Fuel is pressurized by an electric fuel pump. A fuel damper prevents pulsations in the line and maintains fuel pressure in the system. The fuel filter is important because extremely clean fuel is required for fuel injection. Fuel pressure is regulated according to manifold absolute pressure, with excess fuel returned to the tank through a return line.

An airflow sensor measures air flowing into the intake system. The signals from the airflow sensor are called the base pulse, providing the minimum fuel to be injected. The base pulse is modified by a solid state electronic control unit (ECU) to increase the time the injector stays open, adjusting the injectors to engine operating conditions. To do this, the ECU receives and interprets signals from other sensors monitoring coolant temperature, air temperature, throttle positions, engine speed and engine load.

Electronic injectors open the nozzle valve with a solenoid. The ECU controls pulse width at the injector by the length of time the solenoid receives a voltage signal.

Provisions are made for cold starting and warmup with a cold start injector valve, a thermotime switch, and an auxiliary air device. The cold start injector delivers extra fuel while the engine is cranking. The auxiliary air device provides extra air during start and warmup to overcome cold engine friction.

The air/fuel mixture can be metered more closely with a feedback or closed loop fuel control system. A closed loop system continually monitors itself and adjusts the injection pulse rate so the air/fuel ratio is kept as close to ideal as possible. In an open loop operation, the ECU sends pre-programmed signals for warmup, idle, and full-load enrichment.

Fuel Injector Systems

Several popular fuel injector systems are briefly described below.

In the Bosch L-Jetronic system, all injectors open and close at the same time, delivering fuel into the intake manifold to be drawn into each cylinder when the individual intake valves open. The system is easily adapted to turbocharged systems.

Another Bosch electronic fuel injection system is the LN-Jetronic, a low pressure system designed for lower-cost systems in small cars.

In the LH-Jetronic system, the airflow sensor is a hot wire instead of a moving flap. Airflow is calculated by the amount of current the wire requires to stay at a constant temperature when passing air cools it. Other systems use acoustic waves to measure airflow. In the older D-Jetronic system, manifold pressure is monitored instead of airflow to control the injection pulse width.

The K-Jetronic (CI) is a continuous fuel injection system. It's a port injection system, delivering fuel to the intake manifold. Fuel delivery rate is controlled by varying the amount of fuel coming out of each injector. K-Jetronic systems can be fitted with an oxygen (Lambda) sensor for feedback control of the amount of fuel delivered to the injector.

The KE-Jetronic fuel injection system combines the benefits of a basic mechanical system with simple electronic controls for enrichment, cutoff, and closed loop feedback.

The GM Throttle Body Injection (TBI) has central, intermittent injection, and has feedback sensors and an electronic control unit GM calls the ECM (Electronic Control Module).

The Ford Central Fuel Injection (CFI) system uses a microprocessor to control intermittent fuel injection as well as spark time, EGR, and evaporative canister purge. Fuel pressure in this system is developed by an electric pump in the tank.

The Chrysler Electronic Fuel Injection is a single point, continuous flow system. The system measures air flow and fuel flow, comparing these to a set of programmed ratios stored in the ECU. In closed loop, exhaust gas oxygen is monitored to keep the air/fuel ratio correct.

AIR FILTERS

Since the average internal combustion engine "breathes in" approximately 10,000 gallons of air for every one gallon of fuel it consumes, the air that comes into the system must be very clean to avoid damage to the engine.

An air filter permits air to flow freely into the system, while trapping airborne contaminants such as vegetable matter, insects, exhaust soot and dirt. The type of contaminants likely to be introduced into an engine depends on a number