LECTURE NOTE

ON

AUTOMOBILE ENGINEERING AND HYBRID VEHICLES

DIPLOMA 6th SEM

DEPARTMENT OF MECHANICAL ENGINEERING

PREPARED BY:ER.MANAS KUMAR PARICHHA

GANESH INSTITUTE OF ENGINEERING AND TECHNOLOGY
(POLYTECHNIC)
(Approved by AICTE)
ANDHARUA,BHUBANESWAR

COURSE OBJECTIVES:

At the end of the course the students will be able to:

- Understand automobile chassis, transmission, breaking and fuel system etc.
- Understand the basics of electric vehicle kinematics.
- Understand the concepts of hybrid electric vehicles

1.0INTRODUCTION & TRANSMISSION SYSTEM:

1.1 Automobiles: Definition, need and classification: Layout of automobile chassis with major components (Line diagram)
1.2 Clutch System: Need, Types (Single & Multiple) and Working principle with sketch
1.3 Gear Box: Purpose of gear box, Construction and working of a 4 speed gear box
1.4 Concept of automatic gear changing mechanisms
1.5 Propeller shaft: Constructional features
1.6 Differential: Need, Types and Working principle

2.0 BRAKING SYSTEM:

2.1 Braking systems in automobiles: Need and types
2.2 Mechanical Brake
2.3 Hydraulic Brake
2.4 Air Brake
2.5 Air assisted Hydraulic Brake
2.6 Vacuum Brake

3.0 IGNITION & SUSPENSION SYSTEM:

3.1 Describe the Battery ignition and Magnet ignition system
3.2 Spark plugs: Purpose, construction and specifications
3.3 State the common ignition troubles and its remedies
3.4 Description of the conventional suspension system for Rear and Front axle
3.5 Description of independent suspension system used in cars (coil spring and tension bars)
3.6 Constructional features and working of a telescopic shock absorber

4.0 COOLING AND LUBRICATION:

4.1 Engine cooling: Need and classification
4.2 Describe defects of cooling and their remedial measures
4.3 Describe the Function of lubrication
4.4 Describe the lubrication System of I.C. engine

5.0 FUEL SYSTEM:

5.1 Describe Air fuel ratio
5.2 Describe Carburetion process for Petrol Engine
5.3 Describe Multipoint fuel injection system for Petrol Engine
5.4Describe the working principle of fuel injection system for multi cylinder Engine 5.5 Filter for Diesel engine
5.6 Describe the working principle of Fuel feed pump and Fuel Injector for Diesel engine

6.0 ELECTRIC AND HYBRID VEHICLES:

6.1 Introduction, Social and Environmental importance of Hybrid and Electric Vehicles
6.2 Description of Electric Vehicles, operational advantages, present performance and applications of Electric Vehicles
6.3 Battery for Electric Vehicles, Battery types and fuel cells
6.4 Hybrid vehicles, Types of Hybrid and Electric Vehicles: Parallel, Series, Parallel and Series configurations;6.5 Drive train
6.6 Solar powered vehicles

CH1 AUTOMOBILES

Introduction:-

Automobiles

Definitions:-

An Automobile is a self-propelled vehicle which is used for the transportation of passengers and goods upon the ground." A vehicle is a machine which is used for the transportation of passengers and goods. A self-propelled vehicle is that in which power required for the population is produced from within. Aeroplane, ship, motor boat, locomotive, car, bus, truck, jeep, tractor, Scooter, motor cycle are the example of self-propelled vehicles. An automobiles is propelled vehicles upon the ground, so it differs from other types of self-propelled vehicles like aeroplane, helicopter etc.

Automobile engineering is a branch of engineering in which we study all about the automobiles and have practice to propell them.

Mobile or motive means one which can move. Automobile or Automotive means one which itself can move.

Need of Automobile:-

Due to the increasing rate of population and due to the job & work in another place transportation is very necessary and due to this necessities automobile takes a very vital part of our daily life. people go one place to another place every day and they transport their goods from one place to another it may be an business purpose or any book purpose So they depends upon the Automobile. And due to the increase rate of population Automobile vehicles also increases day by day. Automobile is a very good communicating system made by human being is very useful for mankind

Classification of Automobiles:-

1. Based on purpose:-

passenger vehicles:- These vehicles carry passengers eg: cars, passengers trains.

Goods vehicles:- These vehicles carry goods from one plac another place: eg: Goods lorry, Goods carriers.

Special purpose:- These vehicles include Ambulance, fire engi Army vehicles.

2. Based on load Capacity:-

Light duty vehicles:- Small motor vehicles e.g: car, jeep Scooter, motorcycles.

Heavy duty vehicles:- Large motor vehicles e.g: Bus, truck tractor.

3. Based on fuel used:-

petrol engine vehicles:- Automobiles powered by a petrol engi Scooters, cars, motorcyles.

Diesel engine vehicles:- Automobiles powered by diesel engine e.g. Trucks, Buses, Tractors.

Gas vehicles:- Vehicle that use gas turbine as a power sou e.g. Turbine powered cars.

Electric vehicles:- Automobile that use electricity as a power sou Electric cars, electric buses.

Steam engine vehicles:- Automobiles powered by Steam engine Steam boat, Steam locomotive Steam Wagon.

4. Based on Drive of the vehicles:-

Left-hand drive:- Steering wheel fitted on the left-hand sid

Right-hand drive:- Steering wheel fitted on the right-hand

Based on numbers of wheels and axles:-

Two-wheeler:- Motor cycles, Scooters.

Three-wheeler:- Tempo, auto-sick shaws.

Four-wheeler:- Car, jeep, Bus, Truck.

Six-wheeler:- Buses and trucks have six tires out of which four are carries on the rear wheels for additional traction.

Based on type of transmission:-

Automatic transmission vehicles:-

Automobiles that are capable of changing gear ratios automatically as they move e.g: Automatic Transmission Cars..

Manual transmission vehicles:-

Automobiles whose gear ratios have to be changed manually.

Based on Suspension System used:-

Conventional:- Leaf Spring.

Independent:- Coil Spring, Torsion, bar, pneumatic.

Layout of Automobile chassis:-

what is chassis:-

- chassis is a french term which denotes the whole vehicle except body in case of heavy vehicles.
- chassis consists of engine, brakes, steering system & wheel mounted on the frame differential suspension.
- propel and control a automobile.
- It is the bone of vehicle.

Major Components of chassis:-

1. Front Suspension.
2. Steering Mechanism.
3. Radiator, Engine, Clutch, gear box.
4. Propeller shaft.
5. Rear Spring.
6. Road wheels.
7. Differential, half shaft, Universal joint.
8. Brakes and braking System.
9. Storage battery.
10. Silencer.
11. Shock absorbers, fuel tank, petrol and hydraulics pipe coblin and some means of Mountings these components.

The chassis is sub-divided into the running gear and the power plant the running gear includes the frame steering System suspension System brakes, wheels and tyres. The power plant includes the engine assembly and powder transmission assembly. The electrical System is the part of both chassis and body.

Classification of chassis:-

- Ladder chassis.
- Back bone chassis.
- Monocoque chassis.
- Full Forward.
- Semi-Forward.
- Bus chassis.
- Engine in Front.
- Engine at centre.

Ladder chassis:-

- Ladder chassis consists one of the most oldest forms of automotive chassis.
- Ladder chassis resembles a shape of a ladder having two longitudional rails inter linked by several internal and cross braces.

Back bone chassis:-

- Back bone chassis has a rectangular tube like back bone, usually made up of glass fibre that is used for joining front and rear axle together.
- This type of automotive chassis or automobile chassis is strong and powerful enough to provide smaller sports car.
- Back bone chassis is easy to make and cost effective.

Monocoque chassis:-

- Monocoque chassis is a one-piece structure that prescribes the over all shape of a vehicle.

Full-Forward chassis:-

- Full Forward chassis is that in which the engine is fitted outside the driver cabin of seat like in cars and old Tata Trucks.
- In this type of arrangement, the driver seat is far enough from the front wheels and is not able to see just in front of the vehicle.

Semi-Forward chassis:-

In semi-Forward chassis, half portion of the engine is in the driver cabin and the remaining half is outside the cabin like in standard, bedford pick up. It provides better visibility of road to the driver.

Bus Chassis :-

→ In bus chassis, the whole engine is fitted in the driver cab. It provides an increased floor space in the vehicle. The driver seat is just above the front wheel and we can see the full front wheel road sight from the front wheels.

Engine in Front :-

→ In this type of chassis engine is fitted in front side.

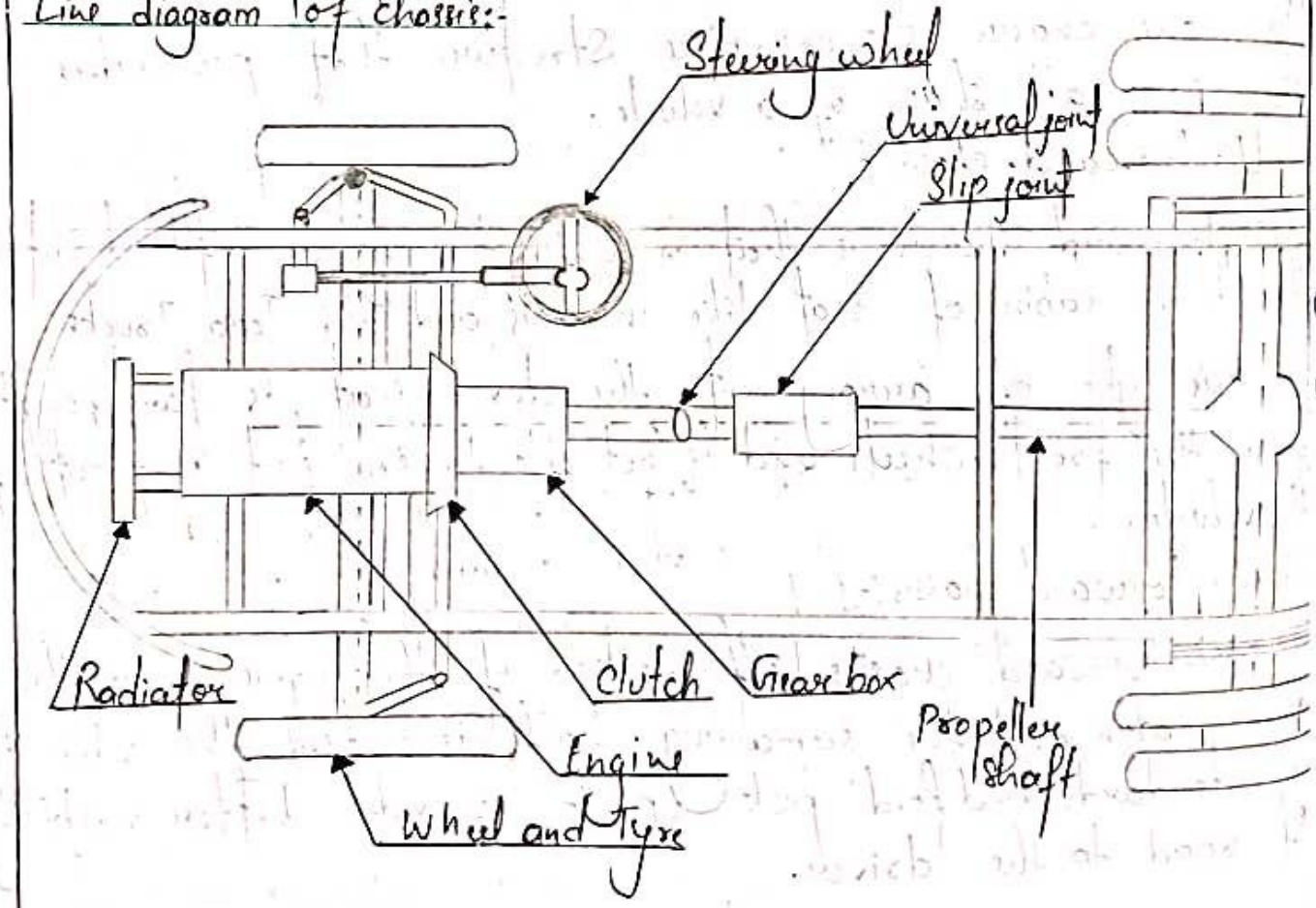
Engine at Center :-

→ In this type of chassis engine is fitted in middle.

Functions of chassis :-

To carry load of passenger or goods carried in the body. To support the load of the body, engine, gear box, steering system, propeller shaft etc.

Line diagram of chassis :-



Specification of Auto-Engine:-

Engine Specification of Hero-Glamour:-

Type : Air cooled, 4-Stroke single Cylinder.

~~Max~~ Displacement: 1247CC

Max. power: 8.6 KW 7500 R.P.M.

Max. Torque: 11 N.M 6000 R.P.M.

Compression: 10:01 Ratio

Starting: Self start

Ignition: DC - fully Transistorised Ignition

Fuel System: (FI) - Fuel injection.

Engine specification of Bajaj chetak Scooter:

Model: Bajaj chetak 150

Year: 2005-0

Engine: Two Stroke single Cylinder

Capacity: 145.5CC

Cooling System: Air cooled.

Ignition: Electronic.

Battery: 12VDC

Starting: Electric

Max. power: 5.6 KW/7.48hp 5500 R.P.M

Max. Torque: 108 NM/1.1 kgf 3500 R.P.M

Engine Specification of Maruti Swift:

Engine	Petrol	Diesel
Type	MPFI DOHC Petrol	CRDi
Displacement	1147 CC	1248cc
Cylinders	4	4
Max. power	63.84 BHP 6000 R.P.M	73.97 BHP 4000 R.P.M
Max. Torque	113 NM 4500 R.P.M	190 NM

Specification of TATA BUS Marcopolo:

Manufacture	TATA Motors
Engine	Front-mounted TATA Cummins 6.BT 5.9 in line-6 Diesel
Capacity	Up to 60 Seats
power O/p	135 HP, 4
Transmission	Manual-6 Forw reverse

Classification of Engines:-

What is Engine:-

An engine is a power generating machine. It converts potential energy of the fuel into heat energy and the into rotary motion. An automotive engine which produces power also runs on its own power overall, the manufacturers classify the engines according to their varied designs Constructions and applications. Generally automotive applications have following sub-categories by which different engine design vary from one another.

Automotive Engines are generally classified according to following different Categories:-

Internal combustion (IC) and External combustion (EC).

Type of fuel petrol, Diesel, Gas, Bio

Number of Strokes:- Two stroke petrol, Two stroke Diesel, Four stroke petrol, Four stroke Diesel.

Type of ignition - Spark ignition, compression ignition.

No. of cylinders - from 1 to up to 18 cylinders (in a cars)

Size / Capacity.

Ch 2 TRANSMISSION System

what is transmission System :-

"A transmission is a machine in a power transmission System, which provides controlled application of the power often the term 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."

what is Clutch :-

Clutch is a mechanism for connecting and disconnecting an engine and the transmission system in a vehicle, or the working parts of any machine.

Need of clutch :-

Vehicle's clutch is very important part of the transmission System. The clutch transfers the power from the vehicle's engine to the transmission system using a complex mechanism. If you are using a manual transmission vehicle, the clutch when operated will create, sync the engine and the transmission system. when your foot is off the clutch pedal, the pressure created operates a hydraulic mechanism, which connects to the engine flywheel and there by transmitting the motion to the wheel. your vehicle's clutch basically connects two shafts, locking them to make both shaft spin at the same speed. It is because of the clutch you are able to stop the car without stalling the engine.

Your vehicle's clutch is one of the most frequently used mechanical components. For example, you need to operate your clutch pedal every time you want to shift gears and to stop the vehicle slowly without any jerk.

Types of clutch:-

The clutches used in major vehicle are almost very similar in constructions and operation. There are some differences in the details of the linkage as well as in the pressure plate assembles. In addition, some clutches for heavy duty application have two friction plates and an intermediate pressure plate.

Different types of clutches are as follows:-

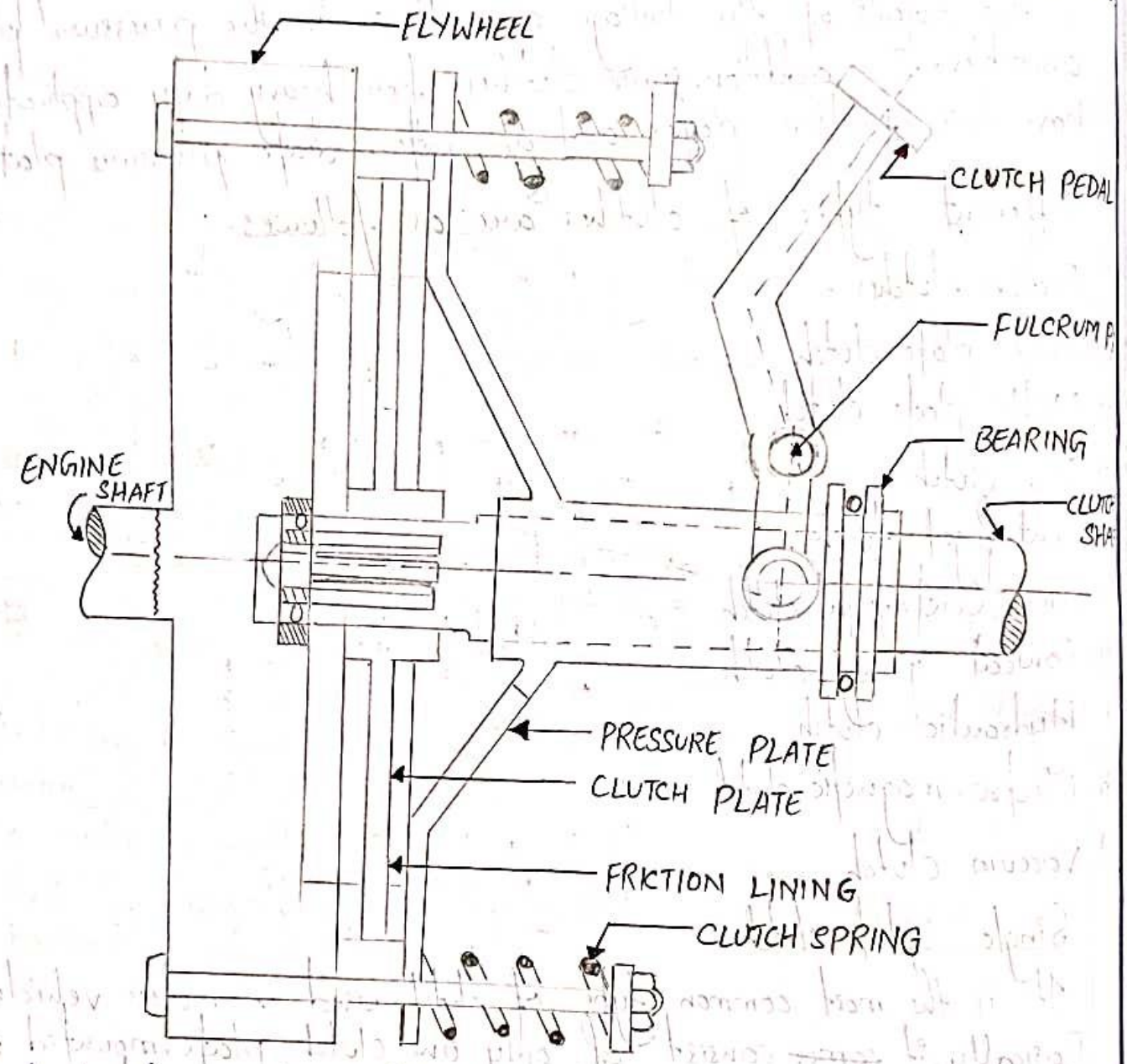
Friction clutches:-

(a) Single plate clutch
(b) Multi plate clutch
(c) Cone clutch.
(d) Centrifugal clutch
(e) Semi-Centrifugal clutch
(f) Conical Spring clutch
(g) Hydraulic clutch
(h) Electro-magnetic clutch
(i) Vaccum clutch

Single plate clutch:-

It is the most common type of clutch used in motor vehicles. Basically, it ~~comes~~ consist of only one clutch plate, mounted on the splines of the clutch shaft. The flywheel is mounted on the engine crankshaft and rotates with it. The pressure plate is bolted to the flywheel through clutch springs and is free to slide on the clutch shaft when the clutch pedal is operated when the clutch is engaged, the clutch plate is gripped between the flywheel and the pressure plate. The friction lining are on ~~betwe~~ both sides of the clutch plate. Due to the friction between the flywheel, Clutch plate and pressure plate, the clutch plate revolves with the flywheel.

As the clutch plate revolves, the clutch shaft also revolves. Clutch shaft is connected to the transmission. Thus, the engine power is transmitted from the crankshaft to the clutch sh

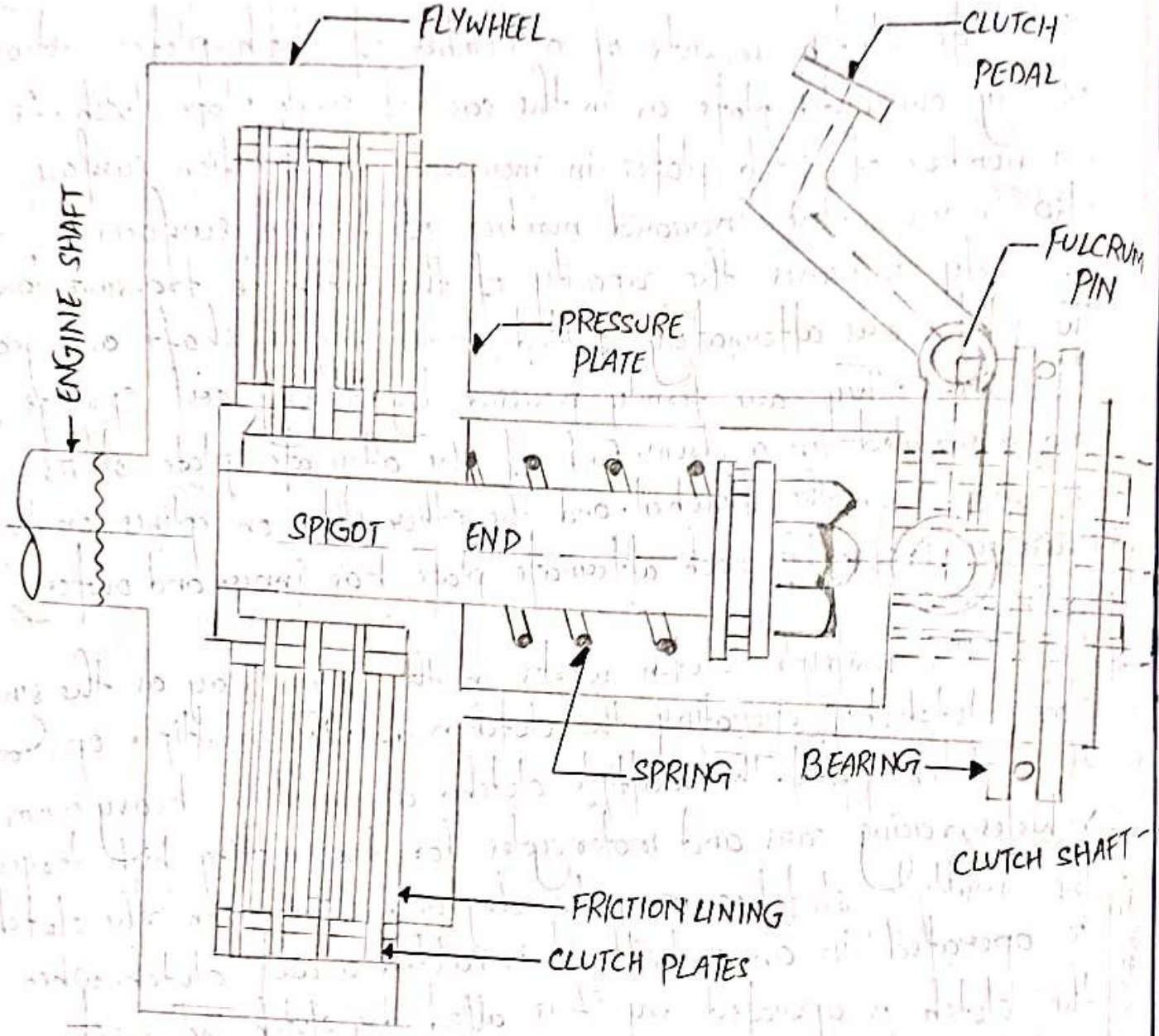


when the clutch pedal is pressed, the pressure plate moves back against the force of the springs, and the clutch plate becomes free between the flywheel and the pressure plate. Thus, the flywheel remains rotating as long as the engine is running and the clutch shaft speed reduces slowly and finally it stop rotating. As soon as the clutch pedal is pressed, the clutch is ~~Clutch pedal~~ said to be disengaged, otherwise it remains engaged due to the spring forces.

Multiplate Clutch:-

Multiplate clutch consists of a number of clutch plates, instead of only one clutch plate as in the case of single plate clutch. As the number of clutch plates in increasing the friction surface also increases. The increased number of friction surfaces obviously increases the capacity of the clutch to transmit torque. The plates are alternately fitted to the engine shaft and gear box shaft. They are firmly pressed by strong coil springs and assembled in a drum. Each of the alternate plate slides in grooves on the flywheel. and the other slides on splines on the pressure plate. Thus, each alternate plate has inner and outer Splines.

The multiple clutch works in the same way as the single plate clutch, by operating the clutch pedal. The multiple operating the clutch pedal. The multiple clutches are used in heavy commercial vehicles, racing cars and motor cycles for transmitting high torque. The multiple clutches may be dry and wet. when the clutch is operated in an or both, it is called a wet clutch. when the clutch is operated dry, it is called dry clutch. The wet clutch are generally use in conjunction with or as a part of the transmission.


FLYWHEEL
CLUTCH PEDAL
ENGINE SHAFT
FULCRUM PIN
PRESSURE PLATE
SPIGOT END
SPRING
BEARING
CLUTCH SHAFT
FRICTION LINING
CLUTCH PLATES

GEAR BOX

what is gear box :-

The gear box is the ~~speed~~ second element of the power train in an automobile. It is used to change the speed and torque of vehicle according to variety of road and load condition. A gear box changes the engine speed into torque when climbing and when the vehicle required. Sometimes it is known as torque converter.

Purpose of gear box :-

1. provide the torque needed to move the vehicle under a variety of road and load conditions. It does this by changing the gear ratio between the engine Crankshaft and vehicle drive wheels.
2. Be shifted into reverse so the vehicle can move backward.
3. Be shifted into neutral for starting the engine.

4-Speed Gear Box :-

The layout of a 4-speed ~~l~~ gear box using Synchromesh System in all the four forward Speeds. The clutch shaft drives the countershaft drive gear through main drive gear. The first, second and third speed gears on the main shaft are in constant mesh with their corresponding gears on the countershaft. The reverse idler gears and the reverse sliding gear are not in mesh. In this position, the gear box is in neutral since no power is transmitting to the mainshaft.

First gear:

The layout of gears transmitting power in first gear. This gear is obtained by shifting the dog clutch to the right. thus engaging its internal teeth with the external dog teeth of the first speed gear.

Second gear:-

To obtain this gear, the 1-2 speed dog clutch is first brought to neutral and then moved to the left thereby engaging its internal teeth with the external dog ~~clutch~~ teeth of the second gear box.

Third gear:-

In order to obtain this gear, th 1-2 speed dog clutch is fi shifted out of mesh from second gear and brought to neutral position. The 3-4 speed dog clutch is then moved to th right, thus engaging ~~th~~ its internal teeth with the external dog ~~clutch~~ teeth of the third speed gear.

Fourth gear:-

In order to obtain this gear, the 3-4 dog clutch is first shifted to neutral position and then shifted to the left thus engaging its internal teeth with the external dog teeth of main drive gear.

Reverse gear:-

This gear is obtained by first bringing the vehicle to rest position. The gear box is then brought to neutral position. Afte this, the reverse sliding gear is moved to the left thus engagin it with the reverse idler rear gear.

Concept of gear changing Mechanism:-

In automatic transmission or Gear drive, there are again like we have in manual, but in this case, instead of Conventional clutch, there is an automatic mechanism called torque converter which works with some fluids and turbine mechanism. when the speed of the car changes, the torque converter helps change the gears automatically. So the driver does not have to operate clutch lever to change gears.

Advantages of Automatic gear mechanism:-

→ Easy to operate.

→ Freedom from manually selecting gear.

→ Torque Converter has transmission losses. (energy loss) which causes loss in fuel economy.

PROPELLER SHAFT

what is propeller shaft:

A shaft transmitting power from an engine to a propeller or to the wheels of a motor vehicle.

Next to the gear box in the transmission system is the propeller shaft. It is connected between the gear box and the differential with universal joint at each The torque is transmitted from the gear box to the differential through the propeller shaft and universal joint.

Concept of gear changing Mechanism:-

In automatic transmission or Gear drive, there are again like we have in manual, but in this case, instead of Conventional clutch, there is an automatic mechanism called torque converter. which works with some fluids and turbine mechanism. when the speed of the car changes, the torque converter helps change the gears automatically. So the driver does not have to operate clutch lever to change gears.

Advantages of Automatic gear mechanism:-

→ Easy to operate.
→ Freedom from manually selecting gear.
→ Torque Converter has transmission losses (energy loss) which causes loss in fuel economy.

PROPELLER SHAFT

what is propeller shaft:

A shaft transmitting power from an engine to a propeller or to the wheels of a motor vehicle.

Next to the gear box in the transmission system is the propeller shaft. It is connected between the gear box and the differential with universal joint at each. The torque is transmitted from the gear box to the differential through the propeller shaft and universal joint.

Constructional features of propeller shaft:-

The propeller shaft is a driving shaft that connects the transmission to the differential the output shaft or main shaft from the transmission and pinion shaft extending from the differential unit are connected to the propeller shaft and the universal joints. A sliding joint is also used between the propeller shaft and the universal joint near the gear box. The rotary motion of the transmission main shaft is carried out through the propeller shaft to the differential causing the rear wheels to rotate. The propeller shaft has to with stand the torsional stress of the transmitting torque and yet it must be light and well balanced so that vibrations and whip will not occur at high speeds for these reasons, it is made of a strong steel tube. Solid propeller shaft are also used. The propeller shaft ~~are also~~ may be exposed to the atmosphere or protected by an outer tube some applications include bearings at or near the propeller shaft centre to support the shaft on some applications the propeller shaft is in two sections, supported by a centre bearing and coupled together by universal joint.

Differential Need:-

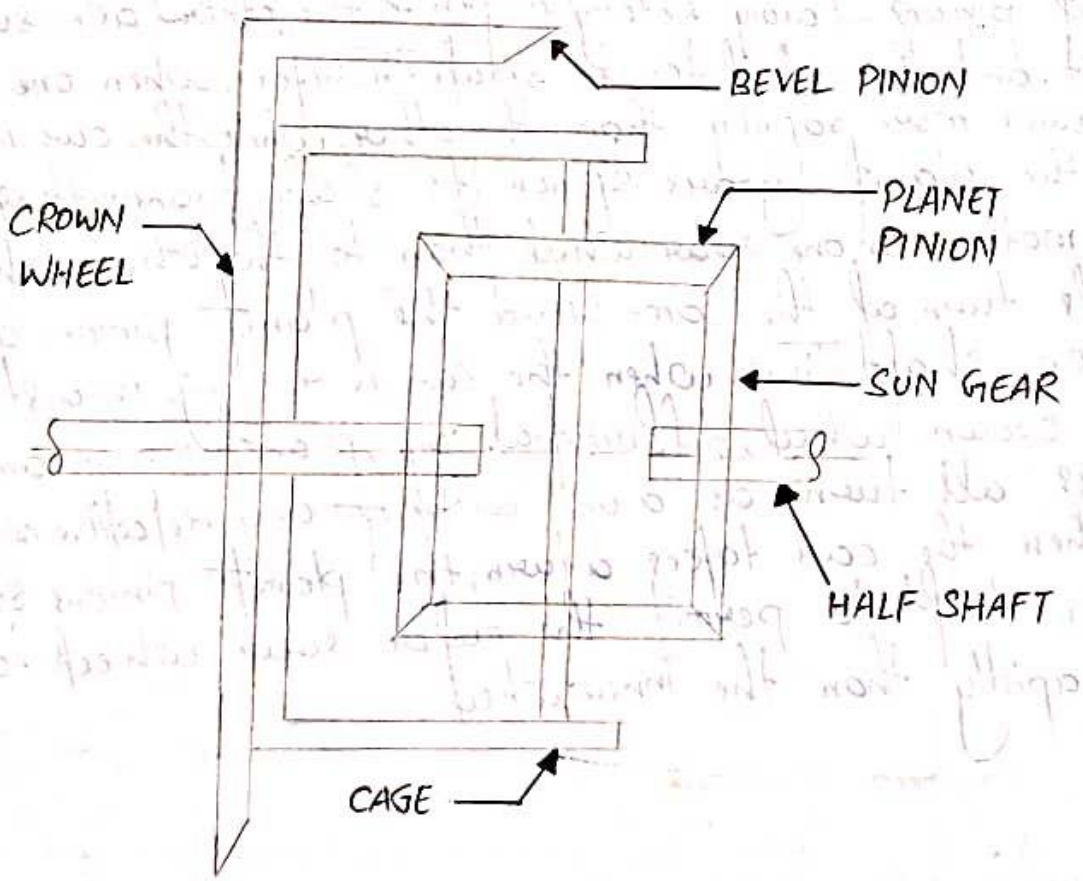
If a car travels in a straight line the two rear wheels turn on the road exactly at the same speed. There is no relative movement between the two rear wheels. The propeller shaft may be geared rigidly, in this case, with the rear axle to rotate the rear wheels together. But when the car takes a turn, the outer wheel travels on a longer radius than the inner wheel. The

Outer wheels turns faster than the inner wheel, that is there is a relative movement between the two rear wheels. If the two rear wheels are rigidly fixed to a rear axle the inner wheel will slip which will called rapid tyre wear steering difficulties and poor road holding. Therefore, there must be some devices to provide relative movement to the two rear wheels when the car is taking a turn, the differential serves this purpose.

What is Differential?

A differential is a gear train with three shaft that has the property that the angular velocity of one shaft is the average of angular velocities of the others, or a fixed multiple of that average.

Construction & working principle of Differential



Above figure shows the Construction of a simple differential. The sun gears are mounted on the inner end of each rear axle (called the half shaft). A differential cage is assembled On the left axle. A ring gear (called the crown gear) is attached to the case, So that the cage rotates with the crown gear. The crown ~~cage~~ gear is driven by the bevel pinion. Both the crown wheel and cage are free on the left rear axle. The cage supports two planet pinions (called the differential pinion gears) on a shaft which mesh with the two sun Gears. Thus, when the differential cage is rotated, both the sun gears rotate and thus, both wheels turn which are attached to the outer end of the rear axles. Now, let us suppose that one wheel is held station. Then when the differential cage is rotate the planet gears will also rotate as the run around on the stationary axle sun gear. while rotating in this manner the planet pinions carry rotary motion to the other axle sun gear, causing it, and the wheel too, to rotate. Therefore, when one rear wheel turns more rapidly than the other, while the car is taking a turn, the planet gears spinon its shaft transmitting more rotary motion to one rear wheel than to the other. When both the wheels turn at the same speed the planet pinions do not rotate on shaft. Thus, when the car is running in a straight line, the crown wheel, differential cage, planet pinions and the sun gears all turn as a unit without any relative motion. But when the car takes a turn, the planet pinions rotate on their shaft to permit the outer rear wheel to turn more rapidly than the inner wheel.

BRAKING SYSTEM

Brake:-

A brake is a mechanical device that inhibits motion by absorbing energy from a moving system. It is used for stopping a moving vehicle, wheel, axle or to prevent its motions most often accomplished by means of friction.

Need of Brake in Automobiles:-

→ The vehicle had been started accelerated and was running on the road. It is now to be stopped. stopping of the vehicle is as necessary as its running. Once the vehicle is started it must be stopped somewhere Brakes are applied on the wheels to stop the vehicle.

or

Imagine you are driving down the road, and/are approaching a stop sign, If brakes is not there you are not able to stop the car and you are summit an accident So Brake is very much necessary for an automobile.

Types of Brakes:-

The automobile brakes, are classified according to the different bases as follows:

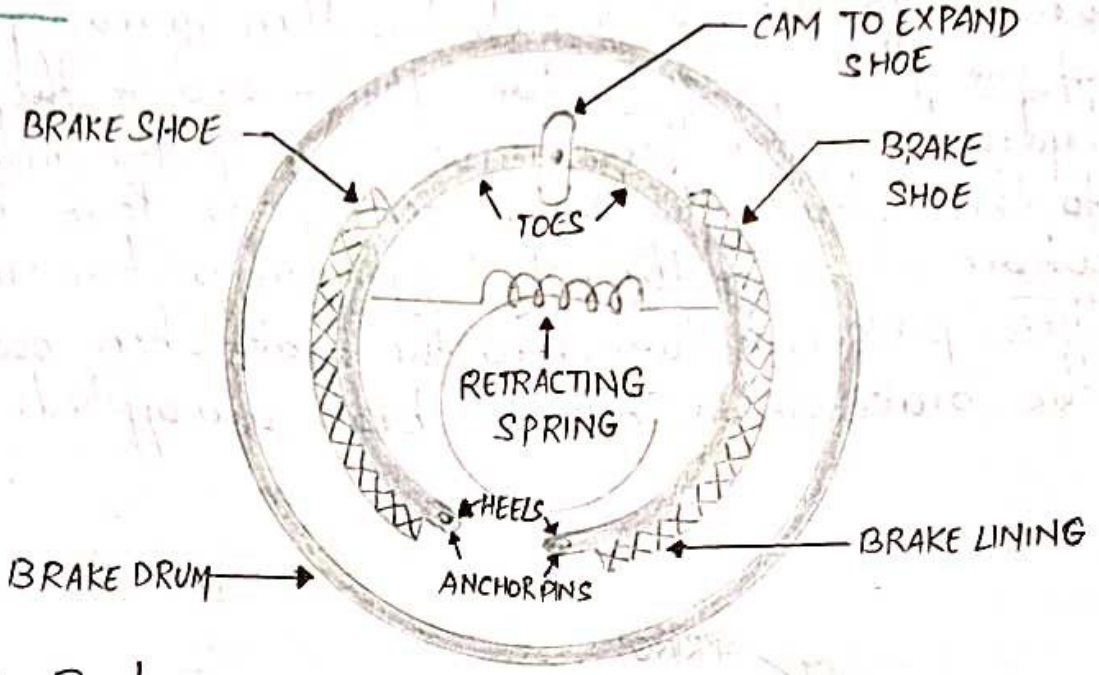
1. With respect to application:
   (a) Foot brake (b) Hand brake.
2. With respect to the number of wheels:
   (a) Two-wheel brakes (b) Four-wheel brakes.
3. With respect to the method of braking contact:
   (a) Internal expanding brakes (b) External contracting brakes.

4. With respect to the method of applying the braking force:
(a) Single acting brakes (b) Double acting brakes.
5. With respect to the brake gear:
(a) Mechanical brakes (b) power brakes.
6. With respect to the nature of power employed:
(a) Vaccum brakes (b) Air brakes.
(c) Hydraulic brakes (d) Hydrostatic brakes.
(e) Electric brakes.
7. With respect to power transmission:
(a) Direct acting brakes. (b) Geared brakes.
8. With respect to power unit:
(a) Cylinder brakes (b) ~~Diag~~ Diophragm brakes.

Mechanical Brakes:-

In a motor vehicle, the wheel is attached to an auxiliary wheel called drum. The brake shoes are made to contact this drum. In most designs, two shoes are used with each drum to form a complete brake mechanism at each wheel. The brake shoes have brake on their outer surfaces. Each brake shoe is hinged one end by an ~~achor~~ anchor pin, the other end is operated by some means so that the brake shoe expands outwards and the brake linings come into contact with the drum. Retracting spring the brake shoes into position when the brakes are not applied. The drum enclosed the entire mechanism to keep out dust and moisture. The wheel attaching bolts on the drum enclose the entire mechanism to keep out dust and moisture. The braking plate completes the brake enclosure, holds the assembly to the car axle and acts at the base for fastening the brake shoes and operating mechanisms.

The shoes are generally mounted to rub against the inside surface of the drum to form internal expanding brake.

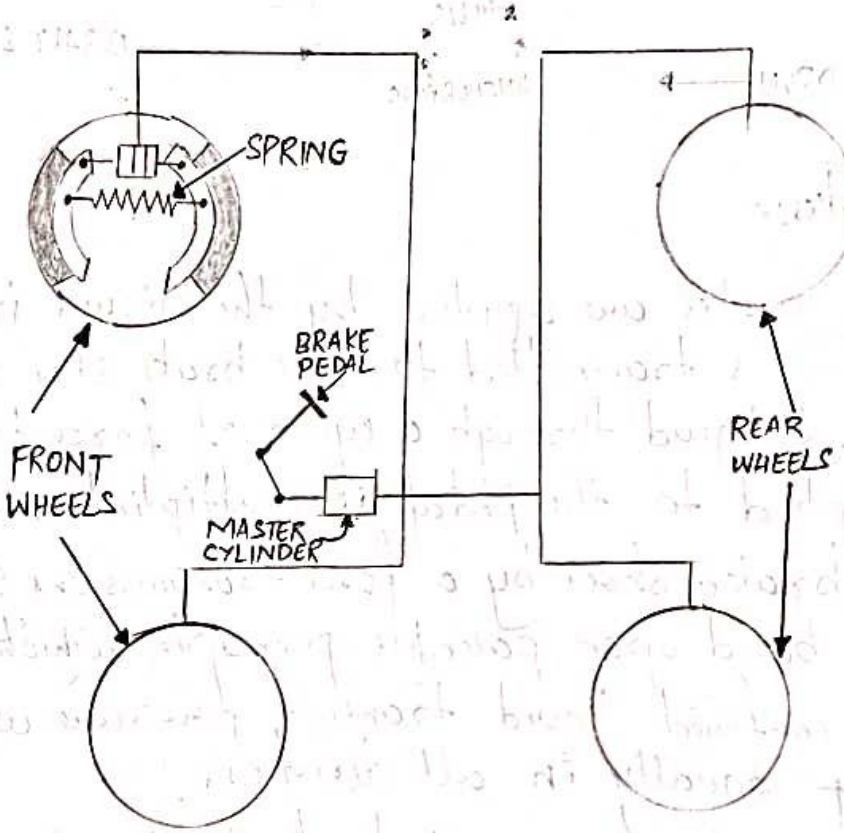


Hydraulic Brakes:-

The hydraulic brakes are applied by the liquid pressure. The pedal force is transmitted to the brake shoe by means of a confined liquid through a system of force transmission. The force applied to the pedal is multiplied and transmitted to all the brake shoes by a force transmissions system. This system is based upon pascal's principle which states that "the confined liquid transmit pressure without loss ~~equality~~ equally in all directions".

Hydraulic brake system is essential consists of two main components master cylinder and wheel cylinder. The master cylinder is connected by tubing to the wheel cylinders at each of the four wheels the system is filled with the liquid under light pressure when the brakes are not in operation. The liquid is known as brake fluid, and is usually a mixture of glycerine and alcohol or shoes are fitted with a heat and wear resisting brake lining on their surfaces.

The brake pedal is connected to the master cylinder piston by means of a piston rod. When the brakes are to be applied, the driver depresses the pedal, the piston is forced into the master cylinder, this increasing the pressure of the fluid in the master cylinder and in the entire hydraulic system. This pressure is conducted instantaneously to the wheel cylinders on each of the four-brakes, where it forces the wheel cylinders pistons outwards. These pistons, in turn, force the brake shoes out against the brake drums. Thus, the brake are applied.



Air Brakes:-

The manufacturers of braking systems offer a variety of air brake equipment. However, the simplest system consist of an air compressor, a brake valve, series of brake chambers, unloader valve, a pressure gauge and a safety valve. These are all connected by lines of tubing. The other braking systems may have additional components such as stop-light switch, a low pressure indicator, an air supply valve to supply air for tyre inflation, a quick release valve to release air quickly from the

front brake chambers when pedal is released, a limiting valve for limiting the maximum pressure in the front brake chambers and a relay valve to help in quick admission and release of air from rear brake chambers.

Air - Hydraulic Brakes:-

In this type of braking system, the air pressure is converted into hydraulic pressure. Here the air power cylinder is combined with the hydraulic master cylinder and the reservoir. The conventional type hydraulic brakes are actuated by the air power with the help of this unit. The bore of the power cylinder is generally kept four times that of the master cylinder. The ratio between the hydraulic pressure and the air pressure is generally maintained at 15:1.
Compressed air brake system consists of the following components:

1. Air Compressor.
2. Tyre inflating bottle.
3. Air pressure regulator.
4. Air container.
5. Truck brake valve.
6. Air pressure gauge.

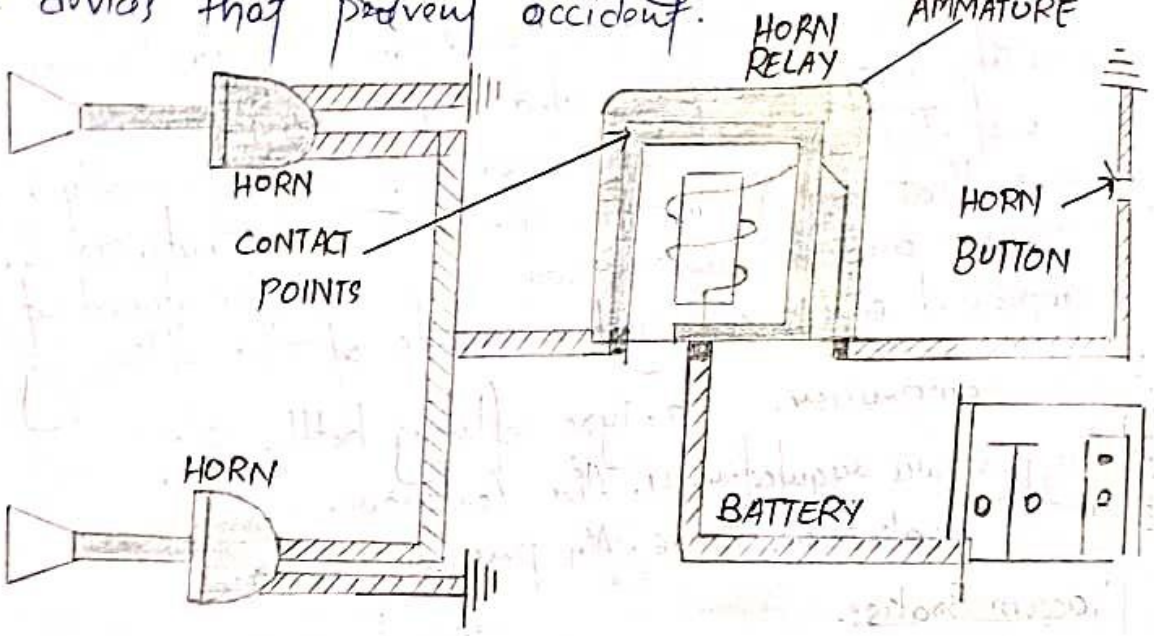
Vaccum Brakes:-

In the air brakes the force of brake application is because of the difference of pressure on the opposite sides of the diaphragm. One side of the piston or diaphragm is exposed to the higher pressure while the other to the ~~atom~~ atmospheric pressure. In fact, it is the potential difference which is utilised to create the braking effect. Similar type of effect can be obtained if one side of the piston or diaphragm is exposed to the atmospheric is obtained by exhausting air from it. This is the principle of vaccum brakes.

AUTO ELECTRIC SYSTEM:

Horn Circuit:-

Horn is a sound creating device. Electrical horns are used in all the automobile vehicles. When the horn is operated it creates loud vibrating sound indicating that vehicle is coming so that the passing or the other slow moving vehicles may clear off the path to pass it. Horn is also used as a calling well to call the persons when the vehicle is ready to start. Lights, breaks and horns are the devices that prevent accident.



Above diagram shows of the horn circuit. It consists of a armature, a diaphragm, a winding and a pair of contact points connected in series. When the horn button is pushed, it connects the horn winding to the battery. The current passing through the winding produces the magnetic field which pulls the armature down, creating a loud click. The armature is attached to a diaphragm. The movement of the diaphragm opens the contact points, due to which the circuit is broken. The cycle is repeated rapidly. The rapid movement of the diaphragm produces a distinctive noise. The tone pitch of the horn depends upon the size and shape of the diagram and also upon the path through which the sound must travel. A relay is also used in some systems to avoid carrying heavy current required by the horn through the steering column and back. The relay closes the contacts to connect the horn to the battery. This way the

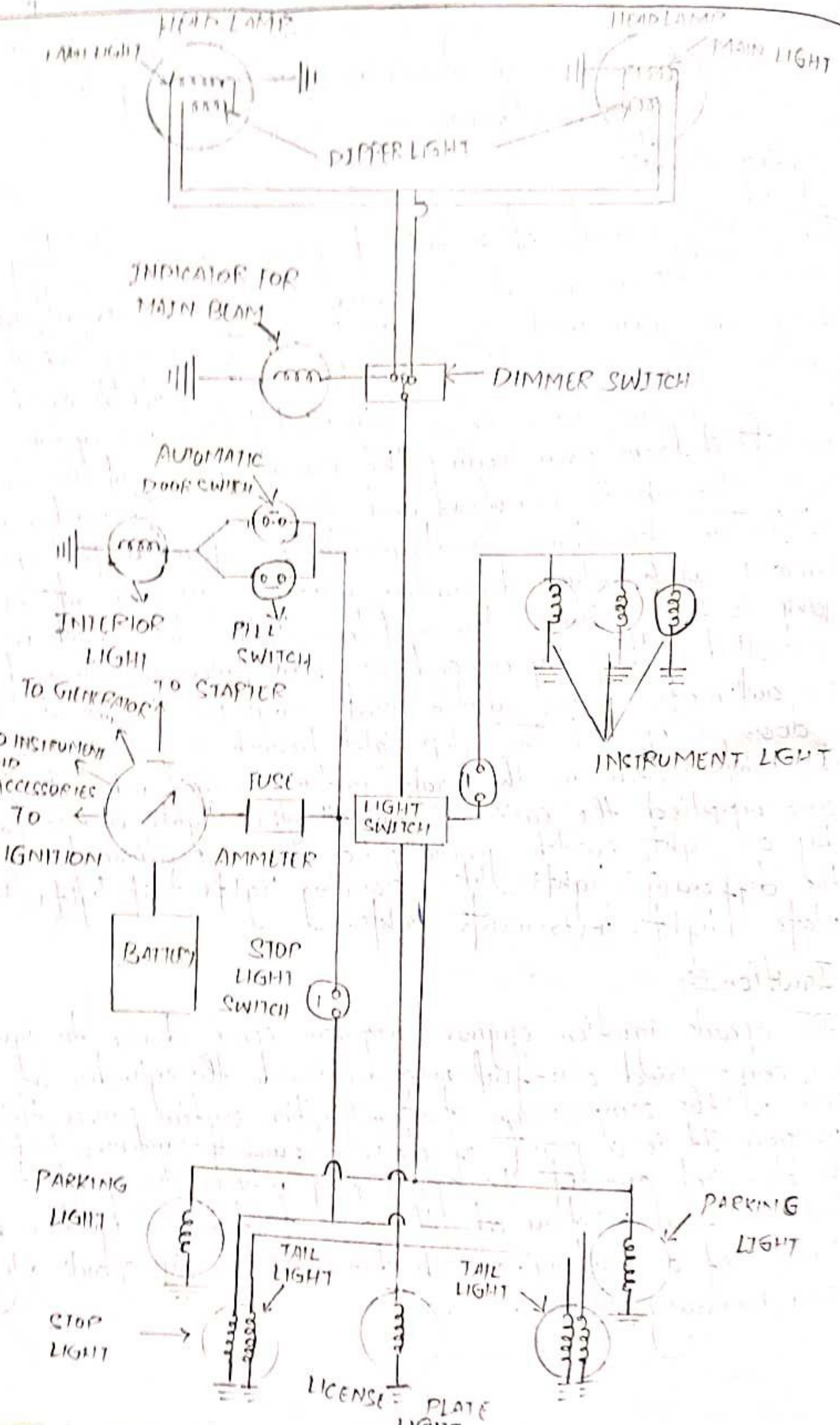
voltage drop in the wiring from battery to horn is eliminated and higher voltage is available for operating the horn with better performance.

Lighting circuits:-

The wiring circuit of a typical passenger car lighting system shown in below figure. It is simple circuit system using one wire and ground. The current is supplied to the system from the battery at 6 to 12 volts suitable switches, fuses or circuit breakers are also included in the system to protect it from over loading. The circuit begins at the battery passes through the armature and fuse before it reaches any switch. The headlamp circuit generally contains a foot operated dimmer switch which determines whether the current is going to the upper or lower filament. The dome light is controlled either by a hand operated pillar switch or by an automatic doors switch that completes the circuit when a door is opened. The stop light branch is controlled by the stoplight switch in the brake system. So that when the breaks are applied the switch is on. All other lights are controlled by a light switch generally has three positions for operating the different lights, like parking lights, tail lights, license plate light, instruments lights.

Iguition :-

The spark iguition engines require some device to iguite the compressed air-fuel mixture inside the cylinder at the end of the compression stroke. Iguition system serves, this purpose. It is a part of electrical ~~current~~ system. which carries the electrical current to spark plug which give spark to iguite the air fuel mixture at the correct time. The iguition system consists of a battery, switch, distributor, coil spark plugs and necessary wiring.


HEAD LAMP
HEAD LAMP
PARK LIGHT
MAIN LIGHT
DIPPER LIGHT
INDICATOR FOR MAIN BEAM
DIMMER SWITCH
AUTOMATIC DOOR SWITCH
INTERIOR LIGHT
PILL SWITCH
TO GENERATOR
TO STARTER
TO INSTRUMENT AND ACCESSORIES
TO IGNITION
FUSE
AMMETER
LIGHT SWITCH
INSTRUMENT LIGHT
BATTERY
STOP LIGHT SWITCH
PARKING LIGHT
TAIL LIGHT
TAIL LIGHT
PARKING LIGHT
STOP LIGHT
LICENSE PLATE LIGHT

Common ignition troubles:-

Symptom	Diagnosis	Remedy
Starter turns engine slowly lights dim or don't work	Weak or flat battery	Push start a manual gearbox car or use jump leads. Recharge battery.
Starter doesn't operate, no sound from engine, lights and windscreen wiper don't work.	Completely dead battery or faulty battery connections.	check and clean the battery connectors at the terminals, also lead from the battery to the car body.

Spark plugs:-

Spark plug is a device to produce electric spark to ignite the compressed air fuel mixture inside the cylinder. The spark plug is screwed in the top of the cylinder so that its electrode project in the combustion chamber.

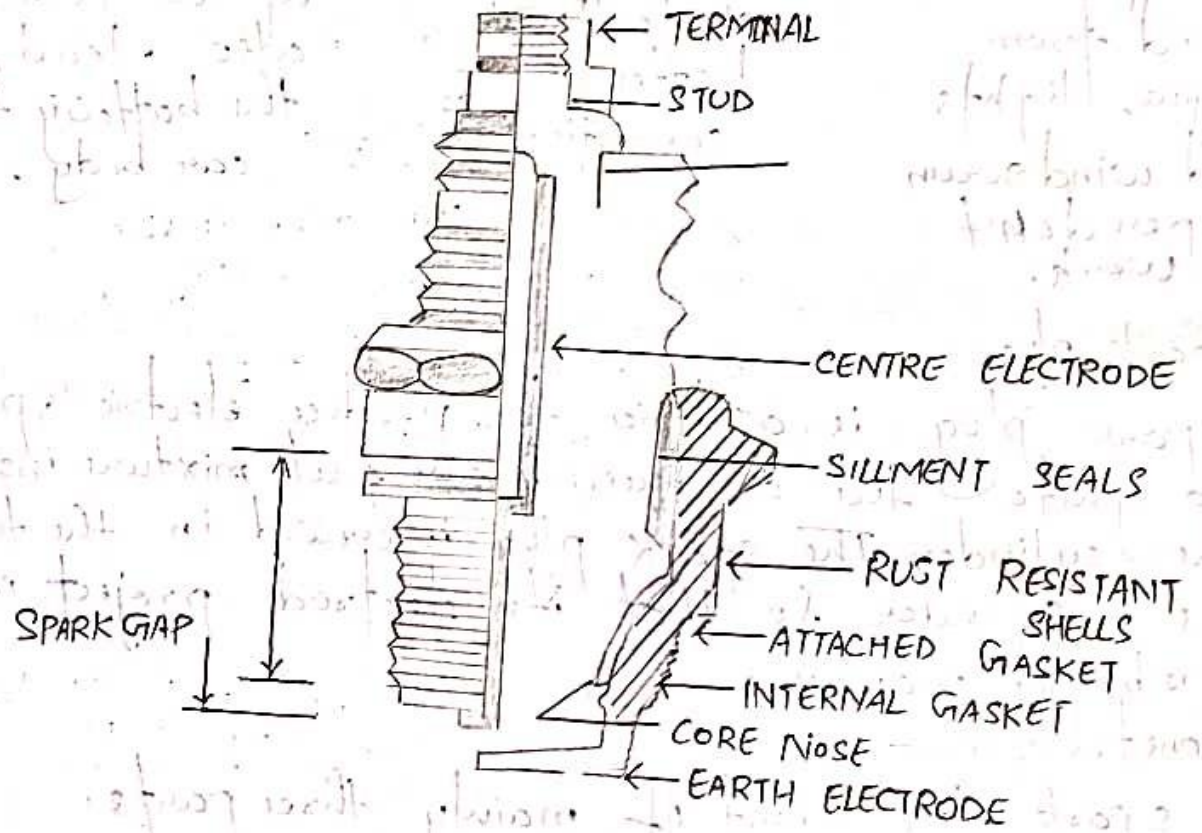
Construction:-

A spark plug consist of mainly three parts.

1. Centre electrode or insulated electrode.
2. Ground electrode or outer electrode.
3. Insulation Separating the two electrodes.

The upper end of the centre electrode is connected to the spark plug terminal, where cable from the ignition coil is connected. It is surrounded by

is connected to the spark insulator. The lower half portion of the insulator is fastened with a metal shell. The lower portion of the shell has a short electrode attached to one side and bent in towards the centre electrode, so that there is a gap between the two electrodes. The two electrodes are thus separated by the insulator. The sealing gaskets are provided between the insulator and the shell to prevent the escape of gases under various temperature and pressure conditions.



SUSPENSION SYSTEM

The automobile frame and body are mounted on the front and rear axle not directly through some form of springs and shock absorbers. This is done to damp the road shocks transmitted to the frame by the wheels as they roll over the road. All those parts which perform this function are collectively called a suspension system. Thus, the suspension system included springs, shock absorbers and their mountings.

Function of Suspension System :-

1. To prevent the road shocks from being transmitted to the vehicle frame.
2. To preserve the stability of the vehicle in pitching or rolling, while in motion.
3. To safeguard the from road shocks.
4. To provide good road holding while driving, cornering and braking.
5. To maintain proper steering geometry.

Front End Suspension :-

The front end suspension is more complicated than the rear end suspension, because the front wheels not only move up and with respect to the car frame, but also swing at various angles to the car frame steering. In order to permit the front wheels to swing to one side or the other for steering, each wheel is supported on a spindle which is part of a steering knuckle. The steering knuckle is then supported through ball joints, by upper and lower control arms which are attached to the car frame.

Rear End Suspension:-

There are three types of rear end suspension usually found in motor vehicles

1. Longitudinal leaf spring rear end suspension.
2. Transverse leaf spring rear end suspension.
3. Coil spring rear end suspension Longitudinal leaf Spring and coil spring rear end suspension are wide used in modern vehicles. Transverse leaf spring rear end suspensions is rarely used. Rear end suspension using longitudinal leaf springs.

Because this type of suspension is generally used in conjuction with the Hotchkiss drive, the leaf springs, must be made strong and resilient enough to transmit the driving thrust and torque and to resist sideways in addition to support the spring weight of the body. The spring weight is kept as less as possible, in order to improve the side of the vehicle. Because the spring do not generally support the wheels, rims, tyres, brakes and rear axle, the weight of these parts is called the spring weight.

Independent Front Suspension:

In the independent type of front suspension each front wheel is independently supported by a coil, torsion bar or leaf spring. Almost all the passenger cars now use the independent front suspension, in which the coil spring arrangement is the most common.

There are three types of coil spring front Suspensions.

1. In first type, the coil spring is located between the upper and lower control arms. The lower control arm has one point attachment to the car frame.
2. In the second type, the coil spring is located between the upper and lower control arms. The lower control arms has two points to attachment to the car frame.
3. In the third type, the coil spring is between the upper control arm and spring tower or housing that is a part of the front end sheet metal work.

Constructional features and working of a telescopic shock absorber.

A shock absorber is a mechanical or hydraulic device designed to absorb and damp shock impulses. Hydraulic shock absorbers are used in conjuction with cushions and springs. An automobile shock absorber contains spring loaded check valves and orifices to control the flow of oil through an internal piston. Telescoping shock absorber is a type of Hydraulic shock absorber.

Construction of Telescopic Shock Absorber:-

It consists of an outer tube, which is attached to suspension system of the automobile. Inner tube is placed inside the outer tube which acts as a working cylinder for the piston that is attached to a piston rod. Other end of this piston rod is attached to chassis flame. Piston is provided with two way valve which is also attached to the base of the outer tube. Viscous fluid is filled inside the inner tube. Viscous fluid also filled.

In the angular space of inner and Outer tube. This viscous fluid is maintained in such a way that there is air space left above the fluid.

Working of Telescopic shock Absorber:-

when Automobile vehicle comes across a bump, the outer tube moves up which increase the pressure between 2 way valve. This high pressure opens the valve assembly in the piston thus allowing fluid to moves in upper chamber of inner tube. Also this pressure opens the valve assembly in baise of inner tube thus allowing to some fluid

State tyre Specification:-

Tyre have a code System moulded into their sidewall which allows you to understand their technical capabilities. This code provides information on the size, Construction its load-carrying capacity and its speed rating.

For example the code on a Common fitment for Australian Car is:

205/65R1595H

205 indicates the nominal section width of the tyre in milimetres (205mm). 65 Indicator its aspect ratio, a Comparion of the tyres section height with its section width (65 indicators the height is 65% of its width). R indicates radial PH Construction. 15 indicates the nominal diameter of the wheel rim (15 in ones). 95H is a symbol indicating the maximum load Capacity and speed at which the tyre can be safely operated subject to the tyre being in Sound condition correctly fitted and with recommended inflation pressure (95

represents a maximum load of 690 kg per tyres.
91 represents a maximum speed of 210 km/h.

Causes of tyre wear and remedies to Solves:

Misalignment:-

One-Sided wear results when the top of tyre leans away from or toward the vehicles. This is your chamber, and your wheels aren't parallel- when your tyres are pointed toward or away from the road. there's a problem with the toe and your vehicles isn't set straight.

Solution:-

Get a wheel alignment from the tyre experts.

Underinflation:-

Under inflation wears your tyres on both outside shoulder because the edge are making excessive contact with the road.

Solution:-

Pump up your tyres to the right tyres pressure according to your manufacturer recommendations.

Describe necessity of engine Cooling:-

During the combustion of air fuel mixture enormous amount of heat is produced inside the engine Cylinder and the temperature as high as 2500°C may be reached by the burning goes. The temperature is so high that it will break the lubricating f. between the moving parts, weld the moving parts of or may cause any mechanical breakage of the engine parts. Hence, this temperature must be reduced by some means to such a value about 200°C-250°C, at which the engine may work efficiently. Too much cooling would, however lower thermal efficiency of the engine. Thus, the purpose of the cooling system is to keep the engine at its most efficient operating temperature at all engine speeds and all driving condition ~~at all engine speeds and~~ so engine cooling is very much necessary.

Defects of cooling & their remedial measure

Most cooling System problems fall into three general areas such as over cooling, Overheating and noise. The four problem another potential problem, in internal engine Overheating.

Internal Engine Overheating:-

This problem is usually caused by rust, Scales, or corrosion formation on the water jacket side of the Cylinder wall. Rust, dirt, or corrosion particles can deposit in the water jackets. This can act like thermal insulator and slow down the heat Flow so that an Overheating of the combustion chamber, pistons, rings, and/or valves may take place while the coolant is at normal temperature However, usually rust and Scale particles break loose and

travel with the coolant until they are caught in the radiator and plug the tubes. This causes the coolant as well as the engine to overheat.

Over Cooling:-

This problem generally appears in the winter because the heater does not work Over cooling in a car using a liquid heated choke may show up as a Carburetter choke that does not come off. In a modern, computer-Controlled vehicle it may show up as an engine Control System that does not into normal operating mode.

Lubrication of I.C Engine:-

Lubrication used in I.C. engine are:- mist Lubrication Systems Two Stroke engines.

Wet pump lubrication System
Dry pump lubrication System > Four Stroke Engines.

Mist Lubrication System:-

In two stroke engines the charge is compressed in the Crankcase, and as such it is not suitable to have the lubricating oil in the pump. Therefore, such engines are lubricated by adding 3% to 6% oil in the fuel tank itself. The oil and fuel mixture is inducted through the carburetor The fuel gets vaporized and the oil in the form of mist, goes into the cylinder through the crankcase walls lubricates the main and connecting rod bearings, and the rest of the oil lubricates the piston, piston rings and cylinder.

Wet Sump Lubrication System:-

In the wet sump system, the bottom of the crankcase contains an oil sump that serves as the oil supply reservoir oil dripping from the cylinders and bearings flows by gravity back into the wet sump where it is picked up by a pump and re-circulated through the engine lubricating system.

Functions of Lubricants:-

Lubricants are used for three purposes to reduce friction to prevent wear, and as a protective cover against corrosion. the use is obvious. As a preventive against wear; the use is equally obvious when you consider the matter of friction. Lubricants form a layer or film between the metal surfaces that actually keeps the metal from touching. The moving parts literally ride on the lubricant. In the instance of two metal surfaces sliding across each other where space cannot be provided for ball bearings the lubricants themselves serve as liquid bearings. In all mechanical devices, lubrication is necessary to counteract friction as much as possible The presence of only a thin film of lubricant separating metal surfaces keeps machinery running.

Fuel and Ignition System

For petrol engine:-

A petrol engine (known as a gasoline engine) is an internal combustion engine : spark ignition, designed to run on petrol gasoline and similar volatile fuels.

In most petrol engines, the fuel and air are usually pre-mixed before compression. The pre-mixing was formerly done in a carburetor, but now it is done by electronics controlled fuel injection, except in small engines where the costly complication of electronics does not justify the engine efficiency. The process differs from a diesel engine in the method of mixing the fuel and air, and in using spark plugs to initiate the combustion process. In a diesel engine, only air is compressed (and therefore heated), and the fuel is injected into very hot air at the end of the compression stroke, and self-ignites.

Describe Carburetion and Air-fuel ratio Carburetor:-

The carburetor is a device for atomized and vaporizing the fuel and mixing in with the air in varying proportion to the changing cons of spark ignite egines. The air fuel mixture so obtained from the carburetor is called the combustion mixture. The process of mixing the gasoline fuel with air to obtain the combustible mixture is caved Carburetion. Hence, the terms vaporization and atomization should understand clearly. Vaporization is the change of state of the fuel from liquid to vapour. Atomization is the mechanical breaking up of the liquid fuel into small particles. so that every particle of the fuel is surrounded by air. In order to produce very quick vaporization of the liquid fuel, it is prayed into the air passing through the carburetor. Spraying of the liquid turns it into many fine

particles, so that the vaporization occurs almost instantly. The carburettor supplies the air-fuel mixture of varying proportions to suit the changing conditions of the engine. The mixture must be rich for starting acceleration and high speed operation.

Air-fuel Ratio:-

The carburettor must supply the air-fuel mixtures of varying proportions to suit the different operating requirements. The mixture must be relatively lean for idling and intermediately speeds for starting the air fuel ratio is 9:1 it is a rich mixture. For idling, the ratio is 12:1 it is a lean mixture. For intermediate speeds between 35 to 105 km/h, the mixture further leans out 13:1. But at higher speed 120 to 150 km/h, with a wide open throttle. the mixture is again enriched about 13:1.

Describe the Battery ignition and Magnet ignition System:

Types of an ignition System

There are two types of ignition System used in petrol engines

1. Battery ignition System (or coil ignition System)
2. Magnet ignition System.

Battery ignition System:-

It consists of a battery, ammeter, switch ignition coil, condensor, Contact breaker, distributor and spark plug. The primary ignition circuit starts at the battery and passes through the switch, ammeter, primary winding, Contact breaker point to the ground. A condenser is also connect in parallel to the contact breaker arm and the other end is grounded. The secondary ignition circuit is not

connected electronically to the primary ignition circuit. The I.t starts from the ground and passes through the secondary winding, distributors, spark plug to the ground. The ignition coil steps up ≠ 6 to 12 Volts from the battery to the high tension voltage of about 20,000 to 30,000 volts required to jump the spark at the spark plug gap, which ignites to combustible change in the cylinder. The rotor of the distributor revolves and distributes the current to the four segements which in turns send it to the spark plugs.

Magnet Ignition System:-

It consists of a magnet, instead of a battery, which produces and supplies current into the primary winding. The remaining arrangement in this system is the same as that in the battery ignition system. The magneto consist of a fixed armature having primary and secondary windings and a rotating magneto assembly which is driven by the engine. when the magnet rotate, current flows in the primary winding. The secondary winding gives high voltage current to the distributor, which distributes it to the respective spark plugs. In a magneto, the magnetic field, is produced by means of permanently magneto. whereas in conventional generator, the magnetic field is produced by passing some of the generated current through the field winding which produces the magnetic field.

Multipoint fuel Injection:-

Petrol vehicles uses device called carburetor for supply the air fuel mixtures in correct ratio to cylinders rpm ranges. Due to construction of the carburetor is relatively simple, it has been used almost exclusively on gasoline engines in the past. However presently we need cleaner exhaust emission system, more economical fuel consumption improved drivability etc. So in order to get all these, we need a carburetor that must have various devices to do the above functions, making it more complex system. So In place of carburettor, therefore the multipoint fuel injection system is used, assuring proper air fuel ratio to the engine by electrically injecting fuel in accordance with various driving condition.

Describe the working principle of fuel feed pump, Injector and fuel filter:-

Working of fuel-feed pump:-

The fuel feed pump used for the diesel engine is similar to that of a fuel lift pump fuel the petrol engine. It delivers the fuel from the tank to the injection, pump continously and at a reasonable pressure. It is necessary because there is possibility of formation of vapour bubbles and subsequently Cavitation in the pump due to suction of the rapidly moving plunger of the injection pump. This would lead to controlled variations in the rate of delivery of fuel to the cylinders causing rough running and possibly even mechanical damage to the engine.

Working of Injector:-

The function of the fuel injection system is to provide the right amount of fuel at the right moment and in a suitable condition for the combustion process. There must therefore be some form of measured fuel supply, a means of fixing the delivery and the atomisation of the fuel. The injection of the fuel is achieved by the location of cams on a camshaft. This camshaft rotates at engine speed for a two-stroke engine and at half engine speed for a four-stroke.

Working of fuel filter:-

In order to ensure uninterrupted work of diesel from the fuel tank out of the impurities must be removed carefully. If bad fuel filtration, fuel pump and injections is in the precision Coupling will quickly wear or stuck. Precision Coupling of wear and tear, will Cause oil tank uniformly, increased fuel consumption and power down.

Diesel engines are generally installed in the two filters. The first is the coarse filter, before it is installed in the pump, engine filter out the larger impurities. The second is the filters can filter out small impurities, before it is installed in the fuel pump.