2.3L FEEDBACK CARBURETOR ELECTRONIC ENGINE CONTROL SYSTEM

DESCRIPTION

Ford 2.3 Liter engine equipped vehicles sold in California (both Turbo and non-Turbo engines) use a Feedback Carburetor Electronic Engine Control System. The main components of this system are a dual catalytic converter, a Thermactor air control system, and an electronic feedback controlled carburetor.

In operation, an electronic Microprocessor Control Unit (MCU) monitors exhaust gas composition with the Exhaust Gas Oxygen (EGO) sensor and commands carburetor main metering mixture for best exhaust gas emission control.

ELECTRONICALLY CONTROLLED FEEDBACK CARBURETION

Besides the thermactor air pump system and the dual converter, the Feedback Carburetor Electronic Engine Control (FCEEC) system consists of the following components which interact with the "feedback" portion of the system:

- Model 6500 Feedback Carburetor
- Exhaust Gas Oxygen (EGO) Sensor
- Microprocessor Control Unit (MCU)
- Vacuum Solenoid/Regulator
- Idle Tracking Switch
- Cold Temperature Vacuum Switch

In operation, the FCEEC system has two modes of operation, as determined by the sensors. These are the "Closed Loop Mode" and the "Open Loop Mode".

Closed Loop Mode – In this mode, each component in the system is sensitive to the other components: carburetor is controlled by vacuum solenoid regulator, which is controlled by MCU in response to a signal from EGO in the exhaust manifold, which is reacting to the mixture from the carburetor. When all components are functioning in this fashion, the system is termed in the Closed Loop Mode.

Open Loop Mode – In this mode, the air/fuel mixture is set to a predetermined, nonvarying setting by the ECU, and is not influenced by the EGO sensor signals. This occurs during cold operating temperatures or when throttle is closed. The fuel mixture is set by the ECU.

OPERATION

DUAL CATALYTIC CONVERTER

This converter assembly consists of two separate converters in one shell, with a mixing chamber in between. The forward converter is designed to control all three major emissions (NOx, HC, CO), and is therefore called a three-way catalyst (TWC). The rear converter is a conventional oxidation catalyst (COC) and controls only HC and CO.

As gases flow out of the TWC, they mix with air from the air pump system. This mixing is required to allow the rear converter to properly control HC and CO emissions.

THERMACTOR AIR CONTROL

This system is similar to the standard Thermactor air pump system, but it also adds a second air control valve (in addition

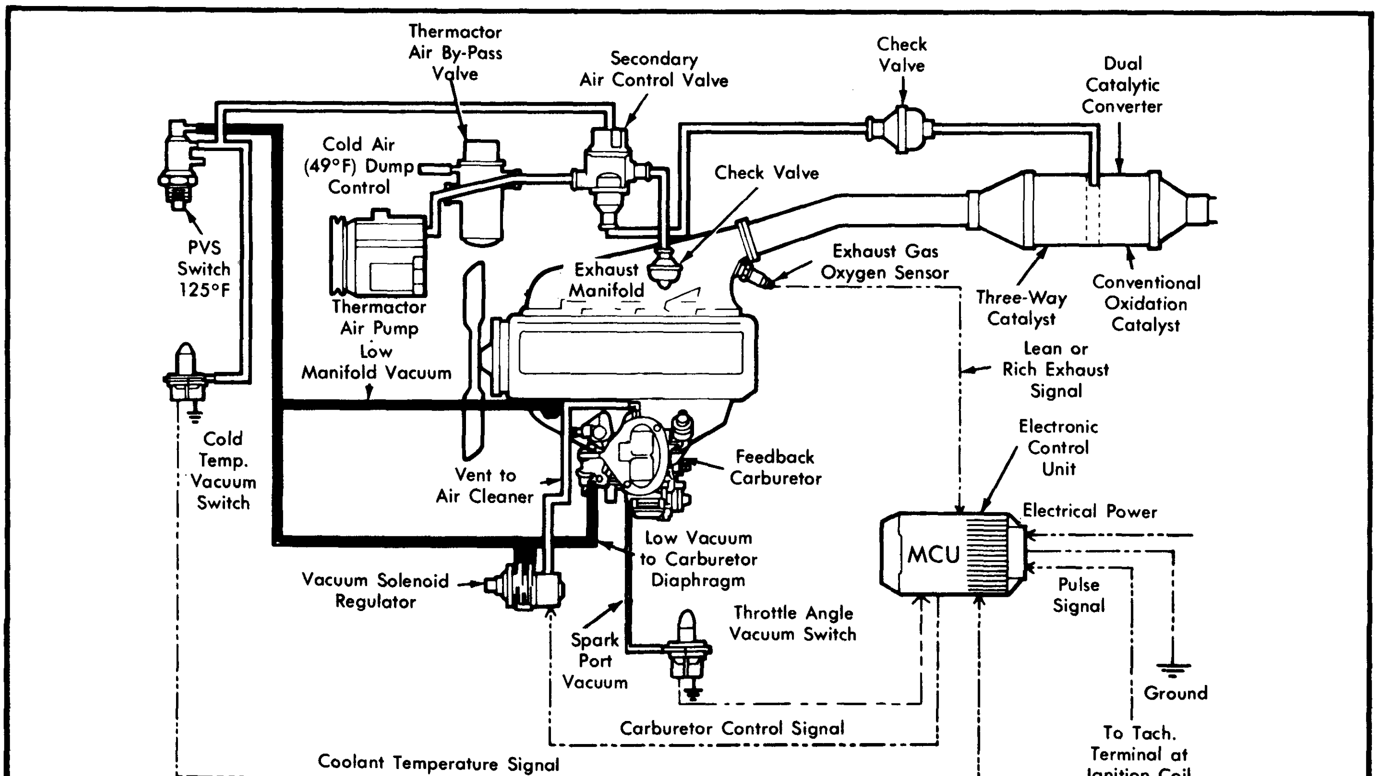

Fig. 1 Typical 2.3 Liter Feedback Electronic Engine Control System

2.3L FEEDBACK CARBURETOR ELECTRONIC ENGINE CONTROL SYSTEM (Cont.)

to the bypass valve), and a second exhaust check valve. Other system components include the air pump, ported vacuum switch (PVS) and the temperature vacuum switch (TVS).

Above 125° F coolant temperature, air pump air is routed to the mixing chamber of the dual catalytic converter. Below 125° F, the PVS applies vacuum to the air control valve which directs air pump air to the exhaust manifold to decrease HC and CO during warmup.

A catalyst protection feature is used when the TVS (on the air cleaner) senses inlet air temperatures below 49° F. This causes the bypass valve to dump air pump air to the atmosphere (not to the exhaust manifold or converter mixing chamber).

MODEL 6500 FEEDBACK CARBURETOR

This unit is basically the same as a Model 5200 carburetor except it has an externally-variable auxiliary fuel metering system in place of the enrichment valve used on the 5200. The auxiliary system is operated by vacuum from the vacuum solenoid regulator under control of the ECU. The Model 6500 carburetor also has a switching bowl vent that allows venting fuel bowl vapors to the canister and a fresh air pickup for the vacuum solenoid regulator.

During wide open throttle, manifold vacuum drops, resulting in little or no vacuum output. The feedback metering valve allows addition fuel to the main well, giving a richer air/fuel mixture for best performance.

One other feature difference, the 6500 carburetor has an internal choke pulldown diaphragm vacuum supply instead of the external vacuum connection on the 5200.

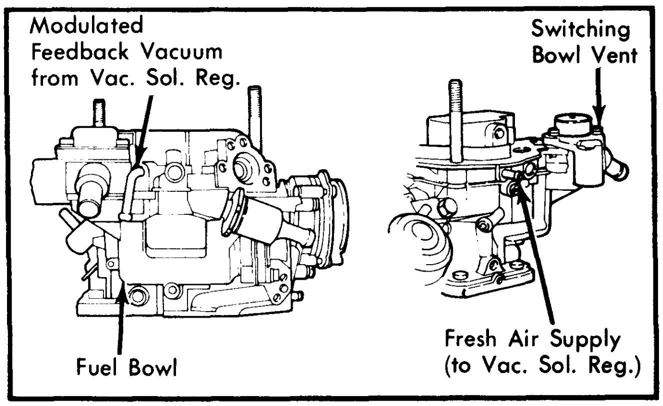

Fig. 2 Model 6500 Feedback Carburetor

VACUUM SOLENOID REGULATOR

This component supplies the vacuum signal to the feedback carburetor. A solenoid and regulator are enclosed in one housing. When the solenoid portion is de-energized, the output port is blocked, and vacuum is dumped to the atmosphere. When the solenoid is energized, the lower output port is open (atmosphere vent blocked) and vacuum is applied to the carburetor auxiliary fuel metering system.

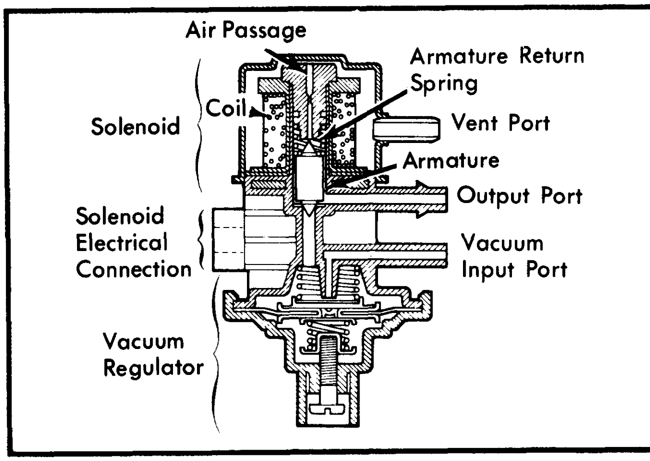

Fig. 3 Vacuum Solenoid Regulator (VSR)

EXHAUST GAS OXYGEN (EGO) SENSOR

The EGO sensor is threaded into the exhaust manifold and provides information to the MCU on the oxygen content of the exhaust gases. The sensor varies the output signal to the MCU in response to oxygen content: the less oxygen (rich mixture), the higher the voltage output signal.

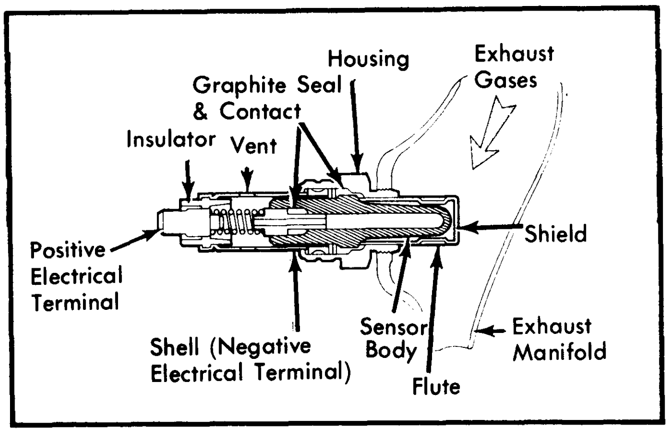

Fig. 4 Exhaust Gas Oxygen Sensor (EGO)

MICROPROCESSOR CONTROL UNIT (MCU)

This is the "brain" of the system. It is the central component of the control loop. It constantly monitors EGO signals, throttle angle and coolant temperature. The determined response is sent out to the vacuum solenoid/regulator, which supplies vacuum signal to the fuel metering rod to obtain the proper air/fuel ratio required for optimum operation of the catalytic converter. The MCU also has a time mechanism which varies the length of time required for a change in air/fuel ratio based on engine RPM.

NOTE — *The electronic control unit sends a constantly cycling voltage to the solenoid regulator. Control is accomplished by varying the duration of the voltage within a given time. A "short duty cycle" means the electronic control is sending voltage less than half the time.*

2.3L FEEDBACK CARBURETOR ELECTRONIC ENGINE CONTROL SYSTEM (Cont.)

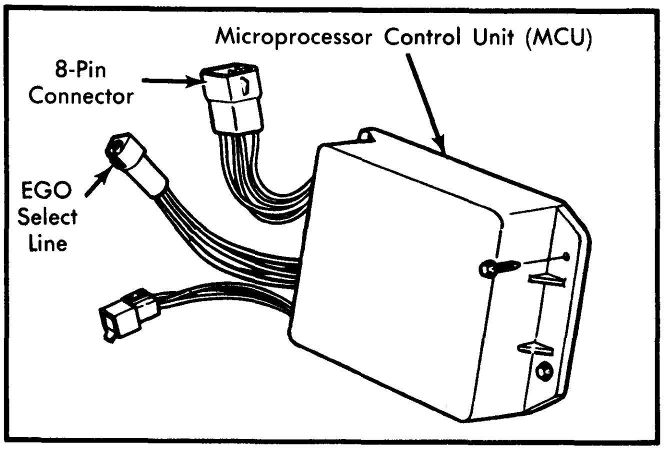

Fig. 5 Microprocessor Control Unit (MCU)

COLD TEMPERATURE VACUUM SWITCH (CTVS)

The CTVS is used on Automatic Transmission equipped models. It is a normally closed vacuum switch, connected to a Ported Vacuum Switch (PVS). As coolant temperature rises above 125°F, the coolant PVS switches, allowing vacuum to the CTVS and signalling the MCU into the "closed loop" mode.

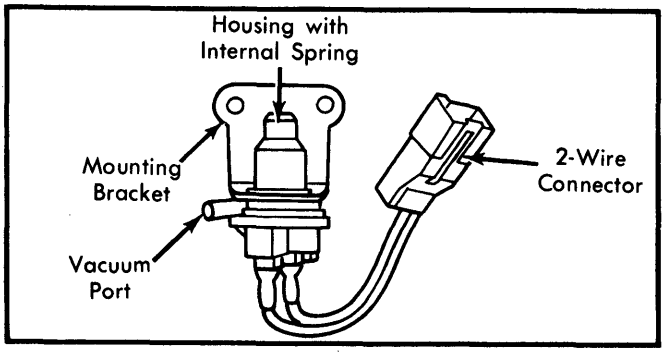

Fig. 6 Cold Temperature and Throttle Angle Vacuum Switch

IDLE TRACKING SWITCH

Signals MCU to go into "open loop" mode during idle and decelerating conditions. Switch is activated by position of throttle lever.

NOTE — *To protect the vehicle from possible overtemperature conditions during extended idling, the MCU causes thermactor air to dump to atmosphere after 2½ minutes of uninterrupted idling.*

TESTING & DIAGNOSIS

► *TESTING OF FORD MOTOR CO. FEEDBACK CARBURETOR CONTROL ELECTRONIC CONTROL SYSTEM* — Due to the complexity of the Feedback Carburetor Control system, a special diagnostic tester is required. This tester consists of a control module tester (test selection box) and a digital volt/ohm meter (DVOM). The DVOM plugs into the computer tester with a special 12 pin plug. The DVOM contains two additional test leads, independent of the special 12 pin plug, for performing volt/ohm readings. The feedback carburetor tester performs 13 different tests. These tests check functions and specifications of the feedback carburetor control module, vacuum regulator and switches, exhaust gas oxygen sensor, and exhaust gas recirculation valve. Other items needed to perform tests are; an accurate tachometer, an accurate vacuum gauge, a hand vacuum pump/tester, and an engine speed control tool.

Without the special test equipment, the Feedback Carburetor Control Electronic Control system cannot be fully tested, but, a number of preliminary checks can be made to help eliminate some problem areas.

PRE-CHECK VISUAL INSPECTION

NOTE — *System will not function properly if air, vacuum or exhaust leaks exist, or if there are poor electrical connections; therefore, the following checks should be made.*

1) Inspect all vacuum lines for proper connections and proper hose condition.

2) Check electrical harness for loose or detached connectors, broken or frayed wires, loose terminals, shorting, corrosion, or bad ground connections.

3) Check major components for signs of physical damage.

4) With engine running (if possible), check around exhaust manifold and exhaust gas oxygen sensor for leaks.

NOTE — *2.3L Turbocharged models with Automatic Transmission have a low-pressure electric fuel pump located in the fuel tank. Pump will not operate in event of oil pressure loss or if inertia switch is open.*

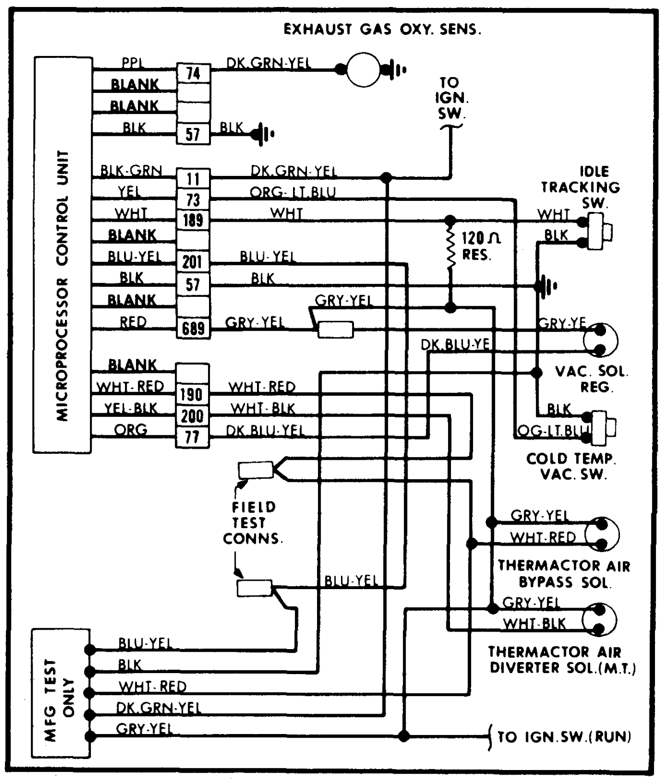

Fig. 7 Wiring Diagram for 2.3L Feedback Carburetor Electronic Engine Control System