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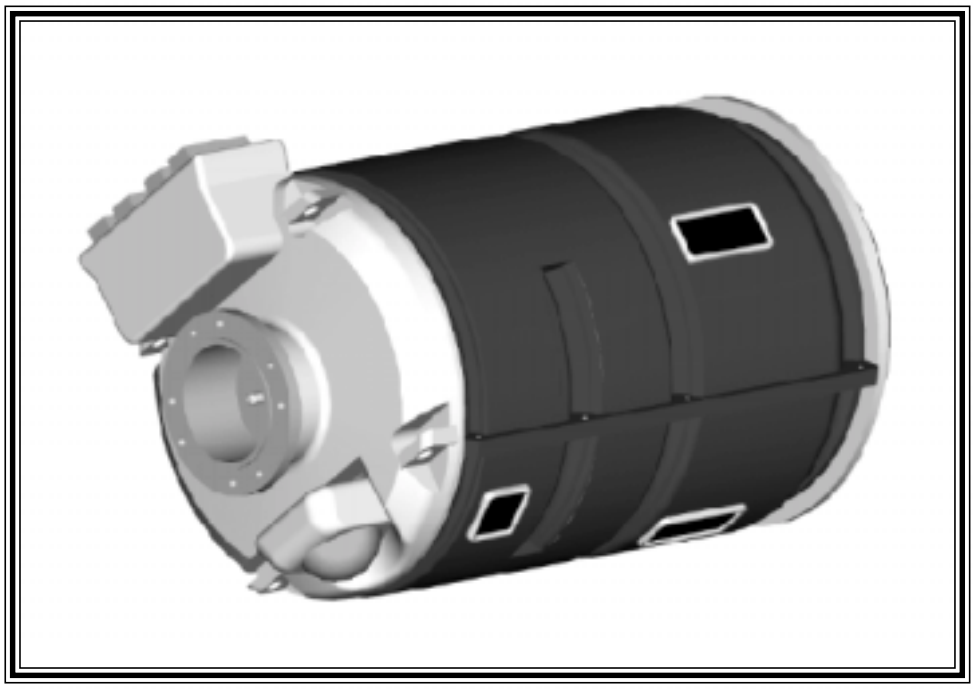
Instructions for the HMB-8 / HMB-8.7 (formerly HMB-11) Mechanism©



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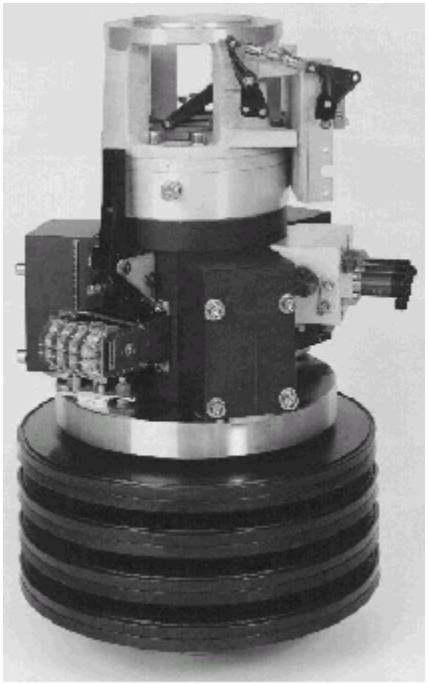
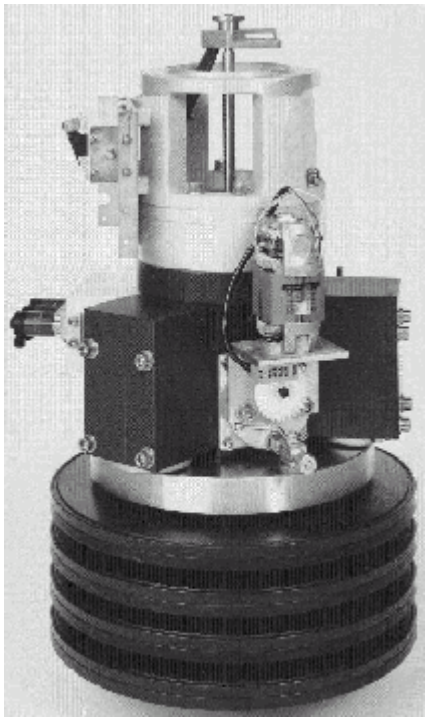
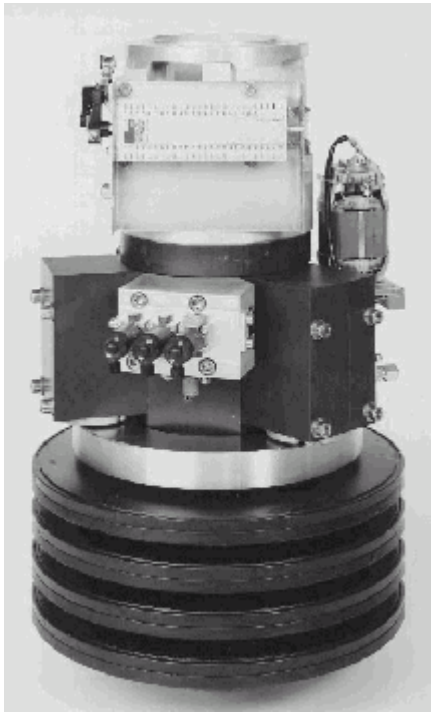






HMB-8 Mechanism

1. Introduction

This module provides a description of components and operating principles as well as instructions for commissioning, operating, and maintaining the HMB-8 mechanism.

1.1 Description

The HMB mechanism is a compact, hydraulically-operated device which uses a compressible stack of disc springs as an energy storage system or accumulator. The mechanism receives operating signals from the electrical control system and translates these signals via open and close pilot valves into linear mechanical motion which respectively open and close the interrupter contacts.

A hydraulic pump draws oil from a low pressure volume and compresses the oil into a high pressure volume which drives three accumulator pistons to compress the disc spring assembly. During breaker operation, stored energy is released from the disc spring assembly 51008 (Fig.1) to the hydraulic system via a changeover valve responding to a signal from the open or close pilot valve. This energy is transferred to the drive piston of the mechanism causing it to move into either the OPEN or CLOSE position. There is no direct mechanical link between the disc spring assembly and drive piston. When the breaker is operating, the disc spring assembly discharges in increments, releasing only the amount of energy required for an OPEN or CLOSE operation. The total energy storage capacity (without recharging) of a fully compressed disc spring assembly allows for two open operations, (O-CO) for HMB-8.3 or HMB-8.7 mechanisms; and (CO-CO) for HMB-8.2 mechanisms.

The hydraulic pump is controlled by a limit switch assembly 97612 (Fig. 1) which monitors the degree of compression of the disc spring assembly and automatically re-charges the disc spring assembly as energy is consumed. By monitoring the degree of compression of the disc spring assembly, the limit switch assembly also provides low spring charge energy alarms and lock-outs should the system energy drop critically low due to failure to re-charge. The HMB design monitors energy storage *only by spring compression (spring travel)* and does not include hydraulic pressure gauges and pressure switches. A mechanical pressure relief valve will release the oil pressure if the limit switches fail to turn off the pump motor.

The velocity of the mechanism for both OPEN and CLOSE operations is factory-set (for the breaker application). An externally visible position indicator 51033 (Figures 1 and 1b) detects the breaker position. The position indicator is operated by a lever system directly coupled to the drive piston. The mechanism covers are made of painted fiberglass material and are divided into two removable halves.

Onboard auxiliary switches 97604 (Figures 1 and 1b) are included that are pre-adjusted and fully wired to waterproof wiring connectors 97606 (Fig.1b) on the mechanism body.

The integrated design affords a compact unit that is essentially maintenance-free. By virtue of its integrated design, the hydraulic spring drive has a minimal amount of high pressure hydraulic connections and no piping connections.

The low pressure hydraulic circuit is sealed from atmosphere by very reliable static and dynamic seals.

A split, bolted coupling is used to attach the drive (or output) shaft of the mechanism to the operating rod of the circuit breaker linkage or pole unit.

2 Hydraulic Elements

The hydraulic components on the HMB mechanism include:

- Pump motor 51002 (Figs. 1 & 5) drives the pump element 51014 (Fig. 5);
- Pump element 51014 (Fig. 5) pumps hydraulic oil from the low pressure volume into the high pressure volume, compressing the disc spring assembly 51008 (Fig. 1);
- Pump limit switch and cam assembly 51046 (Fig. 4) operates the limit switches 97612 (Fig. 1) and determines how far the disc spring assembly travels. The energy storage level for the HMB mechanism is solely determined by the amount of distance the disc spring assembly is compressed. There are no hydraulic pressure gauges or pressure switches. Instead, limit switches start and stop the spring charging motor and provide alarms for insufficient energy levels based on the amount of compression of the disc spring assembly. The pump limit switch and cam assembly controls the following:
  - Pump motor (on/off)
  - Low spring charge alarm
  - Low spring charge lock-out (trip block)
  - Close-Open operation block
- Pressure equalizing valve 51017A (Fig. 2) connects the high pressure section with the low pressure section and acts as a gate to permit deliberate reduction of hydraulic pressure in the mechanism; it also actuates if the limit switch fails during pump operation;
- Oil drain valve 51013 (Fig. 1), when opened, is used to drain or fill hydraulic oil in the mechanism;
- Check valve 51059 (Fig. 5) prevents oil from backflowing from the high pressure section to the low pressure section when the pump element is at rest;
- Filter 51079 (Fig. 5) removes particles from hydraulic oil;
- Pilot valves (close) 51004 (Figs. 2 & 8) and (open) 51005 convert electrical commands to hydraulic commands; after actuation, the pilot valve returns to its initial position;
- Changeover valve 51006 (Fig. 2 & 8) allows hydraulic oil to move the drive piston 51012 (Fig. 7) by changing pressure on the back side of the drive piston;
- The low pressure section of the HMB hydraulic spring mechanism as shown in Figure 2 serves as an oil reservoir.
- Heater 51150 (Fig. 1) within the mechanism prevents condensation in the mechanism;
- Sight windows are located in the mechanism cover 51028 (Fig. 1); the oil level indicator 51036 (Fig.1) can be seen through one window; the spring charge indicator 97611 (Fig.1b) can be seen through the other window.

3 Principles of Operation

The HMB-8 mechanism uses the principles of hydraulics to compress and charge the disc spring assembly. Hydraulic oil is transferred from a low pressure reservoir 97605 (Fig. 1) to a high pressure reservoir by a pump motor 51002 (Fig. 1) and pump element 51014. The high pressure oil is used to compress the disc spring assembly with the accumulator pistons. The disc spring assembly 51008 (Fig.1) acts as an energy storage system. During breaker operation, stored energy is consumed and the disc spring assembly discharges accordingly. The pump motor limit switch (Fig.4) actuates and the pump motor automatically re-charges the disc spring assembly. Principles of the OPEN and CLOSE operations are described in the following sections:

- Section 3.1 CLOSE operation
- Section 3.2 OPEN operation

3.1 CLOSE Operation

The front side of the drive piston 51012 (Fig. 2) is always under hydraulic pressure when the disc spring assembly 51008 is charged. In the OPEN position, the back side of the drive piston is at low pressure.

On actuation of the close pilot valve 51004 (Fig. 2), the changeover valve 51006 moves to the orientation shown in the CLOSE position illustration of Figure 2 allowing high pressure hydraulic oil to flow on the back side of the drive piston. Although there is high pressure on the front side of the drive piston, the drive piston travels in the CLOSE direction because the surface area on the back side of the drive piston is greater than the surface area on the front side of the drive piston, creating a net force in the CLOSE direction.

A low pressure interlock 51016 (Fig. 9) prevents the drive piston 51012 (Fig. 2) from drifting into the OPEN direction in the event of very low system pressure. This interlock is provided when required by the breaker type.

3.2 OPEN Operation

On actuation of the open pilot valve(s) 51005 (Fig. 2), the changeover valve 51006 moves to the orientation shown in the OPEN position illustration of Figure 2. High pressure hydraulic oil flows from the back side of the drive piston 51012 and is released into the low pressure reservoir 97605 (Fig.1). The constantly present high pressure oil on the front side of the drive piston propels the piston into the OPEN position.

3.3 Over-Pressure Relief Device

The HMB mechanism is equipped with a pressure relief valve 51045A (Fig. 2) to prevent damage or catastrophic failure of components due to over-pressurization. Should an over-pressure hydraulic situation occur because of a pump motor failing to stop, the pressure relief valve 51045A (Fig. 2) will prevent damage by automatically releasing high pressure oil into the low pressure reservoir 97605 (Fig.1).

4 Mechanism Maintenance

Major maintenance involving disassembly of the HMB-8 mechanism can be performed by factory-trained representatives or by trained customer technicians. Major maintenance is performed only if a problem arises.

To ensure proper operation, the HMB mechanism requires *routine* maintenance checks every year. Addtional maintenance checks are required after every 5 years of service. Table 1 lists a routine maintenance check schedule for the HMB mechanism.

Table 1

Routine Maintenance Checks

Item to Check	Frequency	
	Yearly	Every 5 Years
Oil Level	Check	Check
Oil Condition	----	Check
Motor Brushes	Check	Check
Anti-Condensation Heater	Check	Check
Wiring	----	Check
Terminals	----	Check
Start Counter	Check	Check
Hardware Tighteness	----	Check

DANGER

Mechanisms pose inherent hazards associated with high energy equipment having rapidly moving parts and electrical components. Only qualified personnel possessing a full understanding of this equipment should operate or service this equipment. Be careful of limbs and extremities when working around this equipment as they may become entangled in moving parts.

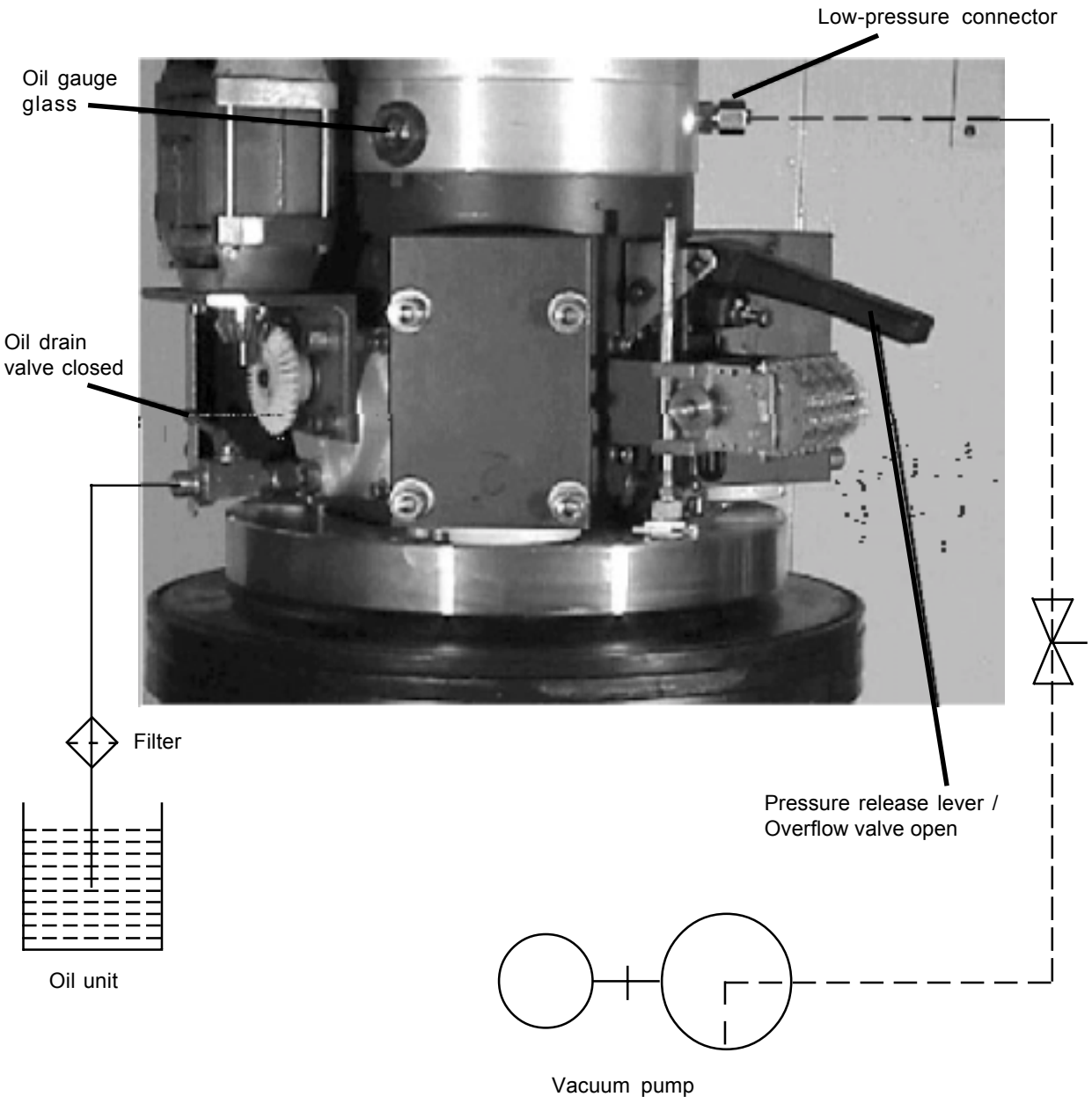


Illustration 1
Filling the Operating Mechanism

To prevent injury or equipment damage, the breaker must be removed from service, isolated, and grounded before performing any maintenance or manual operating procedures. Be sure that the mechanism disc springs are discharged and that all control power is disconnected.

Manual operation of this mechanism overrides all electrical breaker operation lock-outs such as those that occur with low SF_6 gas density.

4.1 Pre-Maintenance Procedures

Before performing maintenance on the mechanism, the following actions are required:

1. Remove the breaker from service and isolate it from the high voltage system.
2. Place the breaker in the OPEN position.
3. Disconnect all control power to the mechanism.
4. Equalize the pressure in the mechanism as described in section 4.1.1.
5. If the mechanism is horizontally mounted, deactivate the close-position as described in section 4.1.5.

4.1.1 Pla cing the Mechanism Out of Service

Equalize the pressure in the mechanism with the breaker in the OPEN position before performing any mechanism maintenance that involves replacing parts or making adjustments.

Caution

Do not equalize pressure with the breaker/ mechanism in the CLOSED position.

Equalizing hydraulic pressure does not remove the mechanical preload from the disc spring assembly. Do not attempt to remove the disc spring assembly.

To equalize the pressure in the mechanism:

1. Place the mechanism in the OPEN position.
2. Slowly open the pressure equalizing valve stem 51017 (Fig. 2) by lifting the black handle (Illustration 1) to discharge the hydraulic pressure and release the energy in the disc springs. The pressure should be allowed to drop only very gradually (approximately 5 thru 10 seconds to release energy).

4.1.2 Equalizing the Pressure in the Mechansim

When doing maintenance work on the operating mechanism, the circuit breaker must be placed out of service.

Prevent an automatic start of the pump motor by disconnecting the electric power.

4.1.3 Manually Operating the Operating Mechanism

The circuit breaker can be operated by hand by pressing the hand plungers of the pilot valves (Figure 8). The circuit breaker may be operated only if the disc spring assembly is charged.

4.1.4 Slow Switching Operations

This manual does not contain instructions for slow switching operations (which are never to be performed when the breaker is in service). If, however, slow switching operations are necessary, they should be done only by trained personnel.

4.1.5 Deactivating the Close-Position Interlock

Deactivate the close-position interlock device on any horizontally mounted mechanism. To do this, remove the spring clip (shown in Figure 9). The close-position interlock facility is engaged by reinserting the clip.

4.2 General Maintenance Practices

The following general maintenance practices should be observed when performing mechanism maintenance.

4.2.1 Cleanliness

Because cleanliness is so important, care must be taken to perform mechanism maintenance under clean, dry conditions. Absolute cleanliness of all hydraulic elements is a prerequisite for trouble-free operation of the HMB mechanism and the circuit breaker as a whole.

The disc springs of the HMB mechanism are treated with an anti-corrosion coating. Avoid cleaning the disc springs with solvent (alcohol, trichlorethane, etc.) or scratching the anti-corrosion coating. Also, avoid any contamination with hydraulic fluid. Areas that are damaged should be recoated.

4.2.2 Mechanism Seals

During inspection/repair, replace old seals with new seals.

- Always check seals for cracks, deformities, and brittleness before they are installed. Acceptable seals are flexible and free of cracks. Do not install seals that are cracked, brittle, or deformed.
- Cleaning of internal parts is done best with a lint-free wipe soaked in clean hydraulic oil. Wipe all oil from o-ring seals with a lint-free wipe before installing them.
- Never clean seals with abrasives even if the abrasives are very fine.

4.2.3 Hydraulic Oil and Service Life

Oil used in the hydraulic system is subject to aging even under no-load use. Oil used in the HMB mechanism should be inspected after every 5 years of service. If the oil is cloudy or much darker than fresh oil, the oil should be drained, the mechanism evacuated, and the mechanism filled with fresh oil as described in sections 4.3.2, 4.3.5, and 4.3.6.

4.2.4 Limits on Pump Motor Operation

During commissioning and testing, the number of pump motor operations should be limited to 20 complete charging operations per hour (from zero spring charge to full spring charge), or 30 pump starts after close-open operations, to avoid overheating the motor. During extensive testing, remove the mechanism cover 51028 (Fig. 1) to help cool the charging motor. Touch the case of the charging motor occasionally to be sure that it is not overheating.

Caution

Pump motor operating duty is limited to 20 complete charging operations per hour due to the thermal capacity of the pump motor.

Important: When reattaching the mechanism cover 51028, torque the cover bolts to 3 Nm.

4.3 General Maintenance Procedures

General maintenance procedures include:

- Checking the hydraulic oil level (section 4.3.1);
- Draining the hydraulic oil (section 4.3.2);
- Replacing the pump element 51014 (Fig. 5) (including check valve 51059) and filter 51079 and (section 4.3.3);
- Replacing the close and open pilot valves 51004 and 51005 (Fig. 8) (section 4.3.4);
- Evacuating the mechanism (section 4.3.5);
- Oil refilling (section 4.3.6);
- Replacing the pump motor (section 4.3.7);
- Leak check the hydraulic system (section 4.3.8);
- Adjusting the pump limit switches (section 4.3.9);
- Checking the pump start counter (section 4.3.10).

4.3.1 Checking the Hydraulic Oil Level

Check the oil level in the oil level indicator 51036 (sight glass) (Fig. 1 and Plate 1) with the spring assembly fully compressed and the breaker in the CLOSED or OPEN position. The oil level should be no less than 1/3 of the total window for a horizontally-oriented mechanism (Plate 1) or 1/4 of the total window for a vertically-oriented mechanism (Plate 2). The oil level can be distinguished by its red color. If the oil level is low, hydraulic oil needs to be added as described in section 4.3.6.1. The oil level should not be more than 1/2 of the window. Drain oil if necessary, using the drain valve.

4.3.2 Draining the Hydraulic Oil

To drain hydraulic oil from the HMB mechanism:

1. Remove the mechanism cover 51028.
2. Place the mechanism in the OPEN position and discharge the disc spring assembly 51008 (Fig. 1).
3. Drain the hydraulic oil into a clean, 5-liter size container by opening the oil drain valve 51013 and oil fill port 51127. The mechanism contains approximately 2.1 liters of hydraulic oil.
4. After draining the oil, close the oil drain valve 51013.
5. Re-install the plug on the oil fill port 51127 to keep out dirt and debris.
6. Proceed to sections 4.3.5 and 4.3.6.2 to evacuate and refill the mechanism with hydraulic oil.

4.3.3 Replacing the Pump Element (including Check Valve and Filter)

Refer to section 4.3.3.1 to replace the pump element.

4.3.3.1 Replacing the Pump Element

To replace the pump element 51014 (Fig. 5):

1. Remove the mechanism cover 51028.
2. Be sure that the mechanism is in the OPEN position and the pressure inside the mechanism is equalized as described in section 4.1.1.
3. Drain the hydraulic oil from the mechanism by performing the procedure described in section 4.3.2.
4. Remove the pump motor 51002 (Fig. 5).

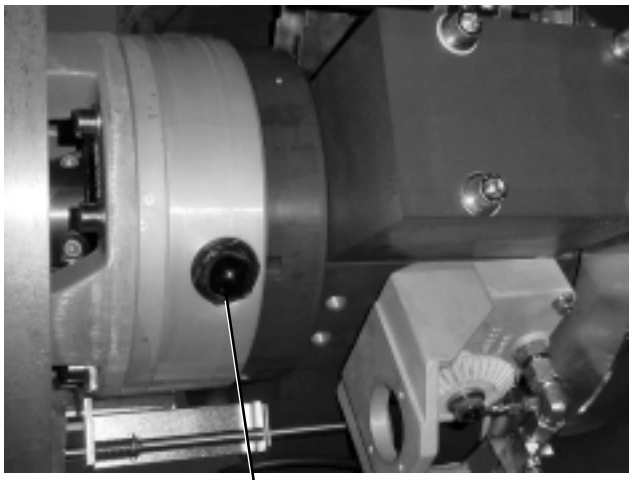


Plate 1: Oil level indicator (Horizontally-oriented)

Plate 2: Oil Level Indicator (Vertically-orientated)

5. Remove the four cap screws 51115 from the cover 51023 and pull the cover straight out from the main body casting. You may encounter some resistance from the O-ring 51078 on the cover. (The eccentric shaft 51015 and inner ring 51021 will also come off with the cover 51023.)
6. Remove the pump element 51014 by pulling the element straight out of the casting. You may encounter some resistance from the O-ring on the check valve.
7. Replace the pump element 51014 with a new pump element. Be sure the pump element is seated securely.

Caution

Be certain that the pump element is properly positioned.

8. Re-install the cover 51023. Use a new O-Ring.
9. Apply Loctite 242 to the cap screws 51115 and re-install the screws.
10. Refer to section 4.3.7 to re-install the pump motor and sections 4.3.5 and 4.3.6.2 to evacuate and refill the mechanism with hydraulic oil.

4.3.4 Replacing the Open and Close Pilot Valves

To replace the open pilot valve(s) 51005 (Figs. 1 and 8) and close pilot valve 51004:

1. Remove the mechanism cover 51028.
2. Be sure that the mechanism is in the OPEN position and the pressure inside the mechanism is equalized as described in section 4.1.1.
3. Drain the hydraulic oil from the mechanism by performing the procedure described in section 4.3.2.
4. Remove the two screws holding the plug-type wiring connector to the pilot valve; remove the connector.
5. Remove the pilot valve (to be replaced) by unfastening the four socket head bolts holding it in place.

Important: Clean and remove all remaining oil from the sealing surface, then make sure the pilot valve is in the correct position.

6. Replace the old pilot valve with a new pilot valve.
7. Refer to sections 4.3.5 and 4.3.6 to evacuate and refill the mechanism with hydraulic oil.

4.3.5 Evacuating the Mechanism

Any time hydraulic oil has been drained or any procedure has been performed which could introduce air into the oil, the air within the mechanism body must be evacuated. A vacuum should be applied to the mechanism body before refilling the mechanism with hydraulic oil.

If unusual breaker timing operations occur after this procedure is performed, it may be necessary to repeat the procedure. This procedure is recommended after transportation, especially for mechansisms not shipped on a circuit breaker.

Important: After any maintenance that could allow even small amounts of air to enter the hydraulic system, evacuate the air and refill the system with oil.

Slow opening or closing times during mechanism timing tests or excessive or erratic pump up time of the hydraulic system may indicate the presence of air in the hydraulic system. The air needs to be evacuated using this procedure.

Remove the breaker from service; isolate it and ground it before proceeding.

To evacuate the mechanism:

1. Remove the mechanism cover 51028 (Fig.1).
2. Be sure that the mechanism is in the OPEN position and the pressure inside the mechanism is equalized as described in section 4.1.1.
3. Remove the cap from the oil fill port 51127. Be sure that the oil drain valve 51013 is closed.
4. Connect a small two-stage vacuum pump to the oil fill port (a special Ermetto hydraulic pressure fitting will be required). A minimum 3 foot vertical, transparent hose is desirable to monitor the oil quantity pulled out of the mechanism during the vacuum process.
5. Be sure that the pressure equalizing handle 51017 (Figure 2) is rotated out to open the pressure relief valve.
6. Apply a vacuum to remove air from the mechanism body. Pull a 1.5 psia vacuum (10 kPa, 100 millibar, 3 mm of mercury) for about 5 minutes. Take care to not pull oil into the vacuum pump. A lesser initial vacuum can be used to limit the amount of oil pulled out until most of the air is removed from the mechanism.

   While the vacuum is being applied, push in on the armature of the close and open pilot valves 51004 (Fig. 8) and 51005 for several seconds each.

   Rotate the large bevel gear 51019 (Fig. 5) of the pump several times.

Important: If significant hydraulic oil is in the mechanism while performing the evacuation procedure, insert an in-line valve between the vacuum pump and the mechanism. Throttle this valve to initially apply the vacuum very slowly to prevent the oil from foaming and being sucked into the vacuum pump.

7. Draw a higher vacuum of .15 to .22 psia (1 to 1.5 kPa, 10 to 15 millibar, or.3 to .45 mm of mercury) for about 5 minutes.

   While the vacuum is being applied, push in on the armature of the close and open pilot valves 51004 (Fig. 8) and 51005 for several seconds each.

   Rotate the large bevel gear 51019 (Fig. 5) of the pump several times.

8. Proceed to section 4.3.6.2 to refill the mechanism with hydraulic oil if it had been drained prior to applying the vacuum.

9. Disconnect the hose from the mechanism.

10. Proceed to section 4.3.6.1 to add oil to the mechanism, if necessary.

11. Operate the mechanism several times. If the oil level reduces noticeably, discharge the mechanism and return to step 10. This procedure will also remove any trapped air pressure in the reservoir.

Important: When reattaching the mechanism cover 51028, torque the cover bolts to 3 Nm.

4.3.6 Refilling the Mechanism with Oil

A mechanism either can be topped off with hydraulic oil if the level is low (section 4.3.6.1) or the mechanism can be refilled with hydraulic oil after the oil has been drained (section 4.3.6.2).

The oil grades listed below are the specified grades to be used when filling the HMB mechanism with oil.

Trade name: Esso UNIVIS J 13 or Aero Shell Fluid 4

ABB designation: GPHL730041R0001 or ED4.1.3326

Notice: *Only use the recommended oils listed above.* ***There are no other equivalents or substitutes.*** *Oil types can be mixed.*

4.3.6.1 Topping Off a Mechanism with Hydraulic Oil

To top off a mechanism that is low with hydraulic oil:

1. Remove the mechanism cover 51028.

2. Be sure that the mechanism is in the OPEN position and the pressure inside the mechanism is equalized as described in section 4.1.1.

3. Remove the cap from the oil fill port 51127 (Plate 3).

4. Add clean, filtered hydraulic oil (as specified in section 4.3.6) into the oil fill port until the oil level is between 1/4 to 1/2 of the window for vertically-oriented mechanisms or 1/3 to 1/2 of the window for horizontally-oriented mechanisms. The oil level can be distinguished by its red color against a metallic background.

Important: Hydraulic oil added to the mechanism must be filtered. Clean, filtered oil is essential to proper operation.

5. Re-install the cap to the oil fill port.

Important: When reattaching the mechanism cover 51028, torque the cover bolts to 3 Nm.

4.3.6.2 Refilling a Mechanism that Has Been Drained

To refill a mechanism that has been drained of hydraulic oil:

1. Remove the mechanism cover 51028.

2. Be sure that the mechanism is in the OPEN position.

3. Remove the cap from the oil fill port 51127 (Fig. 1).

4. Evacuate the mechanism as described in section 4.3.5.

5. Connect a clean hose to the outlet of the oil drain valve 51013 (a special Ermetto fitting will be required).

6. Insert the other end of the hose into a container filled with a least 3 liters of clean, filtered hydraulic oil (as specified in section 4.3.6).

Important: An in-line filter must be inserted into the hose.

7. While the vacuum is still being applied, slowly throttle open the oil drain valve 51013 allowing the vacuum to draw the oil from the container into the mechanism.

Important: Draw the oil in very slowly to prevent the oil from foaming into the vacuum pump.

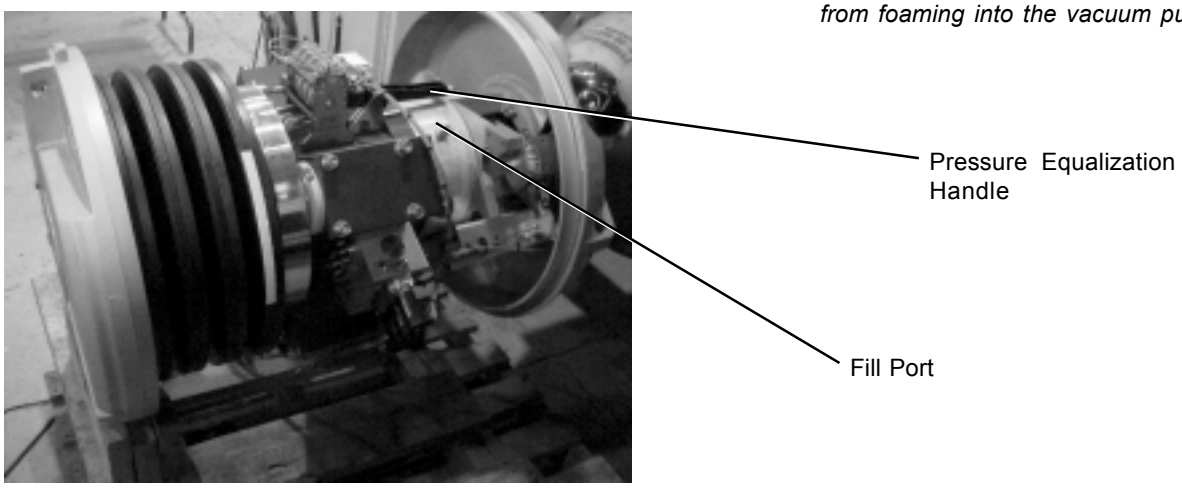


Plate 3: Oil Fill Port and cap

8. Add the hydraulic oil as in 4.3.6.1, Step 4. The total oil volume capacity of the mechanism is approximately 2 liters (2.1 quarts).
9. Close the oil drain valve 51013.
10. Break the vacuum.
11. Top off the oil, if necessary, using the procedure described in 4.3.6.1.
12. Close the oil fill port and low pressure port.
13. Close the pressure equalizing valve stem 51017 by rotating the black lever against the mechanism body.
14. Charge the HMB mechanism and operate it several times.

Important: After filling the mechanism with oil, allow it to stand pressurized for at least 8 hours before checking for leaks. Refer to section 4.3.8.

Important: When reattaching the mechanism cover 51028, torque the cover bolts to 3 Nm.

4.3.7 Replacing the Pump Motor

To replace the old pump motor 51002 (Fig. 1) with a new pump motor:

1. Remove the three screws holding the pump motor to the cover 51023 (Fig. 5).
2. Loosen the set screw holding the small bevel gear 51018 to the pump motor shaft.
3. Install the small bevel gear onto the shaft of the new pump motor but do not tighten the set screw.
4. Install the new pump motor onto the cover 51023.
5. Position the small bevel gear on the new pump motor shaft so that there is small amount of play between the small bevel gear and the large bevel gear 51019 through the entire rotation of the large bevel gear.

Important: Be sure that the small bevel gear and large bevel gear do not mesh too tightly to prevent damage to the gears.

6. Apply Loctite 242 to the small bevel gear set screw and tighten.
7. Replace the three screws holding the pump motor.

Important: When reattaching the mechanism cover 51028, torque the cover bolts to 3 Nm.

4.3.8 Leak Checking the Hydraulic System

Notice: *Before checking for leaks, disconnect the power to the pump motor to prevent the pump from automatically starting.*

Check for oil leaks while the breaker is in both the CLOSE and OPEN positions. This procedure takes approximately 24 hours in both the OPEN and CLOSE positions.

To check for leaks:

1. Place the breaker in the OPEN position.
2. Charge the mechanism fully.
3. Record the travel of the disc spring assembly 51008 (Fig. 6) over a 24-hour period using a caliper. If the disc spring assembly discharges more than 20 mm over a 24-hour period when the breaker is either in the OPEN or CLOSE position, contact ABB Service.
4. Place the breaker in the CLOSE position and repeat step 2.

4.3.9 Spring Travel Limit Switch Settings

Notice: The HMB-8.3 or HMB-8.7 mechanism has O-CO stored energy. The HMB-8.2 mechanism has CO-CO stored energy.

Table 2

Spring Travel Limit Switch Settings for HMB-8 and HMB-8.7 class mechanisms

Limit Switch Settings 63-1	Parameter
Overpressure relief valve operation (1 mm above motor cutoff)	84-85 mm (3.31 in. - 3.35 in.)
Charging motor off 63-1M	83-84 mm (3.27 in. - 3.31 in.)
Charging motor on 63-1M (nominal)	82 mm (3.23 in.)
Low Pressure alarm 63-1A	HMB-8.2 Mech. 69.0 ± 1 mm (2.72 in.)
	HMB-8.3 Mech. 78.5 ± 1 mm (3.09 in.)
	HMB-8.7 Mech. 78.5 ± 1 mm (3.09 in.)
Close Block 63-1C	HMB-8.2 Mech: CO-CO 41.5 mm ± 1 mm (1.63 in.)
	HMB-8.3 Mech: O-CO 52 ± 1 mm (2.05 in.)
	HMB-8.7 Mech: O-CO 50.5 ± 1 mm (1.99 in.)
Trip and Close Block 63-1T1 & 63-1T2	HMB-8.2 Mech. 30.5 ± 1 mm (1.20 in.)
	HMB-8.3 Mech. 40 ± 1 mm (1.57 in.)
	HMB-8.7 Mech. 40 ± 1 mm (1.57 in.)

4.3.10 Checking the Pump Start Counter

A pump motor start counter is provided in the breaker control cabinet to keep track of the number of pump starts. The number of pump starts for any given mechanism will vary. A significant increase in the average number of pump starts may indicate internal hydraulic oil leakage.

The average number of pump starts per day will vary. A maximum average count of 20 operations for pump starts per day is normal. Should the pump average more than 20 starts a day, check the system for hydraulic oil leakage and/or contact ABB Service Department.

Five seconds are required to restore the mechanism to full system pressure from pump start to pump stop when operating due to slow internal leakage.

5 Manual Operation

DANGER

Do not ever manually operate the mechanism when the circuit breaker is energized! Isolate the circuit breaker from the high voltage system before performing any manual operation.

The HMB mechanism should only be operated manually when the disc spring assembly 51008 (Fig. 1) is fully charged and the breaker is at normal operating gas density.

To operate the mechanism manually:

1. Remove the mechanism cover to access the pilot valves 51004 and 51005 (Figs. 1 and 8).
2. Forcefully and quickly press and release the black button on the respective open or close pilot valve.

Important: When operating the mechanism manually, the black button on the pilot valve must be pushed forcefully and quickly and then released. Do not press the button gingerly or hold it down after pressing.

Important: When reattaching the mechanism cover 51028, torque the cover bolts to 3 Nm.

6 Adjusting the Opening Closing Velocities

Circuit breaker timing tests are performed routinely as part of circuit breaker maintenance. Contact velocity measurements are a part of this testing. The velocity of the HMB-8 mechanism is factory-set and should not significantly change over the life of the circuit breaker. However, provisions are available for adjusting the opening and closing velocities if necessary. The location of the open velocity throttle and close velocity throttle are shown in Plate 4.

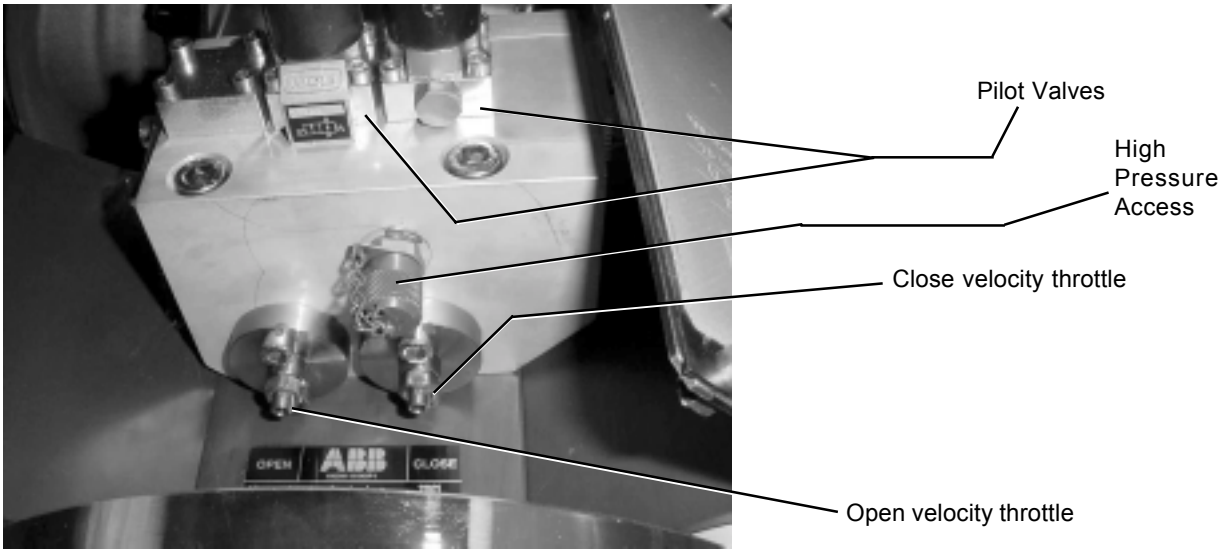


Plate 4: Open and close velocity throttles

To increase or decrease either the open or close velocity:

1. Equalize the hydraulic pressure as described in section 4.1.1.
2. Loosen the locking nut of the respective throttle (open or close)
3. Turn the throttle counter-clockwise to increase the speed; turn the throttle clockwise to decrease the speed. Never turn the throttle more than one turn without re-verifying the speed through timing tests.

7 Adjusting the Onboard Auxiliary Switches

The auxiliary switches 97604 (Figures 1 and 1b) are preset in the factory and should not require readjustment for the life of the mechanism. However, if switch replacement, addition or adjustment does become necessary, the auxiliary linkage will need to be adjusted. Adjustment is done by resetting the length of the adjustable link 97608 (Figures 1 and 1b). When complete, apply Loctite 242 to both end threads and tighten the 2 nuts.

8 Manually Charging the Operating Mechanism

Upon a malfunction with a failure of the pump motor a hand emergency pump can be used to charge the operating mechanism (Illustration 2).

The following hand emergency pump is recommended for this operation:

- Make: HAWE, Type HE 4
- Manufacturer: Heilmeier und Weinlein, Munich
- Maximum pressure: 600 bar
- Weight: 4.8 kg
- Discharge connector: R 1/4”
- Suction side connector: R 1/4”

Further necessary material:

- High-pressure hose with connectors R 1/4” and M 16x1.5,
- Low-pressure hose with connectors R 1/4” and M 18x1.5.

The following procedure shall be observed (Figure 5.1-7):

1. The hand emergency pump shall be fastened so that the operating lever of the pump can be easily handled.
2. The screw caps of the oil drain valve and the high-pressure connector (screw coupling with integrated non-return valve) shall be removed.

Important: Keep any dirt or debris away from the open end of the hoses and the connecting plugs of the pump.

3. The suction side of the hand emergency pump, marked by “S”, shall be connected to the oil drain valve with the low-pressure hose.
4. The high-pressure hose shall be connected to the high-pressure side of the pump, marked by “P”.
5. Open the oil drain valve and pump until oil comes out of the high-pressure hose.
6. Connect the free end of the high-pressure hose to the high-pressure connector of the operating mechanism.
7. Now the charging operation can be started. For opening (O) or closing (C) the disc spring assembly shall be tensioned by at least the values indicated in Table 3.

	HMB-4
O in mm	25
C in mm	11
	HMB-8
O in mm	25
C in mm	9

Table 3
Tensioning the disc spring assembly

8. After the charging, close the oil drain valve, remove the hoses, and remount the screw caps

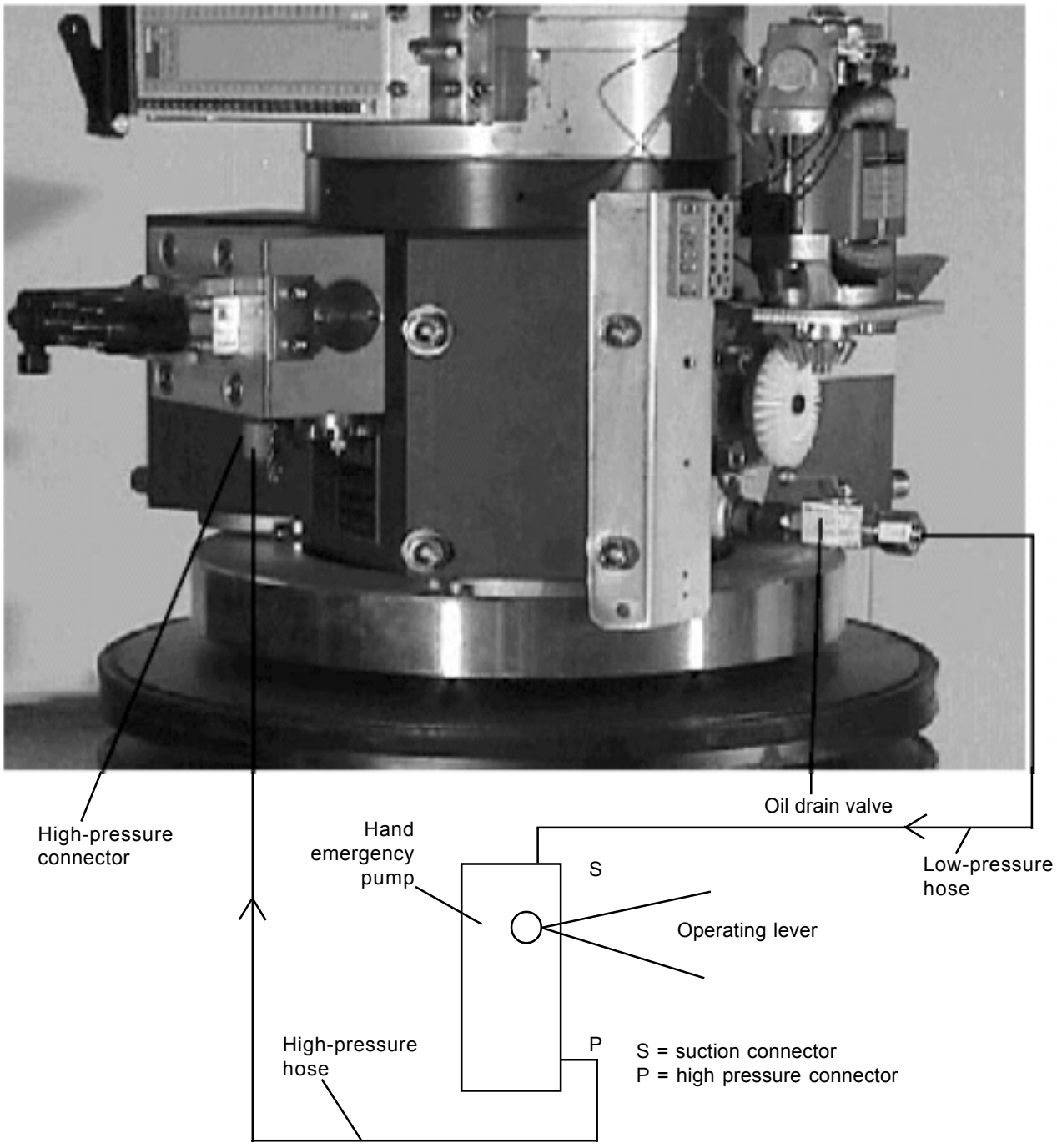


Illustration 2
Hand Emergency Pump

9 Troubleshooting

Although the HMB mechanism is a low-maintenance design, problems can arise if commissioning and maintenance procedures are not followed. Table 4 lists problems, causes, and remedies that could occur when commissioning and operating the HMB-8 mechanism

Table 4

Troubleshooting the HMB-8 Mechanism

Problem	Cause	Action
Drive is not charged automatically	Defective Limit Switch	Replace switch
	Motor Supply Disconnect open	Close the disconnect
	No supply voltage	Turn on the supply voltage
	Defective pump motor	Replace the pump motor as per section 4.3.7
	Worn carbon brushes	Replace the carbon brushes
Motor is running, but the spring is not charged	Pressure relief valve handle is open	Close the pressure relief (rotate handle) against the mechanism body
	Defective pump element	Replace the pump element as per section 4.3.3.1
	Low oil level	Add hydraulic oil as per section 4.3.6.1
	Oil leaking	Locate and correct leak area
	Air in pump element	Perform vacuum procedure as per section 4.3.5
Drive fails to trip	No tripping voltage	Turn the voltage on
	Defective coil	Replace the coil
	Auxiliary switch not working	Re-adjust the switch to pass on the command
	Dirt in oil	Remove, filter and reinstall oil
Corrosion in drive	Disconnect for anti-condensation heater open	Close the disconnect
	No supply voltage for the anti-condensation heater	Turn on the supply voltage
	Defective anti-condensation heater	Replace the old anti-condensation heater with a new one
	Drive covers are not tight	Replace drive cover gaskets
Excessive pump runs; drive charges too frequently	Internal leaking or dirt	Contact ABB Service. Field repair is possible with training or guidance
External leak	Defective seal	Replace appropriate seal
Erratic breaker speed	Trapped air pockets	Perform a vacuum procedure on oil reservoir as per section 4.3.5

NOTES:

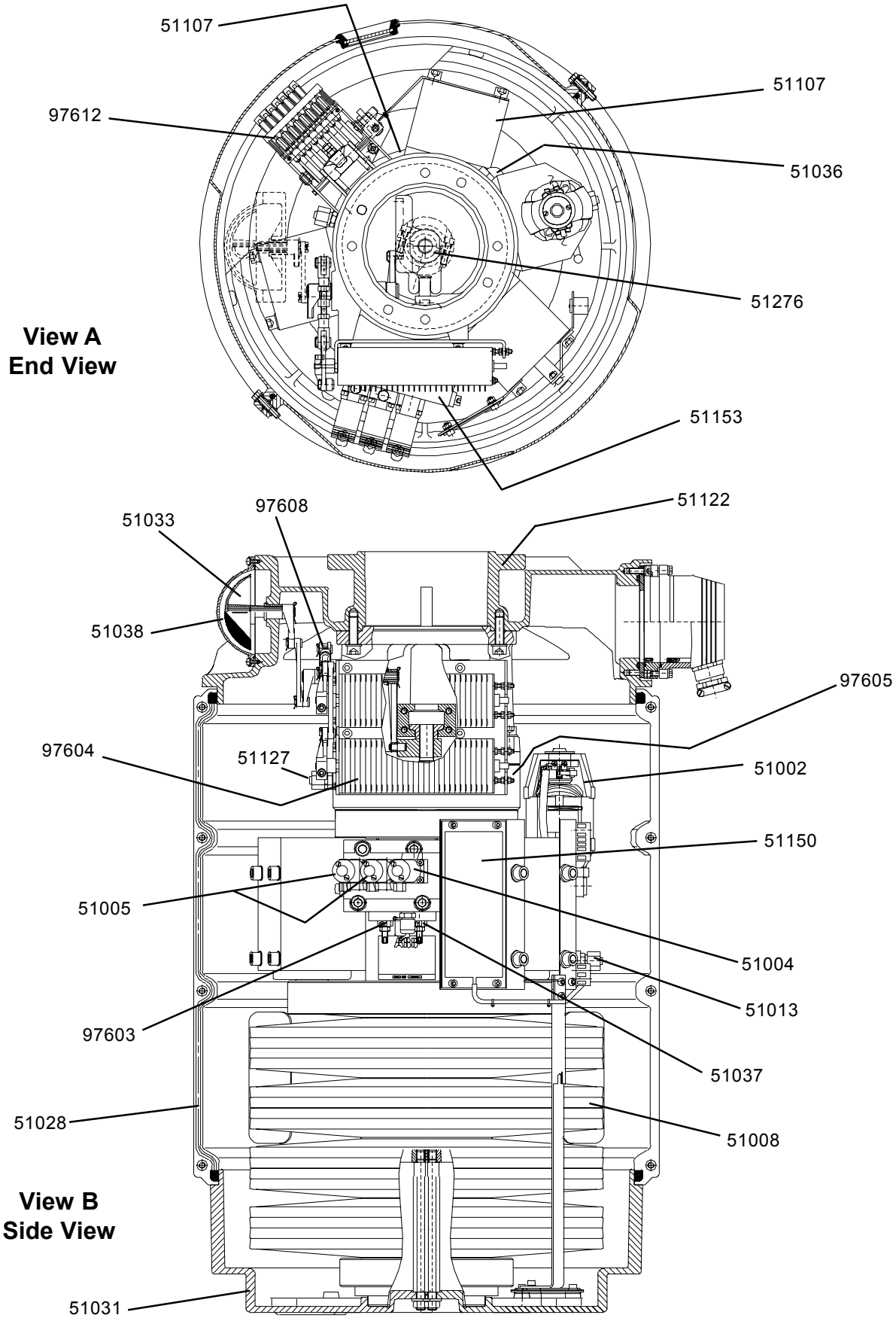
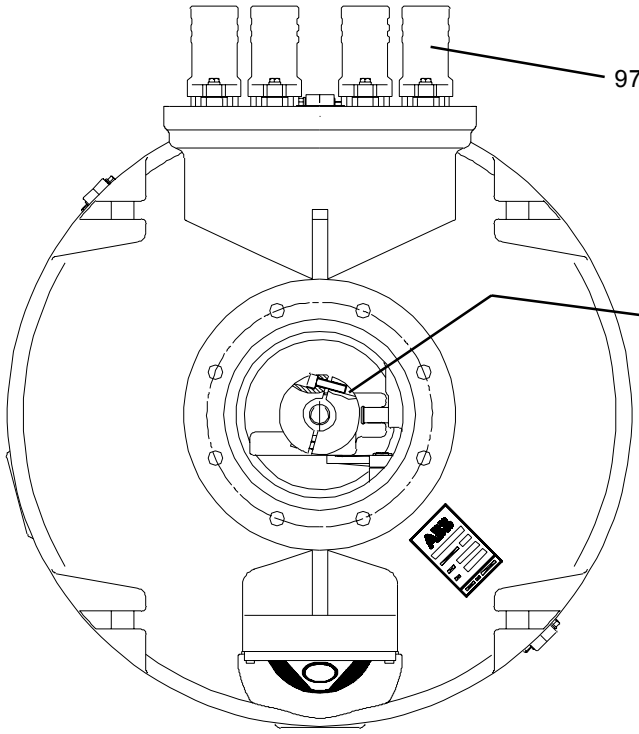

51107
51107
97612
51036
51276
View A
End View
51153
97608
51122
51033
51038
97605
97604
51127
51002
51150
51005
51004
51013
97603
51037
51028
51008
View B
Side View
51031

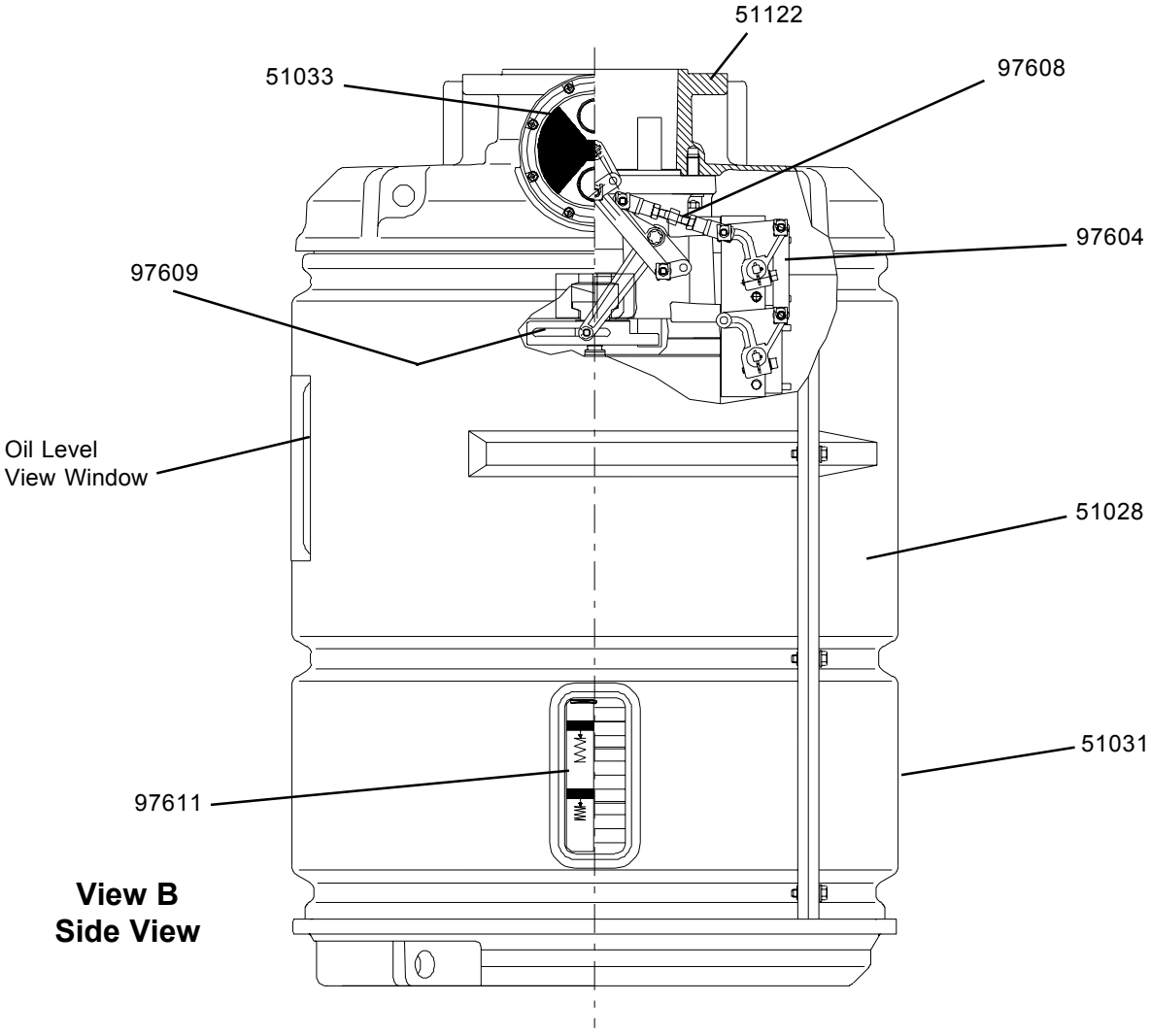
Figure 1
HMB-8 Hydraulic Operating Mechanism (Cross-cut Views)

Weight is 1,030 lbs.

51002	Pump Motor
51004	Pilot Valve (Close)
51005	Pilot Valve (Open)
51008	Disc Spring Assembly
51013	Oil Drain Valve
51028	Mechanism Cover
51031	End Casting
51033	Position Indicator
51036	Oil Level Indicator
51037	Throttle Valve (Close)
51038	Position Indicator Cover
51107	High Pressure Block
51122	Mounting Flange
51127	Oil Fill Port
51150	Heater
51153	Solenoid Valve Block
51276	Coupling
97603	Throttle Valve (Open)
97604	Auxiliary Switches
97605	Low Pressure Reservoir
97608	Adjustable Auxiliary Link
97612	Spring Travel Limit Switch Assembly



View A
End View



View B
Side View

Figure 1b
HMB-8 Hydraulic Operating Mechanism (External Views)

Weight is 1,030 lbs.

51028	Mechanism Cover
51031	End Casting
51033	Position Indicator
51122	Mounting Flange
51276	Coupling
97604	Auxiliary Switches
97606	Wiring Connectors
97608	Adjustable Auxiliary Link
97609	Auxiliary Drive Block
97611	Spring Charge Indicator

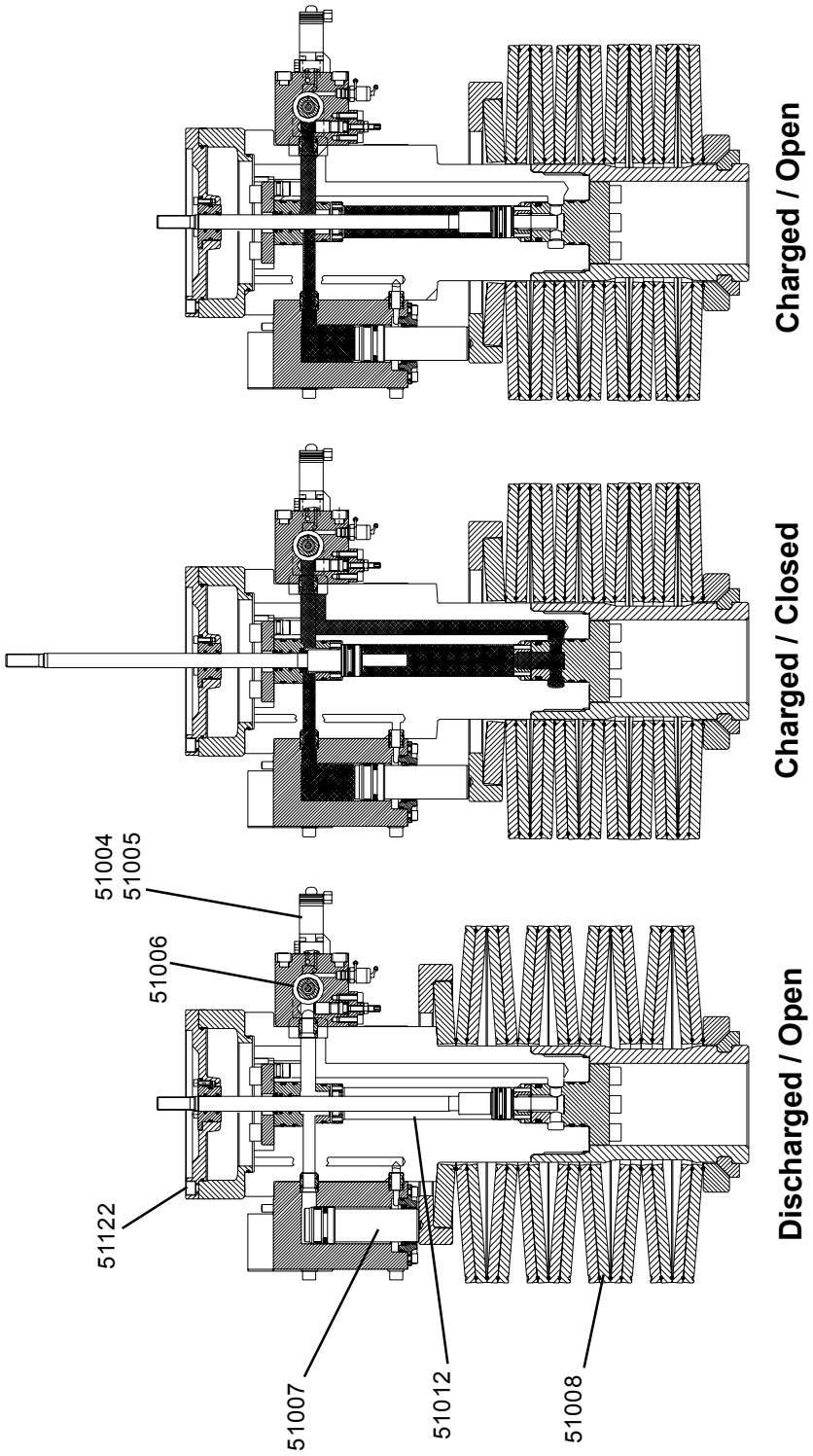


Figure 2
HMB-4 Mechanism - High and Low Pressure

51002	Pump Motor (not shown)	51014	Pump Element (not shown)
51004	Pilot Valve (Close)	51016	Low Pressure Interlock (not shown)
51005	Pilot Valve (Open)	51028	Mechanism Cover (not shown)
51006	Changeover Valve	51045	Pressure Relief Valve (not shown)
51007	Accumulator Piston	51046	Pump Limit Switch and Cam Assembly (not shown)
51008	Disc Spring Assembly	51068	O-Ring 26.58 x 3.53 mm (not shown)
51012	Drive Piston	51122	Mounting Flange
51013	Oil Drain Valve (not shown)	51276	Coupling (not shown)

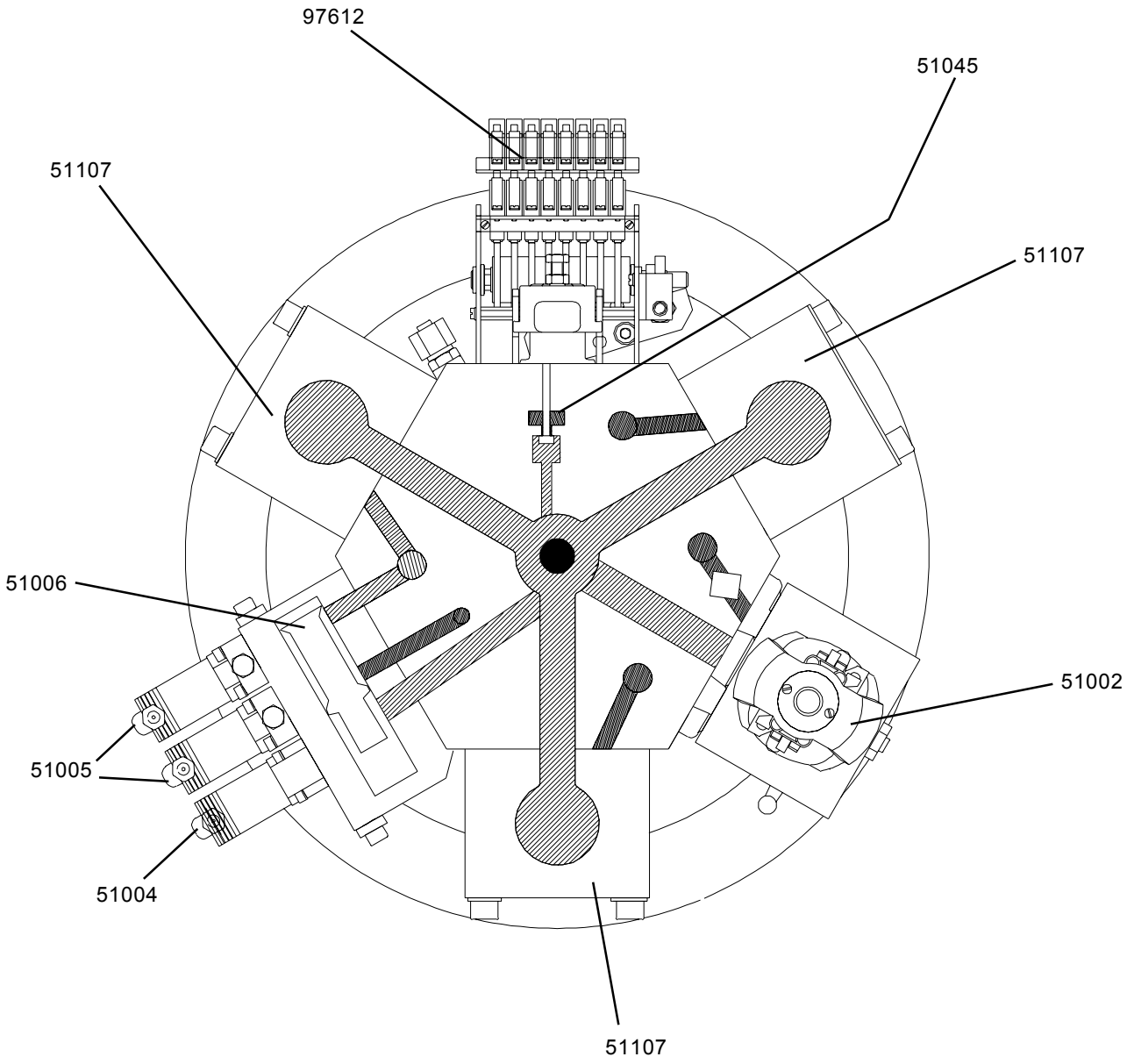


Figure 3
HMB-4 Position OPEN

51002	Pump Motor
51004	Pilot Valve (Close)
51005	Pilot Valve (Open)
51006	Changeover Valve
51045	Pressure Relief Valve
51107	High Pressure Block
97612	Spring Travel Limit Switch Assembly

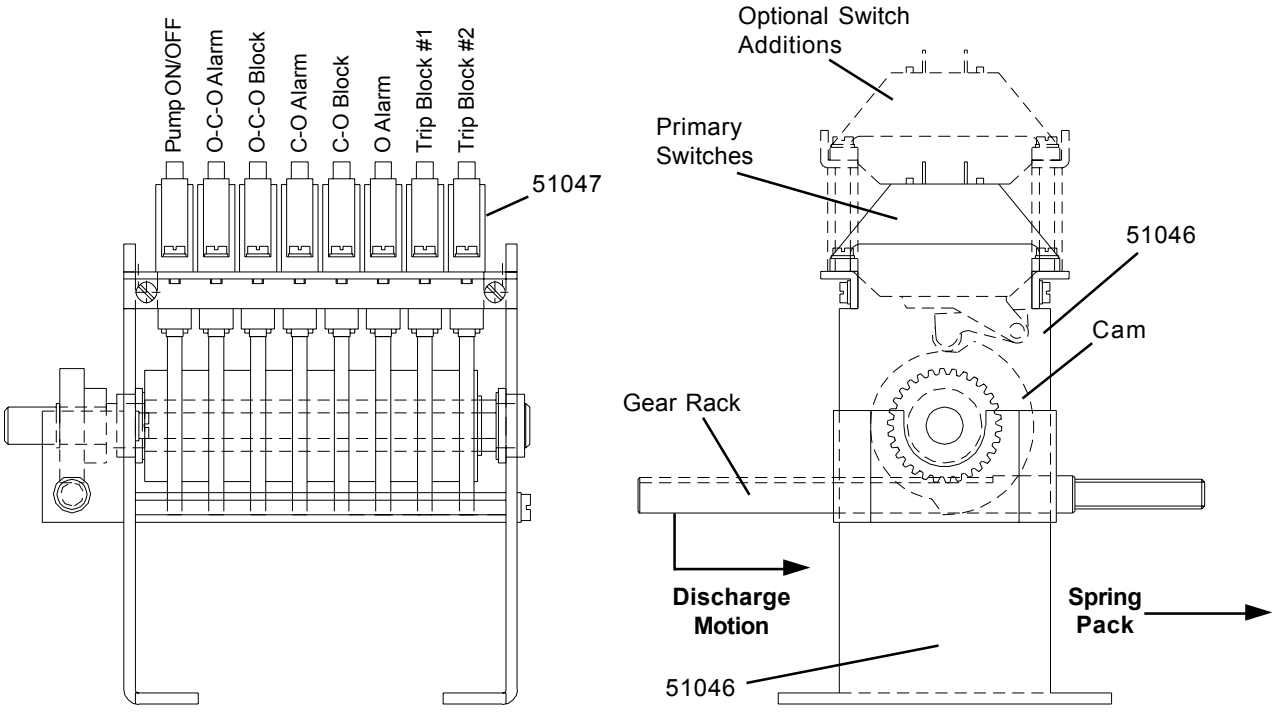


Figure 4
Mechanical Switch

51046	Pump Limit Switch and Cam Assembly
51047	Switch Assembly

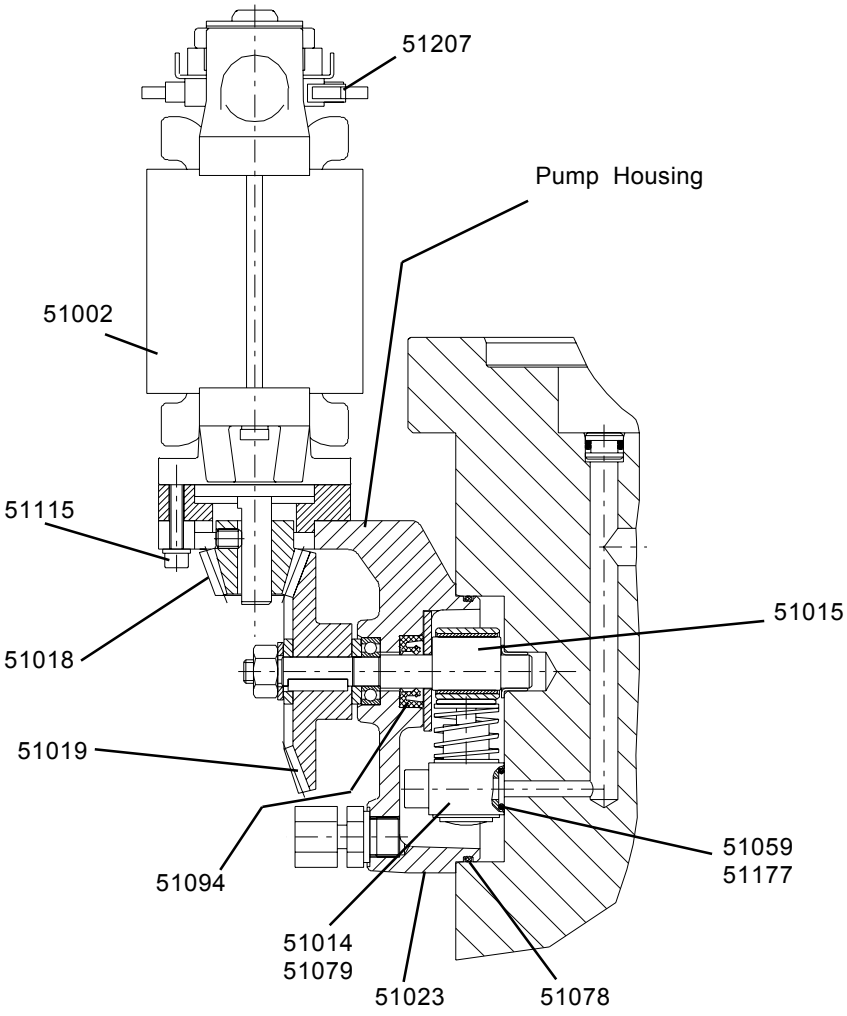


Figure 5
Pump with Motor

51002	Pump Motor
51014	Pump Element
51015	Eccentric Shaft
51018	Small Bevel Gear
51019	Large Bevel Gear
51023	Cover
51059	Check Valve (integrated into pump body)
51078	O-Ring
51079	Filter
51094	Shaft Seal
51115	Hexagon Head Cap Screw
51177	O-Ring 12.37 x 2.62 mm
51207	Carbon Brushes

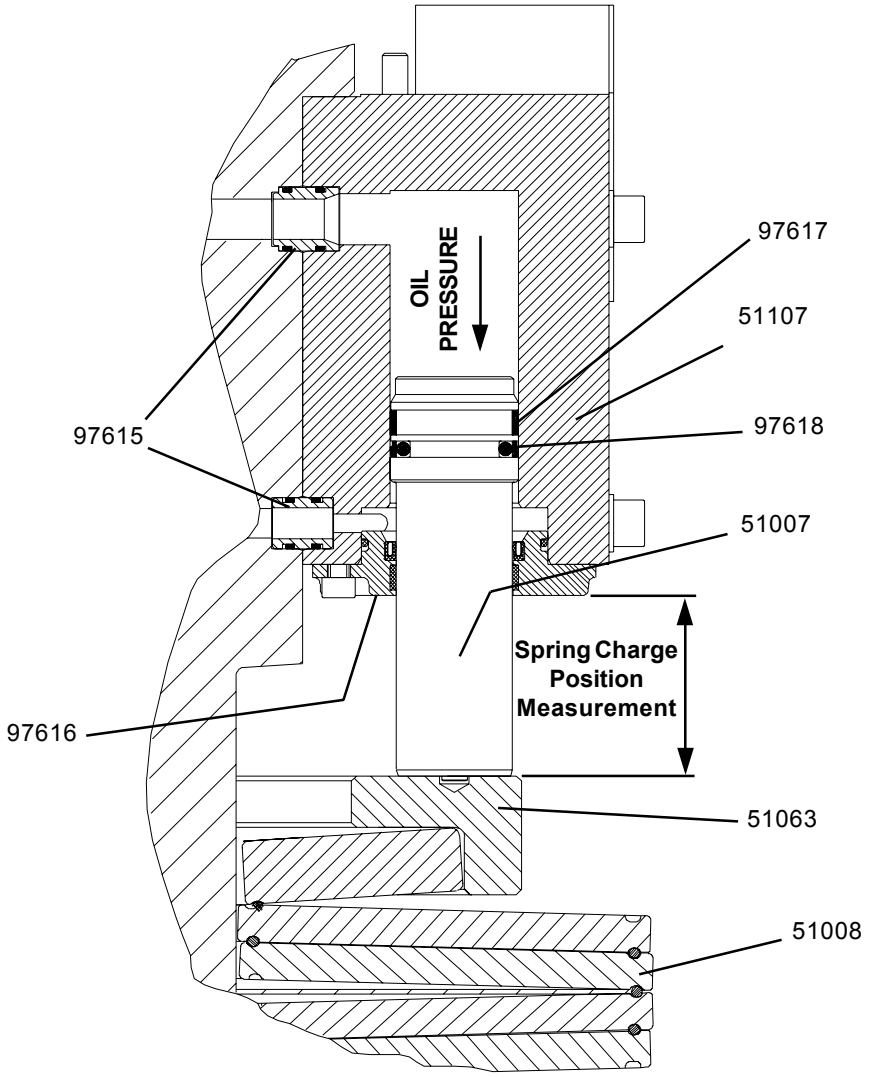


Figure 6
Measurement of Spring Tension

51007	Accumulator Piston
51008	Disc Spring Assembly
51063	Loading Ring
51107	High Pressure Cylinder
97615	Barrel Seal Assembly
97616	Closure Assembly
97617	Bearing
97618	Seals

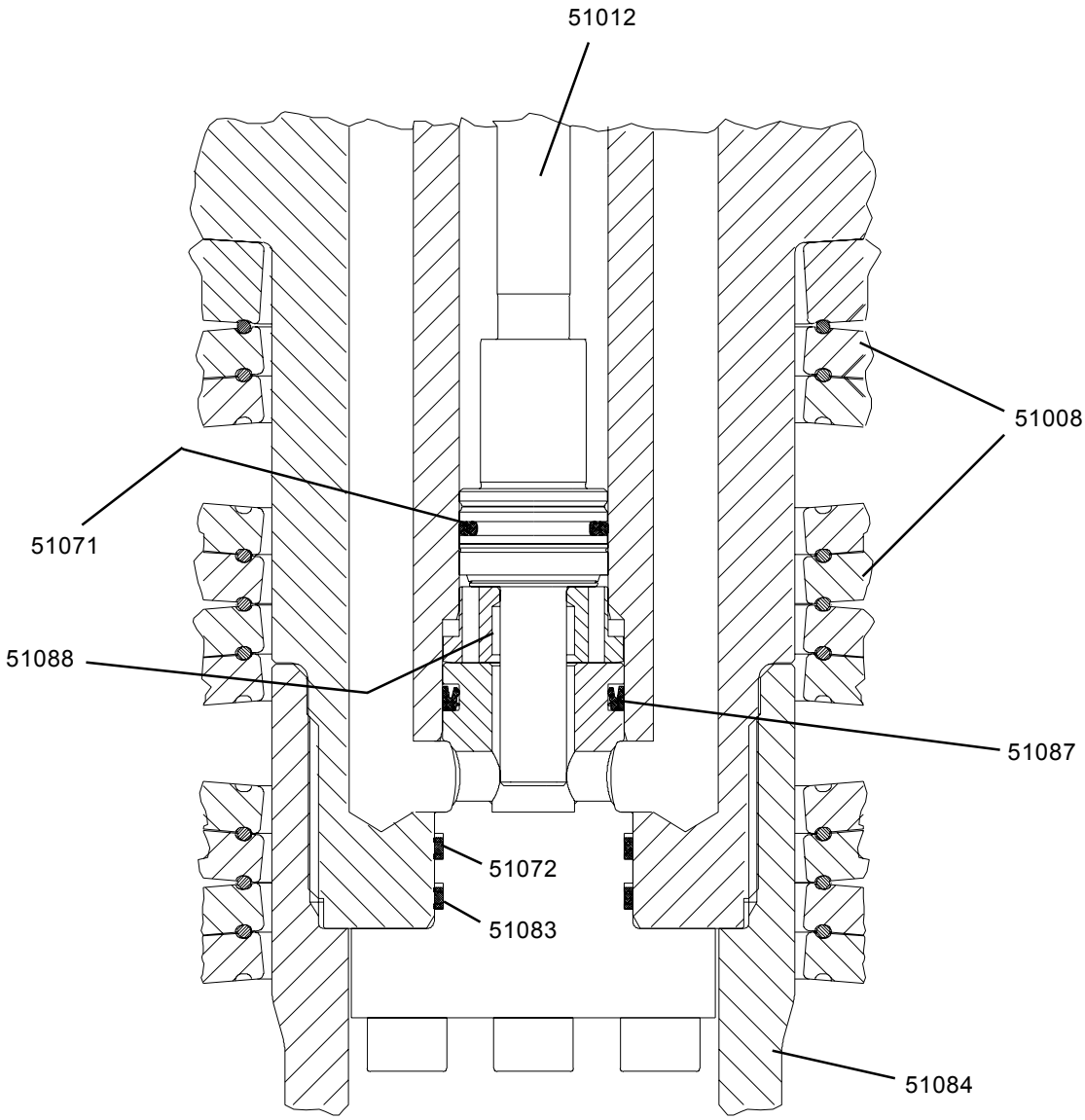


Figure 7
Bottom Side of Working Piston

51008	Disc Spring Assembly
51012	Drive Piston
51071	Turcon Glyd Ring
51072	O-Ring
51083	O-Ring
51084	Supporting Tube
51087	Main Seal
51088	Damping Ring

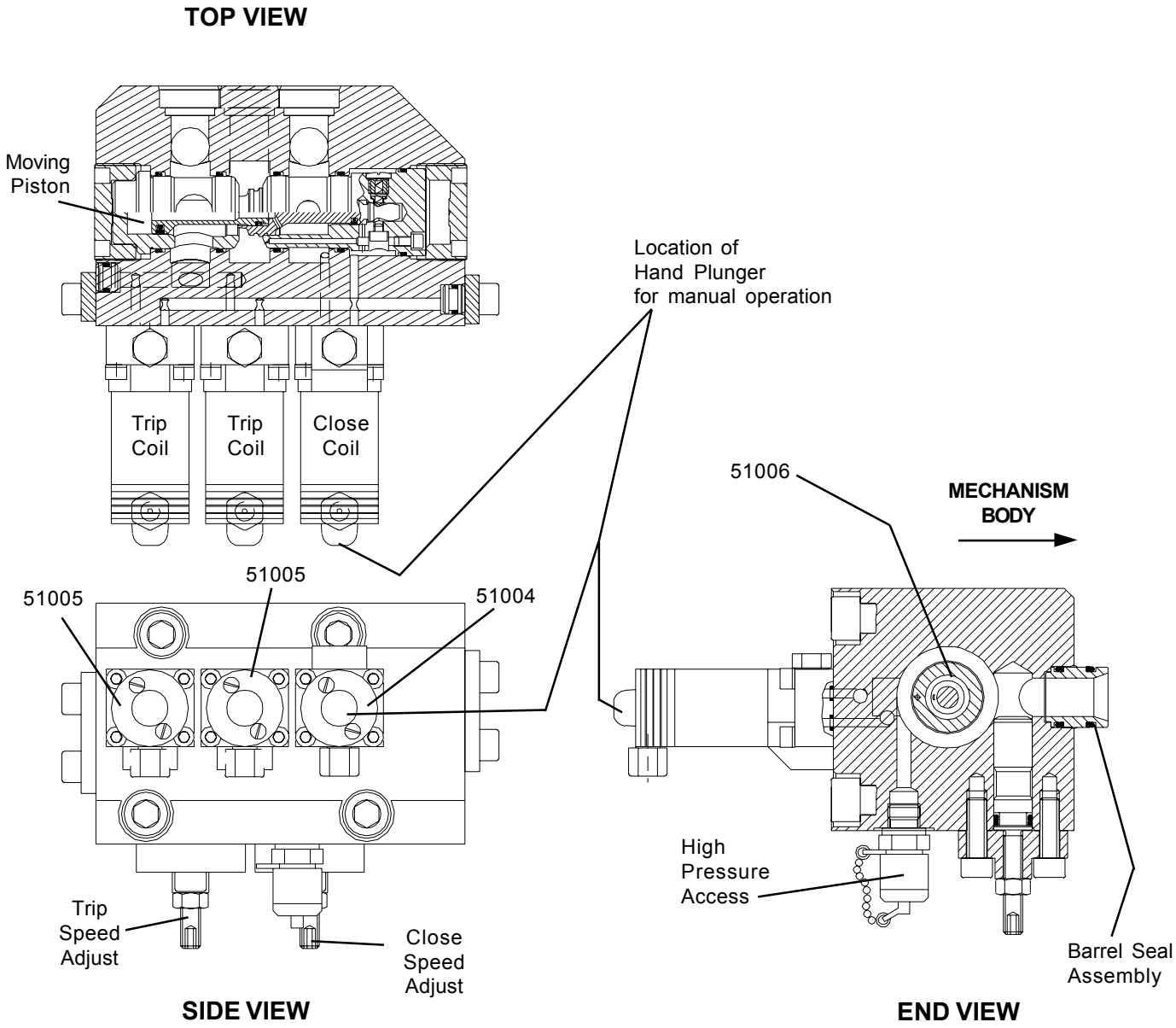


Figure 8
Pilot Valve Assembly

51004	Pilot Valve (Close)
51005	Pilot Valve (Open)
51006	Changeover Valve

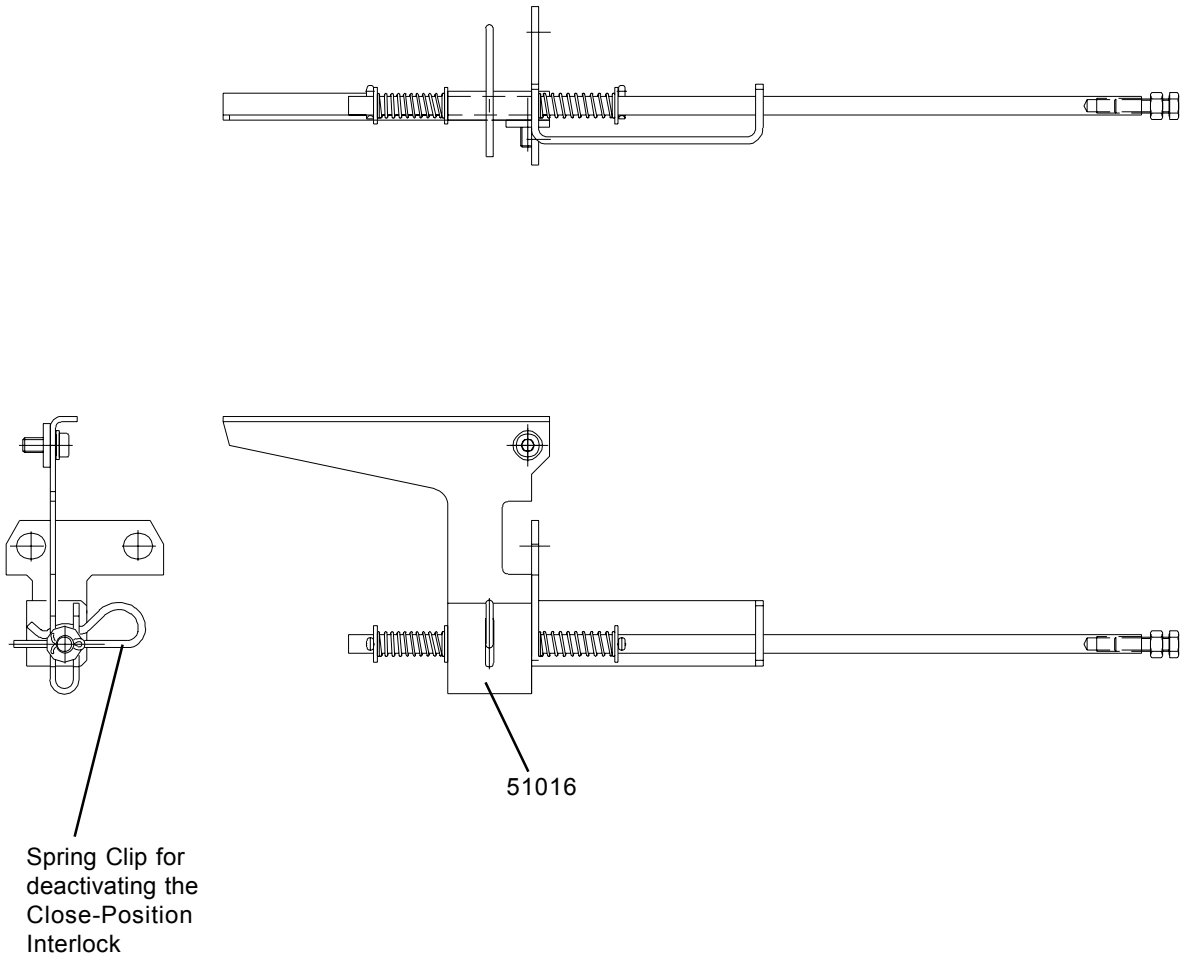


Figure 9
Low Pressure Interlock Assembly 51016

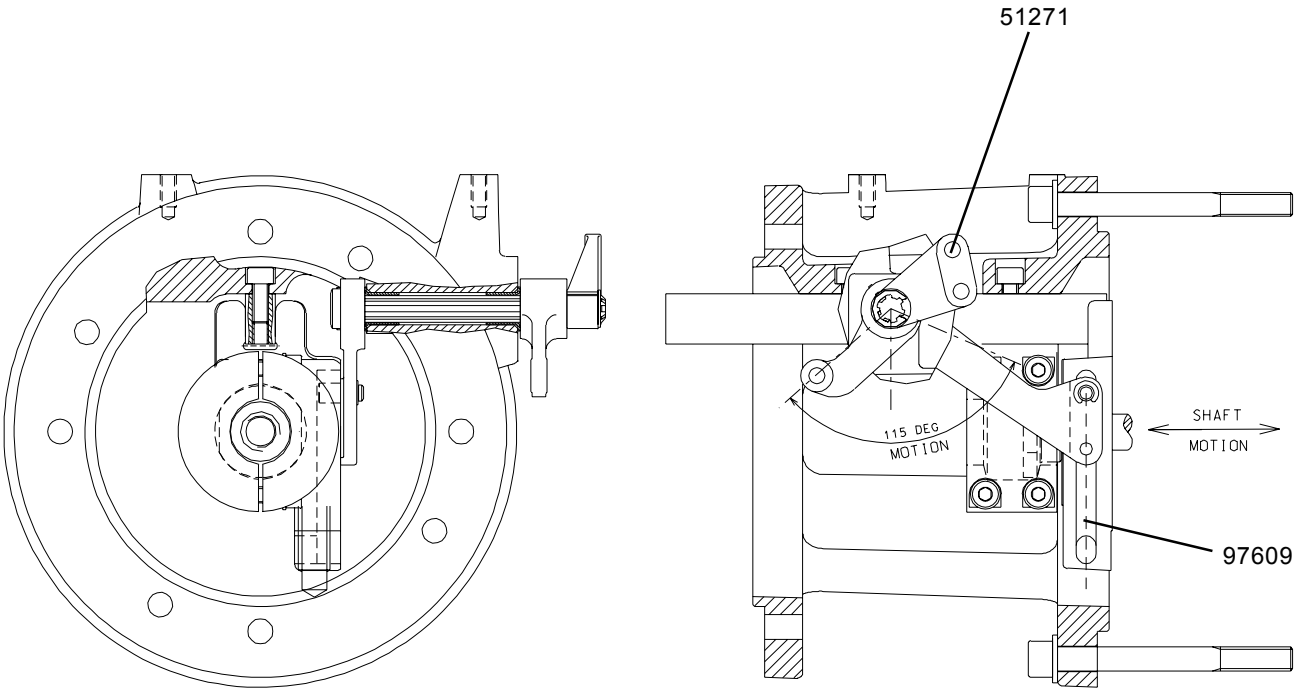


Figure 10
Auxiliary Switch Drive Arm

51271	Drive Lever
97609	Auxiliary Drive Block

NOTES:

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