Diesel fuel

Objective: At the end of this lesson you shall be able to
- **state the concept of quiet diesel technology**
- **state the fuel requirement**
- **explain fuel specification and characteristics of fuel.**

Function of fuel injection system

In this system diesel fuel is injected into the combustion chamber at the end of compression stroke in diesel engine.

If the amount and rate of fuel being injected is not measured, will result in uneven running of engine and it leading to vibrations and loss of power. The diesel fuel injection should be fully atomized into fine particles for it spreads one immediately in the combustion chamber to mix up with hot compressed air for high combustion. The injection should take place at the correct time, according firing order of the engine.

Fuel system must fulfil the following requirement

- Time the fuel injection and distribute the fuel properly in the combustion chamber.
- Measure the correct quantity of fuel injected.
- Control the rate of fuel injection.
- Fully atomize the fuel.
- Develop pressures well in excess of the combustion chamber pressure.

An engine converts heat energy of fuel into mechanical energy. The engine fuel may be solid, liquid or gas. Solid fuel (coal) is used in external combustion engine. e.g. steam engine. Liquid gases and fuel are used in internal combustion Engines.

Specification and characteristics of fuel

Octane number

It is a measure to determine the burning quality of the gasoline. It has the tendency to resist knocking in an engine. The higher the octane number the lesser the tendency to knock.

Volatility

Volatility is the ability of the gasoline to evaporate, so that its vapour will adequately mix with air for combustion. Vapourised fuel will burn easily.

Viscosity

This indicates quality of fuel to flow. Lower viscosity fuel will flow more easily than that of higher viscosity.

Sulphur content

Gasoline contains some sulphur. Sulphur present in fuel increases corrosion of engine and therefore it is reduced at the refinery to the maximum possible extent.

Additives

Several additives are put in gasoline to control harmful deposit and to increase anti-freezing quality of the engine.

Detergents are also added to clean certain critical components inside the engine

Diesel fuel

Diesel engine fuel is a highly refined distillate fuel obtained from fractional distillation of crude oils

There are light medium and heavy diesel fuel available in the market, which are used as per the recommendations of engine manufacturers.

Cetane number

Cetane number (cetane rating) is an indicator of the combustion speed of diesel fuel and compression needed for ignition. It is an inverse of the similar octane rating for gasoline. The CN is an important factor in determining the quality of diesel fuel, but not the only one; other measurements of diesel's quality include energy content, density, lubricity, cold-flow properties and sulphur content.

Concept of quiet diesel technology

Technology for quieter, smoother diesel

The combustion pressure in diesel engine cylinder rises intensely and the maximum pressure is extremely high compared with a petrol engine, because of the differences in the combustion method. As a result, diesel engines generally produce more noise, vibration and harshness than petrol engines, and this is a major complaint among diesel users. Efforts to reduce the NVH to the level of petrol engines by making full use of the latest technology.

Pilot injection system to reduce combustion pressure

The sudden rise in combustion pressure is a major source of diesel engine noise. By the development of the common rail high-pressure injection system and electronic fuel injection, flexible and precise control over the injection timing and amount made possible. The fuel pressure rise controlled by smoothing the combustion process by pilot injection, a method in which a small amount of fuel is injected and ignited just before the main fuel injection process. This is known as pilot injection control process.

Increased rigidity of engine structure

The maximum cylinder pressure in diesel engine is considerably high and the pressure rise during combustion is very rapid, causing the engine vibration and noise. Also, diesel engine components such as the piston are solidly built in

order to endure the high pressure and pressure increase ratio. The extra weight of these components translates into increased inertia, the scale of vibration. it is possible to control noise generation by reforming the engine structure to absorb vibration and to reduce the overall level of vibration. Moreover, vibration travels from the piston to the connecting rod, crankshaft and engine block. This form of vibration attenuated by employing a ladder frame structure with a more rigid crankshaft bearing.

Other technologies used to reduce NVH (Noise vibration and harshness)

A secondary balancer is use to help smooth out the vibrations characteristic of four-cylinder engines.

pairs of gears or scissors gears, working side by side with the same numbers of teeth, help to reduce mechanical engine noise by reducing the gear play.

The two sides of the flywheel, which face the engine and the transmission respectively, are each fitted with a spring and damper to absorb vibration caused during changes in speed.

Clean diesel technology

Clean diesel is a new generation of diesel made up of a three part system.

1 Advanced engines

Highly efficient diesel engines

2 Cleaner diesel fuel

Ultra-low sulfur diesel

3 Effective emissions controls

Advanced emissions control

This new system ensures that advanced diesel engines will continue to play an important role in the transport of people and goods in the future, while helping meet greenhouse gas and clean air objectives in the world.

Technical innovation has helped progressively to lower vehicle emissions - over the last 15 years, nitrogen oxides (NOx) limits for diesel car engines have been reduced by 84% and particulates (PM) by 90%.

15% less CO_2 Emissions than equivalent petrol-powered vehicles. Diesel vehicles contribute to reducing CO_2 emissions from road transport and therefore to reduce climate change. Clean diesel fuel technology is involved with diesel fuel, engine & emission control.

Fuel tank and fuel pipes

Objectives: At the end of this lesson you shall be able to
- **explain the function of the fuel tank**
- **explain the function of each part of fuel tank**
- **explain the function of fuel pipes.**

Fuel tank

The Fuel tank is provided for storing diesel required for running the engine. It is constructed of either pressed sheet metal with welded seams and special coating to prevent corrosion or fiber glass reinforced plastic materials.

It may be round or rectangular in shape. It is mounted above the engine assembly.

Parts of the fuel tank

Filler neck and cap

Baffle

Fuel gauge sensing unit (Float)

Filter

Sediment bowl and drain plug

Filler neck is provided for pumping diesel into the fuel tank. A cap is provided for closing the tank tightly. A vent hole is provided either in filler neck or in cap to maintain atmospheric pressure in the tank above the fuel.

Baffles are provided in the fuel tank to minimize the slushing of fuel due to movement inside the tank.

Fuel gauge sensing unit is provided to know the level of fuel available in tank. It consists of a float resting on the surface of the diesel in the tank. The float with the help of the electrical sensing system indicates the level of the fuel available in the tank, on the dash board fuel-gauge.

Filter is provided at the lower end of the suction pipe. It filters heavy foreign particles.

At the bottom of the fuel tank a drain plug is provided to collect sediments and drain it out of the tank.

Fuel pipe

Fuel pipe between the fuel tank and the feed pump is called suction pipe, the pipes between F.I.P. and the injectors are called high pressure pipes. An over flow pipe is provided on fuel filter bowl and injectors to supply excess fuel back to fuel tank.

Fuel filter

Objectives: At the end of this lesson you shall be able to
- **state the need of a fuel filter**
- **explain the types of fuel filter systems**
- **explain the need for bleeding the fuel system**
- **state the function of water separator.**

Need of fuel filter

Effective filtering of fuel, oil is most important for long trouble free functioning of the engine. Diesel fuel while transporting and handling has chances of getting contaminated by water, dirt, bacteria and wax crystals. Dirt is the worst enemy of the fuel injection equipment. Dirt contamination can be the result of careless filling of the fuel tank. When fuel tank is not filled, moist air condenses inside the metal wall of the fuel tank resulting in water contamination of the fuel.

For these reasons a very efficient filtering system is required to remove these impurities.

Types of fuel filter system

There are two types of fuel filtering system.

Single filter system

Two stage filter system

In a single filtering system one single filter assembly is used in between feed pump and fuel pump. The single filter in this system is capable of separating dirt from fuel. It should be replaced periodically as per the recommendations of the manufacturers.

In a two stage filter system, primary filter (1) (Fig 1) is used for filtering large solid contaminants and most of the water in the fuel is also removed by this filter. The secondary filter (2) is made of a paper element. This filter controls the size of the particles allowed to pass into the fuel injectors. It also separates any water that might have passed through the primary filter. An overflow valve assembly (3) is used to send back excess fuel to fuel tank. A bleeding screw (4) is provided to bleed the air from fuel system.

Fuel filter element

A paper element is most suitable because important properties which determine filter quality such as pore size and pore distribution can be effectively maintained. Generally paper filter elements are used at the secondary stage filtration process.

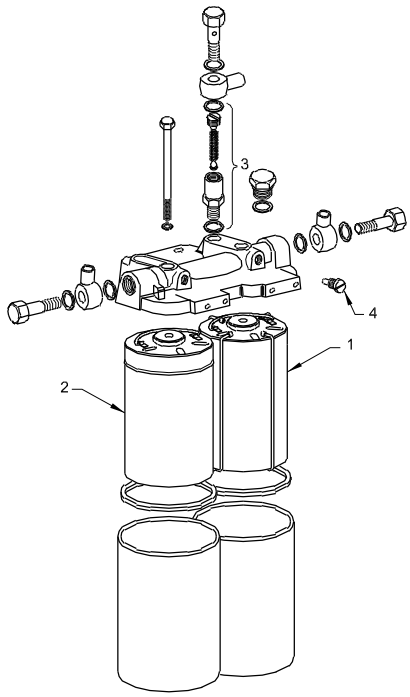
Coil type paper filter inserts are wound around a tube and neighbouring layers are glued together at the top and bottom. This forms a pocket with the openings at the top.

In the star type paper filter inserts, the fuel flows radially from outside to inside. The paper folds are sealed at the top and bottom by end covers.

Cloth type filter inserts are used for primary stage filtration. In this the fuel flows radially from outside to inside. The cloth is wound over a perforated tube whose ends are sealed at the top and bottom by end covers.

Bleeding of the fuel system

Fig 1



Bleeding is the process by which air, which is present in the fuel system, is removed. Air locking in the fuel system will result in erratic running of the engine and may result in stopping of the engine. Bleeding is carried out by priming the filter. A slight loosening of the bleeding screw allows locked air to escape as bubbles along with the fuel. When locked air escapes and the system is free of air, the screw is tightened finally.

Diesel fuel water separator

A fuel water seperator is device that works to ensure clean fuel is delivered to the engine.

The fuel water seperator is a small filtering device used to remove water from the diesel fuel before it reaches to the sensitive partsof the engine. Water and contaminants have a direct impact on the service life and performance of diesel engines.

Besides being abrasive to engine components and cylinder walls, water and combination displaces diesel fuels lubricative coating on precision injector components, causing tolerance erosion, surface fitting, fuel loss and poor performance.

The first stage of the fuel water separator uses a plated paper element to change water particles into large enough droplets that will fall by gravity to a water sump at bottom of the filter. The second stage is made of silicone treated nylon that acts as a safety device to prevent small particles

of water that avoid the first stage from passing into the engine. To remove the water from the fuel water separator, open the valve to drain the water from filter if the water separator fails, water in the fuel can wear away lubricants on the diesel fuel injectors, so that fuel water separator is important part of fuel system.

Components of Fuel water separator filter (FWSF) components

Fuel water, separater filter provide a better way to filter fuel and it have twist fuel filter water seperating system.

- Filter
- Water collection bowl
- Water drain valve with WIF sensor or threaded port

Benefits

- Protect the engine components
- Extend the equipments life

Features

- It is easy to switch over water from fuel
- Water separating fuel filter with standard twist & drain.
- Water collection bowel for easy visual inspection.
- Alternative twist and drain valve with water in fuel (WIF) sensor or threaded port.

Fuel feed pump

Objectives: At the end of this lesson you shall be able to
- **explain the function of a feed pump**
- **explain the construction of a feed pump**
- **explain the working of a feed pump.**

Function

A feed pump is usually mounted on the F.I.P. and is driven by the camshaft of F.I.P. It sucks fuel from fuel tank and supplies it to fuel filters.

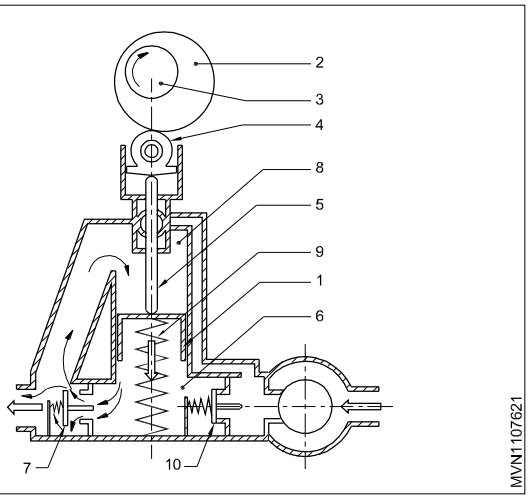
Construction

The fuel feed pump consists of a barrel, a plunger, a plunger return spring, spindle, roller tappet, suction and delivery valves, hand primer and pre-filter.

Working

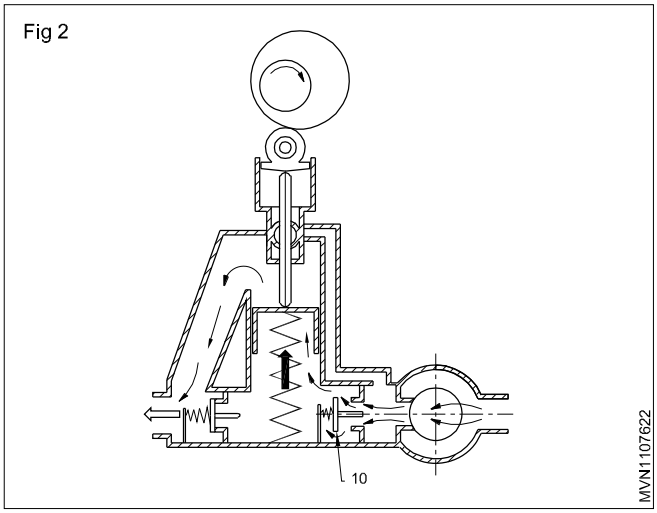
The feed pump plunger (1) (Fig 1 & Fig 2) is driven by the cam (2) provided on the F.I.P. camshaft (3). When the plunger moves "downwards" by means of roller tappet (4) and pressure spindle (5) a portion of the fuel present in the suction chamber (6) is delivered through the pressure valve (7) to the pressure chamber (8) and the plunger spring (9) compressed in an intermediate stroke. Towards the end of this stroke the spring loaded pressure valve closes again.

Fig 1



As soon as the cam or eccentric has passed its maximum stroke, plunger, pressure spindle and roller tappet move

Fig 2



"upward" due to the pressure exercised by the plunger spring. A portion of the fuel present in the pressure chamber is thereby delivered to the fuel injection pump through filter. However, fuel is sucked simultaneously from the fuel tank to the suction chamber through the primary filter provided in the feed pump and suction valve (10).

When the pressure in the feed pipe exceeds a specified, pressure the plunger spring lifts the plunger only partially. The quantity of fuel delivered per stroke in this is comparatively smaller. When the fuel pipe line is full and the F.I.P. does not need further fuel the feed pump should be put out of action. Due to the excess fuel in the fuel outlet line the pressure in the pressure chamber, holds the plunger in the top position putting the feed pump out of action. During this period only spindle works. The moment the pressure falls down the spring forces the plunger down and the pumping action is resumed. This action during which fuel is not supplied by feed pump is known as idling of feed pump.

Hand priming device

The hand priming device is screwed into the feed pump above the suction valve. When the engine is at rest, with the aid of the hand priming device fuel can be pumped from the fuel tank through the filter to the F.I.P. In order to operate the primer the knurled knob is screwed out until the plunger can be pulled upwards causing the suction valve to open for fuel to flow into the suction chamber.

When the plunger is pressed down the suction valve closes while the pressure valve opens and fuel flows through the feed pipe and the filter to the F.I.P. After the use it is essential to screw the knob again in its original position.

Preliminary strainer

The preliminary strainer is usually attached to the feed pump. The function of the preliminary strainer is to prevent the coarser impurities at a very early stage. It consists of a housing with a nylon/wire gauge insert or a wire mesh sieve.

Fuel injection pump

Objectives: At the end of this lesson you shall be able to
- **explain function of F.I.P.**
- **explain constructional features of F.I.P.**
- **state the need of calibration**
- **list out types of fuel injection system**
- **explain air injection and airless injection**
- **state the need of a governor**
- **list out different types of governors**
- **explain constructional features of governors**
- **explain operation of governor.**

Function of the F.I.P.

Fuel Injection Pumps are designed to deliver specific quantity of fuel to the combustion chamber through an injector at a specific time.

Types of F.I.P.

There are two types of F.I.P.

Inline pump

Distributor or rotary type pump.

The inline pump has a plunger and barrel assembly for each cylinder of the engine. The assemblies are grouped together in one housing that resembles cylinders of an engine block.

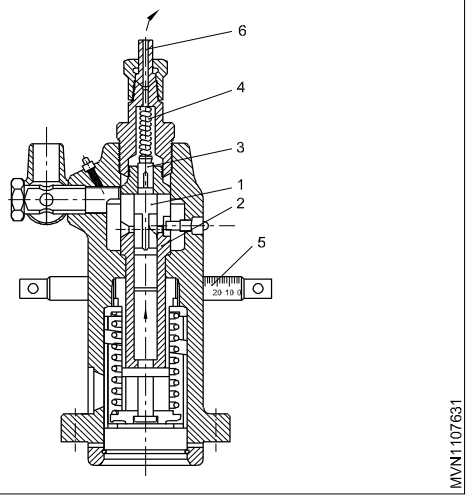
Distributor or rotary type of fuel injection pump has a single pumping element, which supplies fuel to all the cylinders. Distribution to the individual injector is effected by a rotor having a single inlet and delivery, in turn to the appropriate number of outlets. This is done with the help of rotor. Cylindrical plungers and drilled holes in the bore.

Working of a F.I.P.

When the plunger (1) (Fig 1) is at its bottom position fuel enters through the barrel's (2) inlet port from the feed pump, fills the space above the plunger in the barrel and excess fuel flows out through the spill port. In a primed system, the barrel(2), all the pipes and the entire system is filled with the fuel. As the plunger rises up due to cam operation, certain amount of fuel is pushed out of the barrel through the ports. As soon as the ports are closed by the plunger, the flow of fuel is stopped and the fuel above the plunger in the barrel is trapped and is pressurized. The pressure increases to as high as 400 to 700 bar (kgf/cm²) .

This pressure lifts the fuel delivery valve (3) and the fuel enters the fuel line (6) which is connected to the injector. As the pipe is already full of fuel the extra fuel which is being

Fig 1



pumped causes a rise in the pressure throughout the line and lifts the injector valve. This permits the fuel to be sprayed into the combustion chamber in a fine mist form. It continues until the lower edge of the helical groove in the plunger uncovers the port in the barrel. As soon as the port is uncovered, the fuel by passes downwards through the vertical slot and flows to the port. This causes a drop in pressure and delivery valve closes under its springs (4) pressure. With the consequent drop in the fuel line the injector valve also closes and cuts off the fuel injection.

The plunger stroke is always constant. But by rotation of the plunger in the barrel, it is possible to deliver the fuel earlier or later in the stroke and control the quantity of fuel sprayed. (Fig.2) The rotation of the plunger is obtained by operating the control rack (5), which is in turn connected to the governor.

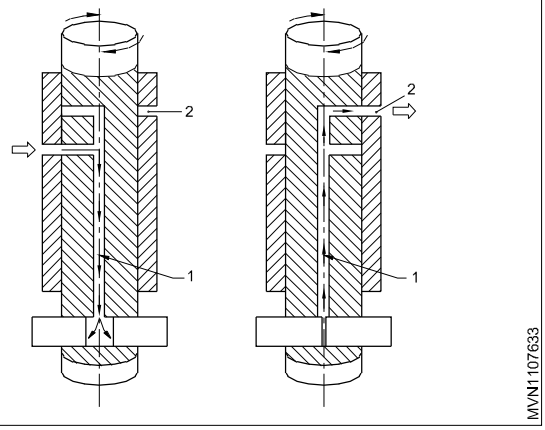
The governor controls all engine speeds upto a maximum, according to pedal pressed by driver. Different positions of the plunger and the fuel flow is given in the figure.

Constructional features of distributor type F.I.P.

It has a single pumping element which supplies fuel to all cylinders. The distribution to the individual injector is effected by a rotor having a single inlet and delivery equal to the number of cylinders. This ensures in built and uniform delivery to all injectors.

The pumping element consists of two plain opposed cylindrical plungers in a diametrical hole in the rotor head, an extension of which forms the distributor. An axial hole (1) (Fig 3) drilled in this extension connects the pumping chamber with a racked hole which registers in turn with racked delivery ports (2) due for each cylinder of the engine.

Fig 3



Need for calibration

In a multi cylinder engine it is necessary that equal and specified quantity of fuel is supplied to each cylinder by fuel injection pump at specified time. The measurement of fuel delivered by each plunger with the control rod in a fixed position and its comparison is called calibration of F.I.P. The adjustment for varying the fuel delivery can be done by altering the position of the control sleeve of each plunger. It is achieved by calibrating the F.I.P. on a test bench by a correct chart as recommended by the manufacturer.

Phasing is the process of testing the pump for the accuracy of their supplying fuel at correct intervals.

Cooling and lubrication

The single-plunger injection pump can be mounted in any position. In operation, its interior is completely filled with Diesel fuel under slight pressure in order to prevent intrusion of air and dust; and also to prevent rust formation caused by condensation. Excess fuel is recirculated within the pump to provide adequate cooling and lubrication.

Types of fuel injection system

There are two types of fuel injection system for diesel engines.

Air blast injection.

Mechanical injection.

Air blast injection

In the air blast injection system, a high pressure air blast drives the fuel at a very high velocity into the cylinder where it is mixed with the compressed air in the cylinder and ignites.

Mechanical injection

In mechanical fuel injection system, fuel is forced in from a mechanical fuel injection pump through injectors. These are of two types -

Low pressure fuel supply system.

Metering injection system.

All fuel supply systems use the same components, although the components vary in size and location within the system.

Low pressure fuel supply system

The low pressure fuel supply system consists of one or more fuel tanks, a feed pump, fuel filters, hand priming pump, overflow valve and a return orifice.

Metering injection system

It consists primarily of injection pump and injector and categorized as below, depending on the metering system.

(i) Pump controlled system

This is operated with a high pressure plunger and metering mechanism

(ii) Unit injectors system

This system is similar to the pump controlled system except that the high pressure pumping and metering mechanism are an integral part of the fuel injector.

(iii) Common rail system

This type of system uses a high pressure fuel pump that is connected to a common fuel rail. Each cylinder's fuel injector is connected to the common fuel rail.

Governors

The governor is a device for holding any speed steady between idling and maximum speed. The fuel injection pump operates in conjunction with a governor, which is required to control the injected quantity of fuel so that the engine neither stalls when idling nor exceeds the maximum speed for which it is designed.

Following Types of Governors are used

Mechanical

Pneumatic

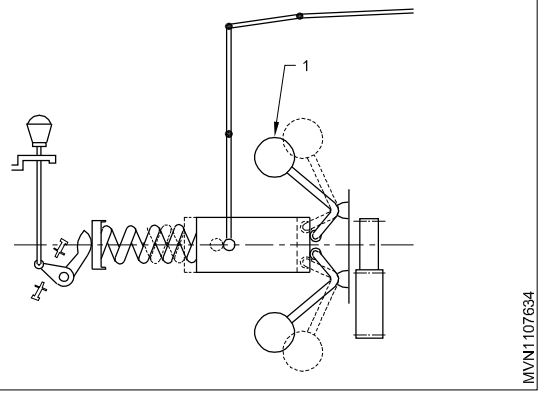
Servo

Hydraulic

Mechanical Governor

Mechanical governors have speed measuring mechanism and fuel controlling mechanism actuated by mechanical arrangement. Two fly weights (Fig 4) (1) are mounted to the governor's drive gear or directly fastened to the camshaft. The centrifugal force of the fly weights actuates the fuel control mechanism.

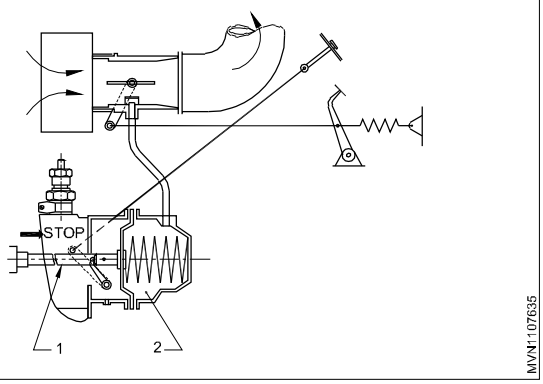
Fig 4



Pneumatic Governor

In this type of governors the fuel control rack (1) (Fig.5) is actuated by joint effort of the atmospheric pressure, governor spring and allow pressure chamber (2) connected through a tube to the auxiliary venturi.

Fig 5



Servo Governor

In servo type of Governors the fuel controlling mechanism is actuated by hydraulication. This of governor reduced the effort required to move the fuel control device since a small force is necessary to move governor control mechanism.

Hydraulic Governor

In this type of Governors the fuel controlling mechanism is actuated by hydraulic action. This of governor reduces the effort required to move the fuel control device since a small force is necessary to move governor control mechanism.

Nozzles

Objectives: At the end of this lesson you shall be able to
- **explain function of injectors**
- **list out different types of injectors**
- **explain special features of various types of nozzles**
- **explain specification of nozzle and nozzle holder.**
- **explain cumming & detroit diesel injection**
- **state the function of glow plug.**

Fuel Injectors Fig 1

The function of the fuel injector is to deliver finely atomized fuel under high pressure to the combustion chamber for the engine. All component parts of the injector are carried in nozzle holder(10.) The main part of the injector is the nozzle comprising nozzle body (12) and nozzle valve (11)The nozzle body and needle valve are fabricated from alloy steel. They are thoroughly machined and have high surface harness necessary for operation in condition of high temperatures and elevated pressures. The bore in the nozzle body and the nozzle needle valve are lapped to a close tolerance and are a matched set, so that neither the nozzle body nor the needle valve may be replaced individually. The needle valve is pressed against a conical seat in the nozzle body by spring (4) acting through the intermediary of stem 8. The spring pressure is adjusted by adjusting screw (2). The adjusting screw is screwed in the bottom of the injector spring cap nut which in turn is screwed in the nozzle holder. Lock nut (3) is used to prevent the adjusting screw from unscrewing spontaneously. The screw is covered by nozzle holder cap nut (1) provided with a threaded hole to connect the leak-off pipe through which the leak-off fuel (used to lubricate the nozzle valve) filling the pressure spring and adjusting screw area is returned to the fuel tank or the secondary fuel filter.

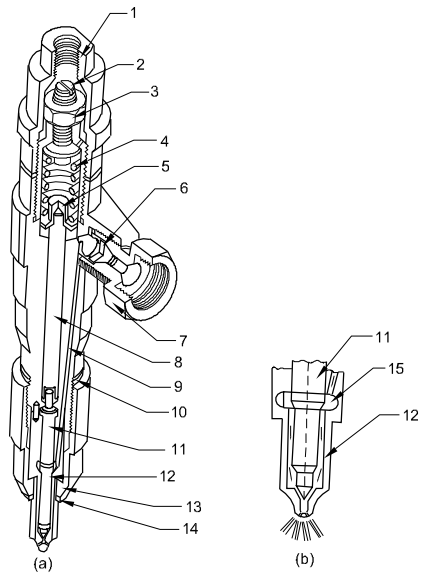
In operation, fuel from the injection pump enters pressure chamber (gallery) (15) in the nozzle body through supply passage (9) and a high-pressure pipe. When the fuel pressure in the pressure chamber becomes so high that the force acting on the pressure taper of the needle valve

from below exceeds the set spring force on the stem, the needle valve lifts off its seat and comes to rest with its upper shoulder against the face of the nozzle holder. Fuel is then forced out of the nozzle spray holes into the combustion chamber in a spray pattern which depends on the type of nozzle used.

After the injection of fuel has been ended, the fuel delivery from the injection pump ceases, the pressure in pressure chamber 15 of the nozzle drops instantly, and the pressure spring snaps the needle valve onto its seat, preventing unpressurized fuel from leaving the nozzle. The fuel injector is installed in a brass injector tube, or sleeve, which is fitted in a hole in the cylinder head, and is held in place by a special clamp.

Injectors are provided to atomise the fuel into engine cylinder. This is done to achieve complete combustion.

Fig 1



(a) Construction :
(b) Illustrating the operation of the injector :
1-Cap nut.
2-Adjusting screw.
3-Lock nut.
4-Spring.
5-Spring nut
6-Screen filter.
7-Inlet fitting.
8-Spindle.
9-Fuel passage.
10-Nozzle holder.
11-Nozzle needle valve.
12-Nozzle body.
13-Nozzle cap nut.
14-Washer.
15-Nozzle pressure chamber (gallery)

FUEL INJECTOR

MVN1107641

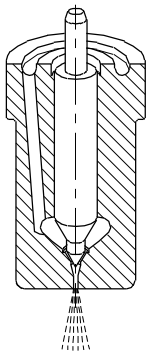
Following types of nozzles are used in engine.

- Single hole type (Fig 2)
- Multihole type (Fig 3)
- Longstem type (Fig 4)
- Pintle type (Fig 5)
- Delay nozzle (Fig 6)
- Pintaux nozzle (Fig 7)

Single hole type (Fig.2)

In this type, one hole is drilled centrally or in an angle through its body which is closed by nozzle valve.

Fig 2



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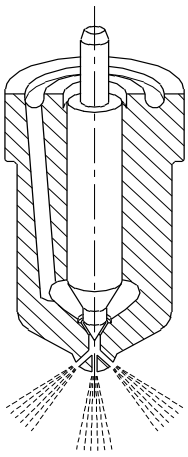
Multihole type (Fig.3)

In this type varying number of holes are drilled at the end of the body. The actual number of holes depend upon the engine requirement.

Fig 3



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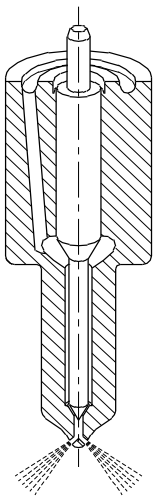
Longstem type (Fig.4)

For providing adequate cooling for the standard short stem nozzle, a different type of nozzle with a small diameter extension has been developed. This is called long stem nozzle.

Fig 4



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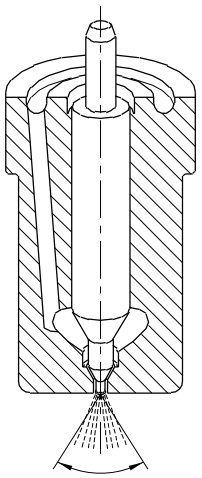
Pintle type (Fig.5)

In this type the valve stem is extended to form a pin or pintle which protrudes through the month of the nozzle body.

Fig 5



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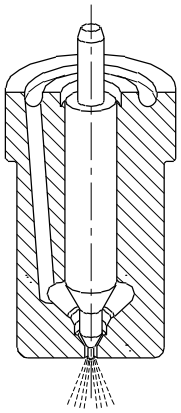
Delay nozzle (Fig.6)

In this type spray pattern is controlled by the modification in pintle design. This will reduce the amount of fuel in combustion chamber, when the combustion begins. This modified nozzle is known as delay nozzle.

Fig 6



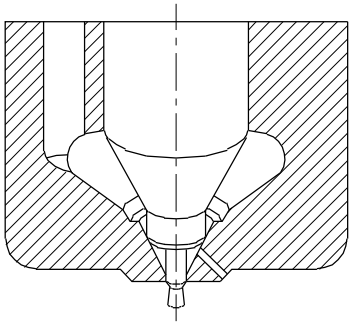
DELAY

MVN1107646

Pintaux nozzle (Fig.7)

This is the further development of pintle type nozzle, having an auxillary spray hole to assist easy starting under cold condition.

Fig 7



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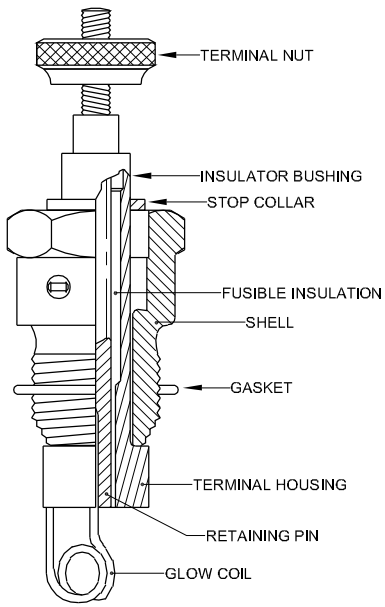
Need of a glow plug

A heater plug or glow plug is used in a Diesel engine having a pre-combustion chamber for igniting the diesel fuel spray. This arrangement makes for an easy starting of a diesel engine in cold weather. Most diesel engines use heater plugs. Figure 8 shows parts of a heater or glow plug.

Description of a glow plug (Fig 8)

The glow plug consists of a heating element (glowing coil) and is provided with an insulator shell and other parts. One such glow plug is shown in Fig 9. In a multi-cylinder engine the number of glow plugs depends on the number of cylinders. They are connected in series (Fig 10), parallel with the battery, through a glow plug switch, (control switch) a resistor and a red indicator light and they are provided on the dashboard (panel) of the vehicle. The glow control switch is a three-way one, connecting to the starter also for starting purposes. The glow control switch serves to connect and disconnect the battery with the glow plug as and when required. The red indicator light indicates to the driver, the working of the glow plug or its failure.

Fig 8



CONSTRUCTION OF THE DUAL - POLE GLOW PLUG

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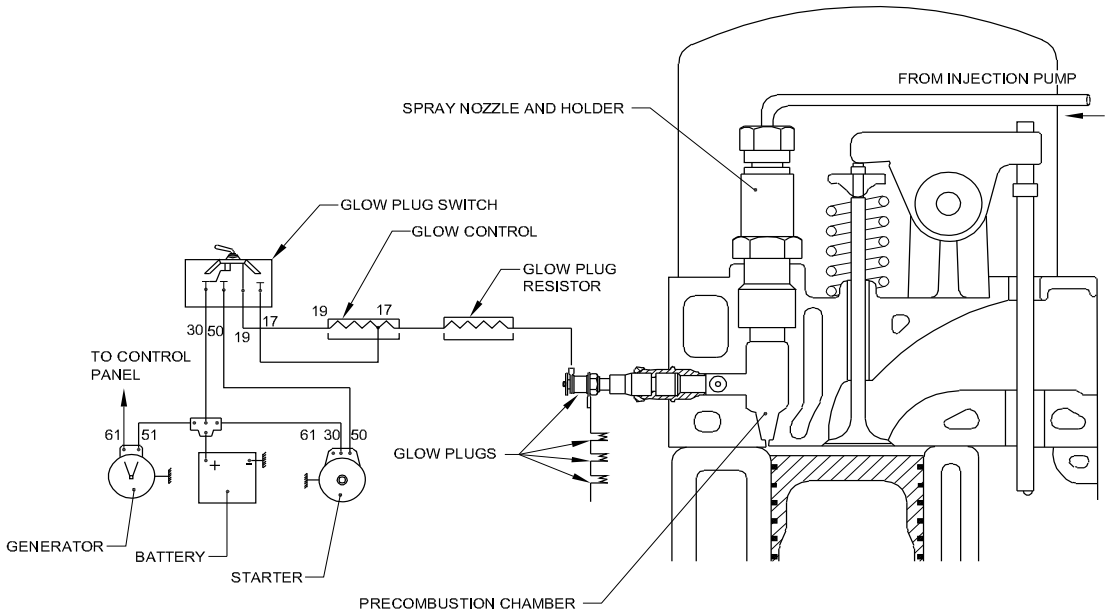
Working of the circuit (Fig 9)

When the switch is closed, the heating element becomes very hot due to the passage of current from the battery, and the surrounding air is heated up. When the engine is cranked heated air is drawn into the cylinder giving the compressed air a higher temperature for ignition. The fuel particles, which happen to be very near the hot air, will be ignited directly, thus initiating combustion. After combustion begins, the burning air-fuel mixture comes out of the pre-combustion chamber and enters into the main chamber. There it gets mixed up with the combustion chamber air and thus combustion is completed.

Precautions

- After the engine is started the glow plug is to be cut off from the circuit. Otherwise the glow coil will be heated up additionally and gets burnt up eventually, resulting in the replacement of the glow plug.
- The glow plug switch should not be operated for more than three seconds.

Fig 9



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IGNITION CIRCUIT DIAGRAM OF GLOW PLUG SYSTEM IN A DIESEL ENGINE

- The glow coil is having low electrical resistance and hence it will be very hot when connected to the circuit. Do not touch it, when it is hot.

Detroit diesel cummins diesel

Detroit diesel cummins diesel well known for favouring unit injectors, in which the high-pressure pump is contained within the injector itself. This leads to the development of the modern unit injector.

Cummins PT (pressure-time) is a form of unit injection where the fuel injectors are on a common rail feed by a low-pressure pump and the injectors are actuated by a third lobe on the camshaft. The pressure determines how much fuel the injectors get and the cam determines the time.

Design of the unit injector eliminates the need for high-pressure fuel pipes, and with that their associated failures, as well as allowing for much higher injection pressure to occur. The unit injector system allows accurate injection timing, and amount control as in the common rail system.

The unit injector fitted into the engine cylinder head, where the fuel supplied via integral ducts machined directly into the cylinder head. Each injector has its own pumping element, and in the case of electronic control, a fuel solenoid valve as well. The fuel system is divided into the low pressure <5 bar fuel supply system, and the high-pressure injection system <2000 bar.

Electronic Diesel Control (EDC) system

Objective: At the end of this lesson you shall be able to
- **state the function of electronic diesel control system.**

EDC system

Electronic diesel control (Fig 1 to 2) is a diesel engine fuel injection control system for the precise metering and delivery of fuel into the combustion chamber of modern diesel engines used in trucks and cars.

The electronic control, the system which provides greater ability for precise measuring, data processing environment flexibility and analysis to ensure efficient diesel engine operation.

- It receives the information from sensor, analyze/ calculate it and sends the instructions to the acturators.
- It converts information from analog to digital.
- It consists of microprocessors to process the information from sensor to ECM and ECM to actuators.
- Number of microprocessors are depends upon the number of sensors and actuators.

Fig 1

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ELECTRONIC DIESEL CONTROL DEVICE