TRUCK, TANK, WATER, HEAVY, MC3 – MACK

TECHNICAL DESCRIPTION

This instruction is authorised for use by command of the Chief of Army. It provides direction, mandatory controls and procedures for the operation, maintenance and support of equipment. Personnel are to carry out any action required by this instruction in accordance with EMEI General A 001.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Blank Page

INTRODUCTION

1. This EMEI contains a technical description of the Truck, Tank, Water, Heavy, MC3 – Mack. For further information on the cab/chassis or repair and servicing information of the cab/chassis, refer to EMEI Vehicle G 70 decade.

Associated Publications

2. Reference may be necessary to the latest issue of the following documents:

a. Complete Equipment Schedules (CES):

(1) SCES 11657.....Truck, Tank Water, Heavy, MC3, 12500L Capacity, Pump Feed;

(2) SCES 11658.....Equipment Kit, Vehicular Distributor, Water, Tank Type, Truck Mtd;

b. EMEI Vehicle G 70 Decade – Truck, Cargo, Heavy, MC3 – Mack;

c. EMEI Vehicle G 753 – Truck, Tank, Water, Heavy, MC3 - Mack – Light Grade Repair;

d. EMEI Vehicle G 754 – Truck, Tank, Water, Heavy, MC3 - Mack – Medium and Heavy Grade Repair;

e. EMEI Vehicle G 757-4 – Fitting of Spraybar Supports;

f. EMEI Vehicle G 757-5 – Fitting of Heavy Duty Discharge Manifold;

g. EMEI Vehicle G 757-6 – Tank Compartment Delivery Pipes;

h. EMEI Vehicle G 757-10 – Fitting of a Walkway Fall Restraint System;

i. EMEI Vehicle G 759 – Truck, Tank, Water, Heavy, MC3 - Mack – Servicing Instruction; and

j. EMEI Vehicle K 016-1 – Total Restraint Access Module (TRAM) Safety System Technical Manual.

Item Identification Locations

3. The item identification locations are described in Table 1.

Table 1 Item Identification Locations

Serial	Item	Location
1	Chassis number	Right-hand rear frame, above intermediate axle
2	Chassis nameplate	Left-hand door inside cab
3	Engine number	Right-hand top of timing gear housing
4	Front axle number	Left rear of axle housing
5	Transmission number	Left-hand side
6	Transfer case	Right-hand rear
7	Intermediate axle number	Right-hand front of carrier housing
8	Rear axle number	Right-hand front of carrier housing
9	Injection pump identification	Side of the pump
10	Power take-off (PTO)	Right-hand side
11	Hydraulic pump	Lower side of the pump
12	Water tank	Left-hand forward area

GENERAL INFORMATION

4. The water tanker utilizes an aluminium three-compartment tank for water transportation. The water tanker comprises the following sub-assemblies and components (Figure 1):

- **a.** the water tank;
- **b.** the PTO;
- **c.** the hydraulic pump;
- **d.** the hydraulic motor;
- **e.** the water pump;
- **f.** the oil reservoir;
- **g.** the control valves;
- **h.** the hoses and spraybar or spray head (if fitted); and
- **i.** the TRAM safety system (if fitted).

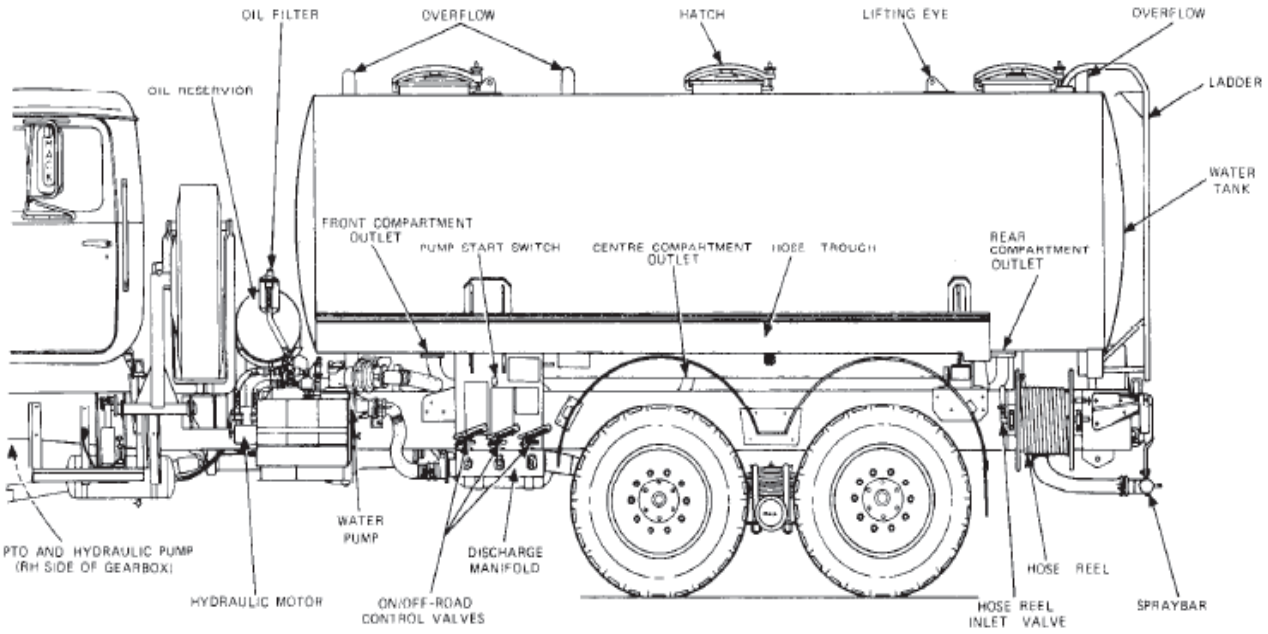

Figure 1 Location of Water Tank Sub-assemblies and Components

Water Tank

5. Each of the three compartments within the tank is completely self-contained. For normal on-road use, only the centre compartment is used, while for off-road use all compartments may be used. Water tank capacity is as follows:

- **a.** front compartment - 3270 litres;
- **b.** centre compartment - 9240 litres;
- **c.** rear compartment - 2370 litres; and
- **d.** design limit loading (all compartments full) - 14 880 litres.

6. Each compartment may be top-filled by an external pressure source, bottom-filled by an external pressure source or bottom-filled using the integral water pump. The hatch at the top of each compartment facilitates top-filling as well as providing access for internal tank inspection. Overflow pipes are installed in each compartment.

PTO

7. The PTO is a Powauto AH225BRll gear-driven single-speed model, mounted on the right-hand side of the truck gearbox. When actuated by the dash mounted ON/OFF control, the PTO drives the hydraulic pump.

Hydraulic Pump

8. A Powauto DS30 hydraulic pump is flange-mounted directly onto the drive-end of the PTO. The pump is a two-gear, constant displacement design which draws hydraulic fluid from the oil reservoir and provides pressurized hydraulic fluid to drive the hydraulic motor.

Hydraulic Motor

9. The hydraulic motor is a Vickers 26M fixed displacement vane type motor, which provides drive for the water pump. The hydraulic motor is installed on the same mounting bracket as the water pump (Figure 2). Drive for the motor is provided by the hydraulic pump via hydraulic hoses.

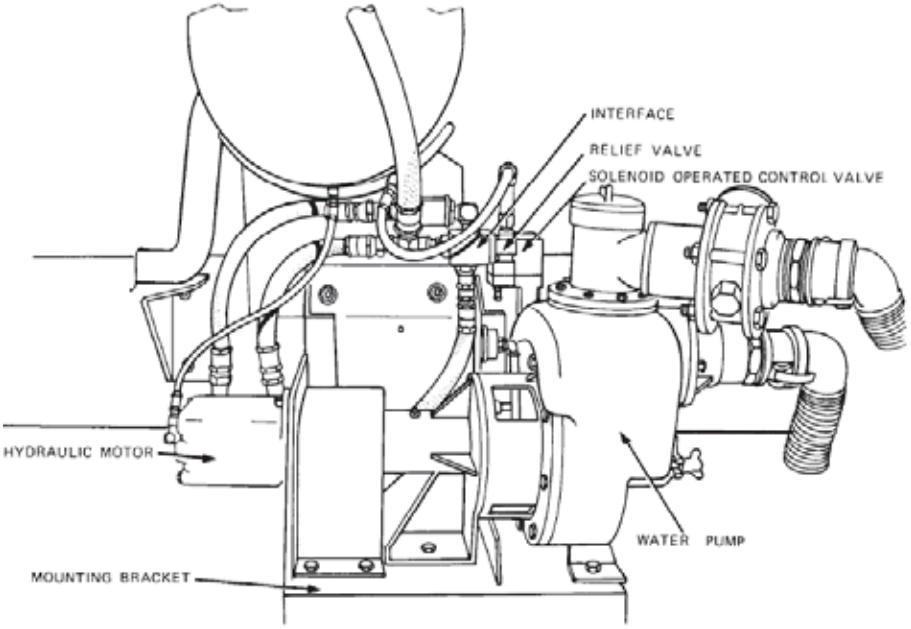

Figure 2 Hydraulic Motor and Water Pump

Water Pump

10. A Finsbury three inch SPD water pump is fitted to the left-hand side of the truck, just behind the jerry can storage area. The purpose of the water pump is to pump water either into or from the tank compartments as required. Water pump operation is controlled by the PUMP START and the PUMP DISCHARGE switches which are located in the cab. The PUMP START switch is also located on the left-hand side of the truck, above the discharge manifold (Figure 1). Drive for the water pump is provided by the hydraulic motor via a Fenner coupling.

NOTE

To reduce the time required to raise the necessary head of water, when bottom filling from a source lower than the tank, a pump priming circuit is provided (Figure 3).

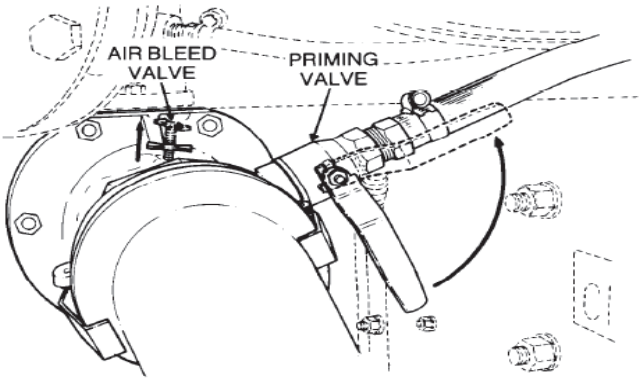

Figure 3 Water Pump Priming

Oil Reservoir

11. The oil reservoir is mounted on two brackets which are bolted to the chassis, in front of the water tank. Reservoir capacity is 135 litres and the fluid level and temperature are indicated on the side-mounted gauge (Figure 4). Oil filtering is provided by a cartridge type filter mounted on the oil reservoir.

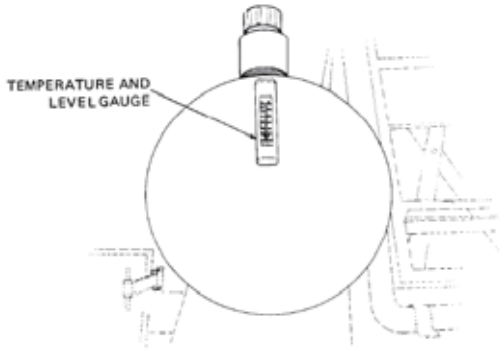

Figure 4 Oil Reservoir and Gauge

Control Valves – Hydraulic Circuit

12. Oil Reservoir Outlet Valve. The oil reservoir outlet valve is a hand operated bronze gate type valve, which is located beneath the reservoir. This valve permits the flow of hydraulic fluid within the hydraulic circuit and provides a means of preventing fluid loss in the event of a hose failure.

13. Solenoid Controlled Relief Valve Assembly. The solenoid controlled relief valve assembly comprises a solenoid operated control valve, a relief valve and interface assembly. Figure 2 illustrates the location of these valves, which together control the flow of pressurized hydraulic fluid to either the hydraulic motor or to the oil reservoir, depending on the position of the PUMP START switch. Para 27 provides a general description of the operation of these valves.

14. Flow Control Valve. A ball type flow control valve is located in the hydraulic line between the interface and the hydraulic motor. This valve is adjusted, by means of a handle, to maintain the hydraulic motor speed between 2800 rpm (engine speed 1150 rpm) and 3100 rpm (engine speed 2000 rpm). Once adjusted, the handle is removed to prevent interference with the valve setting.

15. Check Valve. A check valve is incorporated in the hydraulic circuit between the flow control valve and the relief valve. This check valve, which has a cracking pressure of 34 kPa (5 psi), monitors the fluid pressure across the flow control valve and helps to maintain a constant fluid pressure to the hydraulic motor.

Control Valves – Water Circuit

16. On/Off Road Control Valves. Each water tank compartment outlet is controlled by a hand operated butterfly valve (Figure 5). These valves control the flow of water to or from the water pump via the discharge manifold.

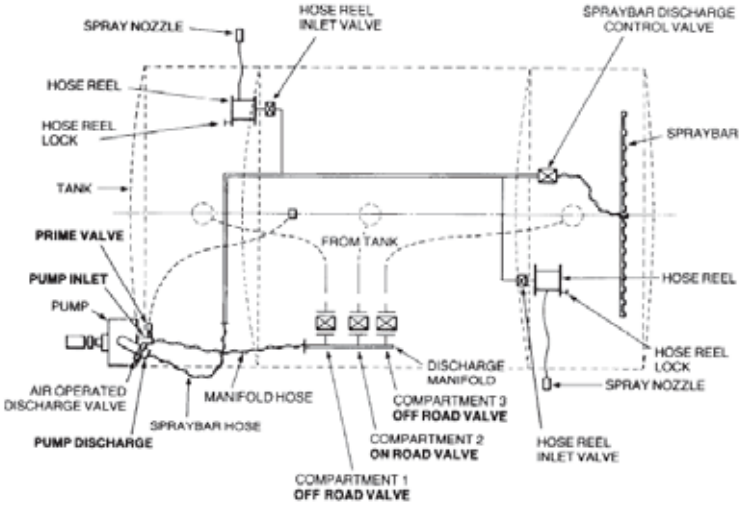

Figure 5 Layout of Water Pipes and Hoses

17. Discharge Manifold. A heavy duty (4.7mm wall thickness) discharge manifold has been fitted to the water circuit (Ref EMEI Vehicle G 757-5).

18. Keystone Valve. The Keystone valve is an air-actuated valve which controls the flow of water from the water pump to the spraybar and hose reels. The PUMP DISCHARGE switch directs air to the valve actuator assembly which in turn opens the butterfly valve within the water outlet hose.

19. Spraybar or Spray Head (If fitted) and Hose Reels. The spraybar or spray head (if fitted) and each hose reel are fitted with hand operated flow control valves.

Water Hoses

20. The water tanker is equipped with two hose reels, each fitted with a 20 metre PVC hose. One hose reel is located on the left-hand side of the truck (Figure 1), and the second is located on the right-hand side, below the oil reservoir. Adjacent to the second hose reel is a 60 metre lay-flat hose, which is housed in a metal frame and covered by a metal cover.

21. Four suction hoses, each 4080 mm long, are housed in the hose trough on the left-hand side of the truck (Figure 1). A foot valve and strainer assembly is fitted to the end of the suction hose when the water tanker is filled from an external source, such as a dam. Figure 5 illustrates the layout of the water pipes and hoses around the tanker.

Spraybar or Spray Head (If Fitted)

22. Spraybar. The normal spraybar width is 2525 mm, but with the addition of an extension piece to each side, the spraybar width can be extended to 3560 mm. When not in use, the spraybar extensions are housed in the spraybar trough on the right-hand side of the truck. Improved rigid spraybar supports have been fitted (Ref EMEI Vehicle G 757-4).

23. Spray Head (If Fitted). The Magnum 1019D spray head fitted to the rear of the tanker consists primarily of the body, head and a drop in valve assembly. The body is fitted with a poly sleeve which forms the seat for the valve. A sliding adjusting ring is fitted to the outside of the body to enable adjustment of spray width, height, angle and flow rate settings. The body is bolted to a steel base plate that screws onto the tanker's pipe work. Slotted holes in the base plate permit rotation of the spray head to alter spray direction.

24. Operation of the spray head is via a combination of water and air pressure and is controlled by a two position toggle valve on the dash. With the toggle valve in the ON position air is exhausted from the spray head allowing water under pump pressure to raise the drop-in assembly against spring pressure and flow through the opening in the body as shown in Figure 6. When the toggle valve is switched to the OFF position, air flows to the air chamber of the spray head forcing the drop-in assembly down onto the poly sleeve and stopping the water flow. When the truck is shut down, the drop-in assembly is held closed by the compression spring in the head.

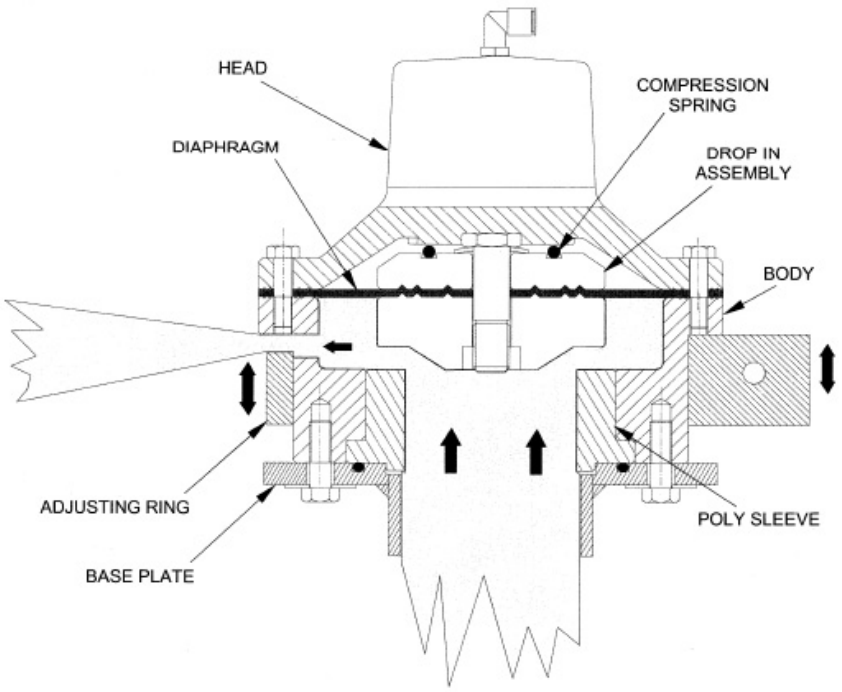

Figure 6 Spray Head

TRAM Safety System

25. The TRAM Safety System is a mobile anchor point that moves along the fixed rail if fitted to the top of the water tank. The system consists of the TRAM, the TRAM belt and the TRAM installation. Refer to EMEI Vehicle K 016-1 for the following:

- **a.** operation,
- **b.** inspection and maintenance,
- **c.** cleaning procedures, and
- **d.** servicing instructions.

General Circuit Description

26. Figure 7 illustrates the relationship between the electrical, air, hydraulic and water circuits on the water tanker.

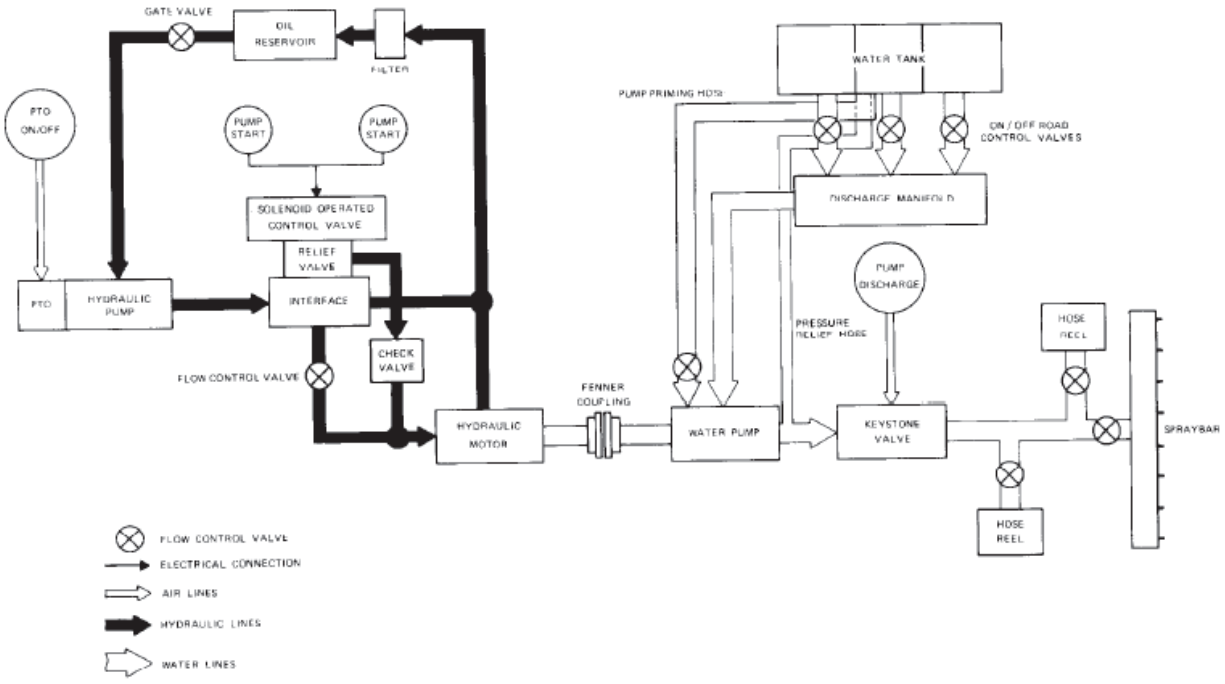

Figure 7 Simplified Water Circuit Diagram

27. When the PTO is engaged, it drives the hydraulic pump which draws hydraulic fluid from the oil reservoir. Depending on the position of the PUMP START switch, the pressurized hydraulic fluid from the hydraulic pump will take one of two paths as follows:

- **a.** With the PUMP START switch OFF, pressurized hydraulic fluid will be dumped via the interface back to the oil reservoir.
- **b.** With the PUMP START switch ON, the solenoid in the solenoid operated control valve energizes, thereby balancing the fluid pressures within the relief valve and interface. The piston within the interface directs the pressurized hydraulic fluid to the hydraulic motor via the flow control valve. The check valve monitors the pressure differential across the valve to ensure a constant, even flow of hydraulic fluid to the motor. The hydraulic motor is coupled to the water pump via a Fenner coupling.

28. Water from the on/off-road control valves is gravity fed to the water pump via the discharge manifold. When the PUMP DISCHARGE control is selected, the Keystone valve opens to allow water to be pumped to the hose reels or spraybar as selected by the appropriate control valves. Bottom-filling is achieved by connecting the manifold hose to the pump outlet and the suction hose to the inlet.

29. The three tank compartment delivery pipes have been modified to prevent cracking by insertion of flexible hose sections into the water circuit at the discharge manifolds on all three pipes and at the first bend on compartment three delivery pipe (Ref EMEI Vehicle G 757-6).

DETAILED DESCRIPTION

Water Tank

30. The water tank comprises three individual compartments, each fitted with a top hatch, an overflow pipe and a bottom outlet section. The centre compartment, being the largest of the three, is divided by a central support baffle. The centre compartment outlet pipe protrudes into the tank effectively creating a reservoir of water which is available for the pump priming circuit.

WARNING

Before working on top of the water tank, personnel must use the TRAM Safety System (if fitted) in accordance with EMEI Vehicle K 016-1.

31. Access to the top of the tank is via the rear mounted ladder. Entry to each tank compartment is via the appropriate hatch, utilizing the step welded to the internal compartment baffle or bulkhead. A zinc block (sacrificial anode) is mounted to a baffle or bulkhead in each compartment to minimise electrolytic corrosion.

PTO

32. The PTO is actuated by compressed air which is controlled by an ON/OFF switch located on the truck dashboard. When the switch is placed in the ON position, compressed air is directed to the PTO where it actuates a piston which operates a gear selector fork. This selector fork, in turn, engages the selector gear which transfers the drive from the adapter gear, driven from the truck gearbox, to the PTO driven gear. This gear is splined with the output shaft which transfers the drive to the hydraulic pump. The PTO is lubricated by oil from the truck gearbox.

Hydraulic Pump

33. The hydraulic pump is flange mounted directly onto the drive output end of the PTO. The pump drive gear is splined to the PTO drive shaft. The drive gear and idler gear shafts are both mounted in bushes (Figure 8). When operating, hydraulic fluid is drawn from the reservoir through the pump inlet port. The rotation of the gears forces the fluid out the outlet port under pressure. The hydraulic fluid also provides lubrication for the working components of the pump.

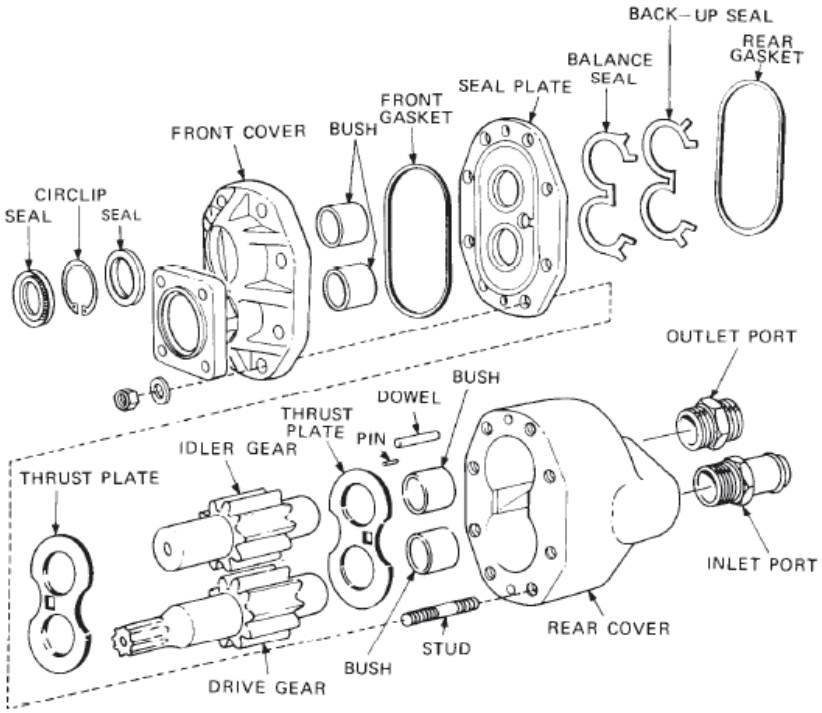

Figure 8 Hydraulic Pump – Exploded View

Hydraulic Motor

34. The hydraulic motor is capable of intermittent or continuous operation in either direction. The direction of rotation is controlled by applying pressurized hydraulic fluid to the motor ports as follows:

a. Port K – counter-clockwise rotation; and

b. Port L – clockwise rotation.

35. The water tanker hydraulic motor is connected for counterclockwise rotation (port K). The pressurized hydraulic fluid entering port K causes the rotor and vane assembly to rotate. This rotation is transferred to the motor output shaft via the spline connection between the rotor and the shaft. The hydraulic fluid that slips past the vanes in the motor lubricates the bearing and the bush within the motor before returning to the oil reservoir via port L or the unrestricted drain line (case drain) connected to the motor cover. An exploded view of the hydraulic motor is shown in Figure 9. The components designated as the Cartridge Kit are to be replaced as a complete item, when necessary.

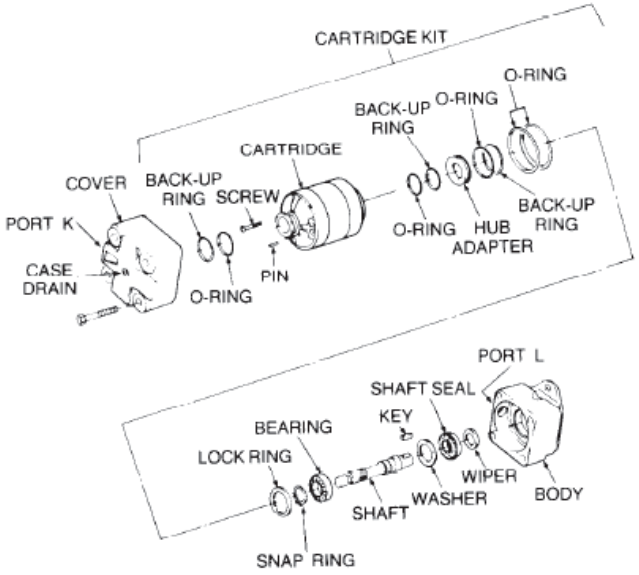

Figure 9 Hydraulic Motor – Exploded View

Fenner Coupling

36. The Fenner coupling transfers the drive form the hydraulic motor to the water pump (Figure 10). The coupling comprises two flanges which are secured to the motor and pump shafts by bushes. The two flanges are interconnected by a flexible coupling insert. The Fenner coupling requires no lubrication or regular maintenance.

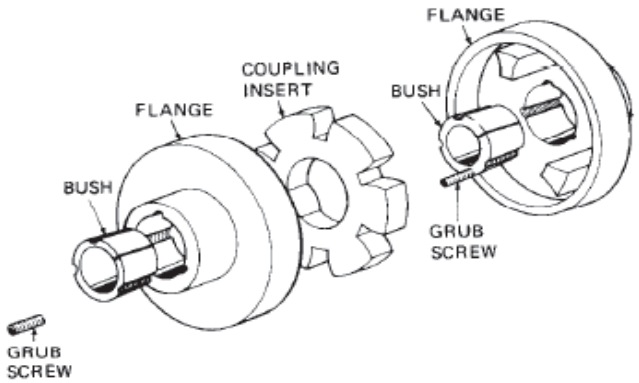

Figure 10 Fenner Coupling – Exploded View

Water Pump

37. The water pump is a self priming, centrifugal type pump, which is fitted with an outrigger assembly to connect the Fenner coupling to the water pump drive shaft. Figure 11 illustrates both the outrigger assembly and the water pump. In the event of the outlet valve being closed while the water pump is still operating, the pump is protected against excessive internal pressure by a pressure relief line connected from the water pump outlet to the centre tank compartment.

38. One end of the outrigger shaft is keyed into the Fenner coupling and the other end is clamped into the water pump extension shaft. The pump impeller is also fitted to the extension shaft. When drive is applied to the water pump, the rotating impeller draws water into the pump via the one-way clacker valve and forces it out through the delivery branch. A cover is provided on the pump bottle to permit inspection and cleaning of the impeller. This cover is held in position by two wing nuts.

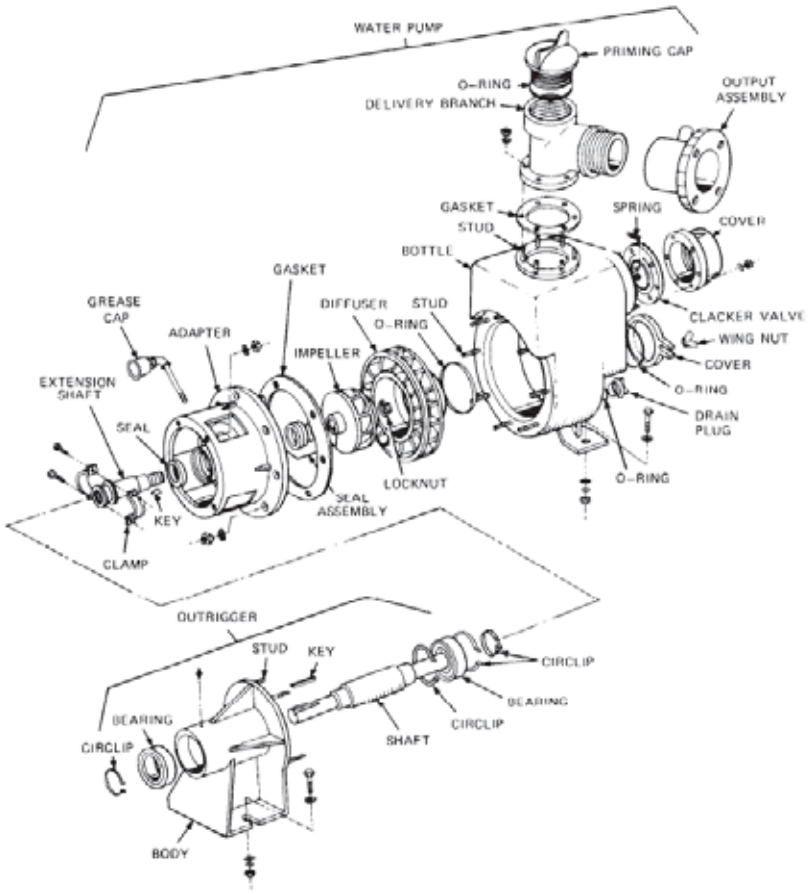

Figure 11 Water Pump and Outrigger Assembly – Exploded View

Solenoid Operated Control Valve

39. The solenoid operated control valve is controlled by the PUMP START switch as follows:

- **a.** In the off position, the solenoid is de-energized and the internal springs locate the spool in a position which allows hydraulic fluid to flow from the relief valve, through the chamber within the solenoid and back to the relief valve, where the fluid is dumped to the oil reservoir.
- **b.** In the on position, 24 V dc is applied to the solenoid, which energizes and moves the spool, blocking the flow of fluid through the solenoid chamber. All pressurized fluid is then directed to the hydraulic motor.

40. An exploded view of the solenoid operated control valve is shown in Figure 12.

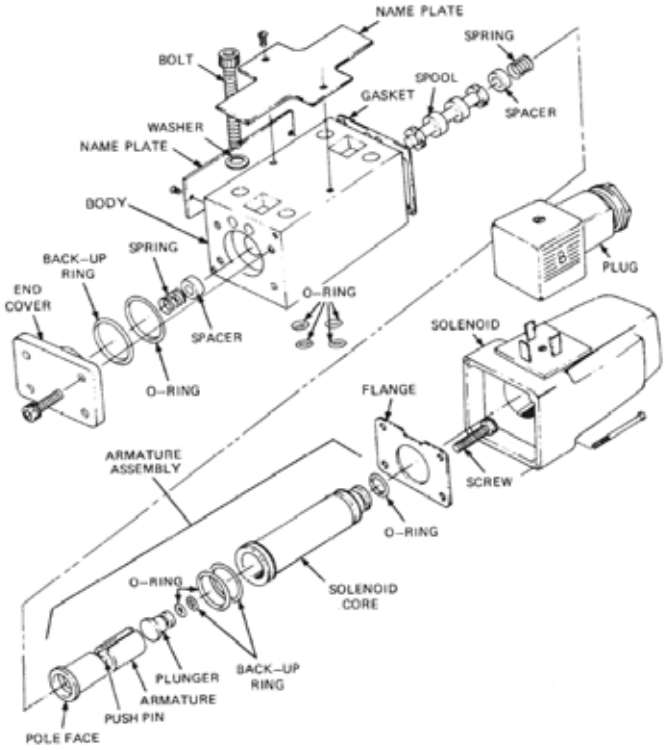

Figure 12 Solenoid Operated Control Valve – Exploded View

Relief Valve and Interface Assembly

41. The relief valve and interface assembly controls the direction of flow of pressurized hydraulic fluid either to the hydraulic motor or to the oil reservoir as directed by the solenoid operated control valve. An exploded view of the relief valve and interface assembly is show in Figure 13. For a detailed description of the operation of the relief valve and interface assembly, together with the solenoid operated control valve, refer to Para 46 to 48.

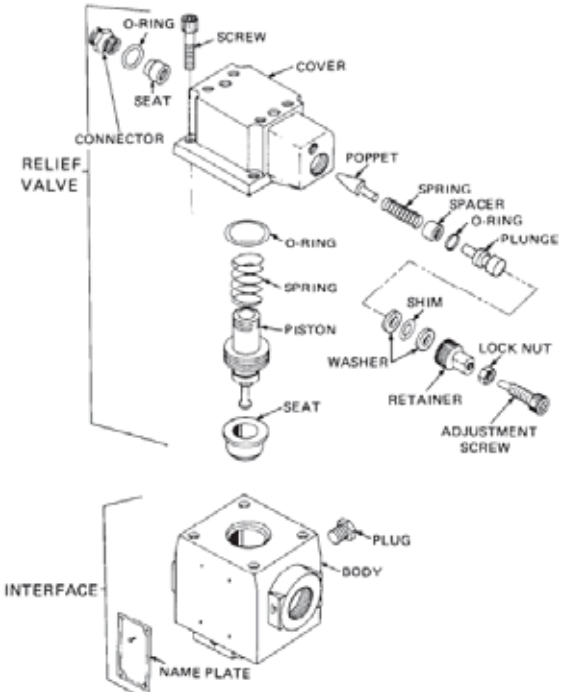

Figure 13 Relief Valve and Interface Assembly – Exploded View

Check Valve

42. The check valve monitors the fluid pressure across the flow control valve and ensures a constant fluid pressure in the line to the hydraulic motor (Figure 14). Free flow through the check valve occurs at a pressure differential of 34 kPa (5 psi).

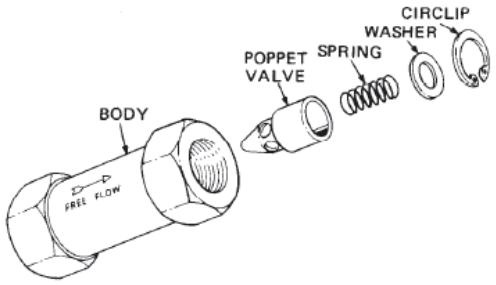

Figure 14 Check Valve – Exploded View

Flow Control Valve

43. An adjustable ball type flow control valve is installed between the interface assembly and the hydraulic motor. This valve controls the flow of pressurized hydraulic fluid to the motor, which provides an effective motor speed control (Figure 15).

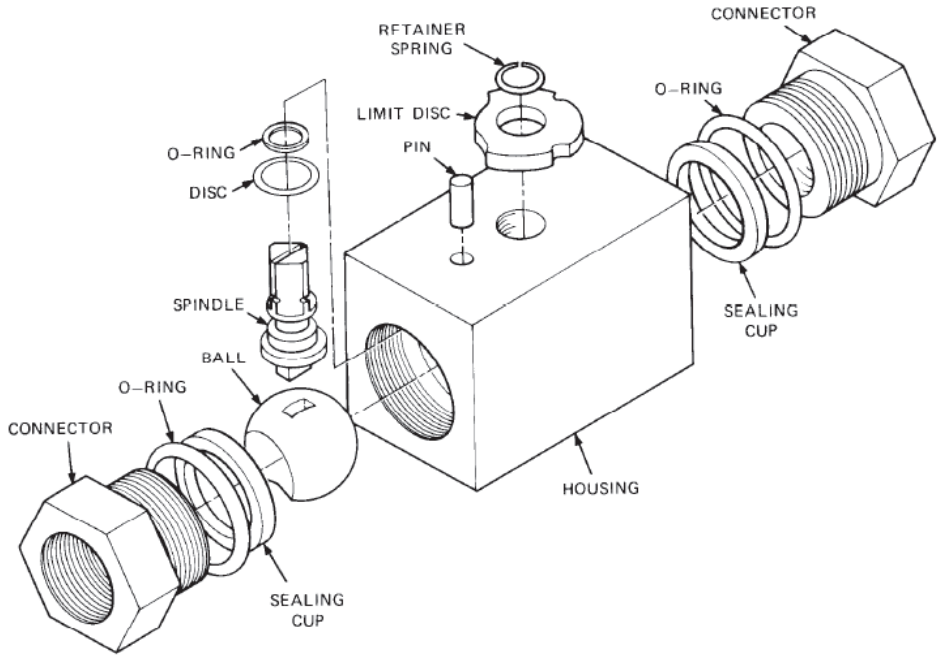

Figure 15 Flow Control Valve – Exploded View

Keystone Valve and Actuator

44. Figure 16 shows an exploded view of the Keystone valve and actuator assembly. The dash mounted PUMP DISCHARGE switch incorporates an air valve, which is connected to the actuator assembly by two air lines. When in the ON position, compressed air from the primary air circuit is directed via the air valve into the actuator body, moving the actuator pistons within the cylinder. Air on the other side of the two pistons is exhausted through the opposite port. Piston movement is transferred to the pinion shaft via the two gears. The pinion shaft is coupled to the valve shaft, which controls the disc within the valve. Shaft rotation turns the valve disc, allowing water to flow through the valve.

45. When the PUMP DISCHARGE switch is set to the OFF position, compressed air is applied to the other side of the pistons, moving the pistons in the opposite direction. This movement is transferred to the pinion shaft and closes the disc within the valve.

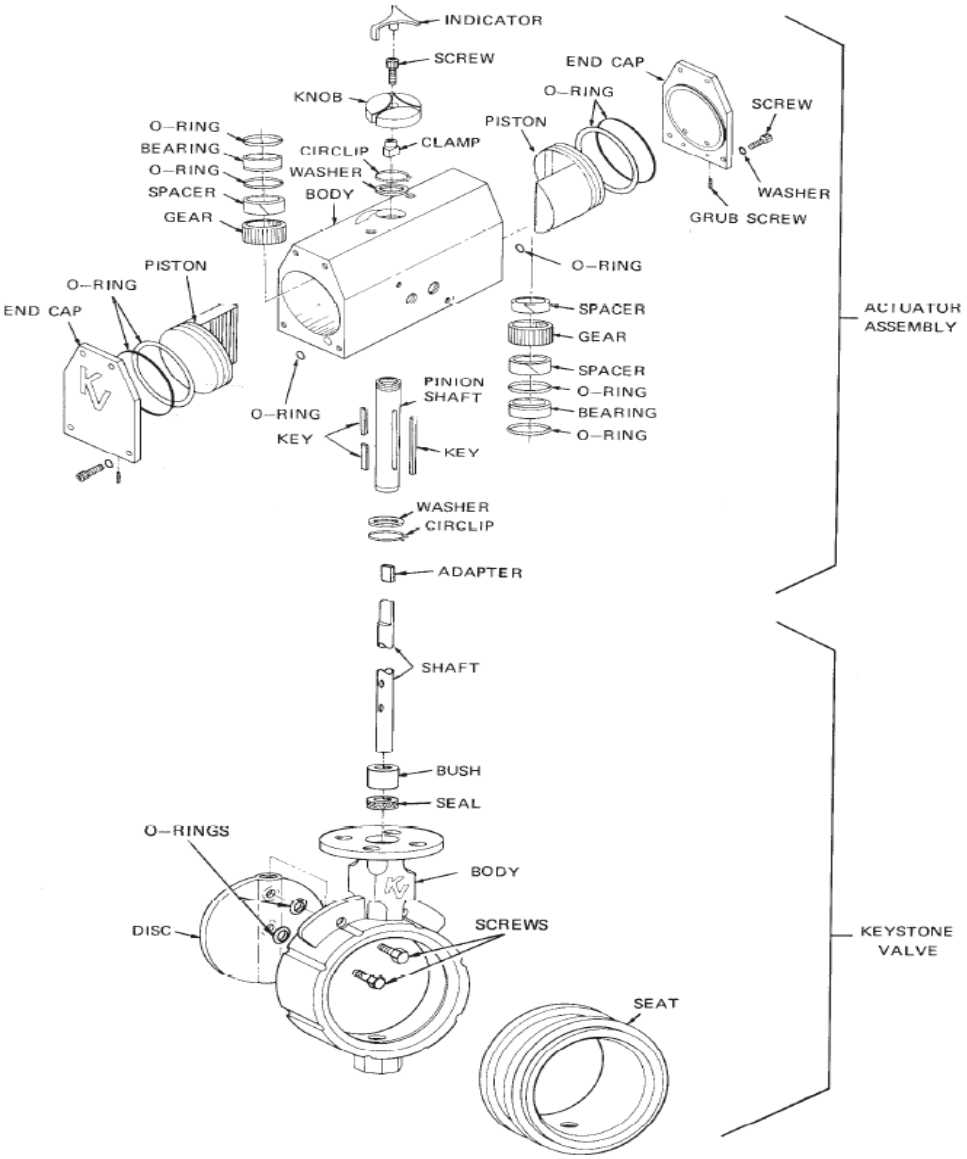

Figure 16 Keystone Valve and Actuator Assembly – Exploded View

Hydraulic Circuit

46. The solenoid controlled relief valve assembly, which comprises the solenoid operated control valve, the relief valve and the interface assembly, directs the flow of fluid within the hydraulic circuit either to the motor or to the oil reservoir. With the PTO ON and the PUMP START switch OFF (solenoid de-energized), pressurized hydraulic fluid flows through the interface to the hydraulic motor, and through the orifice in the piston to the relief valve (Figure 17). As the solenoid is in the de-energized position, fluid flows through the solenoid valve and into the chamber behind the poppet valve, from where it flows to the oil reservoir via the centre drilling in the piston.

47. The flow of fluid through the orifice in the piston creates a low pressure in chamber B. The higher pressure in chamber A overcomes this lower pressure and the piston spring pressure, thereby forcing the piston off its seat. This action dumps fluid from the high pressure line directly to the oil reservoir, thereby relieving the pressure in the line to the motor. Due to the back pressure on the check valve during start-up, the check valve is closed.

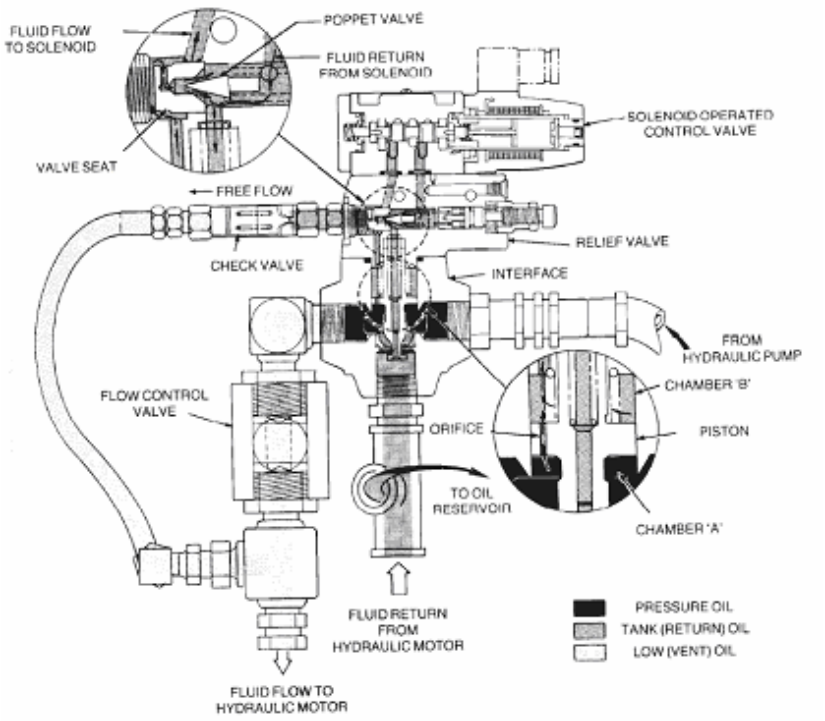

Figure 17 Fluid Flow – Pump Start Switch Off

48. With the PTO ON and the PUMP START switch ON (solenoid energized), the fluid flow through the solenoid valve is blocked by the spool (Figure 18). The relief valve poppet spring overcomes fluid pressure and closes the poppet, cutting off the fluid flow through the centre drilling of the piston. Fluid pressure on each side of the check valve is now equal and the check valve is held closed due to internal spring pressure. The fluid flow through the piston orifice now ceases and the pressures in chambers A and B are equalized, allowing the piston to seat under spring pressure. This action directs all pressurized fluid to the hydraulic motor.

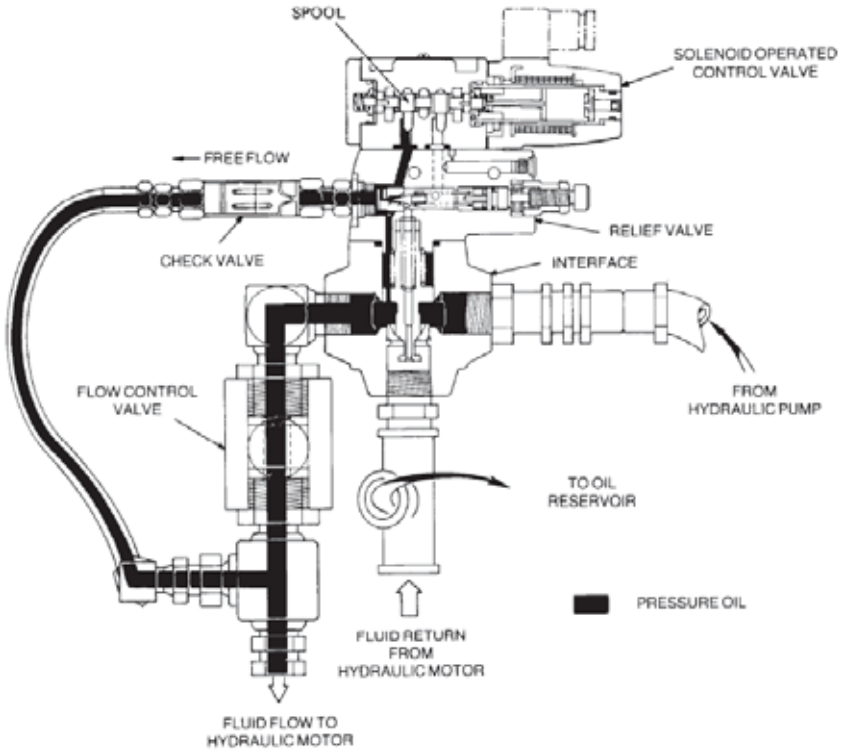

Figure 18 Fluid Flow – Pump Start Switch On

49. The check valve monitors the fluid pressure across the flow control valve. Any increase in pressure is reflected back to the relief valve poppet, forcing it off its seat which causes fluid to be dumped through the piston centre drilling. This action lifts the piston from its seat, allowing fluid to be dumped to the oil reservoir until the line pressure stabilizes (Figure 19).

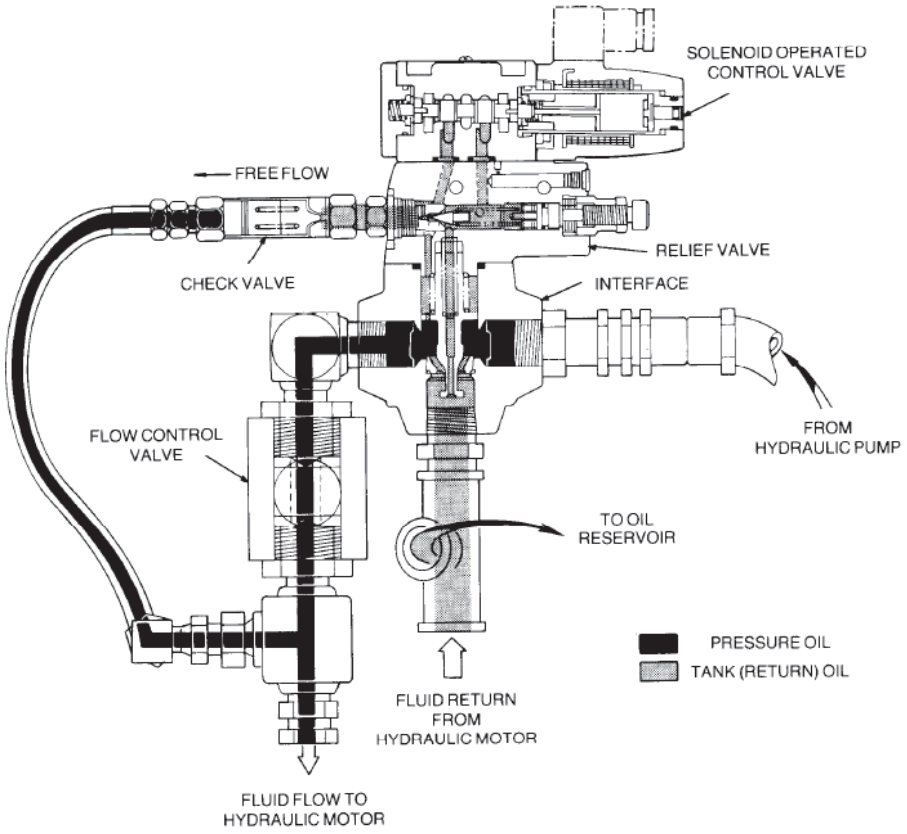

Figure 19 Fluid Flow – Increased Line Pressure

END

Distribution List: **VEH G 55.0 – Code 1** (Maint Level)
(Sponsor: LV SPO, Med/Hvy B Vehicles)
(Authority: TRAMM)