

Definition: → An automobile is the self propelled vehicle which contains the power source for its propulsion and it is used for carrying passengers and goods.

Ex: → Car, bus, truck etc .

Need: → ① An automobile for workers to <sup>use</sup> can help them get to important meeting on time.

② It is constructed primarily for the transport of people rather than goods.

③ It is used to transport people and items from one location to another location.

④ An automobiles are designed to run primarily on roads to have seating for one to six people, typically have four wheels.

Classification: →

→ The automobiles are classified by the following ways.

(i) On the basis of load

(a) Heavy transport vehicle (HTV)

(b) Light transport vehicle (LTV)

(ii) On the basis of wheels

(a) Two wheeler vehicle, ex → Scooter, motorcycle

(b) Three " " " " ex → Autorickshaw.

(c) Four " " " " ex → Car, Jeep, truck, bus

(d) Six " " " " ex → Big truck with two gear axles

(ii) On the basis of fuel

- (a) Petrol vehicle ex: → motorcycle, Scooter, Car
- (b) Diesel " ex: → Trucks, buses.
- (c) Electric " ex: → use battery to drive.
- (d) Gas " ex: → LPG, CNG

Liquefied Petroleum gas

Compressed natural gas

(iii) on the basis of drive

- (a) Left hand drive
- (b) Right " "

(iv) on the basis of driving axle.

- (a) Front wheel drive.
- (b) Rear " "

(v) Position of engine

- (a) Engine in front ex: → Car.
- (b) " " Rear side ex: → Nano Car.

(vi) on the basis of transmission.

- (a) Manual transmission
- (b) Semi-automatic.
- (c) Automatic

~~(vii)~~

Chassis : →

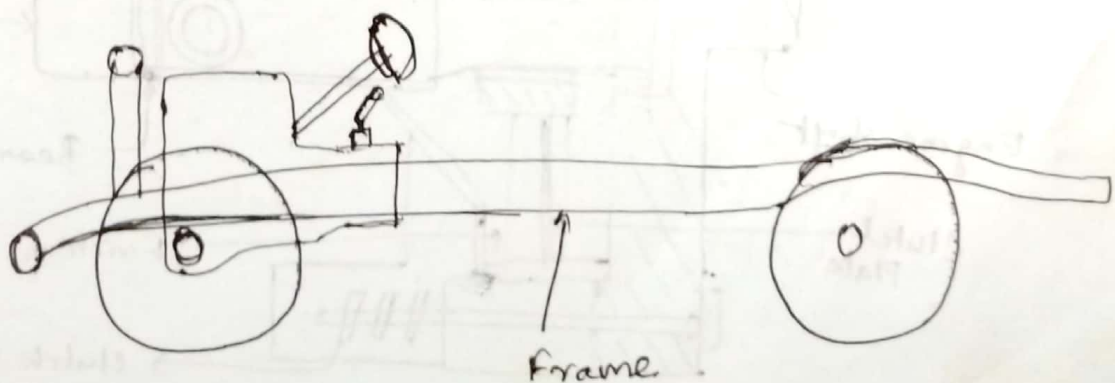
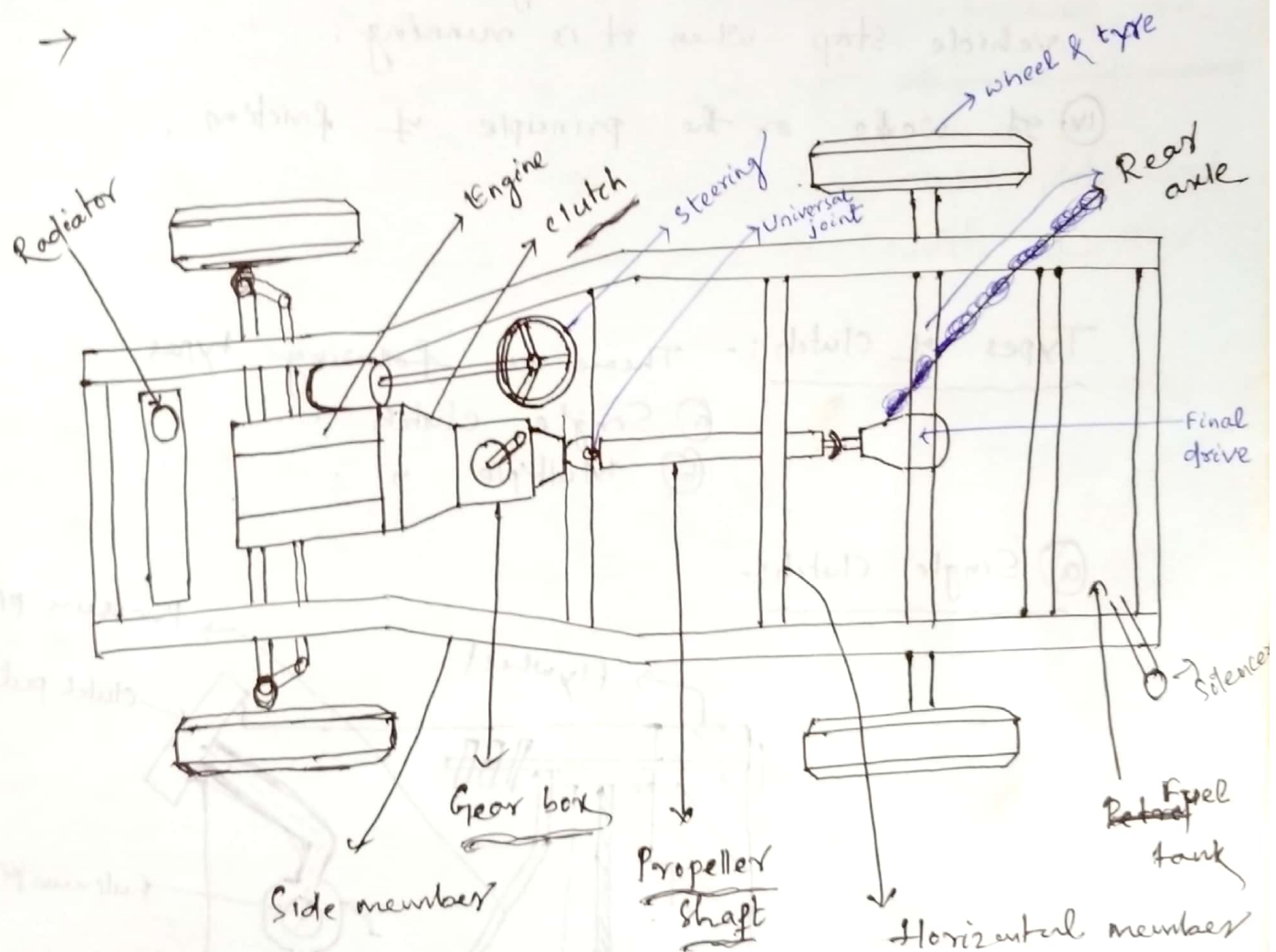
An automobile is made up of mainly two units, these are chassis and body.

Chassis = Frame + Base Component

Vehicle = Chassis + Body

→ of the frame contains the components it called as chassis. The Component are like engine, radiator, clutch, gearbox, Silencer, road wheels, fuel tank, wiring etc.

→ The frame is the skeleton of the vehicle. It serves as a main foundation and base for alignment for the chassis.



### ⑬ Specification of auto engine of motorcycle :-

Example:- BMW R4

Engine:-

Internal Designation - M6953

Motor Type - Four stroke single cylinder vertical

Bore x stroke - 84 x 78 mm (3.30 x 3.07 in)

Displacement - 398 cc

Maximum power - 14 hp at 4,000 rpm

Compression Ratio - 5.7:1

Valves - OHV

Carburettor system - 1 x carburettor + 500 cc  
3/500 cc

Engine Lubricating system - Forced feed Lubrication

Oil Pump - Gear Pump

### Power Transmission

Clutch - single plate dry clutch

Number of Gears - 04

Gear Shift - Manual with frame shift gate

Gearbox Ratio - 3.6 / 2.48 / 1.35 / 1.1

Rear wheel Ratio - 1:5.11 (1:5.63 with sidelenar)

Bevel/crown wheel - 9/46 teeth (8/45 with sidelenar)

### Electrical System

Ignition system - Battery ignition

Generator - Bosch 6V/45W

Spark Plugs - Bosch DM 175/1

## Chassis:

Designation - F 69 S3

Frame - pressed steel duplex frame plate - Spring  
of laminae with friction

Front Suspension - shock absorber

Rear suspension - Rigid

wheel Rims - 26 X 3.5

Front Tyre - 26 X 3.5 SS

Specification of auto engines of Scooter:-

example:- Honda Active 64 classification

Mileage

Displacement - 109.57 cc

Engine Type - fan cooled, 4 stroke, SI engine

No. of cylinders - 1

Max power - 7.79 PS @ 8000 rpm

Max Torque - 8.79 Nm @ 5250 rpm

Front Brake - Drum

Rear Brake - Drum

Fuel capacity - 5.3 L

Specification of auto engines of Car:-

Example:- Maruti Swift

Max power (bhp @ rpm) - 88.50 bhp @ 6000 rpm

Max Torque (nm @ rpm) - 113.7 Nm @ 4400 rpm

Seating capacity - 5

Transmission Type - Automatic  
Boot Space (litres) - 268  
Fuel tank capacity - 37.0  
Body type - Hatchback  
service cost (Avg. of 5 years) - Rs. 4,703

### Specification of auto engines of bus :-

G12.

Chassis platform - LP 712/42 BSIV Diesel  
Engine - TATA 497 TCIC Common Rail  
Engine power - 92 kW @ 2400 r/min  
Engine diameter - 310 mm  
Gearbox - GBS 550 synchromesh ; 6F + 1R  
Brakes - Dual circuit full Air S-cam Brake  
with ABS  
Suspension - semi-elliptical Spring at front & Rear  
Steering - power steering  
Battery - 12 V, 150 Ah  
Alternator - 150 A  
Types - 7.50 x 16 - 16PR  
Fuel tank Capacity - 160 l  
Turning circle Diameter - 14600 mm  
max GVW - 7490 kg

### BODY

Seating Capacity and layout - 27 + 1 AB (2x2)  
Side windows - pasted window glasses  
AC make - Spheros CC225  
Side Luggage Booth - Provided with Lamps

## OVERALL DIMENSIONS

Wheelbase - 4200 mm

Front overhang - 1480 mm

Length - 8200 mm

Rear overhang - 2520 mm

Overall Height - 2800 mm

Max. width - 2200 mm

## 7.4 Classification of Engines based on working principle

\* Internal combustion heat engines work on the principle of the ideal gas law: Raising the temperature of a gas increases the pressure that makes the gas want to expand. An internal combustion engine has a chamber, which has fuel added to it which ignites in order to raise the temperature of the gas.

Fuel used: - Automotive engines are generally classified according to following different categories  
① Internal combustion (IC) and External combustion (EC) type of fuel: petrol, Diesel, Gas, Bio / Alternative fuels. Number of strokes - Two stroke petrol, Two-stroke Diesel, Four stroke petrol / Four stroke Diesel.

Position of cylinder: - Pneumatic cylinder works on principle Double-acting pneumatic cylinders are the most common type since they give the user complete control of the piston movement

A negative position is when the piston rod is retracted, and a positive position is when the piston rod is extended.

Arrangement of cylinders :- There are three arrangements which may be used for an engine, in-line engine the cylinders are arranged in a single row, one behind the other. Vee engine the angle to one another. The angle for two - four - and eight - cylinder engines is usually 90.



# CLUTCH

Needs:- (i) It is used to the transmission system of automobile to engage and disengage the engine to the transmission box, or gear box.

(ii) When clutch is engage, the power flows from the engine to the rear wheels in a rear wheel-drive transmission and the vehicle moves.

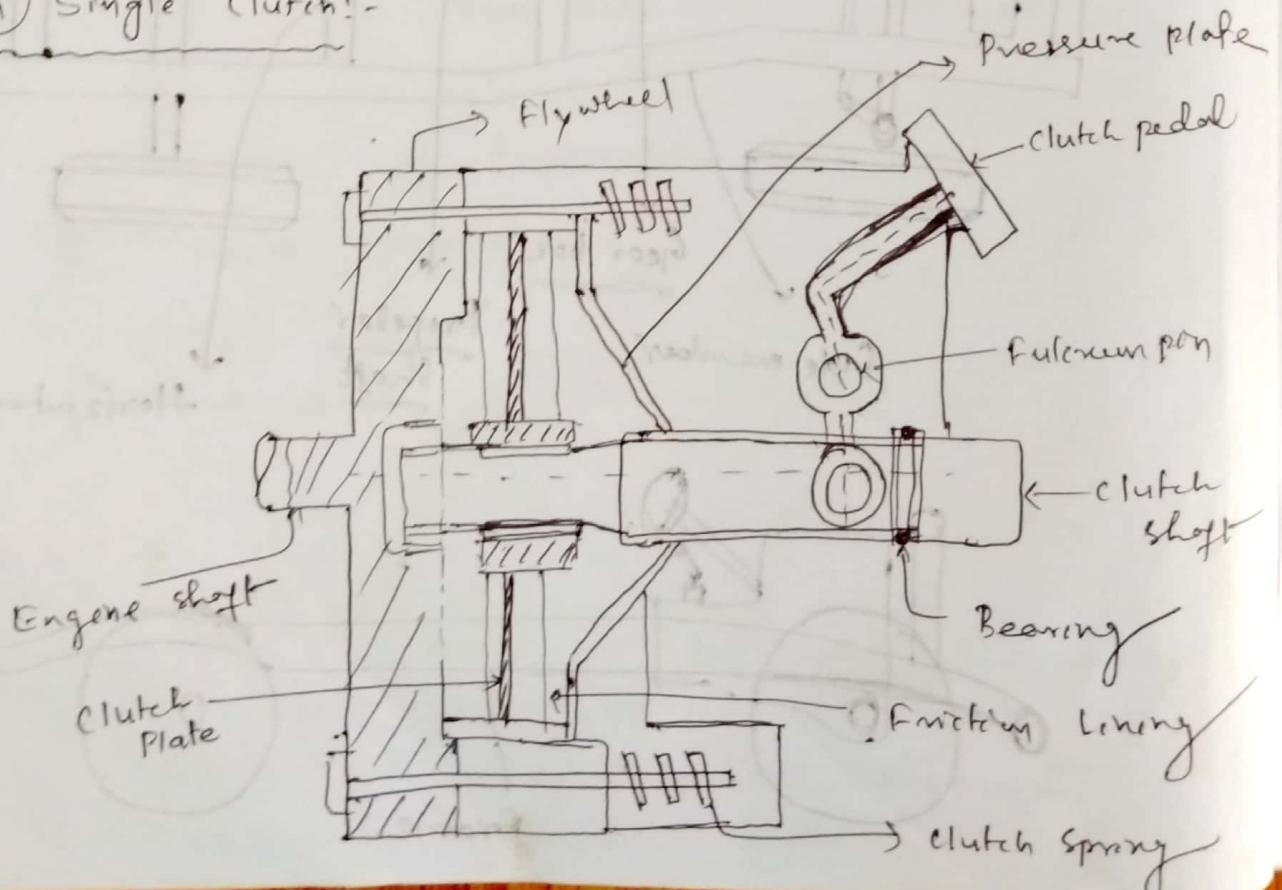
(iii) When clutch is disengaged, the power is not transmitted from the engine to the rear wheel and vehicle stop when it is running.

(iv) It works on the principle of friction.

Types of clutch:- There are following types:-

- (a) Single clutch
- (b) Multiple "

(a) Single clutch:-



Working: → When clutch pedal is pressed, the pressure plate  
plate moves back against the force of the Spring.

→ Therefore the clutch plate becomes free between  
the flywheel and the pressure plate.

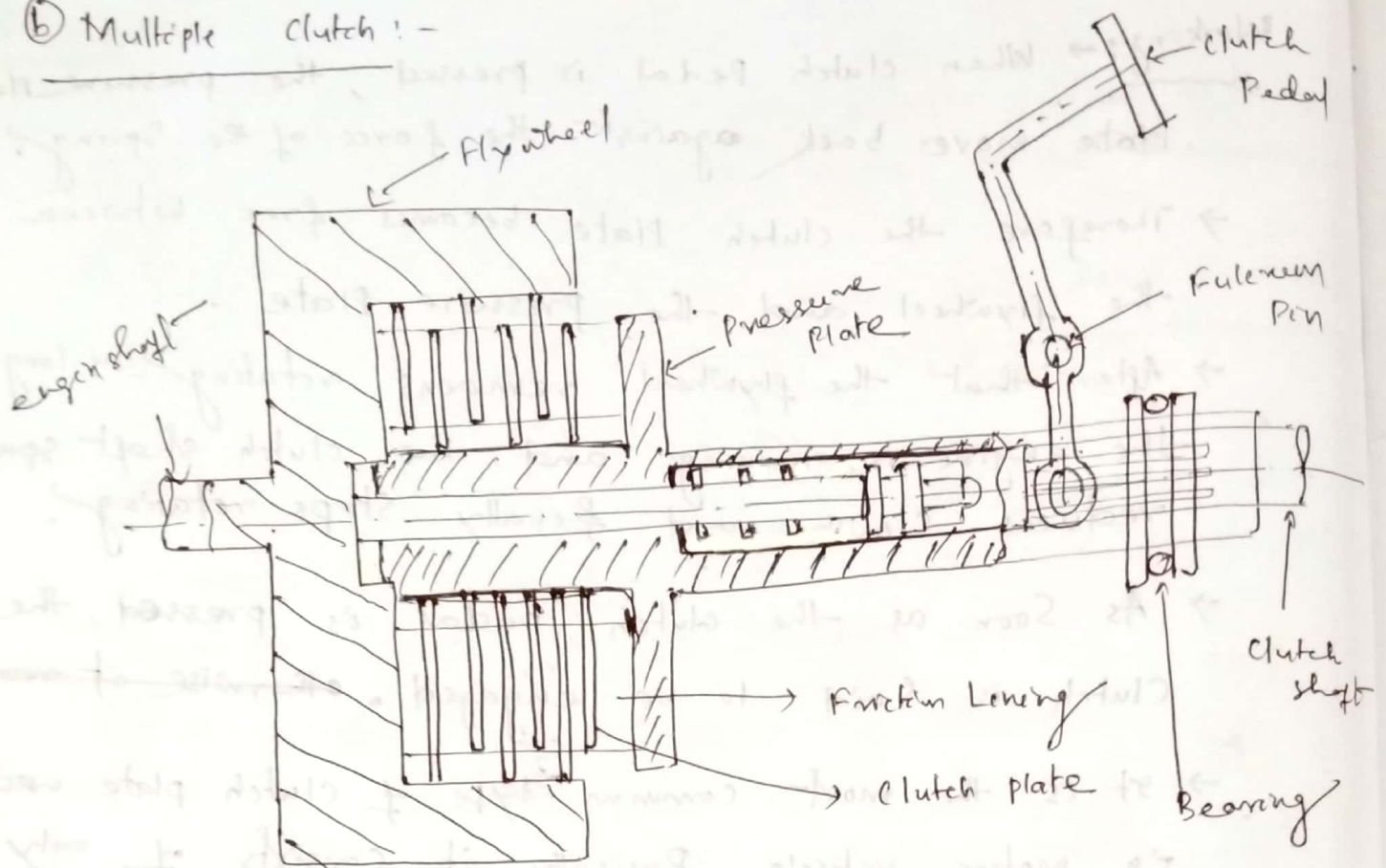
→ After that the flywheel remains rotating as long as  
the engine is running and the clutch shaft speed  
reduces slowly and finally stops rotating.

→ As soon as the clutch pedal is pressed, the  
clutch is said to be engaged. ~~otherwise it remains~~

→ It is the most common type of clutch plate used  
in motor vehicle. Basically it consists of only  
one clutch plate.

→ The single clutch consists of flywheel, clutch pedal,  
pressure plate, clutch shaft, bearing, friction lining, clutch  
spring, engine shaft, pressure plate.

## ⑥ Multiple clutch :-



### Working Principle :-

- Same as Single clutch .
- But in this clutch more number of clutch plates are use .
- This clutch is used for heavy Commercial vehicle , racing cars , motor cycles for transmitting high torque .
- The multiple plate clutch may be dry or wet . when the clutch is operated in an oil bath , it is called as wet clutch and when the clutch is operated in dry , it is called as dry clutch .
- The multiple clutch consists of number of clutch plate . Due to this the friction surface also increase . The increase the friction , then ~~also~~ increase the capacity of the clutch to transmit torque .

## GEAR BOX:-

Purpose of gear box: → A gear box is a mechanical method of transferring energy from one device to another and it is used to increase torque which while reducing speed.

→ The gear box is used to create a right-angle change in direction.

→ In a situation where multiple speeds are needed, the design is commonly found in a transmission with multiple-gear can be used to transmissions.

### Construction & Working of a 4 Speed gear box: →

→ In 4 speed gear, by operating the gear shift lever the external teeth present in the main shaft engage with the large gear of the counter shaft.

→ The main shaft turns along with the clutch shaft and a gear ratio is approximately 1:1 is obtained.

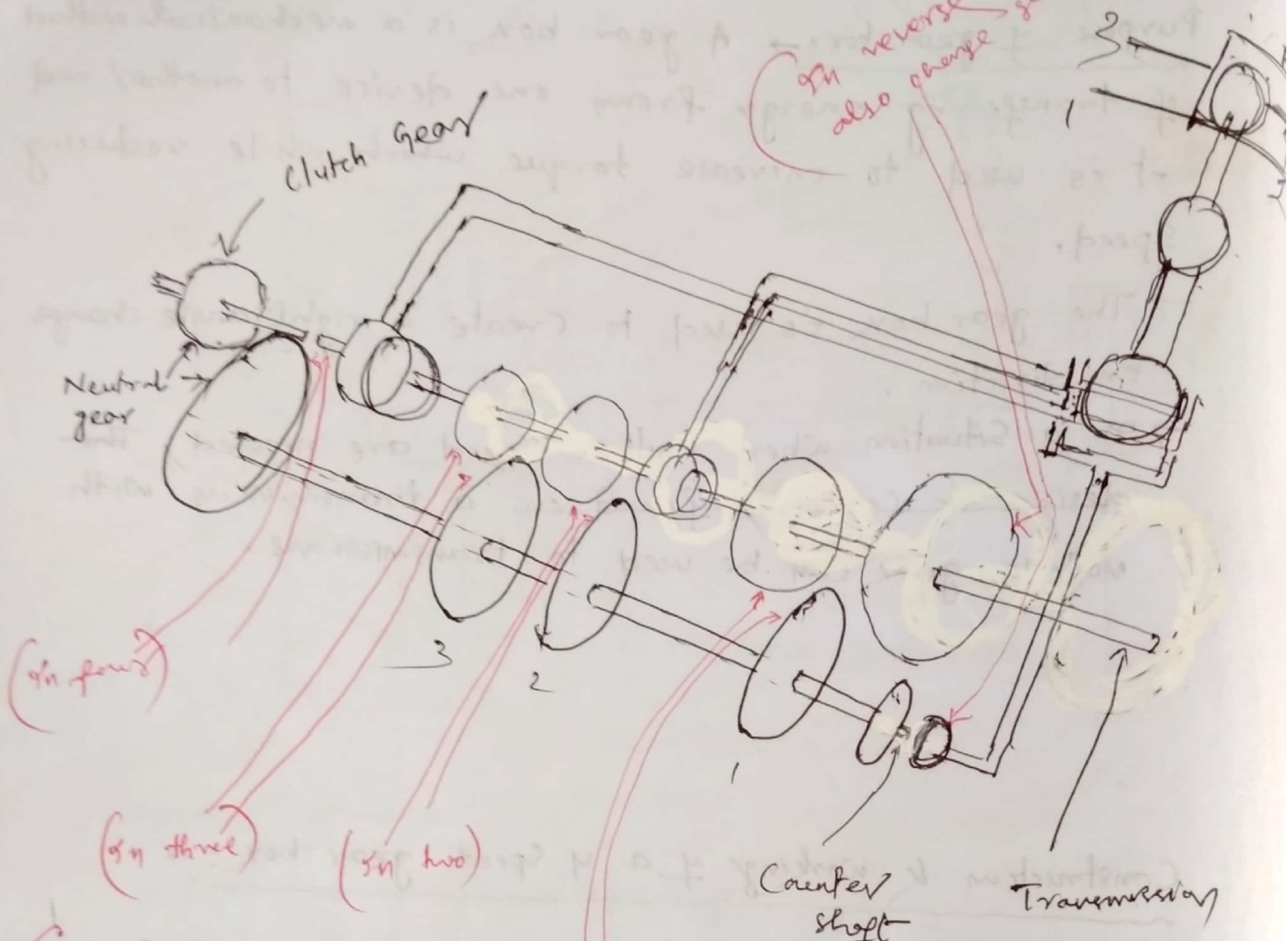
→ In this gear very clutch shaft is very nearly to the main transmission shaft.

→ The main transmission shaft is moving left. After that ~~the gear~~

→ In 1st gear	, gear ratio is	4:1
2nd "	" "	3:1
3rd "	" "	2:1

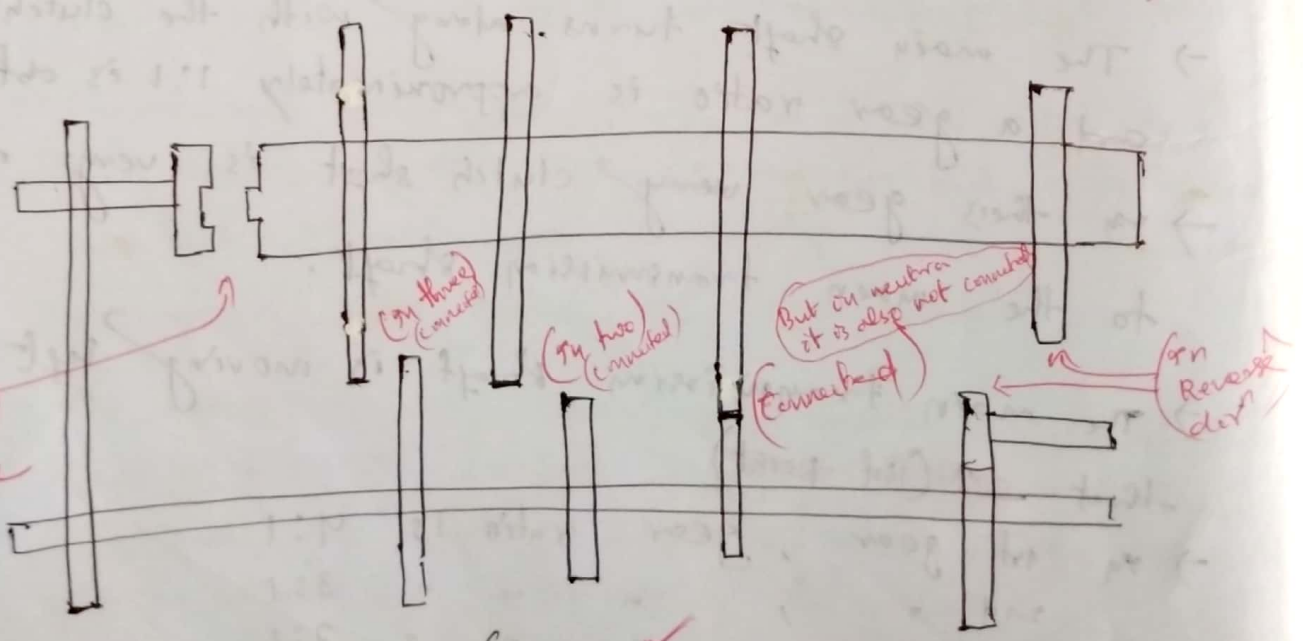
All Gear position : →

Gear or output position : →

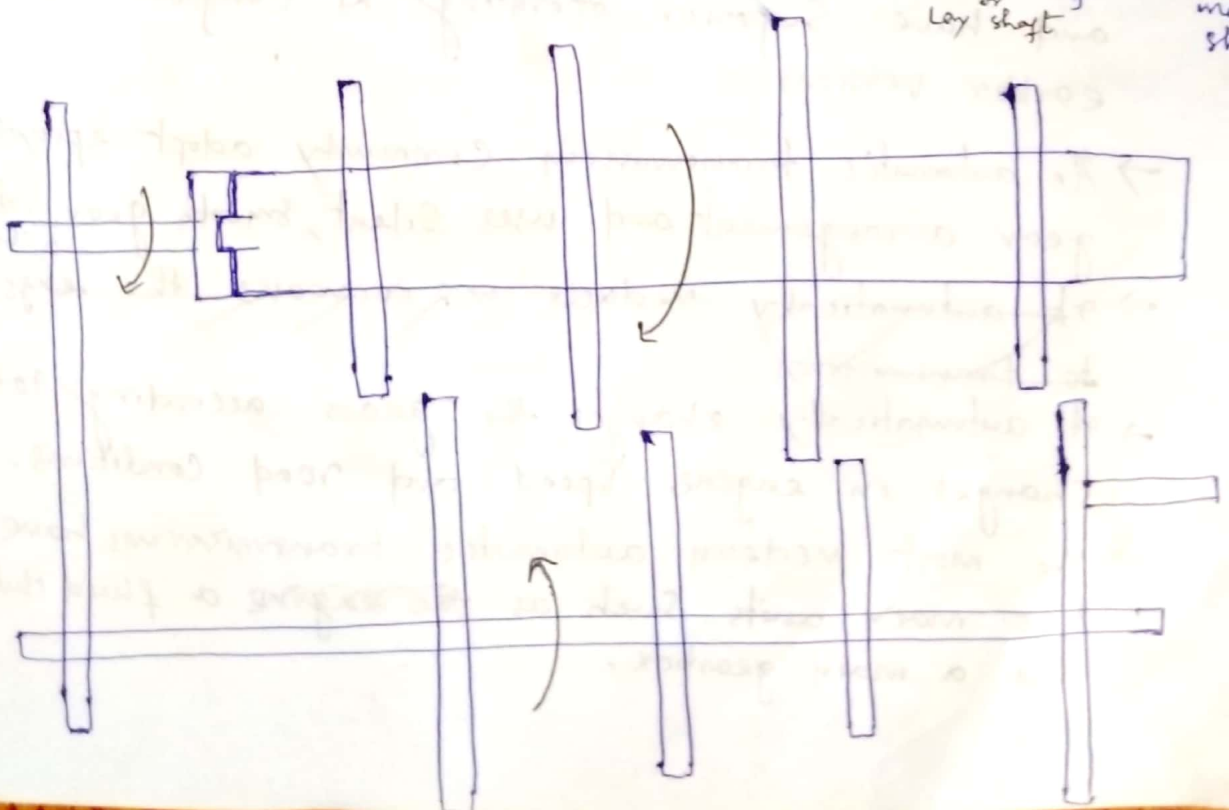
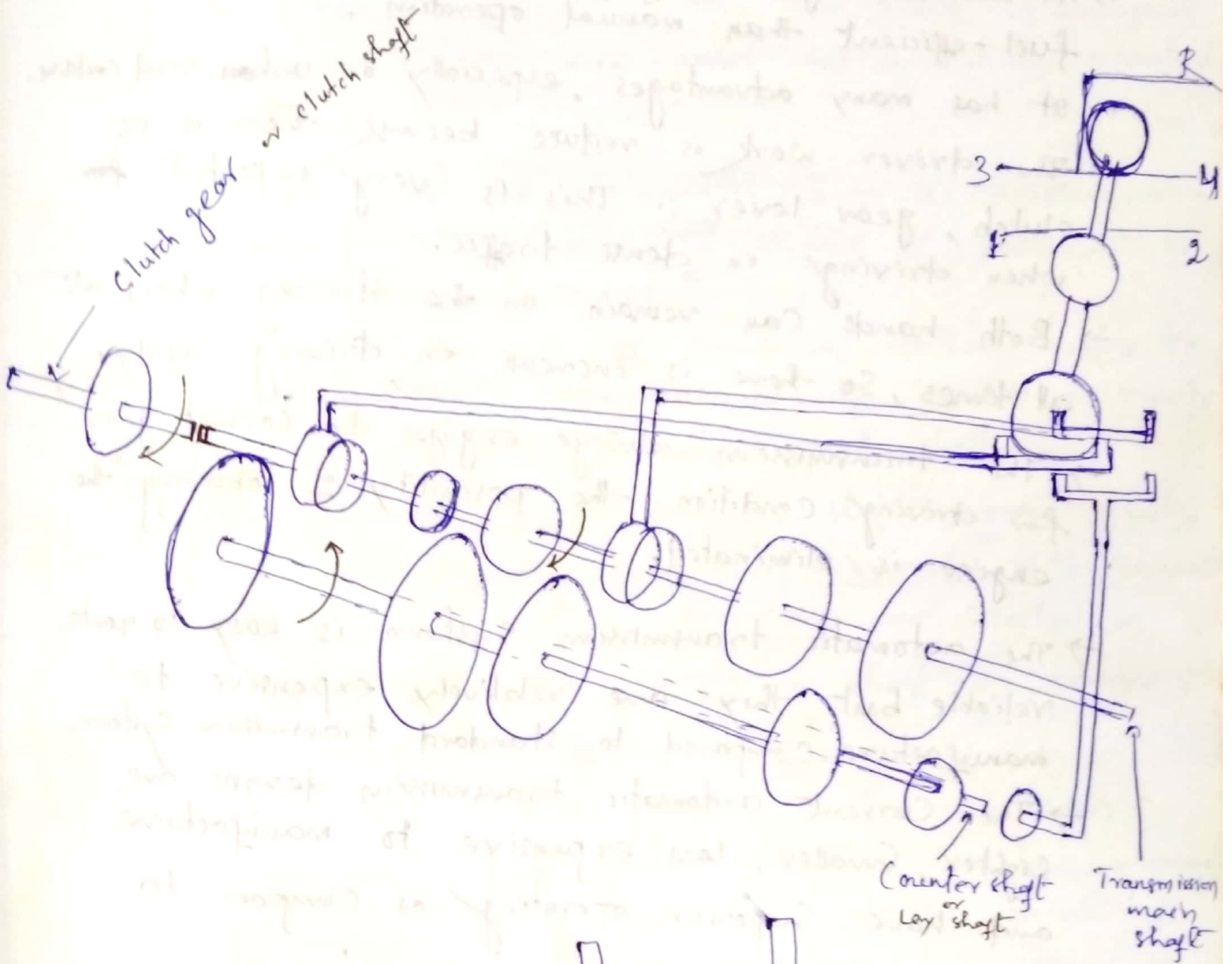


(Also gear handle  
 is change according  
 to gear connected)

9th ~~slow~~ front shaft gear.  
 These are ~~not~~ connected  
 and gear handle on ↓ position



# Construction of 4 Speed Gear box: →



## Concept of Automatic gear changing mechanism or Automatic transmission: →

- An automatic gear changing mechanism are usually less fuel-efficient than manual operation.
- It has many advantages, especially in urban road conditions.
- The driver work is reduce because there is no clutch, gear lever. This is very important for when driving in dense traffic.
- Both hands can remain on the steering wheel at all times, so there is increase in driving safety.
- The transmission always engages the correct gear for driving condition, the possibility of latching the engine is eliminated.
- The automatic transmission system is easy to operate, reliable but they are relatively expensive to manufacture. Compared to standard transmission system.
- The current automatic transmission designs are lighter, smaller, less expensive to manufacture and have superior operating as compare to earlier versions.
- An automatic transmission commonly adopt epicyclic gear arrangement and uses silent, smooth gear ratio changes.
- It ~~automatically reduces or increases the engine to transmission.~~
- It automatically changes the gears according to the changes in engine speed and road conditions.
- The most modern automatic transmissions have two main units such as ~~the engine~~ a fluid clutch and a main gearbox.

## Propeller shaft :-

The " " Sometimes called as a Cardan shaft, transmit power from the gearbox to the rear axle. Normally the shaft has a tubular section and is made in one or two piece construction. The two piece is arrangement is supported at the mid point by a rubber mounted bearing.

→ This shaft must be strong to resist the twisting action of the driving torque and it should be resilient to absorb the torsional shocks.

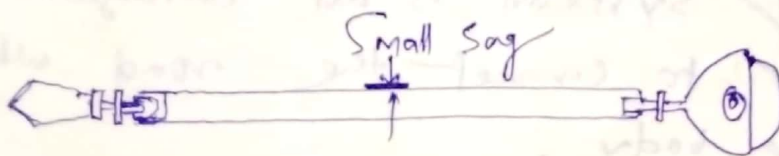
→ It must resist the natural tendency to sag under its own weight because ~~vibration~~ the centre of gravity does not coincide with the axis of the shaft.

→ Critical Speed of the propeller shaft - varies directly as the diameter of the tube and inversely as the square of the length. Therefore diameter are selected as large as possible and length as short as possible.

→ Many vehicles with rear and four wheel drive require a long propeller shaft to span between gear box and final drive. In these situations a bearing is fitted to support the shaft at the point of division. This bearing is mounted in rubber to absorb any vibrations.

## Types :-

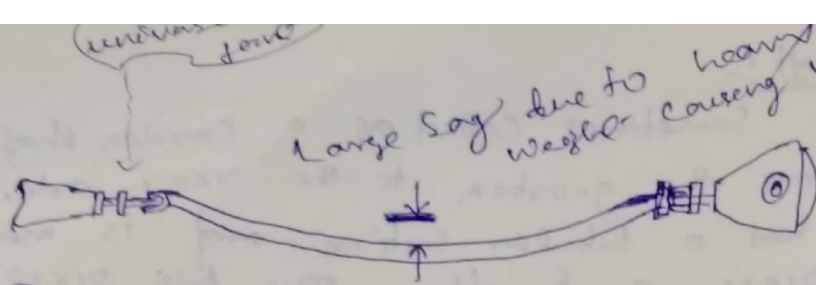
①



(Light weight tubular shaft)

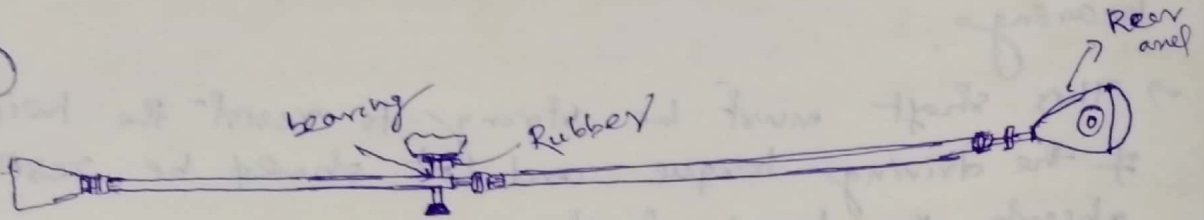


(i)



(Large ~~weight~~ weight tubular shaft)

(ii)



(Long shaft require a centre bearing)

Need :-

- (i) Weight reduction by about 50%.
- (ii) High external shock absorption.
- (iii) Noise, vibration absorption.
- (iv) Corrosion resistance.

working :-

- The propeller shaft connected gearbox to the ~~front~~<sup>rear</sup> axle of the vehicle through universal joint and serves as drive shaft.
- A universal joint allows the drive to be transmitted through a variable angle.
- The driving system is an arrangement for transmitting to connect the road wheels to the vehicle body.
- The ~~front~~ rear axle is the transmission system between propeller shaft and differential. The differential mechanism is built into the centre portion of the final drive.

→ This permit the drive wheel to rotate at different speed without interfering with the propulsion of the vehicle while taking a turn.

## BRAKING SYSTEM:-

Need:- (i) The vehicle should stop within a reasonable distance.

(ii) The retardation should be smooth.

(iii) Permit the operator to retain control of the vehicle.

(iv) Economical maintenance and adjustment.

(v) High reliability and highest degree of safety on road.

Types:- There are following types of braking systems

(i) Mechanical Brake.

(ii) Hydraulic " "

(iii) Air " "

(iv) Air assisted hydraulic brake.

(v) Vacuum brake.

### (i) Mechanical Brake:-

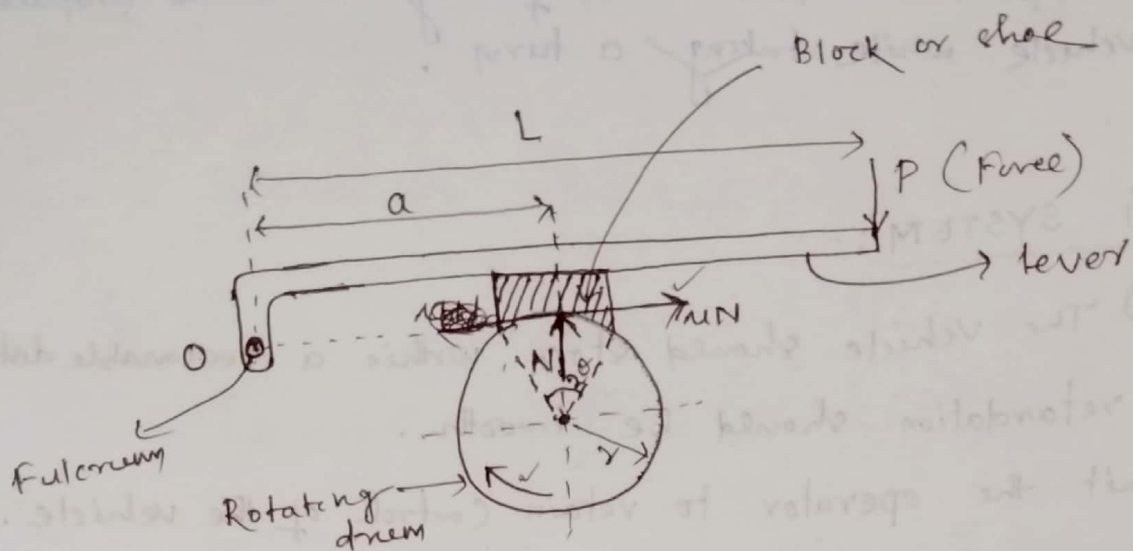
The mechanical brakes arrest the energy of a machine via force, most commonly in the <sup>form</sup> ~~type~~ of friction.

→ The mechanical brakes ~~are~~ function via force delivered to a body in rotary or linear motion, such as an axle, shaft, wheel to slow or stop motion.

→ Mechanical brake are assemble with a mechanical clutch for engaging and disengaging shafts.

→ There are following types of mechanical brakes.

# ① Sample Block or shoe brake:-



→ A Single block or shoe brake consists of a block or shoe which is pressed against a rotating drum. The block is rigidly fixed to the lever and the other end of the lever is pivoted on a fixed fulcrum (O). As the force is applied to the lever, the block is pressed against the rotating drum. The friction between the block and the drum causes tangential force to act on the drum, which is prevent the rotation of the drum.

→ The block is made of a softer material than that of the drum so that the block can be replace easily on wearing. For light and slow vehicle wood, rubber are used where as for heavy ~~and~~ cast steel is used.

- Let
- $P = \text{Force}$
  - $r = \text{Radius of the drum,}$
  - $\mu = \text{Co-efficient of friction,}$
  - $N = \text{Normal reaction on the shoe}$
  - $2\theta = \text{Angle made by contact surface of the block at the centre of the drum.}$

$F = \text{Frictional force} = \mu N$

$T = \text{Braking torque.}$

\* Braking torque of the drums = Frictional force  $\times$  Radius

$$= F \times r$$

$$\Rightarrow \boxed{T = \mu N \times r} \quad \text{--- (1)}$$

\* Taking moment about 'O' point.

$$N \times a = P \times L$$

$$\Rightarrow N = \frac{P \times L}{a} \quad \text{--- (2)}$$

\* Now substituting putting the value of 'N' in eq<sup>n</sup> (1)

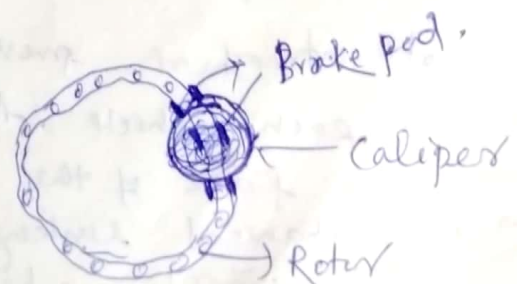
$$\therefore \boxed{T = \mu \left( \frac{P \times L}{a} \right) \times r}$$

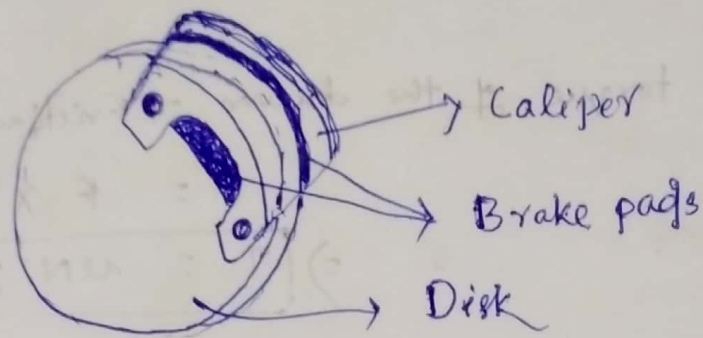
The value given ~~of~~ braking torque, when the line of action of the frictional force passes through the fulcrum 'O' of the lever.

### Disc Brake:-

→ Disc brakes utilize a metal disc, also called a rotor, that is connected to the axle.

→ The rotor spins between a caliper that contains between one and 12 cylinders, which pushes a lining material ~~and~~ fitted on a brake pad against the rotor surface.





### Air Brake:-

- A Air brake worked by air pressure. Similar to the hydraulic brake.
- It is mainly use to reduce speed of aircraft.
- An air brake, a compressed air brake system, is a type of friction brake for vehicle.
- In this brake compressed air pressing on a piston is used to apply the pressure to the brake pad needed to stop the vehicle.
- Air brake are used in large heavy vehicle such as trucks, buses, trailers and semi-trailers, in addition to their use in railroad trains.
- George Westinghouse first developed air brakes for use in railway service.

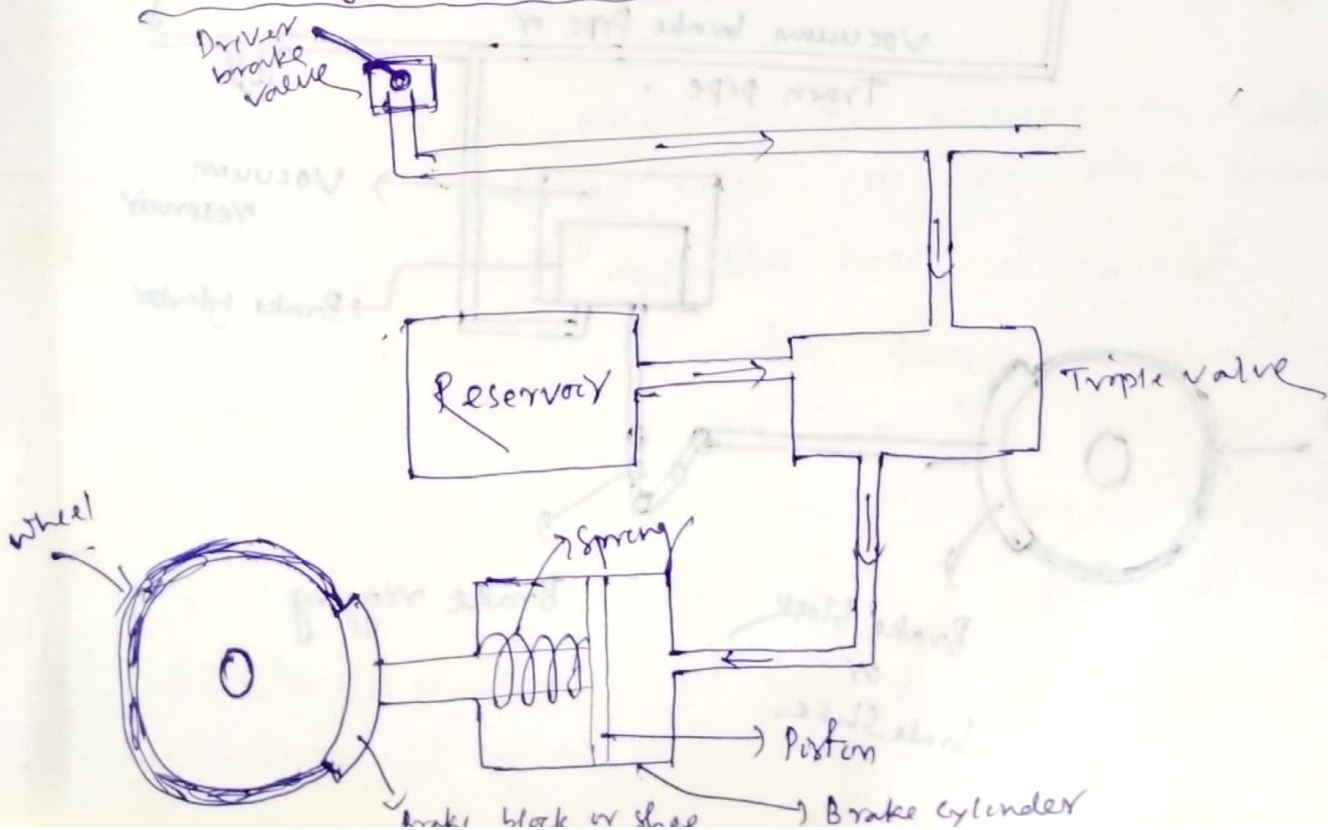
### Vacuum brake:-

- In simplest form, the automatic vacuum brake consists of train pipe throughout the length of the train.
- In normal running a partial vacuum is maintained on the train pipe.
- When air is admitted to the train pipe, the air at atmospheric pressure acts against piston in cylinder in each vehicle. A vacuum is sustained on the other face of the piston, so that net force is applied.
- A mechanical linkage transmits this force to brake shoes which act on the wheels.

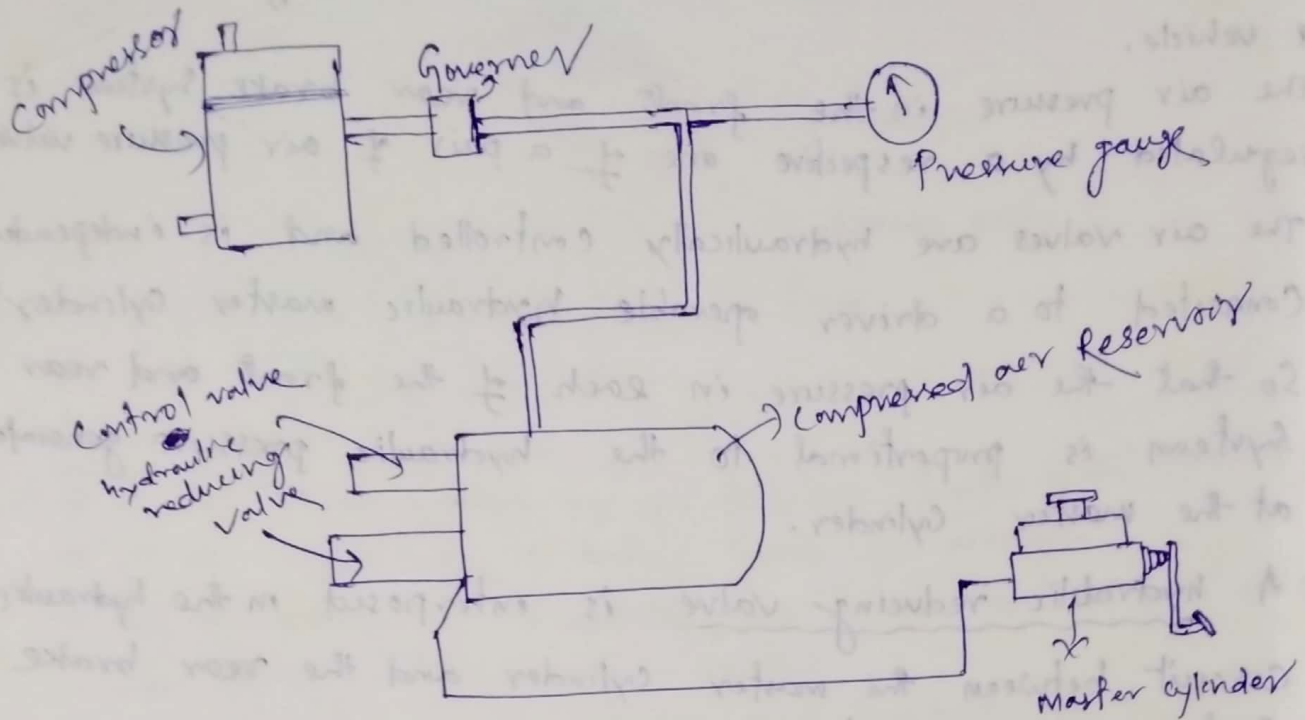
## Air assisted hydraulic brake: →

- This invention relates to an air power braking system for a vehicle.
- The air pressure in the front and rear brake system is regulated by a respective one of a pair of air pressure valves.
- The air valves are hydraulically controlled and is independently connected to a driver operable hydraulic master cylinder, so that the air pressure in each of the front and rear system is proportional to the hydraulic pressure generated at the master cylinder.
- A hydraulic reducing valve is interposed in the hydraulic circuit between the master cylinder and the rear brake system, ~~and operation of~~
- In this braking system, the operation of the reducing valve reduce the hydraulic pressure to that air valve and hence reduces the air pressure to the rear brakes relative to the air pressure to the front brakes.

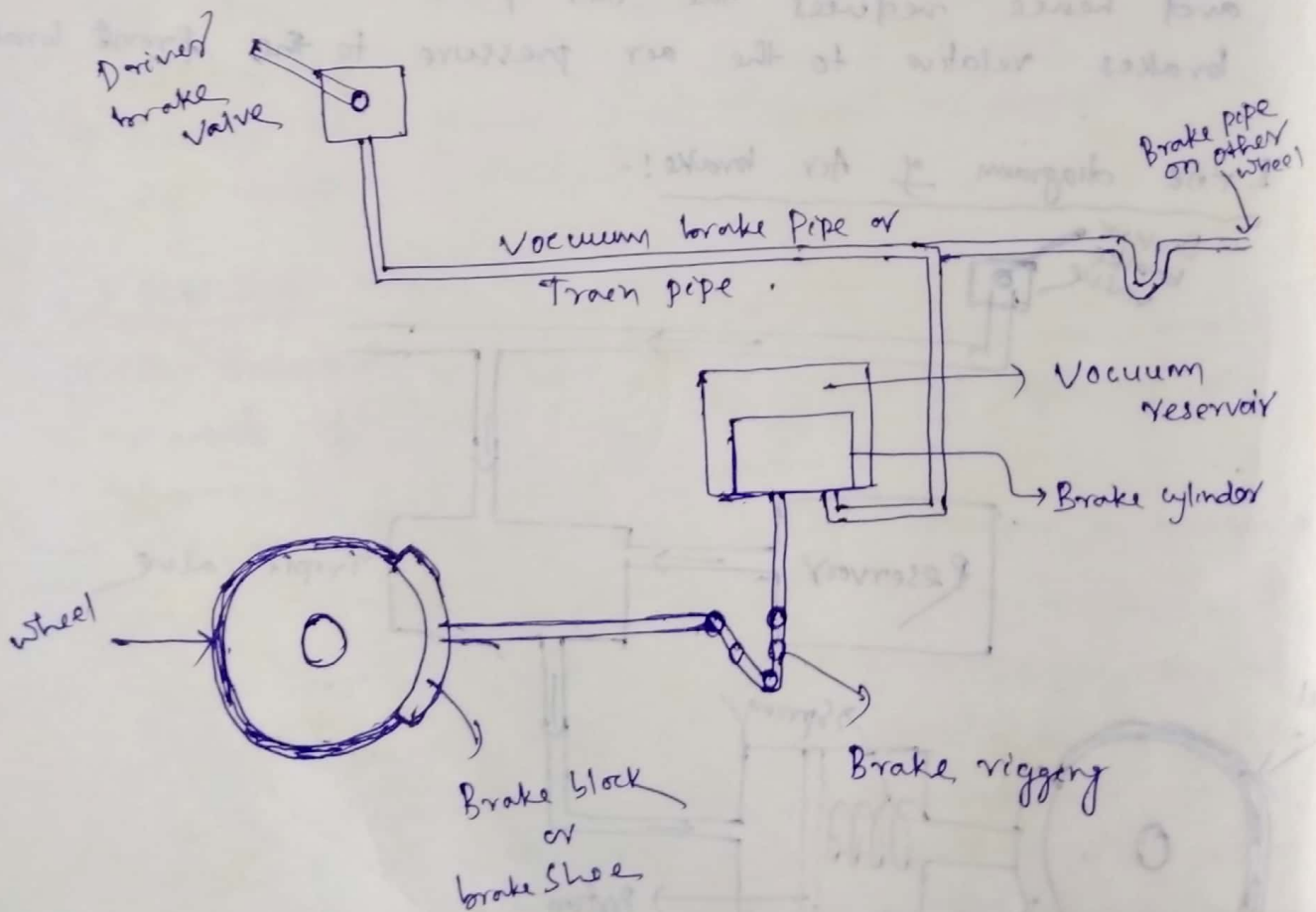
## \* Line diagram of Air brake:-



Line diagram of Air assisted Air brake:-



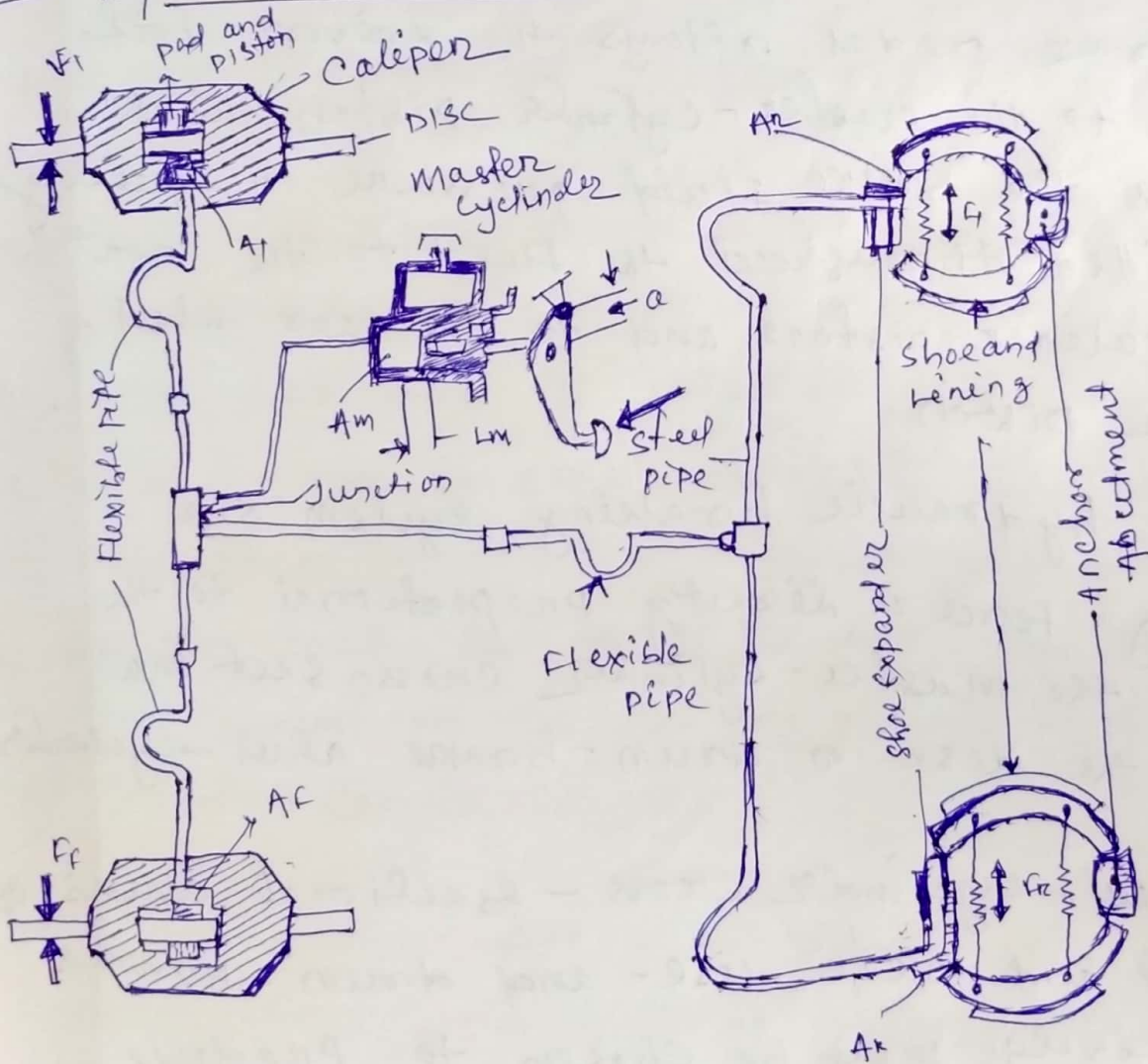
Line diagram of vacuum brake! →





### 3.0 - Braking system

### 3.3 Hydraulic Brake :-



## Construction:—

The hydraulic brake consist of pad and piston, caliper, disc, flexible pipe, junction, master cylinder, foot pedal, flexible pipe, steel pipe, shoe and lining, shoe expander, anchor about ment

## Working Principle:—

- A Hydraulic braking System transmits brake pedal force to the wheel fluid pressure into useful work of braking at the wheels.
- A simple, single-line hydraulic layout used to operate a drum and disc brake system is illustrated.
- The brake pedal relays the driver's foot efforts to the master-cylinder piston, which compress the brake fluid pressure is equally transmitted throughout the fluid to the front disc-caliper piston and to the rear wheel-cylinder piston.
- In a hydraulic braking system the braking force is directly proportional to the ratio of the master-cylinder cross-sectional area to the disc or drum-brake shoe-cylinder.
- The wheel-cylinder cross-sectional areas of the front and rear disc- and drum-brakes respectively may be chosen to produce

The best front-to-rear braking ratio,  
Hydraulic fluid is incompressible provided there is no trapped air in the system. If air is present in the braking circuit, the foot-brake movement become spongy.

→ The friction is caused by the fluid pressure squeezing the seat lips against the cylinder walls as the piston moves along stroke.

Advantages over the mechanical layout :-

- 1- This provides equal braking effort on all wheels.
- 2- This requires relatively less braking effort to deliver the same output.
- 3- This is a fully compensated system so that each brake receives its full share of the pedal efforts.
- 4- The efficiency of the hydraulic system is greater.
- 5- It is easy to alter thrust on shoe because the force exerted on a piston depends on the piston area. The larger the area, the greater the thrust on the trailing shoe, so a larger piston can be used.

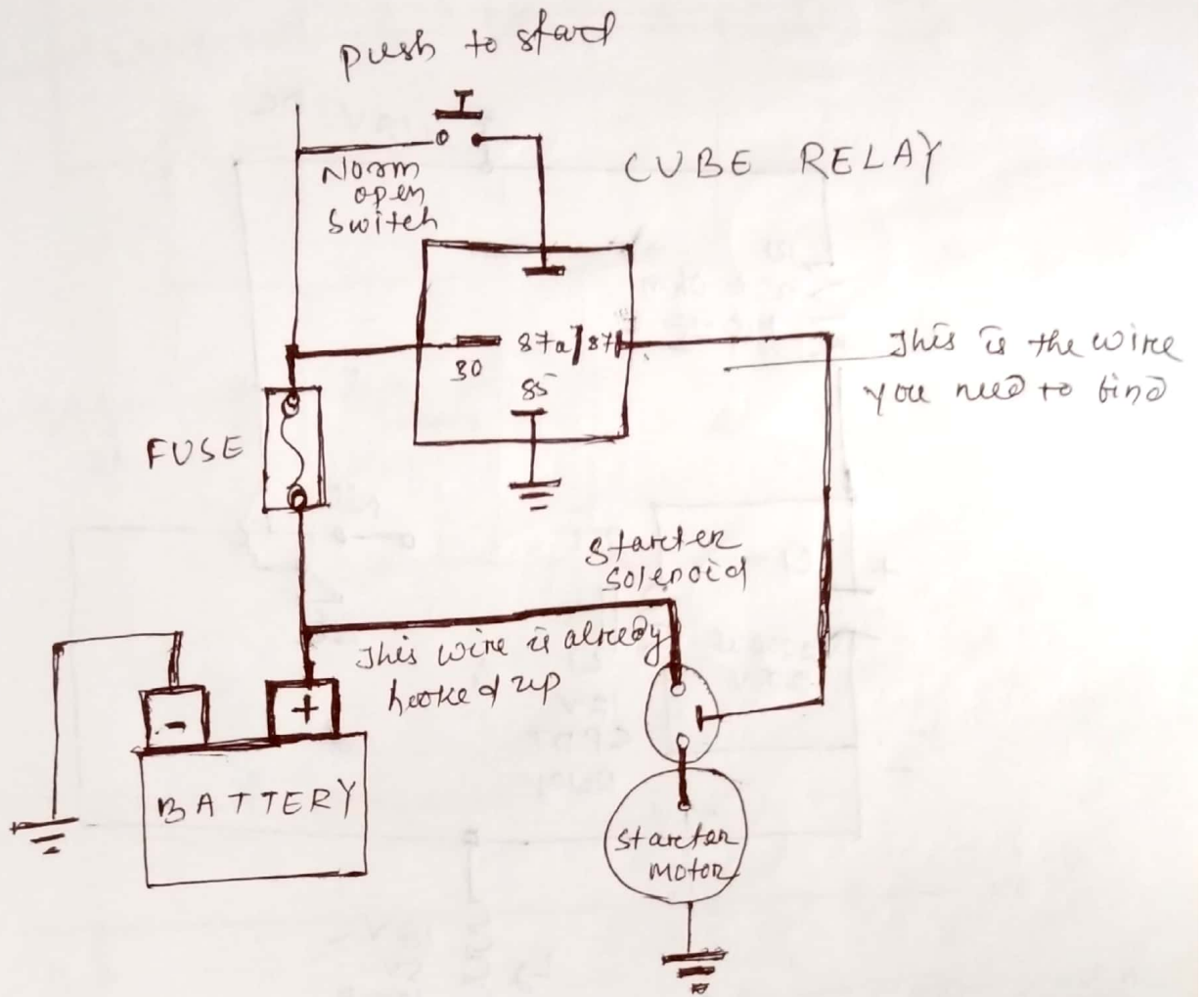
## 3.4 Air operated power Brake system

### Principle: -

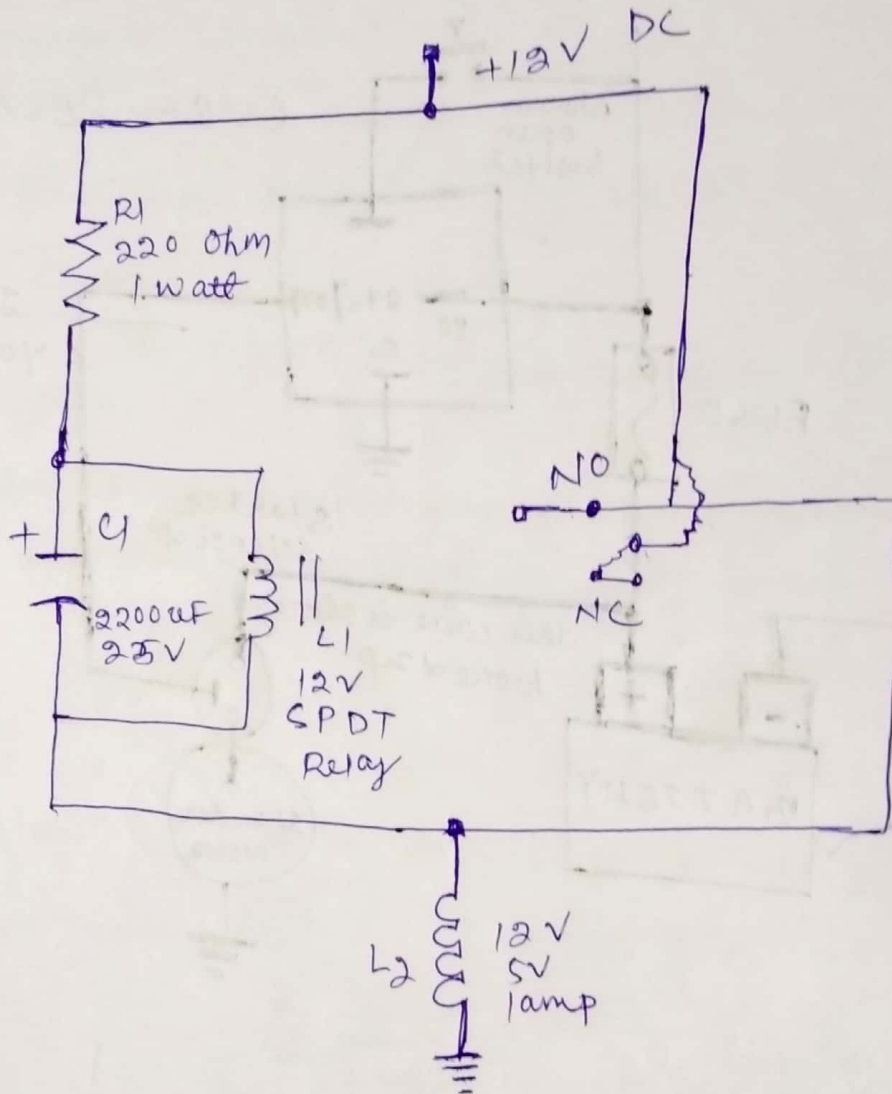
- As the size and weight of road vehicle increases, beyond a certain level, manual brakes become inadequate and hence providing power assistance to the braking system is not meaningful as the contribution by the drivers foot is insignificant relative to the assisted source of power to be it vacuum or hydraulic energy.
- The majority of heavy commercial or public service vehicles are propelled by diesel engines.
- Engine driven reciprocating compressors can operate efficiently trouble-free at pressure range of 690 to 785 kpa, whereas vacuum assisted brakes can only work at the most up to 88 kpa vacuum.
- Compressed air has a power factors advantages of between 7 and 8 times over an equivalent vacuum energy source for transmitting a force.
- The hydraulic pumps are required to work at a pressure range of 4905 to 5885 kpa and the pressures generated in the pipelines may reach values of 9810 kpa or even more.
- A compressed air operated brake system requires pressure of only one-tenth wear of damage.

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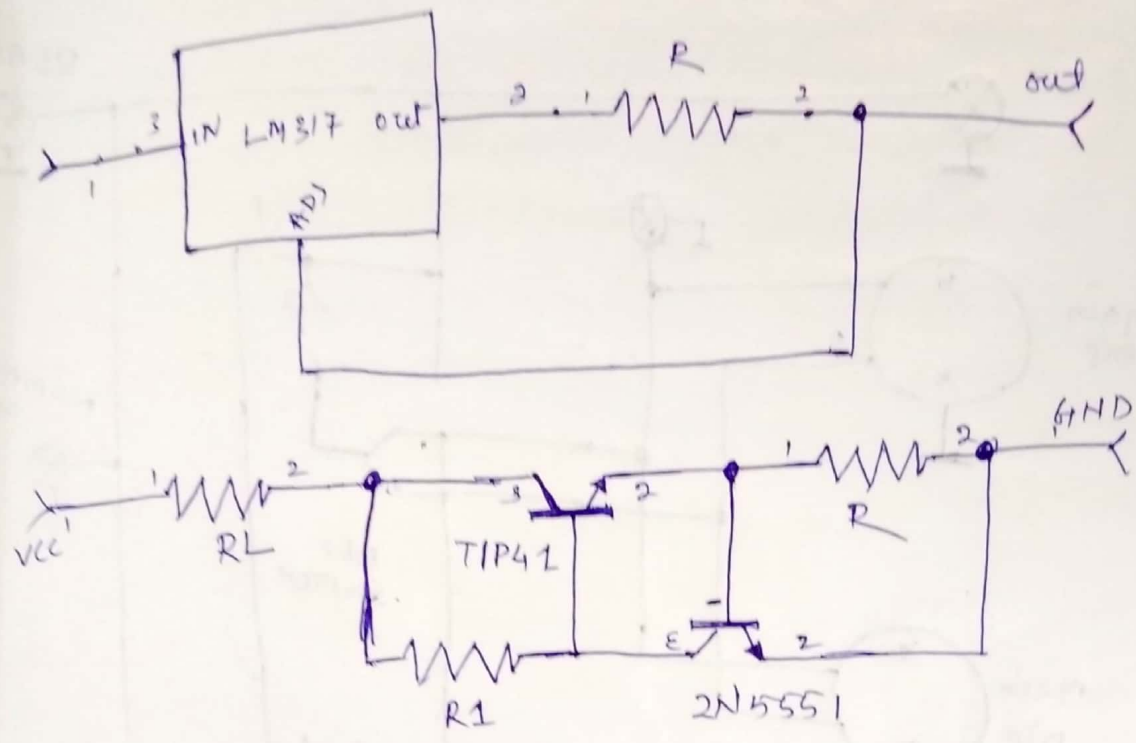
Home circuit Diagram :-



# Flasher circuit :-



Current Regulator circuit: -



Cut-out circuit Diagram: -

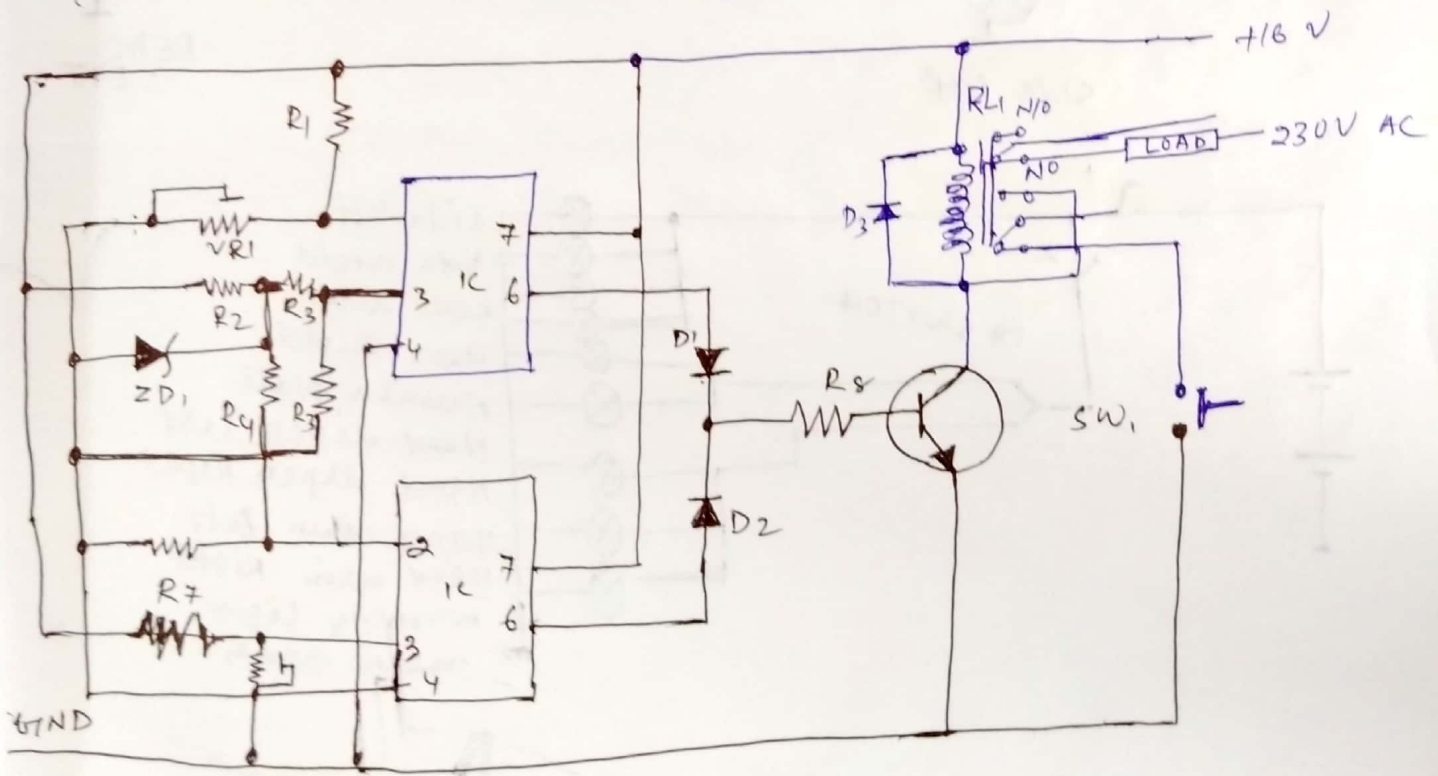
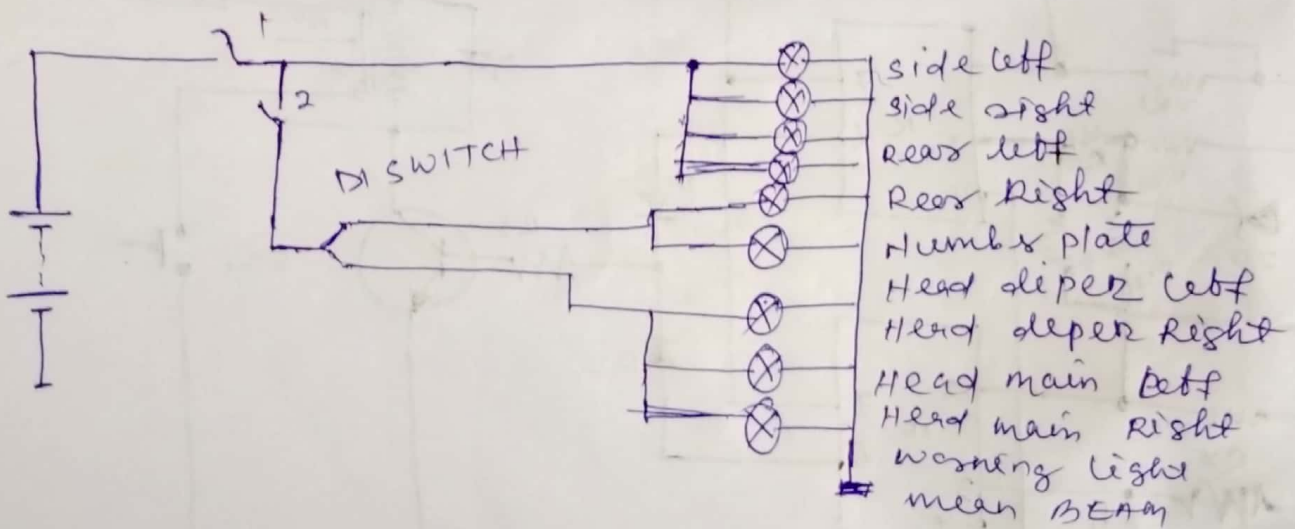
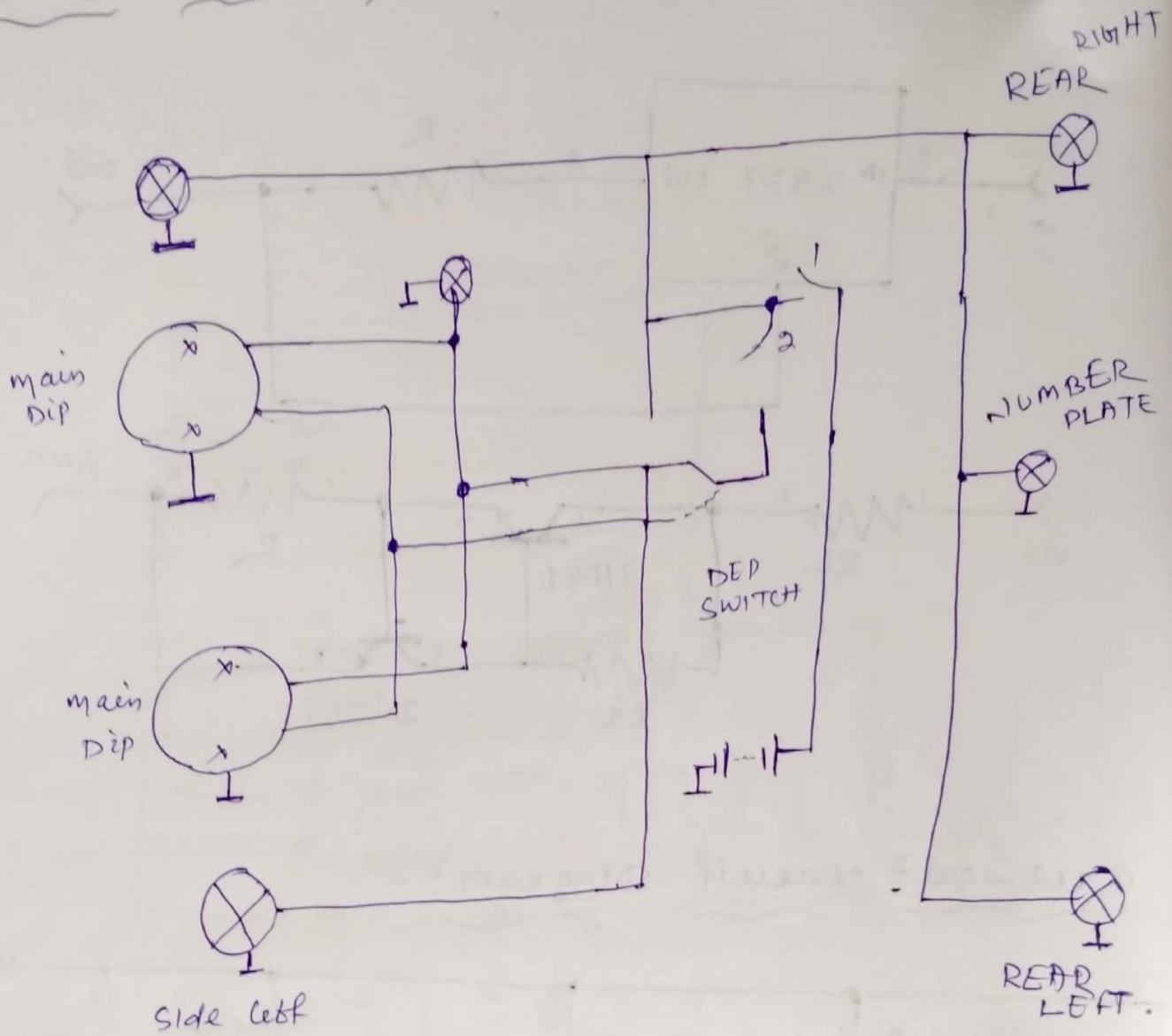


Diagram of High-Low voltage cutout circuit.

# Lighting Circuit Diagram :-





## \* Conventional Suspension system for front axle.

→ The leaf Springs are placed on the front axle  
→ ~~They are~~ <sup>by this axle fitted</sup> fitted with 2 balls of leaf springs.  
This arrangement of Springs on axle is called front Suspension.

→ If there are two wheels fitted to the front axle, the axle is rigid. No support that the vehicle is moving on the road with one wheel & just riding over a bump.  
In this case the axle become inclined the

Position.

→ This is also observe vibration during moving Rear axle.

→ The rear axle is so design as to carry most of the extra load.

→ In this axle housing is connected.

→ The housing is ~~supp~~ consists of leaf Springs & shafts.

→ This is also observe vibration during moving vehicle.

→ This most important for the heavy vehicle motor.

## 6.0 cooling and lubrication

### 2.1 Necessity of engine cooling :-

- The engine cooling must be necessary to avoid engine block/ seize.
- It reduce operation noise.
- It reduce friction and prevent metal to metal contact between the working part of the engine.
- It protect working surface against corrosion.
- It form the sealing medium between the piston ring and cylinder wall.

### 7-2 Defect of cooling and their remedies' -

- The water leakage and water evaporated in are the main cause of the ~~crack~~ cooling system.
- It also may crack head and radiator or pipe leak.
- It may loose cylinder head.

There are ~~four~~ following type of cooling defect

- 1 - over cooling of coolant defect
- 2 - water circulating pipe defect
- 3 - defective temperature gauge.
- 4 - overheating of coolant defect.

## Over cooling of coolant defect :-

Cause: -

→ Over cooling is generally caused by thermo stat that of an too early or remain open at all time

→ Remedies: -

to avoid this effect defective thermo stat must be replaced.

## Water circulating pipe or pump noise defect :-

Cause: -

→ water pump give noise due to dry bearing or bushing.

→ other cause are a loose pulley on the pumped shaft and loose impeller on the shaft

Remedies: -

→ Lubricant must be used in bearing, bushes

→ Properly tight the pulley and impeller

## Detective temperature gauge :-

→ If the temperature gauge on the panel is giving incorrect reading, the temperature of the cooling water

Remedies: -

→ If the gauge engine is found defective it should be replaced.

## Overheating of coolant defect :-

Cause: -

→ This is cause due to rusting of radiators or water jacket.

→ This is also due to less of cooling water

→ slipping of fan belt.

Remedies: -

→ cleaning the radiators by ~~to~~ blocking of air

→ tighten the fan belt as per requirement

### 7.3 Function of Lubricant :-

→ The engine cooling must be necessary to avoid engine block or seize

→ It reduce the engine noise

→ It reduce the friction and prevent metal to metal contact between the working part of the engine.

→ It forms the sealing medium between the piston ring and cylinder wall

→ It protect working surface against corrosion

### 7.4 Lubrication System of IC Engine :-

There are two types: -

(i) Lubricant system for petrol engine

a - splash system

b - full pressure system

(ii) Lubrication system for petrol engine: -

In order to supply of oil to engine parts, a reservation of oil is provide by the lubrication system.

## \* Function of Lubrication:-

- It reduces operation noise.
- It reduces friction & prevents metal to metal contact between the working parts of the engine.
- It protects working surface against corrosion.
- It forms a sealing medium between the piston rings and the cylinder walls.
- It removes grits and carbonaceous deposits of the working surface.

## \* Lubrication System of I.C. engine:-

There are two types:-

① Lubrication System for petrol engines

(a) Splash System.

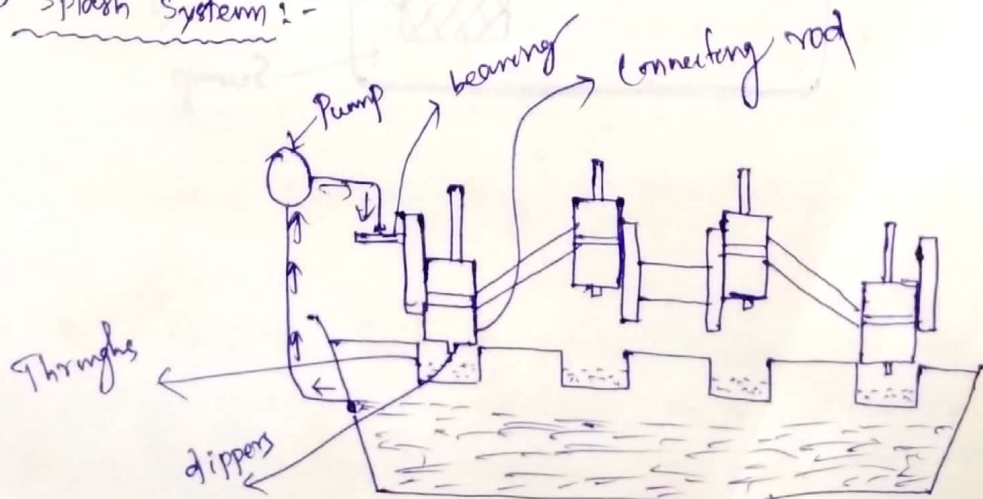
(b) Full pressure System.

② Lubrication for diesel engines.

### ① Lubrication System for petrol engines:-

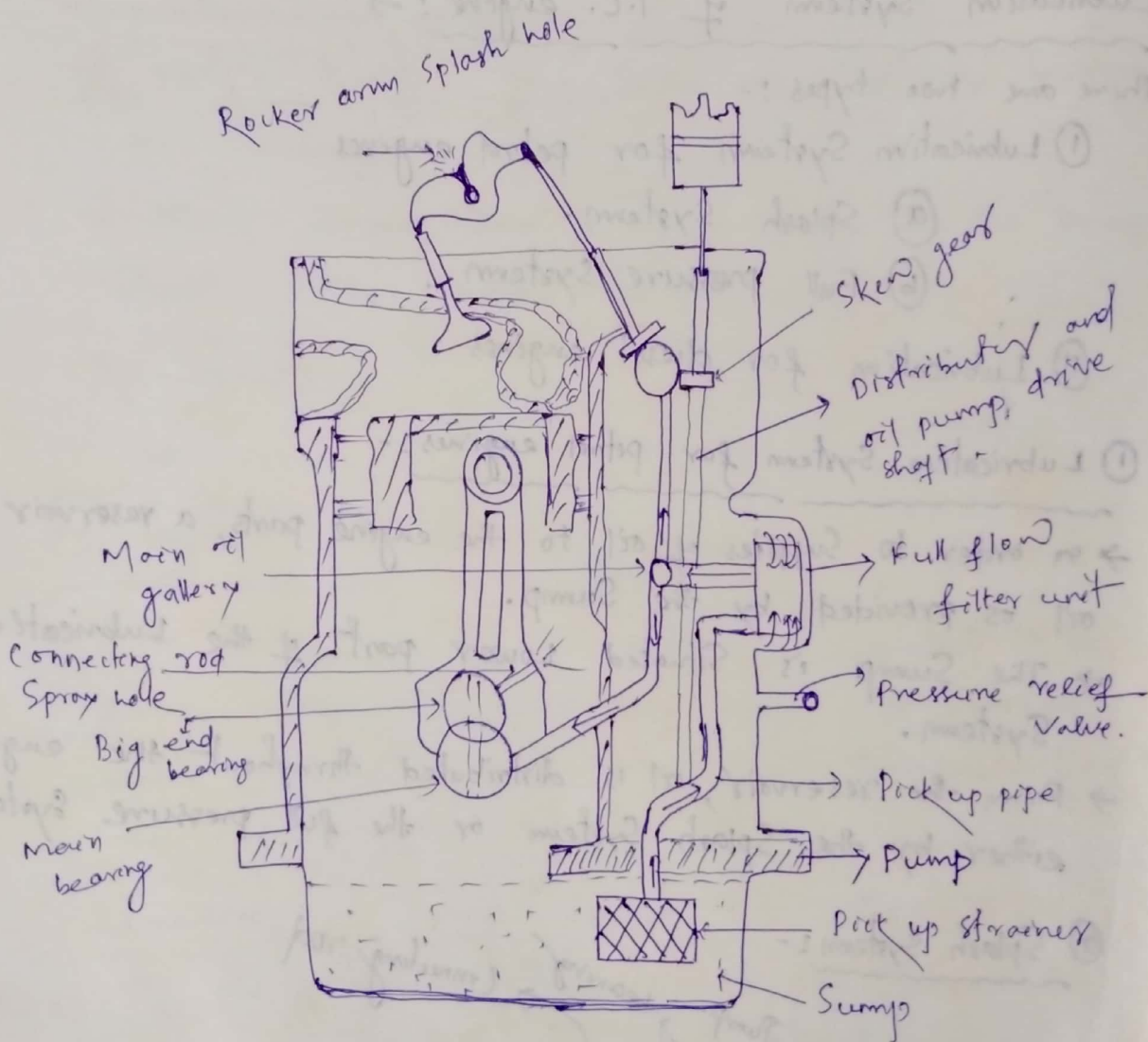
- In order to supply oil to the engine parts, a reservoir of oil is provided by the Sump.
- The Sump is situated lower part of the Lubrication System.
- From the reservoir, oil is distributed throughout the engine either by the Splash System or the full pressure system.

#### (a) Splash System:-

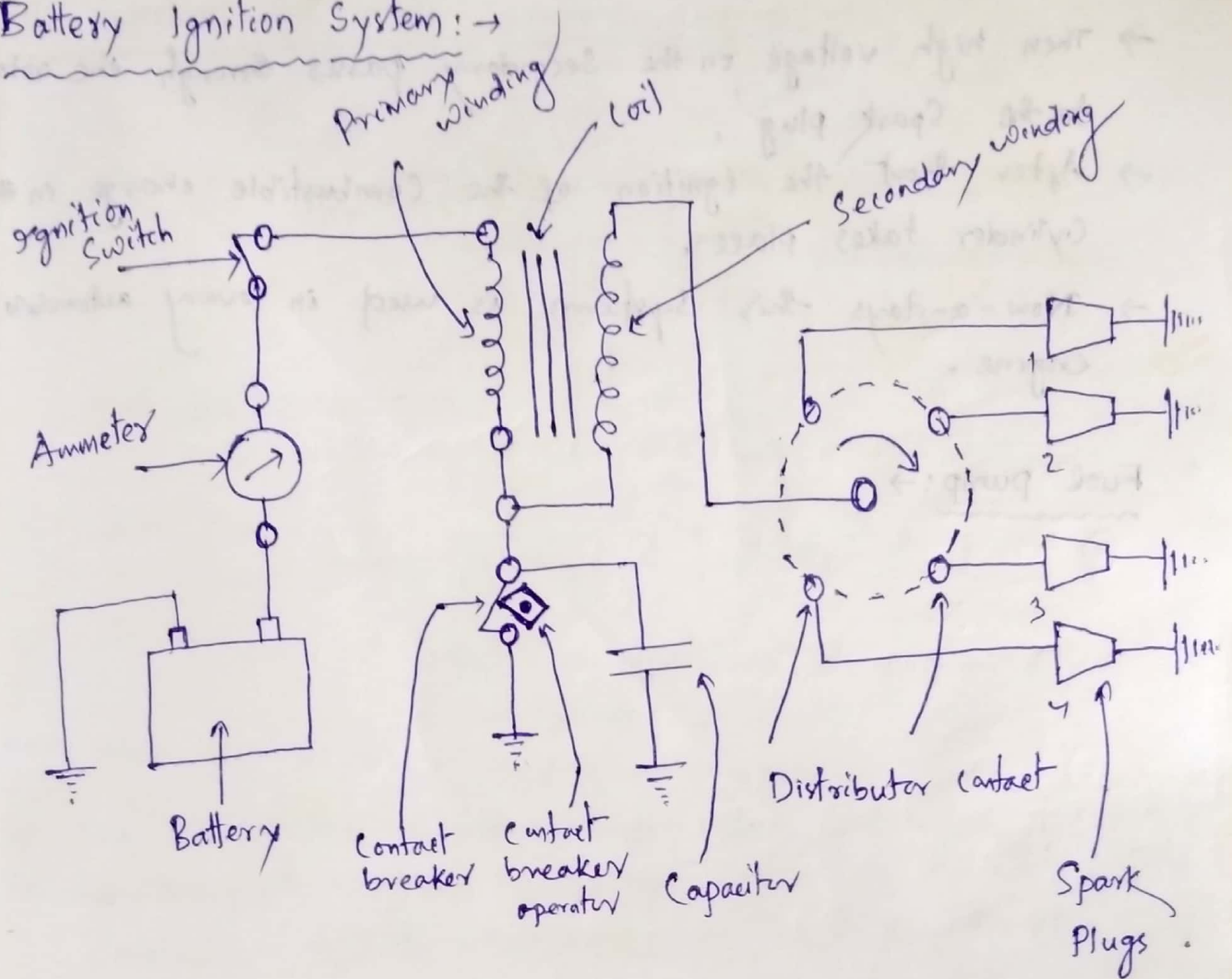


- This system consists of through, pump, dipper, bearing, connecting rod,
- In the splash system the oil is maintained in little throughs,
- There are dippers at the ends of the connecting rods to splash the oil on the various parts like cylinder walls, camshafts,
- The oil is supplied to the main bearing under pressure due to an oil pump.
- This system is now practically obsolete.

(b) Full pressure system! →



## Battery Ignition System: →



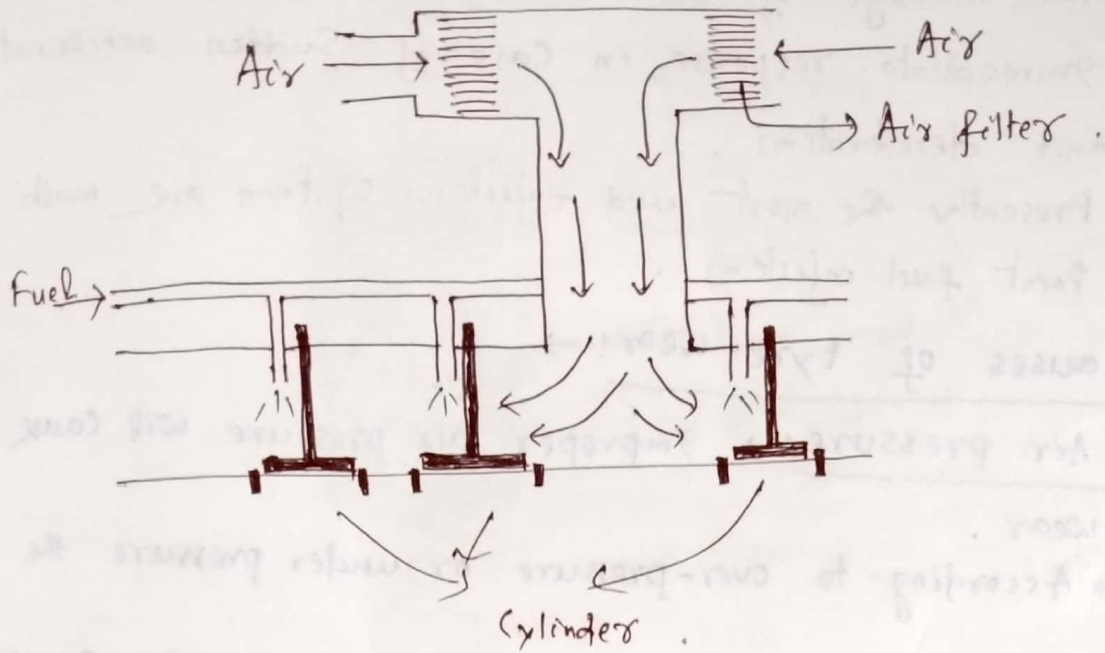
- The Battery Ignition System consists of Battery, Ammeter, Ignition Switch, Spark plugs - - - - -
- The System has a primary circuit of low-voltage current and a secondary circuit for a high voltage ~~current~~ current.
- The primary circuit consists of the battery, ammeter, ignition switch. The primary coil winding approximately 240 turns of copper wire.
- The secondary circuit consists of distributor contact, Spark plugs. The secondary coil winding approximately 21000 turns of copper wire.
- In this ignition system, when ignition switch is on, the low voltage current is produced on the primary winding & high voltage current produce on secondary winding.

- Then high voltage in the secondary passes through the rotor to the spark plug.
- After that the ignition of the combustible charge in the cylinder takes place.
- Now-a-days this system is used in every automobile engine.



## Fuel injection for multi cylinder engine: →

→



→ The petrol vehicle uses device called carburetor for supplying the air fuel mixture in correct ratio to cylinder. The construction of the carburetor is relatively simple.

→ So in order to get all these, we need a carburetor that must be connected in various cylinders to do the above function. It makes a more complex shape.

→ So in place of carburetor, therefore multi point fuel injection is used in multi cylinder engine, that converts proper air fuel ratio to the engine by electrically injecting fuel in according to various driving conditions.

## Advantage of fuel injection for multi cylinder engine: →

→ More uniform air-fuel mixture will be supplied to each cylinder.

- The vibration produce in this engine is low.
- The mileage of the vehicle is improved.
- Immediate response, in case of sudden acceleration and deceleration.
- Presently the most used injection system are multi point fuel injection.

### \* Causes of tyre wear: →

① Air pressure: → Improper air pressure will cause tyre to wear.

→ According to over-pressure or under pressure the tyre <sup>to</sup> wear.

② Balance issues: → Improper balance will cause the tyre to spin due to unbalanced centrifugal forces.

→ This will cause the tyre to wear improperly and after that vibration will produce.

③ Bent wheels: → A bent wheel, in addition to probably causing a vibration in the vehicle.

→ This will affect the tyre wear.

④ Alignment: → A 4-point alignment essentially ensures that the tyres are all parallel to each other, if the alignment is incorrect, any types of wear can develop.

### Remedies of tyre wear: →

→ Air pressure must be limited.

→ Tyre must be balance to road.

→ All tyre of vehicle must be parallel.

→ The tyre can't be bent. It must be vertical to road.

## 4.0 Auto Electric System

4.1 state the common ignition troubles and its remedies :-

Causes :-

- 1 - High resistance in open circuit.
- 2 - primary short - circuit defective, coil
- 3 - Defective condenser
- 4 - generator voltage excessive
- 5 - high resistance of primary circuit
- 6 - too less tension on breaker arm spring
- 7 - Breaker can not lubricated
- 8 - loose condenser lead
- 9 - Corrosive combustion gases
10. much advance of ignition

Remedies :-

- 1 - Test and replace the defective coil
- 2 - Replace the coil
- 3 - Replace the condenser
- 4 - Adjust to proper value
- 5 - clean the point and replace the resistance
- 6 - Adjust to correct force
- 7 - Lubricated the broken
- 8 - Tight condenser
- 9 - use proper fuel
- 10 - Adjust ignition.

### 4.3 Functional Requirements :-

- The spark plug allows a spark to form within the combustion chamber, which initiates burning.
- The spark plug must withstand severe vibration and a harsh chemical environment.
- The spark plug's insulation must withstand voltage upto 40 kV.

### Construction :-

- The construction details of a typical spark plug are shown in figure. A stud connects to the centre electrode to the the top terminal.
- The electrode is made of a nickel based alloy. Silver and platinum are also used for some applications.
- To improve the thermal conduction properties a copper core is also used in the electrode.
- The 'siltment compressed powder seals' prevent gas leakage past the insulator. A gasket or tapered seat stops leakage between the cylinder head and the shell.
- A single - edge electrode of rectangular cross-section is welded to the shell. A hexagon is machined on the shell for easy installation and removal of the plug.
- The insulating material is high grade ceramic based and aluminium oxide,  $Al_2O_3$  is a common choice.

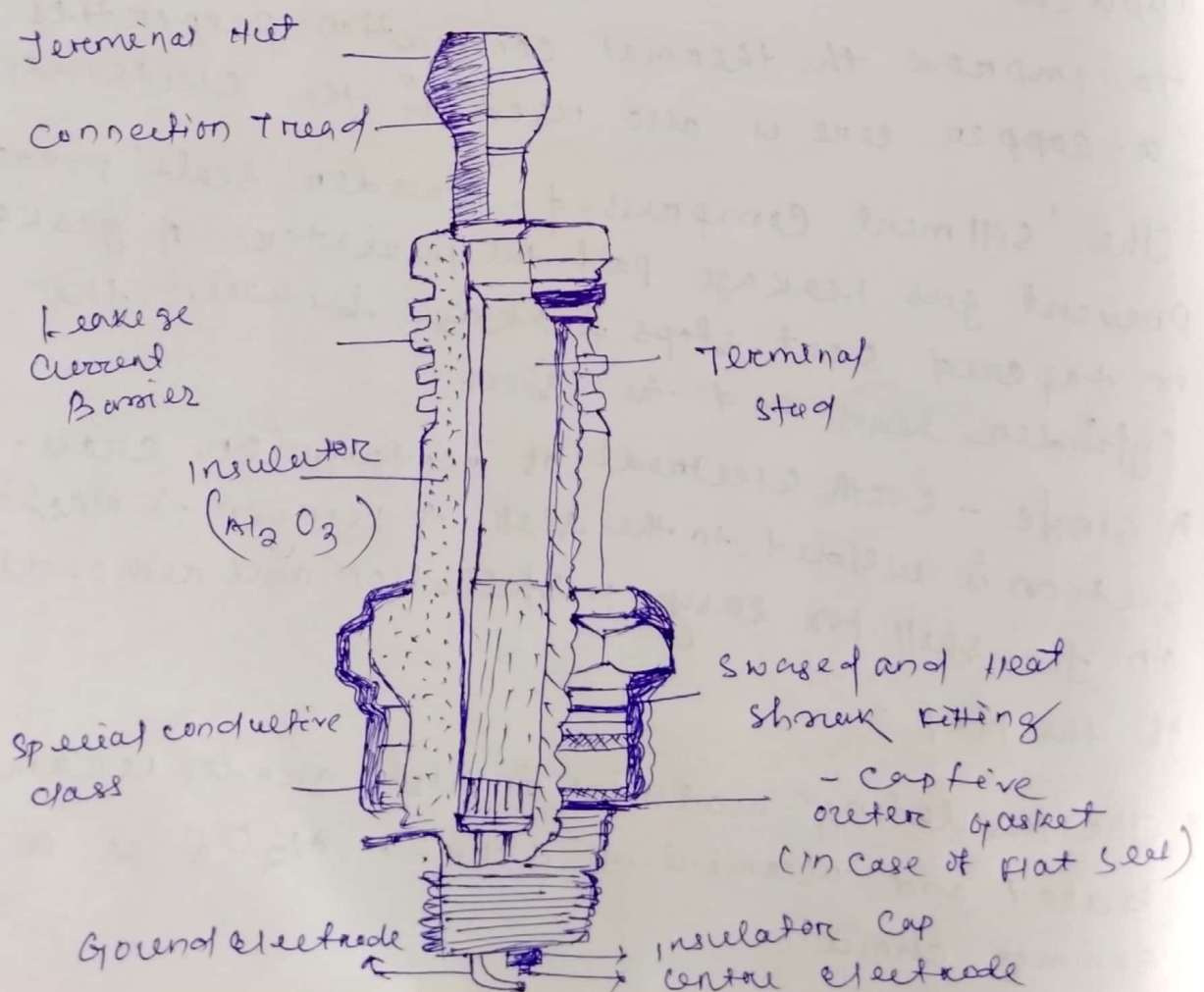
→ The properties of most suitable insulating material are:-

- i - A Youngs modulus of  $340 \text{ kN/mm}^2$
- ii - A coefficient of thermal expansion  $7.8 \times 10^{-6}$
- iii - A thermal conductivity of  $15-5 \text{ W/mK}$   
(Temperature range  $473-1173 \text{ K}$ )
- iv - An electrical resistivity greater than  $10^{13} \Omega/m$ .

The above values may be considered as a guide only.

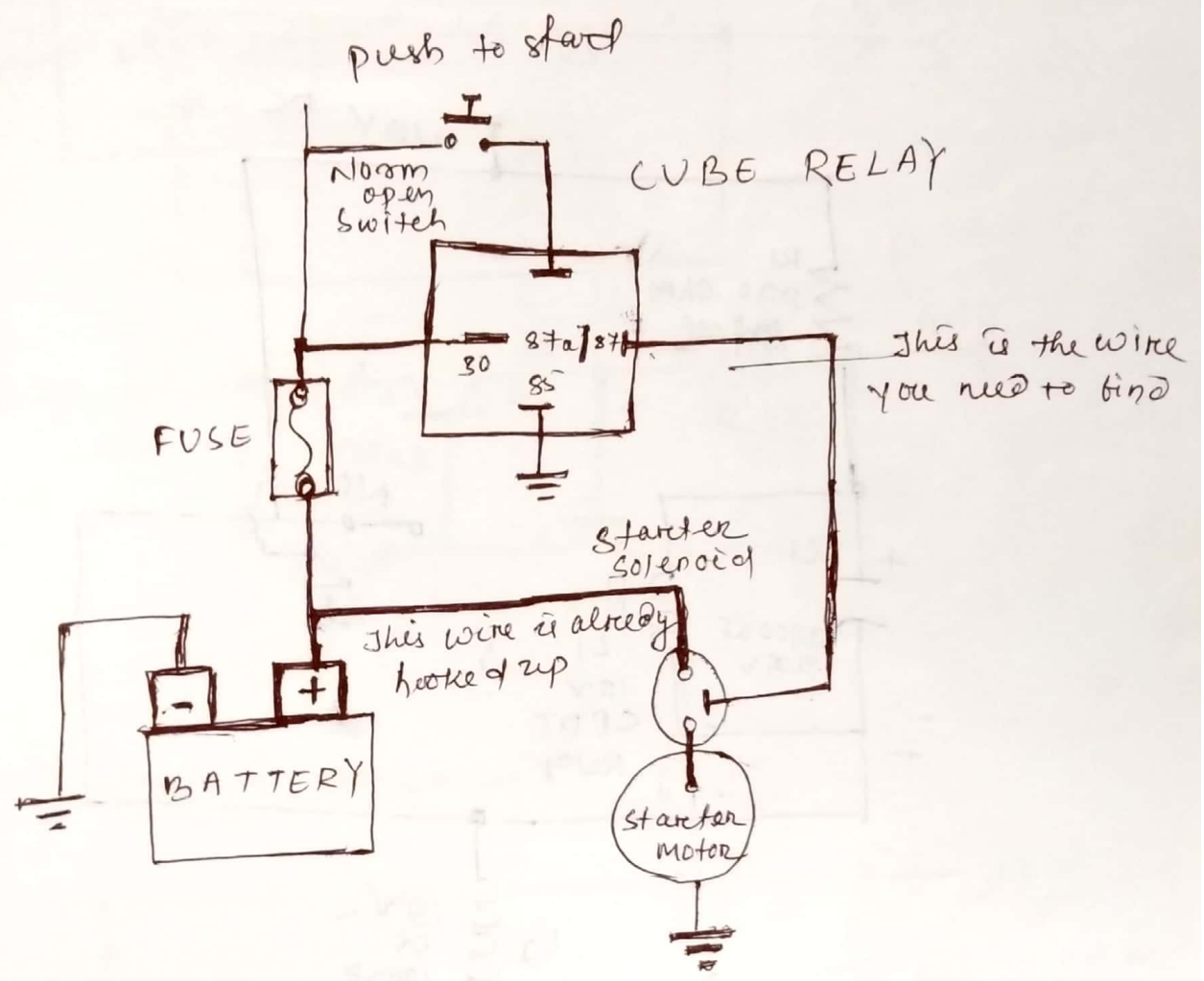
→ The electrically conductive glass seal between the electrode and terminal stud is also used as a resistor.

Diagram :-

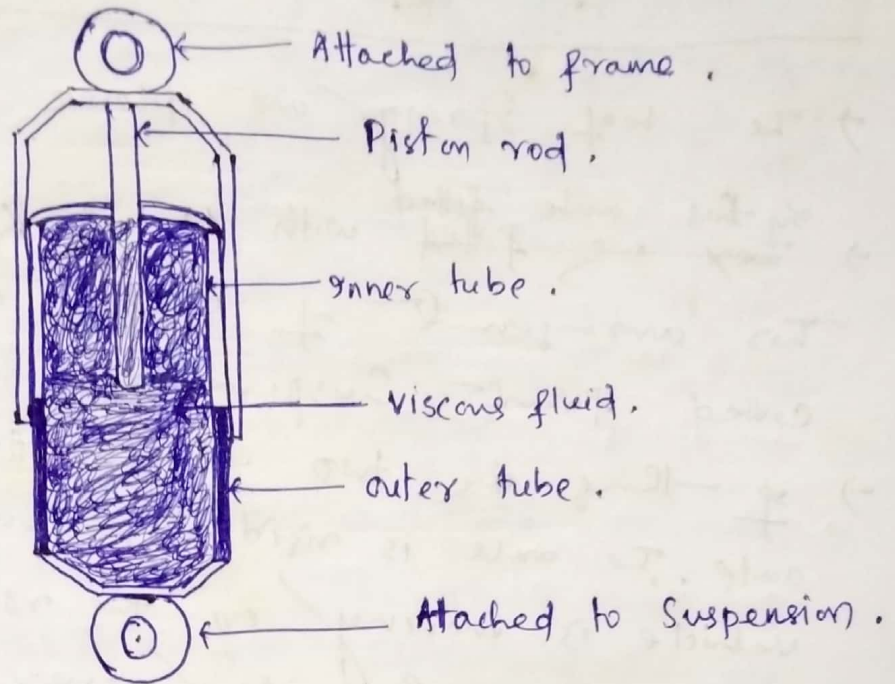


4.1

# Horn circuit Diagram :-



## Telescoping Shock absorber: →



- A shock absorber is a mechanical or hydraulic device design to absorb and damp shock impulse .
- Telescoping shock absorber is a type of hydraulic shock absorber .

### Working principle:—

- consists of
- When automobile vehicle comes across a bump, the outer tube moves up which increase the pressure between 2 way valve. This high pressure opens the valve assembly in the piston thus allowing fluid to moves in upper chamber of inner tube.
- Similarly when automobile vehicle comes across from hole, the outer tube moves down, thus decreasing pressure between both 2 way valve . This low pressure opens the valve assembly in the piston, thus allowing fluid to moves downward of inner tube .