UNIT 4 DIESEL ENGINE POWER PLANT

Structure

4.1 INTRODUCTION

A generating station in which diesel engine is used as the prime mover for the generation of electrical energy is known as **diesel power station**.

In a diesel power station, diesel engine is used as the prime mover. The diesel burns inside the engine and the products of this combustion act as the working fluid to produce mechanical energy. The diesel engine drives alternator which converts mechanical energy into electrical energy. As the generation cost is considerable due to high price of diesel, therefore, such power stations are only used to produce small power.

Although steam power stations and hydro-electric plants are invariably used to generate bulk power at cheaper costs, yet diesel power stations are finding favour at places where demand of power is less, sufficient quantity of coal and water is not available and the transportation facilities are inadequate. This plants are also standby sets for continuity of supply to important points such as hospitals, radio stations, cinema houses and telephone exchanges.

Advantages

(a) The design and layout of the plant are quite simple.

(b) It occupies less space as the number and size of the auxiliaries is small.

(c) It can be located at any place.

(d) It can be started quickly and it can pickup load in a short time.

(e) There are no standby losses.

(f) It requires less quantity of water for cooling.

(g) The overall cost is much less than that of steam power station of same capacity.

(h) The thermal efficiency of the plant is higher than that of a steam power station.

(i) It requires less operating staff.

Disadvantages

(a) The plant has high running charges as the fuel (diesel) used is costly.

(b) The plant doesn't work satisfactorily under overload conditions for a longer period.

(c) The plant can only generate small power.

(d) The cost of lubrication is generally high.

(e) The maintenances charges are generally high

Objectives

After studying this unit, you should be able to

- understand about diesel engine power plant,
- explain fuel injection system and its functions, and
- describe various injection schemes.

4.2 ESSENTIAL ELEMENTS OF DIESEL POWER PLANT

Fuel Supply System

It consists of storage tank, strainers, fuel transfer pump and all day fuel tank. The fuel oil is supplied at the plant site by rail or road. The oil is stored in the storage tank. From the storage tank, oil is pumped to smaller all day tank at daily or short intervals. From this tank, fuel oil is passed through strainers to remove suspended impurities. The clean oil is injected into the engine by fuel injection pump.

Air Intake System

This system supplies necessary air to the engine for fuel combustion. It consists of pipes for the supply of fresh air to the engine manifold. Filters are provided to remove dust particles from air which may act as abrasive in the engine cylinder.

Because a diesel engine requires close tolerances to achieve its compression ratio, and because most diesel engines are either turbocharged or supercharged, the air entering the engine must be clean, free of debris, and as cool as possible. Also, to improve a turbocharged or supercharged engine's efficiency, the compressed air must be cooled after being compressed. The air intake system is designed to perform these tasks. Air intake systems are usually one of two types, wet or dry. In a wet filter intake system, as shown in the Figure 4.1, the air is sucked or bubbled through a housing that holds a bath of oil such that the dirt in the air is removed by the oil in the filter. The air then flows through a screen-type material to ensure any entrained oil is removed from the air. In a dry filter system, paper, cloth, or a metal screen material is used to catch and trap dirt before it enters the engine. In addition to cleaning the air, the intake system is usually designed to intake fresh air from as far away from the engine as practicable, usually just outside of the engine's building or enclosure. This provides the engine with a supply of air that has not been heated by the engine's own waste heat. The reason for ensuring that an engine's air supply is as cool as possible is that cool air is denser than hot air. This means that, per unit volume, cool air has more oxygen than hot air.

Thus, cool air provides more oxygen per cylinder charge than less dense, hot air. More oxygen means a more efficient fuel burn and more power.

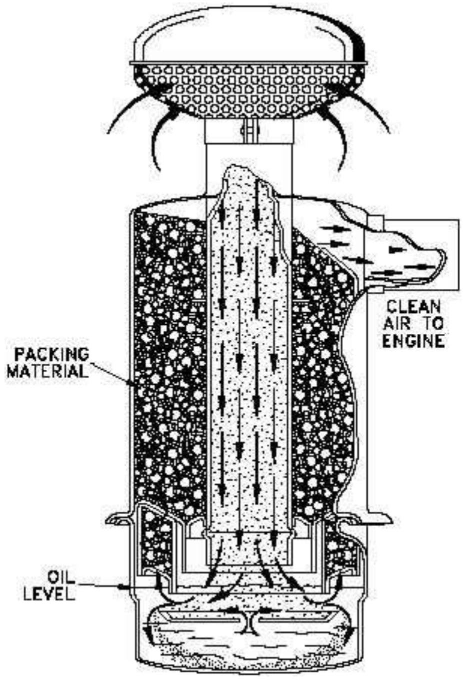


Figure 4.1 : Air Intake System

After being filtered, the air is routed by the intake system into the engine's intake manifold or air box. The manifold or air box is the component that directs the fresh air to each of the engine's intake valves or ports. If the engine is turbocharged or supercharged, the fresh air will be compressed with a blower and possibly cooled before entering the intake manifold or air box. The intake system also serves to reduce the air flow noise.

Exhaust System

This system leads the engine exhaust gas outside the building and discharges it into atmosphere. A silencer is usually incorporated in the system to reduce the noise level.

The exhaust system of a diesel engine performs three functions. First, the exhaust system routes the spent combustion gasses away from the engine, where they are diluted by the atmosphere. This keeps the area around the engine habitable. Second, the exhaust system confines and routes the gases to the turbocharger, if used. Third, the exhaust system allows mufflers to be used to reduce the engine noise.

Cooling System

The heat released by the burning of fuel in the engine cylinder is partially converted into work. The remainder part of the heat passes through the cylinder wall, piston, rings etc. and may cause damage to system. In order to keep the temperature of the engine parts within the safe operating limits, cooling is provided. The cooling system consists of a water source, pump and cooling towers. The pump circulates water through cylinder and head jacket. The water takes away heat form the engine and it becomes hot. The hot water is cooled by cooling towers and re circulated for cooling.

Lubricating System

The system minimises the wear of rubbing surfaces of the engine. It comprises of lubricating oil tank, pump, filter and oil cooler. The lubrication oil is drawn from the lubricating oil tank by the pump and is passed through filter to remove impurities .The clean lubrication oil is delivered to the points which require lubrication. The oil coolers incorporated in the system keep the temperature of the oil low.

An internal combustion engine would not run for even a few minutes if the moving parts were allowed to make metal-to-metal contact. The heat generated due to the tremendous amounts of friction would melt the metals, leading to the destruction of the engine. To prevent this, all moving parts ride on a thin film of oil that is pumped between all the moving parts of the engine. The oil serves two purposes. One purpose is to lubricate the bearing surfaces. The other purpose is to cool the bearings by absorbing the friction- generated heat. The flow of oil to the moving parts is accomplished by the engine's internal lubricating system.

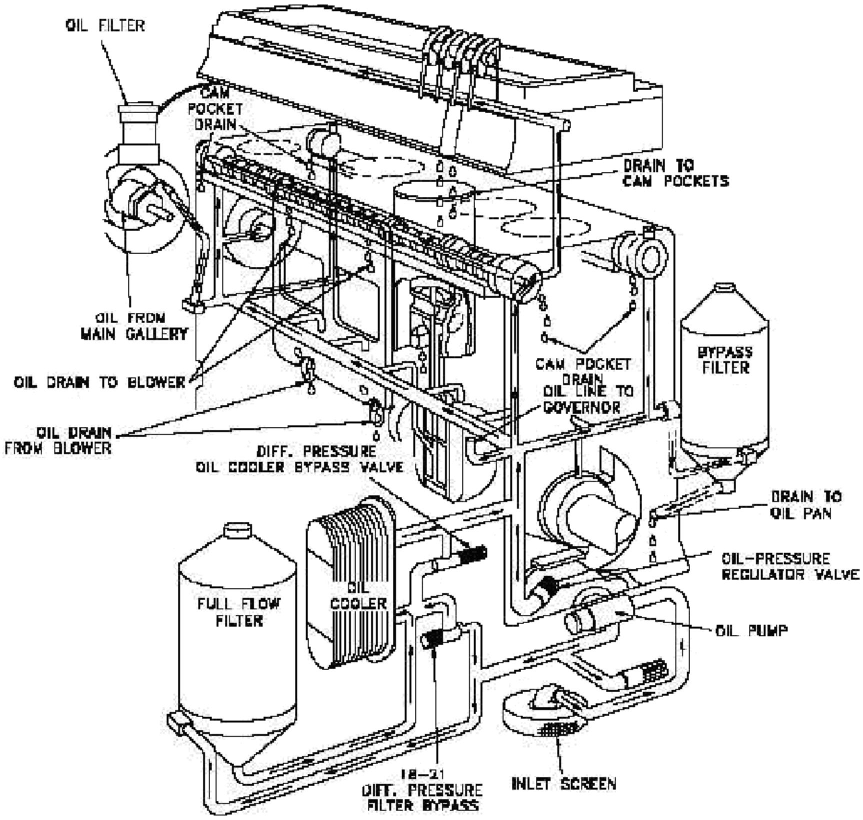


Figure 4.2 : Lubricating System

Oil is accumulated and stored in the engine's oil pan where one or more oil pumps take suction and pump the oil through one or more oil filters as shown in the figure. The filters clean the oil and remove any metal that the oil has picked up due to wear. The cleaned oil then flows up into the engine's oil galleries. A pressure relief valve(s) maintains oil pressure in the galleries and returns oil to the oil pan upon high pressure. The oil galleries distribute the oil to all the bearing surfaces in the engine. Once the oil has cooled and lubricated the bearing surfaces, it flows out of the bearing and gravity-flows back into the oil pan. In medium to large diesel engines, the oil is also cooled before being distributed into the block. This is accomplished by either internal or external oil cooler. The lubrication system also supplies oil to the engine’s governor.

Engine Starting System

This is an arrangement to rotate the engine initially, while starting, until firing starts and the unit runs with its own power. Small sets are started manually by handles but for larger units, compressed air is used for starting. In the latter case, air at high pressure is admitted to a few of the cylinders, making them to act as reciprocating air motors to turn over the engine shaft. The fuel is admitted to the remaining cylinders which makes the engine to start under its own power.

Starting Circuits

Diesel engines have as many different types of starting circuits as there are types, sizes, and manufacturers of diesel engines. Commonly, they can be started by air motors, electric motors, hydraulic motors, and manually. The start circuit can be a simple manual start pushbutton, or a complex auto-start circuit. But in almost all cases the following events must occur for the starting engine to start.

(a) The start signal is sent to the starting motor. The air, electric, or hydraulic motor, will engage the engine's flywheel.

(b) The starting motor will crank the engine. The starting motor will spin the engine at a high enough rpm to allow the engine's compression to ignite the fuel and start the engine running.

(c) The engine will then accelerate to idle speed. When the starter motor is overdriven by the running motor it will disengage the flywheel.

Because a diesel engine relies on compression heat to ignite the fuel, a cold engine can rob enough heat from the gasses that the compressed air falls below the ignition temperature of the fuel. To help overcome this condition, some engines (usually small to medium sized engines) have glow plugs. Glow plugs are located in the cylinder head of the combustion chamber and use electricity to heat up the electrode at the top of the glow plug. The heat added by the glow plug is sufficient to help ignite the fuel in the cold engine. Once the engine is running, the glow plugs are turned off and the heat of combustion is sufficient to heat the block and keep the engine running. Larger engines usually heat the block and/or have powerful starting motors that are able to spin the engine long enough to allow the compression heat to fire the engine. Some large engines use air start manifolds that inject compressed air into the cylinders which rotates the engine during the start sequence.

4.3 FUEL INJECTION SYSTEM

Fuel injection is a system for mixing fuel with air in an internal combustion engine. A fuel injection system is designed and calibrated specifically for the type of fuel it will handle. Most fuel injection systems are for diesel applications. With the advent of electronic fuel injection (EFI), the diesel gasoline hardware has become similar. EFI's programmable firmware has permitted common hardware to be used with different fuels. Carburetors were the predominant method used to meter fuel before the widespread use of fuel injection. A variety of injection systems have existed since the earliest usage of the internal combustion engine.

The primary difference between carburetors and fuel injection is that fuel injection atomizes the fuel by forcibly pumping it through a small nozzle under high pressure, while a carburetor relies on low pressure created by intake air rushing through it to add the fuel to the air stream.

The fuel injector is only a nozzle and a valve: the power to inject the fuel comes from a pump or a pressure container farther back in the fuel supply.

Objectives

The functional objectives for fuel injection systems can vary. All share the central task of supplying fuel to the combustion process, but it is a design decision how a particular system will be optimized. There are several competing objectives such as :

- power output,
- fuel efficiency,
- emissions performance,
- reliability,
- smooth operation,

- initial cost,
- maintenance cost,
- diagnostic capability, and
- range of environmental operation.

Certain combinations of these goals are conflicting, and it is impractical for a single engine control system to fully optimize all criteria simultaneously. In practice, automotive engineers strive to best satisfy a customer's needs competitively. The modern digital electronic fuel injection system is far more capable at optimizing these competing objectives consistently than a carburetor. Carburetors have the potential to atomize fuel better.

Benefits

Operational benefits include smoother and more dependable engine response during quick throttle transitions, easier and more dependable engine starting, better operation at extremely high or low ambient temperatures, increased maintenance intervals, and increased fuel efficiency. On a more basic level, fuel injection does away with the choke which on carburetor-equipped systems must be operated when starting the engine from cold and then adjusted as the engine warms up.

An engine’s air/fuel ratio must be precisely controlled under all operating conditions to achieve the desired engine performance, emissions, and fuel economy. Modern electronic fuel-injection systems meter fuel very accurately, and use closed loop fuel-injection quantity-control based on a variety of feedback signals from an oxygen sensor, a mass airflow (MAF) or manifold absolute pressure (MAP) sensor, a throttle position (TPS), and at least one sensor on the crankshaft and camshaft to monitor the engine's rotational position. Fuel injection systems can react rapidly to changing inputs and control the amount of fuel injected to match the engine's dynamic needs across a wide range of operating conditions such as engine load, ambient air temperature, engine temperature, fuel octane level, and atmospheric pressure.

A multipoint fuel injection system generally delivers a more accurate and equal mass of fuel to each cylinder, thus improving the cylinder-to-cylinder distribution. Exhaust emissions are cleaner because the more precise and accurate fuel metering reduces the concentration of toxic combustion byproducts leaving the engine, and because exhaust cleanup devices such as the catalytic converter can be optimized to operate more efficiently since the exhaust is of consistent and predictable composition.

Fuel injection generally increases engine fuel efficiency. With the improved cylinder-to-cylinder fuel distribution, less fuel is needed for the same power output. When cylinder-to-cylinder distribution is less than ideal, as is always the case to some degree with a carburetor or throttle body fuel injection, some cylinders receive excess fuel as a side effect of ensuring that all cylinders receive sufficient fuel. Power output is asymmetrical with respect to air/fuel ratio; burning extra fuel in the rich cylinders does not reduce power nearly as quickly as burning too little fuel in the lean cylinders. However, rich-running cylinders are undesirable from the standpoint of exhaust emissions, fuel efficiency, engine wear, and engine oil contamination. Deviations from perfect air/fuel distribution, however subtle, affect the emissions, by not letting the combustion events at the chemically ideal (stoichiometric) air/fuel ratio. Grosser distribution problems eventually begin to reduce efficiency, and the grossest distribution issues finally affect power. Increasingly poorer air/fuel distribution affects emissions, efficiency, and power, in that order. By optimizing the homogeneity of cylinder-to-cylinder mixture distribution, all the cylinders approach their maximum power potential and the engine's overall power output improves.

A fuel-injected engine often produces more power than an equivalent carbureted engine. Fuel injection alone does not necessarily increase an engine's maximum potential output. Increased airflow is needed to burn more fuel, which in turn releases more energy and produces more power. The combustion process converts the fuel's chemical energy into heat energy, whether the fuel is supplied by fuel injectors or a carburetor. However, airflow is often improved with fuel injection, the components of which allow more design freedom to improve the air's path into the engine. In contrast, a carburetor's mounting options are limited because it is larger, it must be carefully oriented with respect to gravity, and it must be equidistant from each of the engine's cylinders to the maximum practicable degree. These design constraints generally compromise airflow into the engine. Furthermore, a carburetor relies on a restrictive venturi to create a local air pressure difference, which forces the fuel into the air stream. The flow loss caused by the venturi, however, is small compared to other flow losses in the induction system. In a well-designed carburetor induction system, the venturi is not a significant airflow restriction.

4.3.1 Basic Function

The process of determining the necessary amount of fuel, and its delivery into the engine, are known as fuel metering. Early injection systems used mechanical methods to meter fuel (non electronic or mechanical fuel injection). Modern systems are nearly all electronic, and use an electronic solenoid (the injector) to inject the fuel. An electronic engine control unit calculates the mass of fuel to inject.

Modern fuel injection schemes follow much the same setup. There is a mass airflow sensor or manifold absolute pressure sensor at the intake, typically mounted either in the air tube feeding from the air filter box to the throttle body, or mounted directly to the throttle body itself. The mass airflow sensor does exactly what its name implies; it senses the mass of the air that flows past it, giving the computer an accurate idea of how much air is entering the engine. The next component in line is the Throttle Body. The throttle body has a throttle position sensor mounted onto it, typically on the butterfly valve of the throttle body. The throttle position sensor (TPS) reports to the computer the position of the throttle butterfly valve, which is used to calculate the load upon the engine. The fuel system consists of a fuel pump (typically mounted in-tank), a fuel pressure regulator, fuel lines (composed of either high strength plastic, metal, or reinforced rubber), a fuel rail that the injectors connect to, and the fuel injector(s). There is a coolant temperature sensor that reports the engine temperature, which the engine uses to calculate the proper fuel ratio required. In sequential fuel injection systems there is a camshaft position sensor to determine which fuel injector to fire.

The fuel injector acts as the fuel-dispensing nozzle. It injects liquid fuel directly into the engine's air stream. In almost all cases this requires an external pump. The pump and injector are only two of several components in a complete fuel injection system.

An EFI system requires several peripheral components in addition to the injector(s), in order to duplicate all the functions of a carburetor. A point worth noting during times of fuel metering repair is that early EFI systems are prone to diagnostic ambiguity. A single carburetor replacement can accomplish what might require numerous repair attempts to identify which one of the several EFI system components is malfunctioning. Newer EFI systems can be very easy to diagnose due to the increased ability to monitor the realtime data streams from the individual sensors.

Typical EFI Components

- Animated cut through diagram of a typical fuel injector
- Injectors
- Fuel Pump
- Fuel Pressure Regulator

- ECM – Engine Control Module; includes a digital computer and circuitry to communicate with sensors and control outputs
- Wiring Harness
- Various Sensors (Some of the sensors required are listed here)
- Crank/Cam Position (Hall effect sensor)
- Airflow (MAF sensor)
- Exhaust Gas Oxygen (Oxygen sensor, EGO sensor, UEGO sensor).

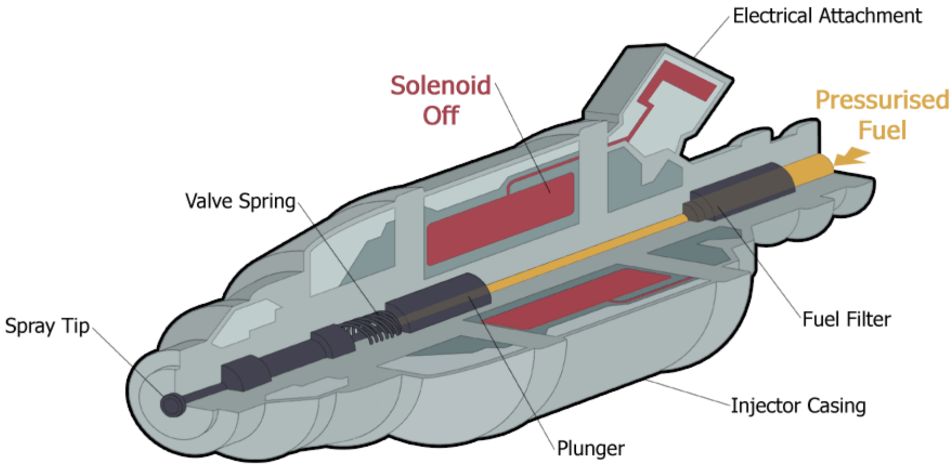


Figure 4.2 : Typical EFI Components

4.3.2 Functional Description

Central to an EFI system is a computer called the Engine Control Unit (ECU), which monitors engine operating parameters via various sensors. The ECU interprets these parameters in order to calculate the appropriate amount of fuel to be injected, among other tasks, and controls engine operation by manipulating fuel and/or air flow as well as other variables. The optimum amount of injected fuel depends on conditions such as engine and ambient temperatures, engine speed and workload, and exhaust gas composition.

The electronic fuel injector is normally closed, and opens to inject pressurized fuel as long as electricity is applied to the injector’s solenoid coil. The duration of this operation, called the pulse width, is proportional to the amount of fuel desired. The electric pulse may be applied in closely-controlled sequence with the valve events on each individual cylinder (in a sequential fuel injection system), or in groups of less than the total number of injectors (in a batch fire system).

Since the nature of fuel injection dispenses fuel in discrete amounts, and since the nature of the 4-stroke-cycle engine has discrete induction (air-intake) events, the ECU calculates fuel in discrete amounts. In a sequential system, the injected fuel mass is tailored for each individual induction event. Every induction event, of every cylinder, of the entire engine, is a separate fuel mass calculation, and each injector receives a unique pulse width based on that cylinder’s fuel requirements.

It is necessary to know the mass of air the engine “breathes” during each induction event. This is proportional to the intake manifold's air pressure/temperature, which is proportional to throttle position. The amount of air inducted in each intake event is known as “air-charge”, and this can be determined using several methods.

The three elemental ingredients for combustion are fuel, air and ignition. However, complete combustion can only occur if the air and fuel is present in the exact stoichiometric ratio, which allows all the carbon and hydrogen from the fuel to combine with all the oxygen in the air, with no undesirable polluting leftovers. Oxygen sensors monitor the amount of oxygen in the exhaust, and the ECU uses this information to adjust the air-to-fuel ratio in real-time.

To achieve stoichiometry, the air mass flow into the engine is measured and multiplied by the stoichiometric air/fuel ratio. The required fuel mass that must be injected into the engine is then translated to the required pulse width for the fuel injector.

Deviations from stoichiometry are required during non-standard operating conditions such as heavy load, or cold operation. In early fuel injection systems this was accomplished with a thermotime switch.

Pulse width is inversely related to pressure difference across the injector inlet and outlet. For example, if the fuel line pressure increases (injector inlet), or the manifold pressure decreases (injector outlet), a smaller pulse width will admit the same fuel. Fuel injectors are available in various sizes and spray characteristics as well. Compensation for these and many other factors are programmed into the ECU’s software.

4.4 VARIOUS INJECTION SCHEMES

4.4.1 Throttle Body Injection Systems

Throttle body injection is a form of continuous injection-one or two injectors delivering fuel to the engine from one central point in the intake manifold. Though throttle body injection does not provide the precise fuel distribution of the direct port injection, it is cheaper to produce and to provide a degree of precision fuel metering. The throttle body injection unit is usually an integral one and contains all of the major system components. The unit mounts on the intake manifold in the same manner as a carburetor. Airflow sensors and electronic computers usually are mounted in the air cleaner body.

Figure 4.3 : Throttle Body Injection Unit

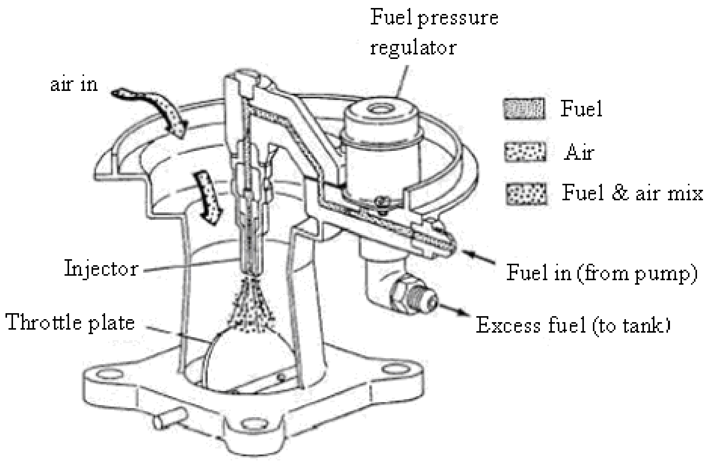


Figure 4.4 : Throttle Body Injection

4.4.2 Continuous Fuel Injection Systems

Continuous fuel injection systems provide a continuous spray of fuel from each injector at a point before the intake valve. Timed injection systems, though a necessity on diesel engines, cost more than continuous systems. They are used on gasoline engines only when more precise fuel metering is desired.

In the continuous system, fuel is delivered to the mixture control unit by the fuel pump.

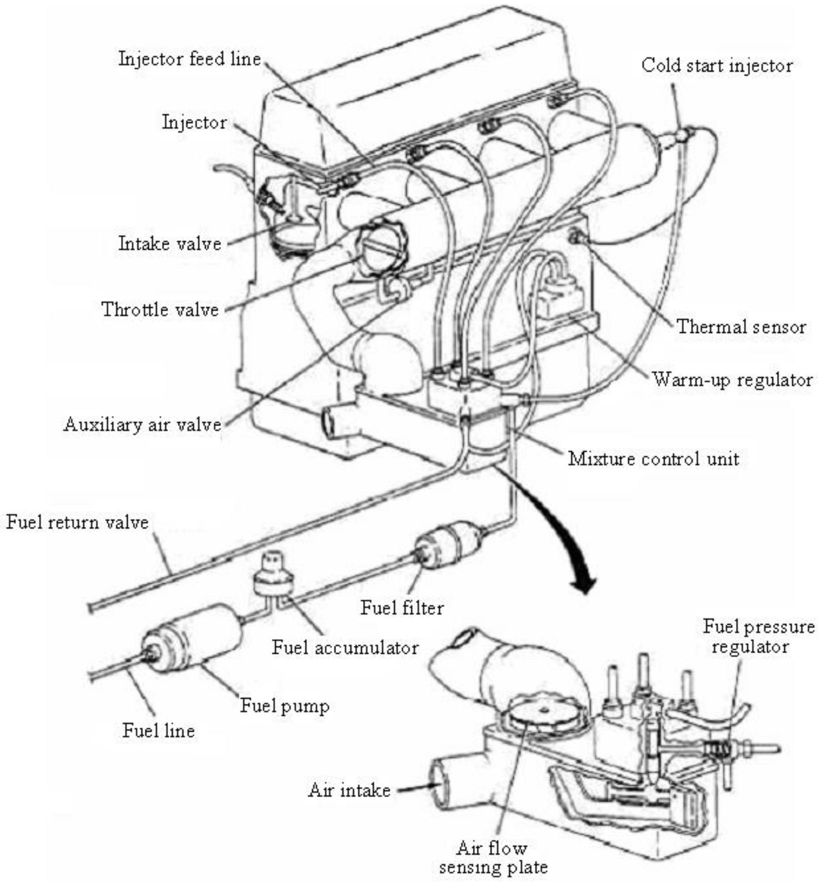


Figure 4.5 : Continuous Injection

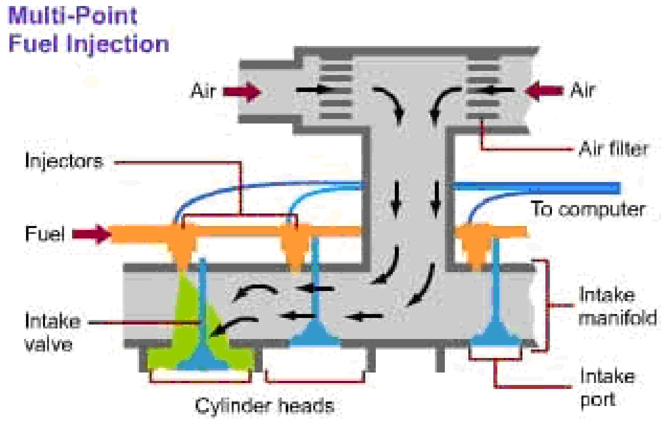
The fuel pressure regulator maintains fuel line pressure by sending excess fuel back to the gas tank. The mixture control unit regulates the amount of fuel that is sent to the injectors, based on the amount of airflow through the intake and the engine temperature. The mixture control unit on mechanical systems is operated by the airflow sensing plate and the warm-up regulator. This information on an electronic system is fed into a computer that regulates the fuel injection rate. The accelerator pedal regulates the rate of airflow through the intake by opening and closing the throttle valve. A cold-start injector is installed in the intake to provide a richer mixture during engine start-up and warm-up. It is actuated by electric current from the thermal sensor whenever the temperature of the coolant is below a certain level. The cold-start injector works in conjunction with the auxiliary air valve. Its function is to speed up the engine idle during warm-up. It is also actuated by the thermal sensor.

4.4.3 Central Port Injection (CPI)

It uses tubes with poppet valves from a central injector to spray fuel at each intake port rather than the central throttle-body. The 2 variants were CPFI from 1992 to 1995 and CSFI from 1996 and on. CPFI is a *batch-fire* system, in which fuel is injected to all ports simultaneously. The 1996 and later CSFI system sprays fuel *sequentially*.

4.4.4 Multi-point Fuel Injection

Multi-point fuel injection injects fuel into the intake port just upstream of the cylinder's intake valve, rather than at a central point within an intake manifold, referred to as SPFI, or single point fuel injection. MPFI (or just MPI) systems can be sequential, in which injection is timed to coincide with each cylinder's intake stroke, batched, in which fuel is injected to the cylinders in groups, without precise synchronization to any particular cylinder's intake stroke, or simultaneous, in which fuel is injected at the same time to all the cylinders.



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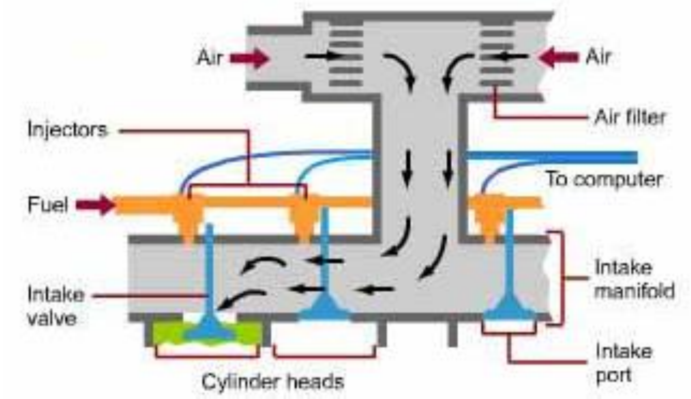

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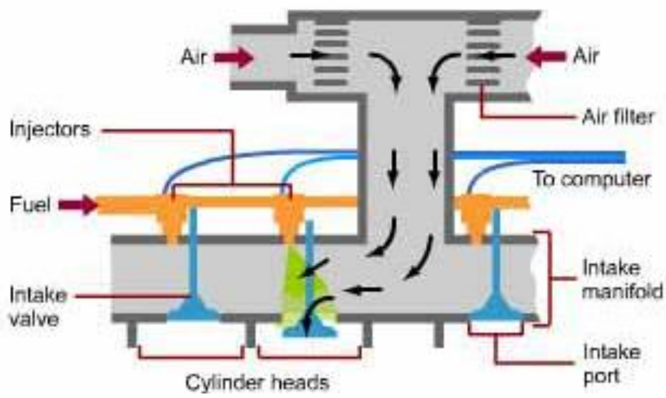

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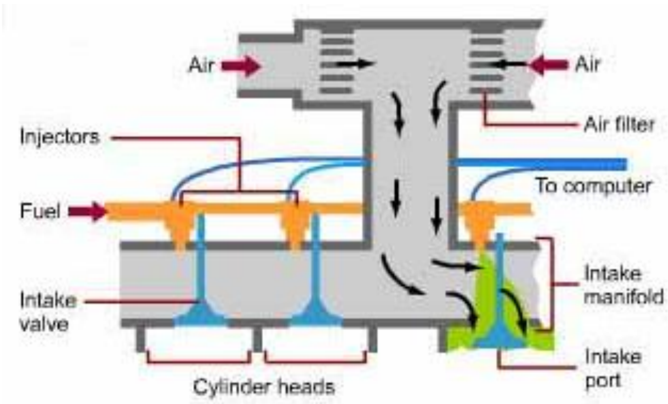

Stage 4

4.4.5 Direct Injection

Many diesel engines feature direct injection (DI). The injection nozzle is placed inside the combustion chamber and the piston incorporates a depression (often toroidal) where initial combustion takes place. Direct injection diesel engines are generally more efficient and cleaner than indirect injection engines. By virtue of better dispersion and homogeneity of the directly injected fuel, the cylinder and piston are cooled, thereby permitting higher compression ratios and more aggressive ignition timing, with resultant enhanced output. More precise management of the fuel injection event also enables better control of emissions. Finally, the homogeneity of the fuel mixture allows for leaner air/fuel ratios, which together with more precise ignition timing can improve fuel economy. Along with this, the engine can operate with stratified mixtures and hence avoid throttling losses at low and part load. Some direct-injection systems incorporate piezo electronic injectors. With their extremely fast response time, multiple injection events can occur during each power stroke of the engine.

Direct fuel injection costs more than indirect injection systems; the injectors are exposed to more heat and pressure, so more costly materials and higher-precision electronic management systems are required.

4.4.6 Performance Testing of Diesel Engine Power Plant

The performance of the diesel engine focuses on the power and efficiency. The engine varies with parameters of the engine like piston speed, air-fuel ratio, compression ratio inlet air-pressure and temperature. The two usual conditions under which I.C. engines are operated are :

(a) constant speed with variable load, and

(b) variable speed with variable load.

The first situation is found in a.c. generator drives and the second one in automobiles, railway engines and tractors etc. A series of tests are carried out on the engine to determine its performance characteristics, such as : indicated power (I.P.), Brake power (B.P.), Frictional Power (F.P.), Mechanical efficiency (η_m), thermal efficiency, fuel consumption and also specific fuel consumption etc. The measurement of these quantities is discussed below.

Indicated Mean Effective Pressure (IMRP)

In order to determine the power developed by the engine, the indicator diagram of engine should be available. From the area of indicator diagram it is possible to find an average gas pressure which, while acting on piston throughout one stroke, would account for the network done. This pressure is called indicated mean effective pressure (IMEP).

Indicated Horse Power (IHP)

The indicated horse power (IHP) of the engine can be calculated as follows :

$$IHP = \frac{P_m \; LANn}{4500 \times k}$$

P_m = IMEP, kg/cm^2,

L = Length of stroke, metres,

A = Piston areas, cm^2,

N = Speed, RPM,

n = Number of cylinders, and

k = 1 for two stroke engine

= 2 for four stroke engine.

Brake Horse Power (BHP)

Brake horse power is defined as the net power available at the crankshaft. It is found by measuring the output torque with a dynamometer.

$$BHP = \frac{2\pi\ NT}{4500}$$

T = Torque, kg.m.

Frictional Horse Power (FHP)

The difference of IHP and BHP is called FHP. It is utilized in overcoming frictional resistance of rotating and sliding parts of the engine.

$$FHP = IHP - BHP$$

Indicated Thermal Efficiency (η_i)

It is defined as the ratio of indicated work to thermal input.

$$\eta_i = \frac{IHP \times 4500}{(W \times C_v \times J)}$$

W = Weight of fuel supplied, kg per minute,

C_v = Calorific value of fuel oil, kcal/kg, and

J = Joules equivalent = 427.

Brake Thermal Efficiency (Overall Efficiency)

It is defined as the ratio of brake output to thermal input.

$$\eta_b = \frac{BHP \times 4500}{(W \times C_v \times J)}$$

Mechanical Efficiency (η_m)

It is defined as the ratio of BHP to IHP. Therefore,

$$\eta_i = \frac{BHP}{IHP}$$

SAQ 1

(a) What are the advantages and disadvantages of diesel engine power plants?

(b) State the applications of diesel power plant.

(c) Describe the essential components of the diesel power plant.

(d) Name and explain briefly various types of fuel injection systems.

4.5 SUMMARY

In this unit, we have learnt the functioning of diesel power plant. The diesel engine drives alternator, which converts mechanical energy in to electrical energy. In this unit, we have also studied the concept of fuel injection system and its functioning. The unit, also elaborated on various types of injection schemes. The diesel engine plants are mainly utilised to generate small power output. Which are mostly utilised as standby modes, when power not takes place? Its cost is high.

4.6 ANSWERS TO SAQs

Refer the preceding text for all the Answers to SAQs.