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Study About Electronic Fuel injection systems, its advantages over Mechanical Fuel Injection System : A Review

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Abstract : Fuel injection is the introduction of fuel in an internal combustion engine, most commonly automotive engines, by the means of an injector. Electronic Fuel injection works on the some very basic principal. The following discussion broadly outlines how or Conventional Electronic Fuel Injection (EFI) system operates. Fuel injection is a Fuel system for admitting fuel into an internal combustion engine. In olden days carburetors are used to fulfils this action. A Carburetor is a device that blends air and fuel for an Internal Combustion Engine. Carburetor works on the Bernoulli's Principle. The lower its static pressure, and the higher its dynamic pressure the throttle (accelerator) linkage does not directly control the flow of liquid fuel.

Key Words : Fuel injection, Electronic Fuel Injection system.

Introduction : The Electronic Fuel Injection system can be divided into three: basic sub-system. These are the fuel delivery system, air induction system, and the electronic control system.

1. Strict emission standards require precise fuel delivery
2. Computers used to calculate fuel needs
3. EFI very precise, reliable & cost effective
4. EFI provide correct A/F ratio for all loads, speeds, & temp range.

With increased demand to lower emissions from diesel engines, the flexibility and improved performance offered by electronic control was an important driver for many engine manufacturers to introduce electronically controlled fuel injection systems in the late 1980s and early 1990s. An important tool for lowering emissions from diesel engines produced during this period was fuel injection timing that could be varied over the speed and load range of the engine. While injection timing could be varied with a purely mechanical approach, electronic control offered a much more flexible and a potentially simpler way to achieve this while also providing the option of introducing a number of other desirable features. Some of the first electronically controlled fuel injection systems in heavy-duty engines appeared in the Detroit Diesel Series 92 in 1985 and the Series 60 in 1987 [Bara 1990]. Caterpillar applied it to the 3176 in 1988 [Dingle 2009].

Fuel Injection System

For the engine to run smoothly and efficiently it needs to be provided with the right quantity of fuel/air mixture according to its wide range of demands. Traditionally, the fuel/air mixture is controlled by the carburetor, an instrument that is by no means perfect.

Its major disadvantage is that a single carburetor supplying a four-cylinder engine cannot give each cylinder precisely the same fuel/air mixture because some of the cylinders are further away from the carburetor than others.

Electronic injection

Because mechanical injection systems have limited adjustments to develop the optimal amount of fuel into an engine that needs to operate under a variety of different conditions (such as when starting, the engine's speed and load, atmospheric and engine temperatures, altitude, ignition timing, etc.) electronic fuel injection (EFI) systems were developed that relied on numerous sensors and controls.

Electronic fuel injection (EFI) is simple, in theory. The design goal for an EFI system is to deliver the correct air fuel ratio for varying load, speed and temperature. Most modern EFI systems are incorporated in an ECU which also controls the ignition system, and may control may other functions such as anti-lock brakes, traction control systems, the transmission, etc. A fuel injection system itself consists of a source of pressurized fuel, fuel injectors and the electronic controller. The fuel system is composed of the fuel tank, a high pressure pump, and some method for regulating fuel pressure. The injectors can be though of as electrically operated valves. The amount of fuel delivered to the engine is determined by size of the injectors, the amount of time that the injectors are open, and on the fuel pressure. The electronic controller to determines how much fuel is needed and commands the injectors to remain open for the necessary amount of time to deliver the needed fuel volume. The amount of time that the injector is open is called the pulse width and is usually expressed in milliseconds.

Basic injection

All modern petrol injection systems use indirect injection. A special pump sends the fuel under pressure from the fuel tank to the engine bay where, still under pressure, it is distributed individually to each cylinder.

Depending on the particular system, the fuel is fired into either the inlet manifold or the inlet port via an injector. This works much like the spray nozzle of a hose, ensuring that the fuel comes out as a fine mist. The fuel mixes with the air passing through the inlet manifold or port and the fuel/air mixture enters the combustion chamber.

Many diesel engines, however, use direct injection in which the diesel is injected directly into the cylinder filled with compressed air. Others use indirect injection in which the diesel fuel is injected into the specially shaped pre-combustion chamber which has a narrow passage connecting it to the cylinder head.

Injectors

The injectors through which the fuel is sprayed are screwed, nozzle-first, into either the inlet manifold or the cylinder head and are angled so that the spray of fuel is fired towards the inlet valve.

The injectors are one of two types, depending on the injection system. The first system uses continuous injection where the fuel is squirted into the inlet port all the time the engine is running. The injector simply acts as a spray nozzle to break up the fuel into a fine spray - it doesn't actually control the fuel flow. The amount of fuel sprayed is increased or decreased by a mechanical or electrical control unit - in other words, it is just like turning a tap on and off.

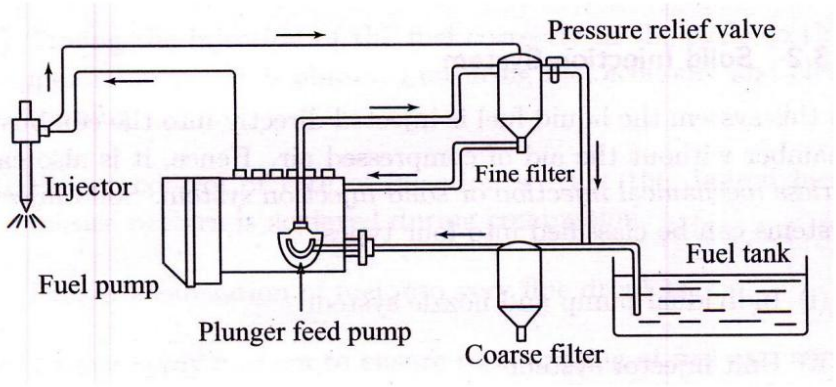
Types of fuel injector

Two main types of injector can be fitted, depending on whether the injection system is mechanically or electronically controlled. In a mechanical system, the injector is spring-loaded into the closed

position and is opened by fuel pressure. The injector in an electronic system is also held closed by a spring, but is opened by an electromagnet built into the injector body. The electronic control unit determines how long the injector stays open.

Mechanical fuel injection

Mechanical fuel injection was used in the 1960s and 1970s by many manufacturers on their higher-performance sports cars and sports saloons. One type fitted to many British cars, including the Triumph TR6 PI and 2500 PI, was the Lucas PI system, which is a timed system.



A high-pressure electric fuel pump mounted near the fuel tank pumps fuel at a pressure of 100psi up to a fuel accumulator. This is basically a short-term reservoir that keeps the fuel-supply pressure constant and also irons out the pulses of fuel coming up from the pump.

From the accumulator, the fuel passes through a paper element filter and then feeds into the fuel-metering control unit, also known as the fuel distributor. This unit is driven from the camshaft and its job, as the name suggests, is to distribute the fuel to each cylinder, at the correct time and in the correct amounts.

The amount of fuel injected is controlled by a flap valve located in the engine's air intake. The flap sits beneath the control unit and rises and falls in response to airflow - as you open the throttle, the 'suck' from the cylinders increases the airflow and the flap rises. This alters the position of a shuttle valve within the metering control unit to allow more fuel to be squirted into the cylinders.

From the metering unit, the fuel is delivered to each of the injectors in turn. The fuel then squirts out into the inlet port in the cylinder head. Each injector contains a spring-loaded valve that is kept closed by its spring pressure. The valve only opens when the fuel is squirted in.

For cold starting, you cannot just block off part of the airflow to enrich the fuel/air mixture as you can with a carburetor. Instead a manual control on the dash (resembling a choke knob) or, on later models, a microprocessor alters the position of the shuttle valve within the metering unit. This activates an extra injector mounted in the manifold, causing it to squirt in extra fuel to enrich the mixture.

Electronic injection systems

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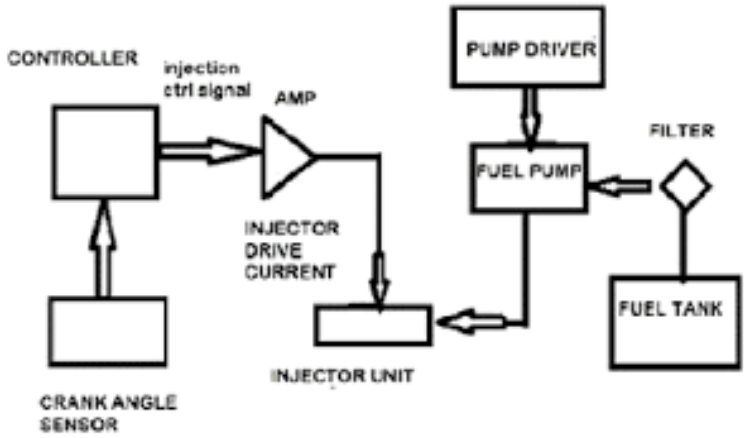
The main difference between electronic injection and mechanical injection is that an electronic system is controlled by a complex microprocessor control unit (sometimes called an electronic control unit or ECU), which is basically a miniature computer.



This computer is fed with information from sensors mounted on the engine. These measure factors such as the air pressure and temperature in the air intake, the engine temperature, accelerator position and engine speed. All this information allows an electronic system to meter the fuel far more accurately than the simple mechanical system, which relies on sensing the airflow alone.

The computer compares the input signals from the sensors with information already programmed into it at the factory, and works out exactly how much fuel should be delivered to the engine. It then signals the on-off valve ig the injector to open and squirt fuel into the inlet port. All this happens in a fraction of a second, the control unit responding instantly to changes in accelerator position, temperature and air pressure.

As well as improved control over fuel flow, the electronic system also operates at lower pressure than a mechanical system - usually at around 25-30psi. This makes it run more quietly than a mechanical system does.

A typical system is the Bosch LJetronic, which is fitted to a wide range of European cars. In this system, fuel is drawn from the tank by an electric pump. It is then fed straight up pipes to the injectors. The system pumps more fuel than is needed for injection - a loop circuit returns the excess to the fuel tank via a pressure regulator which keeps the pressure in the pipes constant.

The injector valves are held closed by springs, and opened by solenoids (electromagnets) when signalled to do so by the control unit. The amount of fuel injected depends on how long the solenoid holds the injector open.

Advantage Of EFI

- Uniform Air/Fuel Mixture Distribution
- Excellent fuel Economy With Improved Emissions Control
- High Accurate Air/Fuel Ratio throughout all engine operating conditions
- Superior throttle response and power

- Improved cold engine
- Start ability and operation
- Simple mechanics, reduced adjustment sensitivity.

Conclusion :

Electronic control of fuel injection is feasible and may easily provide the control flexibility necessary for optimum overall engine performance. An electronically actuated injection valve with sufficient flow rate and actuation speed can be fabricated and applied in either port or direct injection system. The development in electronic fuel injection system has made it possible to overcome the level of pollution and improve the performance of engine in term of parameters like fuel consumption. It has eliminated the short circuiting losses completely.

References :

1. Murthy, P.V.K., Narasimha Kumar, S., MuraliKrishna, M.V.S., Seshagiri Rao, V.V.R. and .Reddy, D.N.,(2010). Aldehyde emissions from two-stroke and four-stroke spark ignition engines with Methanol blended gasoline with catalytic converter, International Journal of Eng. Research and Tech.,3(3), 793.802.
2. Nedunchezhian N and Dhandapani S,(2000). Experimental investigation of cyclic variation of combustion parameters in a catalytically activated two-stroke SI engine combustion chamber, Eng Today, 2, 11-18.
3. Murali Krishna, M.V.S., Kishor, K., Murthy, P.V.K., Gupta, A.V.S.S.K.S. and Narasimha Kumar, S.,(2010). Performance evaluation of copper coated four stroke spark ignition engine with gasohol with catalytic converter, International Journal of Eng.Studies, 2(4), 465-473.
4. Narasimha Kumar, S., Murali Krishna, M.V.S., Murthy, P.V.K., Seshagiri Rao, V.V.R..and Reddy, D.N., (2011).Performance of copper coated two stroke spark ignition engine with gasohol with catalytic converter "International. Journal on Mechanical & Automobile Eng (IJMAE), 12(1), 36-43.
5. G. BAUMANN, Bosch Electronically Controlled Gasoline Injection System for Spark Ignited Engines, Robert Bosch G.m.b.H., Stuttgart, W. Germany (1967).
6. Effect of the injection pressure on the internal flow characteristics for diethyl and dimethyl ether and diesel fuel injectors, Thulasi vijaykumar , rajagopal thundil karuppa raj, and kasianantham nanthagopal.
7. K.Kumaravel, "Experimental studies on the Comparison of static fuel injection characteristics of fuel injectors used in GDI engine''. International journal of advanced scientific and technical research'' ISSN 2249-9954, 2014.
8. Aprilia S.P.A., "DITECH, Direct Injection Technology", Press release, May 2000