SECTION 13

PROTECTIVE DEVICES

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ELECTRO-MOTIVE

ENGINE MAINTENANCE MANUAL

SECTION 13

PROTECTIVE DEVICES

GENERAL

This section contains the description and maintenance information for engine protective devices. These devices are designed to shut down the engine in the event of a malfunction occurring during engine operation.

LOW OIL PRESSURE SHUTDOWN

DESCRIPTION

The low oil pressure shutdown plunger, Fig. 13-I, is part of the low oil pressure shutdown device, which is contained in the governor. Although it is a protective device it is not an accessory to the engine. Refer to Section 12 for description and maintenance of the low oil pressure shutdown device.

Fig. 13-1 - Low Oil Pressure Shutdown Plunger

DIFFERENTIAL WATER AND CRANKCASE PRESSURE DETECTOR ASSEMBLY

DESCRIPTION

The combination differential water and crankcase pressure detector, Fig. 13-2, is a mechanically operated, pressure-sensitive device used to determine abnormal conditions of the engine cooling system and crankcase pressures. If potentially harmful conditions exist, this protective device will cause engine shutdown.

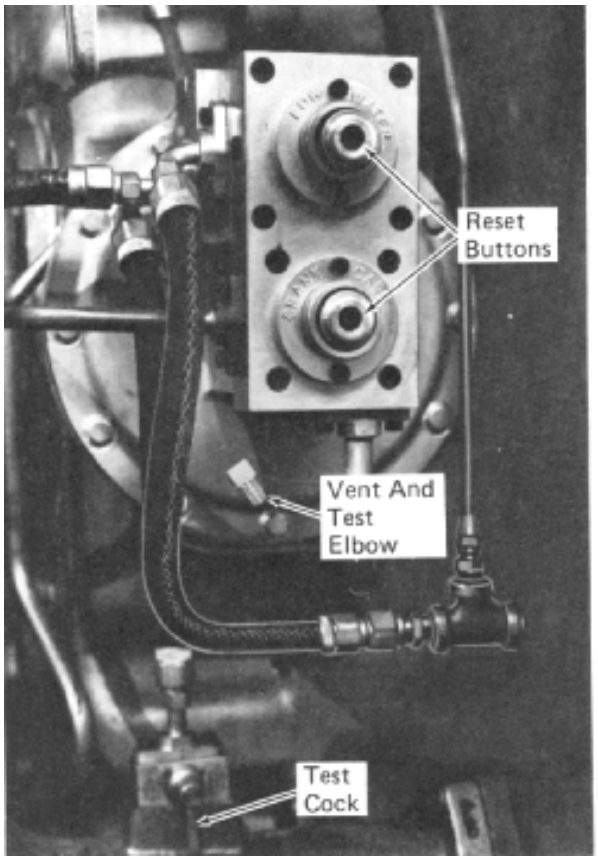
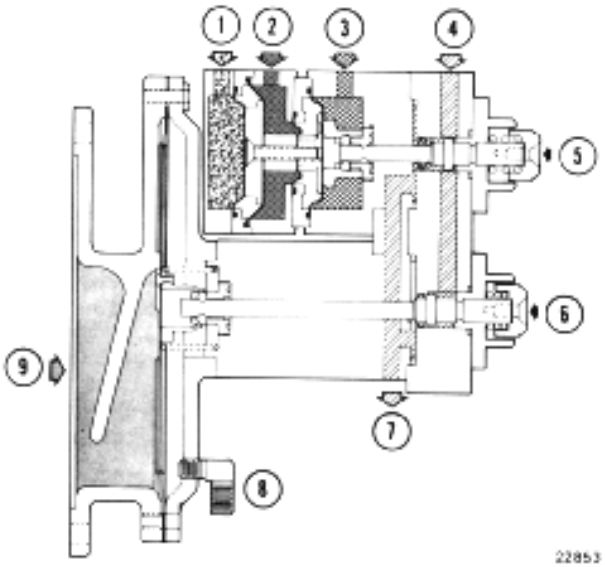


Fig. 13-2 - Differential Water And Crankcase Pressure Detector Installation

The water pressure portion of the detector balances the differential pressure of the water pump output and the water pump input against the air box pressure to hold an oil relief valve in the latched position. When the differential pressure across the water pump becomes less than the air box pressure, Fig. 13-3, the diaphragm moves causing the oil drain valve to open and dump engine oil from the low oil sensing device in the governor. The governor senses low oil pressure and initiates low oil shutdown. Bleed holes are provided between the pump inlet and outlet diaphragms and the pump inlet and air box diaphragms to visually indicate a leak. This device provides protection against water pump cavitation, which can result from low coolant level, excessive coolant temperature, exhaust gases in the cooling system, or several other cooling system failures. The water portion of the detector will trip whenever the cooling system is drained.

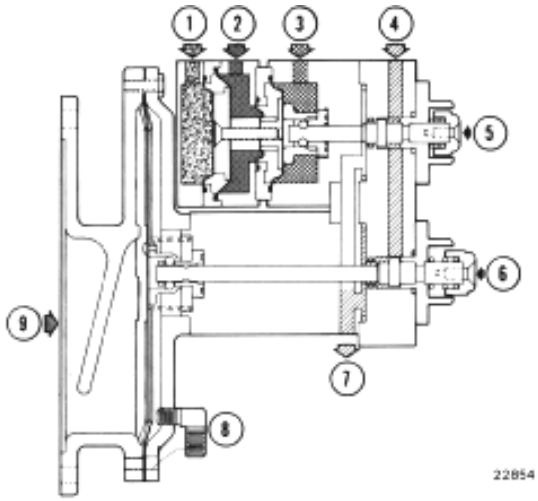
NOTE: To latch the water portion, the engine must be running and the cooling system vented.



1 Water Pump Discharge Pressure
2 Water Pump Inlet Pressure
3 Air Box Pressure
4 Oil In From Governor
5. Trip Position
6. Latch Position
7. Oil Return To Crankcase
8. Vent Elbow
9. Crankcase Pressure Negative

Fig. 13-3 - Low Differential Water Pressure Condition

The crankcase pressure portion of the device consists of an oil relief valve, comparable to the one in the water portion, held in a latched position until a positive pressure is built up in the crankcase. The oil relief valve is released and lube oil pressure to the engine governor is relieved, Fig. 13-4. As in the water portion, the governor senses low oil pressure and initiates engine shutdown.



1. Water Pump Discharge Pressure
2 Water Pump Inlet Pressure
3 Air Box Pressure
4 Oil In From Governor
5 Latch Position
6 Trip Position
7 Oil Return To Crankcase
8 Vent Elbow
9 Crankcase Pressure Positive

Fig. 13-4 -- Positive Crankcase Pressure Condition

WARNING: Following an engine shutdown because the engine pressure detector has been actuated, do NOT open any handhole or top deck covers to make an inspection until the engine has been stopped and allowed to cool off for at least two hours. Do NOT attempt to restart the engine until the cause of the trip has been determined and corrected. The action of the pressure detector indicates the possibility of a condition within the engine, such as an overheated bearing, that may ignite the hot oil vapors with an explosive force, if air is allowed to enter. If crankcase pressure detector can not be reset, do NOT operate the engine until the detector has been replaced, since the diaphragm backup plates may be damaged.

MAINTENANCE

The differential water and crankcase pressure detector should be tested periodically to ensure proper operation.

A test valve, Fig. 13-5, is installed in the water pump outlet line to the water safety portion and provides a means of manually dumping the water pressure on the diaphragm and, in turn, provides a check on the tripping action of the water detector. By rotating the test valve handle to the horizontal position, the discharge of coolant from the small orifice hole in the valve should be a steady flow. Because of contaminants in the coolant, the small orifice in the

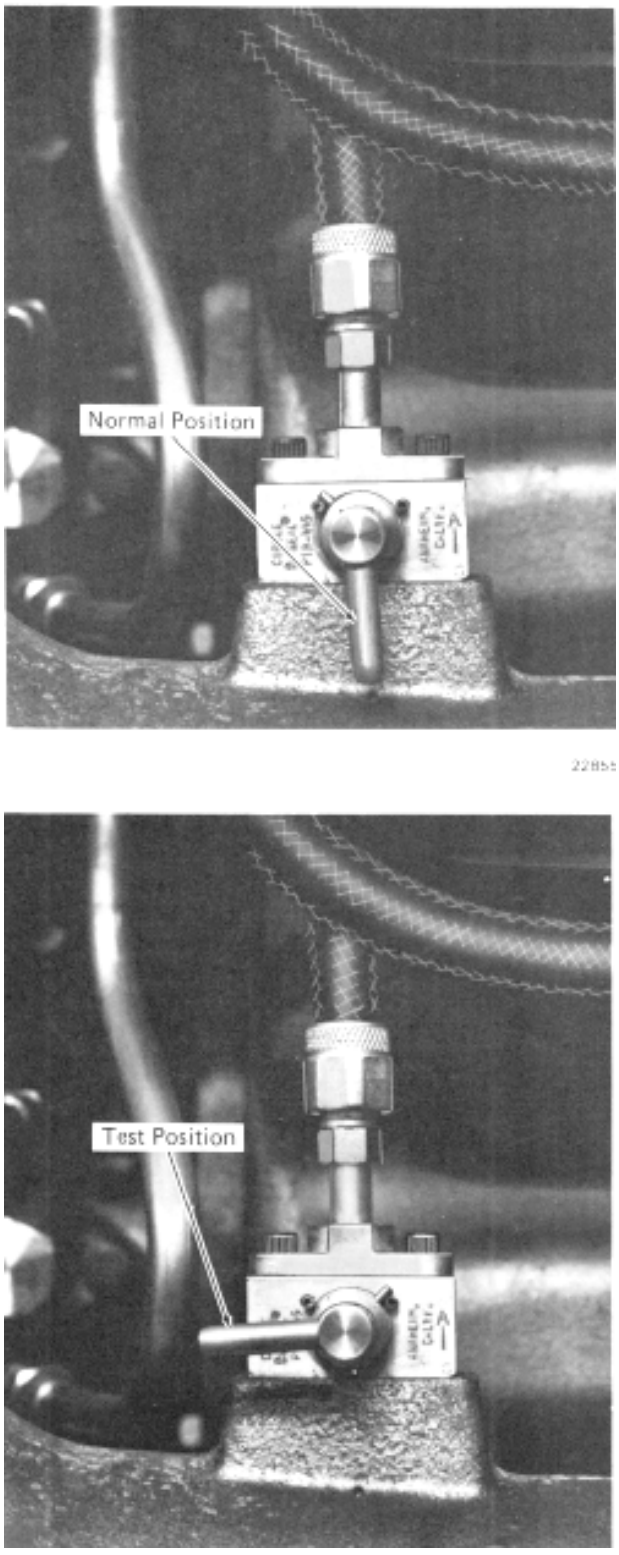


Fig. 13-5 - Test Valve Positions

valve may become plugged, reducing or restricting the bleed off of pressure on the diaphragm. In most cases, rapidly opening and closing the test valve a few times will dislodge the obstruction and allow the water detector to trip. Plugging of the test valve in no way affects the operation of the water device. With the engine running at idle speed, opening the test valve and obtaining a free flow of coolant, should trip the device on the first or second try. If the device does not trip, the device should be taken off and checked on a test panel to determine the cause of malfunction. It is recommended that the operation of the water detector be checked monthly with the test valve. Test valve handle must be returned to vertical position, Fig. 13-5, before starting engine.

To test the crankcase pressure portion without starting the engine, use a hydrometer bulb, tocreate a suction on the vent elbow. This should trip the reset stem, as it simulates a positive pressure being applied to the opposite side of the diaphragm.

CAUTION: Diaphragm can be damaged by applying a positive pressure through vent tube. Exhaust air from bulb before testing.

If this test is unsatisfactory, repeat the test. If the detector still does not trip, replace the detector. The pressure detector can also be tested by using a hand operated vacuum pump. Connect the vacuum pump to a tee in a line between the vent elbow and a water manometer. Operate the pump slowly until the detector trips. Reset the detector and repeat the procedure, checking the manometer for tripping pressure. See the Service Data for limits.

OVERSPEED TRIP

DESCRIPTION

An overspeed mechanism is provided as a safety feature to stop the injection of fuel into the cylinders should the engine speed become excessive.

Fig. 13-6 shows the mechanical ovespeed trip mechanism. If the engine speed should increase to the specified limits, the overspeed mechanism will shut down the engine.

A trip shaft extending the length of each engine bank under the camshaft is provided with a cam at each cylinder, which when rotated, contacts a spring-loaded catch pawl mounted on each cylinder head, and located directly under the injector rocker arm. In the overspeed trip housing on the front of the engine, the trip shafts are connected to springoperated links and a lever mechanism. A reset lever on the trip lock shaft, when pulled towards the right bank, puts tension on an

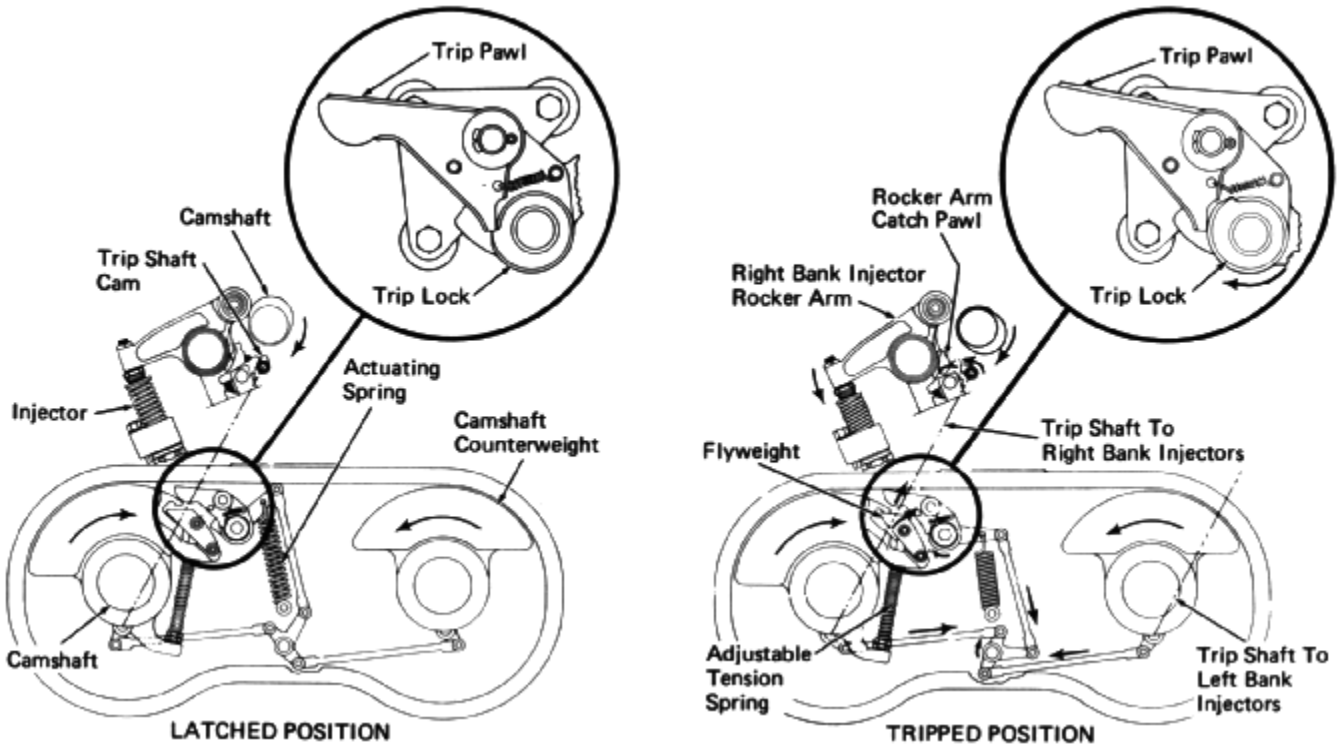


Fig. 13-6 - Overspeed Trip

actuating spring; this tension being held by a trip pawl engaging a notch in the trip lock lever shaft. This is the normal running position, in which the cams on the trip shaft are held away from the rocker arm catch pawls.

The overspeed trip release mechanism is incorporated in the right bank front camshaft counterweight. It consists of a flyweight held by an adjustable tension spring. When engine speed exceeds the set limit, the tension of the spring is overcome by the centrifugal force acting on the flyweight, causing the flyweight to move outward to contact the trip pawl. This allows the actuating spring, acting through connecting links, to rotate the trip shafts. Consequently, the trip shaft cams contact and raise the injector rocker arm pawls preventing full effective injector rocker arm roller contact on its cam. This prevents fuel injection and stops the engine.

Upon resetting, by counterclockwise movement of the reset lever, Fig. 13-7, the trip shaft cams release the injector rocker arm catches. Rotation of the camshafts on starting the engine lift the rocker arms slightly allowing the catch pawls to resume unlatched position, releasing the injector rocker arm for normal operation.

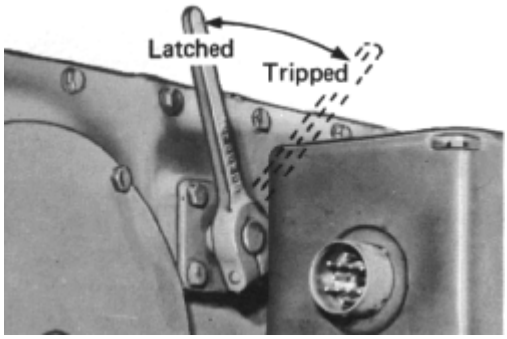


Fig. 13-7 - Reset Lever Positions

MAINTENANCE

DRAIN SLEEVE REMOVAL

Lubricating oil from the overspeed trip housing drains into the top of the accessory drive housing through two removable cast aluminum drain sleeves, Fig. 13-8. Each sleeve has two rubber O-ring seals.

If oil leakage is detected between the housings, the sleeves should be removed and the O-ring seals replaced as follows:

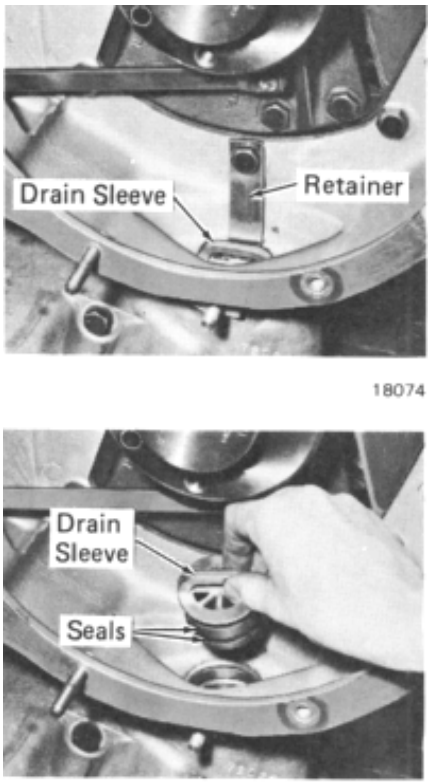


Fig. 13-8 - Overspeed Trip Housing Drain Sleeves

1. Remove the overspeed trip housing cover.
2. Bar over the engine until the counterweights are positioned at the top of the engine.
3. Remove the bolt and steel retainer strap, Fig. 13-8, holding the sleeve.
4. Using a suitable pry bar, insert under sleeve handle, and carefully remove sleeve from housing. Remove seals and clean sleeves.
5. Install seal marked with red dot in upper groove of sleeve and unmarked seal in lower groove.
6. Apply film of oil on seals and sleeve and install sleeve, bolt, and retainer strap.

ADJUSTING MECHANICAL OVERSPEED TRIP

To adjust the overspeed trip, shut engine down, remove the cover from right side of overspeed trip housing and turn adjusting nut, Fig. 13-9, to increase or decrease spring tension as required. To increase engine speed at which overspeed trip operates, increase spring tension.

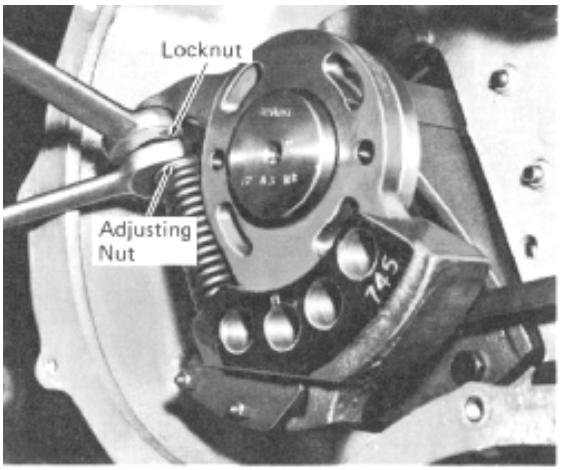


Fig. 13-9 - Overspeed Trip Adjusting Nut

After the adjusting nut has been moved, the locknut must be tightened and the engine run to test speed at which trip operates. The speed rise of the engine from idle to trip should be made in 20 to 30 seconds. Several adjustments may be required before final setting of tripping speed is reached.

HOT OIL SHUTDOWN

DESCRIPTION

The hot oil shutdown device, Fig. 13-10, consists of a thermostatic valve and the associated piping.

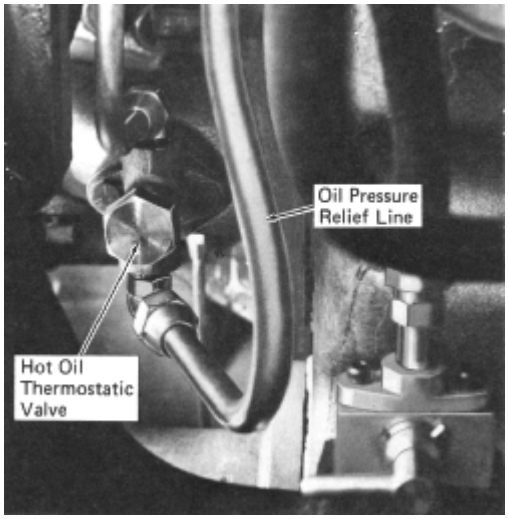


Fig. 13-10 -Hot Oil Shutdown Installation

The valve is located in the discharge elbow of the main lube oil pump. Piping from the valve is connected into the oil pressure line between the

differential water and crankcase pressure detector and the governor. There is also drain line piping from the valve to the governor drive housing.

When oil temperature rises to 124°-126° C (255°260° F), the thermostatic valve will open and the pressure oil is allowed to pass through the valve and drain into the governor drive housing. The governor senses the resultant low oil pressure, and initiates an engine shutdown.

MAINTENANCE

The thermostatic valve should be removed and tested at intervals specified in the applicable Scheduled Maintenance Program.

SERVICE DATA
PROTECTIVE DEVICES

SPECIFICATIONS

Clearance and dimensional limits listed below are defined as follows:

1. New limits are those to which new parts are manufactured. (Drawing tolerances.)

2. Minimum, maximum, and tolerance measurements are provided as service limits. At time of rebuild or any time unscheduled maintenance is performed, the service limits should not be exceeded. Engine components within these limits may be reused with the assurance that they will perform satisfactorily until the next scheduled overhaul.

Differential Water and Crankcase Pressure Detector

Water Portion

Tripping pressure - (With no pressure on the water chambers, increase air box pressure from zero to tripping pressure.)

*New - Min.	508 mm (20") H_2O
Used - Min.	762 mm (30") H_2O

Crankcase portion

Tripping pressure -

*New	20.32-45.72 mm (.8"-1.8") H_2O
Used	20.32-76.20 mm (.8"-3.0") H_2O

*Meaning new or rebuilt devices with less than 3 months service.

Overspeed Trip

Clearance, trip latch to flyweight - Min.	0.25 mm (.010")
Trip setting	990-1005 RPM

EQUIPMENT LIST

	Part No.
Hydrometer bulb	8140866
Test panel	9339066
Vacuum pump	8470956