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SURVEY ON MULTI POINT FUEL INJECTION (MPFI) ENGINE

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ABSTRACT
The Multi Point Fuel Injection (MPFI) is a system or method of injecting fuel into internal combustion engine through multi ports situated on intake valve of each cylinder. It delivers an exact quantity of fuel in each cylinder at the right time. The amount of air intake is decided by the car driver by pressing the gas pedal, depending on the speed requirement. The air mass flow sensor near throttle valve and the oxygen sensor in the exhaust sends signal to Electronic control unit (ECU). ECU determines the air fuel ratio required, hence the pulse width. Depending on the signal from ECU the injectors inject fuel right into the intake valve. Thus the multi-point fuel injection technology uses individual fuel injector for each cylinder, there is no gas wastage over time. It reduces the fuel consumption and makes the vehicle more efficient and economical.

KEYWORDS: Multi point fuel injection (MPFI), Cylinder, Gas pedal, Throttle valve, Electronic control Unit (ECU).

I. INTRODUCTION
Petrol engines used carburetor for supplying the air fuel mixture in correct ratio but fuel injection replaced carburetors from the 1980s onward. Carburetor is completely a mechanical device and has poor efficiency and high emission. In a multi cylinder engine with a carburetor, it is difficult to obtain a uniform mixture in each cylinder as various cylinders receive air-fuel mixture in varying quantities and richness. The primary difference between carburetors and fuel injection is that fuel injection atomizes the fuel through a small nozzle under high pressure, while a carburetor relies on suction high pressure, created by intake air accelerated through a Venturi tube to draw the fuel into the airstream. Multipoint fuel injection (also called PFI, port fuel injection) uses sensors, a computer and a solenoid operated fuel injector to meter and inject the right amount of fuel in the engine cylinders. This system uses computerised system engine control unit (ECU) to monitor and control engine operation. Thus MPFI not only result in better power balance but also higher output from each of the cylinder providing effective utilization of fuel with low emission level. In section I components are discussed, further in section III, IV, V, VI, VII Electronic Control Unit, Working, Advantages, Conclusion and References are discussed.

II. COMPONENTS OF MPFI ENGINE
The major components of MPFI engine are as follows:-

a) Throttle body
In fuel injected engines, the throttle body is the part of the air intake system that controls the amount of air flowing into the engine, in response to driver accelerator pedal input in the main. The throttle body is usually located between the air filter box and the intake manifold, and it is usually attached to, or near, the mass airflow sensor. The largest piece inside the throttle body is the throttle plate, which is a butterfly valve that regulates the airflow.

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Figure 1: Throttle body

b) Intake manifold

An intake manifold is a component that delivers either air or an air/fuel mixture to the cylinders. The design of these components varies widely from one application to another, but they all perform that same basic function, and they all have a single input and multiple outputs.

Figure 2: Intake manifold

c) Fuel injector

A fuel injector is nothing but an electronically controlled valve, supplied with pressurized fuel , and it is capable of opening and closing many times per second. The injectors are mounted in the intake manifold so that they spray fuel directly at the intake valves. A pipe called the fuel rail supplies pressurized fuel to all of the injectors. When the injector is energized, an electromagnet moves a plunger that opens the valve, allowing the pressurized fuel to squirt out through a tiny nozzle. The amount of fuel supplied to the engine is determined by the amount of time the fuel injector stays open. This is called the pulse width, and it is controlled by the ECU.

Figure 3: Fuel injector

d) Map sensor

The manifold absolute pressure sensor (MAP sensor) is one of the sensors used in an internal combustion engine's electronic control system. Engines that use a MAP sensor are typically fuel injected. The manifold absolute pressure sensor provides instantaneous manifold pressure information to the engine's electronic control unit (ECU). The data is used to calculate air density and determine the engine's air mass flow rate, which in turn determines the required fuel metering for optimum combustion and influence the advance or retard of ignition timing.

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Figure 4: Map sensor

e) Throttle position sensor

A throttle position sensor (TPS) is a sensor used to monitor the throttle position of a vehicle. The sensor is usually located on the butterfly spindle/shaft so that it can directly monitor the position of the throttle. The TPS sensor is a potentiometer, providing a variable resistance depending on the position of the throttle valve (and hence throttle position sensor).The sensor signal is used by the engine control unit (ECU) as an input to its control system. The ignition timing and fuel injection timing (and potentially other parameters) are altered depending on the position of the throttle valve, and also depending on the rate of change of that position.

Figure 5: Throttle position sensor

f) Piston

Pistons are at the very heart of the reciprocating internal combustion engine, which is why they are often called a "piston engine". At its most basic, the piston is simply a solid cylinder of metal, which moves up and down in the hollow cylinder of the engine block. The piston is attached via a wrist pin to a connecting rod, which in turn is connected to the crankshaft, and together they turn the up and down (reciprocating) motion into round and round (rotational) motion to drive the wheels.

Figure 6: Piston

g) Spark plug

A spark plug is an electrical device that fits into the cylinder head of some internal combustion engines and ignites compressed aerosol gasoline by means of an electric spark. Spark plugs have an insulated center electrode which is connected by a heavily insulated wire to an ignition coil or magneto circuit on the outside, forming, with a grounded terminal on the base of the plug, a spark gap inside the cylinder. Electrical energy is transmitted through the spark plug, jumping the gap in the plugs firing end. If the voltage supplied to the plug is high enough. This electrical spark ignites the gasoline/air mixture in the combustion chamber.

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Figure 7: Spark plug

a) Crankshaft

A crankshaft is a fundamental feature in a vehicle's engine. It is the system that converts linear energy into rotational energy. This enables the wheels to drive the car forward. All the pistons in the engine are attached to the crank which is also connected to the flywheel. The crankshaft moves the pistons up and down inside the cylinders. The movement of the pistons is regulated by the crankshaft. When the shaft moves, it causes the flywheel at the end of the shaft to adopt a circular motion. This motion eventually causes the vehicle's wheels to turn since the flywheel is connected to other engine parts.

Figure 8: Crankshaft

b) Flywheel

A flywheel is a rotating mechanical device that is used to store rotational energy. It provides continuous energy when the energy source is discontinuous. For example, flywheels are used in reciprocating engines because the energy source, torque from the engine, is intermittent. It is specifically weighted to provide balance for the crankshaft, provides a means to get the engine started (starter ring).

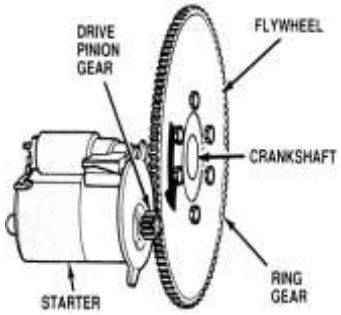

Figure 9: Flywheel

c) Exhaust manifold

A vehicle's exhaust manifold plays the leading role in a car or truck's exhaust system. An exhaust manifold collects the exhaust gases from multiple cylinders into one pipe. It connects to each exhaust port on the engine's cylinder head, and it funnels the hot exhaust down into one simple exhaust pipe. With the help of the exhaust manifold gaskets, it also prevents the toxic exhaust fumes from sneaking into the vehicle and harming exhaust manifold gaskets, it also prevents the toxic exhaust fumes from sneaking into the vehicle and harming the occupants.

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Figure 10: Exhaust manifold

d) Oxygen sensor

The Oxygen sensor (lambda sensor) is mounted in the exhaust manifold to monitor how much unburned oxygen is in the exhaust as the exhaust exits the engine. Monitoring oxygen levels in the exhaust is a way of gauging the fuel mixture .It tells the computer if the fuel mixture is burning rich(less oxygen) or lean(more oxygen).

Figure 11: Oxygen sensor

III. ELECTRONIC CONTROL UNIT (ECU)

In automotive electronics, electronic control unit (ECU) is a generic term for any embedded system that controls one or more of the electrical systems or subsystems in a motor vehicle.

An engine control unit (ECU), also known as power-train control module (PCM), or engine control module (ECM) is a type of electronic control unit that determines the amount of fuel, ignition timing and other parameters an internal combustion engine needs to keep running. It does this by reading values from multidimensional maps which contain values calculated by sensor devices monitoring the engine.

Following are important functions of ECU:-

- Control of fuel injection
- Control of ignition timing
- Control of idle speed

IV. WORKING OF FOUR STROKE MPFI ENGINE

Multi point fuel injection

The MPFI is an advanced version of carburetor engine. MPFI engine is having a fuel injector for each cylinder. A computer is used to control each and every fuel injector individually. The computerized system of the car consists of a microcontroller. This microcontroller monitors each **fuel injectors** and keeps on telling each injector about the amount of fuel to be injected to the cylinder so that the fuel wastage can be reduced. Since there is a controlled fuel usage, the engine is known for its fuel efficiency. An input is fed to the computerized system in order to calculate the amount of air and fuel is to be mixed and send to the combustion chamber. A several stages of calculations are to be made in order to judge the right amount of fuel to be mixed. After this calculation, the proper fuel is delivered at the proper instance.

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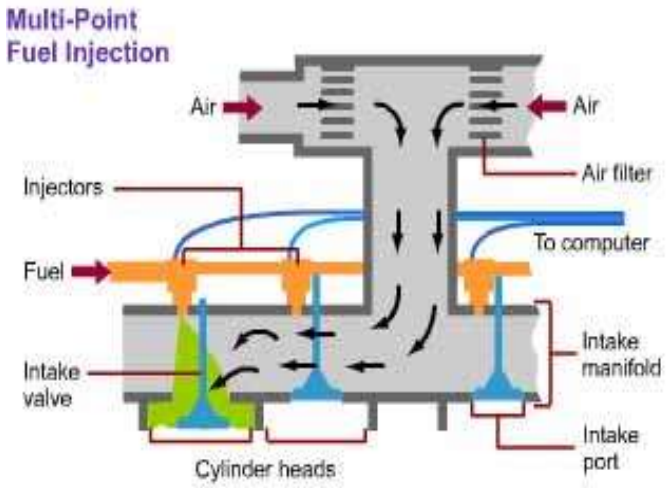

Figure 12: Multi point fuel injection

V. ADVANTAGES

- More uniform air-fuel mixture will be supplied to each cylinder, hence the difference in power developed in each cylinder is minimum.
- The vibrations produced in MPFI engines is very less, due to this life of the engine component is increased.
- No need to crank the engine twice or thrice in case of cold starting as happen in the carburetor system.
- Immediate response, in case of sudden acceleration and deceleration.
- The mileage of the vehicle is improved.
- More accurate amount of air-fuel mixture will be supplied in these injection system. As a result complete combustion will take place. This leads to effective utilization of fuel supplied and hence low emission level.

VI. CONCLUSION

Carburetor were replaced by the single point injection in single cylinder engine. The multi cylinder engines used distributors. But very shortly MPFI system replaced the distributors. The modern day cars use MPFI engines, which has electronic control unit. They use the engine sensors, integrated chips to monitor the fuel injection time and quantity. The multipoint fuel injection are also used in the engines which use LP gas as the fuel, with very less alterations in the gasoline run engine.

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