# AUTOMOBILE ENGINEERING LAB MANUAL

**For**

**6TH SEM MECHANICAL ENGINEERING**

**(SCTE&VT SYLLABUS)**

*Prepared by*

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# LIST OF EXPERIMENTS

1) **Study of an Automobile Chassis**
2) **Study of Differential Mechanism of an Automobile**
3) **Study of Multiple Clutch of an Automobile**
4) **Study of Braking System (Hydraulic / Air Brake)**
5) **Study and Demonstration of different circuit of carburetor**
6) **Checking the spark plug and setting the port and check the ignition in the spark plug**
7) **Calibration of Bourdon's tube Pressure Gauge**
8) **Study the Electrical System of an Automobile**
9) **Study the assembly of Car Engine**
10) **Air Pollution testing of $CO_2$,CO,HC,$NO_X$**

# EXPERIMENT NO. 01

**OBJECTIVE: Study of Automobile Chassis**

**EQUIPMENT: A model of Chassis of Automobile**.

**THEORY –**

**Components of an Automobile**

**1) BASIC STRUCTURE –** This is the unit on which are to be built the remainder of the units to turn it in to a power operated vehicle. It consist of frame, suspension system, axles, wheels and tyres

**Frame –** There are two distinct forms of construction

1. The conventional pressed steel frame to which all the mechanical units are attached and on which the body is superimposed.

2. The integral or frameless construction, in which the body structure is so designed as to combine the functions of body and frame, the units normally attached to the frame being attached directly to the body. Frameless construction is possible only in case of a closed car, since the roof, screen pillars, door pillars and rear panel are essential load taking parts of structure.

**Suspension System –** Functions of suspension systems are

1. To prevent the road shocks from being transmitted to the vehicle components
2. To safeguard the occupants from road shocks
3. To preserve the stability of the vehicle in pitching or rolling, while in motion There are two types of suspension systems

1. The conventional system, in which the springs are attached to a rigid beam axle
2. The independent system, in which there is no rigid axle beam and each wheel, is free to move vertically without any reaction on the other wheel.

**Axles –** The weight carrying portions of the axles , whether it may be front or rear ,may be considered as beam supported at the ends , loaded at two intermediate points and subjected to following loads

1. The vertical load at the spring centers due to which the weight of the vehicle.

2. A fore and aft load at the wheel centre due to driving or braking effort

3. Torque reactions due to the drive or brakes.

4. A side thrust at the radius of the tyre due to centrifugal force when rounding a curve.

**Wheels –** Wire spoked wheels have been used mainly on sports cars, primarily on account of their light weight and quickness in changing the wheel .However the pressed steel wheel has displaced these all ordinary purposes. Such a wheel consist of a central flanged disc pressed in to a rolled section rim retained I n position by welding. Light alloy wheels are currently used in case of luxury and sport cars.

### 2) POWER PLANT-

The power plant provides the motive power for all the various functions which the vehicle or any part of it, may be called upon to perform. The power plant generally consists of an internal combustion engine which may be either of spark-ignition, or of compression ignition type.

### 3) TRANSMISSION SYSTEM –

Functions of transmission system are

1) To disconnect the engine from the road wheels when desired
2) To connect the engine to driving wheels without shock
3) To vary the leverage between the engine and the driving wheels
4) To reduce the speed permanently in a fixed ratio
5) To turn drive through a right angle
6) To make a provision such that the driving wheels may rotate at different speeds while taking turns.

**Clutch –** Its purpose is to enable the driver to disconnect the drive from the road wheels instantaneously and to engage drive from the engine to the road wheels gradually while moving the vehicle from rest.

**Gear Box (Transmission) –** The gear box or transmission provides the necessary leverage variation between the engine and road wheels.

### Bevel pinion and crown wheel –

They turn the drive through 90 and also provide a permanent reduction in speed .The permanent reduction is necessitated because of the fact that speed of engine has to be maintained at optimum level at all times, yet a minimum value of torque has to be made available at the road wheels.

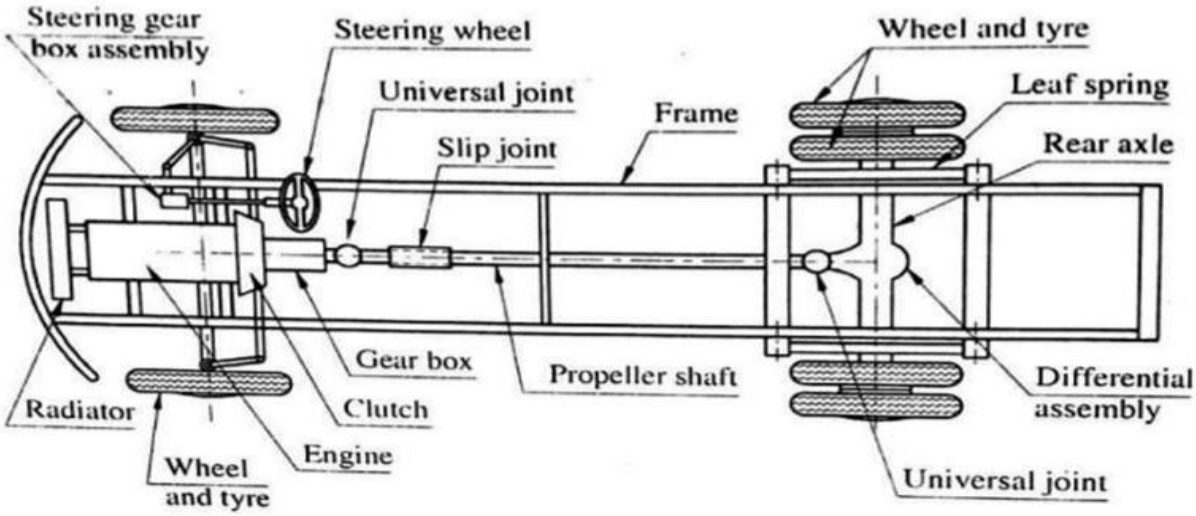
### Universal joint-

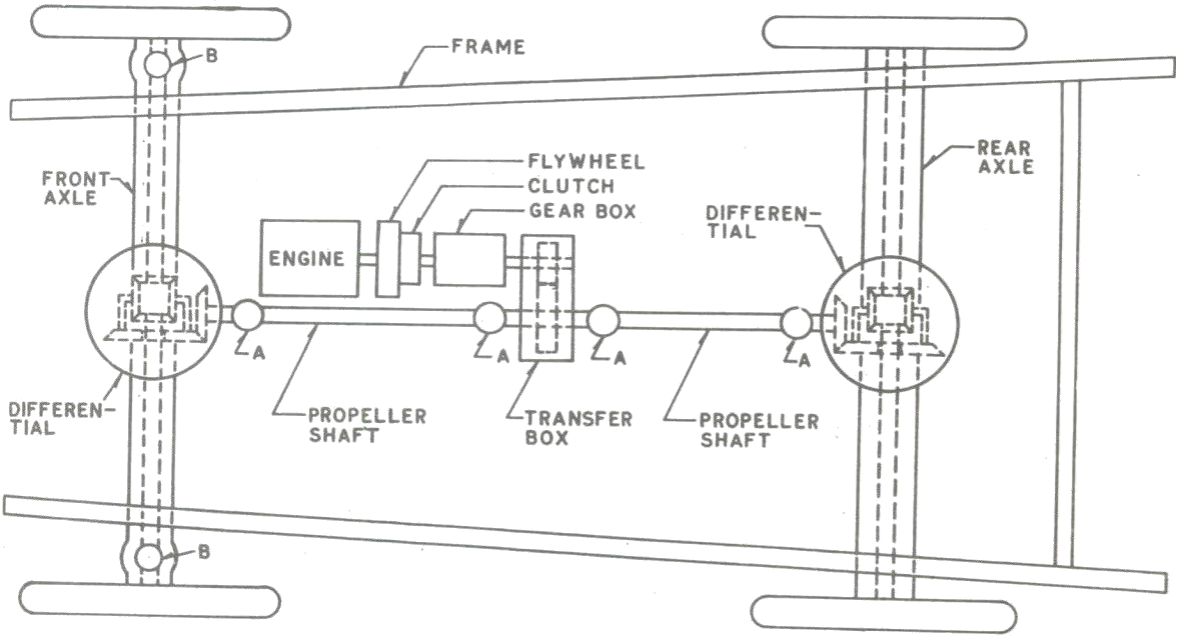
They provide for the relative movement between the engine and the driving wheels due to flexing of road springs.

### Differential –

While taking turns, the driving wheels must run at different speeds. This is done with the help of differential. Instead of using the long propeller shafts and transmitting the power from engine to the rear axle , a number of alternative methods have been used.

**SIMPLE CONSTRUCTION OF TRUCK CHASSIS**




# Conclusion

From the above experiment we have successfully studied about the chassis of an automobile

# EXPERIMENT NO.-02

**OBJECTIVE: Study of differential mechanism of an automobile**.

**EQUIPMENT: A model of differential gear mechanism** .

**THEORY:** The purpose of the differential assembly is to allow the two drive wheels to turn at different speeds when the car goes around a corner. This is necessary because when cornering, the wheel on the inside of the turn goes through a smaller arc or corner than the wheels on the outside. If the wheels were not allowed to turn at different speeds, they would tend to skip around the corner and steering would be very difficult.

Differentials are used in:

i) The rear drive axle of front engine, rear wheel drives vehicles.

ii) The transaxles of front engine, front wheel drive and rear engine, rear wheel drive vehicles.

iii) The front drive axle and rear drive axle of four wheel drive vehicles.

iv) The transfer case of some four wheel drive vehicles.

Both the front drive and rear drive differential have the same job to do. They also have many of the same parts. The basic difference is the way in which engine torque is delivered to the differential assembly.

Power enters the rear axle assembly from the final drive which consists of bevel pinion connected through a rear universal yoke to the propeller shaft. The bevel pinion is meshed with the crown wheel, which is bolted to the case. This arrangement allows the bevel pinion to turn the crown wheel.

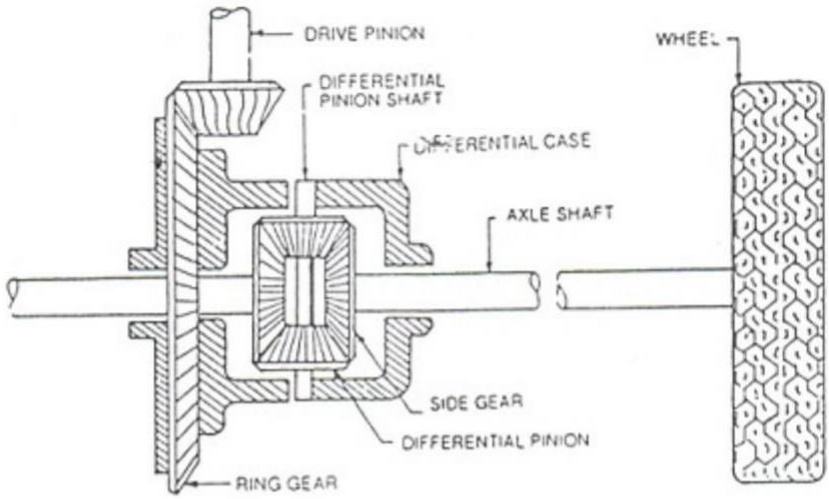
As the crown wheel turns, the case attached to it also turns. A shaft through the case also goes through the middle of two small pinion gears. As the case turns, this shaft turns the small pinion gears, each of which meshes with a side gear. Each side gear is attached to a shaft called an axle, which on a rear drive system runs through housing to one of the rear wheels.

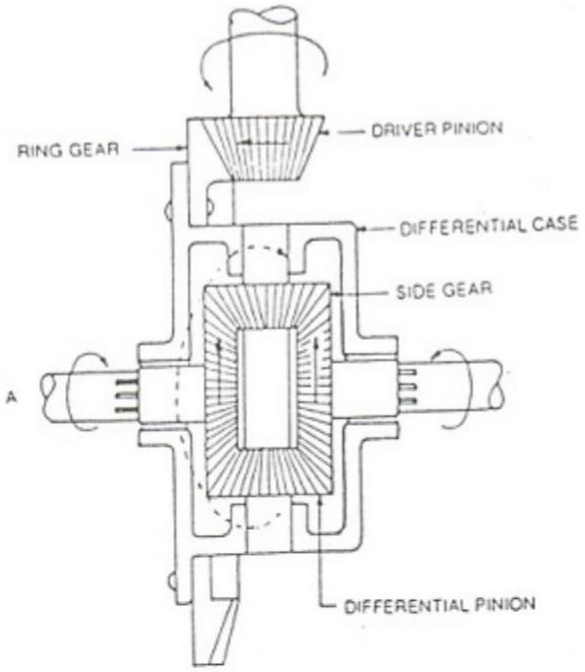
When the automobile is travelling in a straight line, the power flow through the system is fairly simple. The crown wheel turns the case. The case, through its shaft and pinion gears, turns each of the side gears at the same speed. The axles or drive shafts turn the drive wheels, which drive the vehicle.

When the vehicle makes a turn, however, the power flow becomes more complicated. If the automobile is making a left turn, the left drive wheel must go through a sharper corner or travel through a shorter distance than the right drive wheel. The crown wheel turns the case. Since the left wheel is going through a sharp corner, the left axle is slowed or stopped

momentarily. The pinion gears in the case still turn with the case but they also rotate on the case shaft. Thus they can walk around the slowed or stopped left side gear and provide all the power to the right side gear so the right wheel will turn faster than the left wheel.

During a right turn there is more resistance on the right axle, because the right wheel must turn through a sharper corner than the left. The pinions in the case walk around the right side gear and drive the left axle gear.




# Conclusion

From the above experiment we have successfully studied about the differential mechanism of an automobile

# EXPERIMENT NO.-03

**OBJECTIVE: Study of Multiple Clutch of automobile**.

**EQUIPMENT – Model of Multiple plate clutch**

**THEORY –**

## Introduction-

The power developed by the engines is delivered to the driving wheels of the automobile by the power train. The transmission is the major part of the power train. In the manual transmission, clutch is a device used to connect and disconnect engine power flow to the transmission the will of the driver. The driver operates the clutch via a clutch pedal inside the vehicle.

When the clutch pedal is depressed, the three main clutch assembly components – flywheel, friction disc and pressure plate are disengaged, interruption of the power flows. As the clutch is release, the pressure plate moves closer to the clutch disc.

## Functions of Clutch –

1. To permit the engagement or disengagement of a gear when the vehicle is stationary and engine is running.

2. To transmit the engine power to the road wheels smoothly without shock / jerk to the transmission system.

3. To permit the engaging of gears when the vehicle is in motion without damaging the gear wheels.

**WORKING PRINCIPLE –**

The working principle of clutch is based on friction .When the two friction surfaces re brought in contact with each other and pressed they are united due to friction between them .If now one is resolved ,the other will also resolve. One surface is considered as a driving member and other as driven member. The driving member is kept rotating .When the driven member is brought in contact with the driving member, it is also starts rotating .When the driven member is separated from the driving member, and it stops revolving. The driving member of clutch is the flywheel mounted on crankshaft, the driven member is a pressure plate mounted on the transmission shaft.

**MULTIPLE CLUTCHES:**

A multiplate clutch consists of more than one clutch plate. As the numbers of clutch plates are increased, the friction surface also increases. The increased number of friction surfaces increases the capacity of the clutch to transmit torque.

The plates are alternately fitted to the engine shaft and gear box shaft. They are firmly pressed by the strong coil springs and assembled. Each of the alternate plate slides on splines on the pressure plate.

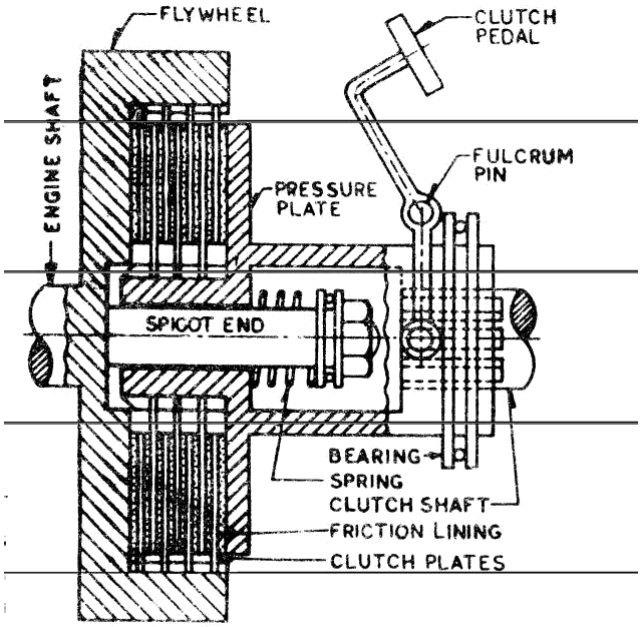


Fig. 3.21 Multiplate Clutch.

A multiplate clutch works in the same way as a single plate clutch while the flywheel is rotating, the pressure plate rotate and press against the friction plate. This causes the clutch plate to rotate, which in turn rotate the clutch shaft. When the pedal is pressed, the flywheel continues to rotate but the clutch plate is released. This happens because they are not fully pressed by the pressure plates. Thus the clutch shaft also stops rotating.

A multiplate clutch may be dry or wet. When the clutch is operated in an oil bath, it is called as a wet clutch. When the clutch is operated dry, it is called dry clutch.

**Advantages:**

1. The number of friction surfaces increases the capacity of the clutch to transmit torque. Therefore, considering the same torque transmission the overall diameter of the multiplate clutch is reduced when compared to a single plate clutch.
2. It is used in scooters, motorcycles, where there is space problem.
3. As it can transmit more torque, it can be used in heavy vehicles and racing cars.

# Conclusion

From the above experiment we have successfully studied about the working of multiple plate clutch of an automobile

# EXPERIMENT NO.-04

**OBJECTIVE: Study of Braking System (Hydraulic / Air Brake)**

**EQUIPMENT: A model of Braking system.**

**THEORY:**

**Functions of Brake:**

There are two distinct functions of the brake:

1. To stop or slow down the vehicle in the shortest possible distances in emergencies.
2. To control the vehicle to be retained when descending a hill.

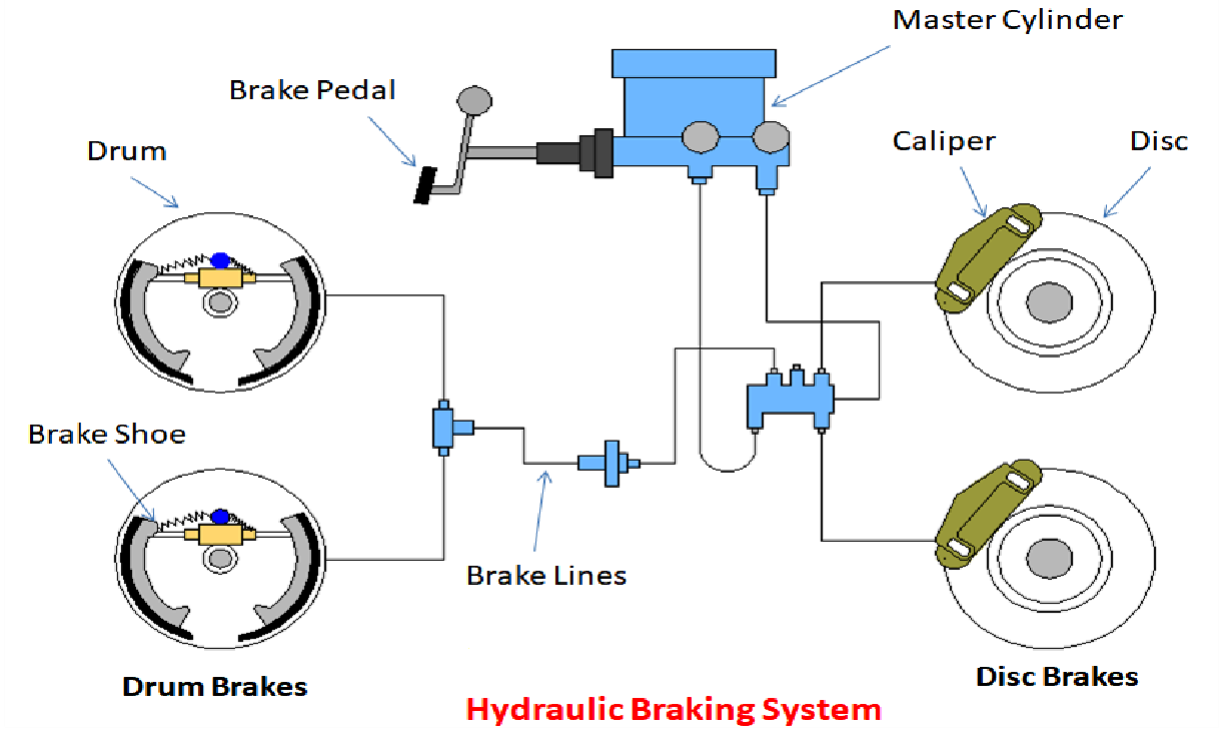
**Classification of brakes:**

I. From construction point of view

(a) Drum brakes (b) Disc brakes II. By method of actuation

(a) Mechanical brakes (b) Hydraulic brakes (c) Electric brakes (d) Vacuum brakes (e) Air brakes

**HYDRAULIC BRAKE SYSTEM:**

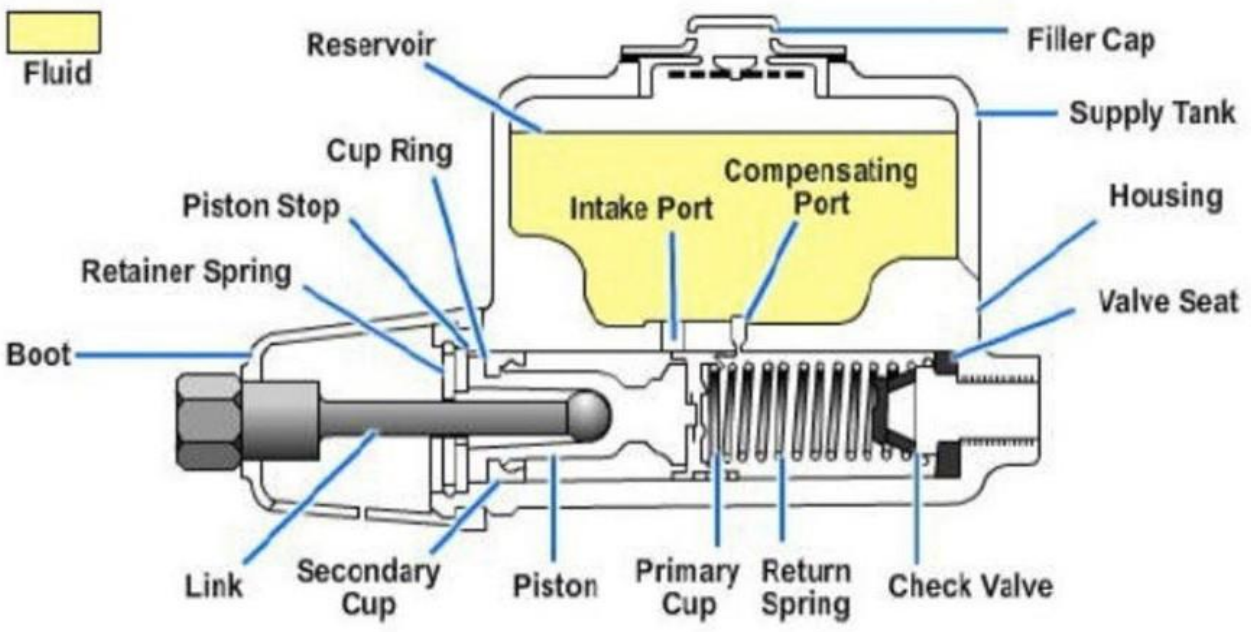



Hydraulic Braking System

These types of brakes consist of master cylinder, which contains hydraulic brake fluid. Master cylinder is operated by the brake pedal and is further connected to the wheel cylinder in each wheel through pipelines, unions and flexible lines. The system is so designed that even when the brakes are in the released position, a small pressure of about 50kpa is maintained in the pipelines to ensure that the cups of the wheel cylinder are kept expanded. This prevents the air entering the wheel cylinders when the brakes are released. Besides this pressure also serves the following purposes:

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

**Master Cylinder:**




It consists of fluid reservoir and compression chamber in which piston operates. The fluid in the reservoir compensates for any change in the fluid volume in the pipelines due to temperature variations and to some extent due to leakage. To prevent leakage there are rubber seals on both sides of the piston in the compression chamber. The fluid always surrounds the reduced diameter region of the piston. A rubber boot covers the push rod and of the master cylinder to prevent the dirt entering inside. Towards the brake lines side

of the compression chamber, there is fluid check valve with a rubber cup inside. It serves to retain the residual pressure in the brake lines even when the brakes released.

There are a number of holes in the piston head on the primary (high pressure) seal side. Two holes connect at the reservoir to the compression chamber. The smaller one out of these is about 0.7 mm diameter and is called the bypass or compression port. The second hole is called the intake or recuperation port. Besides, there is a vent in the cap, to keep the brake fluid always at atmospheric pressure.

The push rod is operated with the foot brake pedal through the linkage. As the pedal is pressed, push rod moves against the force of the spring, till it covers the bypass port. Further movement of the push rod causes building up of pressure in the compression chamber. Finally, when sufficient pressure has built up, the inner rubber cup of the fluid check valve is deflected, forcing the fluid under pressure in the lines. This fluid enters the wheel cylinder or the caliper and moves the pistons thereby applying the brakes.

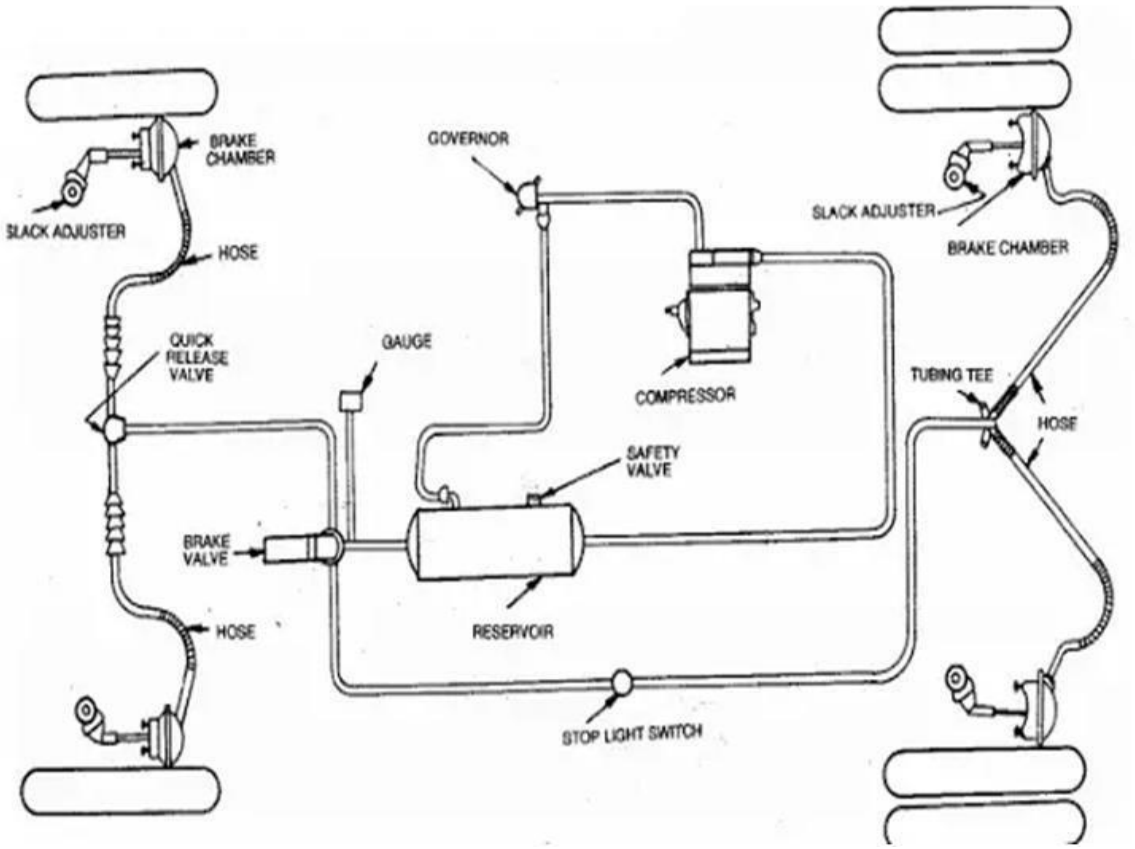
When the brakes are released, the spring pressure in the master cylinder moves the piston to the right extreme position. This same force of the spring keeps the fluid check valve pressed on its seat for sometime and thereby delays the return of fluid from the lines into the compression chamber again. Some delay is also caused by the inertia of the fluid in the lines. This produces a vacuum in the compression chamber and unless this is destroyed immediately, there are all chances of air leakage into the system. Even a very small amount of air will render the brakes unless, the air being compressible. Having intake port as shown in figure solves this problem. As soon as some vacuum is formed, the atmospheric pressure in the fluid reservoir forces the fluid through intake port and holes in the piston, which deflects the rubber, cup and enters the compression chamber, destroying the vacuum.

But by the time, the vacuum is destroyed; the fluid from the lines comes back into the reservoir by lifting the fluid check valve off its seat. This extra fluid now has to be accommodated somehow, because compression chamber is already full. If this is not done, the pressure in the lines will not be relieved fully and there are chances of brake shoe rubbing with the drum. Once this happens, there will be more heat generated at the drum, which when transmitted to the wheel cylinders would cause the fluid to expand and exert still more pressure, causing the shoes to move still further towards the drum. In this way, a vicious circle will start, causing the brakes to jam ultimately.

This is avoided by means of bypass port. The extra fluid coming from the lines passes to the fluid reservoir, where pressure is maintained atmospheric by providing an air vent.

Wheel Cylinder: The construction is very simple. The brake fluid under pressure forces the piston apart, thereby applying the brakes.

**Air brake system:**




In drum brakes, a brake drum is attached concentrating to the stub axle hub whereas on the axle casing is mounted on a back plate. The back plate is made of pressed steel sheet and is ribbed to increase rigidity and to provide support for the expander, anchor and brake shoes. It also protects the drum and shoe assembly from mud and dust. Moreover, it absorbs the complete torque reaction of the shoes due to which reason it is sometimes also called torque plate. Two brake shoes are anchored on the back plate. One or two retractor springs are used which serve to keep the brake shoes away from the drum when the brakes are not applied. The brake shoes are anchored at one end, whereas on the other ends force F is applied by means of some brake actuating mechanism, which forces the brake shoe against the revolving drum, thereby applying the brakes. An adjuster is also provided to compensate for wear of friction lining with use. Sometimes, in smaller cars a single pin anchor is employed.

# Conclusion

From the above experiment we have successfully studied about the hydraulic and air brake system

# EXPERIMENT NO.-05

**OBJECTIVE: Study and Demonstration of different circuit of Carburettor**

**EQUIPMENT: A model of Carburettor**

**THEORY:**

**Carburettor is a mixing device which supplies air fuel mixture to the engine. It atomizes the fuel and mixes it with air in a varying proportion to meet the changing operating conditions of automotive engines.**

Some of the important types of modern carburetors used in automobiles are

Solex carburetor

Carter carburetor

S.U. carburetor.

**Solex Carburetor:**

The solex carburetor is one of the well known carburetor for easy starting, good performance and its reliability. It is used for various Indian Cars and Jeeps. The schematic diagram of a Solex carburetor is shown in Fig. below. It is down draught type carburetor. It consists for various fuel and air circuits. These are

2. Normal running
3. Cold starting and warming
4. Idling and slow speed operation
5. Acceleration.

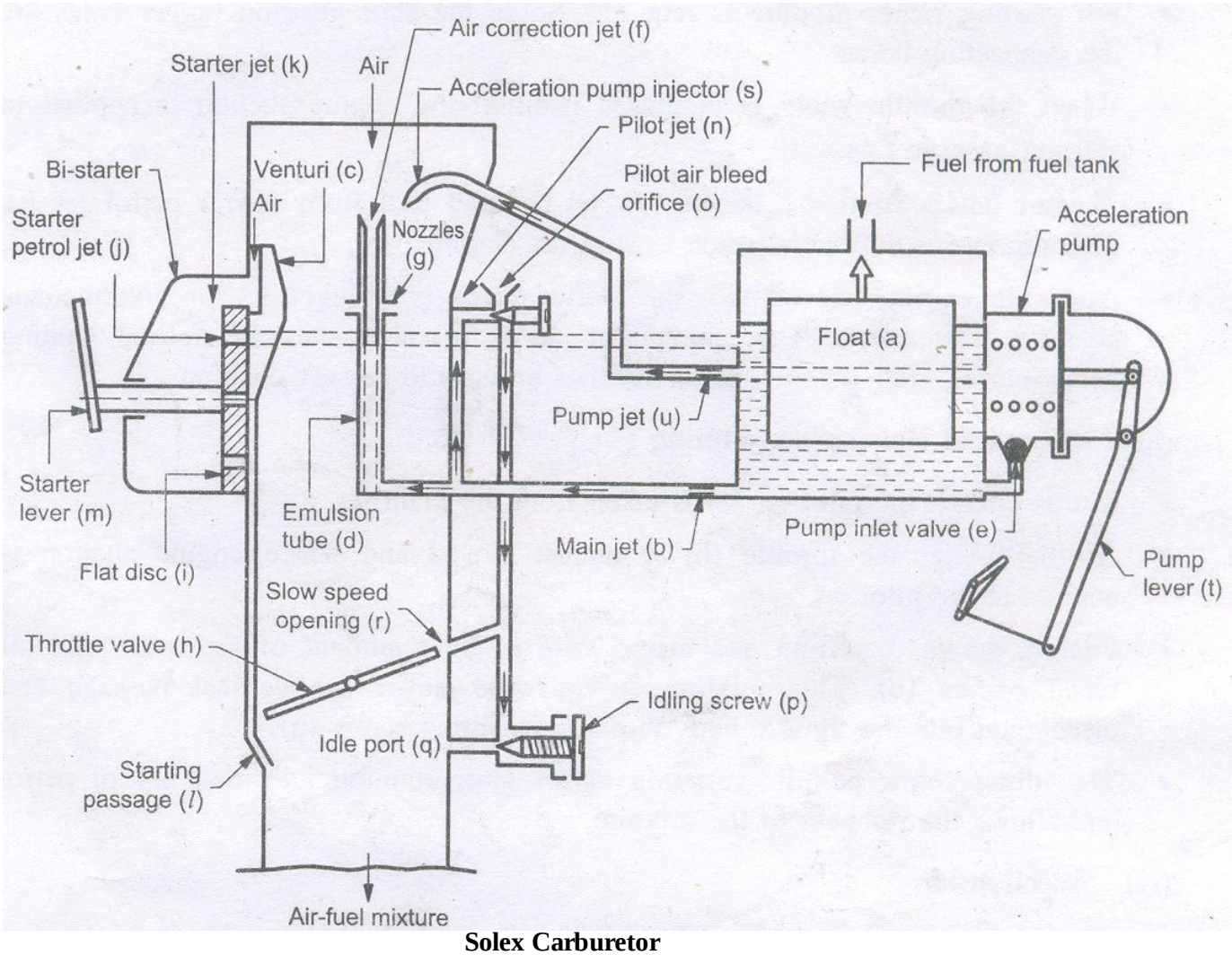
**(I) Normal running**

In normal running circuit, the fuel is provided by the main jet (b) and the air by the choke tube or venturi (c). The fuel from the main jet enters into the air bleed emulsion tube (d). The correct balance of air and fuel is automatically ensured by air entering through air correction jet (f). The metered emulsion of fuel and air is discharged through the orifice (g) drilled horizontally in the vertical pipe in the middle of venturi tube.

**(ii) Cold starting and warming**

The unique feature of this carburettor is to provide progressive starter. The starter valve is in the form of a flat disc (i) with holes of different sizes. These holes connect the starter petrol jet (j) and starter air jet sides to the passage which opens just below the throttle valve at (I). Depending upon the position of the starter lever

1 either bigger or small holes of flat disc come opposite the passage. For starting richer mixture is required. So in the start position bigger holes are the connecting holes. When the throttle valve is in closed position the engine suction is applied to starting passage (l). The air enters from the starting air jet (k) and fuel from starter petrol jet (j). This mixture is sufficiently rich to start the engine. After the engine has started, the starter lever is brought to the intermediate position, thus reducing the amount of petrol, till it reaches the normal running temperature. After this the starter lever is brought to the off position.




**Solex Carburetor**

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**(iii) Idling and slow speed running**

In this circuit, the pilot jet (n) is taken from the main jet. At the idling, the throttle (h) is almost closed and hence engine suction is applied at the pilot jet. Fuel is drawn there from and mixed with a small amount of air from pilot air bleed orifice (o). This mixture is conveyed down the vertical passage and discharged into the throttle body through the idling screw (p). The idling screw permits variation of the slow running jet's

delivery of petrol and allows the richness of the mixture. .

**(iv) Acceleration**

In order to, provide extra quantity of fuel during acceleration, this carburettor is provided with a diaphragm pump system. When accelerator pedal is pressed for acceleration, the pump lever (t) connected to it is also pressed. Due to this movement, the fuel is compressed and it flows through pump jet (u) and accelerator pump injector (s) to mixing chamber. When the force on lever is removed; the diaphragm retains its original position due to spring. Due to this movement of diaphragm a suction is created, thus opening the pump valve (e) and admitting the fresh fuel into the pump.

# Conclusion

From the above experiment we have successfully studied about circuit of solex carburattor

# EXPERIMENT NO.-06

**OBJECTIVE- Checking the spark plug, setting the port and check the ignition in the spark plug.**

**APPRATUS REQUIRED**

| SL.NO | EQUIPMENT | SPECIFICATION | QUANTITY |
|---|---|---|---|
| 01 | Model of a spark plug | | 01 |
| 02 | Condenser | | 01 |
| 03 | Distributor | | 01 |
| 04 | Battery | | 01 |

**THEORY:-**

Spark plug is device to produce electric spark to ignite the compressed air-fuel mixture inside the engine cylinder .The spark plug is screwed in the top of the cylinder, so that its electrodes projects in the combustion chamber.

It must produce the spark at the correct movement at the end of the compressionstroke.

A proper gap is to be maintained between the two electrodes of the spark plug, so that the sparking may takesplace.

When the spark plug is screwed in the cylinder head, the ground electrode is said to be connected with ground.

The terminal of the centre electrode is directly connected with H.T. lead of the ignition coil incaseofsinglecylinderengine, orthroughthedistributor incase ofmulticylinderengine.

The secondary circuit of the electrical system is to be completed through the gap between the electrodes. When the H.T. current passes through the circuit, it jumps the gap producingaspark, whichignitesthecompressed air fuelmixture in thecylinder.

**CONSTRUCTION:-**

A spark plug is a device consists of mainly three parts:-

1. centre electrode or insulated electrode.
2. ground electrode or insulated electrode.
3. Insulation separating the two electrodes.

- The upper end of the centre electrode is connected to the spark plug terminal, where H.T cablefromtheignitioncoilisconnected. It issurroundedby porcelaininsulator.
- The lower half portion of the insulator is fastened with a metal shell. The lower portion of theshellhas ashortelectrodeattachedtoonesideand bent in towardsthecentre electrodes, so that there is a gap between the two electrodes.
- The two electrodes are thus separated by insulator. The sealing gaskets are provided betweentheinsulatorandtheshelltopreventtheescapeof gasesundervarious temperature and pressure condition.
- The lower part of the shell has screw threads and the upper part is made in hexagonal shape like a nut, so that the spark plug may be screwed in or unscrewed from the cylinder head.
- The material used in the construction of a spark plug are as follows:-

  1 SHELL :- STEEL

  2 INSULATION:- PORCELAIN,MICA(the porcelain has disadvantages of brittleness and low resistance to thermal shocks .mica is somewhat attacked by fuels ,sintered alumina is now almost extensively used for insulation.).

  3 ELECTRODE:- Nickel, alloy of nickel, manganese and silicon , Platinum alloys are better for electrodes ,but their high cost limit their use.

**PROCEDURE**

First connect the terminal of the condenser to the terminal of the battery

Then connect the black terminal to positiveand red terminal to negative terminal of the battery from the condenser.

Then ON the main switch of the spark plug model.

When we switchis ON , the ignition system supply high voltage surges of current to the spark plug .

The ignition coil steps 12 volts from the battery to the high tension voltage of about 20,000 to 30,000 volts required to jump the spark at the sparkplug gap, which ignites to combustible charge in the engine cylinder .

The rotor of the distributer revolves and distributes the current to the four segments which in turn , send it to the spark plugs

The distributor then directsthis high voltage to the proper spark plug when it jumps the gap, producing a sparkwhich ignites the combustible mixture in the cylinder.

**CONCLUSION**

From the above experiment we have successfully set the port and check the ignition in the sparkplug.

# EXPERIMENT NO.-07

**OBJECTIVE - Calibration of strain gauge.**

**APPARATUS REQUIRED**

| SL.NO | EQUIPMENT | SPECIFICATION | QUANTITY |
|---|---|---|---|
| 01 | STRAIN GAUGE KIT | DIGITAL | 01 |
| 02 | WEIGHTS | 100gms. | 10 |
| 03 | WEIGHTS | 50gms. | 05 |

**THEORY**

If a metal conductor is stretched or compressed its resistance change on account of the fact that both length and diameter of the conductor change.

There is a change in the value of resistivity of the conductor when it is strained and this property is called piezoresistiveeffect.

If a conductor of elastic material is subjected to tension or in other words positively strained, its longitudinaldimensionwillincreasewhilethere will be areduction in the lateraldimensions.

So when a gauge is subjected to a positive strain its length increases while its area of cross- section decreases.

Sincetheresistanceofaconductor is proportional to its areaofcross-section theresistanceof the gauge increases with positive strain.

**PROCEDURE**

- Open the top cover of the trainer kit wooden box.
- Connectthecantileverbeamleadswiththetrainerkitterminal.

- Connect the three pin mains plug of the kit to the main socket.
- Keep DVM switch at "μs" position.
- Connect patch cord between o/p terminal and DVM terminal.
- Switch on the trainer kit, the display will light up and will show some reading.
- Adjust zero pot to set 0.00 reading on display, without apply any load on the pan.
- Put 1kgs weight on the pan of the cantilever beam,and adjust span pot to show reading on display.
- Now apply loads in steps of 50/100gms .And note down the readings in the following table in increasing and decreasing mode.

**TABULATION**

| SL. NO | READING IN INCREASING MODE | | | | READING IN DEACREASING MODE | | | |
|---|---|---|---|---|---|---|---|---|
| | APPLIED LOAD (GMS) | LOAD (N) | CALCULATED STRAIN IN μS | DVM READING IN μS | APPLIED LOAD (GMS) | LOAD (N) | CALCULATED STRAIN IN μS | DVM READING IN μS |
| 01 | | | | | | | | |
| 02 | | | | | | | | |
| 03 | | | | | | | | |
| 04 | | | | | | | | |
| 05 | | | | | | | | |

**CONCLUSION**

From the above experiment we have successfully test the performance of strain gauge

# EXPERIMENT NO.-08

**OBJECTIVE - Study the electrical system of automobile.**

## APPARATUS REQUIRED

| SL.NO | EQUIPMENT | SPECIFICATION | QUANTITY |
|---|---|---|---|
| 01 | ENGINE | DIESEL | 01 |
| 02 | BATTERY | 12VOLT.DC. | 01 |
| 03 | CIRCUIT OF ELECTRICAL SYSTEM | | |

## THEORY

- The wiring circuit of a typical passenger car lighting system uses one wire for positive terminal connection and body is itself ground. The power/current is supplied to the system from the battery of 6 volt or 12 volt.
- The circuit begins at the battery and passes through the armature and a fuse before it reaches to any switch .
- The hand lamp circuit generally contains a foot operated dimmer switch which determines the flow of current to the upper or lower filament .
- The dome light is controlled either by a hand operated pillar switch or by an automatic door switch that completes the circuit .
- The stop light is controlled by stop light switch in the brake system so that when the brakes are applied the switch is ON .
- All other lights are controlled by light switch on the instrument panel .

## CONCLUSION

From the above experiment we have successfully studied aboutthe electricalwiring system of an automobile