FORD MOTOR CO. THERMACTOR SYSTEMS

DESCRIPTION

The Thermactor Exhaust Emission Control System reduces carbon monoxide (CO) and hydrocarbon (HC) content of exhaust gases. It injects fresh air into the exhaust gas stream as it leaves the combustion chamber, allowing continued combustion of unburned gases. A typical system consists of the following components: Air supply pump, air by-pass valve, check valve(s), air manifold and air hoses. Individual systems vary in number and type of components dependent upon engine size and application.

The Managed Thermactor Air (MTA) System uses the same basic components but "manages" thermactor air according to operating conditions. Air is bypassed to atmosphere by a Thermactor Air Bypass (TAB) valve and is directed upstream near the exhaust manifold or downstream to the underbody catalytic converter by the Thermactor Air Diverter (TAD) valve.

OPERATION

Inlet air to the air pump is drawn through a centrifugal air filter fan. The pump then supplies air under pressure to the exhaust port near the exhaust valve, by either an external air manifold, or through internal drilled passages in the cylinder head or exhaust manifold. The oxygen in the fresh air, plus the heat of the exhaust gases, causes further oxidation (burning), which converts the exhaust gases into carbon dioxide and water.

AIR PUMP

Pump is belt driven, positive displacement, vane type that provides air for the thermactor system. It is available in 11 cu. in. and 19 cu. in. sizes. The 11 cu. in. pump takes air in through a filter attached to the air inlet nipple. The 19 cu. in. pump takes air in through an impeller type centrifugal air filter fan, thus eliminating the need for a separate air filter. Dust and dirt particles cannot enter the pump because these heavier-than-air contaminants are thrown from the air intake by centrifugal force. The air pump does not have a pressure relief valve, this function being controlled by the air bypass valve.

AIR BYPASS VALVE

NOTE – *Several types of air bypass valves are used by Ford Motor Co. In addition, these valves may be mounted in line with the air pump or mounted directly on the pump.*

Air Bypass Valve (Normally Closed Type) – During normal operation, engine intake manifold vacuum applied through the vacuum differential valve (VDV) holds the normally closed valve upwards, allowing thermactor air to flow to the cylinder head(s) and blocking the vent port.

When intake manifold vacuum rises or drops sharply (such as during acceleration or deceleration, or system blockage or failure), the VDV operates and momentarily cuts off the vacuum to bypass valve. The spring pulls stem down, seating the valve to cut off pump air to exhaust manifold, and opening the dump valve at lower end of bypass valve to momentarily divert pump air to the atmosphere.

In the case of excess air pump volume or a downstream restriction, the excess pressure will unseat the relief valve in lower portion of bypass valve and allow a partial flow of pump air to the atmosphere. At the same time, the valve in upper portion of the bypass valve is still unseated, allowing a partial flow of pump air to the exhaust manifold to meet system requirements.

Air Bypass Valve (Normally Open Type) – This bypass valve contains an integral vacuum differential valve and a vacuum vent. A separate vacuum differential valve (VDV) is not required with this valve.

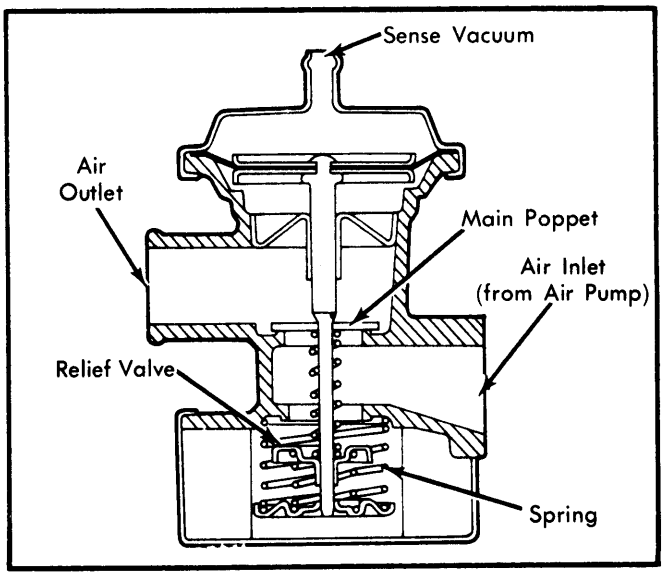

Fig. 1 Cutaway View of Air Bypass Valve (Normally Closed Type)

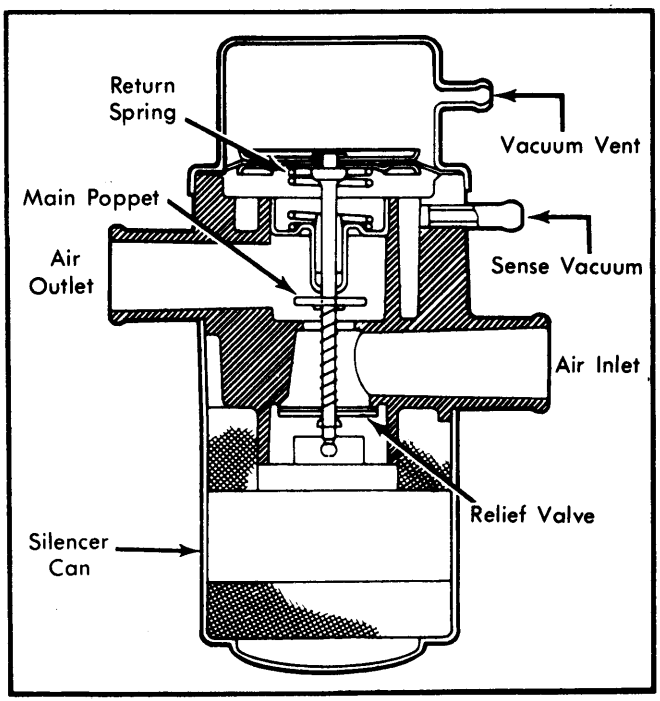

Fig. 2 Cutaway View of Air Bypass Valve (Normally Open Type)

FORD MOTOR CO. THERMACTOR SYSTEMS (Cont.)

During normal operation, the vent is blocked and vacuum is equalized on both sides of the diaphragm. The diaphragm return spring holds the valve closed, allowing thermactor pump air to the exhaust ports.

When the vent is open to atmospheric pressure, and a vacuum of 4 in. Hg or more is applied to the sense port, intake manifold vacuum under the diaphragm overcomes the return spring pressure and pulls the valve downward. Thermactor air is then diverted to the atmosphere momentarily.

AIR SUPPLY CONTROL VALVES

Thermactor Bypass/Diverter Valve – Used only on models equipped with Electronic Engine Control III (EEC III). Differs from standard type bypass valve in that it can route thermactor pump air to 3 different locations:

- Downstream (air is injected into the three-way catalyst).
- Upstream (air is injected into the exhaust manifold).
- Bypass (air is bypassed to the atmosphere).

Proper routing of thermactor air is determined by the Electronic Control Assembly (ECA) based on engine coolant temperature and other sensor data. *For additional information, see Ford Motor Co. Electronic Engine Control III (EEC III) article in this section.*

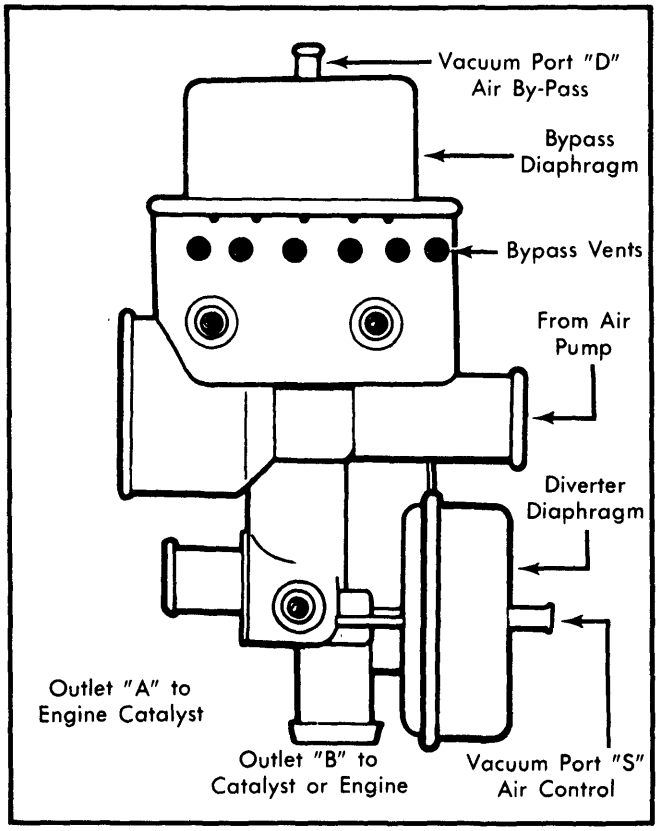

Fig. 3 Thermactor Bypass/Diverter Type Valve

Standard Air Control/Shut-Off Valve and Air Control/Shut-Off Valve with Orifice – Direct air pump output to exhaust manifold or downstream to catalyst, depending on engine control strategy. Air control and air control/shut-off valves are of similar construction, except that air by-pass valve inlet is capped. Air control/shut-off valve with orifice has no bottom outlet tube as does the other type.

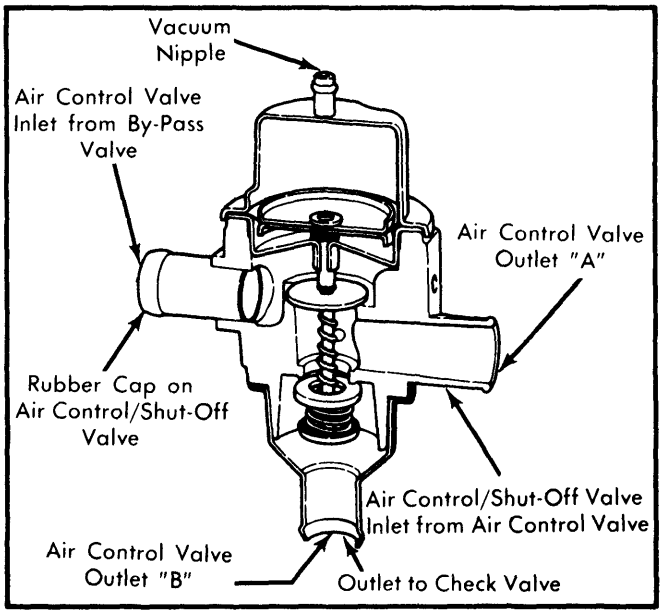

Fig. 4 Standard Air Control/Shut-Off Valve

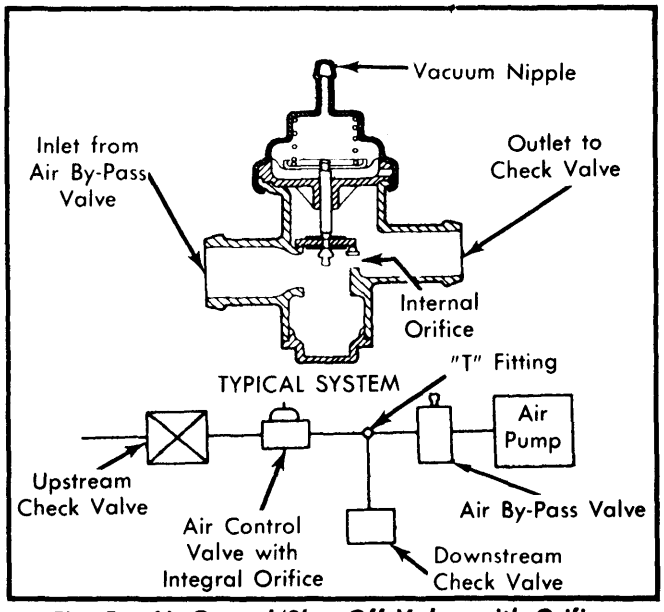

Fig. 5 Air Control/Shut-Off Valve with Orifice

SOLENOID VACUUM VALVE

Controlled by the Electronic Control Assembly (ECA) or Microprocessor Control Unit (MCU) to direct vacuum and operate thermactor valves more precisely.

DIFFERENTIAL VALVE DELAY VALVE (DVDV)

This delay valve is used to delay air bypass during periods of low engine manifold vacuum. The DVDV is installed in series with the vacuum differential valve (VDV).

FORD MOTOR CO. THERMACTOR SYSTEMS (Cont.)

This installation of a delay valve in the sense vacuum line delays operation of the vacuum differential valve during sudden drops in manifold vacuum such as during hard acceleration. During sudden deceleration, the sudden rise in intake manifold vacuum opens the check valve in the delay valve, passing the signal along instantly.

VACUUM VENT VALVE

This valve may be a combined vent and delay valve. It controls fresh air into the vacuum system to prevent chemical decay of vacuum diaphragms, which could occur on contact with fuel vapors. Vent valve has a black cap, while combined vent-delay valve has a natural cap. Valve must be mounted with vacuum ports pointing downward, source connected to cap port, and system or device operated connected to body port.

EXHAUST CHECK VALVE

The exhaust check valve(s) allows thermactor air to enter the exhaust manifold port drillings (and converter on models with 3-way catalyst), but prevents the reverse flow of exhaust gases in the event of improper operation of system components. The valve is located between bypass valve and exhaust port drillings. Models equipped with a bypass/diverter type valve also have a check valve located between the valve and the catalytic converter.

TESTING

AIR PUMP

Check belt tension and adjust to specifications. Disconnect air supply hose from control valve. Observe air flow from pump outlet with engine running. Flow should increase as engine speed is increased.

AIR BYPASS VALVE

Normally Closed Type Bypass Valve – 1) With engine at normal operating temperature, transmission in park or neutral and parking brake set, disconnect bypass valve-to-air manifold check valve hoses at the bypass valve.

NOTE – *For a tee system, remove both hoses connecting bypass valve to check valves.*

2) Connect a tachometer to engine. Start engine and accelerate to 1500 RPM. Verify that air is flowing from bypass valve hose connection(s) by placing hand over valve connection. Air flow should be heard or felt.

3) Remove vacuum hose from bypass valve and plug off the hose. With engine at 1500 RPM and hand held over bypass valve connection, there should be virtually no air flow. Air flow will be discharged through the exhaust ports in end of valve silencer cover. If air flow is felt or heard through the bypass valve connection, the valve should be replaced.

NOTE – *Ensure that air pump is operating satisfactorily.*

Normally Open By-Pass Valve (Without Vacuum Vent) – Disconnect valve air outlet hose and disconnect vacuum line at vacuum nipple. With engine running at 1500 RPM, air should be heard and felt at outlet. Connect unrestricted vacuum source to vacuum nipple and air should be shut off or decreased. Air should be felt at silencer ports.

Normally Open By-Pass Valve (With Vacuum Vent) – 1) With air supply line and vacuum lines disconnected from valve, run engine at 1500 RPM. Air should be felt and heard at valve outlet.

2) Connect unrestricted vacuum line from intake manifold to vacuum source nipple on valve. Little or no air should be felt at valve outlet and virtually all air should be by-passed through silencer ports.

3) Cap the vacuum vent and accelerate the engine to 2000 RPM. Release throttle suddenly. A momentary interruption of air pump supply air should be felt at the valve outlet.

SOLENOID VACUUM VALVE

Normally Closed Valve – 1) With engine idling at normal operating temperature and ambient air above 65°F (18°C), disconnect vacuum hose to thermactor air by-pass valve. If air dumps to atmosphere through exhaust ports in silencer cover, hose connections are correct. Reconnect vacuum hose.

2) Disconnect vacuum supply hose from bottom fitting of solenoid valve and check for manifold vacuum. If no vacuum, check and/or replace vacuum source hose as required. Reconnect vacuum hose. (Vacuum supply ALWAYS goes to bottom fitting on solenoid vacuum valve.)

3) Disconnect wires to solenoid vacuum valve and determine which wire has B+ voltage with ignition switch in RUN position. Connect B+ wire to solenoid vacuum valve. With engine idling, ground other exposed terminal on valve. Air should NOT dump to atmosphere.

4) Connect wires as originally installed and note that thermactor air is NOT being dumped to atmosphere. Replace solenoid valve if air dumps in either solenoid test.

Normally Opened Valve – Perform same test as for Normally Closed Valve EXCEPT that thermactor air SHOULD be dumped to atmosphere when solenoid terminal is grounded.

DIFFERENTIAL VALVE DELAY VALVE (DVDV)

NOTE – *For testing of this valve see Air Cleaner Delay Valve testing in Ford Motor Co. Vacuum Delay Valves article in this section.*

CHECK VALVE

1) Disconnect air supply hose at pump side of check valve. Blow through check valve toward manifold, then attempt to suck back through valve. Flow should be toward manifold only.

FORD MOTOR CO. THERMACTOR SYSTEMS (Cont.)

2) If available, connect bulb type tester (T75L-9487-A or equivalent) to pump side of check valve. Squeeze bulb as flat as possible and release. Bulb should not return to normal size in less than 15 seconds.

AIR SUPPLY CONTROL VALVES

Standard Air Control Valve – Remove vacuum line at vacuum nipple and disconnect hoses at outlets "A" and "B". With engine running at 1500 RPM, air should be heard and felt at outlet "B" with little or no air flow at outlet "A". See *Fig. 4*. Connect direct manifold vacuum to vacuum nipple. Air flow should be heard and felt at outlet "A" with little or no air from outlet "B".

Air Control/Shut-Off Valve – Verify that air flow is present at valve inlet by disconnecting air supply hose momentarily at valve inlet. See *Fig. 4*. Disconnect hose from outlet and vacuum line from nipple. With engine running at 1500 RPM, air should be heard and felt at outlet. Connect direct manifold vacuum to nipple. There should be little or no air flow at valve outlet.

Air Control/Shut-Off Valve with Orifice – Verify air flow at valve inlet and disconnect vacuum line at nipple. Disconnect air supply hose at valve outlet. With engine running at 1500 RPM, some air flow should be heard and felt at valve outlet. Connect direct manifold vacuum to vacuum nipple. A noticeable air flow should be detected when vacuum is applied.