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Mechanic Diesel - Transparencies (CIMI, GTZ; 51 pages)

Mechanic Diesel - Transparencies

CENTRAL INSTRUCTIONAL MEDIA INSTITUTE, MADRAS

ANINDO - GERMAN PROJECT

Directorate General of Employment & Training, Ministry of Labour, Govt. of India.

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CENTRAL INSTRUCTIONAL MEDIA INSTITUTE
in collaboration with DEUTSCHE GESELLSCHAFT FUER TECHNISCHE ZUSAMMENARBEIT (GTZ) Germany

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Diesel Fuel Feed Pump

TR 10 01 03 05 99

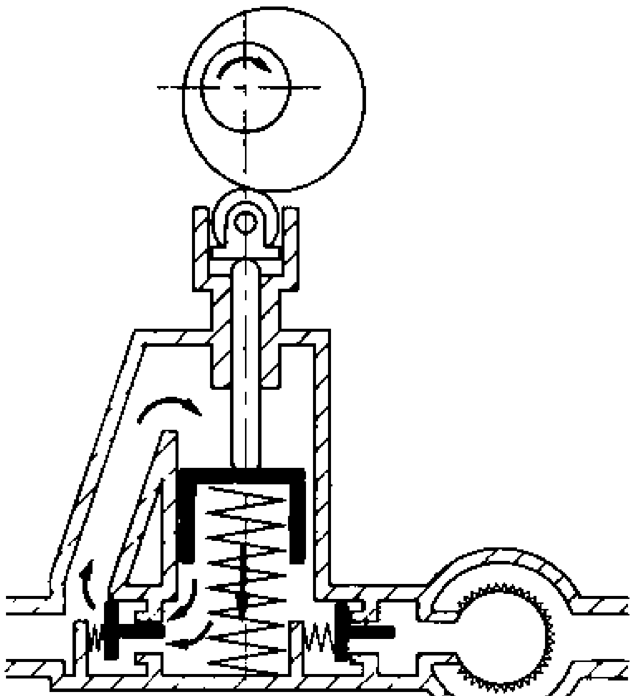
Function

Fig A: Delivery and Suction

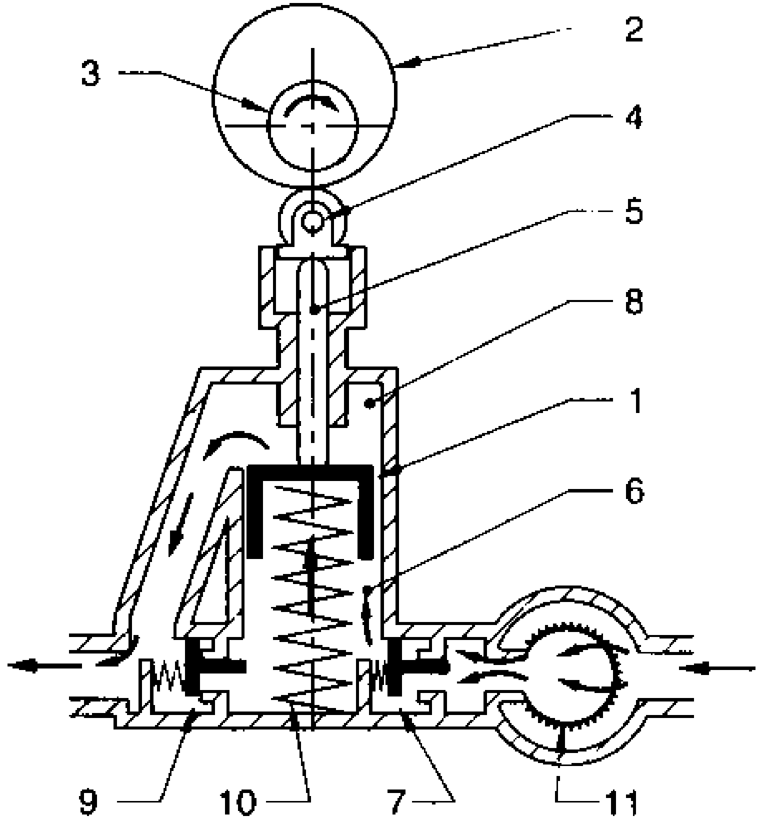
The feed pump piston (1) is operated by an eccentric (2) on the camshaft (3) through a roller tappet (4) and a thrust pin (5). This action creates suction in the suction chamber (6), to which place, fuel is drawn through Inlet marked with arrow via suction valve (7). When the suction valve (7) is closed, fuel is delivered to pressure chamber (8) through pressure valve (9). The piston spring (10) is compressed at the same time and the spring loaded valve (9) closes at the end of the stroke. As soon as the eccentric (2) has passed the point of maximum lift, piston (1), thrust pin (5), roller tappet (4) move upwards due to the pressure exerted by piston spring (10). This action forces part of the fuel out of the pressure chamber (8) and through the filter to the Injection pump. This is called delivery stroke. During this time, fuel is sucked simultaneously from the fuel tank to suction chamber (6).

Idling Action

Fig B: When the fuel pipe line is full the F.I.P does not need any fuel and the pressure in the pressure chamber (8) holds the piston (1) in the top position, putting the feed pump out of action. No fuel will be delivered to the F.I.Pump.



A INTERMEDIATE STROKE / IDLING ACTION



B DELIVERY AND SUCTION STROKE

Valve Timing Diagram (4 Stroke Cycle Diesel Engine)

TR 10 01 01 06 99

Valve timing

Valve timing is set and checked with reference to TDC and BDC marked on flywheel (1).

Checking Inlet valve opening

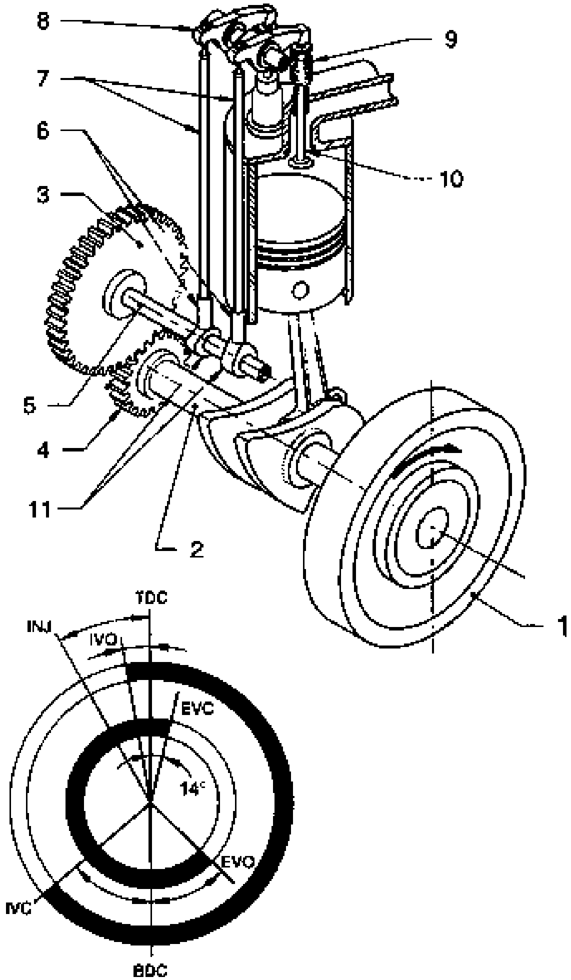
The valve timing angles are marked on the face of the flywheel (1). Hence rotate flywheel (1). The crankshaft (2) Timing gears (3 & 4) camshaft (5). Tappet (6) pushrod (7) and Rocker arm (8) and springs (9) will operate. Observe position of pushrod (7) and compression of springs (9). Feel the push rod for tightness and ensure the valve opening. Now the Inlet valve (10) is fully opened.

Now measure the distance on the flywheel (1) from TDC to the point of opening Inlet valve (9) by using a measuring tape.. Convert, this flywheel distance into degrees of crankshaft revolution by using the formula

D = 2π 360 × A × R [Where A =,Timing angle, R = Radius of flywheel]

Result

If in the conversion you get 10° as the degrees marked on the flywheel, the Inlet valve opening is correct. Also check the timing gear marks for alignment. If they align, the timing is correct.



IVO - INET VALVE OPEN
IVC - INLET VALVE CLOSE
EVO - EXHAUST VALVE OPEN
EVC - EXHAUST VALVE CLOSE
INJ - INJECTION

Valve Timing Diagram (2 Stroke Cycle Diesel Engine)

TR 10 01 01 07 99

Function

In this engine inlet ports (1) and exhaust valves (2) are used. The Inlet ports (1) are opened and closed by the movement of the piston (4) in the cylinder (5) from TDC to BDC and vice versa. The ports could be seen when the piston (4) is at BDC. The exhaust valves (2) are opened by camshaft gear & Rocker mechanism.

Port and valve timing

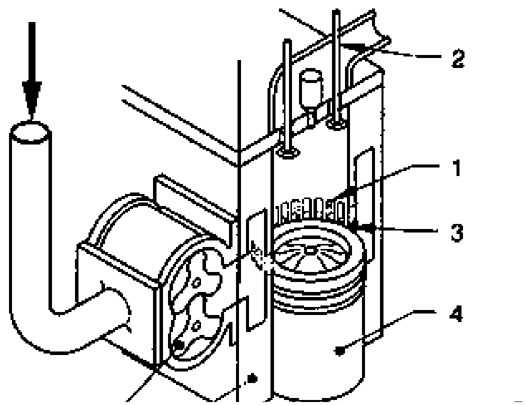
Port and Valve timing are set and checked with reference to TDC and BDC marked on the flywheel (1). During overhauling an engine this timing is checked and reset.

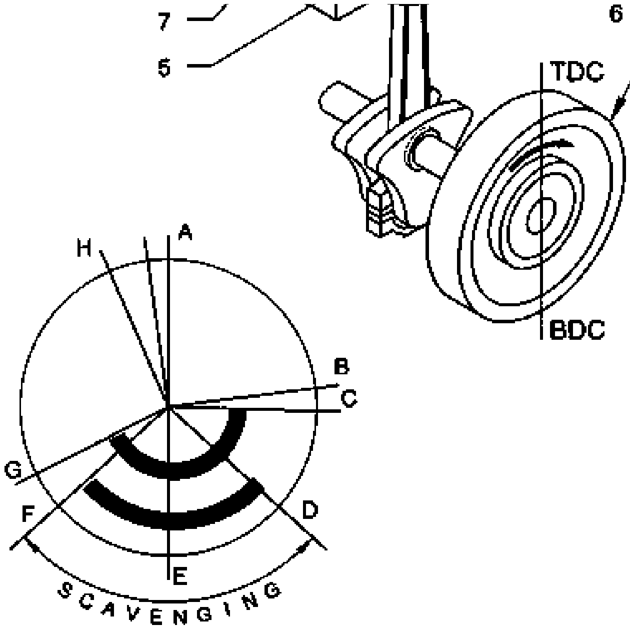
Checking Exhaust Valve Opening

Port and valve timing angles are marked on the face of flywheel (6). By rotating flywheel (6). Timing gear and crankshaft, the push rod will lift the exhaust valve compressing the springs. In this figure Exhaust Valve (2) is shown in the open position. Now measure the distance on flywheel (6) from TDC point to the point of opening the valve. Convert this flywheel distance into degrees by using the formula D = 2π 360 × A × R

Where

A = Angle
R = Radius of flywheel





A - TDC
B - Ex. VALVES START TO OPEN 82.5° ATDC
C - Ex. VALVES OPEN - 91.5° ATDC
D - In. TAKE PORTS OPEN - 132° ATDC
E - BDC
F - In. TAKE PORTS CLOSE - 48° ABDC
G - Ex. VALVES CLOSE - 117° BTDC
H - INJECTION - 23.5° BTDC

Result: If in the conversion you get 82 1/2° as the degree marked on the flywheel (6) the exhaust valve (2) opening is correct. Also check for Alignment of timing marks. If the marks align timing is correct.

Checking Inlet ports Opening

Follow the same procedure. These Inlet ports (1) open at 132° ATDC. Here also bring the flywheel (6) to TDC position and from there rotate it to the opening point of ports (1). This could be felt by the suction on the blower (7) side, as free air will enter through ports from outside. Measure the flywheel distance from TDC and calculate the degrees and compare markings.

Checking closing of ports and valve

Checking closing of ports and valve

Similar procedure could be followed for Inlet port (1) closing from BDC and Exhaust Valve (2) closing from TDC.

Refer to markings on the flywheel (6)

Diesel Engine Lubrication with oil cooler

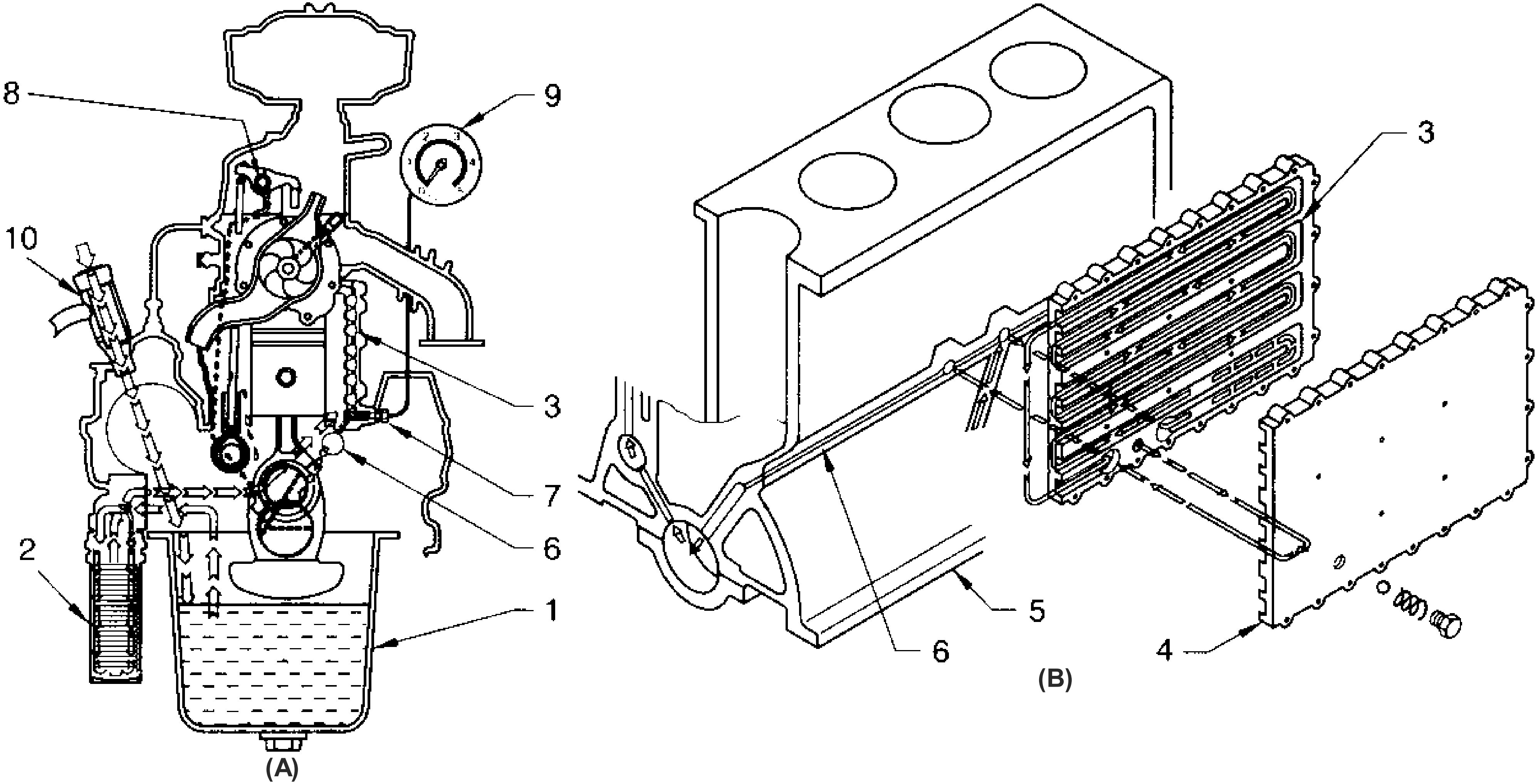
TR 10 01 06 02 99

Function

An oil cooler is provided in the lubrication system of the engine, to cool the engine oil, which becomes hot during working.

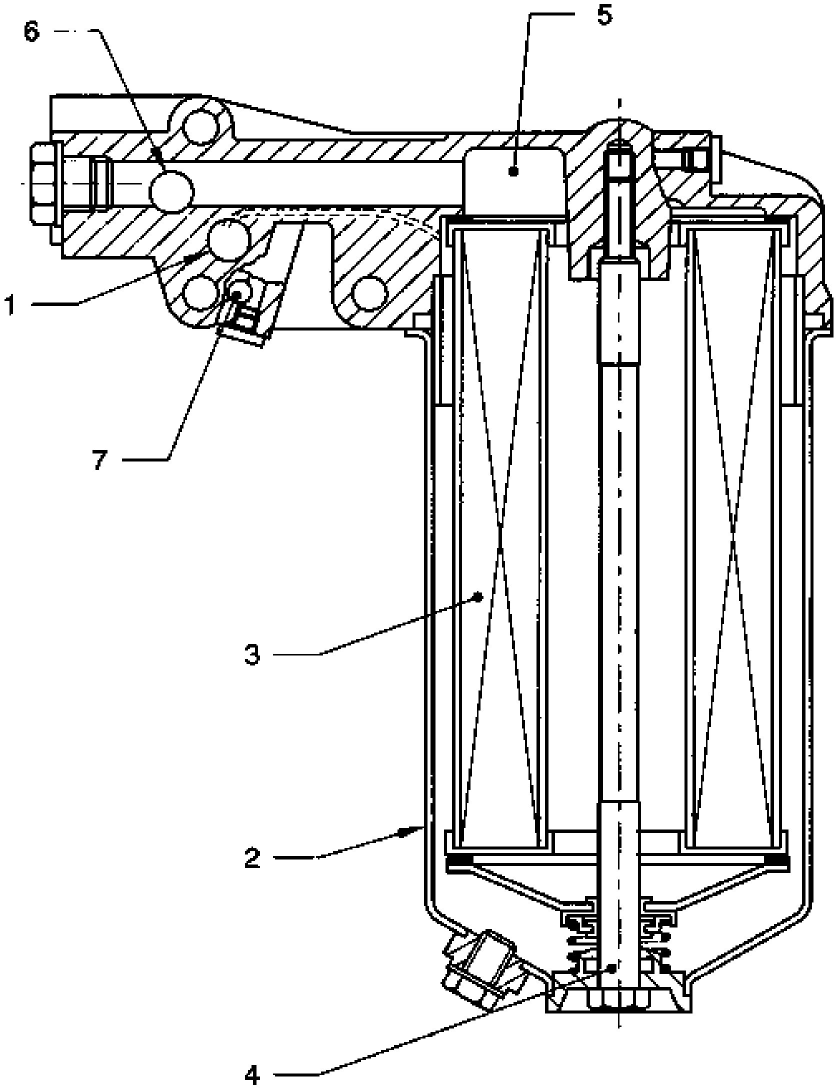
Flow of Lubrication oil

The engine oil in the oil sump/pan (1) is delivered under pressure created by the oil pump. The oil passes into the full flow filter element (2). (Filter located outside the engine cylinder) and gets fully filtered. After filtration the oil passes into the channels of the oil cooler (Heat exchanger) (3). The oil cooler (Heat exchanger) (3) channel plates and cover (4) are bolted to cylinder block (5) with gaskets. The inner plate is in contact with water in the water jacket of engine. The hot oil passing through heat exchanger (3) channels, transfer its heat to the cooling water. The cooled oil, passes on to oil main gallery (6) in the cylinder block (via the by pass valve (7)) and from there it is delivered to main bearings, cam shaft bearings and then to Rocker Arm shaft (8) and finally it returns to the oil sump (1). A tube from by pass valve (7) is connected to oil pressure gauge (9) and the gauge records the working pressure of lubricating oil. The engine oil may be filled through oil filler pipe (10) to the recommended level. The drain plug is used for draining the oil during service.



Diesel Engine Lubrication oil filter (full flow)

TR 10 01 06 03 99



Introduction

The oil filter is a full flow type, which means that 100% of oil passes across the filter element out of which 94% of oil is passed on to the engine bearings after filteration.

The oil circulation

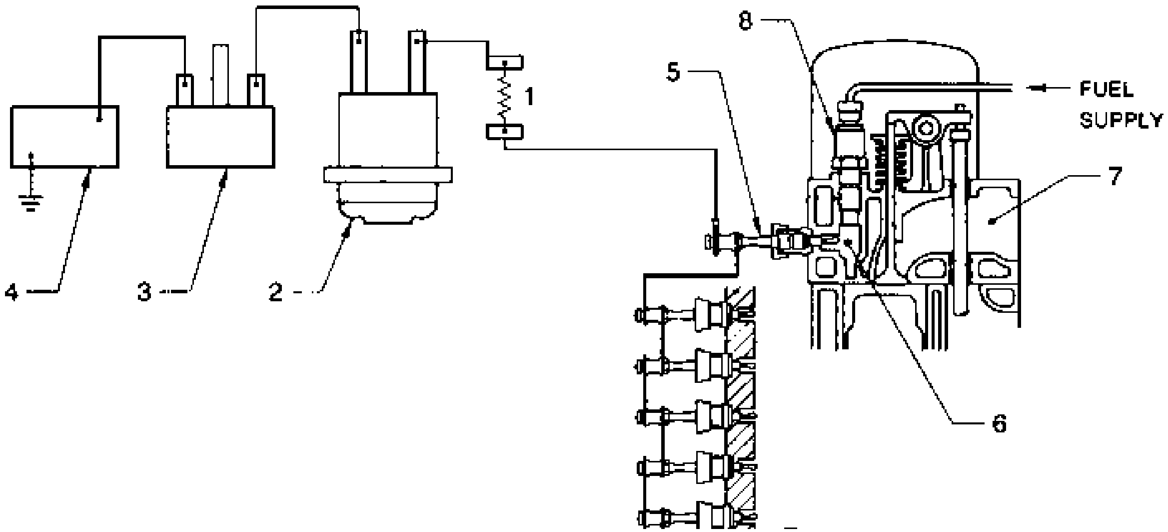
The Lubricating oil from oil pump under pressure enters the Inlet port (1) of the filter and passes on to the housing (2) (or Bowl) through a drilled passage (shown in dotted lines). After circulating through the filter element (3) (cartridge paper type) it gets fully

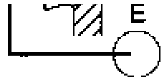
filtered and then the filtered oil enters the drilled passage in tension bolt (4) and reaches oil outlet passage (5) in the filter assembly. From this passage, oil flows into outlet port (6) and from there it flows into oil cooler, main bearings and finally reaches oil sump.

A by pass to sump (7) is provided to allow excess oil to reach oil sump from the filter.

Glow Plug Electrical Circuit

TR 10 10 10 01 99





Function

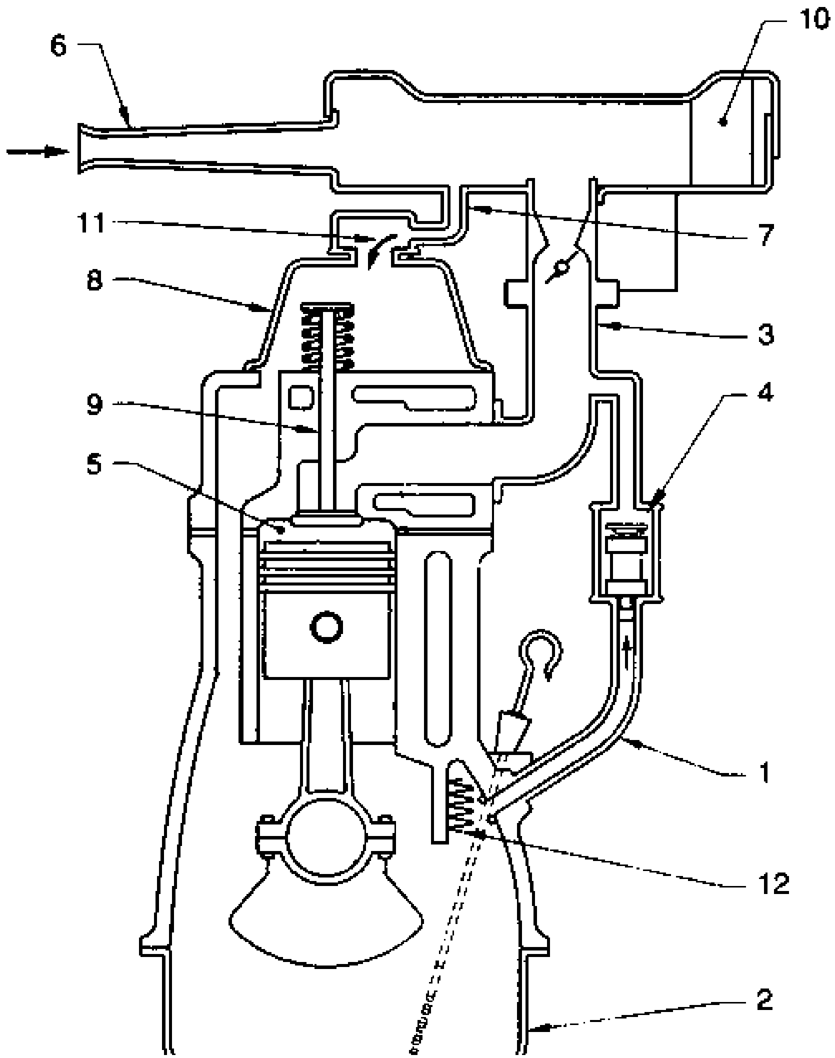
In this system Glow Plug resistor (1) and pre-heating monitor (2) are connected in series. The line resistor (1) and the preheating monitor (2) provide for the over all electrical resistance of the pre-heating system to match with battery voltage.

The pre-heating control switch (3) has two positions. In the first position all the electrical resistors are in the battery (4) current circuit. When the glow plugs (5) reach the correct temperature the yellow monitor light comes on and the second stage is switched on. In this position the glow control circuit (3) (Monitor) is short circuited because the battery voltage will drop due to high rate of current discharge. After the engine is started the glow system is switched off. The battery (4) supplies all the current to this glow system. The glow plugs (5) are located in the pre-chamber (6) provided on the cylinder head (7) in all diesel engines. The operation time is only for few seconds.

Each cylinder will have one glow plug and in a six cylinder engine, these glow plugs are connected in series with the battery.

Crank Case Ventilation

TR 10 01 06 01 99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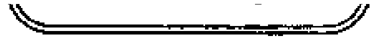


Function

In IC engines, products of combustion leak past the rings into the crankcase. These products are to be removed to reduce oil contamination, dilution, corrosion and other undesirable chemical effects. For removal of these products positive crankcase ventilation is used in engines.

As per MV Act all Motor Vehicle Engines are to be provided with P.C.Ventilation system and this is compulsory.

Working

Generally a Tube or Hose (1) connects the crankcase (2) to the Intake manifold (3) via a PCV valve (4). The crankcase gases are drawn into the Inlet manifold (3) by engine vacuum, then goes into the combustion chamber (5) with air fuel mixture and gets burnt up as a fuel. Clean Air is delivered to the engine through air entry tube (6) and also through a Breather pipe provided on the oil filler or A Tube or Hose (7) connecting the engine air filter to the crankcase or rocker cover (8). The PCV Valve (4) controls the flow of air through the crankcase (2) and prevents excess air admission during suction and acceleration of the vehicle. Also it protects engine against damage due to back firing.

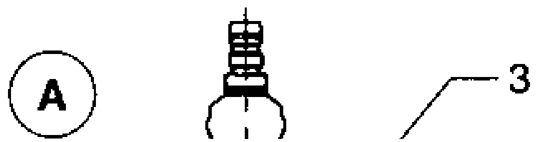
Sparking Plug

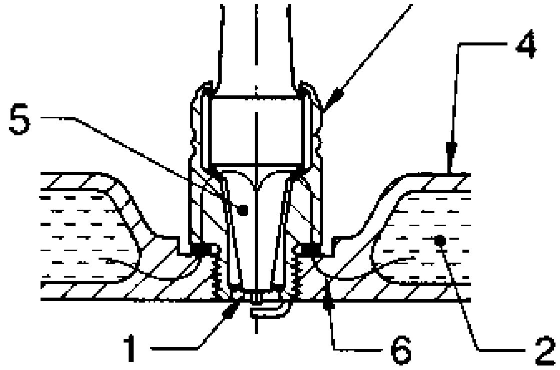
TR 10 10 04 01 99

Function

Sparking plugs are classified as Hot plug and Cold plug.

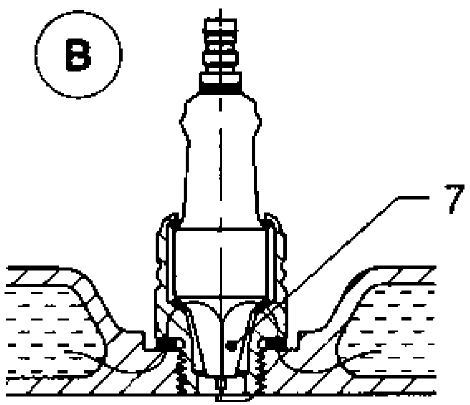
I. Hot plug (Fig A)





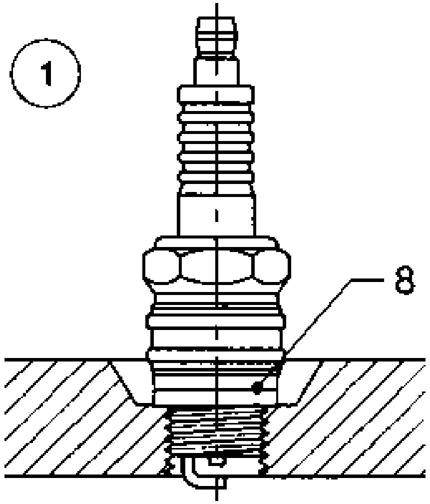
The travel of heat in a Hot plug (A) is shown. The heat travels from Insulator nose (1) and reaches the cooling water (2) through shell (3) and cylinder head (2). The Insulator Base (5) is long and so heat travel path (6) is also long. Hence it is called as Hot Plug (A). The Insulator Nose (1) is the hottest part of a plug, which determines the "Heat Range". The Nose of Insulator Projects into combustion chamber. The Hot Plug vaporises carbon deposits quickly.

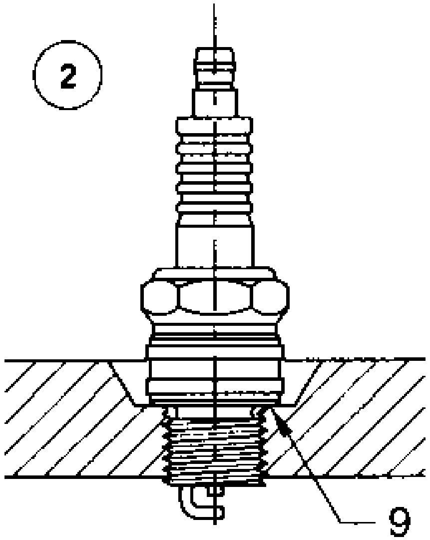
II. Cold Plug (Fig B)

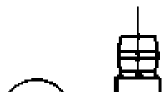


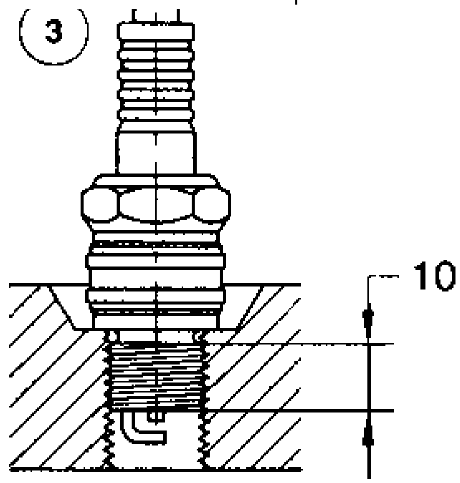
In this plug, the heat travel path/Insulator base (7) is shorter. Hence plug is cooled quicker by cooling water in the jacket (2). It works comparatively cooler. Hence it is called as “Cold Plug” (B).

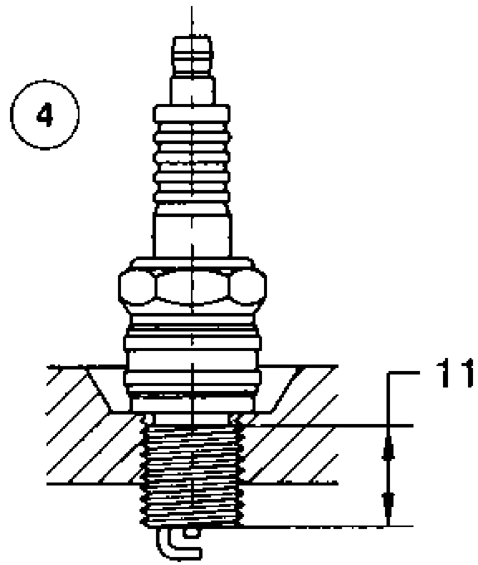
III. Installation











Plug No. 1: This is fitted with 2 gaskets (8). Hence danger of misfiring and difficulty in removal are present. This is not the correct way.

Plug No. 2: No gasket (9) is shown between the plug shell and cylinder head. Danger of preheating and overheating will result. This is also not the correct way.

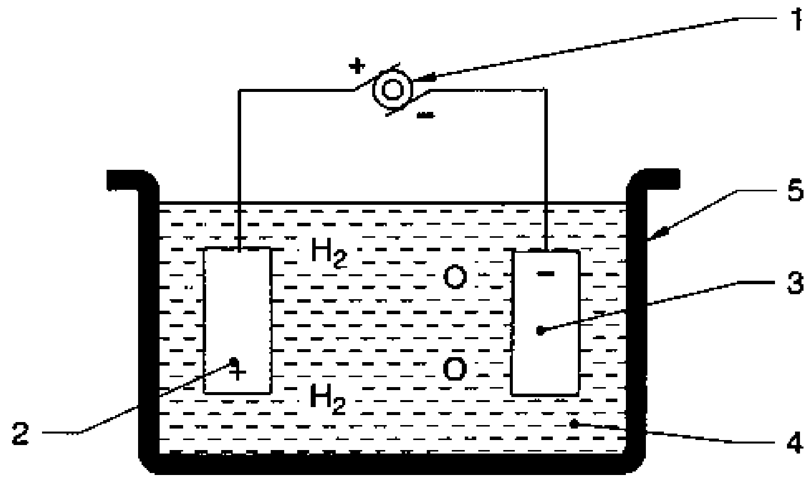
Fig 3: Spark plug with short reach of thread (10) in the cylinder meant for long reach. Combustion action will be delayed.

Fig 4: This long reach (11) plug is fitted in a cylinder head meant for short reach. The plug projects into the combustion chamber

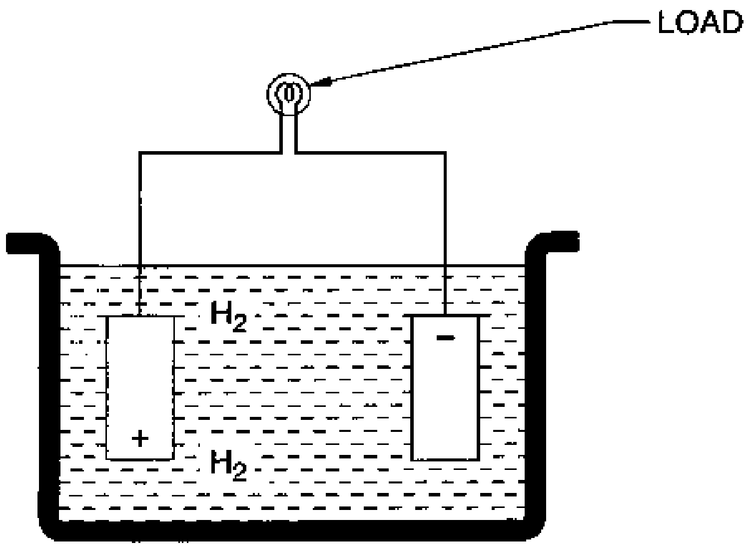
Fig 4. This long reach (11) plug is fitted in a cylinder head meant for short reach. The plug projects into the combustion chamber and may hit piston head and damage it. The combustion also will be affected.

Chemical action in Lead Acid Battery

TR 10 10 01 01 99



CHARGING



DISCHARGING

Function

Chemical Action between Plates and Acid

A. Charging

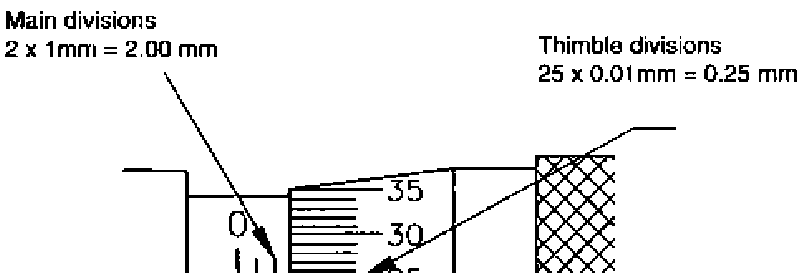
For charging a battery it is connected to a generator (1). Both the plates (+ve (2) and -ve (3) are Lead Sulphate (Pbs04). The current from Generator (1) enters the Battery terminals (+ve) and (-ve) (2 & 3) and passes through the water. The water content in the Acid (4) is broken into (H_2) Hydrogen and Oxygen (0). The So_4 sulphate ions moves back to the Electrolyte from plates and gets united with Hydrogen to form Sulphuric Acid. The oxygen atoms are driven back into positive plate (2), thus forming into Lead peroxide. Lead sulphate disappears in both the plates leaving lead on the negative plate (3) called spongy lead. The specific gravity of electrolyte increases. Positive plate (2) becomes chemically lead peroxide and negative plate (3) becomes spongy lead. Now battery is fully charged, specific gravity of Electrolyte increases and voltage also increases. The container (5) holds the Sulphuric Acid (4) and plates.

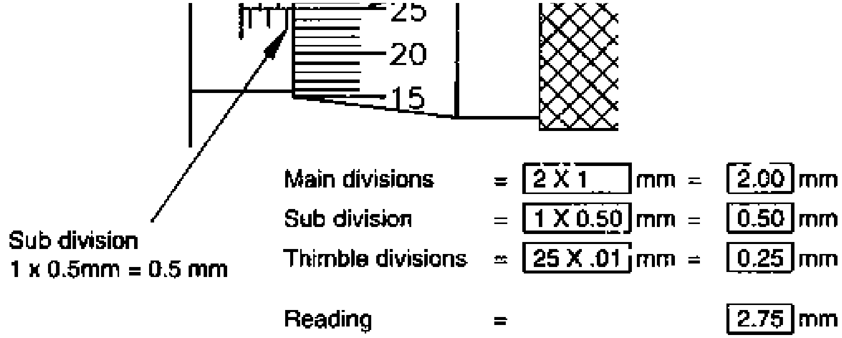
B. Discharging

During discharging the current is supplied to a lamp (1) from Battery. The Sulphuric Acid (4) is split up into H2 and So4. One S04 unites with P.b (Spongy Lead Pb) of negative plate (3) and other units with pb of the positive plate. (2) This action makes both plates lead sulphate. (Pbs04). The uniting of hydrogen and oxygen (b) becomes water. Now Sulphuric Acid (4) becomes water. Both plates converted into Pbs04. Specific gravity of electrolyte becomes less and voltage is also less.

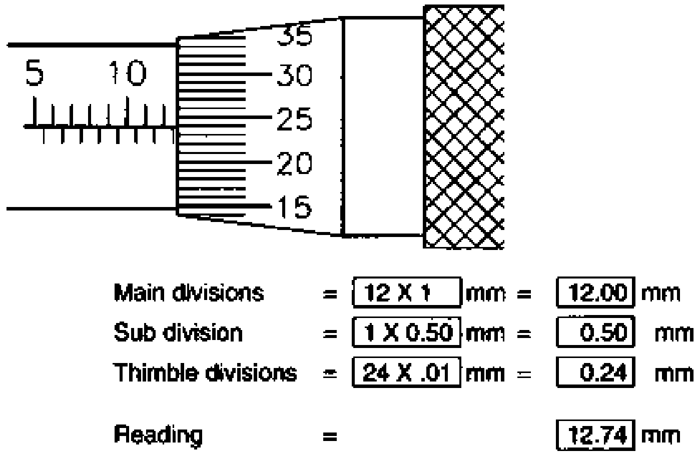
Reading of Micrometer (Outside)

TR 01 02 02 02 98



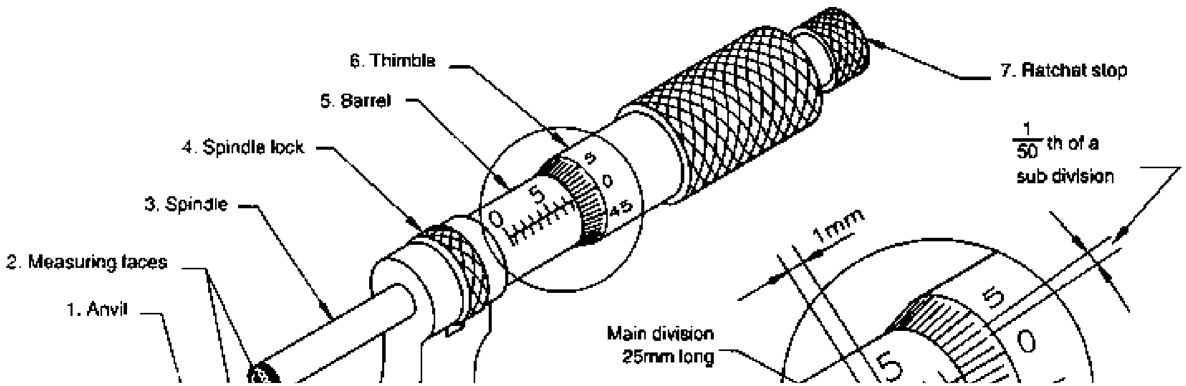


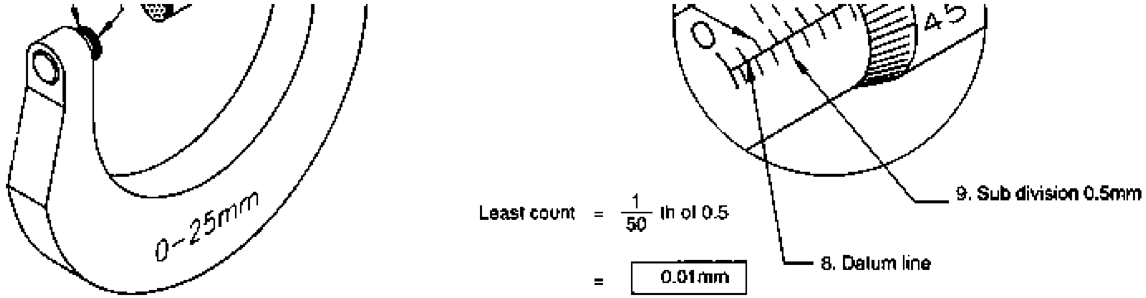
EXAMPLE



Micrometer parts and graduations

TR 01 02 02 01 98

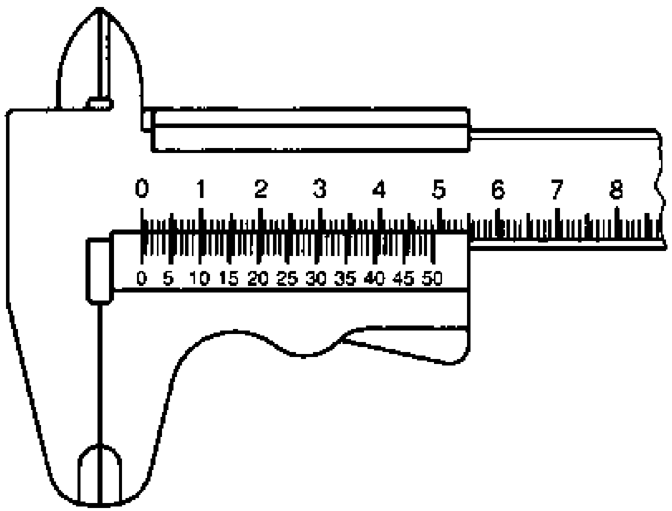


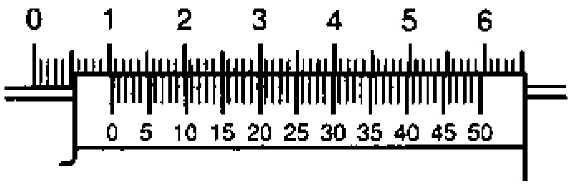


The range of the Micrometer is 0 - 25 mm.

Reading of Vernier Caliper

TR 01 02 01 02 98





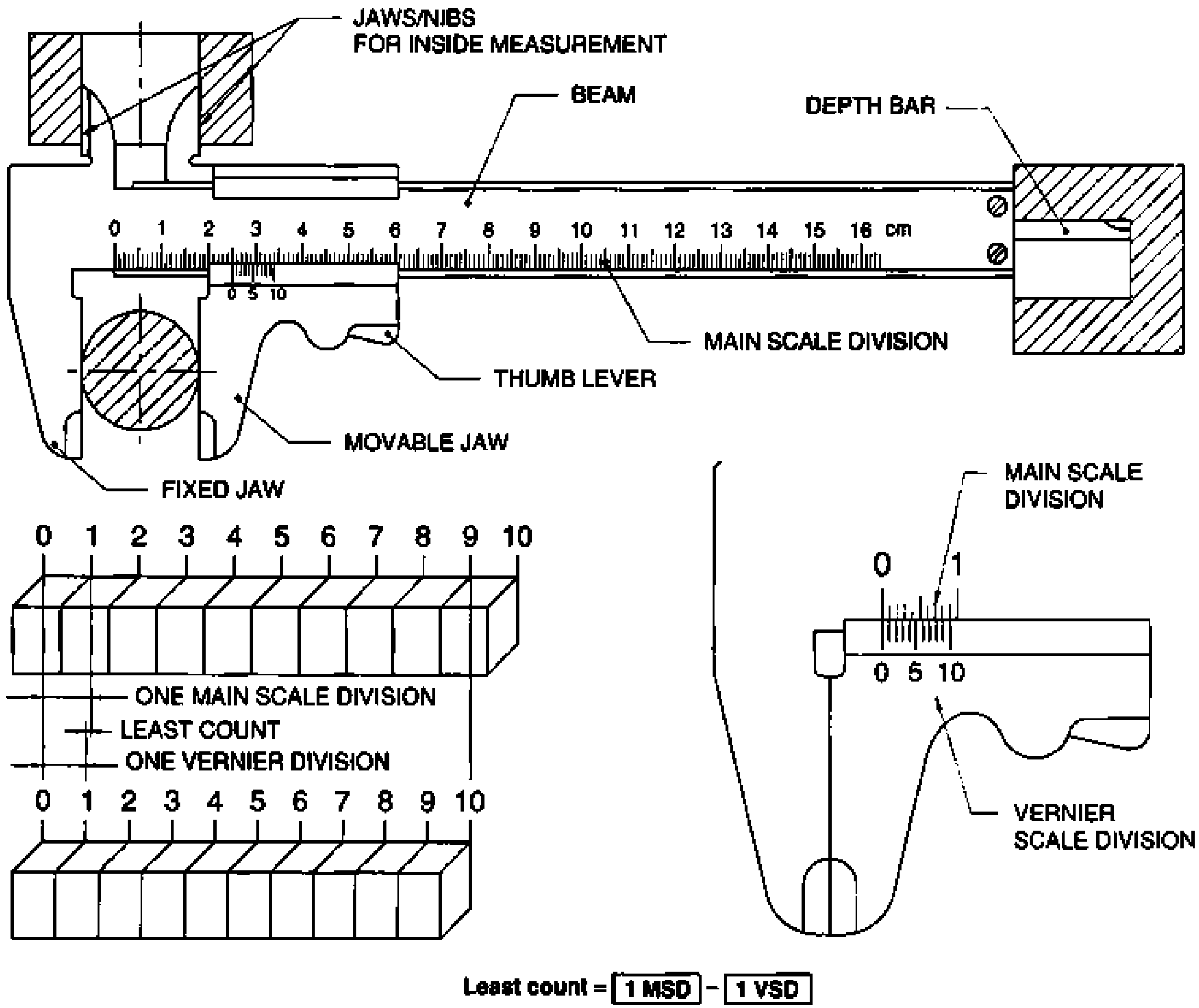
49 Main scale divisions are divided into 50 vernier scale divisions

49 Main scale divisions are divided into 50 vernier scale divisions

Value of 1 VSD	$= \frac{49}{50} mm$
Least count	**= 1 MSD - 1 VSD**
	$= 1 - \frac{49}{50}$
	$= \frac{1}{50} = 0.02$ mm
Main scale reading	**= 10.00 mm**
No of VSD coinciding with MSD	**= 20**
Value of coinciding vernier division	**= 00.40 mm**
Reading	**= MS Reading + VS Reading**
	= 10.00 + 0.40 mm
	= 10.40 mm

Vernier Caliper Parts and Principle

TR 01 02 01 01 98



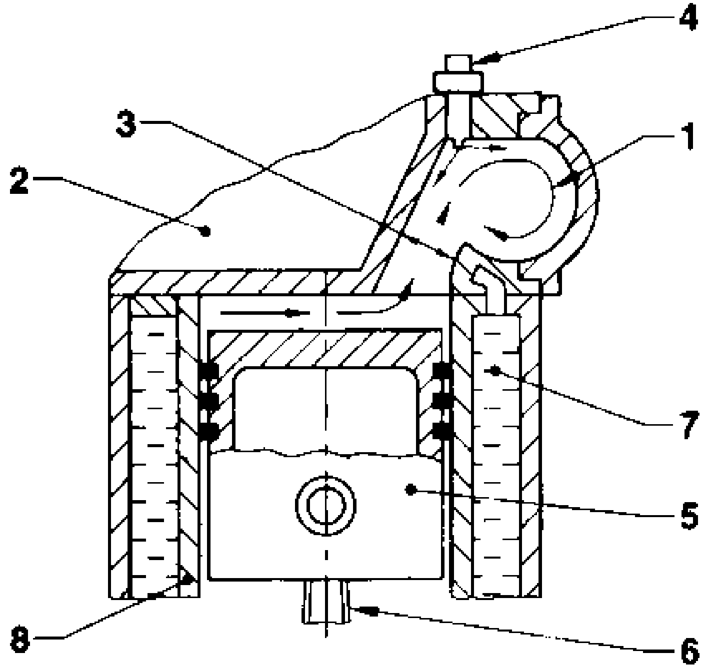
Combustion chambers

TR 10 01 04 01 99

Function

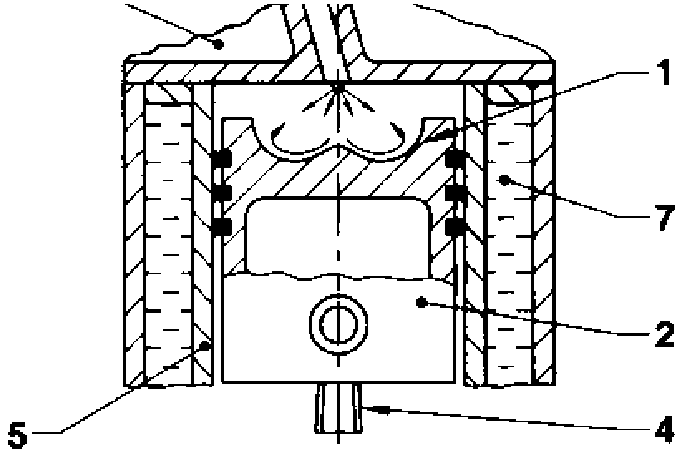
Diesel Engine combustion chambers are of special designs.

A. Indirect Injection - Aero flow chamber



This combustion chamber (1) is used in Perkins engines which is also known as AERO FLOW CHAMBER, The shape of the chamber is spherical and formed in the cylinder head (2). The outer portion can be unbolted, for cleaning purposes. Air enters with great velocity into the combustion chamber (1) through tapered passage (3). The turbulence of air is good and it mixes well with fuel sprayed from 2nd hole of the Injector Nozzle (4). This is called Indirect injection. (Air seeks the fuel). A second spray is injected directly on the surface of the air and this is called direct injection of fuel. (Fuel seeking the air). Fuel gets ignited quickly without the heater plug. The combustion of fuel takes place in the chamber and as well as on the top of piston. (5) The force on the piston (5) is carried to crankshaft through connecting rod (6). The engine runs continuously under the piston force and produces the required power. The injection pressure can be low. i.e 1800 LBS/Sq. Inch.

B. Direction Injection OR Open Combustion Chamber



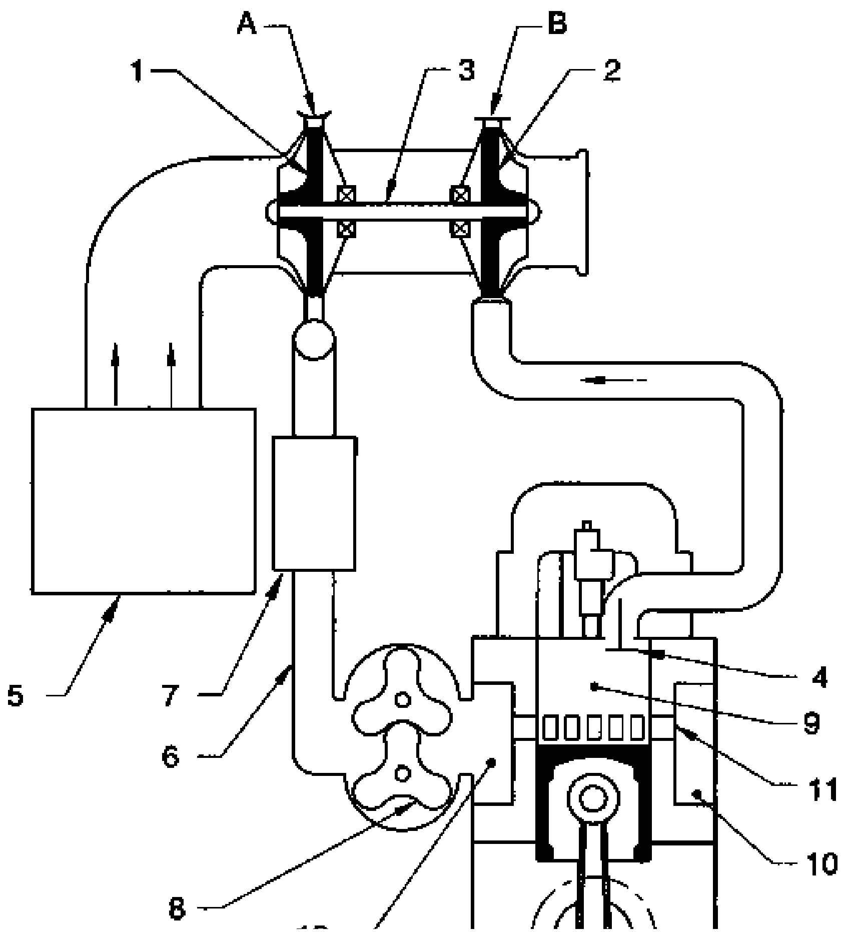
This combustion chamber (1) is provided on the top of piston (Crown) (2) in the form of cup shaped recess called “TORRIDAL”. A swirling motion with squish is provided by the air when it passes into the Torridal chamber. The mixing of fuel and air is good and quick.

Since the Air is very hot due to high compression, the engine starts quickly without a heater plug. A 4 spray hole nozzle (3) is used for injecting the fuel into all direction of air. Here “FUEL SEEKS THE AIR”. Hence the Injector pressure is very high (ie 2400 LBS/Sq. Inch) as air depth is more in the chamber.

The force on the piston (2) is transferred to crankshaft through Connecting rod (4). The engine runs continuously under piston force and produces the required power.

TURBO Charged Engine (Two stroke diesel)

TR 10 01 04 02 99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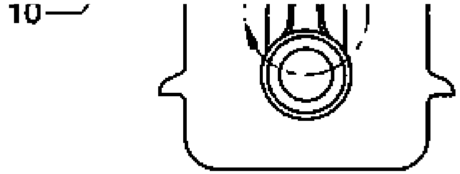


Function

The Turbo charger increases the amount of air delivered to the engine, thereby more fuel can be burnt. More engine power is produced due to increased volumetric efficiency. It also improves high altitude operation of the engine by making up the decreased atmospheric pressure of air.

Operation

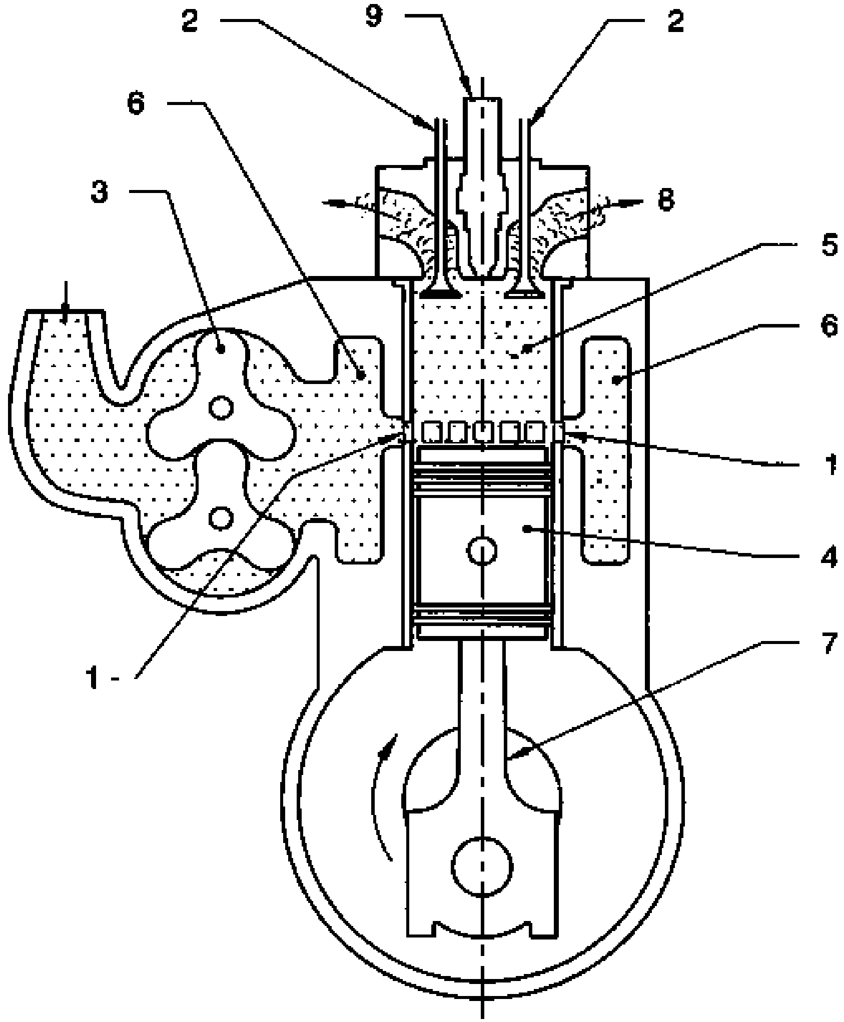
The Turbo charger is an exhaust driven compresser. The turbo charger is fitted on the exhaust manifold. It has a compressor wheel (1) and a Turbine wheel (2) both mounted on the same shaft (3). The exhaust gases enter the Turbine Housing (B) through the exhaust valves (4) and rotate the turbine wheel (2) which in turn causes the compressor wheel (1) to rotate as it is connected on a common shaft (3).

The Compressor Housing Inlet (A) is connected to the Air cleaner (5). The Compressed Air is discharged into the Inlet manifold (6) through the after cooler (7). This air enters the Blower housing where it is further pressurised by the rotation of the Blower (9) to a higher pressure than atmospheric, and flows into the main cylinder (9) via Air Box (10) and Inlet Ports (11) drilled on the periphery of cylinder wall. The Exhaust gases pass through the Exhaust valves (4) and reaches the exhaust pipe and finally reaches the Turbine Housing (B). After driving the Turbine wheel (2), the remaining exhaust gases passes into the exhaust pipe and then into the atmosphere.

Thus the cycle of Air entry is repeated and power is developed during its working. An engine may have one or two Turbo chargers to increase Torque and B.h.p.

Uniflow Scavenge

TR 10 01 05 01 99



Function

Introduction

The two stroke engines are classified according to the flow of air into the cylinder and drives out exhaust gases. In the Uniflow scavenge the scavenge air goes in an Unidirectional path in driving out exhaust gases into atmosphere.

Working

In this engine, Inlet ports (1) are used for admitting air and exhaust valves (2) are used in the cylinder head to allow the flow of scavenge air with burnt exhaust gases into the atmosphere. A Roots type blower (3) is used in all these engines. The Inlet ports

Scavenge air with burnt exhaust gases into the atmosphere. A Roots type blower (3) is used in all these engines. The inlet ports (1) are covered by the movement of the piston (4) and the exhaust valves (2) are opened by camshaft drive arrangement. In the figure shown both intake ports (1) and exhaust valves (3) are in open position when the piston (4) is at the bottom of its stroke. The blower (3) supplies air at a certain pressure above atmospheric and air goes into the main cylinder (5) through the air manifold or air chamber (6) and Inlet ports (1) cut on the periphery of cylinder wall. THE AIR FLOW PATH IS UNDIRECTIONAL. Hence it is called Uniflow Scavenge. This system is largely used in GM Diesel Engines.

Scavenging system (Diesel) Loop Scavenge

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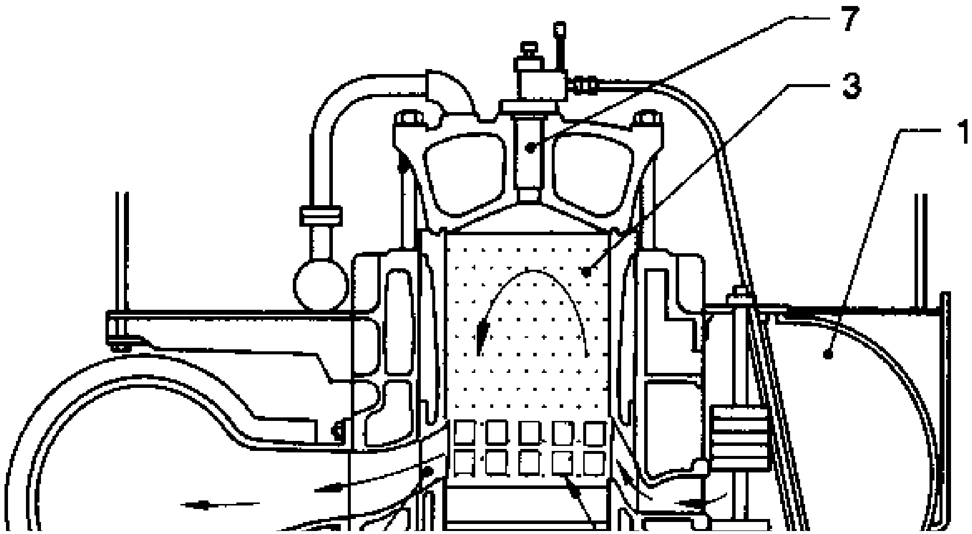
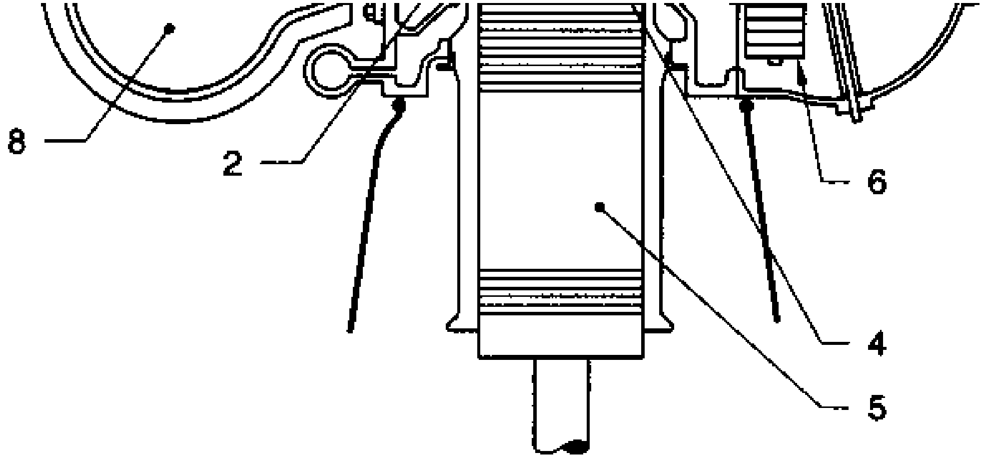




Introduction

Two stroke cycle diesel engines are classified according to the flow of air into the cylinder to drive out exhaust gases. The most common arrangement shown in the chart is called “Loop Scavenge System” as Air goes in the form of Loop.

Working

In this engine the scavenging air is supplied by a Blower (1) attached to the engine cylinder.(3)

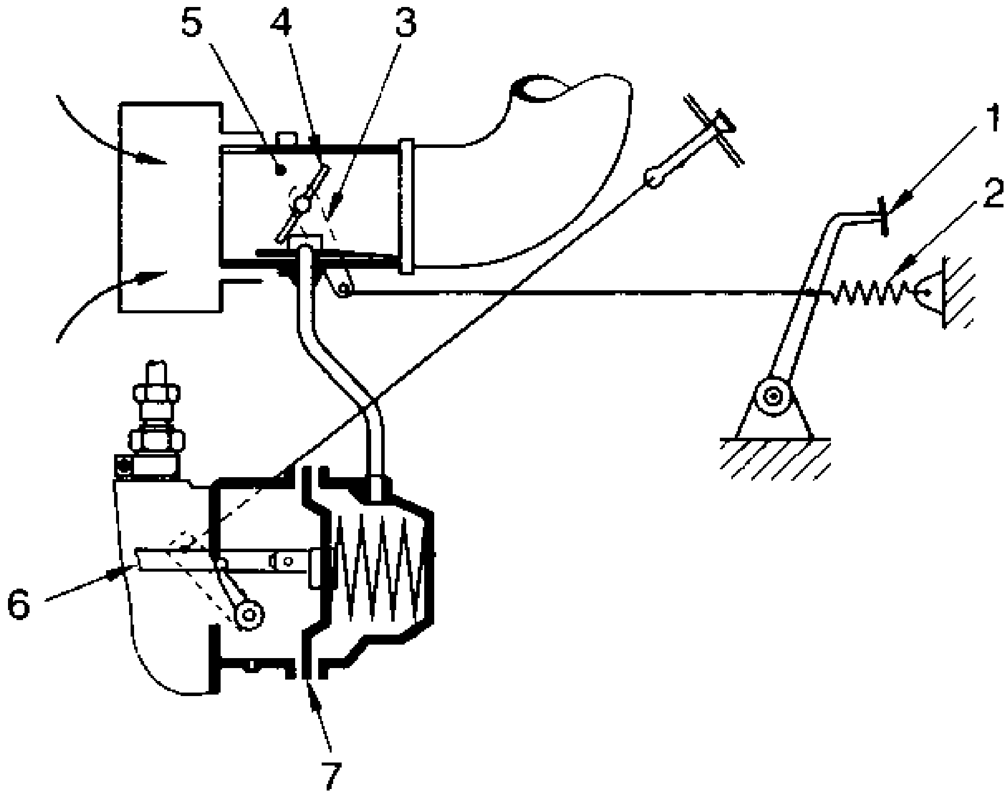
In the design of this engine, the exhaust ports (2) are placed as close as possible to the bottom of the main cylinder (3). The upper edges of the port are at the same level as the upper edges of the Inlet Air Port (4). The descending piston (5) starts to uncover both sets of ports simultaneously.

The Automatic Air Valves (6) keep the burnt gases from flowing out through Air Ports (4).

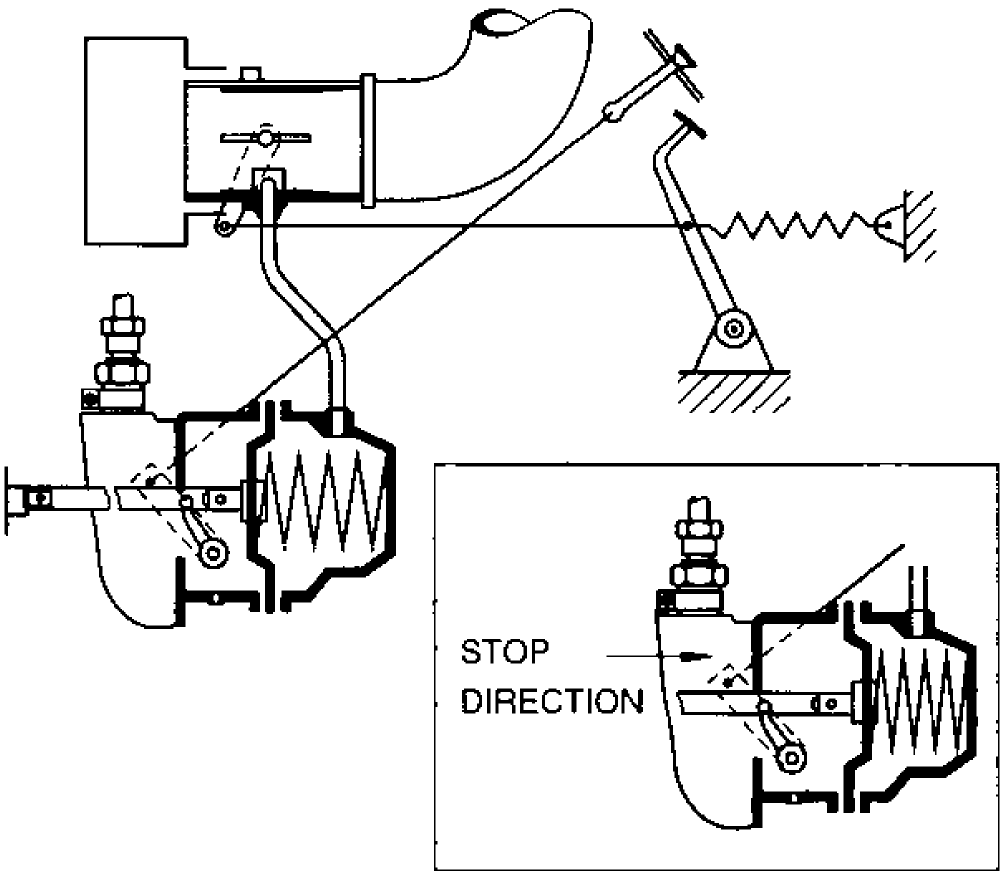
The scavenging Air from Blower (1) enters the main cylinder (3) and drives out the exhaust gases and it goes in the form of Loop. Hence called “Loop Scavenge”.

Pneumatic governor function

TR 10 01 03 08 99



IDLING



MAXIMUM RATED SPEED

Function

Idling of the engine

The Accelerator Pedal (1) is in the rest position, The return spring (2) on the accelerator Pedal (1) pulls the control lever (3) of the venturi butterfly valve (4) towards the adjustable Idling stop so that the venturi (5) Is practically closed. As a result a vacuum Is created which Is sufficient to pull the control rod (6) to Idling position.

Load decrease

The engine speed Increases but the diaphragm (7) moves the control rod (6) towards stop position due to increased vacuum - thus engine speed decreases.

Load increase

The engine slows down, vacuum decreases - the diaphragm (7) moves the control rod (6) to full load position.

Maximum speed and Rated speed

The Accelerator Pedal (1) Is fully depressed and the venturi valve control lever (3) rests against its full load stop. The butterfly valve (4) Is fully opened and the vacuum available Is very less. The engine now reached rated speed. The governing of maximum speed starts at this stage by moving control rod (6) away from full load stop.

Mechanical governor Principle (A)

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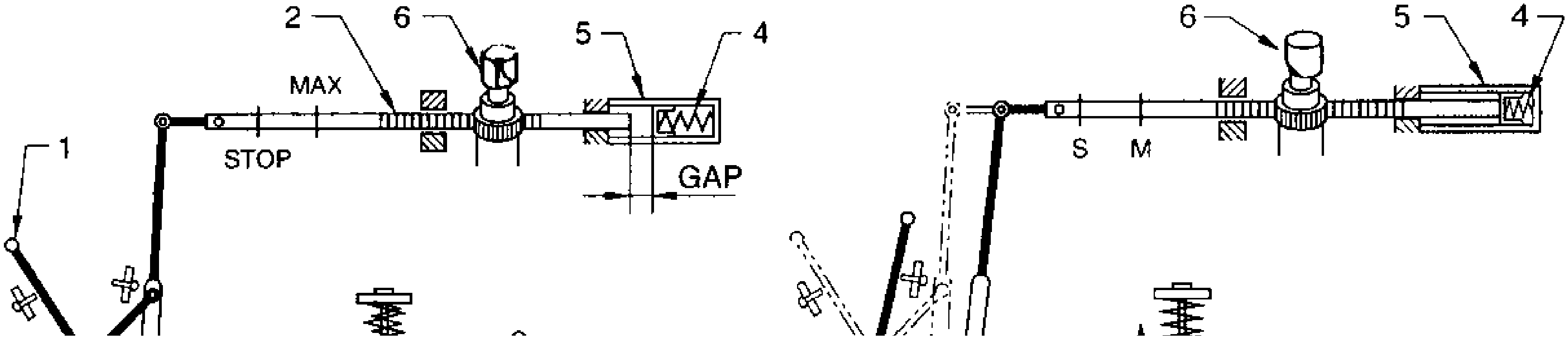
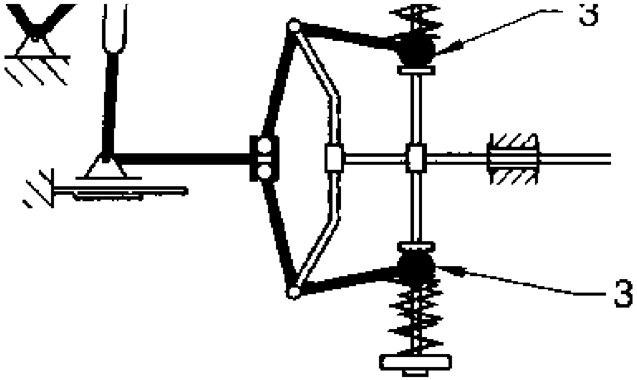
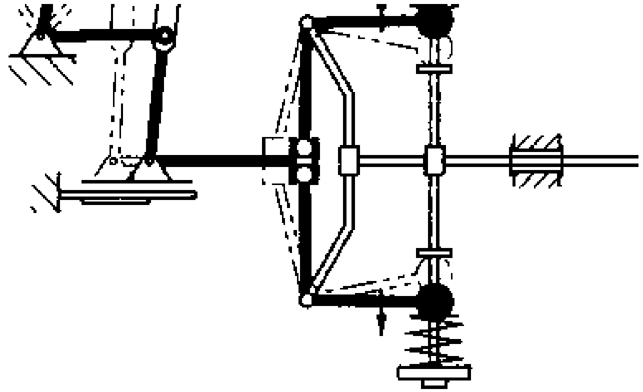




AT REST


STARTING

Function

Mechanical governor

A. Rest Position

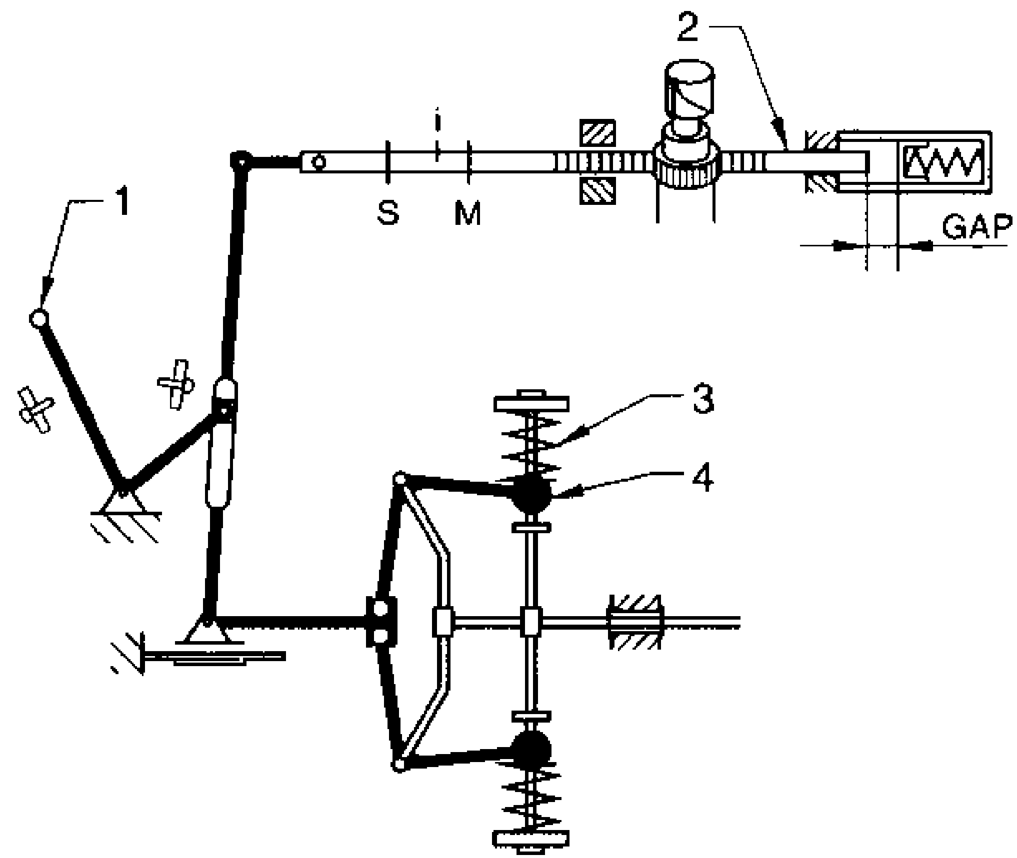
The control lever (1) and control rack (2) are in the stop position.
Fly weights (3) are at their Inner most position.

B. Starting position

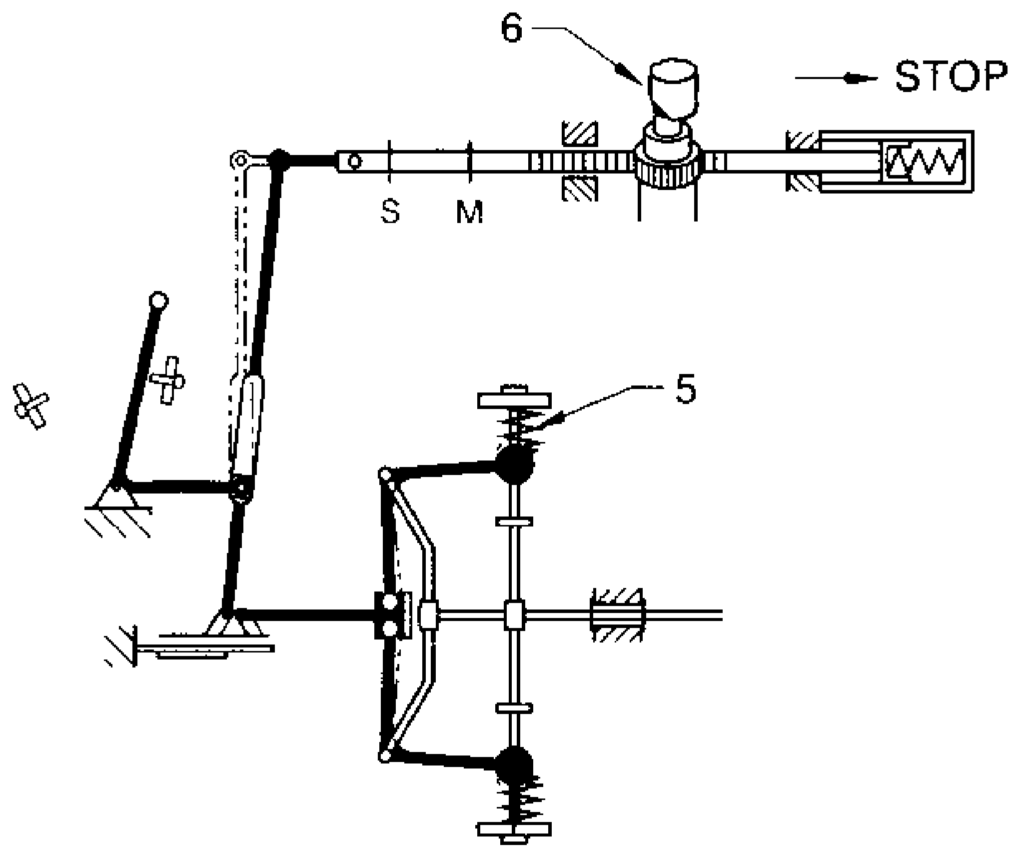
The control lever (1) is pressed to maximum position after over coming the force of return spring (4) in the Automatic control rack stop (5). The control rack (2) move to its starting fuel delivery position. (Plunger (6) turned). Fly weights (3) has moved outwards. Engine starts now.

Mechanical governor Principle (B)

TR 10 01 03 02 99



IDLING SPEED



MAXIMUM SPEED

A. Idling speed position

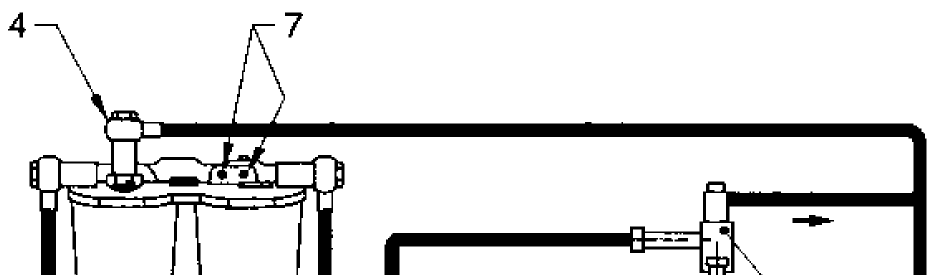
The engine has now started - the control lever (1) (connecting accelerator pedal)is released and it returns to Idling position. The control rack (2) also returns to its corresponding position determined by governor. The Idle speed is governed by the outer springs (3). The fuel quantity delivered to the engine during idling is less than starting fuel quantity - Observe position of control lever (1) and fly weights (4).

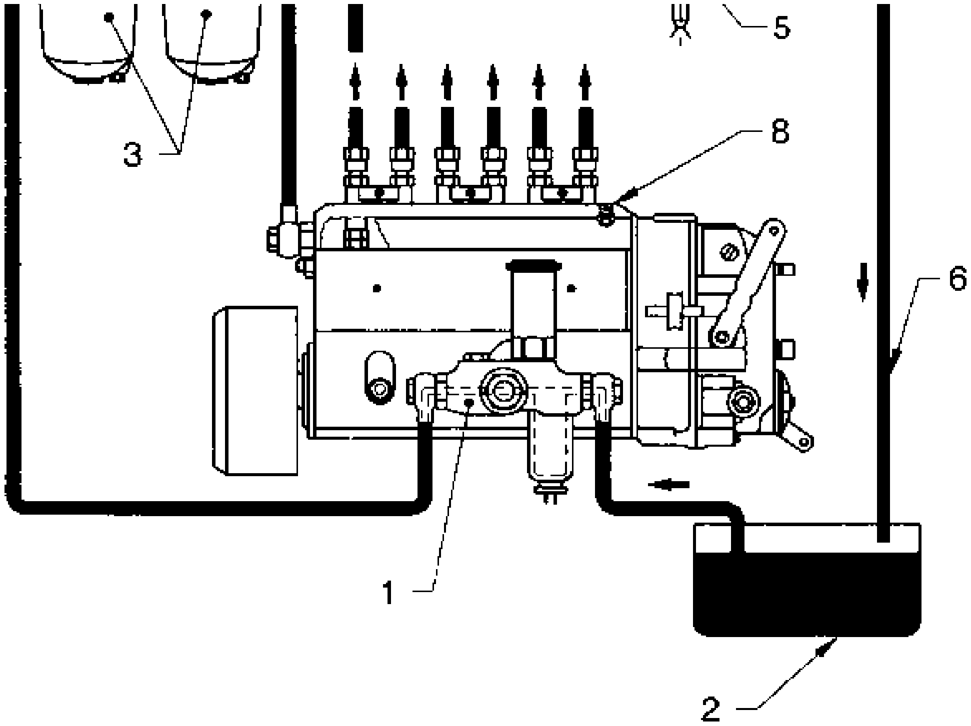
B. Maximum speed regulation (at full load)

Maximum speed may occur when the engine exceed normal speed. When this happens the maximum speed control springs (5) get compressed and fly weight (4) move outwards. Now the control rack (2) begins to move towards stop position. The fuel quantity is thus reduced and the maximum speed is regulated by the action of governor spring (5).

Fuel Feed System (Diesel Inline Jerk Pump)

TR 10 01 03 04 99





Fuel circulation

In a Motor Vehicle fitted with diesel engine, diesel fuel is drawn by the fuel feed pump (1) from the fuel tank (2). The fuel from the feed pump (1) is supplied to the fuel filters (3) under low pressure. From fuel filters (3) the fuel flows into the fuel Injection pump gallery. The excess fuel is sent back to the fuel tank through the overflow valve (4). From the fuel injection pump the fuel is supplied to the injectors (5) under high pressure. The excess fuel from the Injector Nozzle is delivered back to the fuel tank (2) through overflow pipe line (6).

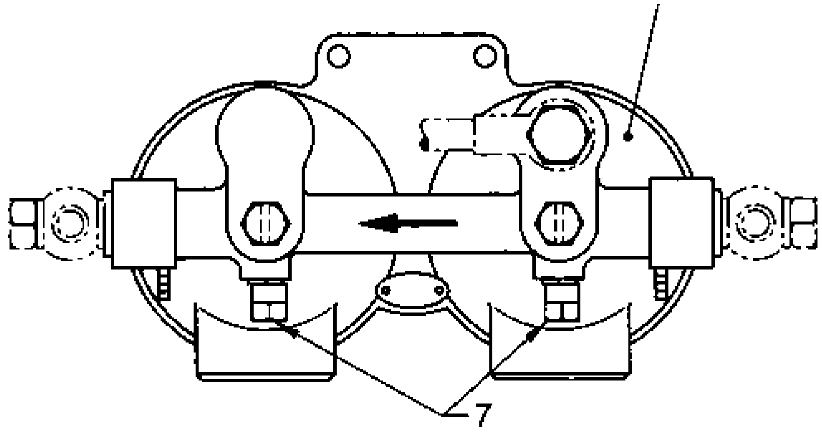
For removing the air trapped in the pipe lines, bleeder screws (7) on the filter and Bleeder screws (8) on the F.I.Pump are provided and they are to be opened up and then closed tightly after exit of air from the fuel lines.

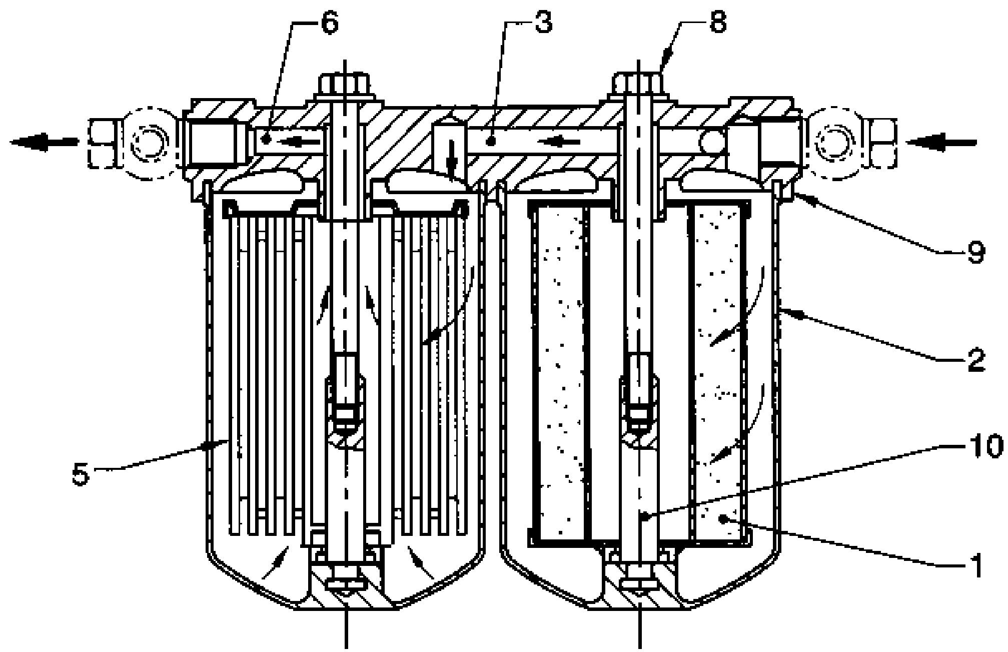
The system of removing air from the pipe lines is called bleeding or air venting.

Diesel Engine fuel filter

TR 10 01 03 06 99

–4





Function

In a Diesel Engine a number of fuel filters are used to clean the fuel free of contaminants to enable the fuel to pass through clearances of very highly precision finished parts like Elements and Nozzles.

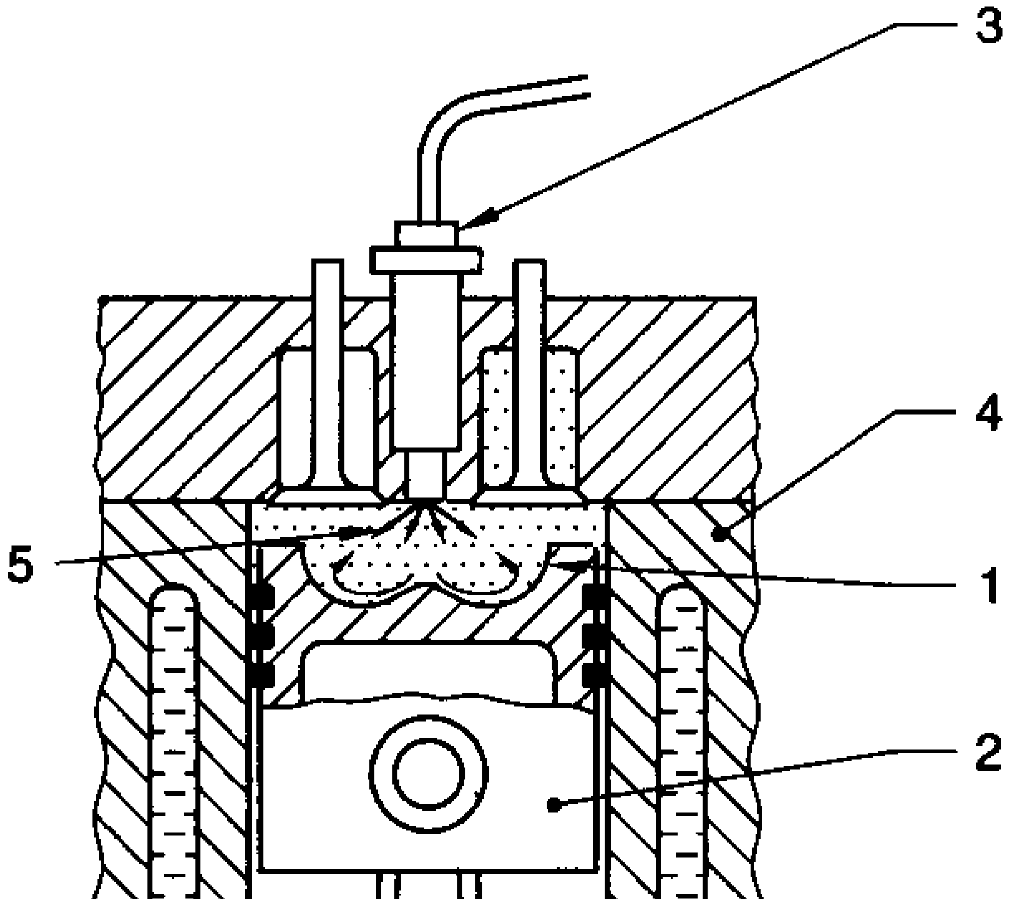
Fuel flow

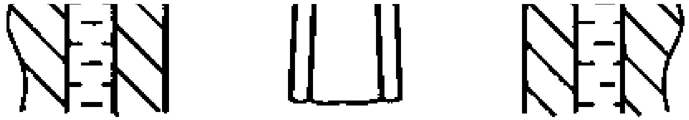
The fuel passes through cloth insert (1) in the Bowl (2) of the pre-filter. Then it passes through the drilled passage (3) in the top cover (4) and enters into Bowl of Micro filter. Then the fuel passes through paper insert (5) and comes out fully cleaned off impurities, dust and dirt and enters the outlet passage (6) provided in the top cover (4) and reaches the F.I.pump. Bleeding screws (7) are provided to remove air from the system (fuel lines). At the Inlet and outlet, Banjos, Banjo bolts with copper washers are provided for connection of fuel lines from lift pump and F.I.pump. The copper washers prevent leakage of fuel through Banjos.

Comparison of Function multi hole and Pintle Nozzles

TR 10 01 03 07 99

A. Multi-Hozzle Nozzle





Functional aspect

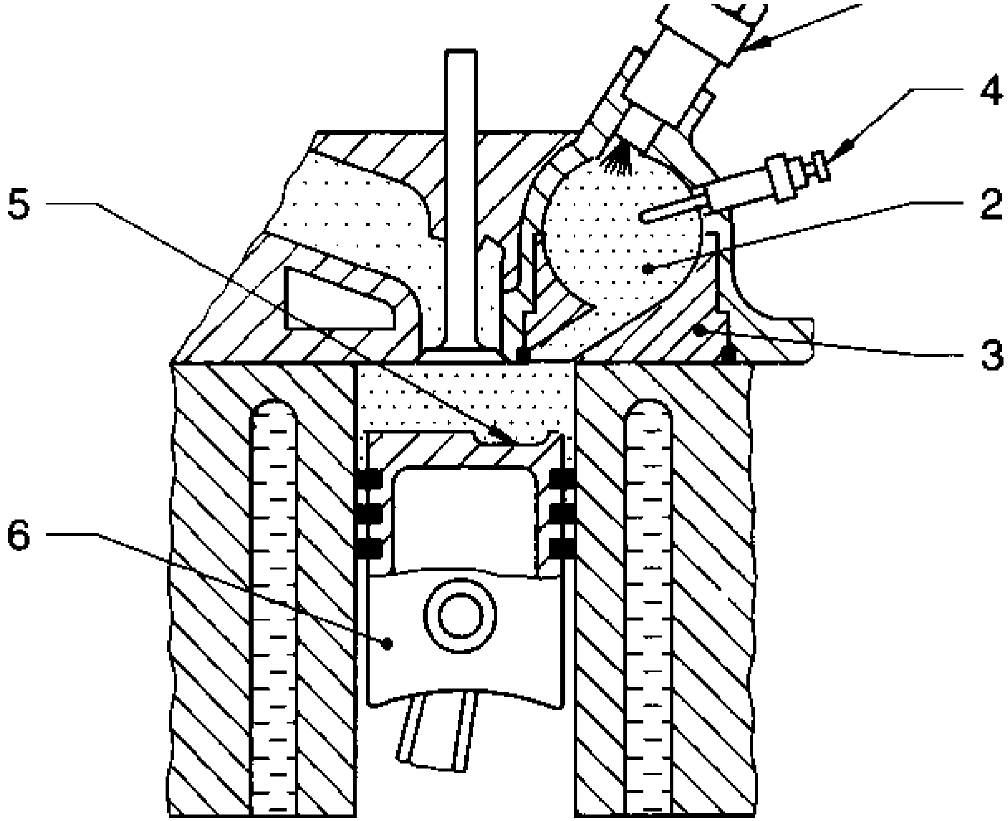
This nozzle works in conjunction with a Torroidal chamber.

The provision of torroidal chamber (1) on the top of the piston (2) provides a squish turbulence of air to enable fuel to mix with air fully.

The air in the cylinder (4) is compressed to a very high pressure. The fuel nozzle (3) has 4 spray (5) holes and fuel is sprayed at a very high pressure to penetrate into the highly compressed air. The fuel is ignited very quickly and combustion proceeds in the cylinder (4).

No heater or glow plug is necessary. Hence starting of engine is easy. The method is called direct injection in diesel engines. (D.I.Engines)

B. Pintle Nozzle



Functional aspect

The pintle nozzle (1) works in conjunction with Pre-chamber (2) provided in the cylinder head (3).

The pintle nozzle (1) provides a conical spray of fuel at a low pressure on the compressed air in the pre-combustion chamber (2). The pre-chamber provides good turbulence of air for mixing with fuel spray. Since the air in the pre-chamber (2) is not compressed to high pressure enough heat is not available for igniting the fuel. Hence a glow plug (4) to preheat the air is provided.

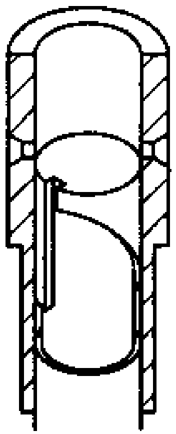
The combustion of fuel takes place in two stages, i.e first in the pre-combustion chamber (2) and it is continued in the spherical chamber (5) on the top of the piston. The burnt gas and unburnt fuel particles pass to the main chamber through passage in the pre-chamber (2). During this process further atomisation of fuel takes place and all fuel is burnt out. The combustion process is continued on the top of the piston (6).

This method is called Indirect Injection in diesel engine.

Fuel Injection Pump

TR 10 01 03 03 99

Fuel Delivery position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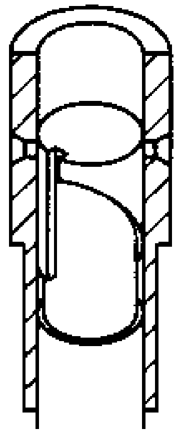
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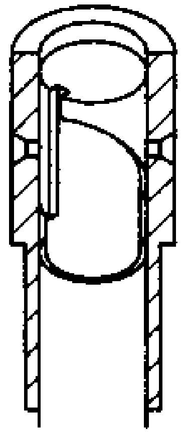
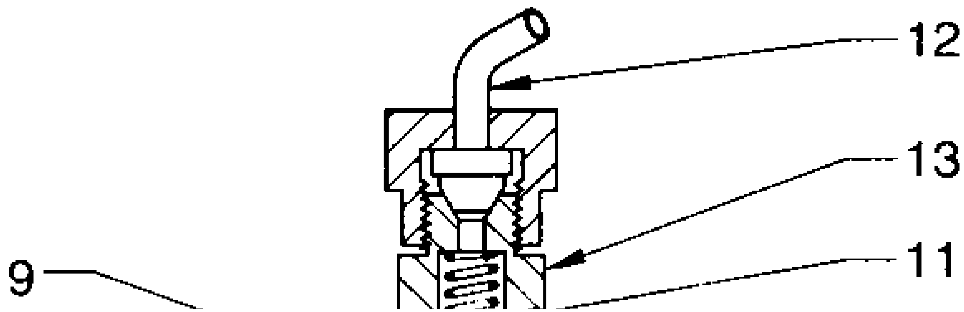

3

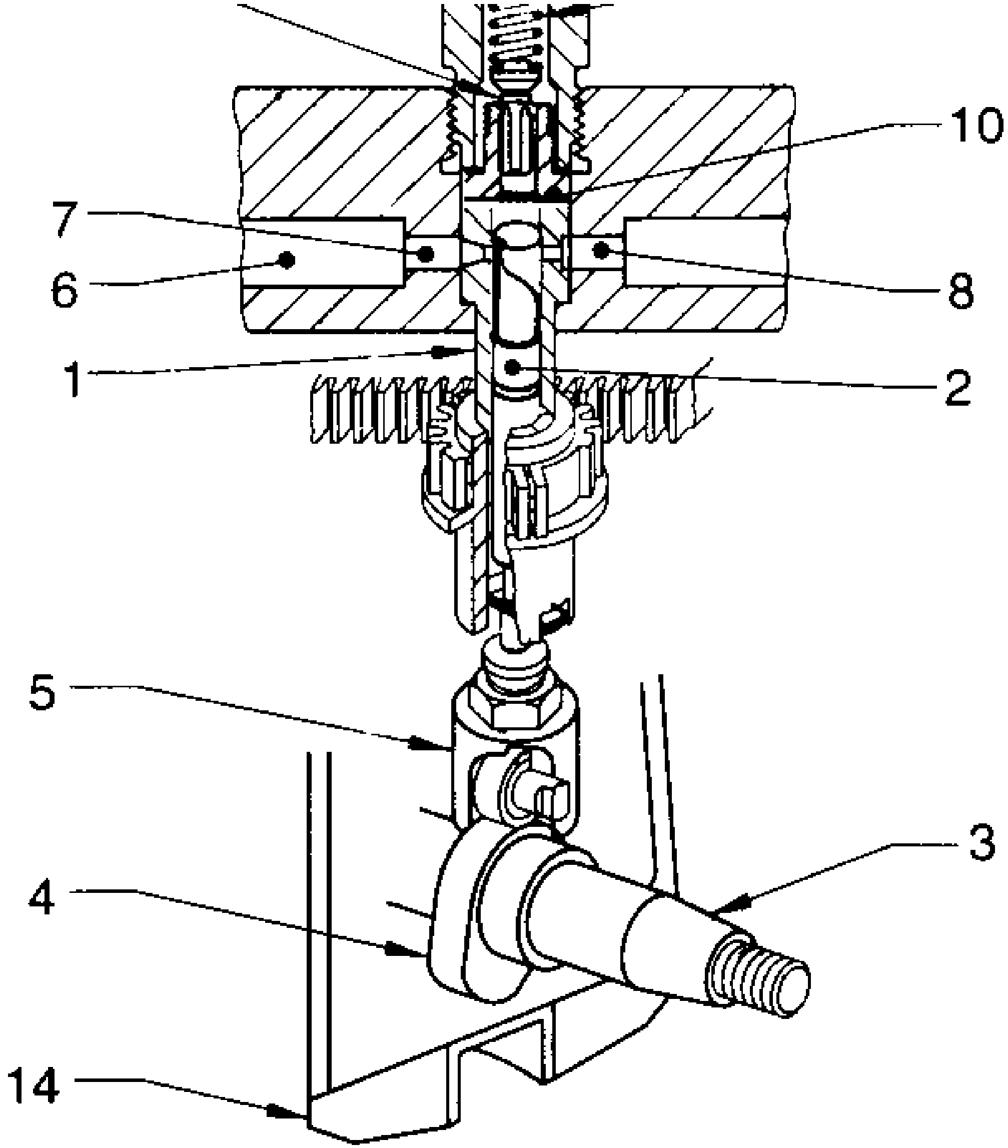
Position 1: The Plunger (2) is now at BDC - Fuel enters the Top of Plunger (2) from gallery (6). No fuel is delivered now.

Position 2: Plunger (2) moves up in the Barrel, closing both the ports (7 & 8). The fuel is being pressurised by the moving plunger (2) during the movement to TDC.

Position 3: When the helix of the plunger uncovers the spill ports fuel delivery is complete. The pressure drops in the fuel line. But the plunger will continue to move upto TDC to complete its stroke.

NOTE: The height of helix determines the quantity of fuel delivered to the engine.





(B) ARRANGEMENT OF PLUNGER & BARREL

Working of F.I.Pump (Fig B)

The figure (B) indicates assembly of components of a Fuel Injection Pump.

This pump has a Barrel (1) and plunger (2) for each Engine Cylinder in a Multi-cylinder engine. The camshaft (3) is driven by the engine and a cam lobe (4) operates each plunger. When a lobe of a cam (4) comes up with roller tappet (5) under a plunger (2),

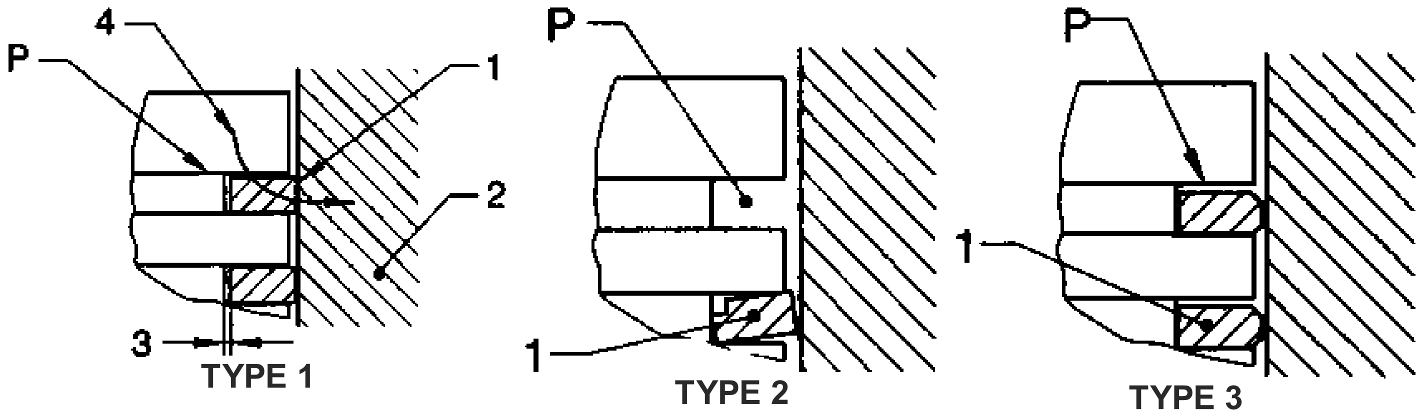
the plunger (2) is lifted and its movement pressurises the Diesel entered from the gallery (6) through feed port (7). The pressure of fuel is raised to a high value when both ports Feed Port (7) and spill port (8) closed. This pressurised fuel lifts the delivery valve (9) off its seat (10) compressing the spring (11) and passes into the fuel out let pipe (12) and then delivered to the Injector nozzle by opening it. The Injection of fuel is stopped, when bottom of helix on the plunger uncovers the spill port (8). The fuel pressure in the pipe line drops. Due to this the delivery valve is seated first on its seat increasing the drop in the fuel pressure. The Injector Nozzle is closed abruptly without dribbling of fuel.

NOTE: The quantity of fuel delivered can be altered by rotating the plunger in the barrel. As plunger is rotated the effective stroke of the plunger is varied and the quantity of fuel delivered to the engine also varies.

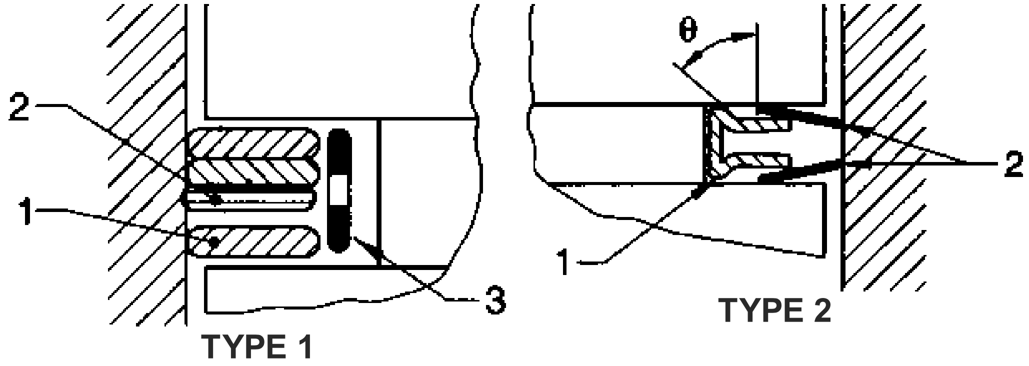
Piston rings assembly

TR 10 01 11 01 99

(A) COMPRESSION RINGS



(B) OIL CONTROL RINGS



Function

Piston Rings

A Compression Rings

3 Types are normally used in engines.

Type I: Rectangular rings

These have rectangular faces (1). These faces contact cylinder wall (2). These are mounted on Piston Top grooves (P) with some back clearances (3). These rings seal the compression pressure and leakage of combustion gases. Also they transfer heat to cylinder wall (2). Heat flow path (4) from piston (P) to cylinder wall (2) is shown in the figure.

Type II: Inside Bevel Rings

A step is cut on the top surface at the inner diameter of ring (1). These are used in second grooves. These prevent blow by gas into oil sump.

Type III: Taper Faced Rings

The face of the ring (1) is tapered on both sides. The lower edge of the ring 3s in touch with cylinder wall (2). These rings (1) scrapes all the oil from the cylinder wall. Function

B Oil Control Rings Type I: Oil Scraper Rings

They are also called Duaflex Rings.

These rings have greater force against cylinder wall because they are made of steel. They scrape oil well and reduce oil consumption. Hence they are used for re-ringing jobs. They are made in three parts.

One set of Ring has a rail, a crimped spring and expander. The rail (1) is made of good steel and number of rails vary in accordance with width of groove. It wipes oil from the cylinder wall.

The crimped spring (2) keeps the rail space apart and seals against Top & Bottom of the groove. The expander (3) exerts correct amount of pressure against the rail and provides a good sealing on the cylinder wall. Irrespective of cylinder bore wear, these rings provide effective sealing.

Type II: 'T' Flex Rings

In this type T shaped expander (1) is used with two scraper rails (2). The expander (1) forces the rail (2) against cylinder wall. This enables ring to scrape excess oil.

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