ELECTRO-MOTIVE DIVISION • GENERAL MOTORS CORPORATION
SERVICE DEPARTMENT

MAINTENANCE INSTRUCTION

LOW WATER AND CRANKCASE PRESSURE DETECTORS

17/11/76

DESCRIPTION

Greater reliability and more consistent operation have been provided in the engine detectors now being furnished on EMD engines, see Fig. 1. Operational and functional differences between the low water and crankcase pressure detectors are explained below.

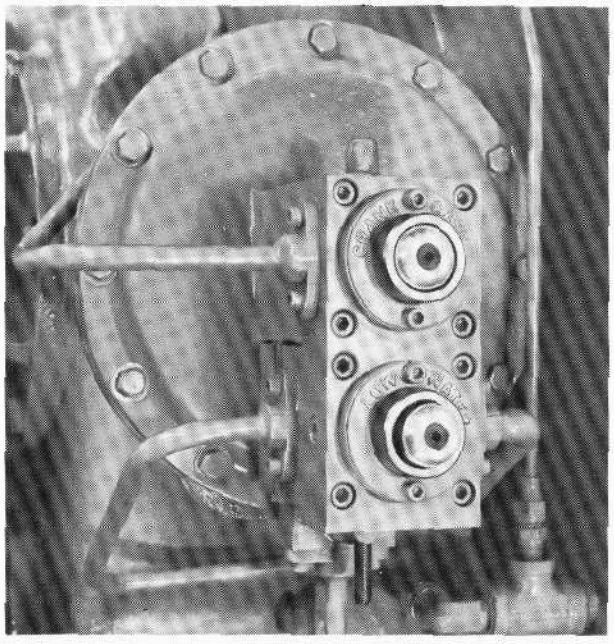

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Fig. 1 — Combination Low Water And Crankcase Pressure Detector

1. The low water reset button on detectors is more difficult to latch and keep latched on a dead engine and when starting an engine, due to the fact that the spring force under the button is 8-10 lbs. This means there is a greater force provided to release the button and it therefore requires a high water level to keep the button latched. The detectors require the water level to be at the top of the sight glass. Since this is the maximum height the water can reach, the latching of the detector will be marginal until the engine is started and water pump pressure is available.

   The low water reset button may trip on initially starting the engine (particularly the 645 engine). After 1 to 2 minutes depress reset button whether it has tripped or not. This will ensure positive latching.

2. The low water reset button will trip when water pressure is within 1/2 lb. of airbox pressure. The following conditions will cause water pressure to be less than air box pressure and will therefore trip the detector:

   a. Loss of water level.

   b. Pump cavitation due to air entrainment, as when starting engine.

   c. Pump cavitation due to water being near boiling temperature.

   d. Excessive air box pressure due to turbine surging at low throttle speeds.

   e. Air box pressure surge due to a slipping clutch on turbocharged engines.

3. The rate at which the large diaphragm moves from trip to latch position on the crankcase pressure portion is dependent on pressures involved and

*This bulletin is revised and supersedes previous issues of this number.

the freeness with which air can enter the vent fitting at top of detector body.

When pressing the crankcase pressure detector reset button on a dead engine, the air pressure on the diaphragm is the same on both sides and only the light spring force is available to move diaphragm to a latched position. With the reset button held in to release the diaphragm, air must enter front of the diaphragm through the vent fitting to permit the spring to move the diaphragm until the valve stem and reset button remain latched. This takes several seconds when detector is reasonably warm (60° - 70° F.) and longer when detector is cold. The reset button must therefore be pressed and held in for several seconds to ensure complete latching.

4. The crankcase pressure portion of the detector will trip when crankcase pressure becomes positive. Conditions which cause the detector to sense positive pressure are as follows:

   a. Blockage of oil separator or aspirator tube in exhaust.

   b. Cylinder compression leak to crankcase.

   c. Overheated part causing ignition of oil vapor.

   d. Incorrectly applied lube oil relief valve in accessory gear train. Oil splash reaches the diaphragm.

   e. Excessive oil level in crankcase.

5. The crankcase pressure portion is designed to detect very low pressure. Therefore, application of pressures appreciably above the normal 0" - 5" of water may permanently damage backup plates on diaphragm. A detector with damaged backup plates cannot be reset.

6. Manual operation of crankcase pressure diaphragm through crankcase opening must be done with caution to avoid distorting aluminum backup plates. Damaged detectors will not latch properly, if at all.

7. Both reset buttons actuate lube oil valves which are sealed with "O" rings. To ensure lubrication and free movement of the valves, the "O" rings and retaining grooves are designed to seal only when normal oil pressure is present.

   When engine is being started or stopped and oil pressure falls below 20 psi, the "O" rings will seep oil momentarily and thereby lubricate "O" ring, valve stem, and guide. No leakage should occur when oil pressure is above 20 psi.

MAINTENANCE

The maintenance of these detectors is very important and requires the use of special tools and a test panel to assure correct functioning of the detector at the time of assembly. In order to ensure proper operation the detectors should be dismantled, cleaned, and inspected annually. Special care should be taken in cleaning and handling the parts to avoid scratching or marring the finish of the valve shafts or surfaces mating with "O" rings or diaphragms.

INSPECTION

Disassemble and clean all parts to remove foreign material. Do not remove vent cap. Do not wire brush or use other means that may scratch or alter finish on valve shafts or surfaces mating with "O" rings or diaphragms. Inspect parts as follows:

VALVE SHAFTS

Sliding surfaces must be free of scratches and tool marks.

BALL CUP

Free of pits and brinell marks.

BALL RETAINER

Ball passages must be free of tool marks and dents and provide free movement of balls. Ball retainer must be checked for flush engagement of face into aluminum housing. If loose, tighten and secure with single punch mark at intersection of threads. Remove the "O" ring in the ball retainer bore by spearing it with a sharp pointed instrument such as a scribe, and pulling it from the groove. Be extremely careful not to scratch the bore. Install a new "O" ring by inserting it in the bore and using the stem shaft to work it into place in the groove.

Replace the three steel balls in the crankcase portion of the detector with those furnished in the replacement kit.

LOWER BLOCK (Containing water cavity)

Button or buttons controlling diaphragm travel must be located .090" below gasket face. Gasket face must be smooth and free of nicks. All surfaces contacting diaphragm must have radius and be free of nicks.

UPPER BLOCK (Containing oil valve)

Mounting face must be flat and square with bore within .003".

RESET BUTTON ENCLOSURE

Sliding "O" ring surface must be free of tool marks, scratches, pits, and show high polish.

REASSEMBLY

Reassemble as follows using the equipment as listed in Maintenance Data, see Figs. 2 and 3.

LOW WATER PRESSURE SECTION

1. Assemble diaphragm spacer block, air box pressure diaphragm, spring seat gasket and ball cup in that order with diaphragm positioned so that spacer block fits within cavity formed by diaphragm convolution. Thread attaching bolts through parts and into ball cup loosely. Position assembly in centering fixture, see Maintenance Data for part number, with ball cup over center pilot and diaphragm positioned over four 1/4" dowels. Lock ball cup from rotating with clamp screw in fixture. Tighten retaining bolts in assembly to 10 in.-lbs torque.

2. Place four 1/4"-20 × 1" socket head screws through water pressure block, gasket, low water diaphragm (with convolution pointing away from block), gasket, spacer ring (with 1/8" diameter vent opening position at same side as water connection on block), gasket, air box pressure diaphragm assembly, and gasket.

3. Place three steel balls in ball passages of ball retainer of center block, using Lubriplate grease to hold in place.

4. Position red diaphragm spring over ball cup of air box pressure diaphragm and center block assembly over spring. Position air box pressure connection 90° counterclockwise of water connection, when facing center block. Thread retaining bolts into center block and tighten to 40 in.-lbs torque. Leave assembly set a minimum of 24 hours and then retorque.

5. Apply new "O" rings to upper block containing oil passages, and check fit up with valve stem to ensure seating of "O" ring without twisting.

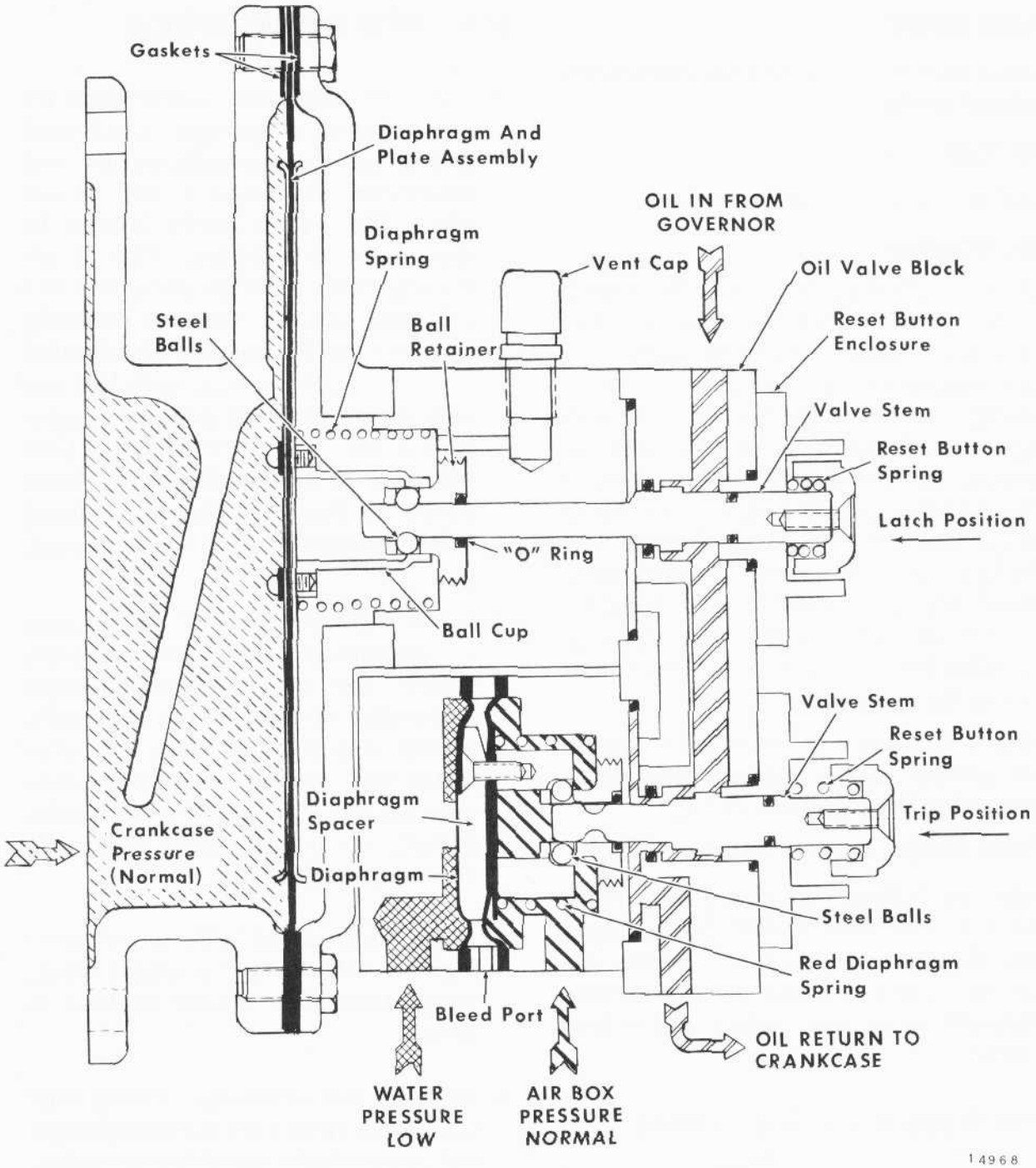

Fig. 2 — Cut Away View Of Combination Low Water And Crankcase Pressure Detector

6. Apply new "O" rings to valve stems and lubricate with Lubriplate grease. Insert stem guide housing and slide back and forth to ensure seating of "O" ring without twisting. Clamp stem at major diameter in manner that will not damage valve stem. Apply new reset button spring, reset button and retaining screw. Tighten retaining screw to 15 in.-lbs torque.

7. Place upper block containing oil passages over water and air box pressure portion with new "O" ring gasket.

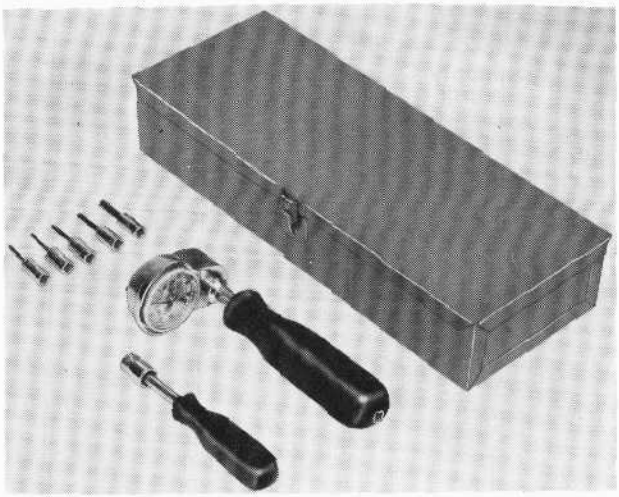

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Fig. 3 — Tool Kit

Align assembly through valve stem opening with alignment tool, see Maintenance Data page for part number, inserted to full engagement. Apply four 1/4"-20 × 1-1/4" retaining bolts and tighten to 40 in.-lbs. torque. Alignment tool must be free of bind.

8. Install low water valve stem assembly into valve body with new "O" ring gasket. Apply retaining bolts finger tight. Depress reset button for full engagement and hold while tightening retaining bolts to 15 in.-lbs torque. Valve stem must move freely without bind.

CRANKCASE PRESSURE SECTION

9. Assemble new crankcase pressure diaphragm, which has an aluminum backup plate on each side, to ball cup. Backup plates must have raised edge facing away from diaphragm. Tighten attaching screws to 5 in.-lbs torque.

10. Assemble crankcase pressure diaphragm between mounting housing and cover, with gasket on each side. Start retaining bolts but do not tighten. Install diaphragm centering fixture into ball cup and secure before aligning pilot of fixture with cover opening. See Maintenance Data page for part number of diaphragm centering fixture. Release plunger to pull diaphragm beyond trip position; tighten retaining bolts to 20 in.-lbs torque before removing centering fixture.

11. Apply replacement steel balls to ball retainer in center block with Lubriplate grease to hold in place. Place center block with crankcase pressure diaphragm spring over ball cup in diaphragm. Position center block so that vent fitting is at top of assembly.

12. Tighten 1/4"-20 cap screws retaining diaphragms in low water block assembly to 40 in.-lbs torque.

13. Apply low water block assembly to the crankcase pressure assembly with new "O" ring gasket. Align with alignment tool, see Maintenance Data page for part number, inserted in valve stem opening to full engagement. Apply four long 1/4"-20 retaining bolts and tighten to 40 in.-lbs torque. Alignment tool must be free of bind.

14. Insert valve stem and reset button into valve block with new "O" ring gasket. Depress crankcase pressure diaphragm spring with pressure of finger inserted through opening in mounting face, against backup plate on diaphragm, until valve stem drops into ball latch assembly. Release diaphragm and depress reset button and hold until diaphragm moves to latch position to hold button depressed. Apply retaining bolts and torque to 15 in.-lbs torque. Depress crankcase pressure diaphragm spring to release valve stem and reset button. Quickly depressing and releasing reset button should not reveal any binding during movement.

INSTRUCTIONS FOR TESTING

Mount detector on test panel, see Maintenance Data for part number, and test in accordance with the following instructions. The complete instructions apply to testing the combination detector, however, the single detectors (crankcase pressure and low water pressure) will only use the applicable section as outlined in the instructions.

The test panel uses air pressure only for all tests, therefore an air supply of not less than 80 psi pressure is required. It must be remembered whenever the instructions call for an oil or water test that these are made with air pressure. No water or oil supply should be connected to the test panel.

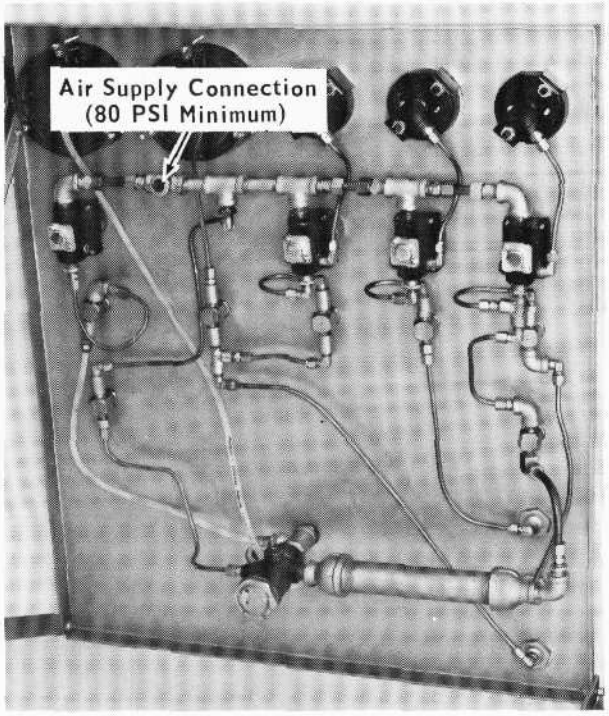

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Fig. 4 — Air Supply Connection To Test Panel

TEST PANEL CONNECTIONS

1. Visually check ports to be sure none are plugged.

2. Connect test panel, see Maintenance Data for part number, to 80 lbs. minimum of clean, dry air supply. See Fig. 4.

3. Mount detector on panel with two nuts at top and bottom corners and fasten adapter to water, air, and oil hoses as shown in Fig. 5.

4. Fasten water line to port No. 4.

5. Fasten air line to port No. 3.

6. Fasten oil line to port No. 1. Turn water, air, and oil valves to ON position, in this order only, see Fig. 6.

LOW WATER TEST

7. Turn water pressure regulator to attain 10 psi pressure. Latch low water button then raise pressure to 50 psi.

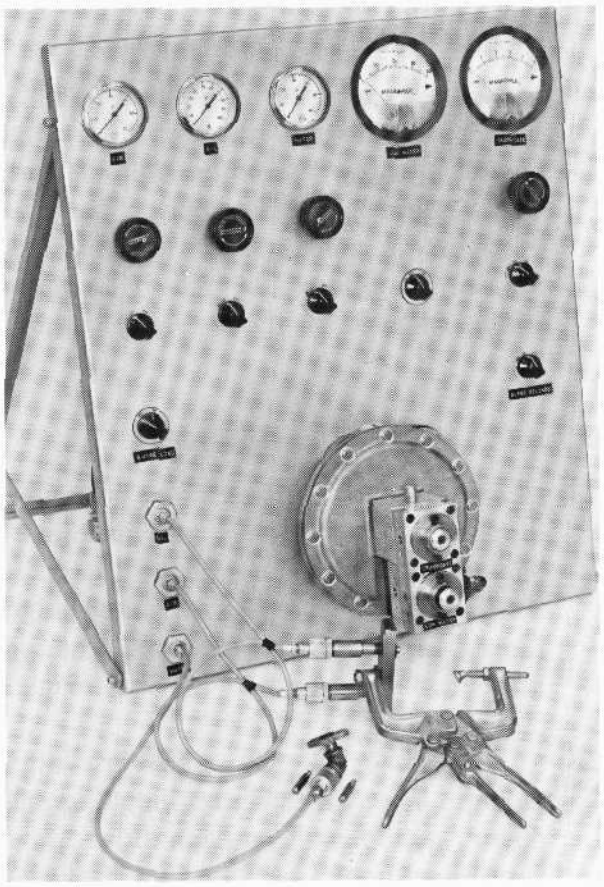

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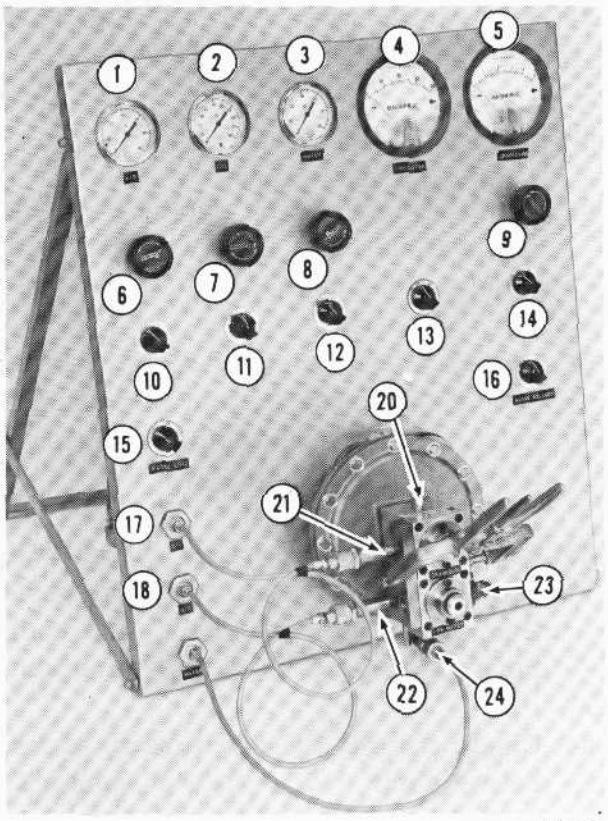
Fig. 5 — Test Panel Showing Hose Connection



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1. Air Gauge
2. Oil Gauge
3. Water Gauge - lbs. per sq. in.
4. Water Gauge - inches of water
5. Crankcase Gauge - inches of water
6. Air Pressure Regulator
7. Oil Pressure Regulator
8. Water Pressure Regulator
9. Crankcase Pressure Regulator
10. Air Valve
11. Oil Valve
12. Water Valve - lbs. per sq. in.
13. Water Valve - inches of water
14. Crankcase Valve
15. Surge Load Valve, (Not Used)
16. Surge Release Valve
17. Oil Hose Connection
18. Air Hose Connection
19. Water Hose Connection
20. Vent Cap
21. Port No. 1 - (Oil)
22. Port No. 3 - (Air)
23. Port No. 2 - (Oil Outlet)
24. Port No. 4 - (Water)

Fig. 6 — Test Panel With Combination Detector In Position For Testing

8. Turn air pressure regulator to attain 20 psi pressure.

9. Turn oil pressure regulator to attain 80 psi pressure.

10. Check for leaks with soap and water. (No air blow through oil return port.)

11. Reduce oil and air pressure to 0 psi.

12. Reduce water pressure to 1 psi on water gauge, No. 3, Fig. 6. Leave on water valve, No. 12, and turn on water valve, No. 13, to read in inches H_2O, water gauge, No. 4.

13. Reduce water pressure to trip point of low water button (see Maintenance Data for trip point).

14. Raise water pressure to 28" H_2O and check low water button. (Reset button must latch.) Raise pressure to 40" H_2O to ensure positive latching.

15. Repeat check of trip and latch points.

16. Check both crankcase and low water buttons for overtravel in latched position (must be .015" minimum).

CRANKCASE PRESSURE TEST

17. Reduce water pressure regulator to 0" H_2O. Close oil, air, and water valves, in that order (No's. 11, 10, 12, and 13, Fig. 6).

18. Be sure crankcase pressure regulator is in a decreased pressure position to avoid damage to crankcase gauge (pegging needle) when crankcase valve is turned on.

19. Crankcase pressure button must be in latched position. May require holding button in until crankcase gauge reads zero.

20. Turn crankcase valve to ON position and adjust crankcase pressure regulator until crankcase gauge reads zero. If the needle remains above zero this may be due to air being trapped in back of detector, loosen mounting nuts slightly to release the air and retighten nuts. If needle fluctuates move crankcase pressure button in and out in the latched position and turn surge release knob on and off to obtain stable conditions.

21. Turn crankcase pressure regulator to raise pressure slowly until crankcase pressure button trips (see Maintenance Data for trip point). Repeat test three times and use third test for final reading.

22. Reduce crankcase pressure regulator to 0" H_2O and turn crankcase valve to OFF position.

23. Remove oil and air lines from detector.

GENERAL TESTS

24. Remove detector from test panel and lay on side with port No. 3 up.

25. Turn water valve, No. 12, Fig. 6, to ON position.

26. Turn water pressure regulator to provide 10 psi pressure, water gauge No. 3, Fig. 6.

27. While turning water valve, No. 12, Fig. 6, on and off observe movement of ball latch cup, within spring, through port No. 3. Travel must be .050" minimum with low water valve button in tripped position.

28. Turn water pressure regulator to zero reading of water gauge, No. 3, Fig. 6

29. Turn water valve, No. 12, Fig. 6, to OFF position.

30. Remove water line from detector.

31. Position detector on spring tester (if not available use 8 lbs. weight) with reset buttons upward.

32. Deflect water reset button with ram on spring tester, to bottom position and raise ram .032" and hold. Spring force to be 8 lbs. minimum.

33. Deflect crankcase reset button with ram on spring tester, to bottom position and raise ram .032" and hold. Spring force to be 8 lbs. minimum.

34. Check 10-24 NC-2B thread at six holes, depth 1/2" - 1-1/4" center to center.

35. Check 11/32" drill through eight holes for size and location on mounting face.

36. Check vent cap (on top of reset button block) for freeness. (Must be loose.)

37. Check button labels for secure mounting.

38. Replace closure caps at reset buttons and ports.

TROUBLESHOOTING

The following are some conditions and their causes that may be encountered in testing and servicing these detectors.

1. Low water button latches and trips in area of 30" H_2O pressure.

   Ans. Steel balls are not all in place in ball retainer.

2. Low water button latch point OK, trip point low.

Ans. Alignment of air box diaphragm incorrect or, convolution in diaphragm is reversed.

3. Low water button latch point OK, trip point high.

Ans. Valve stem only partially latched.

4. Low water button fails to trip with air box pressure and no water pressure.

Ans. Lack of pretravel in diaphragm.

Lack of overtravel in valve stem.

Misaligned valve stem passages.

Incorrect or broken reset button spring.

5. Engine oil pressure fails to build up with reset buttons latched.

Ans. "O" ring in valve body missing or damaged.

6. Air box pressure portion full of oil and carbon.

Ans. Small "O" ring at valve stem in the ball retainer is damaged or missing.

7. Air leaking from bleed hole in diaphragm spacer. (Pressure applied only at water port.)

Ans. Water diaphragm faulty.

8. Air leaking from bleed hole in diaphragm spacer. (Pressure applied only at air box port.)

Ans. Air box pressure diaphragm faulty.

9. Crankcase pressure button trips at too high pressure.

Ans. Incorrect diaphragm spring.

10. Crankcase pressure button trips at too low a pressure.

Ans. Incorrect diaphragm spring.

Valve stem only partially latched.

11. Tripping of low water portion trips crankcase button, when testing on test panel.

Ans. Transfer seal on test panel for exhausting oil dump line, leaking.

12. Crankcase pressure button refuses to latch.

Ans. Positive pressure not being relieved from test panel.

Vent on top of device is plugged.

Litho in U.S.A.

MAINTENANCE DATA

	8358536	8402726 and 8358537	8358538	8362040	8370362
Port No. 1	Oil Inlet (100 PSI Max.)	Oil Inlet (100 PSI Max.)	Oil Inlet (100 PSI Max.)	Crankcase Normally Negative	Oil Inlet (100 PSI Max.)
Port No. 2	Oil Outlet	Oil Outlet	Oil Outlet		Oil Outlet
Port No. 3	Air Box (0 to 20 PSI)	Air Box (0 to 20 PSI)	Air Box (0 to 20 PSI)		Breather and Test
Port No. 4	Engine Cooling Water (0 to 60 PSI)	Engine Cooling Water (0 to 60 PSI)	Engine Cooling Water (0 to 60 PSI)		Crankcase Normally Negative
Port No. 5			Breather and Test		
Port No. 6			Crankcase Normally Negative		

Test Limits:

8358536 and 8358537

Port No. 1 normally blocked from Port No. 2.
Port No. 1 connected to Port No. 2 if Port No. 4 pressure does not exceed Port No. 3 pressure by 10" to 20" H_2O.
Manually resetable when Port No. 4 pressure exceeds Port No. 3 pressure by 28" H_2O maximum.

8358538

Port No. 1 normally blocked from Port No. 2.
Port No. 1 connected to Port No. 2 if:
a. Port No. 4 pressure does not exceed Port No. 3 pressure by 10" to 20" H_2O.
b. Crankcase pressure exceeds .8" to 1.7" H_2O.
Low Water Detector:
Manually resetable when Port No. 4 pressure exceeds Port No. 3 pressure by 28" H_2O maximum.
Crankcase Explosion Detector:
Manually resetable when crankcase pressure does not exceed 0" H_2O.

MAINTENANCE DATA (CONT'D)

8362040 Crankcase Explosion Detector:
Manually resetable when crankcase pressure does not exceed zero psi.
Trips from .8" to 1.7" H_2O.
Switch:
Single pole, double throw
Rating - 110 V AC - 2 Amps.
74 V DC - 6 Amps.

8370362 Crankcase Explosion Detector:
Manually resetable when crankcase pressure does not exceed zero psi.
Shutdown or trip point .8" to 1.7" H_2O.

8402726 Port No. 1 normally blocked from Port No. 2.
Port No. 1 connected to Port No. 2 if Port No. 4 pressure does not exceed Port No. 3 pressure by 5" to 10" H_2O.
Manually resetable when Port No. 4 pressure exceeds Port No. 3 pressure by 10" to 15" H_2O maximum.
This detector is physically identical to 8358537 detector except there is no red diaphragm spring.

EQUIPMENT LIST

Test Panel	8349133
Alignment Tool	8361214
Air Box Diaphragm Centering Fixture	8361216
Crankcase Diaphragm Centering Fixture	8361217
Torque and T-Bar Wrench Kit	8361215