GENERAL MOTORS
EXHAUST GAS RECIRCULATION (EGR) SYSTEM

DESCRIPTION

The Exhaust Gas Recirculation (EGR) System used on General Motors vehicles is designed to reduce emission of oxides of nitrogen (NOx). This process is accomplished by lowering 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.

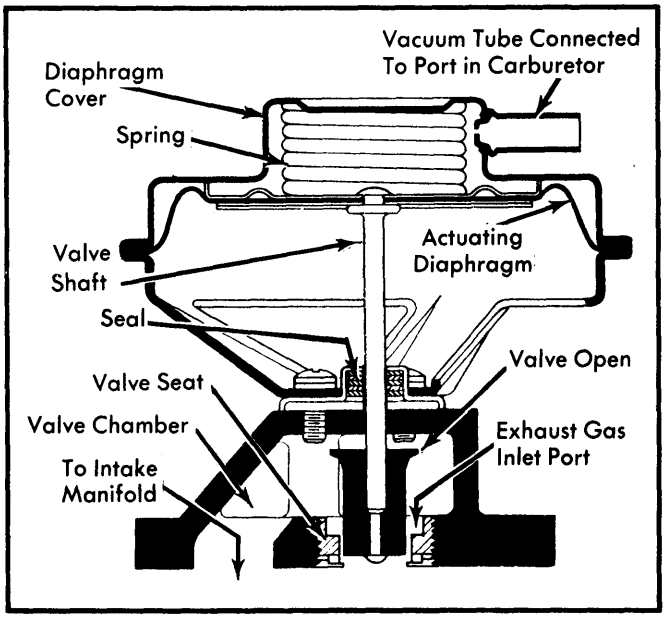

Fig. 1 Cutaway View of Ported Type EGR Valve

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 and a Negative Back Pressure EGR valve. Operation of these two systems is explained as follows:

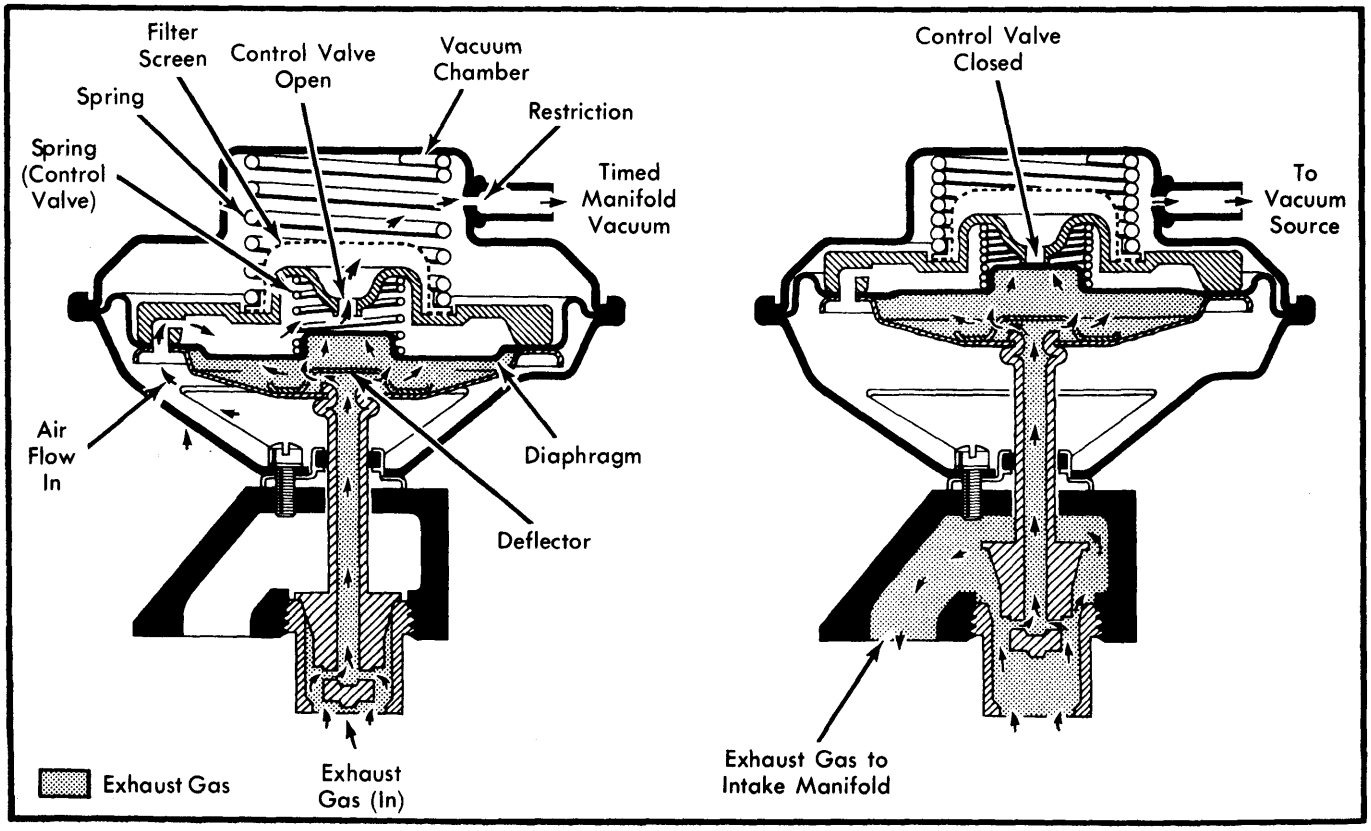

Fig. 2 Cutaway View of Positive Back Pressure EGR Valve

GENERAL MOTORS
EXHAUST GAS RECIRCULATION (EGR) SYSTEM (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.

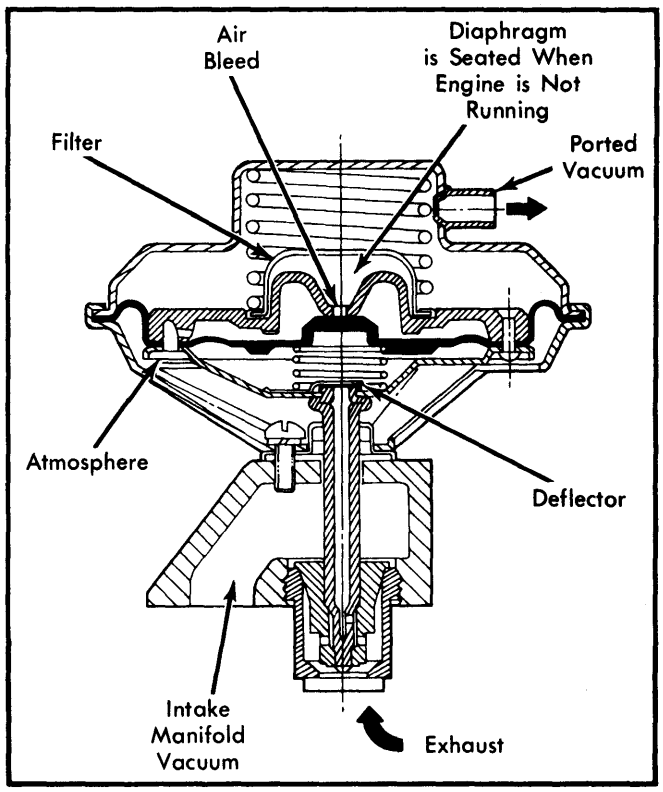

Fig. 3 Cutaway View of Negative Transducer Back Pressure EGR Valve

EGR THERMAL CONTROL VALVE

Some models use a temperature sensitive control valve in vacuum line to EGR valve. Valve is closed below 61°F, blocking vacuum to EGR valve and giving better cold driveability.

The thermal control valve is open above 76°F engine temperature allowing EGR ported vacuum to be directed to EGR valve.

EGR THERMAL VACUUM SWITCH

Some models use a temperature sensitive control switch in the vacuum line to EGR valve. The switch prevents vacuum from reaching EGR valve when engine is cold, improving warm-up driveability. When engine coolant reaches a pre-determined level, thermal vacuum switch opens and exhaust gas recirculation begins.

TROUBLE SHOOTING

ROUGH IDLE AND STALLING

Hoses routed improperly. Leaking EGR valve, loose attaching bolts or failed gasket. Thermal control valve or vacuum switch malfunctioning. Improper vacuum to EGR valve.

GENERAL MOTORS
EXHAUST GAS RECIRCULATION (EGR) SYSTEM (Cont.)

RUNS ROUGH ON LIGHT THROTTLE
POOR PART-THROTTLE PERFORMANCE

Hoses routed improperly. Loose EGR valve. Stuck or binding EGR valve, no gasket or spacer.

ENGINE STALLS ON DECELERATION

Control valve blocked or air restricted. Restriction in EGR vacuum line or control valve vacuum signal line.

PART THROTTLE DETONATION

Control valve blocked or air flow restricted. Insufficient EGR flow. Control valve blocked or flow restricted.

ENGINE STARTS AND IMMEDIATELY STALLS WHEN COLD

EGR valve hoses misrouted. EGR thermal vacuum switch malfunction when engine is cold.

TESTING

FUNCTIONAL TESTS

EGR Valve Installed (Exc. Ported and Negative Back Pressure Types) – 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 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.

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. 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. Clean EGR valve as described under EGR Valve Cleaning in this article.

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. Clean 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 VALVE CLEANING

CAUTION – *Do not wash valve assembly in solvents or degreaser, permanent damage to valve diaphragm may result. Also, sand blasting of the valve is not recommended since this can affect the operation of the valve.*

1) Remove EGR valve and discard gasket. Hold valve assembly in hand, then tap lightly on the sides and end of valve, and on the pintle itself using a plastic hammer to remove the exhaust deposits from the valve. Empty loose particles.

NOTE – *DO NOT place EGR valve in a vise.*

2) With a wire wheel, buff the exhaust deposits from mounting surface and around valve. Depress valve diaphragm and look at valve seating area through valve outlet to ensure it is clean.

3) Inspect for exhaust deposits in valve outlet. Remove deposit build up with a screwdriver.

4) Clean mounting surfaces of intake manifold and valve assembly, then using a new gasket, install valve assembly on intake manifold. Tighten attaching bolts and connect vacuum hose.

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.