SWAMI VIVEKANANDA SCHOOL OF

ENGINEERING & TECHNOLOGY

LECTURE NOTE

AUTOMOBILE ENGINEERING

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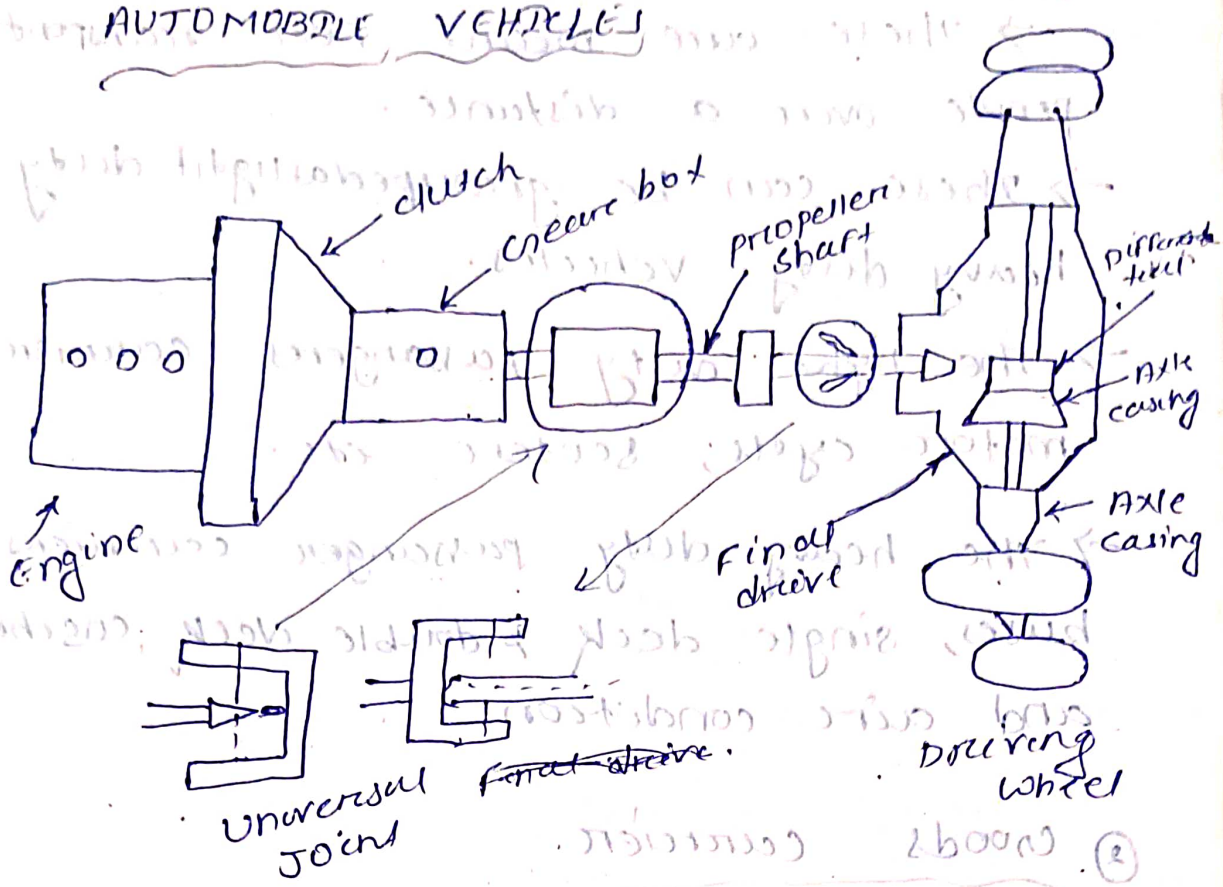
Jeey hanuman Date: 6.1.2017

AUTOMOBILE VEHICLES



DEFINATION

→ An automobile is a self propelled vehicle driven by an internal combustion engine and is used for transportion of passangers and goods on ground.

→ Example → Bus, car, jeep, truck, motorcycle.

TYPES OF AUTOMOBILE

The automobiles are classified in to two types basin upon the carrying system. or porpose.

① passenger carriers

② Good carriers

③ special porpose.

① Passenger carriers

→ These are meant for transporting people over a distance.

→ These can be grouped as light duty and heavy duty vehicles.

→ The light duty passengers carriers are motor cycle, scooter etc.

→ The heavy duty passenger carriers are buses, single deck & double deck coaches, and air conditioned.

② Goods carriers

→ Goods carriers are meant for transporting materials over a distance.

→ These can be grouped as light duty and heavy duty vehicles.

→ The light duty goods carriers include delivery van, light truck etc.

→ Heavy duty goods carriers include truck tractor, universal truck for pulled and loose load.

③ Special purposed vehicle

→ Vehicle for municipal service sprinkler, snow removers, dust collections,

→ Fire Fighting vehicles with automotive pump and mechanised ladders.

→ Automobiles for load handling and insertion crane, loaders, excavators,

(B) According to capacity

① Light vehicles → ex - scooter, car etc

② Heavy vehicles → ex - Bus, tractor etc

(C) Fuel used

① Petrol vehicle → motor cycle, scooter, car

② Diesel vehicle → Bus, car, truck.

③ Electric vehicle → Battery truck, Forklift, solar power vehicles.

④ Steam carriage → steam road rollers.

(D) Number of wheels

① Two-wheelers

② 3-wheelers

③ 4-wheelers

(E) Drive

→ single

→ Two drive

→ 4 drive wheel vehicles.

(E) DRIVE

① single, 2-4 wheel drive vehicle.

② Front wheel and Rear wheel drive vehicle

③ Left hand and Right hand drive vehicle.

COMPONENTS OF AN AUTOMOBILE

The main components of an automotive vehicles are ① chasis
② Body

Chasis

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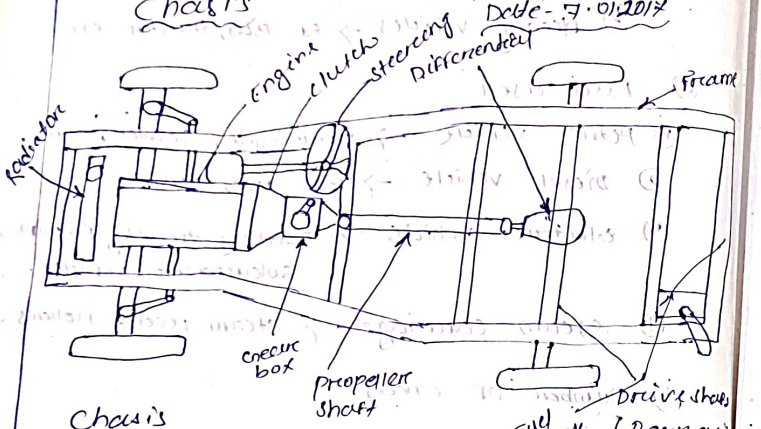


Chasis

chasis also known as carreraging unit which is derived from a French term.

→ It was initially used to denote the Frame or main structure of a vehicle

→ The term chasis is know extensively used to denote the complete vehicle except the body for the heavy vehicle having a seperate body.

→ The chasis contains all the measure units necessary to propell the vehicle, direct its motion, stop it, and allow each to roun smoothly over on even surfaces.

→ The chasis of an automobile consist of the following component

(1) Frame
(2) Front axle
(3) steering system
(4) Rear axle
(5) suspension system
(6) Transmission system
(7) Breaking system
(8) Roldiator
(9) Engine
(10) clutch
(11) creeve box
(12) propeller shaft
(13) Differentedal
(14) Electrical system.

① Frame

it supports the engine, vehicle body, wheels, and others components.

(2) r

② Front axle

(i) → The Front axle or ~~vehicle~~ a vehicle ~~st~~ transmit the weight of the Front part of the vehicle to the road surface through the Front wheel.

(ii) → These Front axle is made up drop Forging From steel having 0.4 % carbon or ~~1 2 3 %~~ 1 to 3 % Nickel steel.

(iii) → The Front axle is made of I-section in the centre position. The ends are made either circular or elliptical.

Steering system

→ It is used to change the direction of motion of the vehicle by turning the Front wheels.

→ The Front wheels are link to the steering wheels which is operated by the driver, by a system of levers and Rods.

④ Rear wheel axle

The power is transmitted From the differential through the rear axle to the driving wheels.

⑤ Suspension system

→ The primary Function of suspension system is to isolate the vehicle and its occupants From shocks and vibration generated by the road surfaces while maintaining steering control and stability at all times.

→ It improve ~~corde~~ Ridge quality, better road holding, improve steering control, reduce axle tramp, Reduce pitching.

⑥ Transmission system

The Function of transmission system are (1) To disconnect the engine From the driving wheels when starting the engine.

(2) To connect the driving wheels smoothly and without shock to the engine when the engine is running.

③ To varies the leverage between the engine and the driving wheels, depending on the resistance encounter by the vehicle.

④ To reduce the speed of the engine at the driving wheels in the ratio of about 4 to 1

in the passenger cars and ... ... reaction in lorries lorries.

⑥ To turn the drive through 90°.

⑥ → To rotate the driving wheels on either side of the vehicle at different speeds, while the vehicle is turning a circle.

⑦ → To provide for the relative movement between the engine and the driving wheels due to flexing of suspension spring.

Types of suspension system

(i) Mechanical suspension system

② Hydraulic " "

③ Electrical and electromagnetic suspension system

Brake system

It ensures ~~the~~ safe driving of the vehicle. with the brake system the vehicle can be stop quickly or slow down while going down a slope.

→ The brakes are mounted on all the wheels of a vehicle.

→ The brakes are connected with the brake peddle or leaver by means of different types of brake such as

(i) mechanical brake

② Hydraulic brake

③ Air operated brake

Date - 9.1.2017

Engine

→ It produce power required to move the vehicle at desired speed to overcoming the external resistance.

→ The engine have various components such as

(i) different mechanical parts

(ii) Intake and exhaust system

(iii) Fuel supply system

(iv) cooling system

(v) Lubricating system.

Clutch

→ Clutch is a device used in transmission system of a motor vehicle to engage and ~~dis~~ en disengauge the engine power to the transmission system.

→ It helps to isolate the engine from the transmission system as and when required.

→ It also permits the vehicle to be started from rest, smoothly and without Jerks.

Gear box

→ It provides the torque of the required amount at the driving road wheels.

→ When ever the resistance to be overcome by the vehicles either the gear ratio of the power train is to be changed.

→ The gear box also helps to reverse the vehicle.

Universal joint cum Propeller shaft

→ Transmits the torque from the gear box shaft to the final drive.

→ The gear box is usually attach to the vehicle frame.

→ The final drive, differential and Rear axle are connected to the frame by means of spring.

→ As the tyre of the vehicle heat the bumps on the road the rear axle moves up and down.

→ Universal joint helps the propeller shaft to assume different inclination.

→ The propeller shaft has a sliding arrangement within itself.

→ This helps the shaft to have different length when the shaft assumes different inclination.

Differential

→ It is present on the rear axle of the vehicle on the back side of the vehicle.

→ It allows the driving wheel on the two side of the vehicle to rotate at the same speed when moving over a straight road and at different speed when ever the vehicle makes a turn.

→ When the vehicle takes a turn, the outer wheel travel a longer radious than the inner wheel i.e there is a relative movement between the ~~two~~ Rear wheels.

→ All these facilite are provided by the differential so that the vehicle can make a turn on a curve surface ~~on the~~ on Road.

Electrical system

→ The electrical system is provided on a vehicle such as battery, starting system, ignition system, charging ckt, Lighting ckt, horn ckt, wiper ckt

and other necessary ckt.

Radiator

A device to recool the hot engine cooling water for recirculation purpose.
→ The radiator is connected by Rubber ~~hoses~~ hoses to the engine, to allow the cooling system water to circulate between them.
→ Other part of the cooling system are Fan, Fan belt drive, water circulating pump.

(3) Body

Body of a vehicle is meant to carry the load or passenger or people.

2nd chapter Date 10.1.2017

AUTOMOTIVE ENGINEERS

Engine → An engine is a device which transform one form of energy in to another form of energy.
→ This engine is classified on two types basing upon the combustion of fuel to Produce power i.e
(1) External combustion engine
(2) Internal " "

External combustion engine → If the combustion of the fuel takesplace outside the engine cylinder then it is called external combustion engine.
→ Example → steam engine, or steam turbine. Floos cycle gas turbine.

Internal combustion engine

If the combustion of the fuel takesplace inside the engine cylinder then it is called internal combustion engine.
→ Example → petrol and diesel

Advantages of S.I engine over C.I engine

(i) → Corrected mechanical simplicity
(ii) → Weight to power ratio is Low
(iii) → Lower initial cost.
(iv) → Efficiency is high.
(v) → Easy starting from cold condition.
(vi) →

Automotive engines

The automotive reciprocating piston engine may be a 4-stroke engine or 2-stroke engine.

→ In a 4-stroke engine the cycle of operation is completed in 4-stroke of the piston.

→ In a 2-stroke engine the cycle is completed in 2-stroke of the piston.

→ There are 4-stages occurs for the compliation of the 2-stroke and 4-stroke. The stages are

(1) suction stage
(2) compression "
(3) Expansion "
(4) Exhaust "

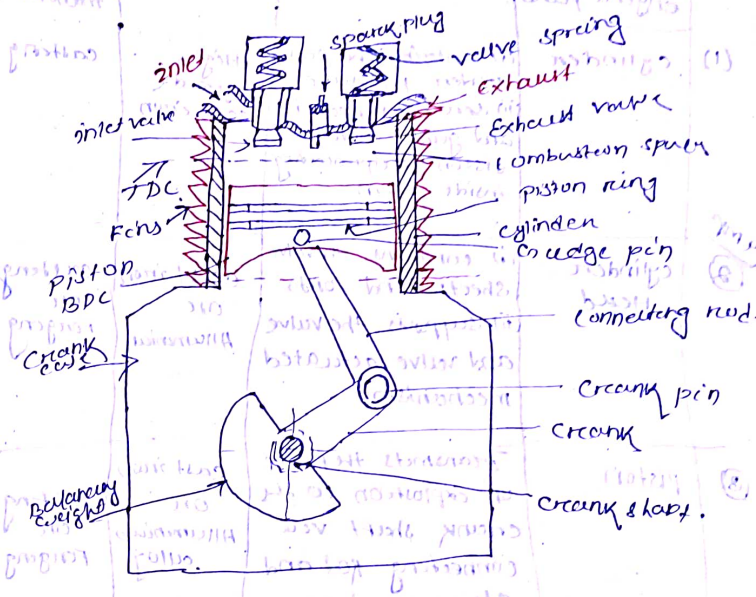
→ Stroke is the movement of the piston from one end (Dead centre) to other end (Dead centre)

→ Piston also moves up and down within the cylinder.

→ The extreme up ward position of the piston cylinder is known as Top dead centre and extreme Lower position is known as Bottom dead centre.

Date- 11.01.2017

Main components or parts of an I.C engine



The petrol and diesel engine are the reciprocating internal combustion engine comprising many parts both small and big, stationary and moving, metallic and non metallic, cast and forge.

→ The engine gets form when the different components of various shape and size are assembled together.

Different components and their function.

	Name of the engine parts	Function	Material	method of manufacturing
(1)	cylinder	(i) contains the gas under pressure. (ii) serve as bearings and guides for the piston reciprocating inside them.	High grade cast iron	casting.
(2)	cylinder Head	(i) contains the valve sheets and ports (ii) supports the valve and valve actuated mechanism.	cast iron or Aluminium	casting or Forgeng
(3)	piston	Transmits the force of explosion to the crank shaft via connecting Rod and its bearing. → Form a seal so that high pressure gases in the combustion chamber do not escape to the crank case.	cast iron or Aluminium alloy	casting or Forgeng.
(4)	piston Rings	→ Maintain and create seal against combustion gasses leaking past the piston into the crank case. → provide a means to transmit surplus heat from the piston to cylinder wall and hence to the cooling media. → Strip some of the Lubricating oil from the cylinder wall and return that to the crank case.	cast iron	casting
(5)	Gudgeon pin	Supports and allow the connecting Rod to swivel.	Hardened steel	Foregging
(6)	connecting Rod	→ Transmit the piston load to the crank. → convert the reciprocating motion of piston into Rotary motion of crank shaft.	Alloy steel	Foregging
(7)	crank shaft	→ converted the reciprocating motion of the piston into rotary motion by connecting Rod and crank mechanism.	High tensile Forgeng or special cast iron	Forgeng

(8) Main bearings	→ Reduce friction and allow the parts to move easily.	steel or bronze	Casting
(9) Cam shaft	Operate the intake and exhaust valve through cams, cam Follwers, push Rods, and rocker arm		
(10) Intake valve	Admit Air Fuel mixture into the engine cylinder.	silicon chrome steel	Forging
(11) exhaust valve	Discharge the combustion products after expansion to the atmosphere	Austenate steel	Forging
(12) crank case	Supports the engine block. → withstand the load. → Protects the engine parts against dust and splashing mud. → Serve as an oil pump.	Grey cast iron or Alluminium alloy	Casting
(13) Flywheel	→ Reduce cyclic variation of speed and ensure uniform rotation of crank shaft.	steel or cast iron	casting

Date-16.01.2017

Classification of I.C engine on Different Basis

→ The internal combustion engine may be classified in many ways but the following are the most important classification of I.C engine.

(a) According to the type of Fuel used
- (1) Petrol engine
- (2) Diesel engine
- (3) Gaseous engine (CNG) or (LPG)

(b) According to the method of ignition system
- (1) Spark Ignition
- (2) Compression Ignition
- (3) Hot spot Ignition

(c) According to number of stroke
- (1) Two-stroke
- (2) Four-stroke

(d) According to cycle of operation
- (1) Otto cycle (constant volume cycle)
- (2) Diesel cycle (constant pressure cycle)
- (3) Dual cycle

(e) According to speed of engine

(1) High speed engine.
(2) Medium speed "
(3) Low speed "

(f) According to cooling system

(1) Air cooling engine
(2) Water " "
(3) Evaporative cooling engine

(g) According to method of fuel injection

(1) Carburettor engine
(2) Air injection engine
(3) Air less or solid injection engine

(h) According number of cylinder

(1) Single cylinder engine
(2) Multi cylinder "

(i) According to the arrangement of cylinder

(1) vertical engine
(2) Horizontal engine
(3) Radial engine
(4) Inclined engine
(5) V-type multicylinder
(6) opposite cylinder
(7) opposite piston engine

(j) According to valve mechanism

(1) Overhead valve engine
(2) Quantitatively governed engine
(3) Qualitatively governed engine

Manufacturers specification of Automobiles

The following specifications are mention by the manufacturer for an automobile

(1) Type — car, bus, truck, motorcycle etc.

(2) Capacity — 5 tonn, 3 ton, 1 ton, $\frac{1}{2}$ ton, 4 seaters 6 seaters, 30 seaters 45 seater

(3) Make → TATA, Lyland, Honda, Hero, suzuki.

(4) Drive → Left hand drive, Right hand drive, Single wheel drive, Two wheel drive, 4 wheel drive, 6 wheel drive.

(5) Model → Year of manufacturer or code number.

Chapter- 2

Date 17.01.17

Transmission system

Clutch → The clutch is located between the engine and transmission system.

(ii) → It provides a smooth engagement and dis engagement between the engine and the transmission system.

(iii) → If the clutch engage or dis-engage with heavy load or less load then the revolution of engine may be stop. Therefore it is necessary to gradually connect the power.

(iv) → When the clutch is engaged, it transmit power of the engine to the transmission system generally through the use of Friction.

(v) → When the clutch is disengaged the power is not transmited from the engine to the transmission system.

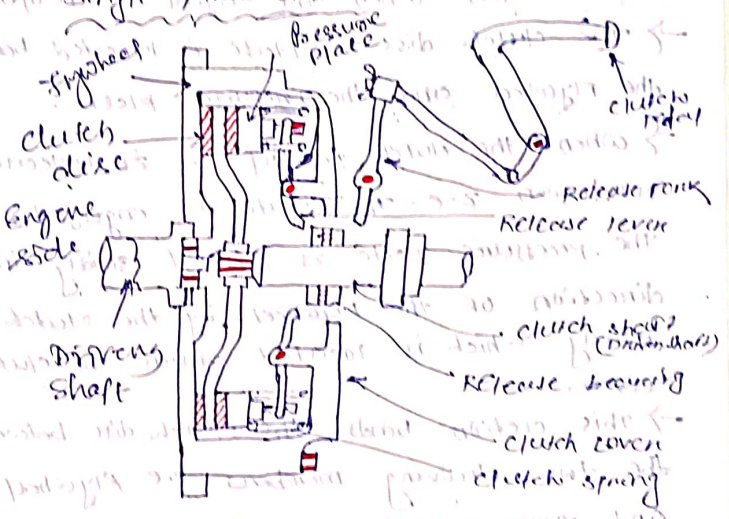
(vi) → The clutch is disengaged when starting the engine, changing the gear, stoping the engine and idling the engine.

(vii) → The clutch is engaged only when the vehicle is to move and is kept engage when the vehicle is moving.

Types of clutch

- clutch
  - → positive clutch
  - → Friction clutch
    - → cone clutch
    - → disc plate clutch → single plate clutch / multi plate clutch
    - → centrifugal clutch
    - → semicentrifugal clutch

Single plate clutch



when clutch is engaged

→ The main component of the clutch

(1) Flywheel
(2) Pressure plate
(3) Clutch ~~plate~~ pedal
(4) Cover plate
(5) Friction lining
(6) Clutch shaft
(7) Spring
(8) bearings

Date - 19.01.17

→ The Flywheel is connected to the engines crankshaft. The pressure plate is assembled to the Flywheel through clutch spring. The Flywheel and pressure plate will rotate in unction when the engine is in operation.

→ The clutch disc or plate is located between the Flywheel and the pressure plate.

→ when the clutch pedal is in released condition i.e The clutch is engaged, The pressure plate is pushed solidly in the direction of the Flywheel by the clutch spring which is located inside the clutch cover.

→ This action binds the clutch disc between the two driving members i.e Flywheel and Pressure plate.

→ These 3 component will rotated as one when in this condition that allow the rotation of the engine to be transfer to the transmission system.

→ when the driver dipresses the clutch pedal that is to disengage the clutch, the motion of the pedal is transfer using either hydraulic pressure or a cable to the release of the fork.

→ The release fork then moves the release bearing as a result the springs are compressed.

→ Thus the pressure plate is ~~pushed~~ pulled outwards in a motion which is pivoted at the spring to the clutch covered connection point.

→ This action disengages the clutch disc from the Flywheel and the Pressure plate, and the transfer of engine power to the transmission system is cut off.

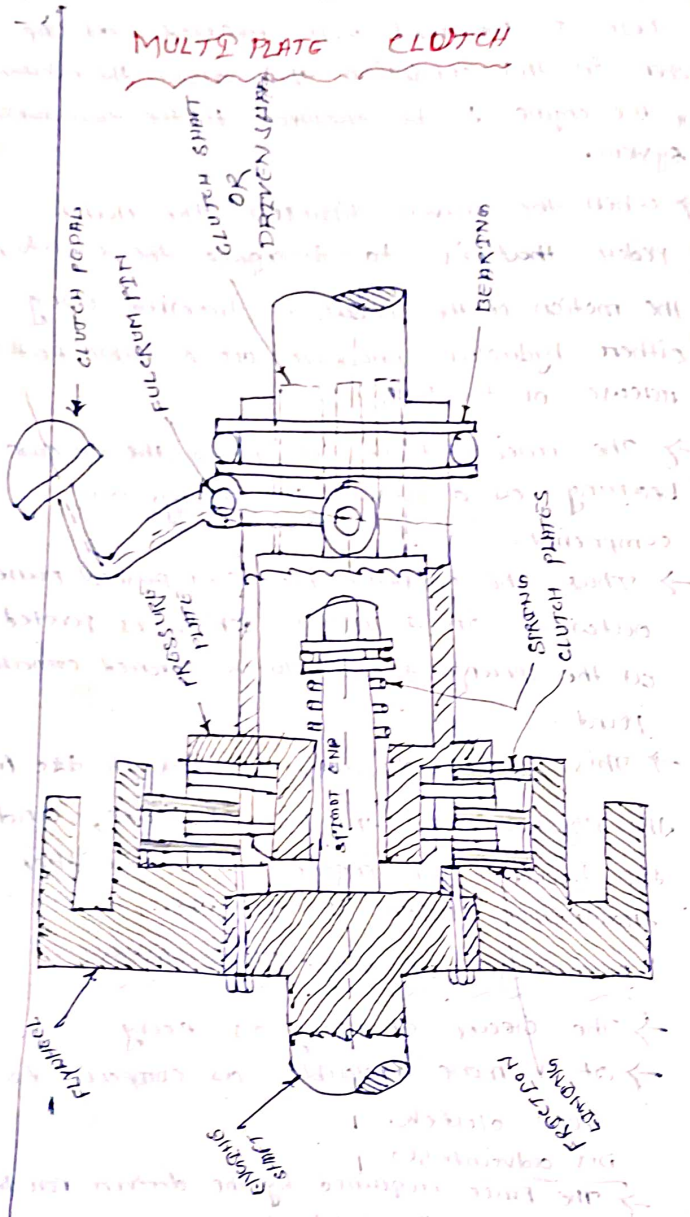
Advantages of single plate clutch

→ The gear changing is easy.
→ It is more reliable as compair to Cone clutch.

Dis advantages

→ The Force required by the driver for dis-engaging the clutch is more.

MULTI PLATE CLUTCH



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→ Main parts of multiplate clutch

(1) Driving member (Engine shaft & clutch)
(2) Driven member
(3) Bearing
(4) Clutch plate (multiple)
(5) Pressure plate
(6) Nut
(7) Spring
(8) Frictional lining
(9) Lock

Working

→ A multiplate clutch consist of more than one clutch plate. The number of clutch plates are increased so that the Frictional surface also increased. This results in increased capacity of torque transmission in comparison to single plate clutch.

→ In case of multiplate clutch the plates are alternately fitted to the pressure plate and Flywheel.

→ They are firmly pressed by the strongs coils steo springs and assembly in a drum type casing.

→ The teeth of the alternate plate slides in grooves on the Flywheel and other slides on splines on the pressure plate.

→ A multiplate clutch works on the same principle as that of a single plate clutch.

→ It may be noted that while the flywheel is rotating, the pressure plate also rotated and press against the friction plate.

→ This forcess the clutch plate to rotate which in ~~turquetwo~~ rotate the clutch shaft.

→ When the clutch pedal is pressed, the flywheel continue to rotate but the clutch plates are released.

→ This heppens because they are not fully pressed by the pressure plate. Thus the clutch shaft also stop rotating.

Advantages of multiplate clutch

→ The number of friction surfaces increase the capacity of the clutch to transmit torque. Though the size remains fixed.

→ Thus it may be notated that the overall diameter of multiplate clutch is reduced in comparission to single plate clutch considering the same torque transmission.

→ It is generally used in motor cycles, scooters, where there is limitation of space.

→ It is also used in heavy comercial vehicles and racing cars since it can transmit high torque.

Gear box

→ The engine which is the only sources of motive force in a vehicle must be able to co-operate with a vast range of operating condition from start up to high speed.

→ The transmission system plays an important role in ensuring this.

The transmission is actually a set of gears which is used to transfer the powere developed in the engine to the driving wheel according to the requirements.

→ The gear box is the speed or torque changing device present between the engine and driving wheel. It generally it is suituated between the clutch and propeller shaft.

Date- 21.01.2017

Purpose of gear box

(i) → It exchange engine power for a greater torque and thus it provides a mechanical advantages to drive the vehicle under different condition.

(ii) → It exchange forward motion to reverse motion.

(iii) → It provides a natural position to disallow to move the vehicle.

(iv) → when a vehicle is running various resistance oppose it. In order to keep the vehicle at uniform speed at various condition gear box is provided.

(v) → When the vehicle is started, ~~1st~~ Four acceleration is needed to gain speed quickly. this can be based achieved in 1st gear because in this gear the tractive effort available is maximum.

(vi) → It may be noted that when the vehicle has reached the necessary speed the driver may shift in to higher gears because the vehicle speed has to be simply maintained and no acceleration is required. This results in maximum fuel efficiency.

Resistance that oppose movement of vehicle

→ Air or wind resistance
→ Gradient Resistance
→ Rolling resistance (Frictional Resistance)

Types of gear

(1) Spur gear
(2) Helical gear
(3) Worm gear
(4) Bevel gear
(5) Rack and pinion gear
(6) Herringbone gear
(7) Planetary gear (Epicyclic gear)

① Spur gear

These gear have teeth parallel to axis of wheel.

(2) Helical gear

It is similar to spur gear but the teeth are inclined to the axis of the wheel so that the helical gears have more teeth contact in the same area.

→ The helical gear produces axial thrust on the shaft.

② Herringbone gear box

The double helical gears are known as herringbone gears.

→ The advantages of herringbone gears is that it helps to avoid issues related to side thrust created with the use of helical gears.

(4) Bevel gear

→ The bevel gears are used mostly in applications that require power to be transmitted at right angles

⑤ Worm gear

The worm gears are used to transmit power at 90° and where high reductions are required.

⑥ Rack and pinion gear

A rack and pinion gear is basically used to transmit power and motion in a linear movement.

⑦ Planetary gear

The planetary gear consist of one or more outer gears revolving about a central gear.

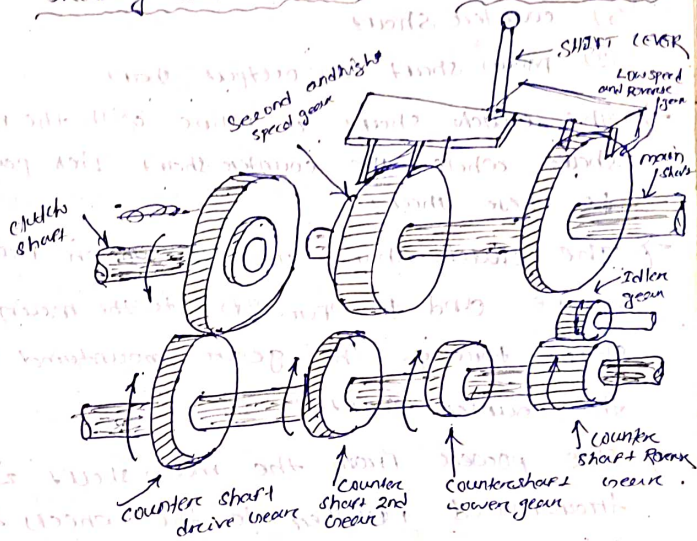
Types of gear box

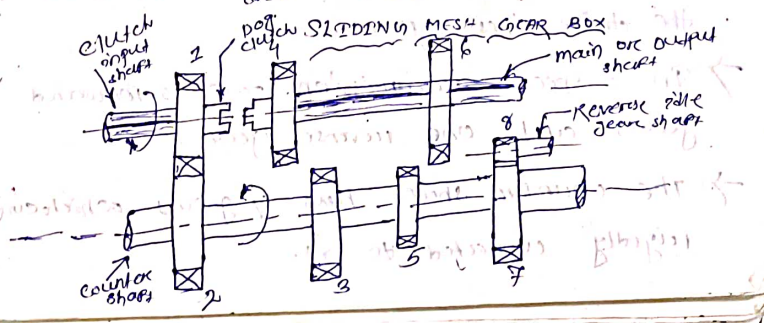
① selective type
(2) Progressive type
(3) planetary type

① selective type

- Sliding mesh gear box
- Constant " "
- Synchronous " "

Sliding mesh gear box Date - 23.01.2014





This type of transmission is the simplest type of transmission out of the available transmission system.

→ In this type of transmission system gears are changed by sliding one gear on the other.

→ This gear box consist of 3 shafts i.e

① clutch shaft or input shaft

② counter shaft

③ Main shaft or output shaft

→ The clutch shaft is inline with the main shaft while the counter shaft lies parallel to these shaft.

→ The clutch shaft receives power from the engine and transfer it to the main shaft through the gears mounted on the counter shaft.

→ The power from the main shaft is transmitted further to the wheels through the drive lines system.

→ In 3 speed transmission i.e 3 forward gears and one reverse gear.

→ The counter shaft has 4 gears whereas rigidly connected to it.

→ The clutch shaft has one gear and main shafts has two gears.

→ The two gears on main shaft can slide in the horizontal direction along the splines of the main shaft.

→ The gear on the counter shaft can not slide.

→ The clutch gear is rigidly fixed to the clutch shaft. It is always connected to the counter shaft drive gear.

→ The two gears on the main shafts can be slide by the shifter yoke by operating the shift lever.

→ A Reverse idler gear is mounted on the counter shaft and it's always mesh with reverse gear on counter shaft. It is meant for the reverse movement of the vehicle.

WORKING

→ The working of this type of transmission is explained step by step as follows.

Neutral position

→ Fig. 24.9 shows sliding mesh gear box in neutral position.

→ In this position, the engine is in running condition, clutch remains engaged and clutch gear drives the countershaft drive gear.

→ The direction of rotation of countershaft is opposite to that of clutch shaft.

→ In this position all other gears and reverse gears are free. The main shaft of the transmission

does not rotate and thus drives the rear wheels. Therefore, the vehicle remains stationary.

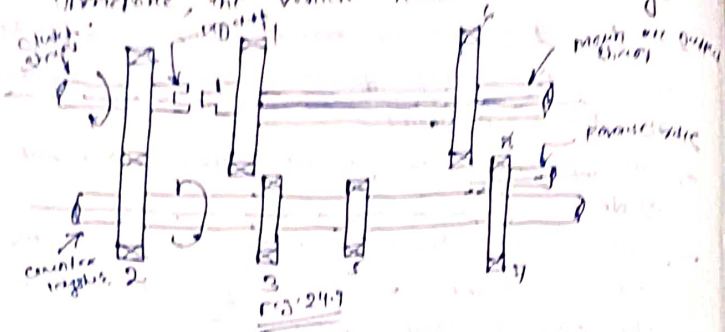
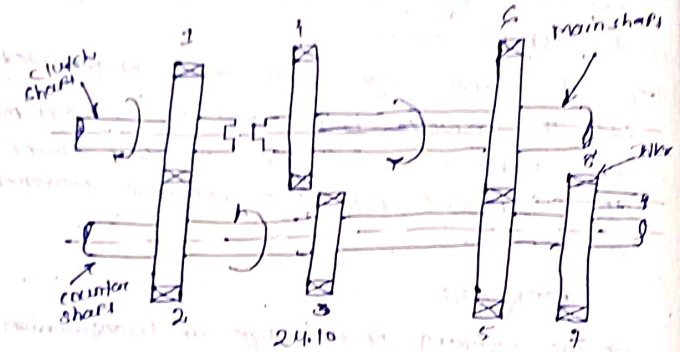


Fig 24.9

② First gear



24.10

→ When the first gear position is selected by the shift lever, first gear on the main shaft slides and is connected to the first gear on the counter shaft as shown in fig 24.10.

→ The direction of rotation of main shaft is same as that of the clutch shaft.

→ In the first gear, a small gear of countershaft meshes with larger on the main shaft and

Speed reduction in the ratio 3:1 (approximately) is obtained.

→ Further, a gear reduction in the differential takes place, which produces a higher speed reduction of approximately 12:1, between the engine crankshaft and the wheel.

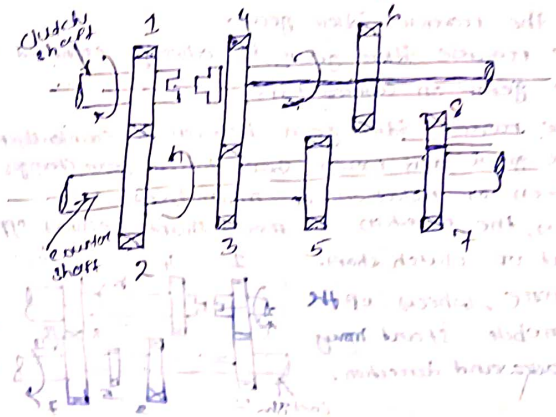
③ Second gear

When second gear is selected by the shift lever, second gear on countershaft meshes with second gear (i.e smaller gear) on the main shaft as shown in fig 24.11.

→ The direction of main shaft is same as that of clutch shaft.

→ The speed reduction of the order of 2:1 is obtained in second gear.

→ Further a gear reduction in the differential takes place, which produces a higher speed reduction of approximately 8:1, between the engine crankshaft and the wheels.



(2) Third Gear

In this gear the main shaft is slided axially towards the clutch shaft so that main shaft is directly connected to the clutch shaft as shown Fig 24.12.

→ In this position, the main shaft rotates at the speed of clutch shaft.

→ Thus, a speed ratio of 1:1 is obtained. The differential reduction produces a gear ratio of about 4:1 between the engine crankshaft and the wheels.

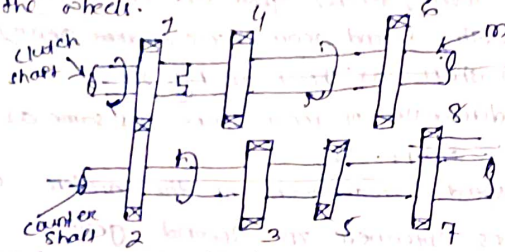


Fig 24.12

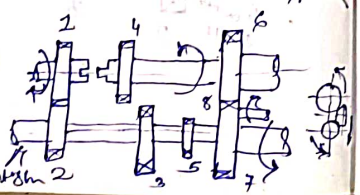
(3) Reverse gear

When the shaft lever is operated to engage the reverse gear, the largest gear of the main shaft meshes with the reverse idler gear.

→ The reverse idler gear is always connected to reverse gear on countershaft.

→ The reverse idler gear between the countershaft reverse gear and main shaft largest gear changes the direction of rotation of main shaft.

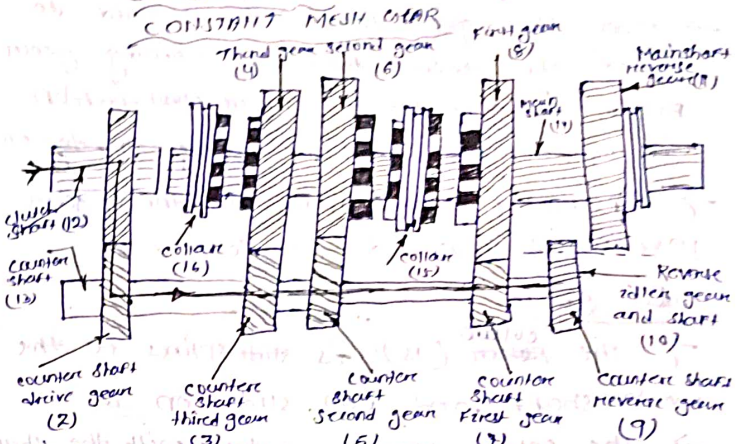
→ Thus, the direction of main shaft becomes opposite to that of clutch shaft. Therefore, wheels of the automobile start moving in backward direction.



Date 24.07.2017

~~SLIDING MESH~~

CONSTANT MESH GEAR



→ In constant mesh transmission the drive and driven gear combination for each speed with the exception for the reverse gear.

→ All the gears are engaged constantly with each other. When the gear shift lever is in the neutral position, all gear combinations are in mesh and turning.

→ However no power is transmitted in this condition as one of each gear combination are free wheeling on their shafts.

→ The main shaft is splined shaft, and the gears provided on the main shaft are free.

→ The gears on the counter shaft are fixed.

→ The dog clutches are provided between the gears on the main shaft.

→ The dog clutch can slide on the main

shaft and rotate with it.

→ When the gear shift lever is used to select the gear the free wheeling gear from the appropriate gear combination is locked on the shaft using the dog clutch.

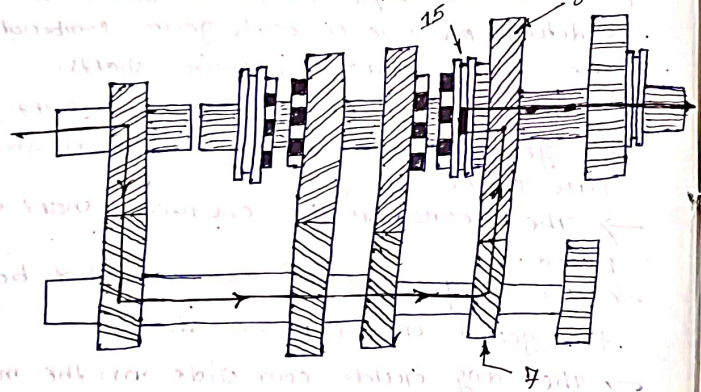
→ The power transmission in the 1st gear position is discussed as follows.

1st gear.

→ The collar (15) is splines to the main shaft and can slide on it.

→ The collar revolves with the shaft. It is locked to gear (8) by means of a dog clutch.

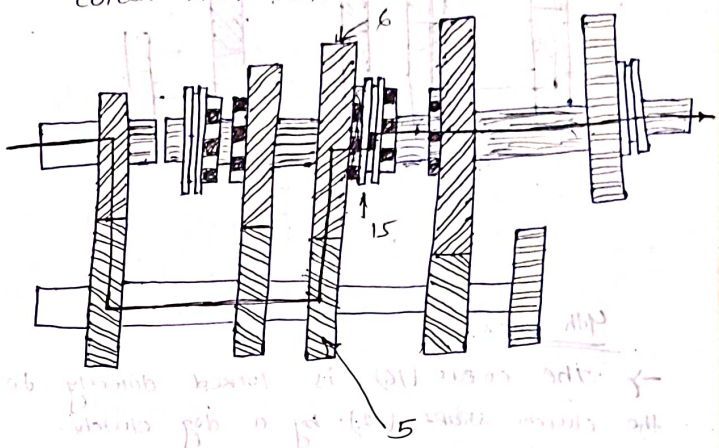
→ The power is transmitted from gear (7) to gear (8) and then to collar (15). The collar then rotates the main shaft and the motion is transmitted.



2nd gear

The collar (15) slides in opposite direction along the main shaft. This collar is locked to gear (6) by means of dog clutch.

→ The power is transmitted from gear (5) to gear (6) and then to collar (15). The collar then rotates the main shaft.



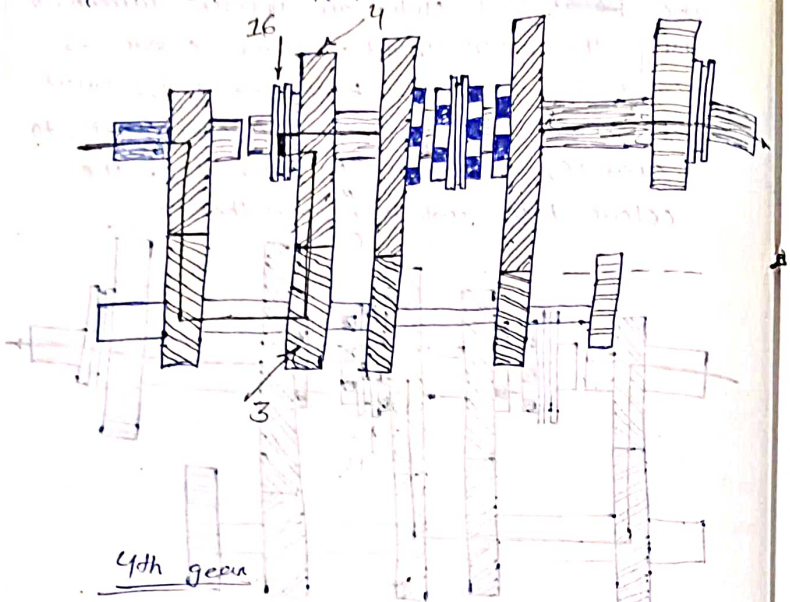
Second gear position in constant mesh transmission

3rd gear

→ The collar (16) is splines to the main shaft and can slide along it.

→ This collar revolves with the shaft. It is locked to gear (4) by means of dog clutch. The power is transmitted from gear (3) to gear (4) and then to collar (16).

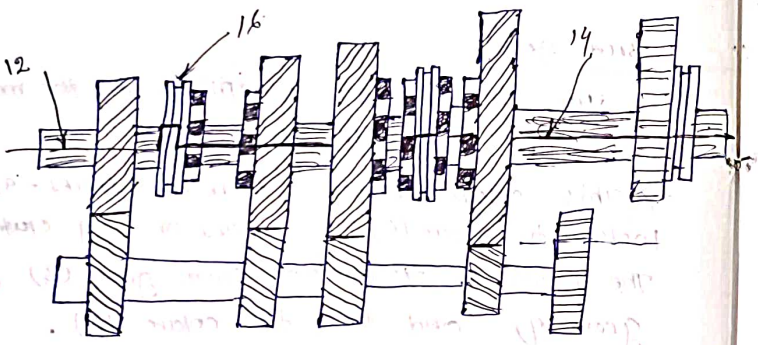
→ The colour rotate the main shaft.



4th gear

→ The colour (16) is locked directly to the clutch shaft (12). by a dog clutch.

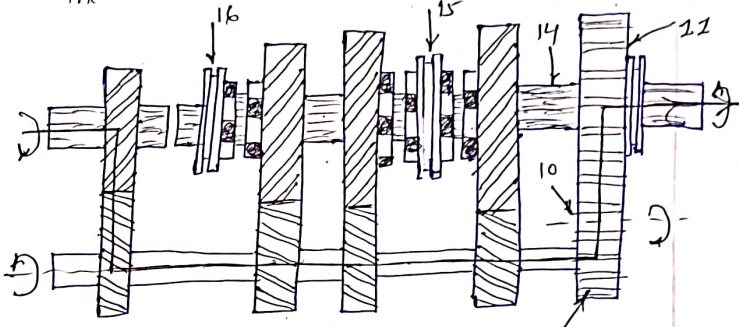
→ The power is transmited from the cluter to the main shaft directly.



Reverse gear

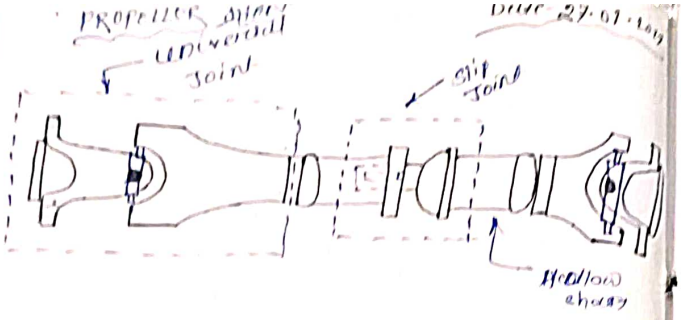
→ In this case colour (15) and (16) are in dis-engesed position. The gear (11) can slide along main shaft (14).

→ The gear (10) is the Reverse gear the power is transmited from gear wheel (9) to gear wheel (11) through the reverse gear (10). due to this the main shaft Rotate in the oposite direction thus the vehicle moves in the reverse direction.



Reverse gear position in constant mesh transmision

Date 27.07.2019



→ The propeller shaft is the shaft by means of which drive is given to the driving axle.

→ The propeller shaft is also known as long drive shaft by means of which the power from the transmission system is transmitted to the driving axle at rear (Front engine, Rear drive vehicles) at various lengths and various angles.

→ It may be noted that since shaft has to with stand many torsional loads. It is usually made of Tubular cross section.

→ The shafts are made of steel, Aluminium or composite materials.

→ The propeller shaft transmit power from gear box to the differential at various lengths and angle.

→ According to the shaft's configuration the shaft may be one piece or two piece.

→ The shafts are jointed to the gearbox and differential by universal joint.

→ There is a presence of slip joint which is used to allow constantly changing distance between the gear box and differential.

Universal joint

→ The universal joint is the joint which enables the drive shaft to transmit power at various angle.

→ The transmission is connected to one end of the propeller shaft by means of universal joints.

→ The differential is connected to the other end of the propeller shaft by means of another universal joint.

→ The universal joints are required because the rear end of the propeller shaft is constantly raising and falling due to the up and down flexing of the rear springs.

→ This joint also allow for the rear axle assembly to twist due to the drive and break torque application.

Types of universal joint

(a) variable velocity joint

- Cross spider
- Ring type
- Ball and trunion type

(b) constant velocity joint

- Rzappa joint
- Tripod joint

Slip joint

One slip joint in each shaft is necessary to allow constantly changing distance between the gear box and differential.

→ It is happens due to flexing of saeke due to Rough and irregularity of road.

→ It facilitated add'd changing of propeller shaft.

→ The sliping joint is carried out due to splinging arrangement.

→ A universal joint is attached one end of the shaft and the other end is splined which is meshed with another splined shaft to make a slip joint and the other end of the shaft has an universal joint.

DRIVE AXLE

It is the axle through which drive goes to the wheel.

→ It is also known as live axle.

purpose

→ It acts as the axis of the wheel.

→ It transmit power to the wheel.

→ It support the weight of the Body.

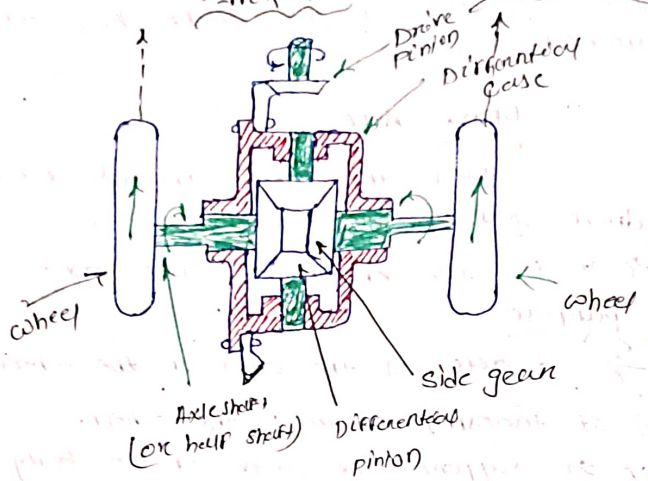
Classification

(1) Front drive axle

(2) Rear drive axle.

DIFFERNTIAL

Date - 29.01.2014



→ It is the mechanism which consist of a system of gear arrangement in such a way that connects the propellen shaft with the rear axle.

→ It facilited the outer wheel runs faster than the inner wheel while taking a turn on a curved road.

TYPES OF DIFFERNTIAL

1. conventional Type
2. Power lock or non sleeve type or Limited sleeve.
3. viscous type differential

main parts of differential

1. Driver pinion / Tell pinion
2. Crown wheel / Ring ~~wheel~~ gear
3. Cage
4. planet gear
5. Sun gear
6. Bearing
7. Drive
8. Pin

construction

→ consist of a cage which contains the differential gears i.e Sun and planet gears. (Sun gear - 2, planet gear = 4)

→ All gears are bevel type of gear.

→ The planet gears are fitted on a pin of these are two in number and of planets gear are 4 in number then these are fitted on a spider.

→ The planet gears are free to move around their axis.

→ The pin or spider is held in between the two part of the cage which encase the differential gears.

→ The sun gears and planets gear are always in mesh with each other, the sun gears are free to rotate inside the cage.

→ The differential assembly is supported on tapper roller bearing. which is provided on both side of the cage.

→ The cage is attach to the ring gear an crown wheel which forms part of the final drive.

→ The sun gears are located parallel to Ring gears inside the cage and face towards each other and shaft to each wheel is spline in to the sun gear of that side.

→ Drive is given to the ring gear by means of tell pinion to which propeller shaft is attach.

Working

→ when the vehicle is moving on straight level Road and the resistance affecting both the driving wheel is same then there is no relative movement among the differential gears.

→ so the whole arrangement mesh together and moves as one unit.

→ Therefore the shaft in the driving wheel Rotated at the same speed.

→ when the front wheel are turn to any direction to take a turn a binding Force acts on the inner wheel.

→ The sun gear of that side is held slow on relation to the movement of the complete crown wheel.

→ when the vehicle is going straight on a level road the power is divided equally at the differential i.e $\frac{1}{2}$ one half Flowing to one side of the wheel and other half to anthor side.

→ while taking a turn the binding Force acts on the inner side sun gear and its speed. slows down as a result of loss on the innerside and gain on the outer side so higher speed of the outer side which Rotate the differential assembly.

→ This results in a Faster movement of the outer wheel.

3rd chapter BRAKING SYSTEM Date- 2.02.17

→ Brake is a mechanical device which is used to increase the Frictional resistance for the purpose of control or stops the motion of the vehicle.

→ When the brakes are apply to a moving vehicle the kinetic energy of the vehicle is transform into to heat generated by the Friction.

→ The heat generated is dissipated to the Surrounding air.

Function of brake

It stops the moving vehicle in the minimum possible time.

→ It helps in controlling the speed of the vehicle and to reduce the speed at turning and other crowded places.

→ It holds the vehicle in stationary position without the presence of the operator after it has been brought to stop.

Requirements of for good Braking system

(i) → The brake must be strong enough to stop the vehicle within shortest possible distance and time.

(ii) → The brakes must act instantaniously during emergency breaking.

(iii) → The brakes should not cause the vehicle to skid or pull to one side.

(iv) → The brake should have good antifed characteristic i.e there effectiveness should not loose due to repeated hard stop.

(v) → The brake must operated with the minimum effort by the driver.

(vi) → The brake should not be effected by water, heat, road grid, or dust etc.

(vii) → The brake should work equally good in all weather.

(viii) → The brake should have less wearing parts and Required little maintenance.

Breaking principle

(i) → when brakes apply in a running vehicle the kinetic energy converted to heat energy which is generated by the friction between the brake lining and the drum, which helps further stoping vehicle.

Classification of Brake

→ The Automobiles brakes are mainly classified as follows

(A) According to purpose of the brake

1. Service or Foot brake
2. Hand brake or parking brake

(B) According to construction of brake

1. Drum brake / internal expanding brake
2. Disk brake

(C) According to method of operation

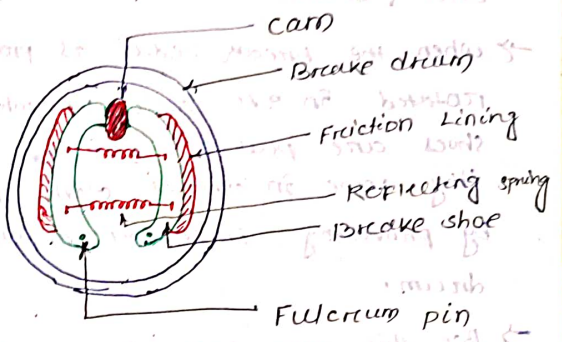
1. Mechanical brake
2. Hydraulic brake
3. Vacuum brake
4. Air brake
5. Electric brake

Brake line material

The brake shoes are made up of Aluminium metal, steel alloy with Frictional Lining or brake Lining

Frictional lining
NAO - Non asbestos organic → Aramids Fibres made up

DRUM BRAKE



→ The internal expanding drum brake contains two brake shoe, spring, and one cam.
→ It is fixed to the axle or Flanges.
→ Brake shoe are made up of aluminium metal and steel alloy with Frictional Lining or brake lining.
→ In two-wheeler brake lining is pasted to the brake shoes but in LCV, MCV, HCV the brake lining are rivited in the brake shoe.

→ The breake shoes cure mounted on the breake plate by means of fulcrum pin.

→ The breake shoes cure held together by means of rectracting spring against the cam.

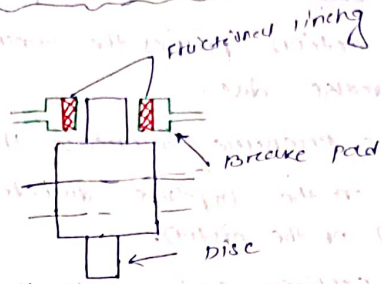
→ When breeak pedael is not operated the breeak shoes i.e the friction lining does not come in contact with the breeak drum.

→ when the break pedal is pressed cam rotated in its axis by which the breeak shoes cure pushed outwards by which they come in contact with the drum by providing frictional resistance to the drum.

→ By this way breeaking action takes place.

→ As soon as the effort is removed from the breeak pedal the breeak shoes return to their original position by the spring force. and also rotating the cam in opposite direction.

DISC BRAKE



(i) → In a disc breake system breaking is perform by pressing breake pads against a disc which is rotating with the wheel.

(ii) → A disc breake consist of a breake disc, breake calliper and two breake pads.

(iii) → The breake disc is made from cast iron and is bolted to the wheel hub and rotates with the wheel.

(iv) → The calliper is suspented over the disc.

(v) → The calliper breaket is attach to the knuckle.

(vi) → A piston is attach to the calliper body and held in place by piston seal and piston boot.

(vii) → The breake pads cure placed in between the piston and disc and cure held in position by pad retainers on the calliper breaket.

(viii) → when the breake pedal is pressed, hydraulic pressure enters the calliper cylinder resulting the piston being

pushed out from the caliper body.

→ This action pushes the inner pad against the brake disc.

→ As the pressure increase the caliper body moves in the opposite direction to the motion of the piston.

→ The caliper body pulls the outerpad applying it to the brake disc.

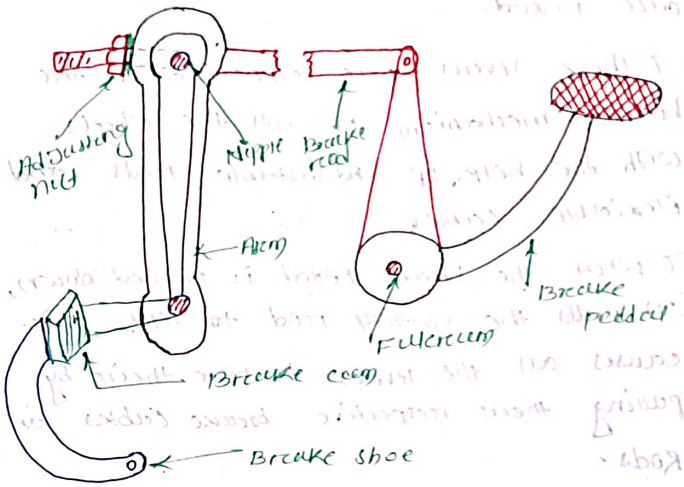
→ In this way the brake disc is sandwiched between the inner and outer brake pads and braking is perform.

→ When the brake pedal is released the hydraulic pressure that was directed to the piston is removed.

→ This terminates braking by allowing the piston to be pulled back to its original position by the elastic force in the piston seal.

MECHANICAL BRAKE

Date - 8.02.17



Mechanical Brake

→ The brake which are operated mechanically by means of levers, linkage, pedal, cams, brake rod, brake shoe, are known as mechanical brakes.

→ Now a days the mechanical brakes have limited use.

WORKING

→ The layout of the operation of mechanical brake as service brake in an internal expanding drum brake shown in Fig.

→ The breake pedal is attach to the central rod and on this rod 4 levers are fixed.

→ These levers are connected to the breake mechanism of all the wheels with the help of adjustable rods and flexicible cables.

→ When the breake pedal is pressed down, it pulls the central rod to left. this causes all the levers to move their by pulling their respective breake cables or Rods.

→ When the breake cable is pulled, it actuated the cam inside the breake drum over which the free ends of the breake shoes are resting.

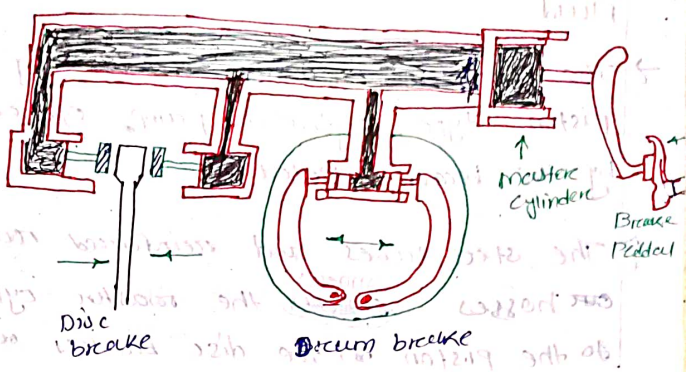
→ The operating cam expands the breake shoes outwards, against the inner surface of ~~break~~ breake drum causing it to stop its motion.

→ When the breake pedal is released the cam is operated in oposite direction and return spring brings back the breake shoe thus releasing the breakes.

AIM OF THE EXP.

To Study Hydraulic Brake.

HYDRAULIC BRAKE Date- 9.02.17



→ The breakes which are operated by means of hydrolic pressure are known as hydrolic breake.

→ This type of breake system function on the principle pascal's law.

→ The pascal's law states that when a pressure is applied to a liquid it is transmitted equally in all direction.

→ All modern automobile breake system use a hydrolic system to transmit the force from the breake pedal to the breake shoe or pad.

Construction and working

The brakes hydraulic system starts from the master cylinder which also contains reserevare for the brake fluid.

→ The master cylinder is basically a piston type hydraulic pump operated by the brake pedal.

→ The steel tubes and reinforced rubber ~~are~~ hosses connects the master cylinder to the piston in the disc brakes and wheel cylinders in the drum breake.

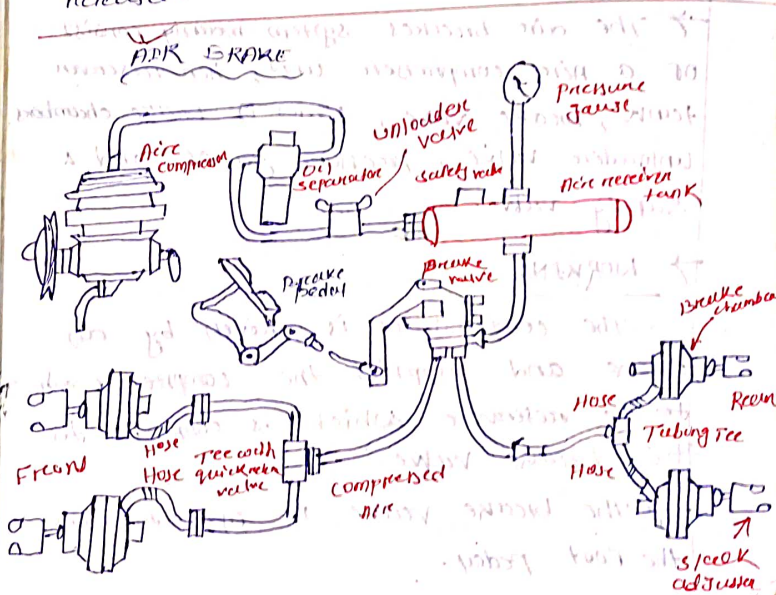
→ As the breake pedal is pushed, A push rod exerts a force on the piston in the master cylinder and the breake fluid is pumped through the tubes to the caliper or wheel cylinder piston.

→ The fluid pushes the piston to move outward which in term pushes the breake pads or shoes against the disc or drum.

→ When the breake pedal is released the master cylinder piston returns to its Origenal position due to the return spring pressure and thus the fluid Pressure in the entire system drops to origenal condition.

→ This relieves the hydraulic pressure on the caliper allowing the breake piston in the caliper assembling to slide back in to its housing and the breake pads to release the disc.

→ In case of a drum breake retracting spring pulls the breake shoe into their origenal position thus the breakes are released.



Date- 11.02.12

→ The air breakes are generally used on heavy vehicles such as buses, trucks, and highway vehicles.

→ In air breakes compressed air is used to apply the breaking force to the breake shoes.

→ The air under pressure can be easily stored and carried through lines and tubes.

→ Thus considerable force is available for breaking since operating air pressure may be as high as about 900 kpa.

→ The air breakes system mainly consist of a Air compressor unit, Air reservoir tank, breake valve, series of breake chambers, unloader valve, pressure gauge and a safety valve.

→ WORKING

The compressure is driven by an engine and supplies the compressed air to the reservoir which is connected to the breake valve.

→ The breake valve is operated by the foot pedal.

→ The breake valve is further connected to the breake chamber (diphragm unit) by a tubes.

→ The breake chambers are separate for each breake shoes.

→ When the breake pedal is pressed, the breake valve is operated and it allows the air pressure to act on the diphragm of the breake chamber.

→ The diphragm is pushed out words in the breake chamber which operates the cam and expends the breake shoes outwards there by applying the brakes.

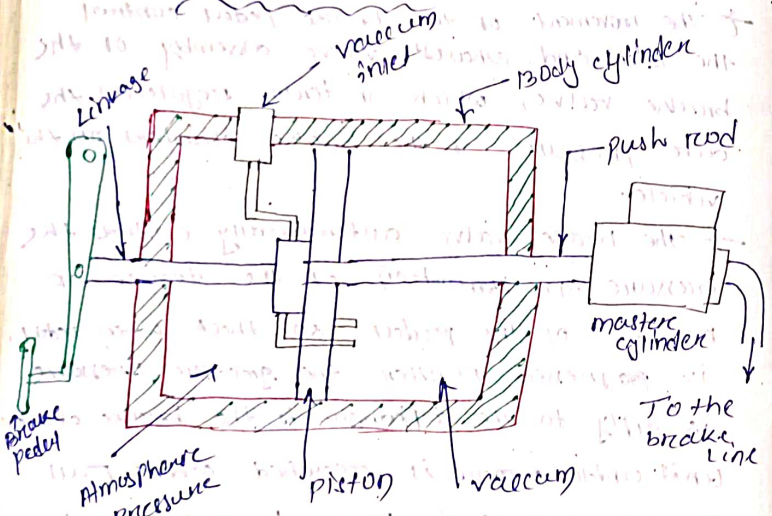
→ The movement of the breake pedal control the inlet and exhaust valve assembly of the breake valve, which in term regulates the air pressure in the breake chambers on the vehicle.

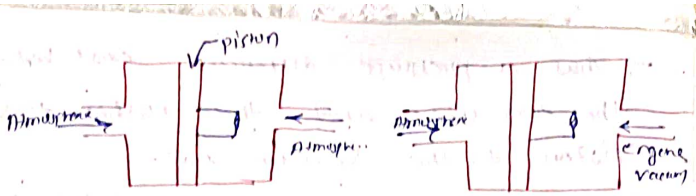
→ The breake valve automatically controls the pressure in proportion of the degree of movement of the pedal, so that when pedal is pressed Further the greater pressure is apply to the diphragm in the breake chamber until a pound is reached where Full reservoir pressure is deliver to apply the brakes

→ The

→ When the breake pedal is released it comes back with the help of return spring.
→ This results in closing of brake valve and release of pressure inside the brake chamber.
→ The brake shoe operating cam moves in reverse direction as a result of pressure released on the breake chamber.
→ The brake shoe contracts in words with the help of retracting spring hence releasing the breake drum or the braking effect.

VACUUM BRAKE





→ Vaccum breake refers to the breaking system that utilises suction, from the engine inlet manifold for the breake application, the breaking force is provided by the pressure difference that exist on the opposite side of the piston or diaphragm that operates in a cylinder.
→ The vaccum breakes are two types.
① The atmospheric suspended type
② Vaccum suspended type.

① Atmospheric suspended type

The atmospheric suspended vaccum breake consist of a piston cylinder arrangement in which the piston or the master cylinder communicate with one side of the cylinder piston whose other side is connected to the breake peddal.
→ There is a vaccum control valve that admits vaccum to one side of the cylinder piston with atmospheric pressure preventing on its side connected to the baccume pedal.

→ Thus a pressure difference exist between the two sides and that pushes the piston to the vacuum side.

→ This piston movement is communicated to the linkage mechanism that makes contact between the brake shoes and drum.

→ And the brake will operate to stop the vehicle.

AIR HYDRAULIC BRAKE

The Air hydraulic brake system uses the air power to assist the operation of conventional hydraulic brake and increase its brake efficiency.

→ The air power cylinder is in connection with the hydraulic pressure cylinder and the reservoir.

→ Generally the following criteria is adopted while designing such a system.

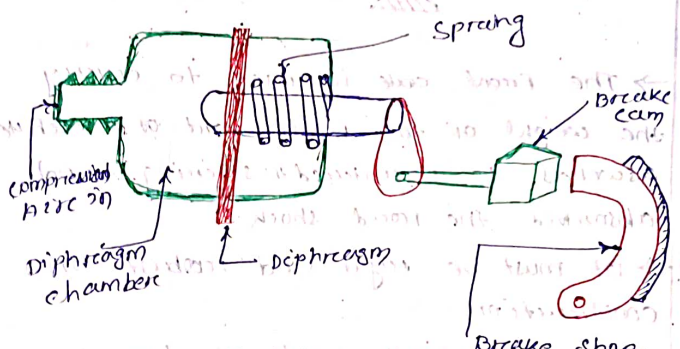
→ ① Ratio of hydraulic pressure to air pressure = 15 : 1

② The ratio of bore of power cylinder to that of master cylinder = 4 : 1

→ The flow of compressed air adopt the road ① compressor → tyre inflator → air pressure regulator → brake valve → air container.

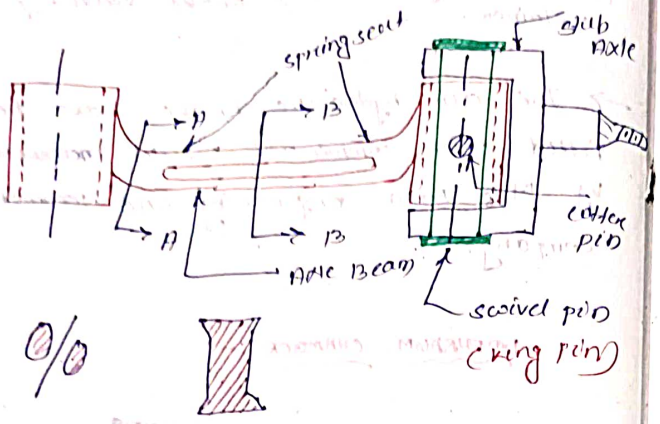
→ The air hydraulic brake have been fitted with commercial vehicles manufactured by M/S Tata engineering and locomotive company.

DIAPHRAGM CHAMBER :-



Suspension system 5th chapter

FRONT AXLE & STEARING



→ The Front axle is used to carry the weight of the Front part of the vehicle assembles to facilitated the steering and absorbed the road shock.

(ii) → It must be rigid and robust in construction.

(iii) → It is generally made of drop forged steel (0.4 carbon steel, & 1-3 % nickel).

(iv) → It is made of I-section at the centre and circular or elliptical at the both end.

(v) → The Front axle consist of ① the axle beam
② cotter pin
③ swivel pin (king pin)

④ Stub Axle

Function

→ It carry the weight of the Front part of the vehicle.

→ It carry the stub axle, king pin, steering arm by which the vehicle can be steered.

→ It support the spring and shock absorber for control drive.

→ It holds the breaking system.

→ It carry the hub and wheel.

STUB AXLE

→ The Front wheel are mounted on the stub axle.

→ Stub axles are connected to the Front axle by means of king pin.

→ The stub axles turns on the king pin which is light drive Fixed in the axle beam and locked by a cotter pin.

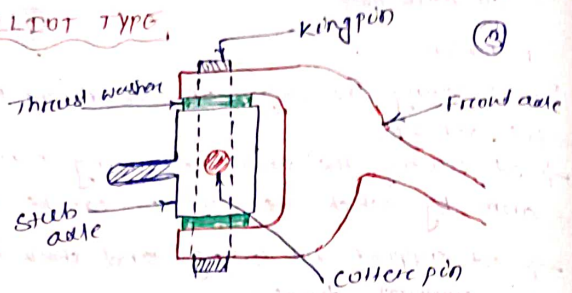
→ posphorous bronze bushes are fitted in to the forked end of the axle to provide bearing surface for king pin.

TYPES OF STUB AXLE

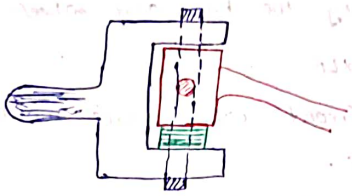
→ 4 types of stub axle

① Elliot type
② Reversed elliot type
③ Lamone type
④ Reversed Lamone type.

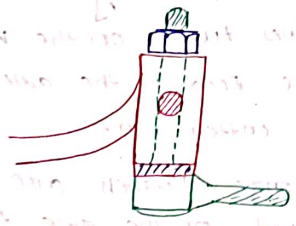
① ELLIOT TYPE



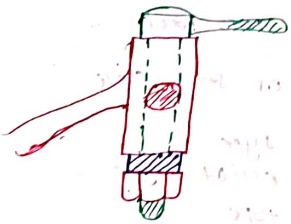
② REVERSED ELLIOT TYPE :



③ LAMONE TYPE



④ REVERSE LAMONE TYPE



Steering system

→ It is the system by means of which we provide the directional change of an automobile

→ This system converts the rotary movement of steering wheel in to angular turn of the front wheel.

Necessity of steering system

It helps to swing the wheel to left or right.

→ It turns the vehicle at a desire direction.

→ It helps to control wear and tear of the tyre.

→ It converts the rotary movement of steering wheel in to angular turn of front wheel

TYPES OF STEERING SYSTEM

① RACK WHEEL STEERING SYSTEM

② WORM MAN STEERING SYSTEM

Suspension System Date- 15.02.2017

(41)

Introduction

→ The suspension system is located between the wheels and the body of a vehicle.

→ It connects the vehicle body at the wheel and thus supports the weight of the vehicle.

→ It works together with wheels to absorbe vibrations and shocks from the road surface so as to improve driving comfort and protect the passenger from road shocks.

→ It ensures that the wheels are always firmly in contact with road surface and maintains the inclination of the body in order to improve the stability of the vehicle in any possible driving condition including acceleration, breaking, and cornering.

Basic requirement of suspension system

The following are the basic requirements of a good suspension system in automobile.

(42)

→ It should have minimum deflection compliance with the vehicle stability in order to provide good cushioning ability along with better ride quality.

→ It should have minimum wheel hop frequency. or in other words it should have minimum unsprung weight.

→ The total weight of suspension system should be minimum.

→ It should minimise side force acting.

→ It should have low initial cost, operating cost and maintainance cost.

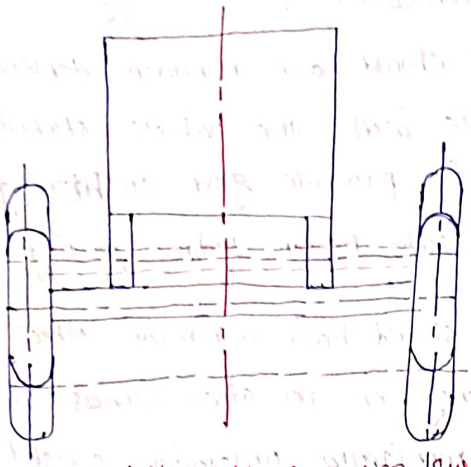
Types of suspension system

The basic suspension system consist of spring, shock absorber, stabilizer and linkage arm.

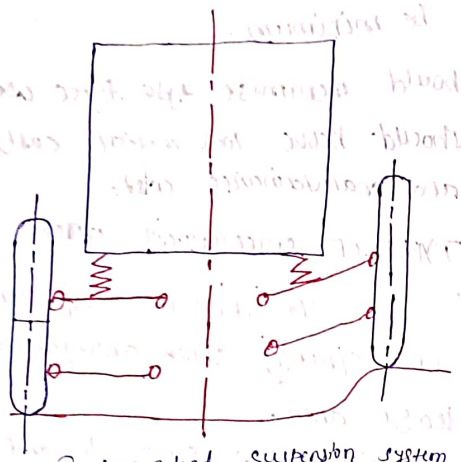
→ The suspension system are divided in two types.

① Rigid axle suspension system

② Independent suspension system.



Rigide axle suspension system



Independent suspension system

Rigid axle suspension system

In this type of suspension system the left and right wheels are connected by a single axle beam.

→ when a vehicle with rigid axle suspension system encounters road

irregularity the wheel axle left and the wheel no longer remain vertical. This causes the whole or the vehicle to tilt to one side.

→ These vehicles are those which exhibites large variation in cargo weight and passenger numbers.

→ It is mainly employed in large and medium size truck and buses.

Independent Suspension System

→ In this type of suspension system there is no axle beam connecting the left and right wheels here the load directed to the wheels is supported by the suspension arem.

→ In this system each wheels move independently in response to the road condition.

→ This type of suspension system is more complicated in terms of design, than that of rigid axle type system.

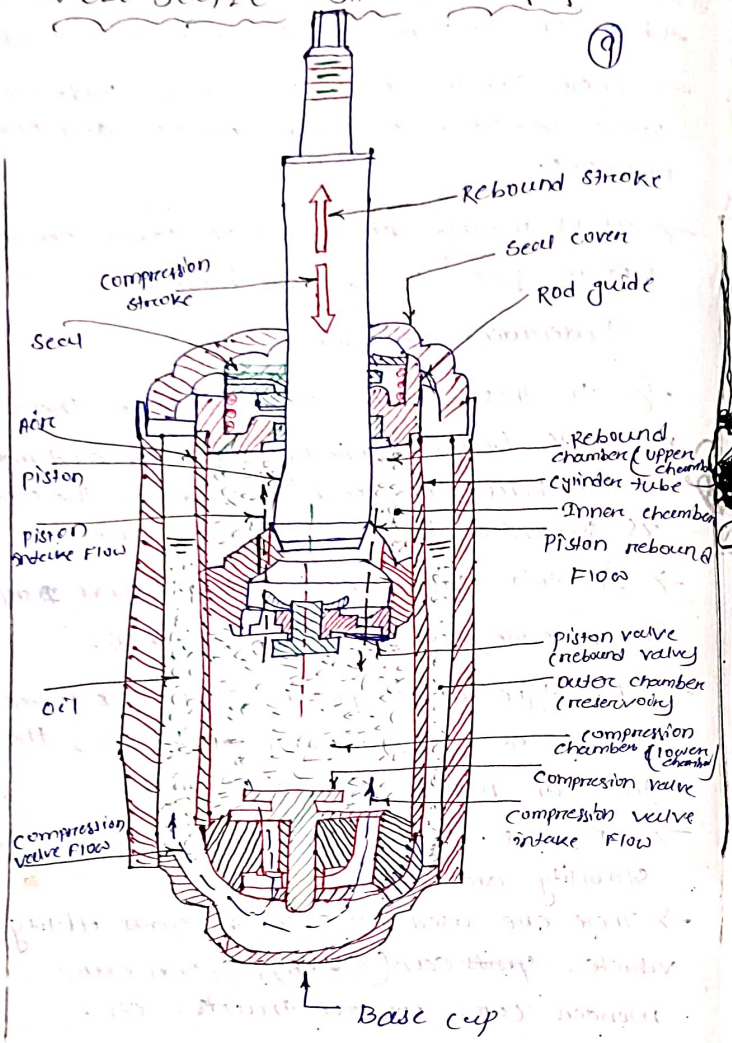
→ In this system the driving comfort and stability are better.

→ These are used in case of sports utility vehicle, sports car (SUVs), Sports car, modern car, compact trucks. etc.

Date- 16.02.2017

TELESCOPIC SHOCK ABSORBER

(9)



Date- 17.02.2017

(10)

Introduction

→ This type of shock absorber is connected between the chassis frame and the axle.

→ most of the modern passanger cars, suspension shock absorbers consist of direct double acting telescopic type hydraulic shock absorbers.

→ As the suspension system moves, the relative motion between the sprung and unsprung masses. Forces the piston and rod assembly to move or telescope, relative to the rest of the unit of shock absorber.

→ This type of shock absorber acts on both the compression i.e down ward movement of the body and rebound stroke i.e upward movement of the body.

→ construction and working

The major componend of shock absorber are

① Two chambers ← outer chamber
inner "

The outer chamber ~~sho~~ serve as a reservoir and consist of a steel tube, base

cup and one of the mounting (11) brackets.

→ The inner chamber is housed in outer chamber and acts as a cylinder.

→ The cylinder is simply drawn steel tube capable of withstanding high pressure and provides a smooth surface for the piston to seal and move.

→ The cylinder aswellas reservoir is filled with adiquate damper oil.

→ At the bottom of the cylinder, a two way valve is fitted.

→ The cylinder contains a combine piston and valve assembly which is connected to ~~the~~ a rod.

→ The combine piston and valve assembly further devides the cylinder in to two chambers. i.e upper and lower.

→ The upper chamber of the cylinder is called as rebound chamber where as the lower chamber is called compression chamber.

→ When (12) the wheel goes over a bump the piston and valve assembly is pushed in to the lower chamber of the cylinder and compressing the oil in this chamber.

→ since the oil is incompressible so it opens the valve connected with the piston and enters in to the upper chamber i.e the rebound chamber of the cylinder.

→ Some of the oil runs in to the reservoir which is almost equall to the volume of the piston rod going inside the cylinder.

→ A relatively small amount of oil also flows through the piston rod to rod guide clearance to lubricate the bearing area and seal.

→ As the shock absorber is extended during this stroke oil is drawn in to the cylinder tube, compression chamber, to account for the piston rod volume being remove along with the amount of oil which flows through the rod guide clearance.

→ This is achieved by drawing fluid through an intake valve in the compression valve assembly.

→ The air or gas in the reservoir tube expands to account for oil leaving the space between the cylinder and reservoir tube.

→ It may be noted that as the oil is forced to flow through the orifice in the piston valve it is heated.

→ This is the mechanism which allow the shock absorber to dissipate energy store by the suspension spring thus the road shock is absorber by converting kinectic energy into heat which is absorbed by the oil in the shock absorber.

TYRE

→ The tyre is fitted arround the wheel rim. It provides a cushion between the vehicle and the road. (GTA)

→ The tyre perform the following importand function.

(i) → It supports the vehicle weight.

(ii) → It transfers the traction and to stop the vehicle with the Friction between the tyre and road surface. (14)

→ It changes and maintain the direction of travel or smooth steering.

→ It absorbers Road shock and thus provides cushion For comfortable driving.

Specification or tyre or tyre designation

The passange car tyre are designated in Following two way.

(1) The bias ply tyre designated as

4.5 — 12 — 4PR

where

4.5 = indicates nominal section width of tyre in inches

— = Bias ply type tyre

12 = nominal diameter of the tyre From bead to bead in inches.

4PR = The ply rating

(2) The radial ply tyre designated as:

175 / 65 R 14.82 T

where

175 = Nominal section width or tyre in mm,

65 = Nominal aspect ratio = Section height to section width X 100.

R = The radial type tyre

14 = Rim diameter in inches.

82 = load index

T = Speed symbol.

Cause of Tyre wear and Remedies

→ The vehicle tyres should wear evenly under normal condition but due to certain problem can cause the tyre wear in evenly. For example: a tyre thread may wear more rapidely in the centre than at the shoulders, more rapidly on the outside than on the inside or more rapidly on the shoulders than at the centre and also the rate wear can differ between the front and rear tyres and between the left and right tyres.

The main cause of tyre uneven wear as follows.

(i) Incorrect inflation pressure (under inflation and over inflation.)

5 psi = 0.35 kg/cm²

(2) Incorrect wheel alignments

(3) Improper matching of tyre and wheelrim.

(4) Excessive vehicle speed.

(5) Sudden acceleration and braking.

~~(6) Skidding~~

(6) Bleeding

(1) Bleeding

→ When a vehicle is running for a long time, the air in a tyre expands due to the heat generated.

→ This results in increase of inflection pressure.

→ The taking out of air to adjust the increase in inflection pressure due to long running and setting it correctly is known as bleeding.

→ It may be noted that in case air is bleeded from a hot tyre and the vehicle runs after it, this lower pressure will

make the tyre run very hot and the temp will go on rising which will affect the tyre performance and bursting of the tyre may be occurs.

Chapter-6 Date-18.02.2017

Fuel and Ignition system

Introduction of ~~x~~ or Petrol engine

The fuel system supplies fuel to the engine which includes the carburetor, fuel pump, fuel filter, fuel tank and various fuel pipes to connect them together.

→ In the fuel system the carburetor is used to supply air fuel mixture to the engine but in some recent engines this function is control by an electronically control fuel injection system.

→ It may be noted that in case of fuel ~~injection~~ ignition system the fuel supply ~~the~~ pressure is much higher than the carburetion system.

Function of Fuel system

→ To store the fuel in a tank for running several 1000 km or vehicle.

→ To deliver the fuel to the engine from the fuel tank.

→ To mix air with fuel in the proper ratio for efficient burning in the cylinder.

Carburetion

The automobile engines do not run on liquid petrol or gasoline.

→ The petrol must be broken down in to tiny drops and then vaporised to produce a highly combusible air fuel mixture.

→ The mixture is then introduce in to the cylinders, ~~and~~ under controlled condition of temperature, pressure and time.

→ The device which mixes the petrol and air is known as carburetor.

→ In simple word we can say the function of carburetor is to make a mixture we can appropriate Air Fuel ratio.

→ According to the automobile running condition and feed this mixture in to engine cylinder.

Function of carburettor

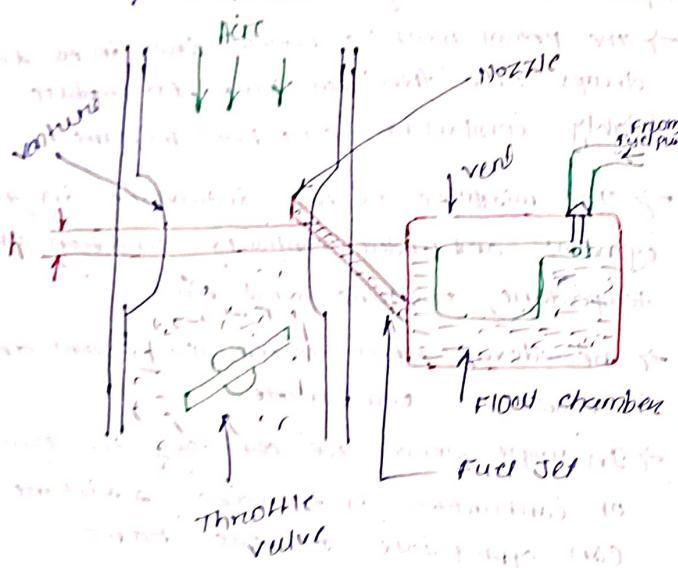
→ It pump of fuel and changes it to a mixed allowing it to vaporised more easily.

→ It control the air fuel ratio.

→ It controls the flow rate of air fuel mixture under all operating condition i.e all driving condition.

Date: 20.02.2017

Carburettor



Working

→ The main component of a simple carburettor are float chamber, venturi (mixing chamber) fuel jet, air bleed, throttle valve and choke valve.

→ During the suction stroke the piston moves down ward i.e From TDC to BDC creates a suction or vacuum in the cylinder.

→ since the inlet valve are open at this time the vacuum is also failed in the intake manifold.

→ It must be noted that the air above the carburettor barrel is at atmospheric pressure.

→ The pressure differences forces the air to rush (speed) down in to the carburettor barrel through the air cleaner to fill the vacuum.

→ The venturi in the carburettor causes the fuel to come out of the jet in the form of spray.

→ This spray of fuel vaporises and mixes with the air comming at a velocity.

→ The mixture of fuel and air From the carburettor goes to the engine cylinder through the throttle valve which is

operated by the accelerated pedal through linkages. (21)

→ During a cold starting choke valve is closed through a choke cable the closing of choke valve causes greater pressure difference due to which more fuel flows out of the nozzle resulting in the rich mixture.

Air/Fuel ratio (A/F) Date- 21.02.2017

The air fuel ratio is the ratio at which petrol and air are mixed in general this is expressed in terms of weight.

→ The air fuel ratio is necessary to maintain proper combustion and it varies with the engine speed, load, temperature and engine design.

→ Theoritically to completely burn 1gm of petrol needed 14.7 gm of air. Thus 14.7 : 1 is the theoritical mixture ratio of air and petrol.

→ The theoritical air fuel ratio is also known as stoichiometric stoichiometric ratio or chemically correct mixture.

→ The fuel can be burnt in the combustion chamber even if the air fuel ratio is somewhat greater or lower than the stoichiometric ratio or chemically correct ratio but if the mixture ratio exceeds certain limit combustion is no longer possible. This is called limit or inflammability.

→ In general the inflamability for petrol engine is 9 to 20 part of air to 1 part of petrol.

→ The mixture producing the highest output torque is called the power output mixture ratio i.e 13:1. and the ratio producing highest fuel economy is called the economy mixture ratio. i.e. 16:1.

① Standing Rich mixture = 5:1

No load

① Starting → Rich mixture = 5 : 1

② No load → very rich mixture = 10 to 12 : 1

③ Low speed driving → Relatively Rich → 14 : 1

④ Light load driving → Ideal → 15 to 17 : 1

⑤ Heavy load driving → Relatively Riched → 13 : 1

Fuel system in diesel engine

Introduction

→ In petrol engine the mixture of air and petrol in proper ratio is supply to the engine cylinder but in case of diesel engine air is drawn into the engine cylinder from the atmosphere during the suction ~~stroke~~ stroke and compressed.

→ The temp of the compressed air varies from 500 to 600 °C.

→ These temp are sufficiently high to ignite the fuel.

→ The fuel is now injected in the form of fine droplets in to this compressed air with the help of fuel pump, and an injector.

→ Every particle of the fuel injected into the engine cylinder gets enough oxygen from the compressed air for its complete combustion.

The basic fuel supply system in diesel engine consists of the following components:

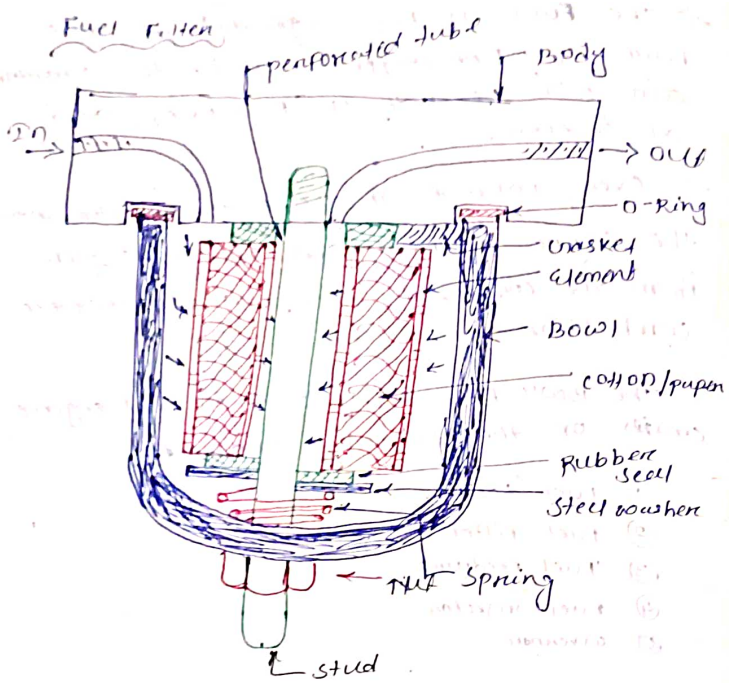
① Fuel tank
② Fuel Filter
③ Fuel Feedpump
④ Fuel injector
⑤ Governor

① Fuel tank

→ It serve as the main reservoir of fuel. It has two separate pipe lines from which one serving as feed line or supply line and other as return line.

→ The Return line returns excess fuel from the fuel injector to the fuel tank.

Fuel Filter



Date-22.02.2017

→ This type of Filter removes the finest particles that may have passes in the fuel.

→ It consist of a fuel element which is made of a series of fuel pads i.e paper and cotton which is built up on a perforated support tube.

→ The fuel enters from the top left side and passes inside of the elements and filtered fuel is taken out from the top right side connection.

→ The top cover body and filter element can be tightend by means of a nut provided at the bottom of the centred stud.

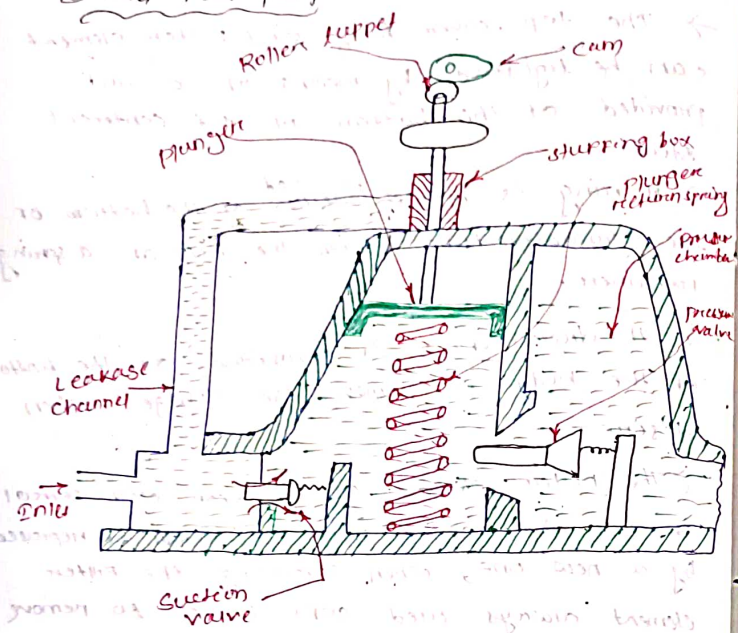
→ A ring is housed ~~retained~~ at the bottom of the perforated tube with the help of a spring retainer.

→ A drain nut is provided at the bottom of the body to remove the sludge when desire.

→ The Filter element can be clean with petrol 3 to 4 times after that it should be replaced by a new one, when servicing the Filter element always used soft brush to remove the dirt.

→ when assembly the unit check that all the exposed opening are sealed with clean cloth plugs and ~~cause~~ cocks.

③ Fuel Feed pump



→ The Fuel Feed pump supplies the diesel Fuel to the Fuel injector under all conditions of load and speed.

→ This pump sucks the Fuel From the Fuel tank usually placed at a lower level than the engine.

→ These generally driven by the eccentric cam situated on the cam shaft of the injection pump.

→ The plunger arrangement is fitted in the pressure chamber.

→ The plunger is activated in down ward direction by a cam through a roller tapped and plunger rod.

→ On the opposite side of the plunger a plunger springs is provided by which the return stroke of plunger is performed.

→ The Fuel comes through the plunger space through a suction valve due to pressure difference and after being compressed, the fuel moves out through a pressure valve in to the pressure chamber From where it goes to the Filter and then to the Fuel injection pump.

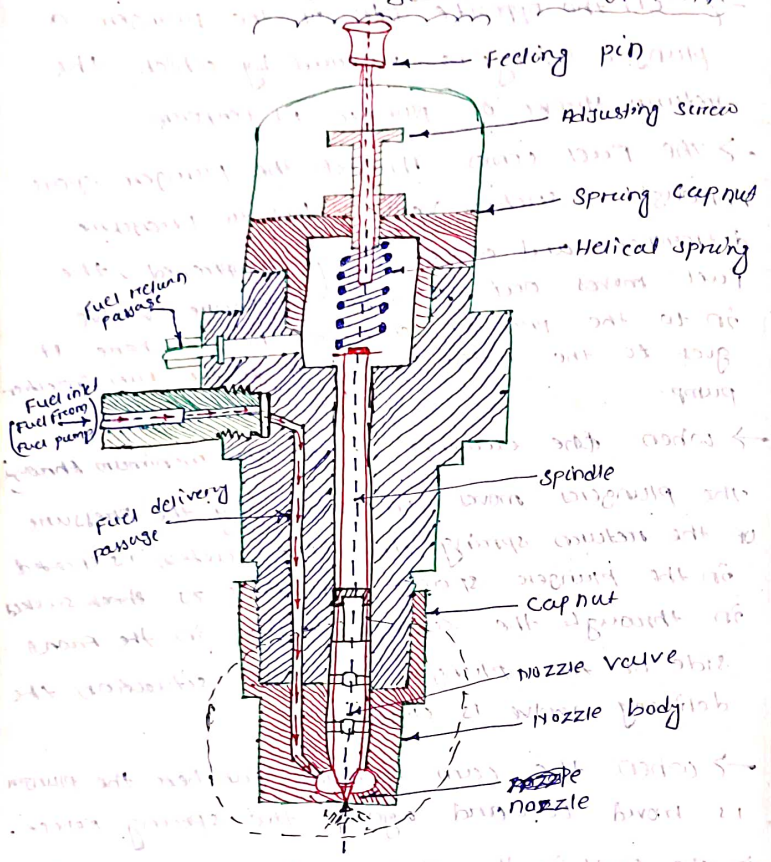
→ When the eccentric is at its minimum through the plungers moves in words by the pressure of the return spring thus the suction is created in the plunger space and Fuel is ~~sheek~~ sucked in through the suction valve in the Front side of the plunger in this situation the delivery valve is closed.

→ When the cam rotates Further the plunger is moved outward against the spring Force.

→ The Fuel in the plunger spaces is compressed which Forces suction valve to close and delivery valve to open.

→ Thus the Fuel flows out under pressure to the injection pump.

Fuel injector Date: 21.02.2017



→ The Fuel injector is also sometimes called as nozzle or atomiser.

→ The main purpose of fuel injector is to inject high pressure fuel (100 - 200 kg/cm²) in atomised form and in proper quantity in to the combustion chamber.

→ The injectors are threaded in to the cylinder head and are subjected to the direct heat of combustion like a petrol engine sparkplug.

→ The cross section of the injector is shown in the Fig.

→ The injector consist of a housing which is threaded in to the combustion chamber. Inside the housing there is a needle valve which is held on its seat by the force of a helical spring which exerts the pressure through the spindle.

→ The small tapered end of the needle valve is placed in the small opening called as spray orifice at the bottom of the nozzle.

→ The pressure on the nozzle valve can be increased or decreased by adjusting the

tension in the spring with the help of an adjusting screw.

→ The needle valve is open by the high pressurised fuel. The high pressurised fuel is supplied by the fuel pump through the annulour passage of the needle valve.

→ The valve is lifted from its seat when the pressurised fuel enters into the orific.

→ The fuel is then injected through the nozzle orific in to the combustion chamber in the form of high droppicles.

→ The Quantity of the fuel injected depends on the time of fuel injection.

→ when the fuel pressure falls after fuel injection the needle valve comes back to its seat under the spring force and posses the nozzle inlet.

→ Thus the fuel supply is cut off.

→ Any fuel leaked past the needle valve and valve spindle is return to the pump or fuel tank through the return line.

→ The injector is then again ready for the next injection.

Ignition system

Date-25.03.2017

Purpose and Requirement of Ignition system

Ignition system is a part of electrical system which carrys the current to a spark plug where spark is produce and the compressed air fuel fixture gets ignited at the end of compression stroke.

Essential Requirements of an ignition system

It should provide high voltage surges (as high as 20 to 40,000 volt) to the spark plug.

→ Sparking to be takes place at correct time towards the end of compression stroke in every cycle of operation and all speeds and loads from the engine.

→ spark duration to be sufficient to ensure burning of air-fuel mixture under all operating condetions.

→ There should be minimum power consumption for producing the spark.

→ It should be moderate price rate and easy to maintain.

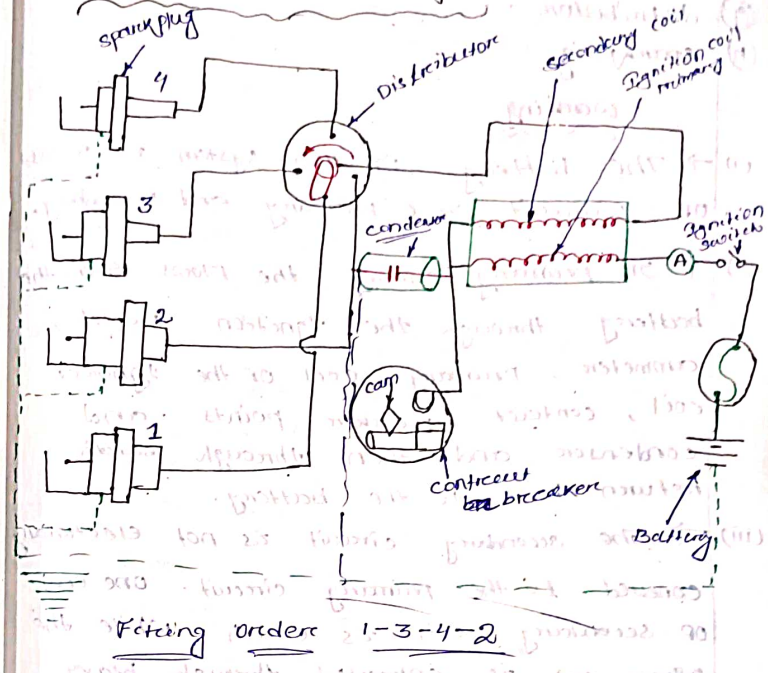
→ It should have longer service life of spark plug and breaker point.
→ Provision for spark advance with speed and load.
→ Reliable with good performance.
→ Good starting even when the opening of breaker point is slow at cranking engine speeds.

→ The Ignition system is mostly used on petrol engine such as

(1) Battery Ignition system / coil Ignition
(2) Magneto Ignition system
(3) Electronic Ignition system.

Battery / coil Ignition system

Date-27.02.17



Fitting order 1-3-4-2

→ In battery Ignition system the electric current is obtained from the storage battery (6-12) volt.
→ The main component of battery Ignition system are as follows

(a) Battery (6-12) volt
(b) Ignition switch
(c) Ammeter
(d) Ignition coil
(e) Contact breaker

(f) condenser
(g) distributor
(h) sparking plug.

Working

(i) → The battery Ignition system is consist of 2 circuit i.e primary and secondary.

(ii) → In primary circuit the flows from the battery through the Ignition switch, ammeter, primary coil of the Ignition coil, contact breaker points and condenser and then through earth return back to the battery.

(iii) → The secondary circuit is not electrically conected to the primary circuit. One end of secondary coil is earth while the other end is connected through heavy insulation to the distributors and spark plug.

(iv) → When the Ignition switch is made on and the engine is cranked, the contact breaker closes the primary circuit and the current starts flowing through the primary coil and a magnetic field builds up around the primary coil.

(v) As soon as the contact breaker points are opened the current flows stops and the magnetic collapses rapidly.

(vi) This sudden collaps builds up a very high voltage in the secondary coil.

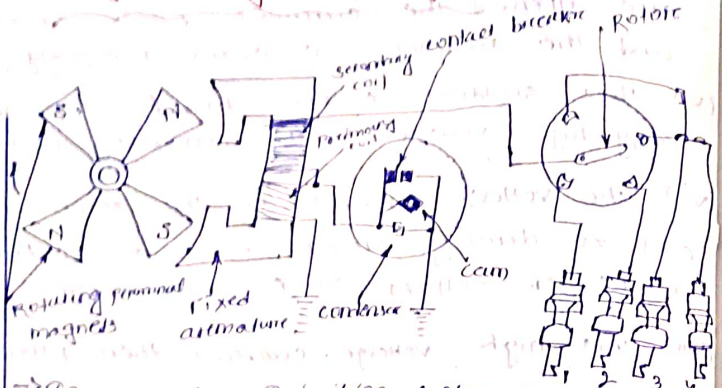
(vii) The voltage endured in the secondary coil is directly proportional as to the rate of collaps of magnetic field.

(viii) This high voltage current then flows from the Ignition coil through the high tension wires to a central point of distributors cap from where it reaches the tip of rotor.

(ix) → From the rotor the high voltage current then goes to the spark plug points through the distributor cap terminates and high tension wires.

(x) → When the high voltage surge jump across the spark plug gap for completing the secondary circuit a spark is produced. which Ignite the compressed air fuel mixture in the engine cylinder.

Magneto Ignition system



→ In magneto Ignition system a magneto produces and supplys the current in the primary circuit instead of a Battery.

→ The magneto Ignition system consist of

(a) magneto
(b) Ignetion switch
(c) contact breaker
(d) Ignetion coil (primary, secondary coil, Armeture)
(e) contact bire
(f) capacitore
(g) Distributore.
(h) spark plug

→ This system is commonly used in two-wheelers.

→ The magneto is basically an electrical generatore which is tuned to create a periodic high voltage pulse rather than continuous current.

→ In an electromagnet there is a coil of wire arround an iron bare (Armeture).

→ When the magnet rotates inside the armeture it creat an electric current in the coil.

→ Working

→ The magneto ignition system consist of a pair of strong permanent magnet attach to the engine Flywheel and rotates at the crankshaft speed.

→ The Armeture is stationary and is shaped like 'U'. The two ends of the U point towards the Flywheel.

→ A primary coil of approximately 200 turns of thick wire is wrapped arround one leg of the 'U' and the secondary coil of approximately 20,000 turns of very thin wire wrapped arround the armeture.

→ When the Flywheel rotates the magnet rotates paned the U shaped armeture and

induce a magnetic field in the armature.

→ This field reduces induces small amount of current in the primary and secondary.

→ However extremely high voltage is required therefore when the magnetic field in the armature reaches its maximum, the rotating cam breaks the contact point.

→ When there is a break in the primary circuit the magnetic fields collapes suddenly which induces a high voltage in the secondary coil.

→ The secondary coil having 100 times more turns that the primary coil amplifies this voltage to approximately 20,000 volts and supply this to the spark plug through the distributor.

Battery Ignition	Magneto Ignition
→ The current is supplied to the primary circuit by the battery (6-12V)	→ The current is generated by the magneto.
→ The spark produced at the starting and low speeds are quite strong.	→ The spark produced at the starting and low speeds are weak.
→ The starting of engine is easy.	→ The starting of engine is difficult.
→ In case the battery gets discharge the engine can not be started.	→ Due to absences of battery there is no such difficulty.
→ The spark strength decreases with the increase of speed.	→ The spark strength increases with increase of speed.
→ This system required more more space.	→ This system required less space.
→ The wiring is quite complicated.	→ The wiring is comparatively simple.
→ This system is used in cars, heavy vehicles like buses and trucks.	→ This system is used in motor cycle, scooter and racing cars.

Date 3.03.2017

Firing order

Types of engine	Firing order
① Three cylinder engine →	1-3-2
② 4 cylinder Engine →	1-3-4-2 or 1-2-4-3
③ 6 cylinder engine →	1-5-3-6-2-4 or 1-4-2-6-3-5 or 1-2-4-6-5-3
④ 8-cylinder Engine →	1-6-2-5-8-3-7-4 or 1-5-4-8-6-3-7-2

Advantages of Firing order

→ It reduces engine vibration
→ It secures even flow of power
→ It maintains engine balancing
→

Ignition troubles and Remedies

Problem	Problem cause	Action or item should be checked or Remedies
(1) Engine missing	(1) Faulty spark plug (2) Defective distributor cap or high tension coil. (3) Large gap in spark plug.	→ Replace the spark plug of correct specification. → Replace the distributor cap or the high tension wire. → Adjust the spark plug gap to the specified value.
(2) Engine over heating	→ Too much retarded ignition time.	→ Set the ignition timing correctly
(3) Engine back Firing	→ In correct heat range of spark plug. → Too much retarded ignition timing	→ Replace with new spark plug with the correct heat range. → Set the ignition timing correctly.
(4) Engine does not start or there is no spark from the coil.	→ Loose connection of battery or discharge battery → Open low tension circuit. → Dirty contacts → Defective condenser → Defective ignition coil.	→ Tighten the battery connection and then check the charge of the battery. → Repair the low tension circuits → Clean the contacts. → Replace the condenser. → Replace the ignition coil.
(5) Engine looks power	→ Dirty spark plug. → Wrongly adjusted → Wrongly adjusted contact breakers point → Retarded ignition timing	→ Clean the spark plug. → Adjust the contact breaker point to the correct setting → Adjust the ignition timing.

Multipoint fuel injection system (MPFI)

→ It is one in which each cylinder has a fuel injector.

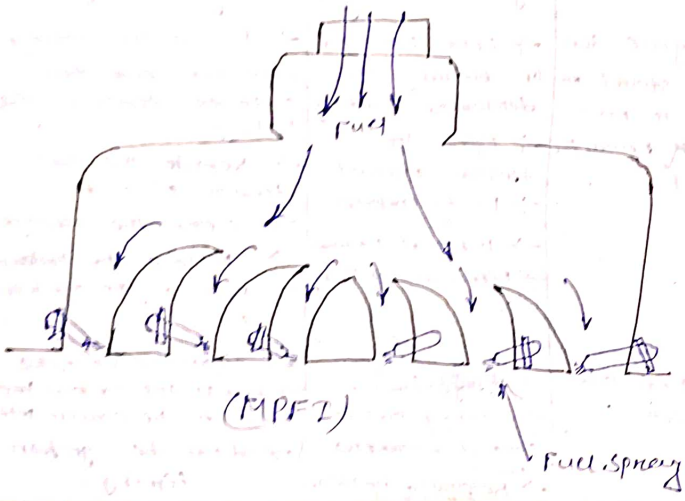
→ This injector injects fuel directly ahead of that cylinders intake valve.

→ The system has a separate nozzle for each injector and each is activated independently.

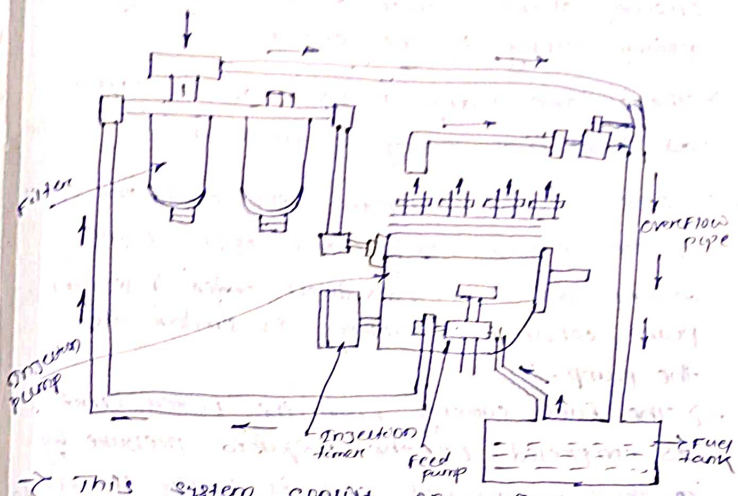
→ Fuel injection takes place on to the air stream prior to entering the combustion chamber.

→ Injection is timed to coincide with the intake stroke of each cylinder.

→ Injection of fuel to all the cylinders occurs at the same time.



Fuel injection system for multicylinder diesel engine



→ This system consist of a fuel feed pump and a fuel injector pump which are integrated on one body.

→ The fuel feed pump sucks the fuel oil from the fuel tank which contains vapour, air bubbles and dirt particle, then supply the oil to a filter unit for purifying it.

→ The filter unit eliminates the vapour air bubbles and that dirt particles from the fuel and further supply it to the fuel injection pump.

→ A vent screw is also provided on the

filter unit for air venting.

→ The injection pump has a main camera shaft which is running by the power supply by the engine.

→ There are many plungers in the pumps as there are many cylinders in the engine.

→ One plungers supplies the fuel to one cylinder of the engine only. And each plunger works as an individual inter injection pump whose construction is similar to the pump.

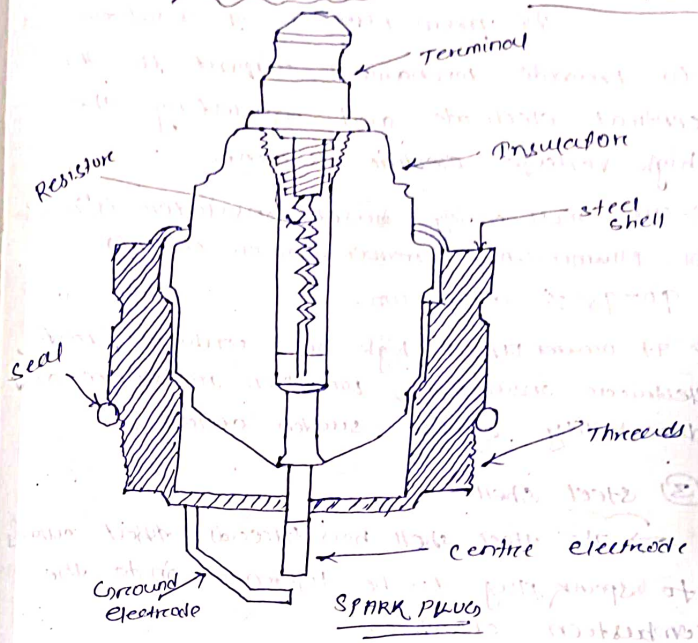
→ The fuel coming from the filter unit is compressed to the required pressure by a these plungers and is supply through the delivery pipes to the injector of the engine at proper timing.

→ Each injector is also provided with an overflow outlet from where the overflow fuel is send to the fuel tank.

→ The injection pump also has a governor which actuates the control rod to govern the supply of fuel through plungers according to the demand of the engine.

SPARK PLUG

Date - 4.3.17



→ The sparkplug is a part of ignition system which sends high voltage in to the combustion chamber to create a spark which causes the compressed air fuel mixture to burn.

→ The main parts and their function of sparkplug as discussed as follows.

① Terminal

The top of the sparkplug contain a terminal which is connected to a high tension wire through which high voltage current flows from the ignition system.

(2) Insulator

The main function of insulator is to provide mechanical support to the central electrode and insulating the high voltage electric current.

→ The most widely used insulator is made of Alluminium ceramic which contents 90-95% alluminium.

→ It offers high heat conduction ratio, electrical insulation, corrosion resistance and durability against sudden cooling.

(3) Steel shell

→ The steel shell has threads that allows to spark plug to be tightened in do the combustion chamber.

→ A hexagonal fitting is provided on the outside of the shell that allows a spanner wrench to be used on the sparkplug for installation and removal.

→ A ground or side electrode is attached to the shell, A small distance away from the central electrode.

→ This distance is the air gap or sparkplug gap (0.8 - 1.1) mm that the current jumps to create a spark.

(4) centre electrode

→ The centre electrode is connected to the terminal through an internal conductor or resistor.

→ The tip can be made of a combination of precious metals.

→ The precious metals high temp. electrodes allows the use of a smaller centre wire which has sharpen edges but will not made or corrode away.

(5) Ground or side electrode

The side electrode is made of high Nickel steel and is welded to the side of the steel shell.

→ The side electrode also runs very hot especially on projected nose plug.

→ Some design provide a copper core to this electrode so as to increase heat conduction.

(6) seal

→ The spark plug mounted in the combustion chamber is subjected to extremely high pressure.

→ The seal ensure that there is no leakage from the combustion chamber.

WORKING

→ An ignition coil generates a high voltage current which flows through an ignition wire and the sparkplug terminal to the central electrode.

→ This current then crosses the gap between the centre electrode and the ground electrode in the form of an ~~earth~~ Arc. and this ~~earth~~ Arc ignites the Air Fuel mixture which is contained in the combustion chamber.

→ Finally the current flows to ground through the sparkplug steel shell and through the engine ~~block~~ Block.

Date-6.03.2017

Electrical system

In an automobile electric current close flows through different system in order to fulfill the different requirements of the engine such as - starting the engine, lighting the lamps, blowing the horns and also operating number of electrical components.

→ The following are the main electrical system necessary for an automobile

(1) starting system
(2) Ignition system
(3) charging system
(4) Lighting system
(5) Miscellaneous system
   - Horn circuit
   - Direction indicator circuit
   - wiper motor circuit
   - speedometer circuit

~~(6) Horn circuit~~

An electromagnet is a type of magnet in which the magnetic field is produced by an electric current. Electromagnet usually consists of a wire wound into a coil. A current through the wire creates a magnetic field which is concentrated in the hole in the center of the coil.

WORKING

→ An ignition coil generates a high voltage current which flows through an ignition wire and the sparkplug terminal to the central electrode.

→ This current then crosses the gap between the centre electrode and the ground electrode in the form of an arc. and this arc ignites the Air Fuel mixture which is contained in the combustion chamber.

→ Finally the current flows to the ground through the sparkplug steel shell and through the engine block.

Date-6.02.2017

Electrical system

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   - Speedometer circuit

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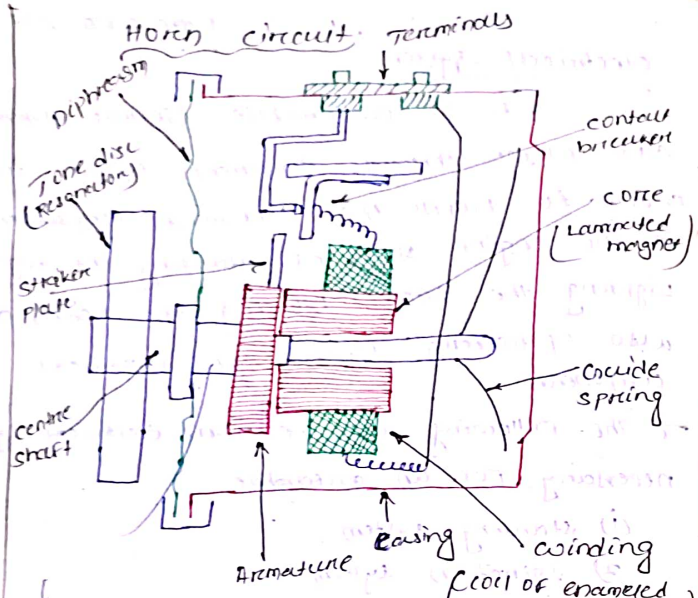


Construction and working of an electric Horn

→ An electric horn are consist of a Flexible Flat circular metal diphragm. (Spring steel) an armature connected to the diphragm, a coil of enamelled wire wound on a core which Forms an electromagnet, Flexible contact points and a casing.

→ The Flexible diphragm will vibrate i.e oscillate back and Forth (upper) continuously as long as current is apply.

→ This will produce the desired sounds.

→ In the centre of the horn casting the electromagnet is provided.

→ The armature is attach to the centre shaft. One end of the shaft is attach to the diphragm and the other end of the shaft is attach to guide spring.

→ The diphragm end of the shaft extends further and near its outer end a metal tone disc is Fitted which is called the second diphragm.

→ WORKING

The electric horns work on the principle on electromagnetic make and brake system to create sound.

→ when the horn bottom is pressed the horn switch is closed and the electric current is supply to the electro magnet through the relay.

→ The electromagnet is then energized and then attract the armature.

→ since the armature is attach to the centre shaft which is attach to the diphragm, Therefore diphragm is also closed along with the armature.

→ This centre shaft while being closed on the contact points make open.

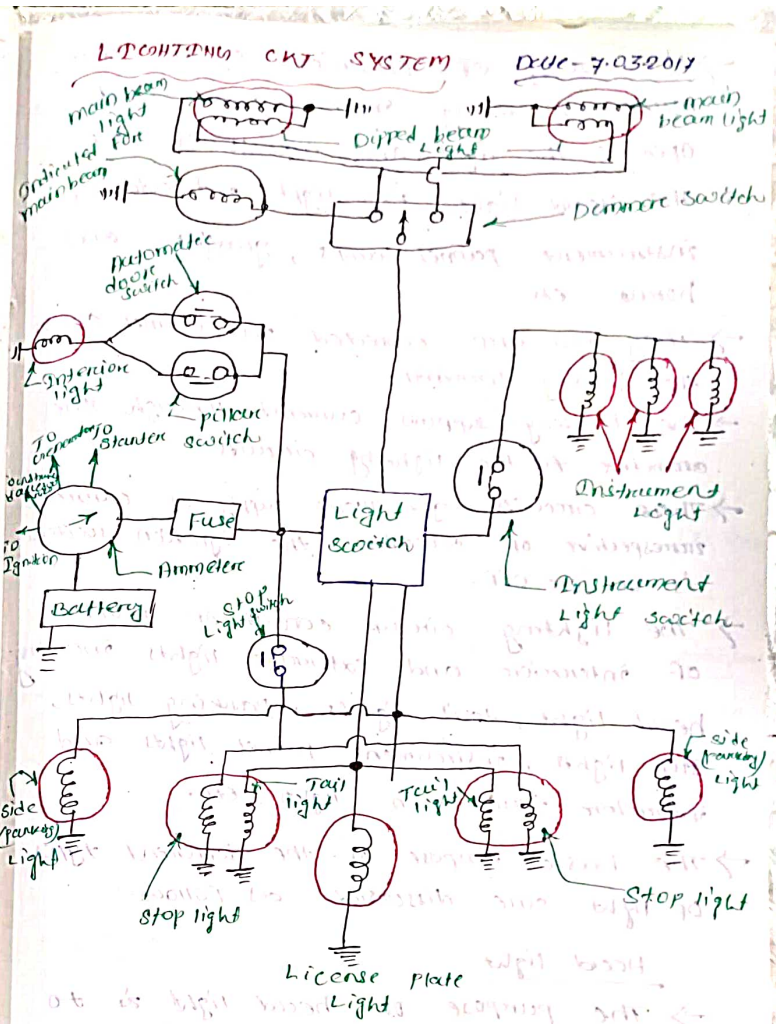
→ when the contact points is open the electric current going through the electromagnet is stop and it is de-energized which results in the di-phragm and armature coming back to its original position.

→ As soon as the diphragm, armature and centre shaft move to there original position the contact point again closes and current starts flowing into the electromagnet which again attracts the armature.

→ In this way the diphragm and armature goes on vibrating.

→ The vibrating action of the diphragm causes the vibration of air column around it.

→ The vibration of air column subsequently produces the sound.



LIGHTING CIRCUIT SYSTEM

→ The body of electrical system are made of many small circuit that operate the light and accessories like the head light, Fog light, indicators, instrument panel lamps, gauges, and horns etc.

→ They all are connected in parallel across the battery terminal.

→ The battery supplies current through the ammeter to the lighting circuits.

→ These circuits get there supply of current irrespective of whether the ignition switch is on or off.

→ The lighting circuit consist of number of interior and exterior lights including head light, tail lights, parking lights, stop lights, instrument panel lights and interior illumination lights etc.

→ The basic purpose of the different types of light are discussed as follows.

Head light

→ The purpose of head light is to produce illumination upto a considerable distance ahead of the vehicle.

→ It may be noted that the provision in design of head light must be provided that the drivers of other vehicles coming from the opposite direction do not experience a glare.

② Side lights

→ The side lights are also known as parking light.

→ The parking lights serve a used ful purpose as a backup light in emergency.

→ If head lights burns out the parking light will still provide some light on that side of the car.

③ Tail Light

The tail lights are used for illuminating back of the vehicle so that the driver of the vehicle coming behind will be able to see it.

→ These are covered by Red lenses so that they can be distinguished clearly by the reflection of light from the automobile approaching from the Rear even when these are not on.

④ Stop lights

These are also known as brake lights.

→ These are provided at the Rear and flash when brakes are apply.

→ It is fitted on vehicles to provide the warning to the following drivers about the disterection of the vehicle in case of left and right stop lights are blocked by other road users.

(5) Turen Indicators

The turn indicators are used to indicates the direction in which the vehicle is about to turen to other road users.

(6) Reverse light

The Reverse lights are used to illuminate small area behind the vehicle when it is reversing.

(7) License light

→ The license light is used to make visible the license plate in night.
→ This is usually a separate light in

(8) Front Fog light

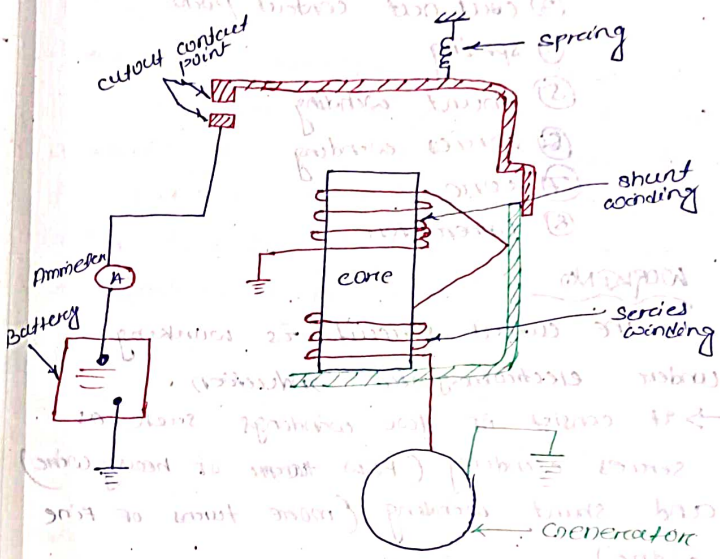
The Front Fog lights are used in case of Fog, snow fall, Rain storms or Dust clouds to improve the illumination of the Road.

(9) Rear Fog light

The rear Fog light is used to make the vehicle more visible from the rear in the dense Fog, snow fall, rain storms, dust clouds.

CUT OUT CIRCUIT

Date - 10.03.2017



→ The cut out circuit is that which is used to close the circuit between the generator and the battery when the generator producing the current.

→ It opens the circuit between generator and battery when the battery stops or slows down.

→ The main component or parts of cut out circuit are

1. Battery
2. Ammeter
3. Cut out contact point
4. Spring
5. Shunt winding
6. Series winding
7. Core
8. Generator

WORKING

The cut out circuit is working under electromagnetic induction.

→ It consist of two windings such as series winding (Few turns of heavy wire) and shunt winding (more turns of fine wire).

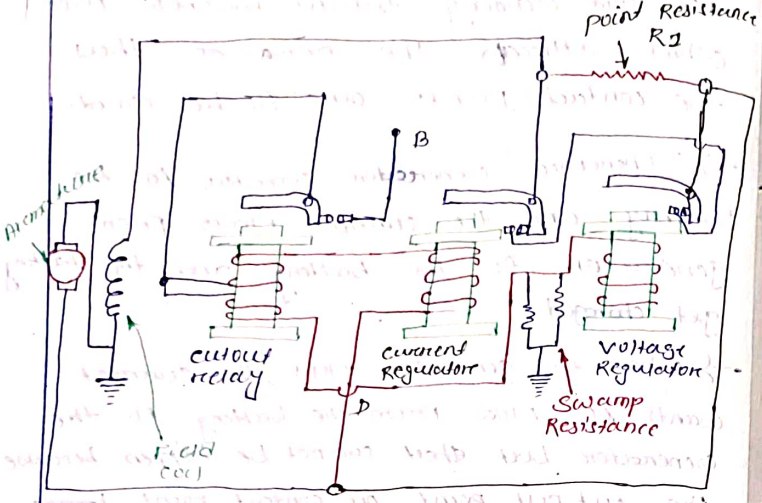
→ The winding is carried out around the core and a flat steel armature mounted on things above the core.

→ when the generator is in operating the core winding creates magnetic field which attracts the armature thus the contact points are to be closed.

→ Therefore generator connected to the battery and the current flows from generator to the battery and the battery get charged.

→ when the generator stops, the current wants to flow from the battery to the generator but that can not be happen because the cut out point or contact point breake break through the core because of demagnetisation or loss in magnetism in the core.

Voltage & current circuit



Circuit diagram for 30C -12V Regulator

→ All modern cars are using a straight shunt wound commutator generator are controlled by a vibrating voltage and current regulator.

→ The voltage regulator limits the voltage of the generator and varies its output in relation to the state ~~limits the voltage~~ of charge of the battery.

→ The current regulator is design to keep the current output of the generator another the safe limits since

→ A commutator generator does not have the current limiting features of some alternator types.

→ Both the regulators are combine with a cut out relay in a single unit.

→ The layout of the current, voltage Regulator for a Fuel 12 Volt generating system shown in Fig.

Voltage Regulator

→ In the 12 volt control box the voltage regulator has one coil which is connected to the parallel with the generator.

→ This makes the regulator responsive to change in the system voltage only.

→ when ever the voltage increase beyond a certain value, the regulator overcomes the current towards the bobbin core and the voltage regulator contacts are open.

→ In this way the vibration frequency of the armature is increase and resulting a steady voltage and current.

Current Regulator

→ The current Regulator has a single low resistance coil which is connected in series with the generator output.

→ The regulator is therefore responsive to changes in output current only.

New chapter

Date - 17.03.2017

Cooling and Lubricating System

Necessity of engine cooling

In an I.C engine the Temp of gasses inside the engine cylinder may varies from 35°c to as high as 2750°c during the cycle.

→ If an engine is allow to run without external cooling, the cylinder walls, cylinder, and pistons will ~~take~~ tends to assume the average temp of the gases to which they are expose which may be of the order of 1000°c to 1500°c.

→ At such high temp. the metals will loose their characteristics and piston will expand considerabilly and seize the Line.

→ Theoretically thermal efficiency of the engine will improve without cooling but actually the engine will seize to Run.

→ If the cylinder wall temp is allowed to rise above a certain limit, about 65°c then the lubricating oil will begins to evaporate rapidly and both cylinder and piston may get damaged.

→ The cooling system is provided on an engine for the following (~~regin~~) reasons.

(1) The even expansion of piston in the cylinder may result in seizure of the piston.

(2) High temp. reduce strength of the piston and cylinder liner.

(3) physical and chemical changes may occur in lubricating oil. which may cause sticking of piston rings and excessive wear of cylinder.

(4) Loss of volumentric efficiency and power.

(5) seize of engine.

(6) Danger of engine Failure.

cooling system is of two types.

(1) Air cooling

(2) water or liquid cooling.

Air cooling

In this system heat is carried away by the air flowing over and surround the cylinder.

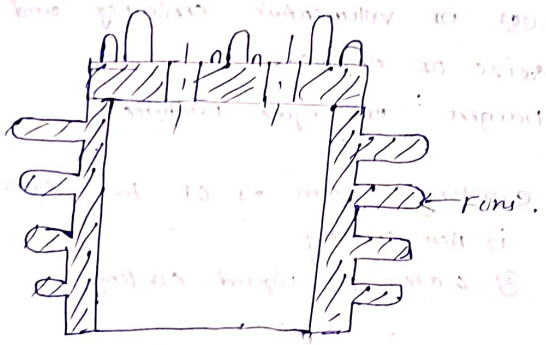
→ Here Fins are provided on the cylinder head and cylinder barrel that provides additional conductive and Radiating the surface.

→ The Fins are arranged at right angle to the cylinder axis.

Application

→ Air craft engines

→ Industrial and agricultural engines



Demerites

→ Movement is noisy

→ Non-uniform cooling.

→ Output of air cooling engine is less.

Water or liquid cooling system

→ In this method of cooling engine the cylinder walls and heads are provided with Jackets through which the cooling liquid can circulate.

→ The heat is transfer from cylinder walls to the liquid by conduction and convection.

→ The liquid becomes heated in its passage through the Jackets and is self cooled by means of an air cooled radiator system.

Antifreeze solution used in water cooling system

1. De-nature alchol
2. Wood alchol
3. gum glycerine
4. Kirosene
5. Calsium and magnesium chloride
6. Ethelene glychol and Propelene glychol

Demerits of cooling

→ There is various demerits due to cooling that occurs due to overbooling and under cooling.

over cooling

→ over cooling of the engine is harmful because of the following region.

(1) At very low temp. starting of the engine becomes very difficult.

(2) Due to over cooling engine lifes is reduce due to corrosion.

(3) If the engine is overcool some of the heat which would be used to expand the gasses will be lost.

(4) The Fuel will not vaporised properly and some of the gases produce by combustion will condense on the cylinder walls.

(5) In adiquate lubrication of the engine because the oil will not warm enough to Flow Freely Results in. get greater Frictional losses.

(6) In general due to over cooling the economy and life span of the engine is reduce.

Under cooling

→ under cooling can cause engine seizer or at least certain valve life and possible distortion of the cylinder block head or gasket.

→ At hot-spot inside the combustion chamber may be sufficient to cause pre-ignition that means to ignite the fuel before the sparkplug, thus causing loss of power and possible damage to the engine component.

Date - 20.3.2017

Lubrication

When ever any two metal surfaces are in contact and a relative motion takes place the force of friction come to exist how ever smooth the surfaces may appear to be.

→ The Frictional Force develop in I.C engine which consist of numerous sliding and rotating components like bearings, pistons and valve, gears etc.

→ It is so large that it may cause excessive wear and tear, necessitating the replacement of the components.

→ A large amount of power developed by the engine would also be used to

overcome this frictional force.

→ Due to the heat generated the temp of the various component may raise to so high value that a complete seizure of the engine component may take place.

→ Therefore to overcome these difficulties a thick film of a suitable lubricant is interpose where ever the metal to metal contact takes place.

Purpose of Lubrication

① → To Reduce Friction

To Reduce friction between two moving parts to a minimum value, there by to reduce power loss due to friction.

② To Minimise wear

③ To form an effective seal.

The seal is form between the piston rings and cylinder wall and thus prevent the escape of gases from the cylinder and avoid pollution.

④ To carry away the impurities

⑤ To Reduce noise

⑥ Mainparts to be needed lubrication

① Main crankshaft bearing
② Big end bearing
③ Small end bearing for gudgeon pin bearing
④ Piston rings and cylinder wall
⑤ Cam
Crank shaft and cam shaft bearings
⑥ Valve guides, valve tappets and Rocker arms

Types of Lubrication

① petrol system lubrication
② splash system lubrication
③ semi pressure system lubrication
④ pressure system lubrication
⑤ wet sump system
⑥ dry sump system

Petroil system Lubrication

Date - 22.03.2023

→ This is the simplest form of lubrication system and is generally adapted in the two-stroke petrol engine.

→ There is no separating pared for lubrication.

→ The lubricating oil is mixed with petrol according to the prescribe ratio which is usually 1:30.

→ During the filling of oil tank the connecting rod crankshaft are totally dipped in the mixture of petrol and oil.

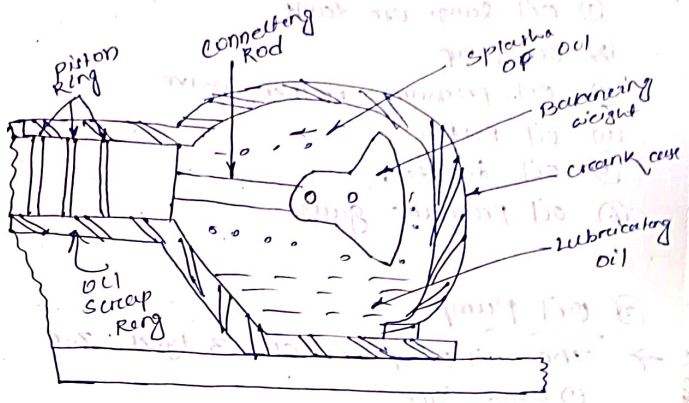
→ The petrol oil mixture also supply to the cylinder about the piston Thus there is also friction is not to be produce.

→ In this process the lubrication is carried out in 2-stroke petrol engine.

→ The main draw back of this system being that the lubricating oil separates OFF from petrol, it allow to remain unused for a considerable period.

→ It leads to clogging of passage in the carburetor resulting the starting of the engine is to be trouble.

Splash system lubrication



→ In this system lubricating oil is contained in the oil sump, when engine operates oil is splashed in the crank chamber by means of connecting Rod.

→ During each revolution of the crank the connecting rod balancing weight stroke through the mass of the oil.

→ Due to the centrifugal force of the weight the oil is splashed to the piston and cylinder walls, gudgeon pin, bearings and connecting Rod small end end thus all the parts are lubricated.

Parts of Lubrication system

→ The Lubrication system of a 4-stroke engine consist of the following parts.

1. Oil sump or tank
2. oil pump
3. oil pressure relief valve
4. oil Filter
5. oil dipstick.
6. oil Pressure gauge.

(2) Oil pump

→ The oil pump is of 3 types i.e

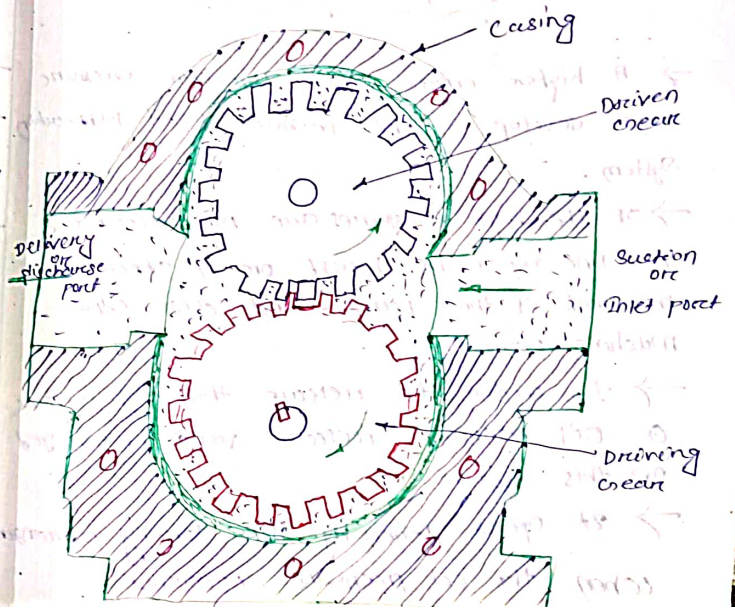
1. Gear type
2. Rotor type
3. Plunger type.

→ The most common form of oil pump used for Pressure Lubrication of I.C engine is the gear type.

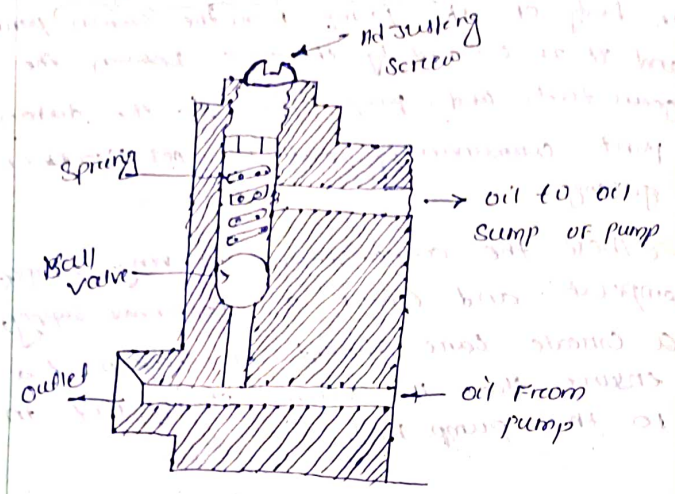
→ It is the simplest type consist of two equal size of gears from which one is the driving gears usually driven from the engine camshaft and the other driven gear which is simply an idler.

→ The two gears fit very closely in to the body of the pump from the suction port and it is covered by the space between the gear teeth and pump body to the discharge port communicating with the oil Leads or gallery.

→ Those the arrangement is very simple compact and gives a continuous supply a Greate care should be taken to ensure that the gears closely fit in to the pump body.



Oil pressure Relief valve



Oil pressure Relief valve

→ A higher engine speed or greater pressure are develop in the pressure feed lubrication system.

→ If the high pressures are not released oil line must be burst or it affect the movement of the pump and also other machine parts.

→ In order to release this high pressure a oil pressure release valve is employed in this system.

→ It open when by the spring arrangement when the oil pressure reaches the predetermine limit.

→ This limit is adjusted by increasing or decreasing tension of the spring in the valve.

→ Main parts
① Ball
② plunger
③ spring

→ The spring keeps the ball, plunger and pushed against the b hole.

→ Due to high pressure the ball, plunger and spring are lifted off the seat and oil goes out through it to the sort sump.

END

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