

**(34421C10) AUTOMOBILE ENGINEERING LAB R-2021
LAB MANUAL
BE MECHANICAL ENGINEERING**



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CERTIFICATE

Name of the lab : (34421C10) Automobile Engineering Lab –R 2021

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LABORATORY MANUAL CONTENTS

This manual is intended for the third Year students of Mechanical branch in the subject of Automobile Engineering. This manual typically contains practical/ Lab Sessions related to Automobile Engineering covering basic aspects related to the subject.

Students are advised to thoroughly go through this manual rather than only topics mentioned in the syllabus as practical aspects are the key to understanding and conceptual visualization of theoretical aspects covered in the book.

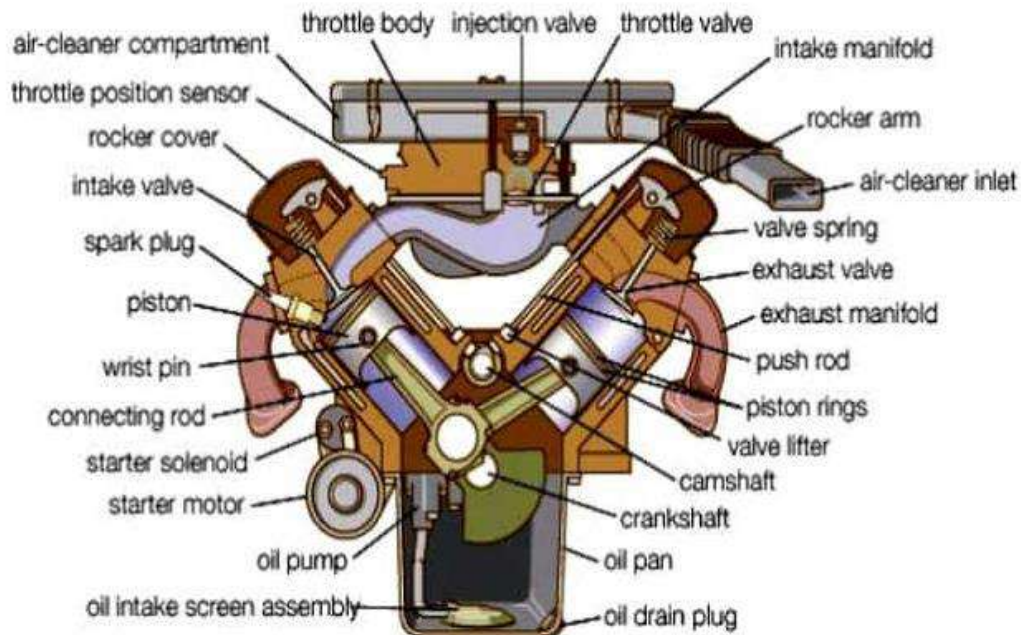
Dos and Don'ts in Laboratory :-

1. Do not handle any model before reading the instructions.
2. Observe type of sockets of equipment power to avoid mechanical damage.
3. Be as neat as possible. Keep the work area and work bench clear of items not used in experiments.
4. Strictly observe the instructions given by the Teacher/ Lab Instructor.

Instruction for Laboratory Teachers:-

1. Submission related to whatever lab work has been completed should be done during the next lab session.
2. Students should be instructed to switch on the power supply after getting the checked by the lab assistant / teacher. After the experiment is over, the students must hand over the model of equipment to the lab assistant/teacher.
3. The promptness of submission should be encouraged by written

Introduction



IC Engine components

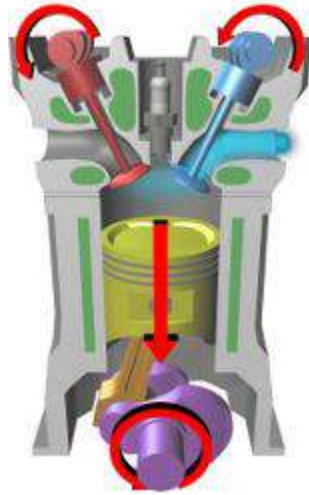
The **four stroke** internal combustion engine works. An internal combustion engine is classified as a **heat engine**. It's called **internal** because the combustion of the air-fuel mixture occurs inside the engine, in a combustion chamber, and some of the burned gases are part of the new combustion cycle.

Basically, an internal combustion engine transforms the **thermal energy** of the burning air-fuel mixture into **mechanical energy**. It is called **4 strokes** because it takes 4 strokes for the piston to execute a complete combustion cycle. The complete name for an engine which powers a passenger car is: **4 stroke piston internal combustion engine**, abbreviated ICE (Internal Combustion Engine).

The **cylinder head** usually contains the camshaft(s), valves, valve buckets, valve return springs, spark/glow plugs and injectors (for direct injection engines). Through the cylinder head flows the cooling liquid of the engine.

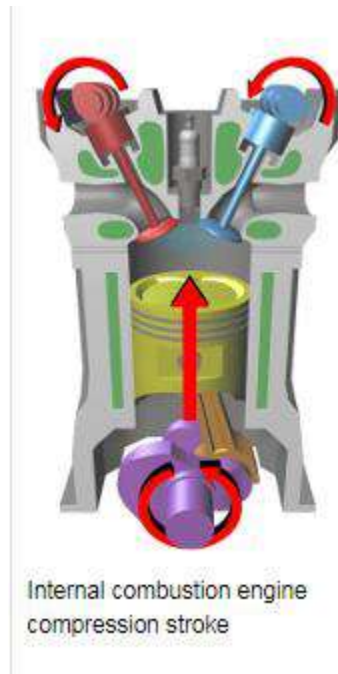
Inside the **engine block** we can find the piston, connecting rod and crankshaft. As for the cylinder head, through the engine block flows coolant to help control the temperature of the engine. The piston moves inside the cylinder from BDC to TDC. The **combustion chamber** is the volume created between piston, cylinder head and engine block when the piston is close to TDC. A stroke is the movement of the piston between the two dead centres (bottom and top). Now, that we know which are the components of an ICE, we can examine what is happening in each stroke of the engine cycle. In the table below you'll see the position of the piston at the beginning of each stroke and the details regarding the events that take place in the cylinder.

Stroke 1 – INTAKE



At the beginning of the intake stroke the piston is close to TDC. The intake valve is opened, the piston starts to move towards the BDC. Air (or air-fuel mixture) is drawn into the cylinder. This stroke is called INTAKE because fresh air/mixture is taken into the engine. The intake stroke ends when the piston is at the BDC. During the intake stroke, the engine consumes energy (the crankshaft is rotating due to the inertia of the components).

Stroke 2 – COMPRESSION



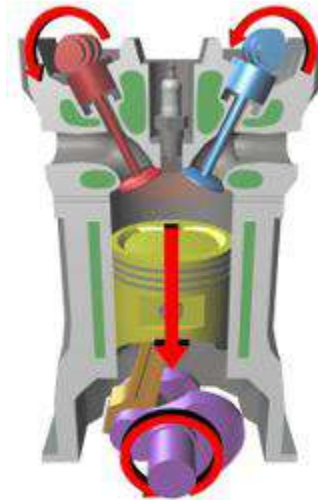
The compression stroke starts with the piston at BDC, after the intake stroke is finished. During the compression stroke both valves, intake and exhaust, are closed, and the piston moves towards TDC. With both valves closed, the air/mixture is compressed, reaching maximum

pressure when the piston is close to TDC. Before the piston reaches the TDC (but very close to it), during the compression stroke:

- for gasoline engine: the spark is generated
- for diesel engines: fuel is injected

During the compression stroke, the engine consumes energy (the crankshaft is rotating due to the inertia of the components), more than the intake stroke.

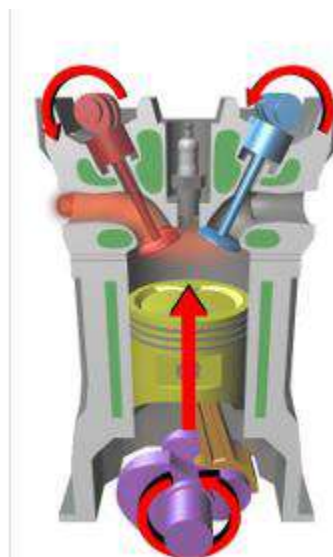
Stroke 3 – POWER



Internal combustion engine
power stroke

The power stroke starts with the piston at TDC. Both valves, intake and exhaust, are still closed. The air-fuel mixture combustion started at the end of the compression stroke, which causes a significant increase of pressure inside the cylinder. The pressure inside the cylinder pushes the piston down, towards the BDC. Only during the power stroke the engine produces energy.

Stroke 4 – EXHAUST



Internal combustion engine
exhaust stroke

The exhaust stroke starts with the piston at the BDC, after the power stroke finished. During this stroke, the exhaust valve is open. The movement of the piston from the BDC towards the TDC pushes most of the exhaust gases out of the cylinder, into the exhaust pipes. During the exhaust stroke, the engine consumes energy (the crankshaft is rotating due to the inertia of the components).

EX.NO: 1
DATE:

Construction Mechanism of Petrol and Diesel engine (Four stroke and Two Stroke)

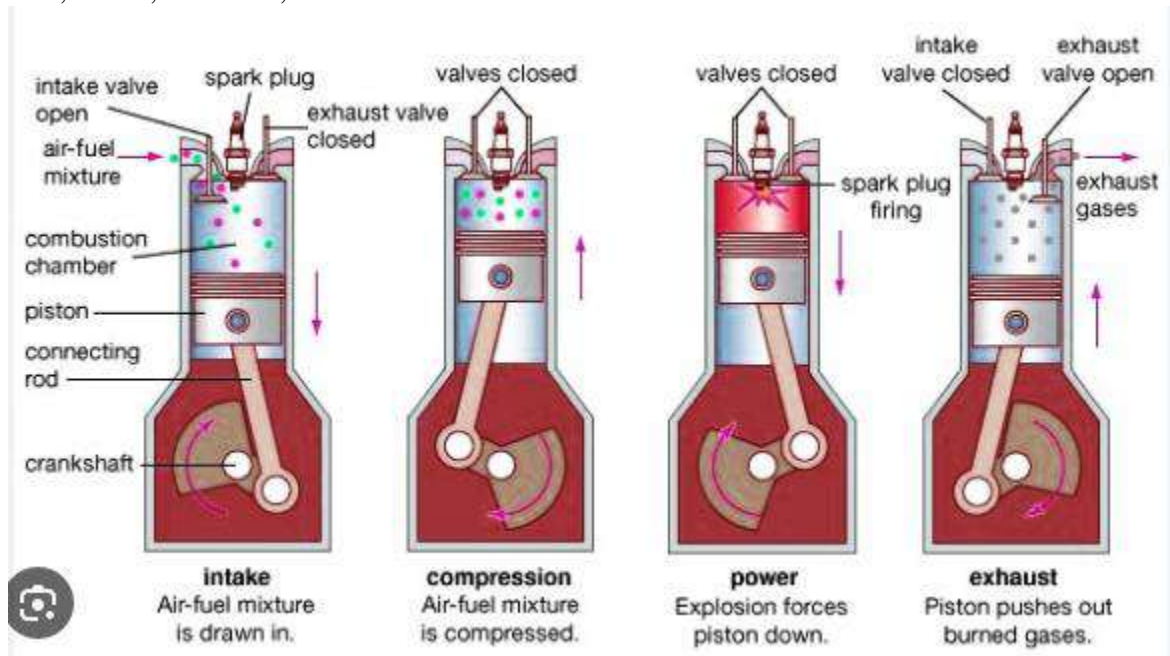
1(a) FOUR STROKE PETROL ENGINE

AIM:

To know about the construction and mechanism of the give four stroke Petrol engine.

TOOLS AND EQUIPMENTS:

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



PROCEDURE FOR FOUR STROKE PETROL ENGINE

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 enginehead.

Finally tappet covers with its gaskets are attached.

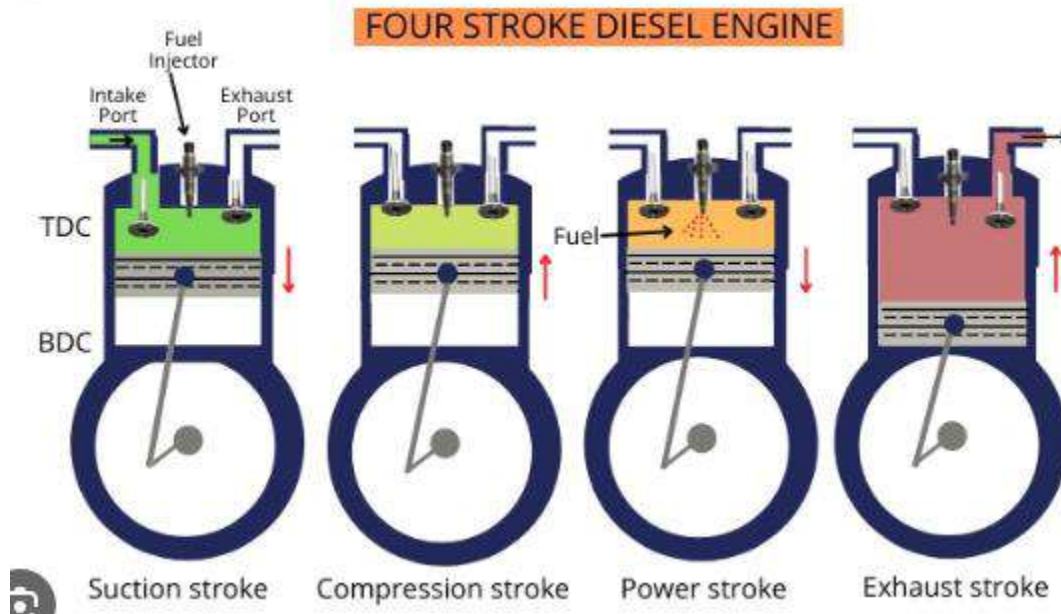
1(b) FOUR STROKE DIESEL ENGINE

AIM:

To know about the construction and mechanism of the give four stroke 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 FOR FOUR STROKE DIESEL ENGINE

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 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

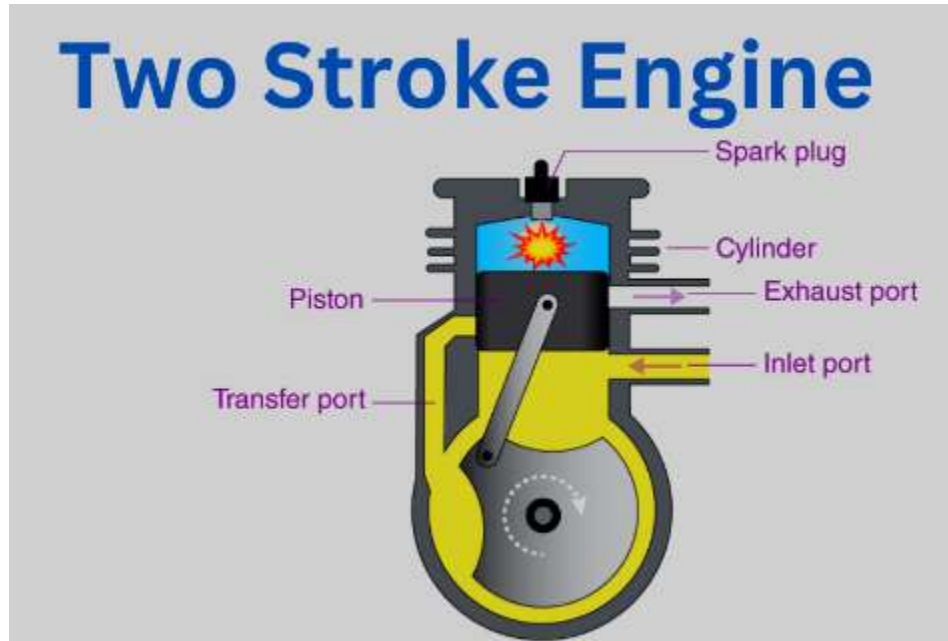
1(C) TWO STROKE PETROL ENGINE

AIM:

To know about the construction and mechanism of the given two stroke 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 FOR TWO STROKE ENGINE

Dismantling

Drain off all the oil from the engine.

Remove the carburetor 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 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.

Assembling

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

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.

Cylinder head with its gaskets is then attached to the cylinder block.

Place the inlet and exhaust manifold.

Place the carburetor with its gasket. in the engine head.

RESULT:

Thus the method we can know about given four stroke petrol, diesel four stroke 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: 2

Construction Mechanism of Clutch Assembly

DATE:

Aim

to know about the construction Mechanism, 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:

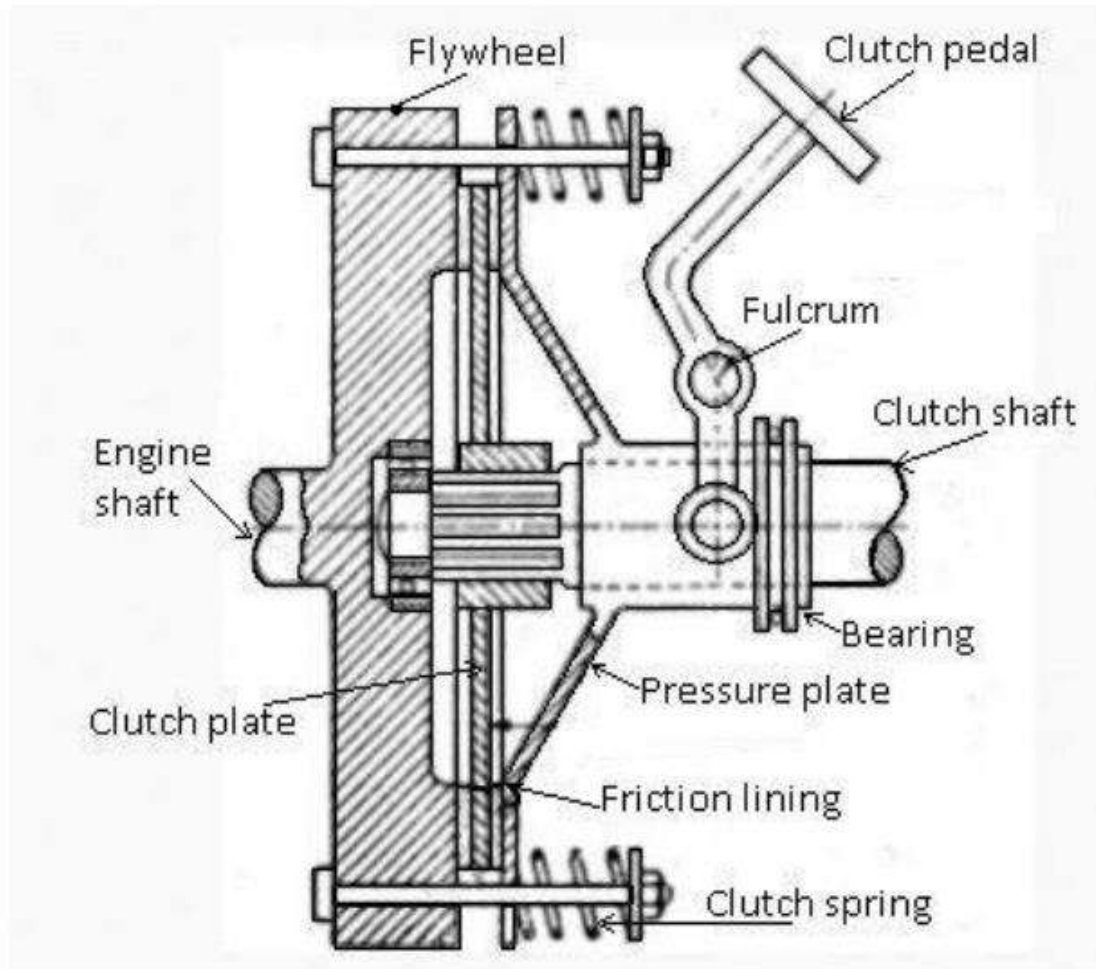
1. It operates on the principle of friction.
2. When two surfaces are brought in contact and are held against each other due to friction between them, they can be used to transmit power.
3. If one is rotated, then other also rotates.
4. One surface is connected to engine and other to the transmission 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



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 tighten 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

EX.NO: 3 Construction Mechanism of Sliding mesh, Constant mesh and

DATE: Synchronesh gear boxes

Aim: To know about the Construction Mechanism dismantle, inspect and assemble the given Gearboxes assembly.

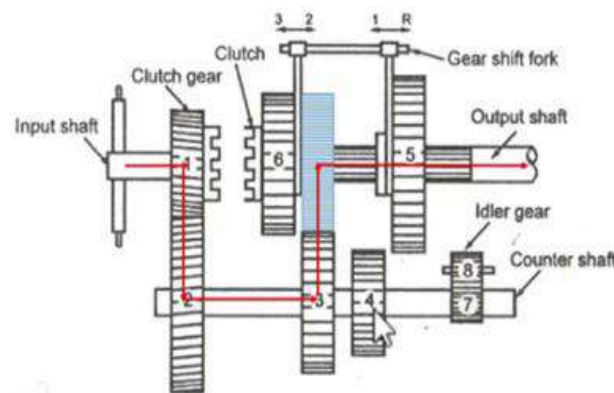
Tools required:

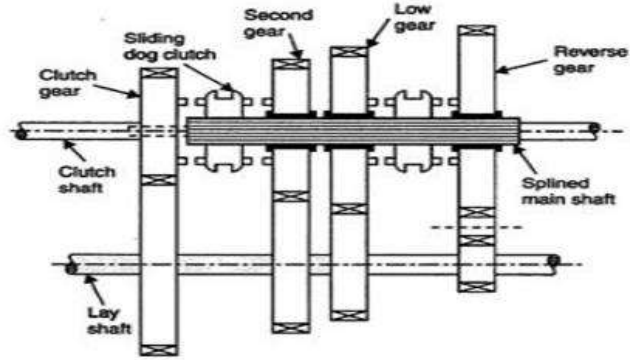
- 1.Hammer
2. Tool set
3. Screw Driver
4. Sockets.
5. Spanner set
6. Pullers

Function of Gear box:

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, 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.Oftent**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.

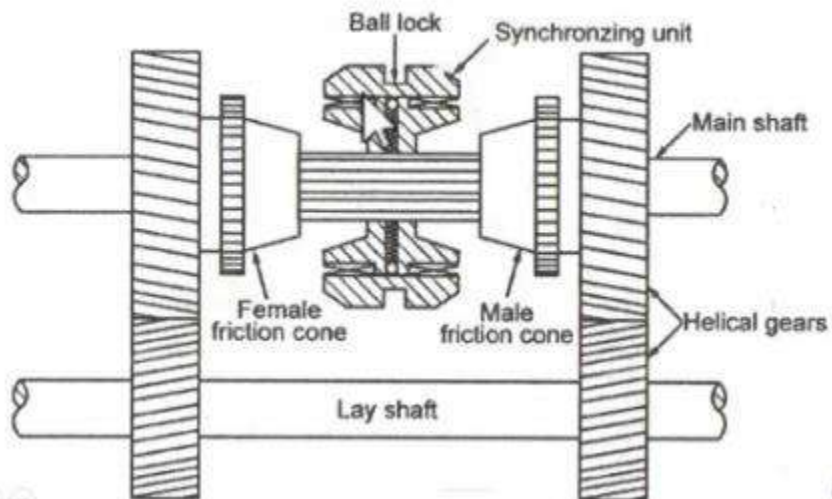
Sliding Mesh Gearbox





Constant Mesh Gear Box

Synchromesh Gearbox



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.

Dismantling:

Given- Gear box assembly

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 method we can learn about dismantling and assembling of Gear box have been performed.

EX.NO: 4

Construction Mechanism of Differential and Rear axles

DATE :

Assembly

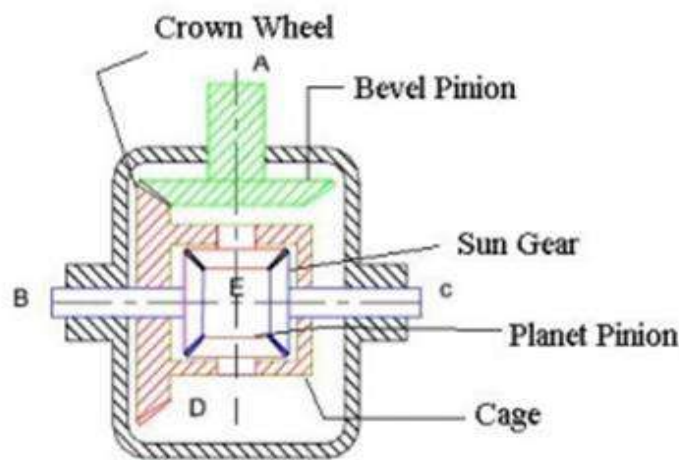
4(a) DIFFERENTIAL UNIT:

Aim :

To dismantle, Study and assemble the given differential unit and Rear axle Assembly

Tools Required.

- i) Double end spanner
- ii) Socket with extension
- iii) Ring spanner.
- iv) Hammer.
- v) Screw driver.



Differential unit

Study of differential unit

To the crown wheel of the final drive is attached a cage, which carries a cross pinor a spider. Two sun gears mesh with the two or four planet pinions. Axle half shafts are splined to each of these gears. The crown wheel is free to rotate on the half shaft. When the vehicle is going straight, the cage and the inner gears rotate as a single unit and the two half shafts revolve at the same speed. In this situation there is no relative movement among the various differential gears. When the vehicle is taking a turn, assume that the cage is stationary. Then turning one sun gear will cause the other to rotate in the opposite direction. That means that if left sun gear rotates 'n' times in a particular time, the right sun gear will also rotate 'n' times in the same period but in the opposite direction. This rotation is super - imposed on the normal wheel speed when the vehicle is taking a turn.

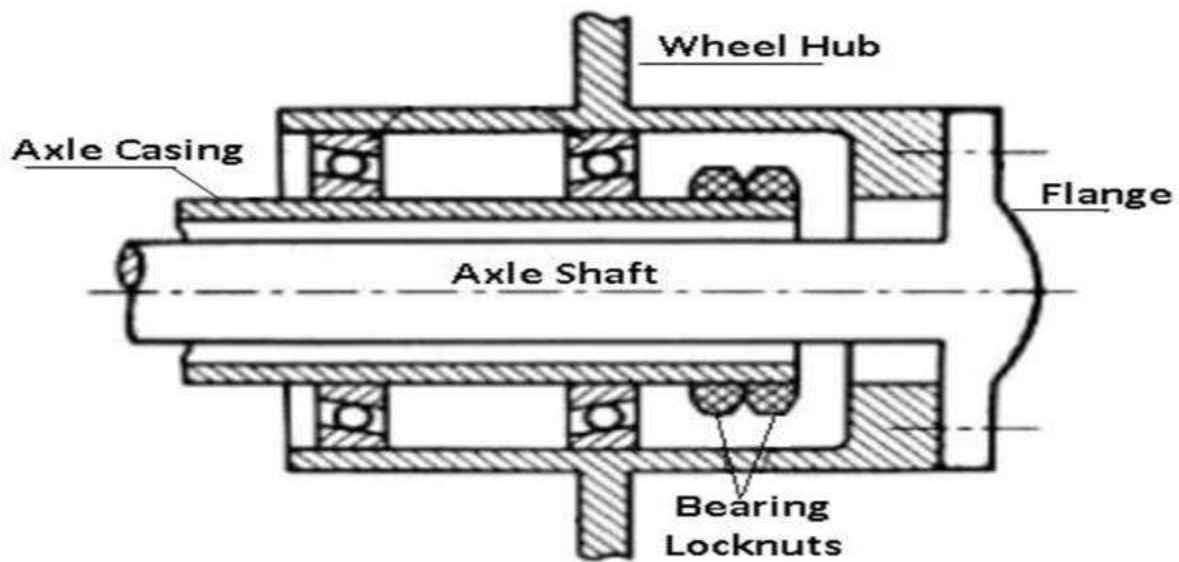
Dismantling Procedure of differential unit

- i) Remove the two half axle shafts of the rear axle.
- ii) Remove the crown wheel with the differential assembly.
- iii) Disconnect the differential assembly from the crown wheel by removing the mounting bolts.

iv) Finally remove the sun gear, planet pinion and cross pin or spider from the differential assembly.

Assembling Procedure of differential unit

- i) Assemble the differential unit by keeping all the planet pinions in the cross pin and by positioning the sun gears in the cage.
- ii) Fit the differential unit with the crown wheel by tightening the mounting bolts.
- iii) Assemble the crown wheel with the differential unit in the rear axle and ensure that the crown wheel tooth meshes with the pinion teeth.
- iv) Finally the two half shafts of the rear axles are positioned and checked for proper working conditions.



Full Floating Axle

4 (b) REAR AXLE SYSTEM:

Aim:

To dismantle, Study and assemble the given rear axle.

Tools Required

- i) Double end spanner.
- ii) Socket with extension
- iii) Ring spanner.
- iv) Hammer.
- v) Screw driver.

Study Of Rear Axle

The rear wheels are mounted on bearings on the ends of the axle shaft. There are two half shafts.

Various forces and torques experienced by the rear axle are.

- i) Weight of the body.
- ii) Driving thrust.
- iii) Torque reaction.
- iv) Side thrust.

Dismantling Procedure of rear axle

Remove the wheel bearing.

Remove the brake shoe assembly.

Remove the brake shoe assembly.

Remove the taper bearings of the half axle Shafts.

Pull the half axle shafts that are splined to the sun gear of the final drive unit.

There are two rear axle drives. In all the drives employed for rear axle, the springs take the weight of the body. The drives are

Assembling of rear axle

Pull the half axle shafts that are splined to the sun gear of the final drive unit.

There are two rear axle drives. In all the drives employed for rear axle, the springs take the weight of the body. The drives are

Assembling the taper bearings of the half axle Shafts.

Assembling the brake shoe assembly.

Assembling the brake shoe assembly.

Assembling the wheel bearing

.Result :

Thus the method we can learn about Differential unit and rear axle assembly construction and mechanism

EX.NO: 5

Construction Mechanism of Hydraulic brake, Disc brake

DATE:

and Air brake systems

Aim

To study about the given Hydraulic brake systems, Disc brake system, and Air brake system

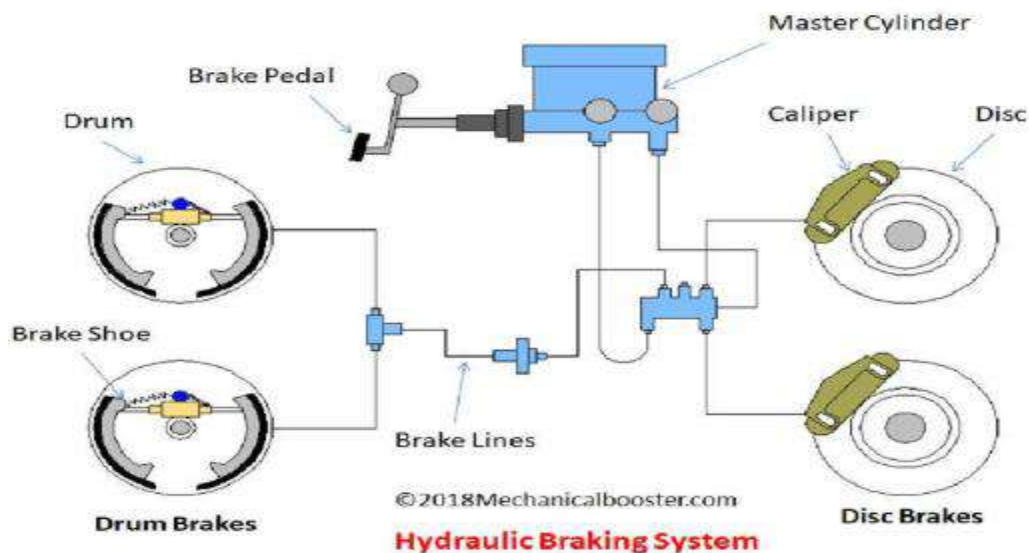
Study Of Braking System

It goes without saying that brakes are one of the most important control components of vehicle. They are required to stop the vehicle within the smallest possible distance and this is done by converting the kinetic energy of the vehicle into the heat energy which is dissipated into the atmosphere.

1 The brakes must be strong enough to stop the vehicle within a minimum distance in an emergency. But this should also be consistent with safety. The driver must have proper control over the vehicle during emergency braking and the vehicle must not skid.

2 The brakes must have good antifade characteristics i.e. their effectiveness should not decrease with constant prolonged application e.g. while descending hills. This requirement demands that the cooling of the brakes should be very efficient.

HYDRAULIC BRAKES

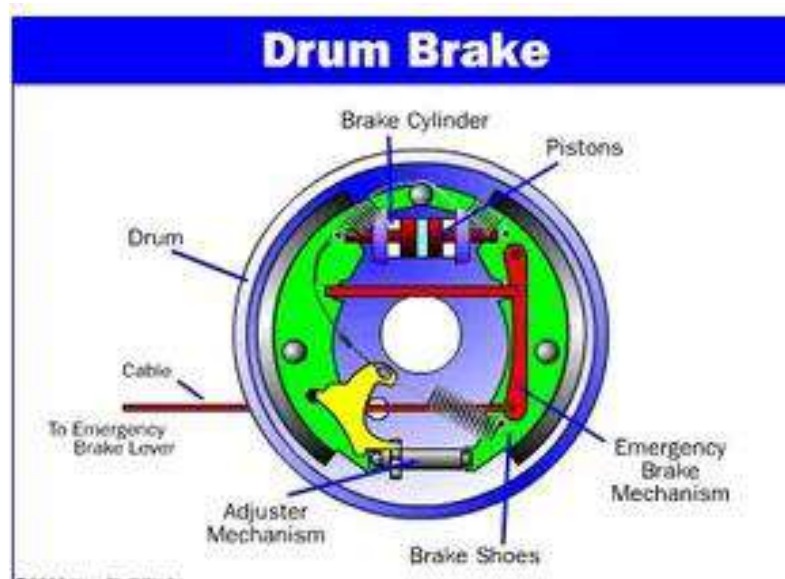


Most of the cars today use hydraulically operated foot brakes on all the four wheels with an additional hand brake mechanically operated on the rear wheels. An outline of the hydraulic braking system is shown in the main component in this is the master cylinder which contains reservoir for the brake fluid. Master cylinder is operated by the brake pedal and is further connected to the wheel cylinders in each wheel through steel pipelines, unions and flexible hoses. In case of Hindustan Ambassador car, on front wheels each brake shoe is operated by separate wheel cylinder (thus making the brake two shoe leading) whereas in case of rear wheels there is only one cylinder on each wheel which operates both the shoes (thus giving one leading and one trailing shoe brakes.) As the rear wheel cylinders are also operated mechanically with the hand brake, they are made floating. Further, all the shoes in the Ambassador car are of

the floating anchor type. The system is so designed that even when the brakes are in the released position, a small pressure of about 50kPa is maintained in the pipe lines to ensure that the cups of the wheel cylinder are kept expanded. This prevents the air from entering the wheel cylinders when the brakes are released. Besides, this pressure also serves the following purposes.

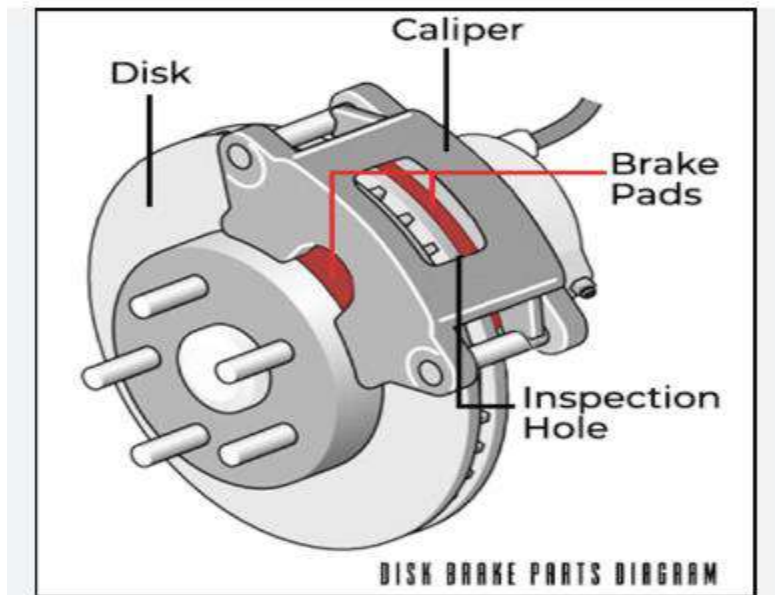
- (i). it keeps the free travel of the pedal minimum by opposing the brake shoe retraction springs
- (ii). During bleeding, it does not allow the fluid pumped into the line to return, thus quickly purging air from the system.

DRUM BRAKES



In this type of brakes, a brake drum is attached concentric to the axle hub whereas on the axle casing is mounted a back plate. In case of front axle, the back plate is bolted to the steering knuckle. The back plate is made of pressed steel sheet and is ribbed to increase rigidity and to provide support for the expander, anchor and brake shoes. It also protects the drum and shoe assembly from mud and dust. Moreover, it absorbs the complete torque reaction of the shoes due to which reason it is sometimes also called torque plate. Two brake shoes are anchored on the back plate as shown in fig. Friction linings are mounted on the brake shoes. One or two retractor springs are used which serve to keep the brake shoes away from the drum when the brakes are not applied. The brake shoes are anchored at one end, whereas on the other ends force F is applied by means of some brake actuating mechanism which forces the brake shoe against the revolving drum, thereby applying the brakes. An adjuster is also provided to compensate for wear of friction lining with use. The relative braking torque obtained at the shoes for the same force applied at the pedal varies depending upon whether the expander (cam or toggle lever) is fixed to the bac

DISC BRAKES



These passages are also connected to another one for bleeding. Each cylinder and contains a rubber sealing ring between the cylinder and the piston. When the brakes are applied, hydraulically actuated pistons move the friction pads into contact with the disc, applying equal and opposite forces on the later. On releasing the brakes, the rubber sealing rings act as return springs and retract the pistons and the friction pads away from the disc.

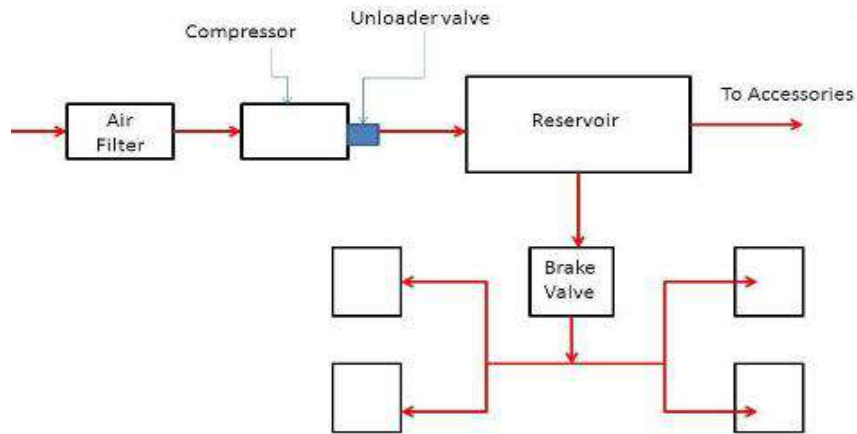
AIR BRAKE SYSTEM

An air brake system comprises a two-stage air compressor driven by the [crankshaft](#) or [gearbox](#) shaft. In this braking system, the air is taken from the atmosphere, compressed, and then delivered to the reservoir through an un-loader valve. When the pressure of the reservoir reaches the maximum degree, the unloader valve opens to the atmosphere. The compressed air is then vented directly into the atmosphere.

The figure illustrates the layout diagram of the air brake system. These brakes generally consist of an air filter, unloading valve, air compressor, air reservoir, brake valve, and brake chamber.

Initially, the compressor carries air from the atmosphere through an air filter. The air filter filters the air and transmits it to the compressor, where it gets compressed. This compressed air is then sent to the reservoir through an unloader valve, which opens at a predetermined reservoir pressure and is connected to a brake valve.

From the brake valve, tubing extends to the front and rear brake chambers. Air is supplied to the brake chambers on each wheel through brake valves. It is controlled by the driver, who can determine how intense the braking should be.



Layout of Air Brake System

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
10. Remember there must be some play in push rod.

Result:

Thus the method we can learn about construction mechanism of suspension system and Brake system

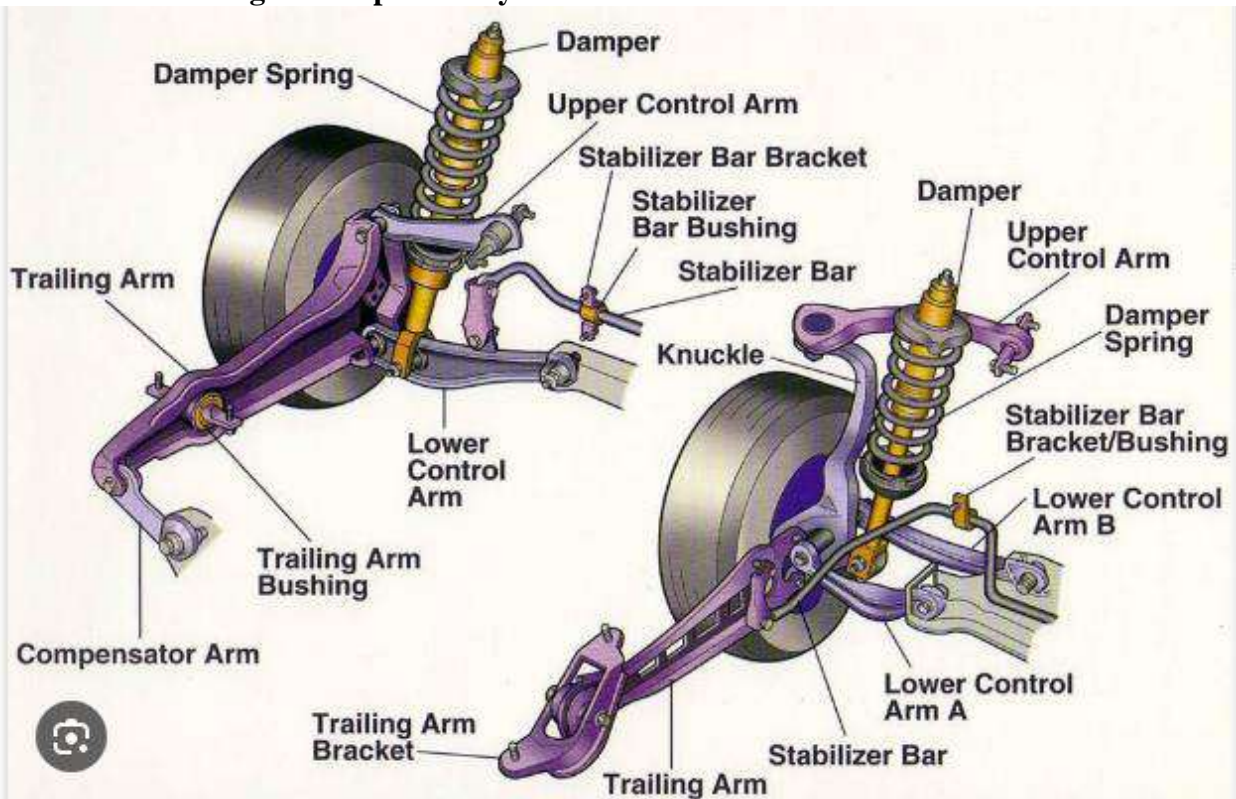
EX.NO: 6 Construction Mechanism of Suspension and Steering systems

DATE: systems

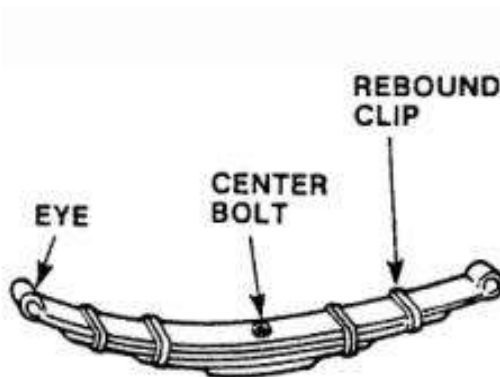
6(a) SUSPENSION SYSTEM:

Aim:

To learn about the given suspension system



Independent suspension system components



Leaf spring components

Study of suspension system

A suspension system in an automobile serves the following functions:

- Shock forces are reduced as much as possible
- Maintain the proper ride height of your car
- Maintain proper alignment of the wheels
- Serve as weight support for the vehicle
- Maintain tire contact with the road
- Controls the vehicle's travel direction.
- To eliminate transmission to car component road shocks.
- To maintain a solid grip on the road while driving, cornering, or braking.
- To maintain the correct steering geometry.
- To achieve a specific body structure and height.
- Torque and braking reflexes must be resisted.
- Maintaining vehicle stability while traveling over uneven terrain or turning in order to reduce the tendency for rolling, pitching, or vertical movement.
- To protect passengers from road shocks and give a comfortable ride.
- To reduce the strains caused by road shocks on the motor vehicle's mechanism and offer a cushioning effect.
- While traveling over tough, uneven terrain, keep the body absolutely level. The up and down movements of the wheels should be proportional to the movement of the body.
- To protect the vehicle's structure from stress loading and vibration caused by road surface irregularities while maintaining its stability.
- To achieve the necessary height for body structure.
- To retain the right geometrical relationship between the body and the wheels, the body must be supported on the axles.

Requirements of Suspension system

1. There should be minimum deflection.
2. It should be of low initial cost.
3. It should be of minimum weight.
4. It should have low maintenance and low operating cost.
5. It should have minimum tyre wear.

6(b) STEERING SYSTEM:

Aim:

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

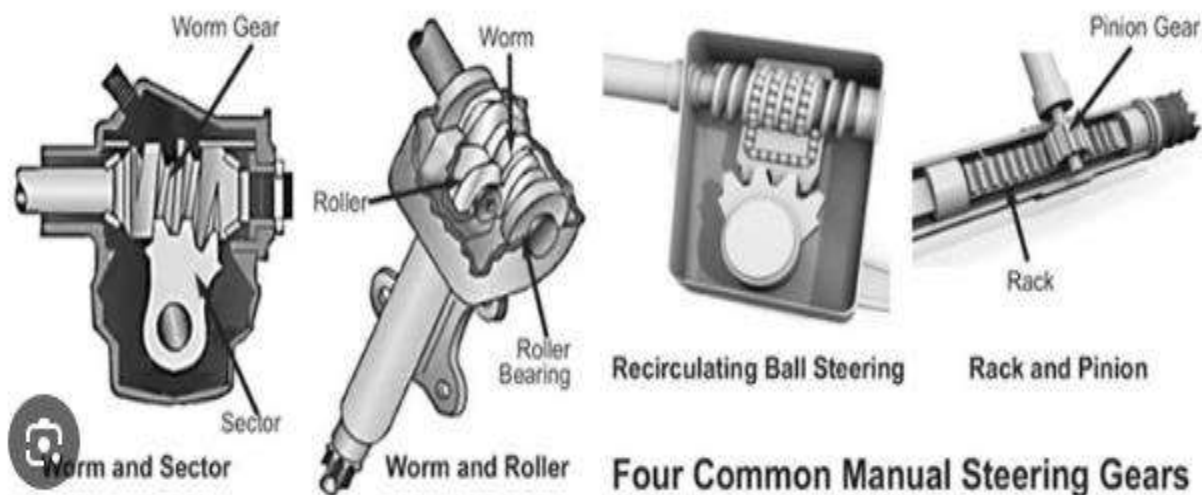
Automotive Steering Systems:

- Manual Steering systems e.g. Pitman Arm Steering, Rack & Pinion Steering
- Power Steering Systems e.g. Rack and Pinion Power Steering System

Purpose of Steering System

The steering system allows the driver to guide the vehicle along the road and turn left or right as desired. The system includes the steering wheel, which controls the steering gear. It changes the rotary motion of the wheel into straight line motion. Manual systems were popular but now power steering has become popular. It is now installed on about 90% of the vehicles being manufactured.

Types of Steering Systems



Worm and Wheel Type:

- This type of steering gear has a square cut screw threads at the end of the steering column; which forms a worm, at the end of it a worm wheel is fitted and works rigidly with it. Generally covered shaft is used for the worm wheel.
- The worm wheel can be turned to a new position the drop arm can be readjusted to the correct working position.

Re-circulating Ball Type

- In this type of gear box the endless chain of balls are provided between the worm and nut members.

- The nut form a ring of rack having an axial movement.
- So that the sector on the rocker shaft racks, the balls roll continuously between the worm and nut.
- Being provided with return chambers at the ends of the worm.
- This method reduces friction between worm and nut members.
- This type of steering gear is used for heavy vehicles.

Cam and Lever Type:

- The cam and lever steering uses one or two lever studs fitted in taper roller bearing.
- When the worm in the form of helical groove rotates the stub axle and it also rotates along with it.
- This imports a turning motion to the drop arm shaft.

Rack and Pinion Type:

- This is common manual type of steering gear box is used in most of the vehicles.
- In this type of steering a pinion is provided the bottom end of the steering column.
- The teeth of the pinion wheel in mesh with corresponding teeth provided on the rack, the end of which are connected to the stub axle through the rod.
- The rotating motion of the pinion operates the rack in FORE and AFT direction which in turn operates the stub axle.

PROCEDURE FOR STEERING SYSTEM

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.

Result:

Thus the method we can learn about steering system construction mechanism

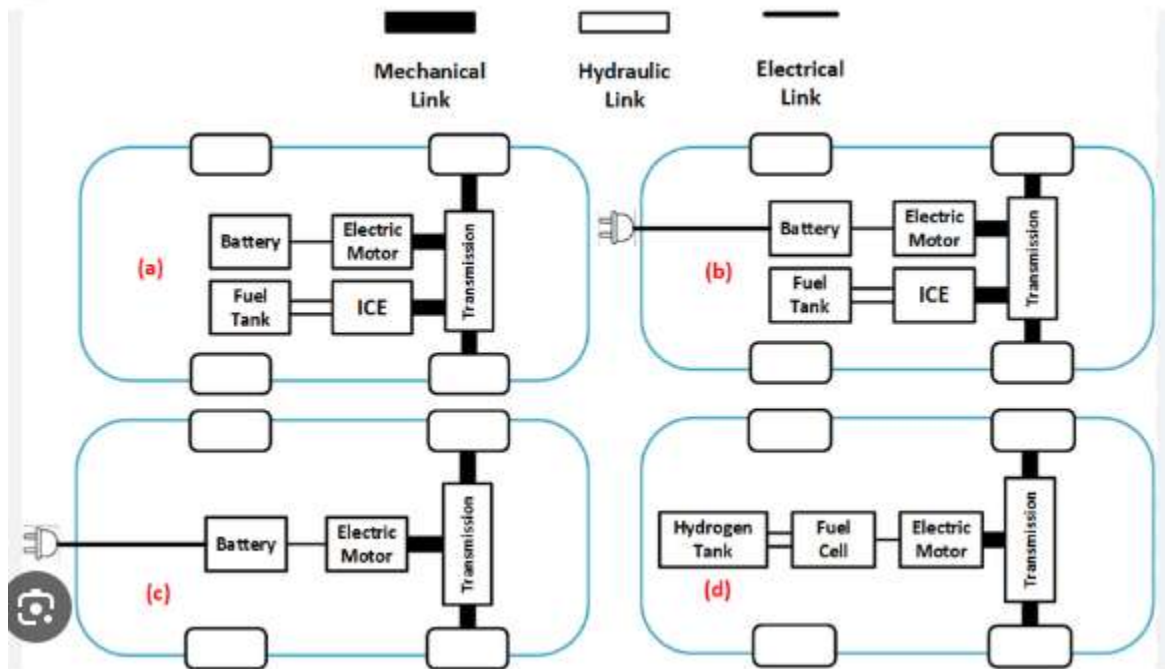
EX.NO: 7 Study of Hybrid and Electric vehicle

DATE:

7 (a) HYBRID SYSTEM:

Aim:

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



Types of Hybrid Cars:

Automobile companies use different hybrid designs to either achieve maximum fuel efficiency or to keep the hybrid car prices as low as possible. Below are the different types of hybrid cars:

1) Parallel Hybrid:

In the most popular or common hybrid design, the parallel hybrid combines both electric and internal combustion engines to power the vehicle. They can run together or can be used as the primary power source while the other kicks in when extra power is required such as a hill climb, overtake a vehicle, etc. Both power sources are parallelly connected to the gearbox or the transmission and hence they are called “parallel”. An example of Parallel Hybrid Cars is the Toyota Camry, Honda Accord, Toyota Prius, Hyundai Sonata, etc.

2) Series Hybrid:

Under this type of hybrid car, the Series Hybrid also employs both the petrol internal combustion engine as well as the electric motor. However, the internal combustion engine does not propel the car, instead it generates electricity to recharge the battery pack. The battery pack in turn

powers the electric motor(s) which in turn sends power to the wheels. An example of a Series Hybrid car is the BMW i3, Kia Optima, Ford Fusion, [Chevrolet](#) Volt, etc.

3) Plug-in Hybrid:

The Plug-in Hybrid elevates the conventional hybrid car with a much larger battery pack that requires to be charged. Generally, it uses a 110-volt electrical socket to charge the battery pack similar to an electric car. Since the Plug-in Hybrid car does depend on an internal combustion engine and can be run after it is fully charged, there is substantial improvement in the vehicle's fuel efficiency. An example of a plug-in hybrid car is the BMW 330e, Hyundai Ioniq Plug-in Hybrid, Volvo XC40 Recharge Plug-in Hybrid, etc.

4) Two-Mode Hybrid:

This type of hybrid design operates in two different ways. While on the first mode, it works just like a regular hybrid card. In the second mode, the design can adjust to different requirements by the engine to meet specific vehicle tasks.

5) Mild-Hybrid:

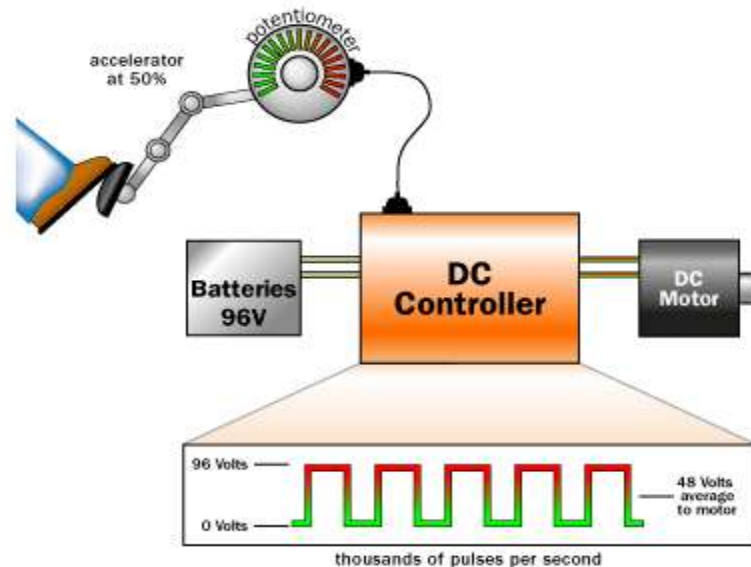
In recent times, the cost to build an efficient hybrid car continues to be high. Car companies are devising new strategies in offering hybrid technology to the common man. Mild-hybrid designs have been adopted by car companies to adhere to emission norms as well as to slightly improve fuel efficiency without increasing the cost considerably. In this type of hybrid, the electric motor assists the petrol engine in increasing fuel efficiency, improving performance or both. Additionally, it acts as a starter for the automatic start/stop function, which switches off the engine when the vehicle comes to rest and thereby reduces the use of fuel. An example of mild-hybrid cars include Maruti Suzuki Ertiga, Ciaz, Baleno, etc.

7 (b) ELECTRIC VEHICLE:

Aim:

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

Functions of different parts of Electric Vehicle



Controller

An electric vehicle motor controller is a machine that is employed to regulate the torque generated by the motors of electric vehicles by means of modifying the energy flow from the power sources to the motor.

Brushless DC motor

A brushless DC motor (known as BLDC) is a permanent magnet synchronous electric motor which is driven by direct current (DC) electricity.

Potentiometer

The signal from the potentiometers tells the controller how much power to deliver to the electric car's motor.

Battery:

A rechargeable battery is made up of secondary cells. The most familiar rechargeable battery is the leadacid battery that is commonly used as a car battery.

Electric Motor

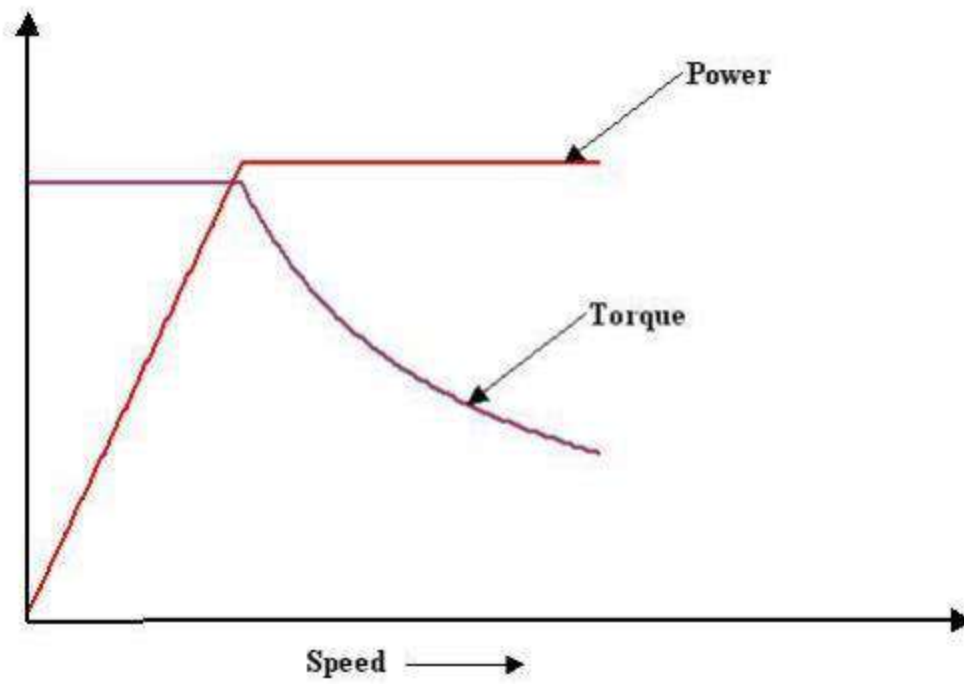
The electric motors have are ideal for vehicle application because of the torque speed characteristics of the motors Electric motors are capable of delivering a high starting torque. It is very important to select proper type of motor with a suitable rating. For example, it is not accurate to simply refer to a 10 h.p. motor or a 15 h.p. motor, because horsepower varies with volts and amps, and peak horsepower is much higher than the continuous rating

ELECRIC VEHICLE PERFORMANCE AND TRANSMISSION CHARACTERISTICS

- The drive train configuration
- Various types of vehicle power plants
- The need of gearbox in a vehicle
- The mathematical model of vehicle performance

Drive train Configuration An automotive drive train:

- a power plant
- a clutch in a manual transmission or a torque converter in automatic transmission
- a gear box
- final drive
- differential shaft
- driven wheels



Result:

Thus the method we can study about the construction mechanism of the Hybrid vehicle and Electric vehicle

