GENERAL MOTORS EXHAUST GAS RECIRCULATION

DESCRIPTION

Exhaust gas recirculation (EGR) is used on all Light Duty emissions models to reduce oxides of nitrogen (NOx) emissions. This process is accomplished by lowering the combustion temperatures of burning gases. Recirculated and metered amounts of exhaust gases are reintroduced into the engine through the intake manifold, where they are mixed with the air/fuel mixture.

There are two types of EGR systems; ported and exhaust back pressure modulated. The ported system uses a timed vacuum port in the carburetor to regulate the amount of exhaust gas recirculation.

The back pressure modulated system regulates the timed vacuum according to the exhaust back pressure level. A special control valve within the EGR valve housing responds as a pressure regulator.

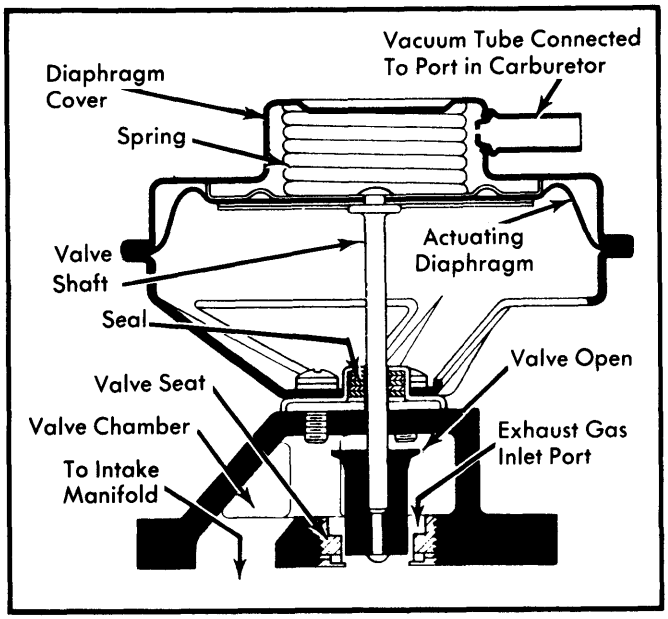

Fig. 1 Cutaway View of Ported Type EGR Valve

OPERATION

PORTED EGR SYSTEM

Ported type EGR valve is operated from carburetor vacuum port. It is fully closed with vacuum less than 2", it starts to open above 2" and is fully open with more than 8.5" of vacuum applied. At idle and wide open throttle, ported vacuum is low, the valve is closed and recirculation does not occur. At part throttle, ported vacuum is high, the valve is open and exhaust gas recirculation is at maximum.

BACK PRESSURE EGR SYSTEM

Two types of back pressure type EGR valves are used by General Motors: a Positive Back Pressure EGR valve (used on Federal V8 models) and a Negative Back Pressure EGR valve (used on some 6-cylinder and most California V8 models). Operation of these 2 systems is explained as follows:

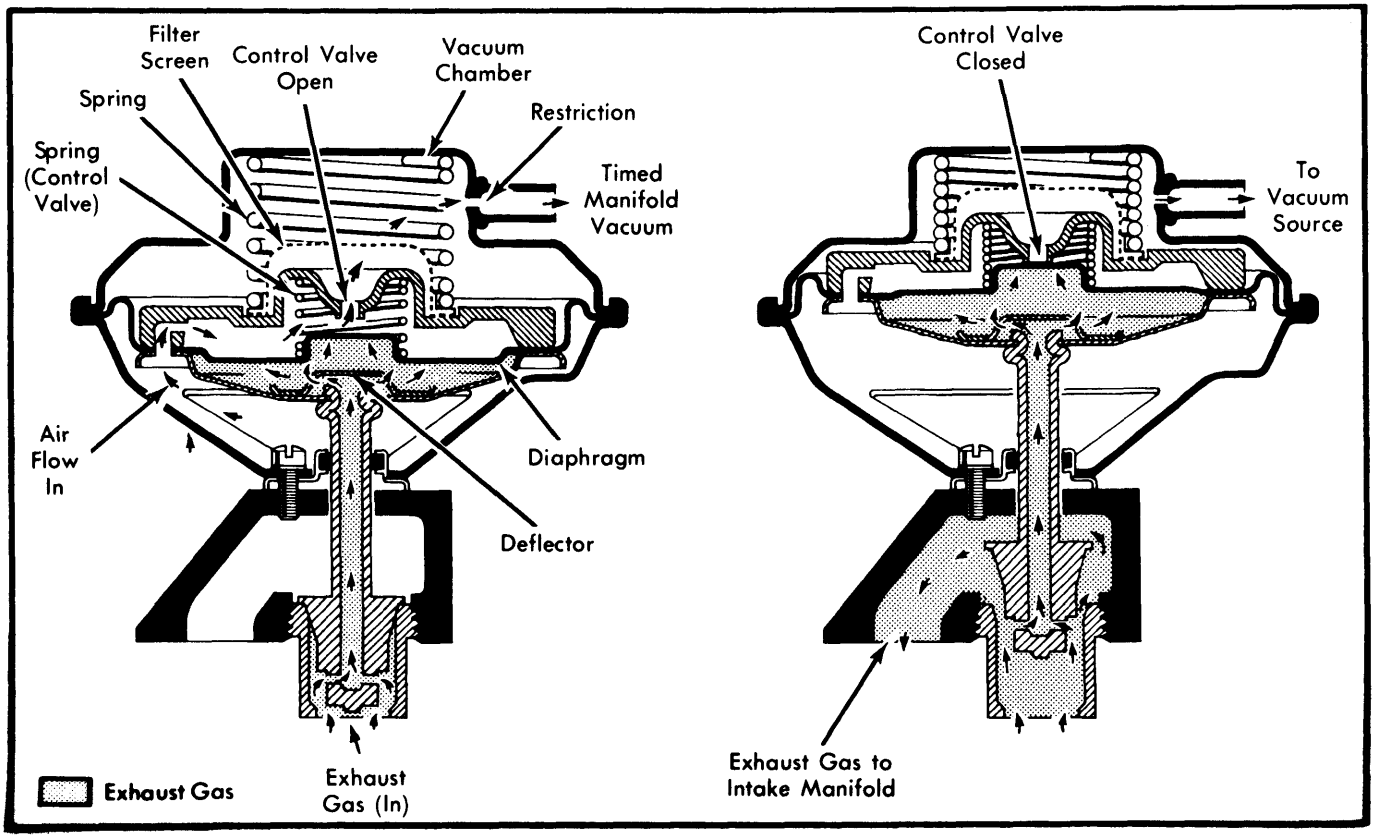

Fig. 2 Cutaway View of Positive Back Pressure EGR Valve

GENERAL MOTORS EXHAUST GAS RECIRCULATION (Cont.)

Positive Back Pressure EGR Valve – A small diaphragm control valve inside the EGR valve assembly acts as a pressure regulator. The control valve receives an exhaust back pressure signal through the hollow shaft which exerts a force on the bottom of the control valve diaphragm, opposed by a light spring. A metal deflector plate prevents hot exhaust gases from flowing directly on the diaphragm.

Vacuum is applied to the EGR valve assembly from the carburetor spark port, to assure no exhaust gas recirculation at idle. During off-idle operation, manifold vacuum is applied to the vacuum chamber through a restriction in the signal tube.

When engine load is light, and back pressure is low, the control valve is open, allowing air to flow from the 6 bleeds in diaphragm plate, through control valve orifice, into the vacuum chamber. The air bleeds off vacuum, decreasing signal trying to open EGR valve. Therefore, if back pressure does not close the control valve, sealing off air flow, there will not be any vacuum built up to open the EGR valve for exhaust gas recirculation.

When power demands are made on the engine, and exhaust gas recirculation is needed, exhaust gas back pressure increases, closing the control valve, thereby shutting off air flow through valve. Vacuum builds up in the vacuum chamber until the spring force holding the EGR valve closed is overcome.

Once the EGR valve opens, the exhaust pressure decreases because some of the exhaust gas is flowing into the intake manifold through the EGR passage. In actual operation, the system will reach a balanced condition providing optimum EGR operation.

Any increase in engine load will momentarily increase the exhaust signal, causing the control valve to close, allowing a stronger vacuum signal. The system will then stabilize at a greater EGR flow.

At maximum engine load, when manifold vacuum is nearly zero, momentarily, there will be no EGR operation. This is because of insufficient vacuum to pull the valve open, even though high exhaust back pressure has closed the control valve.

Negative Transducer Back Pressure EGR Valve – The negative transducer back pressure EGR valve assembly has the same function as the positive back pressure EGR valve except the transducer is designed to allow the valve to open with negative exhaust back pressure.

The flow of the valve is controlled by manifold vacuum, negative exhaust back pressure and the carburetor ported vacuum signal. The control valve spring in the transducer is placed on the bottom side of the diaphragm.

When the carburetor ported vacuum signal is applied to the main vacuum chamber partially opening the valve, the vacuum signal from the manifold side (reduced by exhaust back pressure) is transmitted up the hollow stem of the valve. This enables the signal to act on the diaphragm, opening the bleed and causing the transducer to modulate providing a specific valve flow. Thus the flow of the valve is a constant percentage of engine air flow.

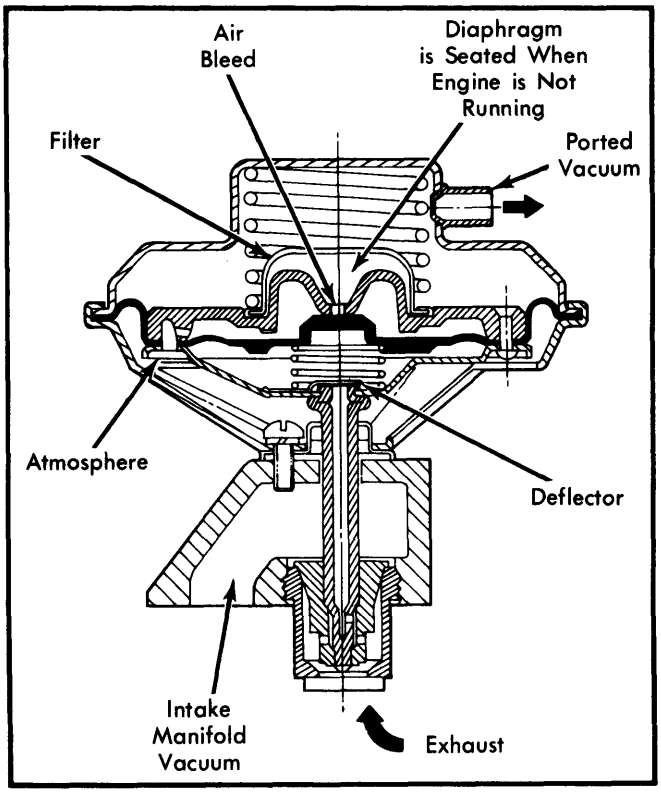

Fig. 3 Cutaway View of Negative Transducer Back Pressure EGR Valve

EGR THERMAL VACUUM (TVS)

The EGR TVS, used on all models, closes to prevent EGR operations when engine coolant temperature is below 85°. This improves cold engine driveability. When coolant temperature rises above 85°F, TVS opens to allow vacuum to be directed to EGR valve.

TESTING

SYSTEM OPERATION

1) With engine at normal operating temperature, set engine speed to fast idle (or high enough to obtain at least 5 in. Hg at EGR valve). Place gloved finger beneath EGR valve so diaphragm movement can be felt.

2) Disconnect vacuum hose from EGR valve and watch for diaphragm movement. Diaphragm should move downward (valve closed) and an increase in engine RPM should be noticed.

3) Reconnect vacuum hose. Diaphragm should move upward (valve open) and engine RPM should decrease.

4) If no diaphragm movement is noticed during test, check for vacuum at hose. If vacuum is present, replace EGR valve. If no

GENERAL MOTORS EXHAUST GAS RECIRCULATION (Cont.)

vacuum is present, check for plugged or leaking hose or carburetor port.

5) If diaphragm moves with no change in engine RPM, check manifold EGR passages for blockage.

FUNCTIONAL TESTS

EGR Valve Installed (Ported and Negative Back Pressure Types) – 1) Check for proper hose routing, according to appropriate diagram. *See "General Motors Vacuum Diagrams" in this section.* Check EGR signal tube orifice for obstructions.

2) Hook vacuum gauge between EGR valve and carburetor and check vacuum with engine running at normal operating temperature. With engine at 3,000 RPM, there should be at least 5 in. Hg.

3) Check operation of Thermal Vacuum Switch by installing a vacuum gauge inline between TVS and its sources and noting presence of vacuum with engine operating warm. Valve can also be removed and checked by placing in pails of warm and cold water (with vacuum source and gauge attached on either side) to check for valve open while warm and closed while cold.

4) With engine off and valve on or off the vehicle, manually depress valve diaphragm. While depressed, hold finger over source tube and release diaphragm.

5) Check for diaphragm and seat movement. Valve is okay if it takes over 20 seconds for diaphragm to move to seated position. If less, replace EGR valve.

EGR Valve Removed (Back Pressure Type Valve Only) – 1) Apply external vacuum (10 in. Hg or more) to EGR valve signal tube.

NOTE – *A constant vacuum supply must be used.*

2) Valve should not open. If it does, control valve is stuck closed and EGR valve must be replaced.

3) With vacuum still applied, apply a stream of air from a low pressure source into the EGR valve exhaust gas intake passage. Valve should open completely. If it does not open at all, control valve is stuck open or exhaust passages are plugged. Replace EGR valve.

4) If EGR valve and control valve are both functioning properly, clean the mounting surfaces, then using a new gasket, install valve on engine. Reconnect vacuum hose.

MAINTENANCE

EGR PASSAGE CLEANING

If inspection of EGR passages in intake manifold indicates excessive build up of exhaust deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

GENERAL MOTORS VACUUM ADVANCE SPARK CONTROL

DESCRIPTION

TRAPPED VACUUM SPARK

Trapped vacuum spark is used on all models. A thermal vacuum switch (TVS) is mounted in cylinder head and used to sense engine coolant temperature. A vacuum check valve is mounted between manifold vacuum, distributor and thermal vacuum switch. The system maintains high vacuum levels to the distributor during cold engine operation and cold engine acceleration.

SPARK VACUUM DELAY

The spark vacuum delay is used on 350" and 400" V8 engines with Heavy Duty Emissions. It is installed between the TVS check valve and the distributor.

OPERATION

TRAPPED VACUUM SPARK

When engine temperature is below a pre-set specified value, the manifold vacuum signal is routed through the check valve to the distributor. Ports on TVS are blocked. The check valve will keep distributor vacuums at levels higher than manifold depression during vehicle acceleration. A small sintered iron bleed orifice is provided in the check valve to allow for a leakdown to enable engine to be restarted if it stalls. (This applies to all models except: Light Duty California and Altitude Emissions; 350" and 400" V8 with Heavy Duty Emissions; all 454" V8 engines.)

When engine temperature is above pre-set value, TVS ports will be open to allow manifold vacuum to the distributor. During this mode of operation, the check valve will act as a connector.

SPARK VACUUM DELAY

As manifold vacuum increases, the check valve opens and allows distributor vacuum to increase to same level. When vacuum decreases during vehicle acceleration, the check valve closes and distributor vacuum will decrease at a rate controlled by the internal bleed.