.
The landing gear warning relays are energized by the position switches when the respective landing gears are down and locked, to open the warning horn circuit, and a part of the red warning light circuit.

Each landing gear warning relay (onefor each gear) is a four pole hermatically sealed unit. Landing gear relays are on J1 relay panel in lower nose compartment. Relay operation is controlled by the landing gear lock and position switches.



LDG WARNING SYSTEM



LANDING GEAR SCHEMATIC