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AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY



VINAYAKA MISSION'S
RESEARCH FOUNDATION
(Deemed to be University under section 3 of the UGC Act 1956)



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AUTOMOBILE ENGINEERING LAB

LAB MANUAL

B.Tech MECHANICAL ENGINEERING



Prepared by
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AARUPADAI VEEDU INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING

CERTIFICATE

Name of the lab : Automobile Engineering Lab

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Approved By : Prof. L.PRABHU
Head of the Department



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EX.NO: 1

DATE:

DISMANTLING OF SIX CYLINDER DIESEL ENGINE

AIM:

To dismantle the given six cylinder diesel engine.

TOOLS AND EQUIPMENTS:

Given six cylinder diesel engine, socket tool kit, spanners, screw drivers, hammer, pliers, chisels, diesel, kerosene, cotton waste etc.

PROCEDURE:

DISMANTLING :

- ❖ Drain off all the oil from the engine.
- ❖ Remove the tappet cover with its gasket.
- ❖ Remove the rocker shaft assembly and then push rod.
- ❖ Remove the nuts of inlet and exhaust manifold and remove them.
- ❖ Remove the cylinder head nuts and remove cylinder head with its gaskets.
- ❖ Tilt the engine to one side, remove the oil sump with its gaskets.
- ❖ Remove timing cover and chain.
- ❖ Remove oil pump with strainer after removing pump foundation bolts.
- ❖ Flywheel is then removed.
- ❖ Remove connecting rod big end bolts, remove the cap, push the connecting rod so that piston comes out from the other side.
- ❖ After the pistons are removed the crank shaft is taken out from the cylinder block.
- ❖ Remove the water pump.
- ❖ Remove timing gear from the cam shaft.
- ❖ Remove the cam shaft.

ASSEMBLING

The procedure for dismantling operation is adopted in the reverse to assemble operation.

- ❖ At first cam shaft is placed properly.
- ❖ Timing gear is attached to the camshaft correctly.
- ❖ Water pump is then attached.
- ❖ Crank shaft is kept inside the cylinder block.
- ❖ Pistons connecting rod assembly is then inserted into the cylinder bore properly and then attached to the crank shaft.
- ❖ Flywheel is then attached to the crank shaft.
- ❖ Oil pump with strainer is then placed, followed by timing cover and chain.
- ❖ Oil sump with its gaskets is then attached.

RESULT:

- ❖ Thus the given six cylinder diesel engine is dismantled.

Viva Questions

- 1 Name of the various fuel supply system?
- 2 Which one is most accurate fuel supply system for petrol cars?
- 3 Where the fuel pump is usually located in the car?
- 4 Why the carburetor float is made hollow?
- 5 What is the function of check valve in the carburetor?
- 6 What is the function of venturi in the carburetor? 7 Name any Indian vehicle using solex carburetor?
- 8 What is the purpose of petrol injection?
- 9 What is the common rail fuel injection system?
10. What are the various types of petrol injection system?
- 11 What is the function of a fuel feed pump?
- 12 What is the function of fuel injector?

EX.NO: 2

DATE:

DISMANTLING AND ASSEMBLING OF FOUR CYLINDER PETROL ENGINE

:

AIM:

To dismantle and assemble the given four cylinder diesel engine.

TOOLS AND EQUIPMENTS:

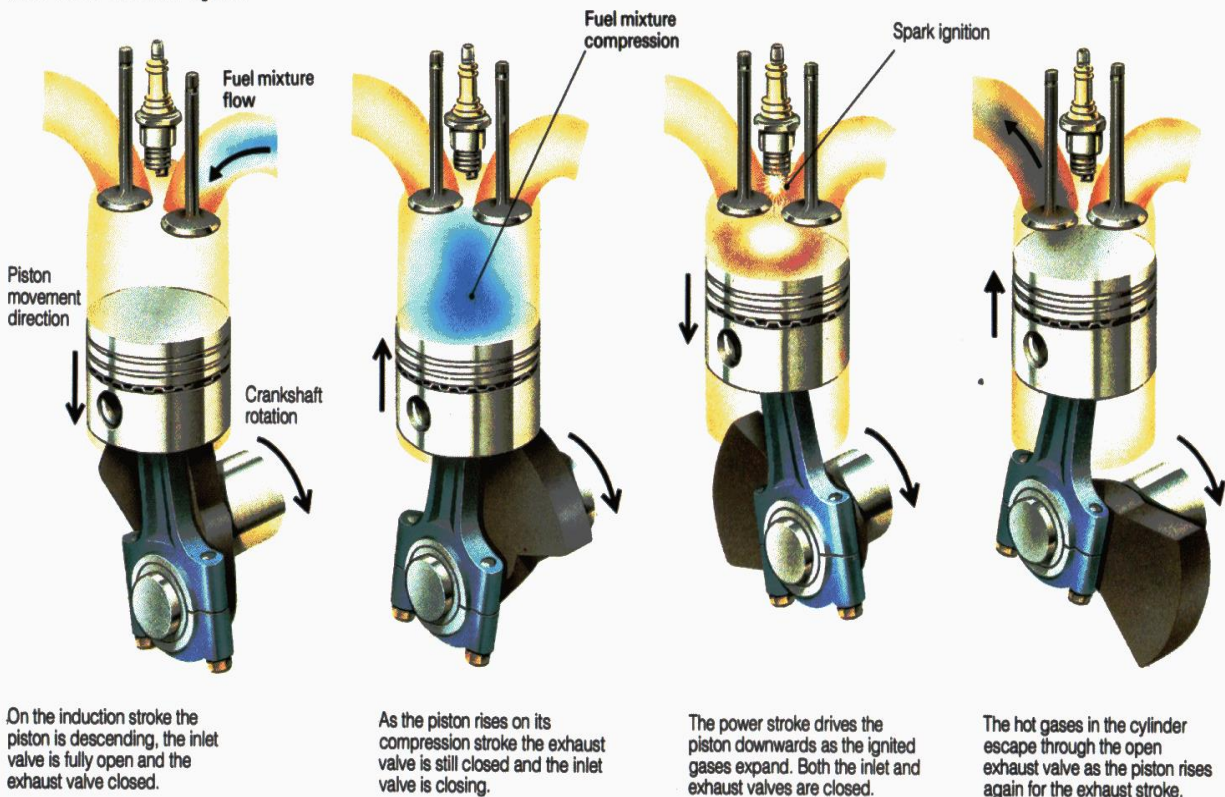
Given four cylinder diesel engine, socket tool kit, spanners, screw drivers, hammer, pliers, chisels, diesel, kerosene, cotton waste etc.

PROCEDURE:

Dismantling

- ❖ Drain off all the oil from the engine.
- ❖ Remove the tappet cover with its gasket.
- ❖ Remove the rocker shaft assembly and then push rod.
- ❖ Remove the nuts of inlet and exhaust manifold and remove them.
- ❖ Remove the cylinder head nuts and remove cylinder head with its gaskets.
- ❖ Tilt the engine to one side, remove the oil sump with its gaskets.
- ❖ Remove timing cover and chain.
- ❖ Remove oil pump with strainer after removing pump foundation bolts.
- ❖ Flywheel is then removed.
- ❖ Remove connecting rod big end bolts, remove the cap, push the connecting rod so that piston comes out from the other side.
- ❖ After the pistons are removed the crank shaft is taken out from the cylinder block.
- ❖ Remove the water pump.
- ❖ Remove timing gear from the cam shaft.
- ❖ Remove the cam shaft.

The four-stroke cycle



ASSEMBLING

The procedure for dismantling operation is adopted in the reverse to assemble operation.

- ❖ At first cam shaft is placed properly.
- ❖ Timing gear is attached to the camshaft correctly.
- ❖ Water pump is then attached.
- ❖ Crank shaft is kept inside the cylinder block.
- ❖ Pistons connecting rod assembly is then inserted into the cylinder bore properly and then attached to the crank shaft.
- ❖ Flywheel is then attached to the crank shaft.
- ❖ Oil pump with strainer is then placed, followed by timing cover and chain.
- ❖ Oil sump with its gaskets is then attached.
- ❖ Cylinder head with its gaskets is then attached to the cylinder block.
- ❖ Place the inlet and exhaust manifold.
- ❖ Place the push rod and rocker shaft assembly in the enginehead.
- ❖ Finally tappet covers with its gaskets are attached.

RESULT:

Thus the given four cylinder petrol engine is dismantled and then assembled.

Viva Questions

- 1 What is the necessity for cooling an engine?
- 2 Name various method of engine cooling?
- 3 Name the main components of water cooling system?
- 4 What is the function of radiator in cooling system?
- 5 What is the necessity of engine cooling?
- 6 State different S.A.E. viscosity rating of oil?
- 7 What is the multigrade oil?
- 8 Which solid lubricant is most commonly used in automobiles?
- 9 What is viscosity?
- 10 Give an example of synthetic lubricant?

EX.NO: 3

DATE:

DISMANTLING AND ASSEMBLING OF THREE CYLINDER PETROL ENGINE

AIM:

To dismantle and assemble the given three cylinder petrol engine.

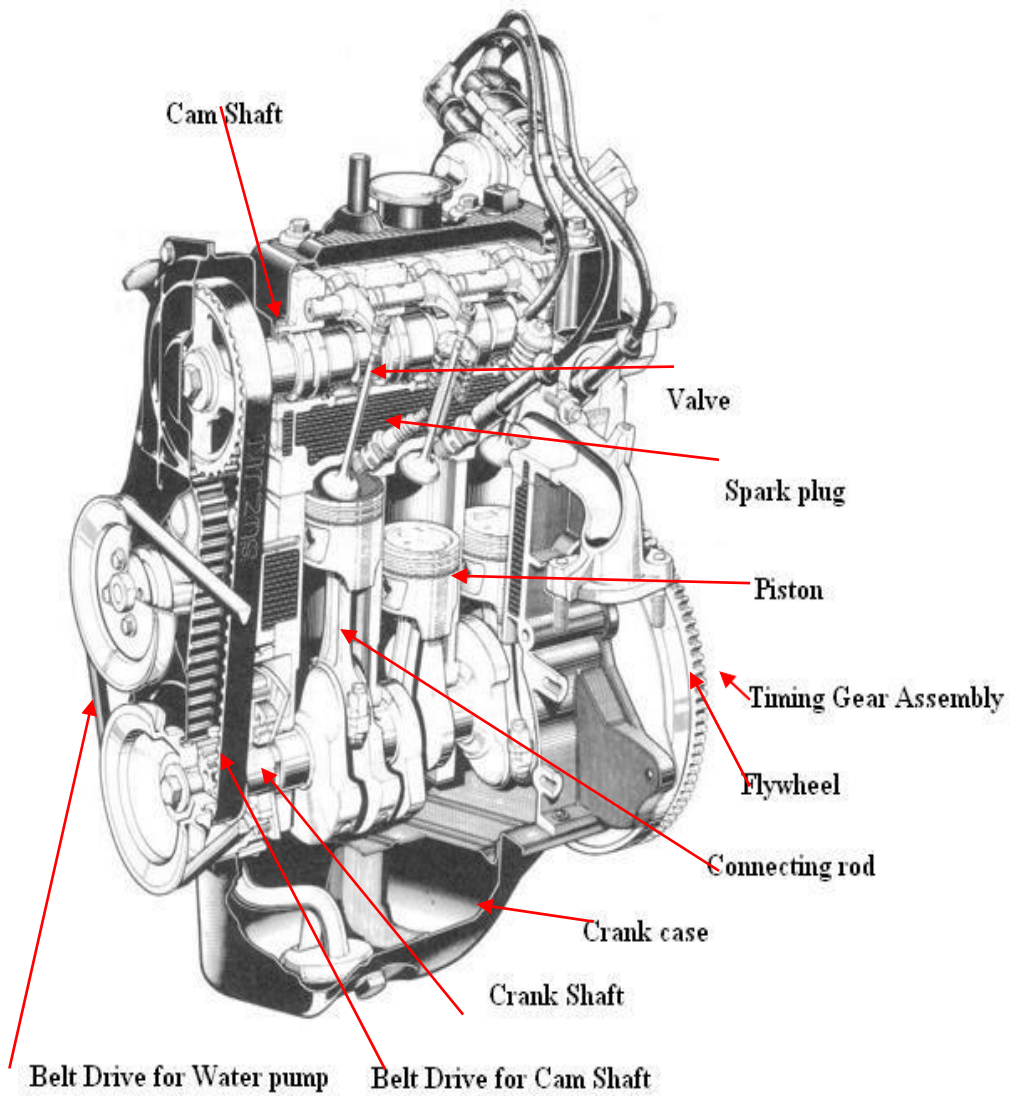
TOOLS AND EQUIPMENTS:

Given three cylinder petrol engine, socket tool kit, spanners, screw drivers, hammer, pliers, chisels, diesel, kerosene, cotton waste etc.

PROCEDURE:

Dismantling

- ❖ Drain off all the oil from the engine.
- ❖ Remove the tappet cover with its gasket.
- ❖ Remove the rocker shaft assembly and then push rod.
- ❖ Remove the nuts of inlet and exhaust manifold and remove them.
- ❖ Remove the cylinder head nuts and remove cylinder head with its gaskets.
- ❖ Tilt the engine to one side, remove the oil sump with its gaskets.
- ❖ Remove timing cover and chain.
- ❖ Remove oil pump with strainer after removing pump foundation bolts.
- ❖ Flywheel is then removed.
- ❖ Remove connecting rod big end bolts, remove the cap, push the connecting rod so that piston comes out from the other side.
- ❖ After the pistons are removed the crank shaft is taken out from the cylinder block.
- ❖ Remove the water pump.
- ❖ Remove timing gear from the cam shaft.
- ❖ Remove the cam shaft.



Assembling

The procedure for dismantling operation is adopted in the reverse to assemble operation.

- ❖ At first cam shaft is placed properly.
- ❖ Timing gear is attached to the camshaft correctly.
- ❖ Water pump is then attached.
- ❖ Crank shaft is kept inside the cylinder block.
- ❖ Pistons connecting rod assembly is then inserted into the cylinder bore properly and then attached to the crank shaft.
- ❖ Flywheel is then attached to the crank shaft.
- ❖ Oil pump with strainer is then placed, followed by timing cover and chain.
- ❖ Oil sump with its gaskets is then attached.
- ❖ Cylinder head with its gaskets is then attached to the cylinder block.
- ❖ Place the inlet and exhaust manifold.
- ❖ Place the push rod and rocker shaft assembly in the engine head.
- ❖ Finally tappet cover with its gaskets are attached.

RESULT:

Thus the given three cylinder petrol engine is dismantled and then assembled.

Viva Questions

- 1 What are the two basic of cooling system?
- 2 How does the shape of combustion chamber effect the combustion efficiency?
- 3 What is the advantage of reducing compression ratio of the engine?
- 4 What is a function of racer arm
- 5 Explain the function of ignition coil?
- 6 How does the fuel injection help to reduce automobile pollution?
- 7 What is the effect of heating the supply air on the engine emission?

EX.NO: 4

DATE:

DISMANTLING &ASSEMBLING OF GEAR BOX – SLIDING MESH, CONSTANT MESH & SYNCHROMESH GEAR BOX, TRANSFER CASE

Aim: To study, dismantle, inspect and assemble the given Gearbox assembly.

Tools required: 1.Hammer 2. Tool set 3. Screw Driver 4. Sockets. 5. Spanner set 6. Pullers

Function:

A machine consists of a power source and a power transmission system, which provides controlled application of the power. The term transmission refers to the whole drive train, including clutch,

Gearbox,

Propeller shaft (for rear-wheel drive), differential, and final drive shafts In motor vehicles, the transmission generally is connected to the engine crankshaft via a flywheel and/or clutch and/or fluid coupling. The output of the transmission is transmitted via driveshaft to one or more differentials, which in turn, drive the wheels.

Study: Gear Box

Often **transmission** refers simply to the **gearbox** that uses gears and gear trains to provide speed and torque conversions from a rotating power source to another device.

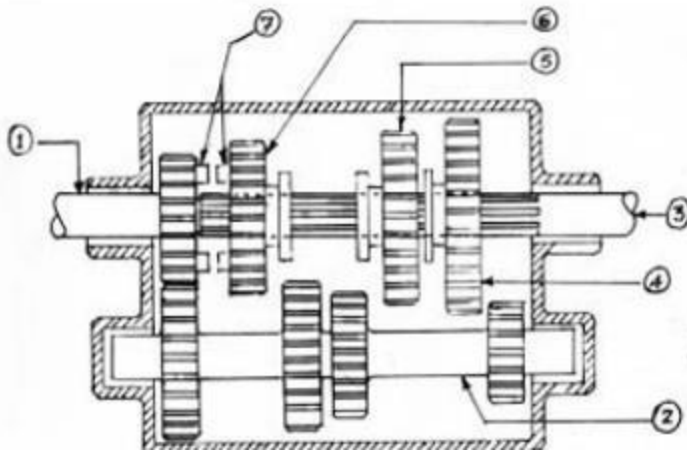
Principle:

1. Gear box contain gearing arrangement to get different speeds.
2. Gears are used to get more than one speed ratios.
3. When both mating gears have same number of teeth, both will rotate at same number speed.
4. But when one gear has less teeth than other, the gear with less number of teeth will rotate aster than larger gear.
5. In a typical car, there may be six gears including one reverse gear.
6. First gear gives low speed but high torque.
7. Higher gears give progressively increasing speeds.
8. Gears are engaged and disengaged by a shift lever.

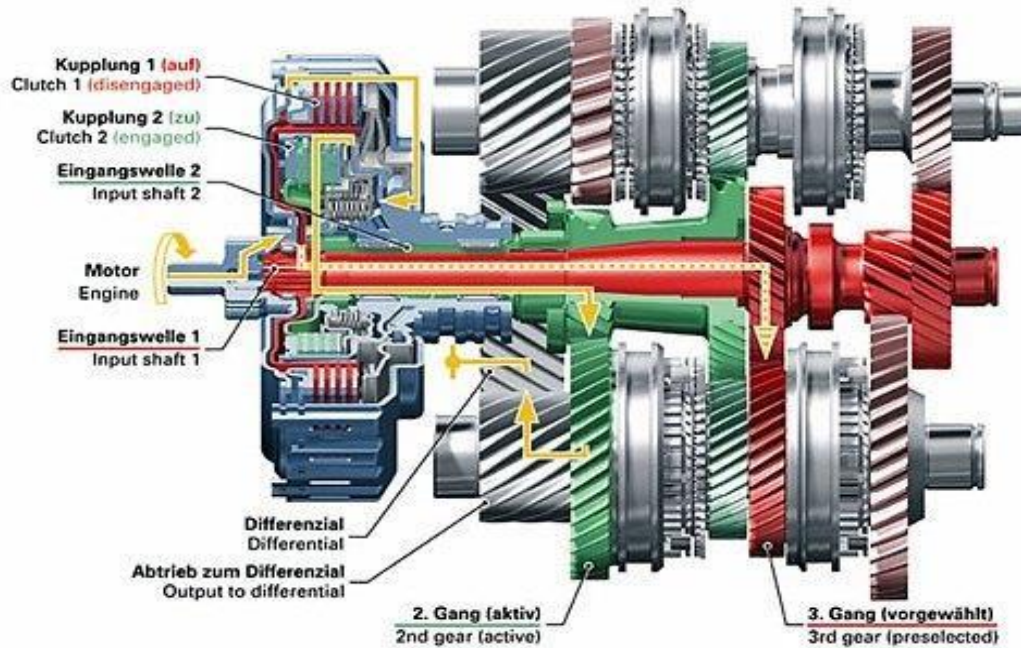
Types of gear boxes:

1. Manual transmission
 - i. Sliding mesh gear box.
 - ii. Constant mesh gear box
 - iii. Synchromesh gear box without overdrive.

Sliding Mesh Gearbox



- 1. main drive gear
- 2. counter shaft
- 3. main shaft
- 4. I gear
- 5. II gear
- 6. III gear
- 7. top speed engaging dogs



Dismantling:

Given- Gear box assembly (Manual- constant mesh type)

1. Mount the gear box on the work stand and remove the selector assembly.
2. Lock the main shaft by engaging only two gears by shifting the respective slipping sleeve on the gear.
3. Remove the locking pin and driving flange kit.
4. Pull out the flange by using driving flange puller.
5. Remove the gear box rear.
6. Remove the speedometer drive gearbox from the main shaft.
7. Remove the gearbox screw rear.
8. Remove the driveshaft and lay shaft end cover.
9. Drive the lay shaft, place the drive shaft puller. Place distance pieces on the gear casing below the puller bolt. Ensure that the distance piece do not sit on any threaded hole of the gear casing.
10. Remove the main shaft from end nut and remove the pilot bearing.
11. Tighten the bolt from the main shaft rear end bearing comes out of gear housing.
12. Pull out the main shaft along with the bearing.
13. Remove the main shaft from the gear casing.
14. Remove the main shaft gear bushes, fixed dog clutch & sliding dog clutch.
15. Remove the reverse idler gear shaft lock, shaft and idler gear.
16. Remove the lay shaft gear set with the thrust washer.
17. Remove the circlip from the drive shaft.
18. Place the drift on the bearing & press drift from top till bearing out of drive shaft.

Inspection:

1. Clean all the components.
2. Check the parts visually for damages due to wear. -
Measure the clearance between the bushes, & their respective gears are placed by bush gears.
4. If the clearance found is more than specific limit, measure the clearance found more than projection of the bush & above the gear.

Assembling:

1. Place the oil seal in the rear end cover & place the drift on the oil seal.
2. Press the oil seal in the cover by the drift & fix it.
3. Mount the gear box casing on the stand & lower down the lay shaft gears in the gear casing.
4. Clamp the lay shaft in its position temporarily.
5. Fix the lever idler gears along with the shaft & level it. Clean all tools and return them to

RESULT:

Thus the dismantling and assembling of Gear box have been performed.

Viva Questions

1. Explain clearly the necessity of a transmission in a vehicle
2. Discuss the advantages of a constant mesh gear box over the sliding mesh type gear box
3. Describe the working of a synchromesh gear box with the help of a neat sketch
4. What is transfer box ? where it is used ?
5. What are the merits and demerits of synchromesh gear box compared to a sliding mesh on constant mesh type
6. Explain the common troubles encountered in gear boxes and suggest suitable remedies
7. What is a synchronizer
8. Why is synchromesh device usually not employed for the reverse gear
9. What may be the possible reason when the gear slips out of engagement
10. What should be the cause when the vehicle is running with excessive noise in the gear box

EX.NO: 5

DATE:

DISMANTLING AND ASSEMBLING OF STEERING GEAR BOX AND BRAKING SYSTEM

AIM:

To dismantle and assemble the steering gear box.

TOOLS AND EQUIPMENTS:

Given gear box assembly, jack, set of spanners, hammer, slims, pliers, screw drivers, tool kit, gear oil, kerosene, cotton waste etc.

PROCEDURE:

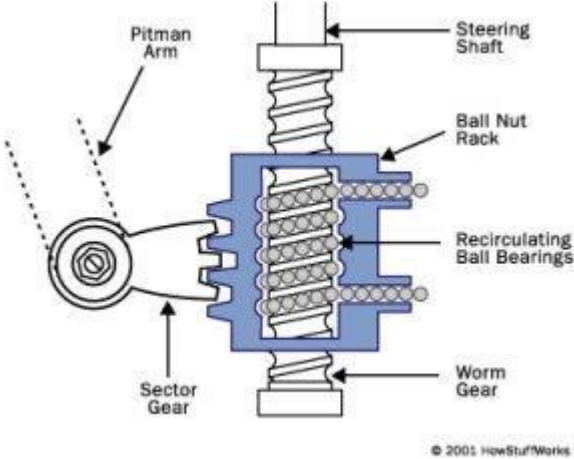
Dismantling

- ❖ Remove the steering wheel, if it refuses to come use puller.
- ❖ Remove drop arm nut and remove the drop arm.
- ❖ With soft hammer push roller sector shaft.
- ❖ Remove the bottom plate then the bearing.
- ❖ Remove the top plate cover and the tube.
- ❖ Remove the outer race, push the steering worm shaft out.

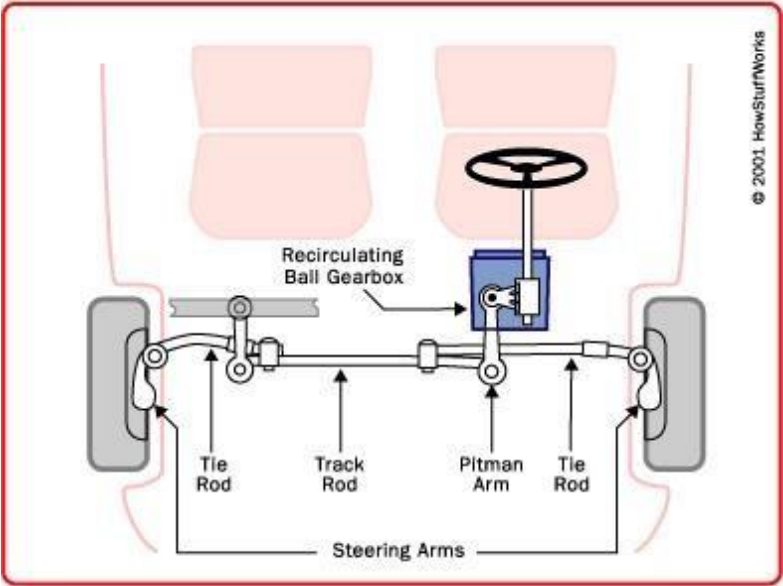
Assembling

- ❖ Fix the roller shaft in with its bushes and tighten the end cover.
- ❖ Fix up worm shaft with taper roller bearing with the bottom cover and top cover.
- ❖ Tight the nuts at the top and bottom plate and fix up steering outer tube.
- ❖ Fix the steering wheel
- ❖ Fix up steering drop arm and the lock nut.

CAM AND DOUBLE ROLLER STEERING GEAR BOX



RACK AND PINION STEERING GEAR BOX



BRAKE SYSTEM

Working of master cylinder

By pressing the pedal the push rod pushes the piston. When the piston moves forward it closes the by-pass port “C”. Now the brake fluid in the cylinder is pushed forward and it moves with pressure with pressure valve “B” and reaches all the wheel cylinders through pipes. The wheel cylinder receives the brake oil with pressure and expands the brake shoes against brake drums.

When the pressure on the pedal is removed, the spring in the cylinder pushes back the piston and by suction the brake oil in the line is pushed back in the cylinder. The oil come back through the bypass port “c” when gets opened with the backward stroke of the piston. This way the oil which was forced to wheel cylinders returns back in the reservoir of the master cylinder and again it is ready for braking operation. The push rod which pushes the piston the piston can be adjusted. There must be some play or clearance between bush rod and piston. It keeps in operation the by pass by the primary washer and thrust releasing the pressure. The secondary washer checks the leakage of oil from the piston grooves and the cylinder At the top of the supply tank a filler cap is provided with a vent hole in it. It is vented to the atmosphere because atmospheric causes the flow through the filter part.

Brake Pipes and Hoses

Brake pipes are made of special material which can stand the high pressure that exists when the brakes are applied. Generally steel pipes are used between master cylinder and the frame connection and the rear axle T fitting and rear wheel cylinders. Flexible hose connect the brake pipe to the front wheel cylinder and to the rear axle fitting.

Wheel Cylinder

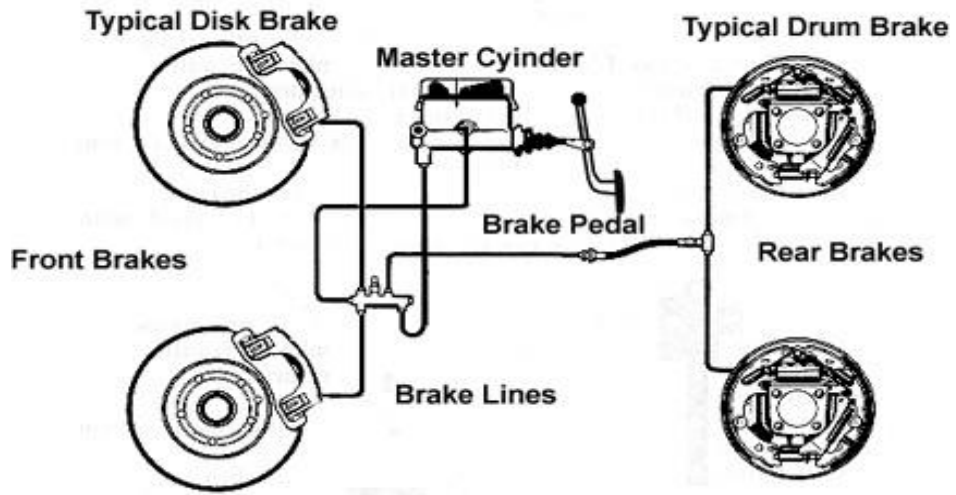
Hydraulic pressure from master cylinder forces the piston apart. Then the brake shoe actuating pins force the brake-shoes into contact with the brake drum. A bleeder valve is also provided in wheel cylinder to allow the air and liquid to be forced out of the system during the bleeding operation. The piston cups are so formed that the hydraulic pressure forced them tightly against cylinder wall of the wheel cylinder.

Brake Drum

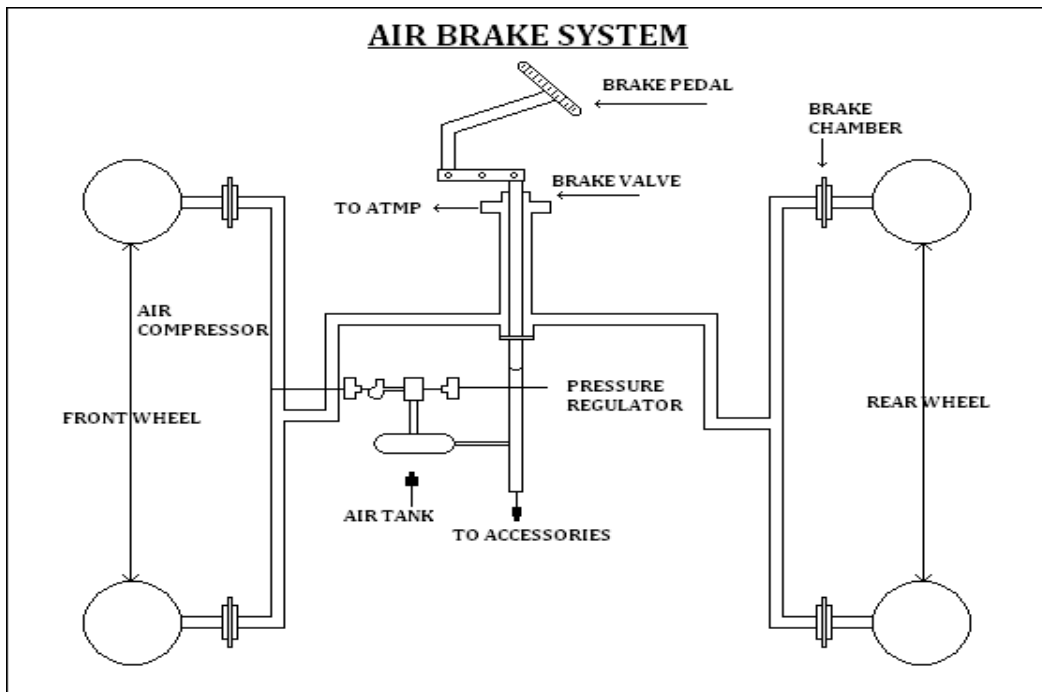
There are generally made of cast iron pressed steel or cast iron and steel. The brake drums are cylindrical members closed from one side and open on the other to house the brake shoe. The drum and wheel rotate together. Cooling ribs or fins are provided around the brake drum rapidly.

Brake Shoes

Generally there are two shoes a primary and secondary. Shoe is made of cast steel or forged steel. The cross section is generally T. Brake lining is fixed on the shoes with the help of rivets. One end of the shoe is fixed in the wheel cylinder and other end is coupled with adjuster Return spring are also fitted on the end.



Typical Automotive Braking System



Brake Lining

Brake lining is of two types, molded or woven. It is made of specially treated asbestos or other heat and wear resistant materials. This lining comes directly in contact with the brake drum to provide braking action. Bonded lining are fixed on the shoe with an adhesive and then backed.

OVERHAULING OF MASTER CYLINDER IN BRAKE SYSTEM

1. Remove the cylinder from the chassis frame by taking out pipe connections and both from the frame.
2. Remove the push rod piston, spring and valve, open the light switch also
3. Remove the primary and secondary washer from the piston. And clean the cylinder and piston nicely and with brake oil. Remember the petrol should never be used. It spoils the washer.
4. Check the valve and the hole and clean these.
5. Now fit the washers after dipping these in brake oil.
6. It is always advisable to change master cylinder repair kit completely
7. Now assemble the master cylinder and mount it on the chassis frame.
8. Connect the pipes and fill up the reservoir with brake oil.
9. The brake oil should not be filled up to the top but about 6mm lower
Remember there must be some play in push rod.

RESULT:

Thus the dismantling and assembling of steering gear box and brake system have been performed.

Viva Questions

- 1 What is the principle of automotive brake
- 2 What do the brakes do to the energy as they stop a moving car
- 3 What are the primary and secondary brakes
- 4 Why brakes with more than 80% efficiency are not used in automobiles
- 5 What is fading of brakes
- 6 On what factors does the force of adhesion between the road wheels and the road depends
- 7 How does skidding takes place
- 8 What is leading shoe
- 9 What is the difference between power assisted and power operated brakes
- 10 What is the advantage of a two shoe trailing brake
- 11 Name important components of a disc brake
- 12 What is the advantage of a swinging caliper type disc brake
- 13 Name important components of a drum brake
- 14 What is a split hydraulic brake system
- 15 What is steering axis?
- 16 What is wheel alignment?
- 17 Define Camber, SAI and Castor.

EX.NO: 6

DATE:

**STUDY OF IGNITION SYSTEM COMPONENTS – COIL, MAGNETO AND
ELECTRONIC IGNITION SYSTEMS.**

AIM:

To test and trouble shoot the starting system used in automobiles.

APPARATUS REQUIRED:

- (1) Starting system.

DESCRIPTION:

The internal combustion engine is not capable of self starting. They are cranked by a small but powerful electric motor called cranking motor, starter motor. The starter motor is a DC electric motor.

The operation of a starter motor is explained below. When the driver presses the switch, current flow from battery to two coil windings like pull in winding and hold in winding. Both windings are energized (magnetic field). Initially to pull the plunger inward, due to the inward movement of the plunger touches the contact disk and close the circuit between the battery and starter motor.

When the contact disk touches the terminals of the starter motor the pull in coil is shorted out, thus no current flows through the coil. The pull in coil is de-energized. At the same time a small amount of current flow through the hold in coil winding. The magnetism produced by the hold in coil winding is sufficient to hold the plunger until the driver release the switch.

PROCEDURE:

Testing the starting system.

- (1) Armature:

Use a multimeter to check insulation between armature core and each segment which should be complete. The meter should also indicate continuity between each segment. Any short circuit in the armature winding may be tested with a growler. If the short circuit is indicated, the winding has to be replaced.

- (2) Field coils:

Continuity should exist in the field windings which may be tested with a multimeter. There should also be perfect insulation between the yoke and the field terminal.

(3) Brushes:

Examine the brushes visually for wear and damage. If the wear or damage is more than the permissible limits, replace the concerned brush.

(4) Brush holders:

Use a multimeter to check the insulation between the positive brush holder and the holder frame. In case of any deviation from complete insulation, rectify the fault by repairing or replacing the damaged component.

(5) Solenoid switch or shift:

Disconnect the lead wire connecting the switch to the starter motor and apply battery voltage between the switch terminals. If correct, the plunger is attracted. In case of shift, the pinion would also project. It must be noted that the test should be done continuously for more than 10-15 seconds

Complete carburetor overhaul should be attempted by a skilled mechanic

1. First disconnect the lines and take off air cleaner. Then disconnect the linkage. Use two wrenches when disconnect the linkage. Use two wrenches when disconnecting the fuel lines, to avoid damage to threads. Keep the carburetor in a clean place where dust and dirt cannot get into openings. Cover the exposed manifold holes with proper coverings. Do not use cotton waste to close the openings because thread of cotton waste may fall into the manifold. Covering the manifold is necessary because some time some nut bolt falls in the manifold hole unknowingly and that cause a serious damage
2. Remove the carburetor as already explained and dismantle it carefully. Thoroughly clean the parts and all the jet holes by blowing air.
3. Check all parts for damage and wear. Check the float needle and seat for wear. Check the floats for dents or distortion. Check the bearing pin of the float. Power piston found scored should be replaced. Check the throttle and choke spindles bores for wear and out of round.
4. Inspect the idle mixture adjusting needle for grooves. In case it is defective it should be replaced. Check the pump plunger cup and replaced it if it is worn or hard.
5. Check the fuel filter and fuel screen for dirt or choking.
6. Check the entire gasket and their mating surface. In case the surfaces are rough these may be repaired.
7. Replace any parts that are worn, damage or excessively loose.
8. Put the carburetor into position on the intake manifold and fix it with the bolt and nuts. Connect the fuel line and distributor advance lines to the carburetor using two wrenches. Connect wires to switches and other electrical controls. Connect linkage and make idle speed, idle mixture and other adjustments. Install the air cleaner.

EX.NO: 7

DATE:

STUDY OF OIL FILTER, FUEL FILTER, FUEL INJECTION SYSTEM, CARBURETOR, MPFI

Working of Simple Carburetor

If you compare MPFI with single-point fuel injection, single-point fuel injection has only one centrally located fuel injector which supplies fuel to all cylinders, but in a multi point fuel injection system, each cylinder has a separate fuel injector that supplies fuel from the fuel tank to the cylinders.

If you have to know that the idea behind an engine is to burn [gasoline](#) to create pressure, and then to turn the pressure into motion. A remarkably tiny amount of gasoline is needed during each combustion cycle. Something on the order of 10 milligrams of gasoline per combustion stroke is all it takes!

The goal of a carburetor is to mix just the right amount of gasoline with air so that the engine runs properly. If there is not enough fuel mixed with the air, the engine "runs lean" and either will not run or potentially damages the engine. If there is too much fuel mixed with the air, the engine "runs rich" and either will not run (it floods), runs very smoky, runs poorly (bogs down, stalls easily), or at the very least wastes fuel. The carb is in charge of getting the mixture just right.

MPFI-Multi Point Fuel Injection System

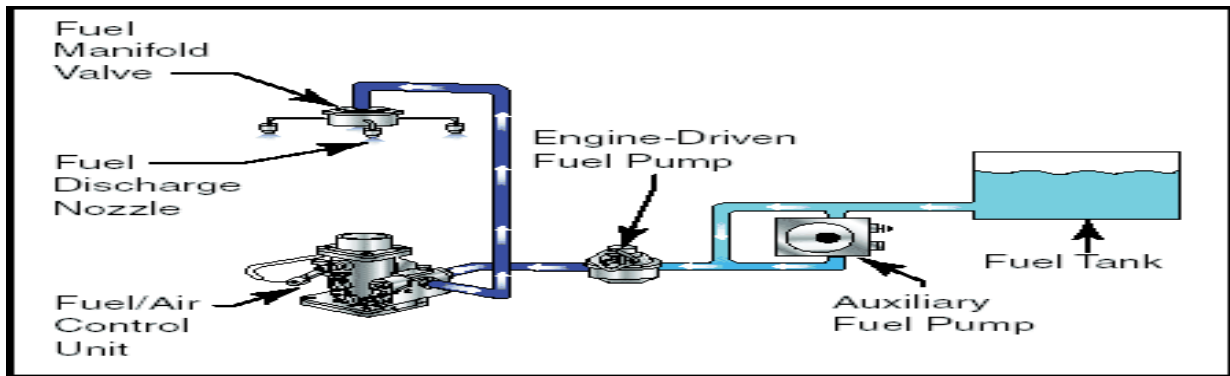
Introduction:

Despite the rapid development in carburetors which are cheap and efficient, the automobile industry prefers to use a gasoline injection system in spark ignition (S I Engines). Then, there must be some advantages of the gasoline injection system over the carburetor system which we are going to see at the end of this article. There are different types of gasoline injection systems in S I Engines, and one of them is a Multi-Point Fuel Injection System (MPFI). In this article, we are going to learn about components, use and working of multi point fuel injection system.

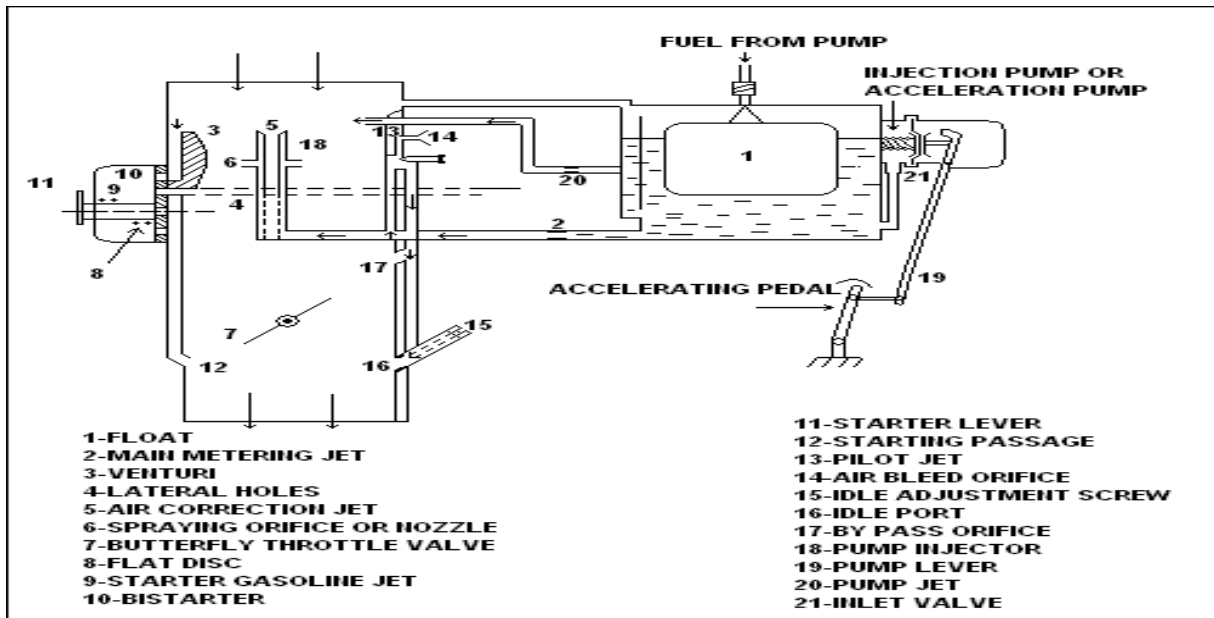
Components in Multi Point Fuel Injection System (MPFI):

There are different components used in the MPFI system as follows:

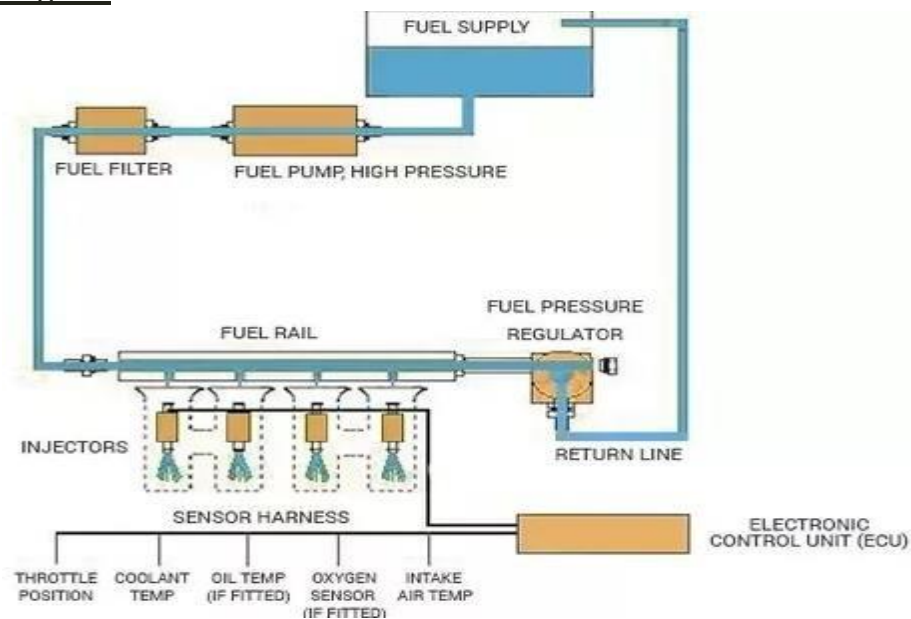
1. A mechanical solenoid injector
2. The [electronic control unit](#) (ECU) - It controls ignition timing and quality of the fuel.
3. Electronic sensors to monitor different output such as exhaust gas temperature, coolant temperature, speed, and throttle position.
4. Air filters to remove solid particles from the atmospheric air.



Simple Carburetor



MPFI System Diagram



Working of Multi Point Fuel Injection or MPFI System:

1. In the MPFI system, using the fuel pump which is driven by the electric motor is used to spray fuel into the engine intake manifold.
2. This technique helps to provide an accurate air-fuel ratio at all operating conditions.
3. The suction pressure of the engine is used to spray the fuel into the cylinders (In carburetors, the vacuum is used to provide the fuel).
4. As shown in the figure, you can see that a single injector is placed on the intake port of the different cylinders.
5. Using the electrical fuel pump, fuel from the fuel tank supplies to each fuel injector equally.
6. The process of fuel injection occurs simultaneously in each injector once in every rotation.

Classification of MPFI system:

MPFI system is classified into systems as follows:

1. D-MPFI System:

D-MPFI is a manifold fuel injection system.

2. L-MPFI System:

L-MPFI is a port fuel injection system.

Advantages of MPFI system:

- The power generated by the engine is more than the carburetion system.
- Due to the accurate mixture of air-fuel supplied to each cylinder, the difference between power generated at each cylinder is negligible.
- Engine vibrations from MPFI equipped engines are very less, hence the life of MPFI system equipped engines is high.
- This system is very responsive in case of sudden acceleration or deceleration.
- Lower fuel consumption leads to better mileage.
- The volumetric efficiency of MPFI is high.

Disadvantages of MPFI system:

- The system is complex hence costly.
- It requires more space.

EX.NO: 8

DATE:

STUDY OF ENGINE COOLING SYSTEM COMPONENTS, STUDY OF ENGINE LUBRICATION SYSTEM COMPONENTS

Aim

To study and prepare report on the constructional details working principles and operation of the following

Automotive Engine Systems And Sub Systems

- a) Multi cylinder; diesel and petrol engines
- b) Engine cooling and lubricating system

Theory

Labeled diagram, construction details, working principle and operation of the engine systems and sub systems

Methods of cooling

Various methods used for cooling of automobile engines are

- 1 Air cooling
- 2 Water cooling

Air cooling

The basic principle involved in this method is to have current of air flowing continuously over the heated metal surface from where the heat is to be removed. The heat dissipated depends upon following factors;

- a) Surface area of metal into contact with air
- b) Mass flow rate of air
- c) Temperature difference between the heated surface and air
- d) Conductivity of metal

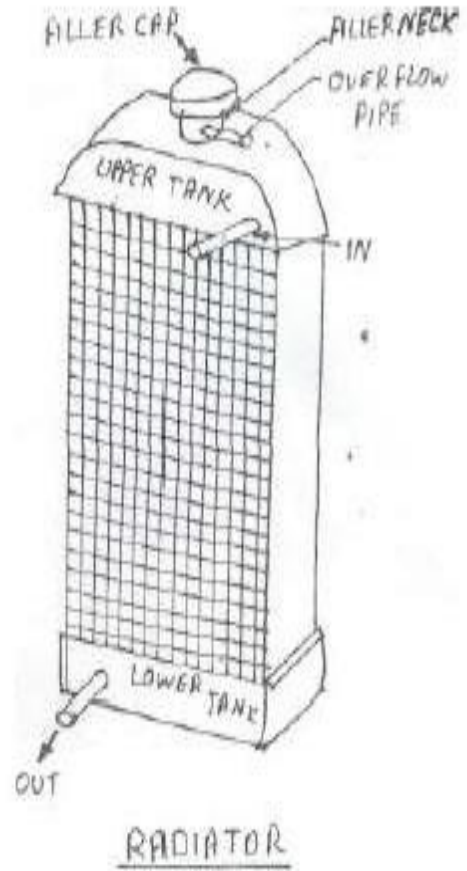
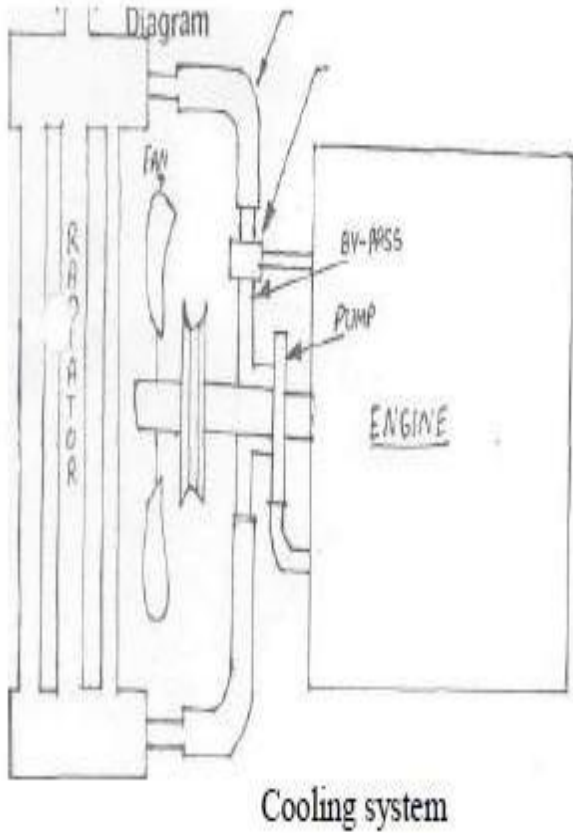
Advantages

- 1 Air cooled engines are lighter because of the absence of the radiator, the cooling jackets and the coolant
- 2 They can be operated in extreme climates where the water may freeze.
- 3 In certain areas where there is scarcity of cooling water, the air cooled engine is an advantage.
- 4 Maintenance is easier because the problem of leakage is not there.
- 5 Air cooled engines get warmed up earlier than the water cooled engine

Disadvantages

- 1 It is not easy to maintain even cooling all around the cylinder, so that the distortion of the cylinders take place. This defect has been remedied sometimes by using fins parallel to the cylinder axis. This is also helpful where a number of cylinders in a row are to be cooled. However, this increases the overall engine length.

COOLING SYSTEMS



2 As the coefficient of heat transfer for air is less than that for water, there is less efficient cooling in this case and as a result the highest useful compression ratio is lesser in the case of air cooled engines than in the water cooled ones.

3 The fan used is very bulky and absorbs a considerable portion of the engine power (about 5%) to drive it.

4 Air cooled engines are more noisy, because of the absence of cooling water which acts as sound insulator. 34

5 Some engine components may become inaccessible easily due to the guiding baffles and cooling which makes the maintenance difficult.

Water cooling

In water cooling system, the cooling medium used is water. In this, the engine cylinders are surrounded by water jackets through which the cooling water flows. Heat flows from the cylinder walls into water which goes to the radiator where it loses its heat to the air. Usually some antifreeze is added to the cooling water, due to which it is often referred to as coolant. Both these terms have been used in this chapter, often mean unless the context requires otherwise.

Water cooling systems are of two types;

1 Thermosyphon system

2 Pump circulation system

Advantages

1 As the circulation of coolant is maintained by natural convection only, the cooling is rather slow. Therefore, to have adequate cooling, the capacity of the system has to be large.

2 Due to the quantity of coolant being large, it takes, more time for the engine to reach the operating .

3 Radiator header tank must be located higher than the top of the cylinder coolant jackets, which is no more possible with the modern body styles.

4 Certain minimum level of coolant water must be maintained in the system. If the coolant falls below that level, continuity of flow would break and the system would consequently fail.

Systems of engine lubrication

The various systems adopted for the lubrication of automobile engine are

1 Petroil system

Splash system

2 Pressure system

3 Dry sump system

Petroil system

This is used generally for small two stroke engines, e.g. in majority of scooter and motor cycle engines. It is the simplest of all types of engine lubrication systems. 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 give dark smoke. When the petrol mixture enters the crankcase, due to high temperatures there, the petrol component vaporizes leaving a thin film of lubricating oil on the crankcase, cylinder walls, crankshaft and bearings. The main requirements of lubricating oil for two stroke engine are that it should readily mix with petrol and burn without leaving much residue.

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 trough (fig.) 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 BDC position. This affects the lubrication of engine walls, gudgeon pin, main crankshaft bearings, big end bearings etc.

Pressure system

This system is used almost universally in modern car engines. The splash system though cheaper, is not suitable for automobile engines because of the absence of positive lubrication. In the pressure system (fig) an oil pump takes the oil from the wet sump through a strainer and delivers it through a filter to the main oil gallery at a pressure of 200 to 400 kPa. The oil pressure is controlled by means of a pressure relief valve, situated in at a pressure of 200 to 400 kPa. The oil pressure is controlled by means of a pressure relief valve, situated in the filter unit or the pump housing.

Dry sump system

This system is employed in some racing car engines for situations where the vehicle has to be operated at very steep angles, for example, sports cars, jeeps etc. if ordinary pressure system of lubrication is used in such cases, the situations may arise when there is no oil at the place where oil pump is installed. To avoid such instances, dry sump system is used (fig)wherein two pumps, instead of one, are used. The scavenge pump A is installed in the crankcase portion which is the lowest. It pumps oil to a separate reservoir B, from where the pressure pump C pumps the oil through filter D, due to the cylinder bearings; a full pressure system of lubrication is employed. The oil pressure is maintained at 400-50 kPa for the main and big end bearings while about 5100 kpa pressure is used for timing gears and cam shaft bearings etc.

EX.NO: 9

DATE

OVALITY AND TAPER MEASUREMENT OF CYLINDER BORE AND COMPARISON WITH STANDARD SPECIFICATIONS

Aim:

Checking the cylinder bore, measurement setting and rebore the worn out cylinder bore of an IC engine and set the tools and rebore the given cylinder

Tools Required:

Telescopic bore gauge, Vernier gauge, Micrometer, Test lamp, Machine clamping tool, bore clamp, telescopic gauge, Vernier calipers, feeler gauge, u- clamp and Allen key setting micrometer.

Cylinder Surface:

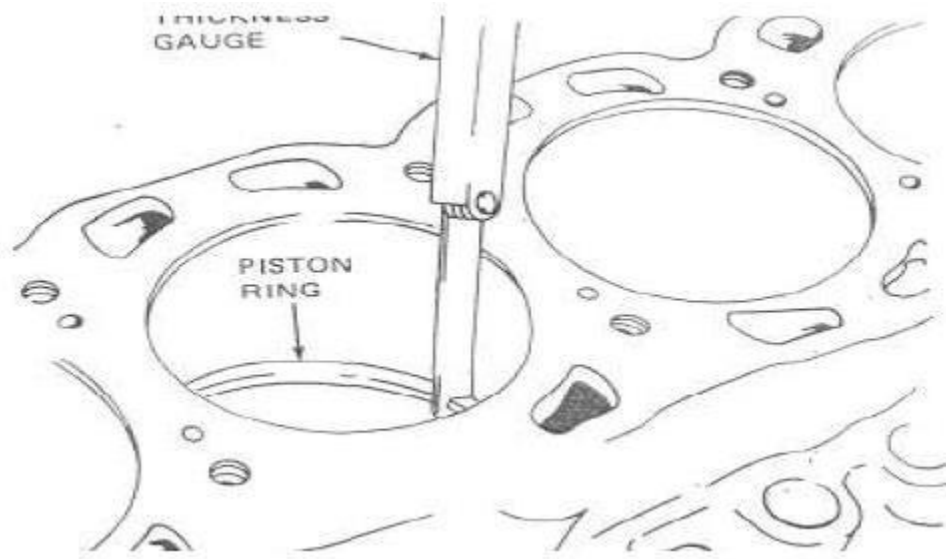
Normally in the IC engine cylinder wear at the top is maximum and impact scoring mark either thrust axis or crank pin axis to eliminate the scoring required by boring. The measurement of the cylinder wears, taper and ovality by using telescopic gauge. These gauge and Vernier calipers can be used to measure the worn out bore. The cylinder ovality and taper should not exceed 0.050mm otherwise u.s.p and blow by will occur Bore dial gauge with setting ring is also used to measure the cylinder taper is high difficult for the rings to control by blow gases. The recondining that have excessive taper or out of cylindricity is done by boring or reboring. Generally a cylinder greater than 0.006inches must be rebored and boring is done.

Reboring:

A cylinder that can not be cleaned by boring and it must be done by reboring process boring which rotates a cutting tool in the cylinder to remove the metals. These operation increase the cylinders bore diameter.

Procedure:

- Initially measure the cylinder bore size at 3 points like top, middle and bottom using telescopic bore gauge or vernier caliper.
- Set the cylinder bore centre and the front mounted spindle centre by using spring loaded pin arrangement.
- After ensuring the boring part is rotated at the exact centre of bore , tight the clamp giving more torque.
- Sides should be bored.
- Set the depth of stopper upto b.d.c.
- Rebore , then clean the ovality, taper , scoring marks e.t.c
- The vertical boring machine is placed on the engine, after it is fixed to the stand.
- Boring machine is fixed to the engine clamp and machine clamp.



- The spindle is lifted and to centered to the cylinder which is to be measured and machines using the pin and spring.
- The centering pins are introduced into their respective holes and the spring is introduced over them.
- The spindle is lowered into the bore and the centering pins are extended by turning the expander knob.
- Machine position is adjusted and the centre pins are extended and brought in such that the gap between the pins and the cylinders walls are same.
- After fixing the spindle is lifted and the centre pin spring are removed.
- The boring tool is now placed in the holder and the nut above the holder is adjusted using Allen key to move the boring tool. Its distance from the centre is measured by tool setting micrometer.
- Tool is set the required length according to the next specified bore diameter and tool adjusting nut.
- The tool position is fixed using the locker nut on one side, now the motor is started and the gear is engaged for automatic movement of spindle.

Result

The IC engine cylinder reboring machine setting and machined to exact size of cylinder bore and tolls are set and cylinder of the given engine is rebored to the next standard size.

EX.NO: 10

DATE

CLUTCH 2 TYPES – COIL SPRING & DIAPHRAGM SPRING CLUTCHES

Aim

To study and prepare report on the constructional details, working principles and operation of the following

Automobile clutches:

- a) Coil Spring Clutch
- b) Diaphragm Spring Clutch
- c) Multi plate Clutch

Clutch:

1. The purpose of the clutch is to allow the driver to couple or decouple the engine and transmission.
2. When clutch is in engaged position, the engine power flows to the transmission through it (clutch).
3. When gears are to be changed while vehicle is running, the clutch permits temporary decoupling of engine and wheels so that gears can be shifted.

Principle:

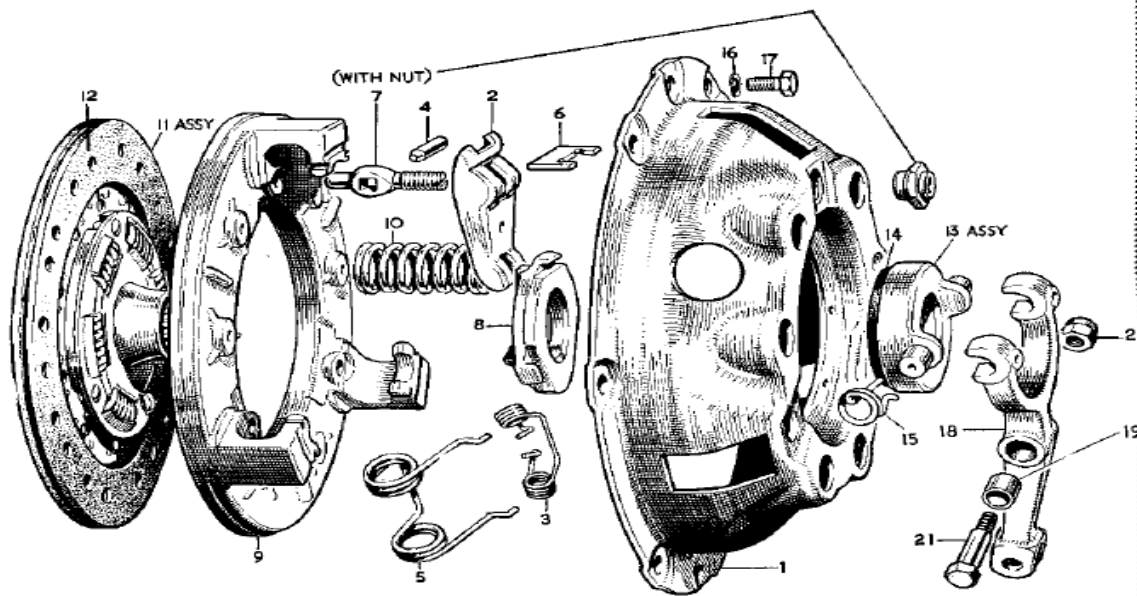
1. It operates on the principle of friction.
2. When two surfaces are brought in contact and are held against each other due to friction between them, they can be used to transmit power.
3. If one is rotated, then other also rotates.
4. One surface is connected to engine and other to the transmission system of automobile.
5. Thus, clutch is nothing but a combination of two friction surfaces.

Requirement:

1. It should ensure smooth engagement without grab or clatter.
2. It should have the clutch with two fold moment of inertia.
3. It should prevent gear clatter due to piston vibration caused by engine Crank shaft.
4. The effort required to disengage should be minimum.
5. It must be cost effective.
6. It must be easy to maintain and adjust.

Dismantling: Given- Single plate clutch assembly:

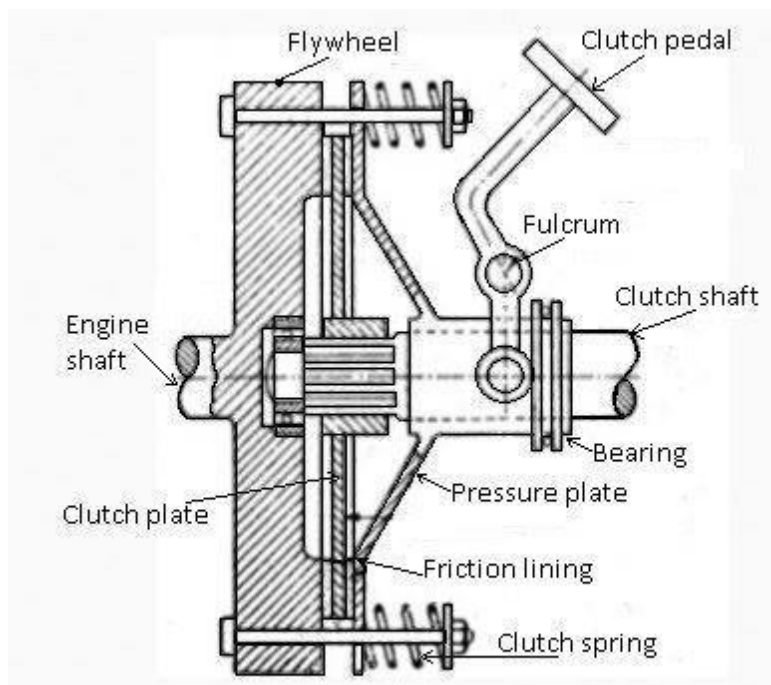
1. Mark the pressure plate and clutch cover position with respect to each other.
2. Place the clutch assembly on the clutch drive aligning the slot on the clutch finger with the thrust and seal on the pressure plate.
3. Compress the spring cups by clutch.
4. Loosen the mounting seat screw of the rotating plate on the retaining plate so removed.
5. Loosen the mounting seat screw of the clutch finger brackets and eccentric Pins



- | No. | Description |
|-----|---------------------|
| 1. | Cover—clutch. |
| 2. | Lever—release. |
| 3. | Retainer—lever. |
| 4. | Pin—lever. |
| 5. | Spring—anti-rattle. |
| 6. | Strut. |
| 7. | Eyebolt with nut. |

- | No. | Description |
|-----|------------------------|
| 8. | Plate—bearing thrust. |
| 9. | Plate—pressure. |
| 10. | Spring—pressure plate. |
| 11. | Plate assembly—driven. |
| 12. | Lining. |
| 13. | Ring assembly—thrust. |
| 14. | Ring—carbon. |

- | No. | Description |
|-----|----------------------------|
| 15. | Retainer. |
| 16. | Washer—spring—cover screw. |
| 17. | Screw—cover to flywheel. |
| 18. | Lever—withdrawal. |
| 19. | Bushes. |
| 21. | Bolt for lever. |
| 22. | Nut for bolt. |



SINGLE PLATE CLUTCH

Inspection:

1. Visually check the fly wheel, ring gear and pressure for crankshaft.
2. Check the flatness of friction faces of the pressure plate with straight edge.
3. If flatness is not found within the specific limit without the pressure plate and flywheel can ground so not ground below the minimum specific thickness.
4. Check the free length and tension of pressure spring.
5. Check the pressure plate tension usually for any damage. Replace the clutch plate if any orsion spring found damaged.
6. Measure the thickness of clutch lever. Release if thickness of clutch lever is less than inimum specified.

Assembling:

1. Place the clutch fingers bush in the clutch fingers.
 2. Fit the clutch bracket with eccentric pin.
 3. Hand tighter the mounting set screw of clutch bracket.
 4. Align the marks of clutch plate and pressure plate and place the clutch over the pressure plate.
 5. Compress the spring with clutch finger.
 6. Place the pressure pad on the pressure plate and tighten the pad mounting set screws.
 7. Release the load from the spring and remove clutch cover assembly from the clutch jig.
 8. Place the withdrawn plate, retaining plate on the clutch jig finger; tighten mounting set screws of the withdrawn plate.
- .

Result:

Thus the given clutch assembly is dismantled, inspected and assembled

Viva Questions

1. What is the functioning of a clutch? Discuss various factors affecting the torque transmissions in a clutch
2. Explain the working of multi plate dry clutch
3. What are the essential properties required for a clutch facing materials
4. Explain in detail various causes of clutch troubles. How can these be remedied?
5. Compare the hydraulic and mechanical methods of operating clutches
6. Where and why we use multi plate clutches
7. Discuss the constructional features of a clutch plate
8. Describe semi and fully centrifugal clutches
9. With the help of a suitable diagram, describe the constructional features of a diaphragm type spring clutch
10. Derive mathematical expressions for the torque transmitted in a multiplate clutch with n no of plates
11. Compare dry and wet type of friction clutches.
12. Why are the clutch friction plates perforated?
13. What is the need of a clutch in an automobile?
14. Why do we have springs in clutch friction plates?
15. What are the functions of a damper springs in a clutch driving disc

Viva Questions

- 1 What is the necessity for cooling an engine?
- 2 Name various method of engine cooling?
- 3 Name the main components of water cooling system?
- 4 What is the function of radiator in cooling system?
- 5 What is the necessity of engine cooling?
- 6 State different S.A.E. viscosity rating of oil?
- 7 What is the multigrade oil?
- 8 Which solid lubricant is most commonly used in automobiles?
- 9 What is viscosity?
- 10 Give an example of synthetic lubricant?