EMD MAINTENANCE INSTRUCTION

THERMOSTAT SWITCH - 8097916

DESCRIPTION

The best performance of the diesel engine is obtained when it operates within controlled limits of temperature. The temperature of the engine cooling system will, of course, vary with engine load, ambient temperatures and other factors, thus some means of temperature detection and control is necessary.

The thermostat switch, Fig. 1, described in this bulletin is designed for accurate measurement of engine water temperature and functions to establish electrical circuits to actuate external water cooling devices such as fans and shutters.

This particular type of switch is used on all Model F locomotives and Model M16 power units. It was also used on a few Model E8 locomotives. When used on locomotives, it is located in the left hand portion of the "Y" in the engine cooling water outlet piping. On M16 power units, this switch is located in the water piping inlet to the engine. In both instances, it is held to the piping by four cap screws extending through the retaining flange of the temperature sensitive element.

The thermostat switch is made up of two assemblies, as shown in Fig. 2. The vernatherm power assembly for temperature detection is made up of a thermal element, retaining flange, return spring, piston and rod with an acorn adjusting nut on the end. The electrical switch portion consists of a spring loaded movable contact bar and a group of stationary contact fingers. The contact bar and

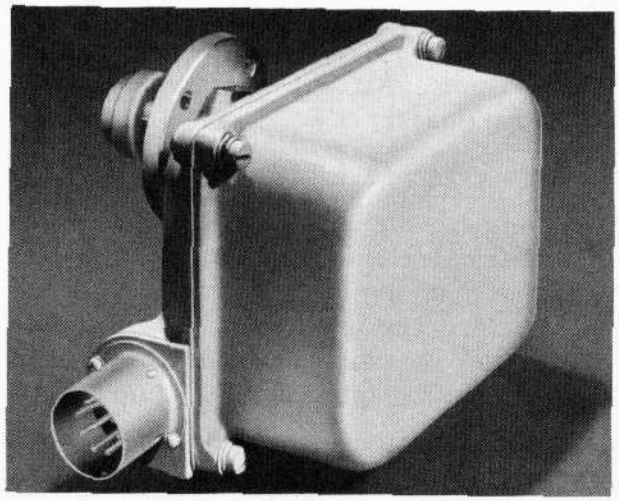


Fig. 1 - Thermostat Switch Assembly

fingers are made of copper that has been silver plated for excellent electrical conductivity and long life.

The mechanical operation and setting of the switch contacts is the same for all applications on locomotives and mobile power units. The six finger switch is currently used which replaces the previous 10 finger switch used on early M16 power units.

OPERATION

The thermostat switch is installed so that the engine cooling water will be in contact with the temperature sensitive thermal element. Referring to Fig. 2, it will be seen that with an increase in engine cooling water temperature, the thermal element (1) responds through expansion causing movement of the power piston (2). The piston compresses the return spring (3) while moving the shaft on which the lock nut (4) and acorn adjusting nut (5) are mounted.

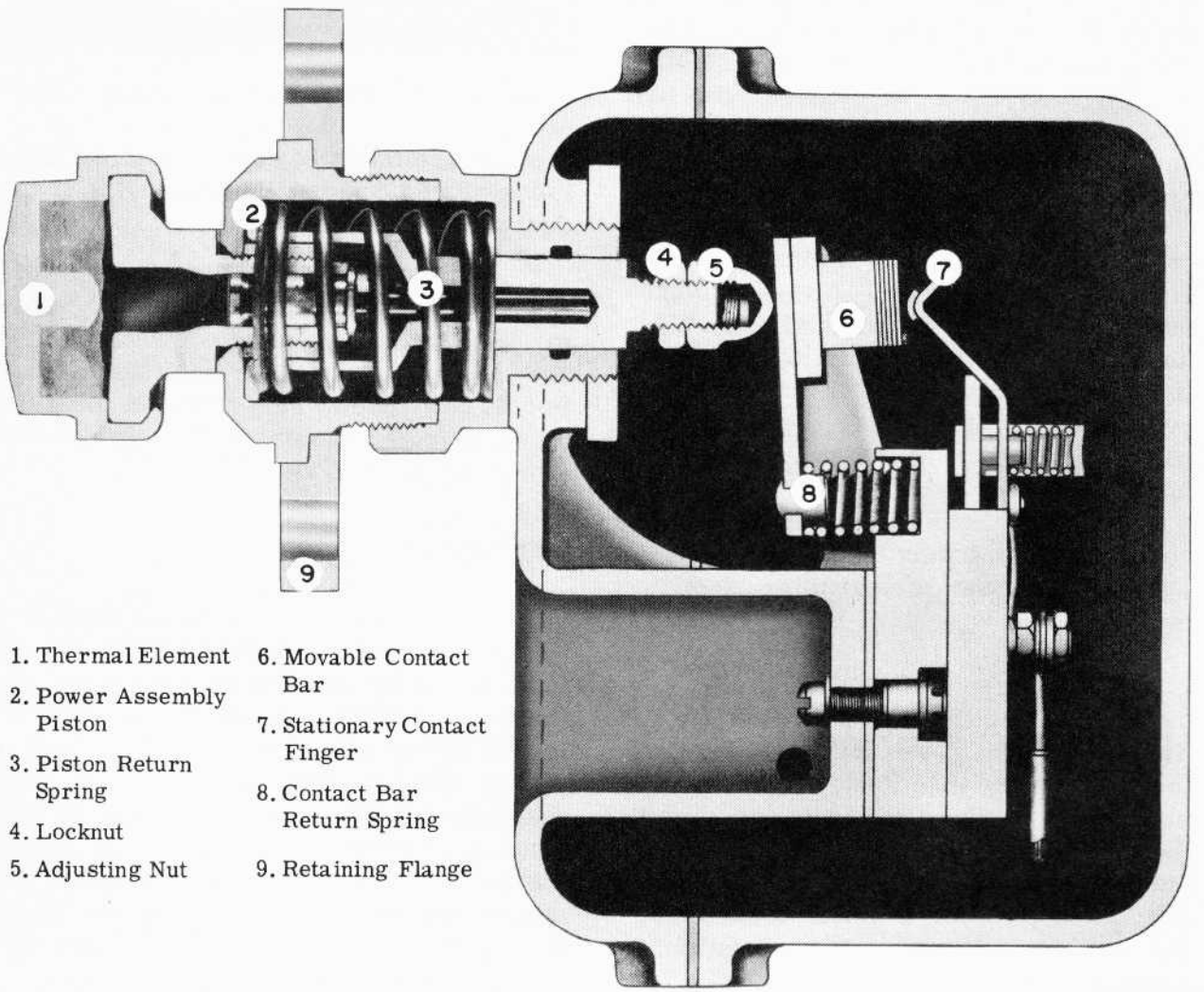
* THIS BULLETIN SUPERSEDES ALL ISSUES OF M.I. 1545.

The acorn nut then causes movement of the contact bar (6), which when sufficient, will make contact with stationary contact fingers (7). The contact bar is machined in steps so that each of the 6 fingers will make contact at different temperatures. The first finger will make contact at approximately 163° F. The remaining fingers will make contact one at a time with each 3° rise in water temperature. All six will be in contact at approximately 178° F.

With decreasing water temperature, the events described above are reversed. The thermal element contracts allowing the return spring to bring back the piston and shaft. The electrical circuits between the movable bar and stationary fingers are broken one at a time as the bar moves back through action of its return spring, Item 8. The last contact finger will open when the cooling water temperature has been reduced to less than 163° F.

Switch Function On Model F Locomotives

On Model F locomotives, the thermostat switch controls the operation of the shutters and the four AC cooling fans. This is accomplished through the fingers making contact and completing electrical circuits to the shutter magnet valve and AC cooling fan contactors. A summer-winter switch is used in the fan circuit to change the sequence of shutter and fan operation. A temperature control relay, TCR, is also used which functions to establish a holding circuit to keep fans



1. Thermal Element
2. Power Assembly Piston
3. Piston Return Spring
4. Locknut
5. Adjusting Nut
6. Movable Contact Bar
7. Stationary Contact Finger
8. Contact Bar Return Spring
9. Retaining Flange

Fig. 2 - Cross-Section View Of Thermostat Switch Assembly

and shutters in operation once energized, until temperature drops below 163° and the last finger opens on decreasing temperature.

The sequence of operation with the summer-winter switch in both "Summer" and "Winter" positions is as follows:

Contact	Temperature	Summer Function	Winter Function
1	163° F.	TCR Holding Circuit Established	TCR Holding Circuit Established
2	166° F.	TCR Relay Energized Shutters Open	TCR Relay Energized
3	169° F.	#1 AC Fan Starts	#4 AC Fan Starts
4	172° F.	#2 AC Fan Starts	#2 AC Fan Starts
5	175° F.	#3 AC Fan Starts	#3 AC Fan Starts Shutters Open
6	178° F.	#4 AC Fan Starts	#1 AC Fan Starts

The thermostat switch is connected electrically to receive power from the fuel pump circuit. Anything affecting this circuit such as a blown fuel pump fuse or the fuel pump switch in OFF will render the shutters and fans inoperative.

CAUTION: The fuel pump switch should not be opened and closed when the temperature of the cooling water is high enough to have three or more fans running. Suddenly placing three or more fans across the alternator may result in a voltage drop sufficient to burn out the fan motor windings. Similar damage could occur if the cover was removed from the switch assembly and the contacts manipulated by hand.

Switch Functions On M16 Power Units

On Model M16 power units, the thermostat switch controls engine cooling water temperature by operating fan relays which, in turn, vary the resistance in the eddy-current coupling coil circuit. The eddy-current coupling drives a single 86 inch fan at variable speeds through a right angle drive mechanism. Complete information on the eddy-current coupling is available by referring to Maintenance Instruction 1208.

With increasing water temperature, commencing at approximately 163° F., the thermostat switch movable bar begins contacting the stationary fingers. These contacts complete circuits to energize the five fan relays. As each relay comes in, it serves to cut out resistance in the circuit for the excitation of the eddy-current coupling coil.

With all of the resistance in the circuit, the fan will operate at its slowest speed which is approximately 120 RPM. A continued rise in cooling water temperature is accompanied by additional fan relays being energized which result in increased fan speed. When the thermostat switch has energized all of the fan relays, all of the resistance is removed from the eddy-current coil circuit. This will result in the cooling fan operating at maximum speed which is approximately 550 RPM.

As the engine cooling water temperature drops, the thermostat switch breaks the circuits to the fan relays, one at a time. This results in a reverse action taking place with proportionate reduction in fan speed due to the addition of resistance in the eddy-current coil circuits which results in less excitation and greater "slip."

MAINTENANCE

The thermostat switch is designed and carefully manufactured to provide a long service life and trouble-free operation. Periodic inspections, however, should be made at intervals outlined in the Scheduled Maintenance Program, Maintenance Instruction 1704. Such inspections may be readily made with the switch installed due to the accessibility provided by the easily removed cover.

The complete assembly may also be readily removed from the cooling system for replacement or for a more thorough inspection and adjustment on a bench.

Gaskets are provided for both the cover and for the flange connection of the assembly to the cooling system. Both

gaskets should be inspected and replaced when necessary. This will insure water tight connections and prevent dust and dirt from entering the switch mechanism.

Removal Of Thermostat Switch Assembly

To remove the thermostat switch from the cooling system, proceed as follows:

1. Drain engine water so that the level is below that of switch location in the piping.
2. Remove electrical control cable.
3. Remove the bolts from the retaining flange which holds the thermostat switch to the piping.

Thermostat Switch Adjustment

All adjustments of the thermostat switch should be performed with the switch assembly removed from the cooling system. It is also important that the switch be at room temperature (50° to 100° F.) before proceeding with the adjustments.

A calibration number is stamped on the edge of the retaining flange by the manufacturer. This number indicates the amount of piston travel between room temperature and 160° F., in thousandths of an inch for that particular power assembly. This number is to be used in conjunction with the dimensions given in Fig. 3 for setting of the switch contacts.

Other numbers may be noted on the bottom of the thermostat bulb but these have no bearing on the maintenance procedure. They are used merely to identify the unit with the first two numbers indicating year of manufacture, the letter indicates which quarter of the year while the last numbers are a manufacturing code.

Fig. 3 illustrates the six fingers and the dimensions to be used in positioning them in relation to the movable contact bar. The bar, however, must first be positioned properly to the No. 1 finger and then the other individual fingers are checked and adjusted as necessary.

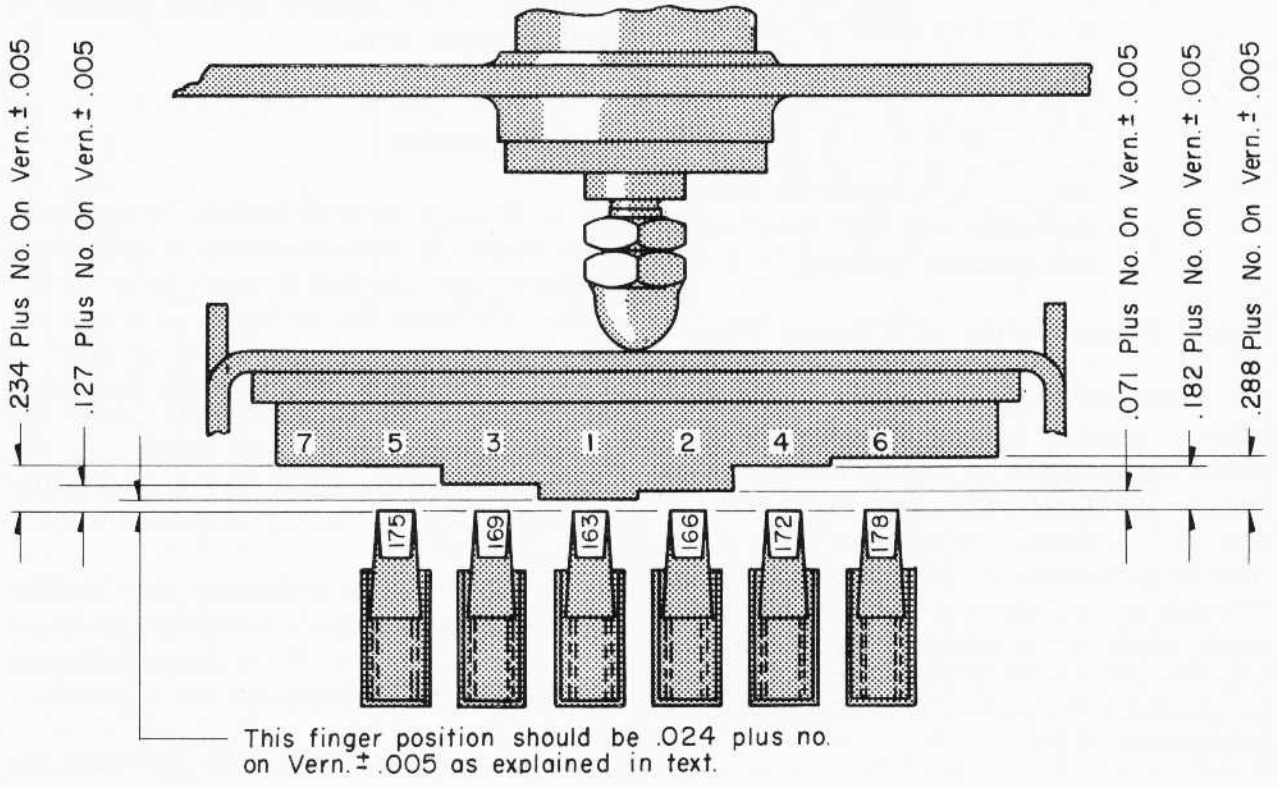


Fig. 3 - Contact Finger Positions

To Adjust Contact Bar And No. 1 Finger

1. Loosen the lock nut holding the low crown acorn nut first. The lock nut and acorn nut are located in the back of the contact bar assembly.
2. Add .024" to the calibration number located on edge of retaining flange.
3. Select feeler gauges to equal total value found in Step 2 and insert them between the acorn nut on the thermostat piston and the bottom of the contact bar support.
4. Adjust the acorn nut on the thermostat piston until the contact bar just touches the No. 1 contact finger. When this point has been established, lock the acorn nut in position with the lock nut.

To Adjust The No. 2 Contact Finger

1. Add .047" to the feeler gauges being used in setting No. 1 contact finger. The thickness of the feeler gauges now equals the calibration number on the edge of the retaining ring plus .071".
2. With this thickness of feeler gauges between the acorn nut and the contact bar support, the contact bar should just touch No. 2 finger. The tolerance on these settings is $\pm$ .005".
3. If the second finger does not make contact within this tolerance range, bend the finger support under the finger (with a pair of duck bill pliers) so that the finger will touch the bar. Be careful not to bend the finger.

To Adjust The Remaining Contact Fingers

The third, fourth, fifth and sixth contact fingers are adjusted in the same manner except that the feeler gauge thickness used in each case is different, see Fig. 3.

When all six fingers have been set, calibration of the thermostat switch is complete.