International Review of Applied Engineering Research.
ISSN 2248-9967 Volume 4, Number 2 (2014), pp. 103-108

http://www.ripublication.com/iraer.htm

Automotive Diesel Engines

Sanchit Saxena

M.V.N. University, Palwal, Haryana.

Abstract

In the era of today, the diesel engines are getting more and more popular because in INDIA diesel is cheaper than petrol. In this research paper we discuss about the diesel engine technology that have bring a new revolution in the automobile industry. During the initial days when diesel engine was invented, it came up with indirect injection engine (IDI) versions, and after that direct injection engines (DI) came in the lame light with a better fuel economy as compared to IDI engines. After that CRDI technology is introduced, which are being used in diesel vehicles and it works with the help of ECM i.e. engine control module. In this paper we have firstly discussed spark ignition engine and compression ignition engine that is the basics of internal combustion engine and then covered the following mentioned issues. This research paper is on the behalf of M.V.N University, in this research paper we guide you about: The Diesel engine, types of Diesel Engine, Indirect injection engine (IDI), Direct injection engine (DI), Common rail direct injection system (CRDI).

Keywords: SI engine, CI engine, Indirect injection engine (IDI), Direct injection engine (DI), Common rail direct injection system (CRDI), ECM.

1. Introduction

We know that the function of engine is to produce power, in automobile industry we use internal combustion engines that is further divided into 2 parts:

1. **Spark ignition engine (SI engine)** - SI engine having spark plug, during power stroke It ignite and blast the fuel and air mixture inside the combustion chamber. It is located in the head of IC engine. Generally SI engine is used in Petrol Vehicles.

2. **Compression ignition engine (CI engine)** – CI engine doesn't have spark plug, the combustion process starts when the fuel enters in the cylinder and get mixed with compressed air and they are self-ignite due to high temperature in the combustion chamber caused by high compression (16 to 21 bar).

Diesel does not evaporate easily hence it is difficult to make air fuel mixture in case of diesel. To overcome this, only air enters the engine during intake stroke and the diesel is injected later.

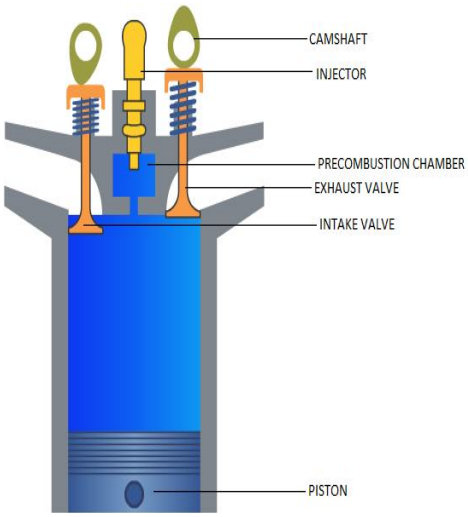
In Diesel engine having 4 strokes, Piston travel from Top dead center to Bottom dead center or Bottom dead center to Top dead center and is called stroke. The 4 strokes in Diesel engine are:

1. **Suction**-The air enters in the cylinder by intake valve, the piston moves from TDC (Top dead center) to BDC (Bottom dead center) and Intake valve gets open and exhaust valve get closed.
2. **Compression**- The air is compressed by the piston, the compression ratio is near about 16 to 21 bar, due to this it increase the temperature in the chamber, the piston moves BDC to TDC during compression stroke and that time intake and exhaust valves are closed.
3. **Power**- In power stroke the fuel is injected by the injector in the combustion chamber, then the fuel burn and explode instantly after getting injected into the cylinder, it self-ignite due to high temperature. During power stroke the intake and exhaust valves are close and the piston moves TDC to BDC.
4. **Exhaust**- The burn gases escape through the exhaust valves. The piston moves BDC to TDC and the exhaust valve is open and in take valve is closed during Exhaust stroke.

The diesel engine is invented by **Rudolf Christian Karl Diesel,** Diesel engines began to be used in automobiles in the 1930s.

2. Types of Diesel Engine

1. **Indirect injection engine (IDI)** – In indirect injection system the diesel is injected into the small chamber above piston which has an opening to the cylinder. This engine having two chambers 1st is called pre-combustion chamber and other is main chamber. Pre combustion chamber plays an important role. During the compression stroke, air from the main cylinder enters the pre-combustion chamber. At this moment, fuel is injected into the pre-combustion chamber and combustion begins. Pressure increases and the fuel droplets are forced through the small holes into the main cylinder, resulting in a very good mix of the fuel and air. The bulk of the combustion actually takes place in the main cylinder. This type of combustion chamber has multi-fuel capability because the temperature of the pre-chamber vaporizes the fuel before the main combustion event occurs.

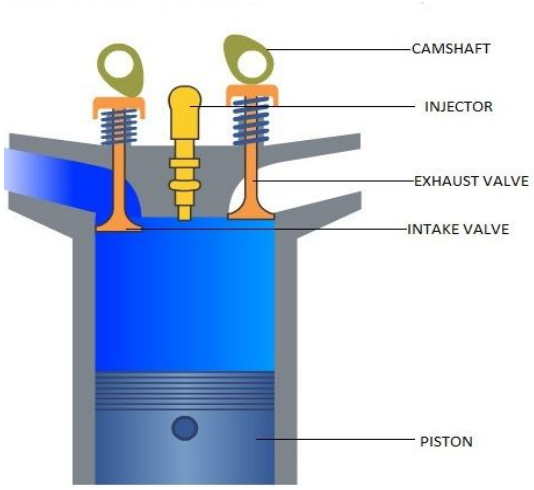


Disadvantages

IDI engine is not very fuel efficient. Fuel consumption is high because of heat loss due to large exposed areas and pressure loss due to air motion through the throats, but is much debated due to indirect injection having a much higher compression ratio.

3. Direct injection Engine (DI)

In direct injection system the diesel is injected directly inside the cylinder, just above the piston.

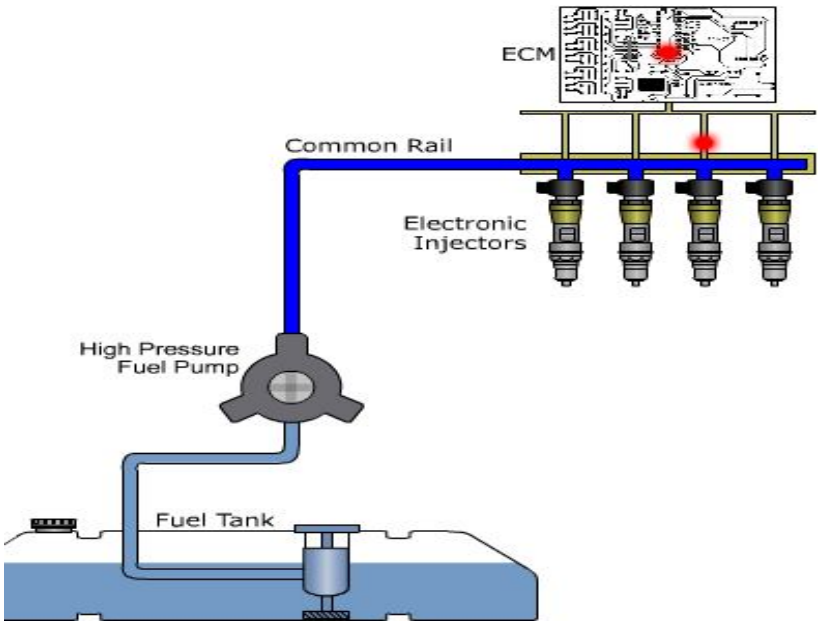


Disadvantages

Engine has higher noise level. The primary disadvantages of direct injection engines are complexity and cost. Direct injection systems are more expensive to build because their components must be more rugged -- they handle fuel at significantly higher pressures than indirect injection systems and the injectors themselves must be able to withstand the heat and pressure of combustion inside the cylinder.

4. Common Rail Direct Injection System (CRDI)

Some of the Indian car manufacturers who have widely accepted the use of common rail diesel engine in their respective car models are Hyundai Motors, Maruti Suzuki, Fiat, General Motors, Honda Motors, and Skoda. In the list of luxury car manufacturers, the Mercedes-Benz and BMW have also adopted this advanced engine technology. All the car manufacturers have given their own unique names to the common CRDI engine system. The common rail direction injection system is an advanced electronic engine management system using electronic injectors. In CRDI engine the fuel distribution is done by engine control module (ECM). The CRDI technology makes the diesel engine run like a petrol powered one. One of the main reasons for the increasing popularity of CRDI is its performance and fuel economy. A CRDI engine is based on direct injection technology and has common rails i.e. tubes which inject pressurized fuel directly into the engine. If we talk about ECM i.e. engine control module most commonly called the powertrain control module (PCM), is a type of electronic control unit that controls a series of actuators on an internal combustion engine to ensure optimal engine performance.For an engine with fuel injection, an engine control unit (ECU) will determine the quantity of fuel to inject based on a number of parameters. If the throttle position sensor is shows that the throttle pedal is pressed further down, the mass flow sensor will measure the amount of additional air being sucked into the engine and the ECU will inject fixed quantity of fuel into the engine (most of the engine fuel inlet quantity is fixed). If the engine coolant temperature sensor is shows that the engine has not warmed up yet, more fuel will be injected (causing the engine to run slightly 'rich' until the engine warms up). Mixture control on computer controlled carburetors works similarly but with a mixture control solenoid or stepper motor incorporated in the float bowl of the carburetor.



5. Scope

Today’s many common rail and unit injection systems already employ new injectors using stacked piezoelectric wafers in lieu of a solenoid, giving finer control of the injection event. Variable geometry turbochargers have flexible vanes, which move and let more air into the engine depending on load. This technology increases both performance and fuel economy. Boost lag is reduced as turbo impeller inertia is compensated for. Accelerometer pilot control (APC) uses an accelerometer to provide feedback on the engine's level of noise and vibration and thus instruct the ECU to inject the minimum amount of fuel that will produce quiet combustion and still provide the required power (especially while idling). The next generation of common rail diesels is expected to use variable injection geometry, which allows the amount of fuel injected to be varied over a wider range, and variable valve timing (see Mitsubishi's 4N13 diesel engine) similar to that on petrol engines. Particularly in the United States, coming tougher emissions regulations present a considerable challenge to diesel engine manufacturers. Ford's HyTrans Project has developed a system which starts the ignition in 400 ms, saving a significant amount of fuel on city routes, and there are other methods to achieve even more efficient combustion, such as homogeneous charge compression ignition, being studied. Japanese and Swedish vehicle manufacturers are also developing diesel engines that run on dimethyl ether (DME).Some recent diesel engine models utilize a copper alloy heat exchanger technology (CuproBraze) to take advantage of benefits in terms of thermal performance, heat transfer efficiency, strength/durability, corrosion resistance, and reduced emissions from higher operating temperatures.

References

[1] AutoNos ,Autonaked.blogspot.com (saxena and joseph blog)
[2] Solar Energy International Biodiesel Workshop
[3] Niklas Nordin, Advanced Combustion, Scania