6th Sem./MECH. /MECH(PROD)/ MECH(MAINT.) / DME /MECH.(IND.INT)/ MECH(SAND.)/2022(S)

Th-2 AUTOMOBILE ENGNEERING & HYBRID VEHICLES

Full Marks: 80 Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10

a. What is Air Fuel ratio?
b. What is the need of a Differential?
c. Define Automobile.
d. What is the function of a Spark Plug?
e. What is an Electric Vehicle? Give two examples.
f. Which types of batteries are used in an Electric Vehicle?
g. Name various types of Fuel cells.
h. What is the need of braking system in automobile?
i. How ignition takes place in petrol engine?
j. What do you mean by Carburetion process?

2. Answer **Any Six** Questions 6 x 5

a. Write down the advantages of Hydraulic Brake.
b. State the layout of Automobile chassis with major components.
c. Differentiate between Sliding mesh and Synchromesh gear box.
d. Differentiate between Hybrid Vehicle and Electric Vehicle.
e. Explain the common ignition troubles and its remedies.
f. With a help of neat sketch, show the pump circulation system of water cooling.
g What are components of Transmission system? Explain in brief.

3 Describe the lubrication system of I.C engine. 10

4 Describe the working principle of Fuel Feed Pump with neat sketch. 10

5 Describe the working of Single Plate Clutch with neat sketch. 10

6 Describe constructional features and working of a Telescopic Shock Absorber. 10

7 Describe the working principle of fuel injection system for multi cylinder (in-line) engine. 10

Th 2 (AE&HV)

1. **A. What is Air fuel ratio?**

Ans- The air–fuel ratio is a significant indicator and very important measure for gasoline engine performance controlling and tuning, and anti-vehicles exhaust emissions pollution reasons. The AFR called or known as stoichiometric mixture when the provided air is exactly enough to completely burn all of the gasoline fuel.

B. What is the need of a differential?

Ans- If a car travels in a straight line, the two rare wheels turn on the road exactly at the same speed. There is no relative movement between the two rare wheels. The propeller shaft may be geared rigidly, in this case, with the rare wheels together. But when the car takes a turn, the outer wheel travels on a longer radius than the inner wheel. The outer wheel turns faster than the inner wheel that is there is a relative movement between the two rare wheels. If the two rare wheels are rigidly fixed to a rear axel the inner wheel will slip which will cause repair tyre wear, steering difficulties and poor road holding.

C. Define Automobile.

Ans- A self-propelled passenger vehicle that usually has four wheels and an internal-combustion engine, used for land transport.

D. What is the function of a Spark plug?

Ans- spark plug, also called Sparking Plug, device that fits into the cylinder head of an internal-combustion engine and carries two electrodes separated by an air gap, across which current from a high-tension ignition system discharge, to form a spark for igniting the air–fuel mixture.

E. What is an electric vehicle? Give two examples?

Ans- An electric vehicle (EV) is a mode of transport which is powered by electricity. Unlike conventional vehicles that use a gasoline (petrol) or diesel-powered engine, electric cars and trucks use an electric motor powered by electricity from batteries or a fuel cell. For example, the Nissan Leaf, the Mitsubishi i-MiEV, Renault Zoe and Tesla cars can be pre-heated while the vehicle is plugged in.

F. Which types of batteries are used in a electric vehicle?

Ans- Nickel-Metal Hydride Batteries
Lead-Acid Batteries
Ultracapacitors

G. Name various types of fuel cell?

Ans- Polymer electrolyte membrane fuel cells.
Direct methanol fuel cells.
Alkaline fuel cells.
Phosphoric acid fuel cells.
Molten carbonate fuel cells.
Solid oxide fuel cells.
Reversible fuel cells.

H. What is the need of braking system in automobile?

Ans- Need of Braking system In Automobile:
(i) To stop or slow down the speed of a vehicle depending upon the driving needs.
(ii) To control the vehicle to be retained when decending a hill.

I. How ignition rakes place in petrol engine?

Ans- Ignition in the Petrol engines takes place due to sparks from spark plugs, whereas in diesel engines, fuel ignites due to the heat of compression. Air gets heated up when it is compressed. Diesel engines can be four-stroke or two-stroke.

J. What do you mean by Carburetion process?

Ans- The process of preparation of a combustible air-fuel mixture by mixing the proper amount of fuel with the air before it goes into the cylinder is called Carburetion.

2. **A. Write down the advantages of hydraulic brake?**

Ans- The advantages of the hydraulic braking system are as follows,

(a) Equal braking action on all wheels.
(b) Increased braking force.
(c) Simple in construction.
(d) The low wear rate of brake linings.
(e) The flexibility of brake linings.
(f) Increased mechanical advantage.

B. State the layout of automobile chassis with major components?

Ans- Components of an Automobile: An automobile consists of two main assemblies viz., (i) Chassis (ii) Body (or super-structure) The chassis is a complete combination of various systems and components that enable it to run on the road. It is, in fact, an auto-vehicle minus the body. The chassis comprises of basis structure, prime mover, transmission system, auxiliaries and controls and the wheel with inflated tyres. A suitably shaped body, mounted on the chassis, makes the complete auto-vehicle which may be in the form of a mini-bus, bus, truck, deluxe coach, goods carrier, cattle truck, car carrier etc.

Functions of Various Components: Various systems and components serve the following purposes:

(1) Frame: It is the main structural component which supports all the chassis systems and the body. It is generally made-up of steel box section or channel section.

(ii) Suspension system: It absorbs the jerks and shocks induced in the vehicle due to road unevenness, bump and hump, and thus provides comfort to the riders. Major components of this system are springs and shock absorbers. The springs of helical or leaf types, or both initiate vibration in the whole vehicle during impact of road and this vibration is damped-down by shock absorbers. The suspension system may be rigid axle type and/or independent type, but the latter type is more popular now.

(iii) Steering system: The movements of vehicles, directional stability and negotiation of curves are accomplished by the steering system. The driver, through steering wheel and linkages, enables turning of the wheels in a desired manner.

(iv) Front Axle system: Front axle is a stationary beam of I-section. Two front wheels are connected to it through stub axles, and thus are able to turn during steering. In latter vehicles, the stationary beam has been replaced by a flexible shaft.

(v) Wheel and Tyre system: A tyre mounted on a wheel imparts rolling motion to the vehicle. The tyre encases a tube which is inflated by air pressure. Provision of braking the vehicles is made within the wheel by placing a brake drum, brake shoe, wheel cylinder or a cam.

(vi) Braking system: This system can be operated by mechanical, hydraulic, pneumatic powers or their combination. It helps in stopping the vehicle at a desired place or under emergency by pressing the brake pedal. Braking effort on pedal magnified through linkages, brings master cylinder in operation. In turn, hydraulic or pneumatic force acts on wheel cylinder placed inside the wheel, and the vehicle stops.

(vii) Prime mover: The propelling force required to run an auto-vehicle comes from a power plant which can be a petrol engine, diesel engine, or others. In I.C. engines, a piston reciprocates within the cylinder on expansion of burnt fuel. This reciprocating motion is transformed into rotary motion of crank-shaft via connecting rod and crank mechanism. Mechanical power, thus. available at crank-shaft flows to clutch from a fly wheel.

(viii) Fuel system: Purpose of fuel system is to supply fuel inside the cylinder for burning. Fuel system of a petrol engine is different from the fuel system of a diesel engine. In petrol engine, a fuel pump lifts petrol from the fuel tank and supplies it to the carburettor. Air from the surrounding also reaches the carburettor via the air cleaner. Liquid petrol atomizes and mixes with air within the carburettor and then goes to the cylinder for burning.

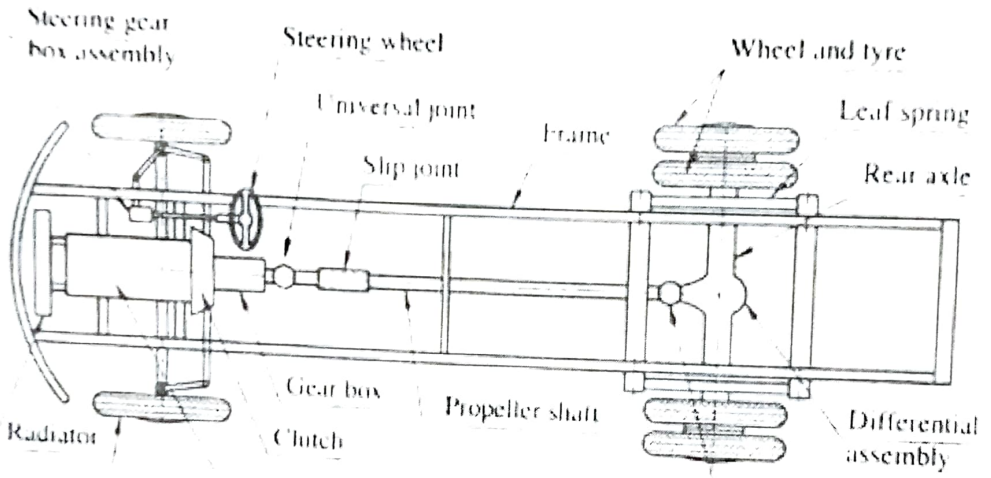
(ix) Ignition system: Function of this system is to ignite the fuel within the cylinder. When the ignition switch is made 'ON', the direct current (d c) flows from the battery to the ignition coil which raises low voltage to a very high value.

(x) Cooling system: The ignition of fuel causes continuous burning. Burning results in generation of heat. A very hot engine is not desired. It may cause seizure of piston within the cylinder. Hence cooling of engine is invariably required. A water pump water to all possible regions of engine from where the heat is to be removed.

(xi) Lubricating system: This system helps in reducing the friction between two mating parts whether in rotary motion or reciprocating. Lubricating oil is pumped by geared pump or by other means and reaches all the joints and essential regions through passages made for it.

(xii) Valve mechanism: In flow of charge into cylinder for burning and then outflow from cylinder after burning is a continued sequence. The inlet and outlet valves regulate these flows. Timely opening and closing of valves take place with the help of cams mounted on the cam-shaft.

(xiii) Clutch system: It is used for smooth transfer of power from engine crank-shaft to the gear box. To serve this purpose, a clutch plate gets engaged between a flywheel and a pressure plate. Sometimes it is desired that the vehicle should be stationary while the engine is operative, then clutch can be dis-engaged.



c. Differentiate between sliding mesh and synchromesh gear box.

Sr No.	constant mesh gear box	synchromesh gear box
1.	It has need of double declutching .	No need of double declutching as in case of constant mesh gearbox.
2.	Problem in engagement of higher gears due to constant mesh device	Smooth engagement of higher gears due to synchromesh device.
3.	It is more noisy.	It is less noisy as helical gears are used.
4.	It has more vibration.	It has less vibration.

D. Differentiate between hybrid vehicle & electric vehicle .

Specifications	Hybrid Cars	Electric Cars
Power/Fuel Source	Electricity and Fossil Fuel (Petrol and Diesel)	Electricity Through Battery Pack (DC
Engine	Internal Combustion Engine (ICE) and Electric Motor(s)	Electric Motor(s)
Fuel Efficiency	Combination of ICE and Battery Range	Depends on Battery Range
Emission Levels	Higher Compared to Electric Cars	Lower Compared to ICE and Hybrid C
Price Range	Similar to Conventional ICE Cars	High
Charging	Not Needed	Needed

E. Explain the common ignition troubles and its remedies.

(b) Mention common ignition troubles in case of petrol engines and ...

Ans. Ignition System Troubles and Their Troubleshooting : The probable troubles and defects encountered in different components of various ignition systems can be listed as follows. Their remedies are also suggested :

Component	Symptom	Probable cause of trouble	Probable remedy
Ignition coil			
	Current in primary circuit less than the specified value	• High resistance in open circuit	Test and replace the defective coil
	Primary current too high	• Primary short-circuited	Replace the coil
	Engine misfires at high speed	• Defective coil	Replace
	Engine does not start in damp weather	• Moisture or dirt on coil's secondary terminal	Wipe and clean
	Hard starting	• Defective high tension cables	Replace
C.B. points			
	Burns rapidly and needs frequent replacement	• Defective condenser	Replace

	• Gap set too small	Set to specified value
Develops crater on the negative	• Generator voltage excessive	Adjust to proper value
Develops crater on the positive	• Condenser of low capacity	Replace
Burnt, pitted and dirty points	• Condenser of too high capacity	Replace
	• High resistance of primary circuit	Clean the points and replace the resistance
Distributor assembly		
Cam angle varies with speed	• Distributor shaft worn	Replace
	• Too less tension on breaker arm spring	Tighten to correct force
	• Breaker plate assembly damaged	Change
Quick wear of rubbing blocks	• Breaker cam not lubricated	Lubricate
	• Breaker arm spring too tight	Loosen to correct tension
Engine does not start in wet weather	• Moisture on inside of distributor cap	Wipe off
	• Cracked cap	Replace
Condenser		
Breaker points burn rapidly	• Loose condenser lead	Tighten
	• Ground condition poor	Clean
	• Connected to wrong terminal	Correct it
Engine misfires at high speeds	• Defective condenser	Replace
Difficult engine starting	• Low capacity condenser	Replace
Ignition switch		
Low current in primary circuit	• Switch resistance high	Replace it
Ballast resistor		
Primary current too high	• Ballast resistor improperly connected or shorted	Connect correctly or replace
Engine does not start quickly	• Open circuit in ballast resistor is by-passed	Repair
Advance mechanism		
Engine 'pings' under load i.e., runs roughtly	• Mechanism operating incorrectly	Check distributor
Engine overheats	• Late ignition timing	Advance it
Magnetio		
Noise	• Magneto cover bent inward	Repair it
	• Fan screws loose	Tighten
	• Rotor/stator plate loose	Tighten
	• Coils touching to pole-shoes of the rotor.	Correct them
Spark plug		
Electrodes erosion occurs	• Corrossive combustion gases	Use proper fuel
Carbon, oil, or lead deposits	• Alternative paths of current flow.	Remove carbon, wipe oil, and clean the pulg
Overheating	• Much advanced ignition	Adjust ignition advance
	• Plug used is unspecified	Use the correct Plug
	• Weak mixture	Adjust carburettor
Misfiring	• Increase in spark plug gap	Adjust the gap, or replace the plug

F. With a help of neat sketch, show the pump circulation system of water cooling.

Ans. Pump Circulation System of Water Cooling : The pump or forced circulating system of water cooling in automobile is similar in construction to the thermo-siphon system except that it makes use of a centrifugal pump to circulate the water as shown in figure.

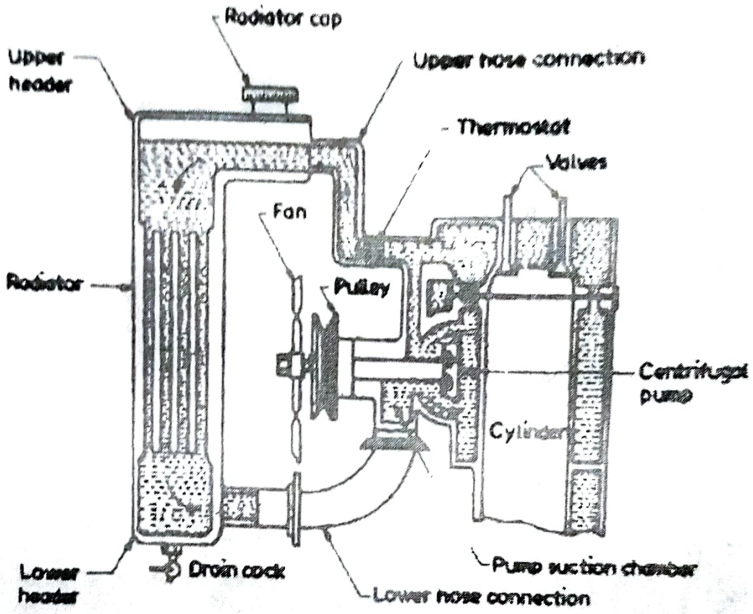


Fig. Layout of pump circulating cooling system.

Water from bottom of the radiator enters the pump's suction chamber through the lower hose connection and after being circulated throughout the water jackets, leaves the cylinder block and enter the radiator through the upper hose connection.

The pump adds to the velocity of water circulation through the system. It causes water to reach all complicated and intricate regions and helps in quick heat removal. The pump is mounted on a common spindle with the fan. The spindle receives power through a pulley connected on it. Power to this pulley is being supplied by camshaft via a belt. Pump circulating system is quite common on auto-vehicles these days.

G. What are components of transmission systems? Explain in brief.

In this type of system, the fuel injection pump injects definite quantity of fuel into individual cylinders in turn according to firing order, through the injectors fitted on them. The injection pump is geared to from the engine camshaft so that it is driven at half the engine speed. Contained in the injection pump on its side, a governor which provides automatic speed control, relative to any set position of the accelerator pedal. Any excess fuel after lubrication of injector nozzle is returned to the fuel tank.

(g) What are the components of transmission system ? Explain in brief.

Ans. Components of Transmission System : The mechanism that transmits engine power to the rear wheel (in case of rear wheel driven vehicles) or to the front wheels (in front wheel driven vehicles), or to all the four wheels (in four wheel driven vehicles) is known as a transmission system.

It comprises of the following main units :

(i) Clutch (ii) Gear box (Manual or Automatic)

(iii) Overdrive (on many recent vehicle)

(iv) Transfer box (in 4 - wheel driven vehicles)

(v) Propeller shaft (vi) Universal joint

(vii) final drive (Crown) differential (viii) Real axles

Fig. : Components of an automobile power transmission system

The power developed inside the engine cylinder alternately aimed to turn the wheels so that the vehicle is driven on the road. The reciprocating motion of the piston turns a crankshaft. It rotates the flywheel through the connecting rod. This circular motion of the crankshaft is now to be transmitted to the rear wheels which is transmitted through the clutch, gearbox, universal joints, propelling shaft or drive shaft, differential and axles extending to the wheels. Given below the main objectives of the power transmission system.

(i) **Clutch :** It is an intermediate mechanism which is placed in between the flywheel and the gearbox for the purpose of allowing or discontinuing the power flow from the engine to the transmission system.

(ii) **Gearbox :** It consists of a set of gears to change the speed.

(iii) **Overdrive :** It behaves like a super top gear and helps the vechiles in achieving faster than the engine speed without any extra fuel consumption.

(iv) **Transfer gear box :** A transfer box or transfer gerbox transfers powers from gear box to the front and rear axles in 4 - wheel drive vehicles.

(v) **Propeller shaft :** The propeller shaft is a driving axle that connects the transmission to the differential.

(vi) **Universal Joints :** These are connected at each end of the propeller shaft at an angle to transmit rotary motion and the torque.

(vii) **Final Drive :** It is employed to provide a permanent reduction in speed ratio i.e. a non - variable torque ratio between the propeller shaft and differential and also to increase the torque.

(viii) **Differential :** It comprises of an epicyclic gear train which delivers power to the two separate rear wheel axles. Its main feature is the ability to allow outer wheels to rotate at a faster speed than the inner wheels while negotiating turns.

(ix) **Real axles :** The rear axles are responsible for [illegible]

(j) Classify the automobile engines based upon various aspects.

Ans. Constructional and Placement Features of Various Automobile Engines : The automobile engines may have one, two, three, four, six, eight, twelve

3. Describe the lubrication system in I.C engine.

Ans. Lubrication System of I.C Engine : The various systems adopted for the lubrication of I.C. engine are

(i) Petroil system

(ii) Splash system

(iii) Pressure system

(iv) Semi pressure system

(v) Dry-sump pressure

(i) Petroil system : This is used generally for small two-stroke engines e.g., scooter and motor cycle engines. It is the simplest of all types of lubrication system. Certain amount of the lubricating oil is mixed with the petrol itself, the usual ratio being 2% to 3% of oil. If it is less, there is danger of oil starvation or insufficient lubrication causing damage to the engine. if however it is more, there will be excessive carbon deposits in the cylinder head and the engine will also given dark smoke.

(ii) Splash system : This was employed for the engines of early motor cycles. It is one of the cheapest methods of engine lubrication. A scoop is made in the lowest part of the connecting rod and the oil is stored in the oil through, it being pumped there from the crankcase oil sump. When the engine runs, the scoop causes, the oil to splash on the cylinder walls each time it passes through its B.D.C. position. This affects the lubrication of engine walls, gudgeon pin, main crankshaft bearings, big end bearings etc.

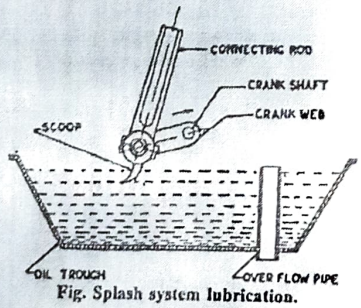


Fig. Splash system lubrication.

(iii) Pressure system : In this system of lubrication, the engine parts are lubricated under pressure feed. The lubricating oil is stored in a separate tank or the sump, from where an oil pump takes the oil through a strainer and delivers it through a filter to the main oil gallery at a pressure of 2-4 kg/cm². The oil from the main gallery goes to the main bearings, from where some of it after lubricating the main bearings, falls back to the sump, some is splashed to lubricate the cylinder walls and the remaining goes through a hole to the crank pin. From the crank pin it goes to the piston pin through a hole in the connecting rod web, where it lubricates the piston rings.

For lubricating camshaft and timing gears, the oil is led through a separate oil line from the oil gallery. The valve tappets are lubricated by connecting to main oil gallery to the tappeet guide surfaces through drilled holes.

An oil pressure gauge at the instrument panel indicates the oil pressure in the system. Oil filters and strainers in the system clear off the oil from dust metal particles and other harmful particles.

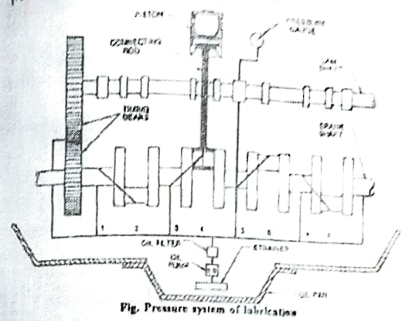


Fig. Pressure system of lubrication

(iv) Semi-pressure system : It is the combination of splash system and pressure system. Some parts are lubricated by splash system and some parts are lubricated by pressure system. Almost all the four stroke engines are lubricated by this system.

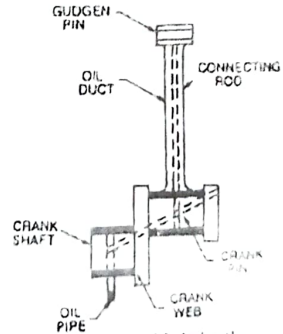


Fig. Small end lubrication

(v) Dry-sump pressure : The system in which the lubricating oil is stored in the oil sump is called wet sump system, like the pressure system. But the system in which the lubricating oil is not kept in the oil sump is known as dry sump system. In this system the oil is carried in a separate tank from which it is supplied to the engine. The oil which falls on the crank is used for lubrication is sent back to the oil tank by a separate delivery pump. This system is used in vehicles where the vehicle has to change its position continuously

4. **Describe the working principle of fuel feed pump with neat sketch.**

The fuel feed pump delivers the fuel from the tank to the injection pump continuously and at a reasonable pressure. The fuel injection system also contains the following important components, which are useful in engineering.

01) Fuel feed Pump
02) Fuel Injection pump
03) Fuel Atomizer and nozzles
04) Fuel Filters

The fuel which is stored in the fuel storage tank is taken to the injection system through fuel filters. This fuel, either by gravity or by mechanical pressure is supplied to the injection system.

The fuel starts flowing to the injection pump under the gravity head as the fuel tank is placed at a higher level than an engine in a gravitation feed system.

Hence this type of arrangement is most suitable for stationary engines.

In a mechanical pressure system, the fuel is sucked from the fuel tank by a mechanically operated fuel feed pump and is forced to the fuel injection pump.

In this case, a fuel tank is placed away from an engine or at a lower level than the engine.

This system is most useful for automobiles using diesel as fuel. Because the fuel placed away from the hot engine avoids the chances of fire hazards.

01) Pressure Chamber
02) Plunger
03) Stuffing Box
04) Cam
05) Roller Tappet
06) Leakage Channel
07) Inlet & Outlet
08) Suction Valve
09) Plunger spring
10) Pressure Valve

A plunger arrangement is fitted in a pressure chamber. So, the plunger is activated downward by a cam through a roller tappet and plunger rod.

On the opposite side of a plunger, a plunger spring is employed; hence the return stroke of the plunger is performed.

The fuel is led to the plunger space through a suction valve and after getting compressed, the fuel moves out through the pressure valve into the pressure chamber from where it goes to the filter and then to the fuel injection pump.

To avoid the wastage of fuel, a leakage channel is provided, so it collects heated fuel from the stuffing box and feeds it again to the inlet pipe.

During the upward stroke of the plunger, suction is created in plunger space and fuel is sucked in, through a suction valve.

During the downward stroke, caused by a cam arrangement, the fuel below the plunger is compressed, which forces the suction valve to close and the pressure valve (Outlet valve) to open.

The fuel thus flows out under pressure1 kilogram/cm^2 into the pressure chamber.

5. **Describe the working of single plate clutch with neat sketch.**

Working Of Single Plate Clutch

When the engine is running and therefore the flywheel is rotating, the pressure plate also rotates because the pressure plate attaches to the flywheel. The friction disc is located between the flywheel and the pressure plate. When the driving force has pushed down the clutch is released.

The pressure plate is bolted to the flywheel through clutch springs and is free to slide (Move) on the clutch shaft when the clutch pedal is operated (Engage and Disengage).

If Clutch Engaged

When the clutch is engaged (which Means when you not pressed the clutch pedal), the clutch plate is held between the flywheel and the pressure plate.

The friction linings are on both sides of the clutch plate. The clutch disc rotates the flywheel due to the friction between the flywheel, the clutch disc, and the pressure plate.

The clutch shaft also rotates with the clutch plate. The clutch shaft is connected to the gearbox. Now the engine power is transferred to the crankshaft and then to the clutch shaft and gearbox.

Clutch is always engaged because of the spring forces.

If Clutch Disengaged

When the clutch is disengaged (which Means when you pressed the clutch pedal), the pressure plate moves back against the force of the springs, and the clutch plate is released between the flywheel and the pressure plate.

The flywheel always rotates with the crankshaft. Then the speed of the clutch shaft will slowly decrease and stop rotating.

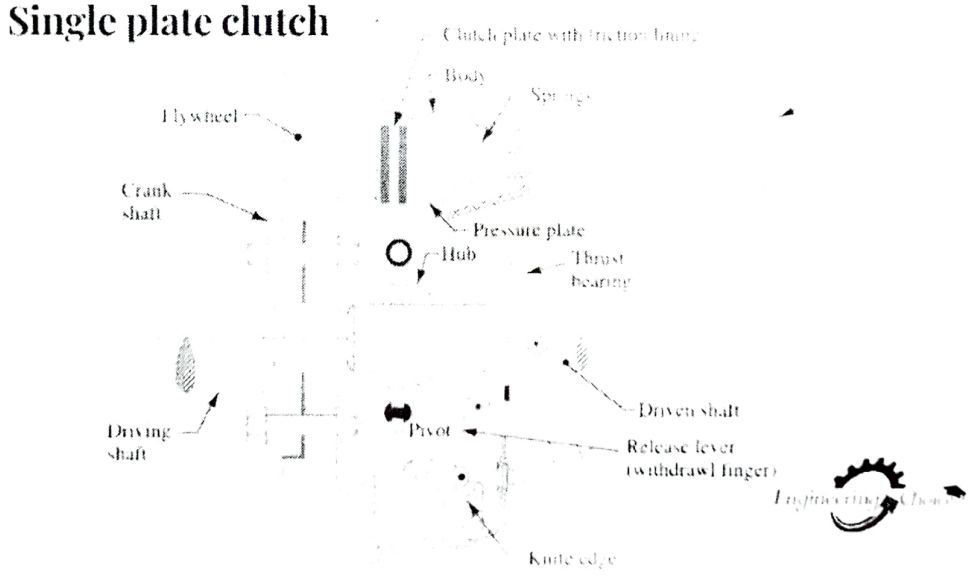


Diagram of single plate clutch

6. **Describe constructional features and working of a Telescopic shock Absorber.**

Purpose of telescopic shock absorber

- To control vibrations in the springs.
- To provide a comfortable ride.
- Act flexible and be rigid enough.
- To resist unnecessary spring movement.
- It is used to absorb shocks that occur while driving on uneven roads.
- It is also used for vehicle stability under sudden acceleration or braking conditions.

Construction

- It consist of a cylinder to which head is welded. The head is screwed into the top end of the outer tube.

- To the bottom end of the outer tube is welded pressed Steel cap and eye or ring. This eye is connected to wheel axle.
- The Piston slides inside the cylinder. This piston is secured to the piston rod which at its upper end has an eyes welded to it with this eye, the piston rod is attached to the frame of the vehicle the outside part of the piston rod is protected by a dust shield which is welded to the fixing eyes.
- A gland prevents oil leakage from where the piston rod passes through the head.
- The gland consists of a piston rod, Oil seal, Oil seal gasket, seal retainer, Oil seal spring and Oil seal cup. Any fluid scraped off by the gland packing passes down a drain hole to the reservoir space between the cylinder and outer tube.
- The Piston has two concentric rings of holes drilled through it. The outer ring of hole is covered at the top by a disc valve which is held down by a star shape disc spring.
- The inner ring hole is covered by disc valve from bottom by the coil spring. There is a foot valve assembly at the bottom of the cylinder. The foot valve assembly is similar to that piston assembly, except that the lower disc valve which covers the inner ring of holes is held up by a disc valve spring instead of coil spring. Both ends of the cylinder are completely filled by a mixture of 60% transformer oil and 40% turbine oil and the space between the tube and cylinder.

Working

- When a vehicle come across the bump, the bottom eyes is moved upwards, then the fluid below the piston must be displaced to the top side of the piston.
- The fluid will now pass through the outer ring of hole in the piston by lifting the top disc against the disc spring. But the volume above the piston is less due to piston rod.
- As such, fluid from the bottom of the piston will also get displaced through inner ring of holes in the foot valve and enter the reservoir space between the cylinder and Outer tube. So the fluid level in the reservoir space will rise.
- The pressure set up in the system will depend upon the size of the passage open by valve in the Piston and foot valve. This will depend on the square of the speed at which the cylinder is moved upward.
- When the cylinder moves downward, fluid will be displaced from the upper end of the cylinder to lower end through the inner ring of hole in the piston by opening the lower disc valve against coil spring. Because of the volume of the piston rod that leaves the cylinder, the fluid will be drawn into the lower end of the cylinder from the reservoir space through the outer ring of hole in the foot valve. This passing of fluid through opening provide damping.

Advantages of the telescopic shock absorber

- Noise-free operation
- Less maintenance required.
- Safer machine operation
- Low manufacturing cost.
- High speed of operation.
- Longer machine life
- Higher operating speeds

Disadvantages

- It has a low ability to resist environmental pollution and temperature change.
- It is difficult for a damper to reach the natural frequency.
- Some types cannot be repaired but must be replaced.

7. Describe the working principal of Fuel injection system for multi cylinder (in line) engine.

7. Describe the working principle of fuel injection system for multi cylinder (in-line) engine.

Ans. Fuel Injection System For Multi-Cylinder (In-line) Engines : The function of a fuel injection system is to inject proper quantity of fuel into the engine cylinders at the correct time and at a predetermined rate. The fuel injection systems may be broadly classified into the following two types

(i) Air blast injection system.

(ii) An less or solid injection system.

(a) Individual pump system.

(b) Common rail system.

Air-Blast Injection System : This method was originally used in large stationary and marine engines. But it is now absolute due to less reliable, less efficient and requires an air compressor for supplying air at 7 MPa or higher (which consumes upto 10% of the power output of the engine).

In this method, the air is first compressed to a very high pressure. A blast of this air is then injected carrying the fuel alongwith it into the engine cylinder. The rate of fuel injection is controlled by varying the pressure of the air. The high pressure air requires multistage compressor so as to keep the air bottles charged. The fuel ignites by the high temperature of the air caused by the high compression.

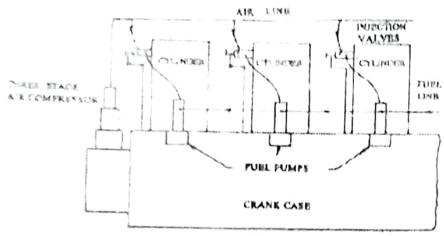


Fig. 1 : Air blast injection

Airless or Solid Injection :

In this method, the fuel under high pressure is directly injected into the combustion chamber. It burns due to the heat of compression of the air. This method requires a fuel pump to deliver the fuel at the high pressure (300 kg/cm^2). This method is used for all types of small and big diesel engines. It can be divided into two systems.

(a) Individual Pump Fuel Injection System :

Individual pump fuel injection system using in-line injection pump is shown in figure. Fuel is drawn from the fuel tank by means of a fuel feed pump which is operated from the injection pump camshaft. Generally, the plunger type or the diaphragm type of fuel feed pumps are employed in automobiles. The pump is provided with hand priming lever so that the diesel oil can be forced into the system and the air bled out without turning the engine. The fuel is then passed through a filter and thence to the fuel injection pump. Without the filter or with a poor quality filter, abrasive matter would reach the fuel injection pump and injectors, resulting in poor starting, irregular idling and deterioration in performance due to decreased fuel delivery from the injection pump. The abrasive matter would also cause faulty satayng and leakage in the injectors thus resulting in increased fuel consumption and heavy exhaust smoke. It is quite compact method and involve higher cost.

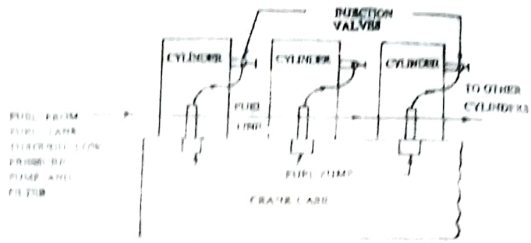


Fig. 2. Individual pump injection

(b) Common Rail System :

In this system a single injection pump with injector, called as unit injector is employed on each cylinder. The unit injectors are operated by raker arms and springs similar to the engine valves. A linkage connects the control racks of all the unit injectors, so that fuel injection in all the cylinders may be equal and simultaneously controlled.

The fuel is taken from the fuel tank by the feed pump and is supplied at low pressure through a filter to all the unit injectors. This avoids the high pressure fuel lines necessary in the common rail system. Any excess fuel from the relief valve is returned to the fuel tank.

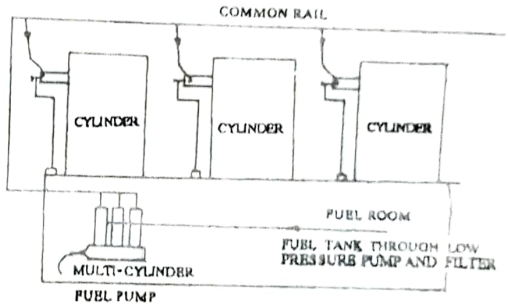


Fig.3 : Common rail system