ABSTRACT

This thesis consists of various types of carburettors used in 2 stroke and 4 stoke engines and made a case study on different carburettors like Amal, zenith, Solex, carter and SU carburettors their construction, working principle, Advantages, disadvantages and deviations of this carburettor from simple carburettor. Advancements took place in Amal and Carter carburettors. The study has been conducted in five different work packages, system understanding to build knowledge of how the carburettor operates, construction, working principle, deviation from simple carburettor, Advantages and disadvantages. Furthermore, all the attributes found has been tested and validated on the engine to seek their contribution to the stability. In this thesis clearly explained about types of carburettors based on the design and position. In this project I have mentioned the topics like history of carburettor, types of carburettors, simple carburettor, construction of simple carburettor, working of simple carburettor, and carburettors like AMAL, SOLEX, SU, ZENITH and CARTER carburettors their construction, working of the particular carburettor. After this I have mentioned an in-depth case study of AMAL and CARTER carburettors its different models released and a new idea they developed.

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CHAPTER 1

INTRODUCTION

1.1 History

In the current quest for improved performance, which may be specified by Numerous criteria comprising less weight, more power and lower cost, currently used carburettors frequently reach the limit of the utility. Thus, material researchers, engineers and scientists are always determined to produce some king of enrichment than the previous modified one. Many changes are being taking place according to the required specifications of users. The first carburettor was invented in the year 1826. The first person to patent a carburettor for the use of petroleum engine was Siegfried Marcus in the year 1872.

Early carburettors were of surface type, in which air is combined with fuel by passing over the surface of gasoline. In 1885 float carburettor based on atomizer nozzle came into existing. Various types of carburettors were manufactured based on requirements. Many evolutions have taken place in order to get the specified efficiency.

Definition of carburettor

A mechanical apparatus for premixing vapourised fuel and air in proper proportions and supplying the mixture to the internal combustion engine.

Need of carburettor

A carburettor's job is to supply an internal combustion engine with air/fuel mixture. Carburettors regulates the flow of air through their main bore (Venturi), this following air draws in fuel and the mixture enters the engine via the intake valve.

Working of carburettor

The carburettor works on the Bernoulli's principle, faster the air moves, the lower the static pressure, and higher the dynamic pressure. The throttle linkage does not directly control the flow of liquid fuel. The speed of the flow, and therefore its pressure, determines the amount of fuel drawn into the airstream. The carburettor consists of open pipe through which the air passe through the inlet manifold of the engine. The pipe is in the form of venturi it narrows the section and then widens again, causing the airflow to increase in speed in the narrowest path. Below the venturi is a butterfly valve called the throttle valve — a rotating disc that can be turned, so as to either allow or block the flow of air. This valve controls the flow of air through the carburettor throat and thus the quantity of air/fuel mixture the system will deliver, thereby regulating engine power and speed. The throttle is connected, usually through a cable or a mechanical linkage of rods and joints or rarely by pneumatic link, to the accelerator pedal on a car, a throttle lever in an aircraft or the equivalent control on other vehicles or equipment.

Fuel is introduced into the air stream through small holes at the narrowest part of the venturi and at other places where pressure will be low. Fuel flow is adjusted by means of precisely calibrated orifices, referred to as *jets*, in the fuel path.

1.2. SIMPLE CARBURETTOR

Carburettor is a device that is used to mix air and fuel in an internal combustion engine. The main objective of carburettor is to provide quality air-fuel mixture for cursing range and other special requirements likes at starting, idling, acceleration, variable load and speed operation condition.

Parts of simple carburettor:

- Throttle valve
- Strainer
- Venturi
- Metering system
- Idling system
- Float chamber
- Mixing chamber
- idling and transfer port
- choke valve

The float chamber is vented to upstream side of the venturi or to the atmosphere.

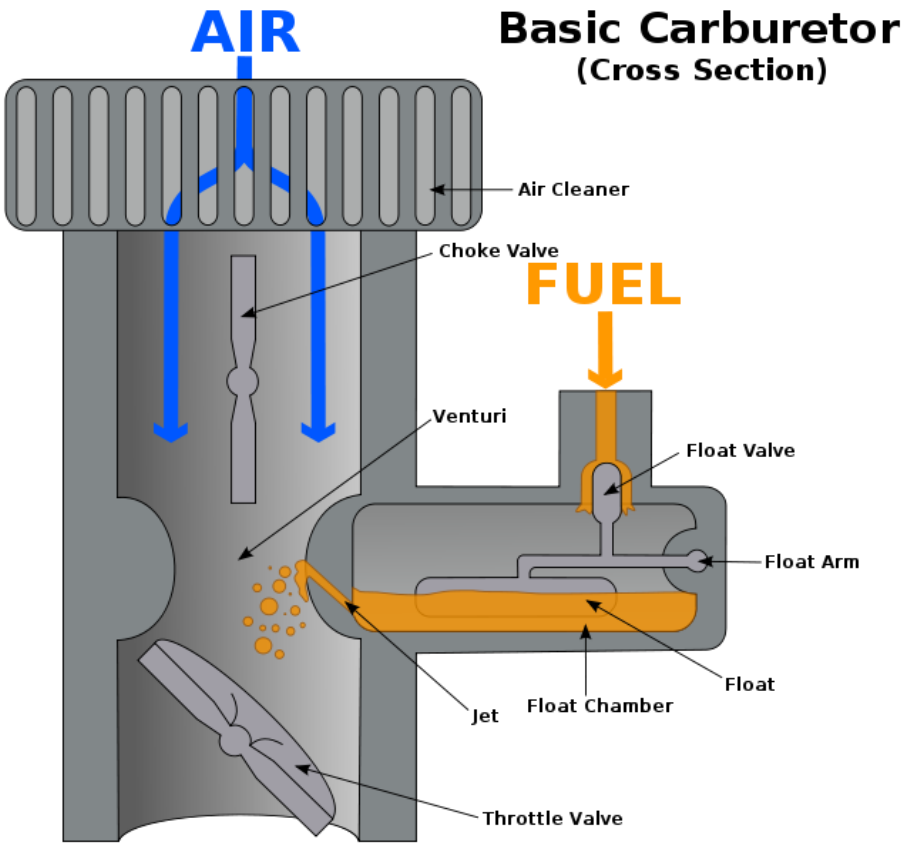

Fig 1.2(a) Simple Carburettor

Working of a simple carburettor:

- Fuel from the external fuel tank is supplied to the float chamber with the help of the fuel pump. This fuel from the fuel tank is filtered using the strainer which removes any solid particles from the fuel.
- Now fuel from the float chamber is supplied to the main nozzle which is a part of the jet tube. This flow of fuel from the float chamber to the main nozzle is carried out by the main fuel jet.
- The engine sucks air from the atmosphere through the choke valve. This air passes through the venturi, it causes a reduction of the area of a cross-section at the throat of venturi.
- Due to this, the pressure at the main nozzle decreases and the velocity of air increases.
- This difference in pressure-induced at the float chamber and the main nozzle causes the mixture of fuel and incoming atmospheric air.
- Increased velocity of air after the venturi partially vaporizes the engine fuel which is then totally evaporated by the heat in the intake manifolds of the combustion chamber and cylinder walls.
- Carburettors only install in a petrol engine because petrol engines are quantity governed.
- When we open the throttle valve present at the bottom of the jet tube, it allows more air flows through the venturi tube and a more quantity of the air-fuel mixture is supplied to the engine, causes, the engine develops more power.
- When we close the throttle valve, reverse action takes place and the power of the engine reduces.

Limitations of a simple carburettor:

- In this carburettor, the air-fuel mixture totally depends upon the position of the throttle valve.
- Also, the air-fuel ratio decreases when the speed of the engine increases.
- The main limitation or disadvantage of a simple carburettor is that when speed is too low, we get a strong mixture which causes trouble in the ignition of the mixture.

1.3. Types of Carburettors:

- According to the arrangement of float chamber:
  - Eccentric.
  - Concentric.
- According to the direction of airflow:
  - Downdraft.
  - Side draft.
  - Up draft.
  - Semi-down draft.
- According to the number of units:
  - Single.
  - Dual.
  - Four-barrel.
- According to the type of metering system:
  - Air-bleed jet.
  - Metering rod type.
- According to the types of venturis:
  - Plain venturi.
  - Double venturi.
  - Vane venturi.
  - Nozzle-bar venturi.
  - Triple venturi.
- According to the pressure above the fuel in the float chamber:
  - Unbalanced.
  - Balanced.
- According to the type of power system:
  - Manually operated.
  - Vacuum operated.
- According to the method of varying the mixture strength:
  - Constant choke carburettor.
  - Constant vacuum carburettor.
- Typical Carburettors:
  - SU Carburettor
  - Solex Carburettor.
  - Zenith Carburettor.
  - Carter Carburettor.

1.According to arrangement of float chamber

- Eccentric type
- Concentric type

Eccentric float chamber	Concentric float chamber
The float chamber is placed at the side of the venturi tube.	The float chamber is placed around the venturi tube.
It does not provide correct air-fuel mixture.	Comparatively good mixture of air fuel is done irrespective of the grade.
When vehicle is in ascending grade too much of gasoline is to be supplied by the jet giving incorrect mixtures.	There will be a constant flow of air-fuel occurs when the vehicle is in ascending grade.
When vehicle is in descending grade too lean of gasoline is to be supplied by the jet giving incorrect mixtures.	There will be a constant flow of air-fuel occurs when the vehicle is in descending grade.

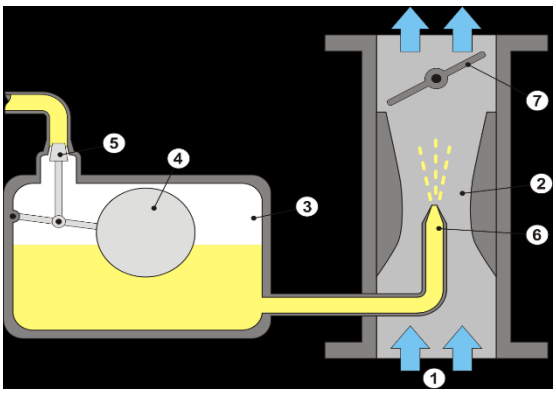

Fig 1.3(a) Float Carburettor

2.According to the direction of air flow

- Down draft
- Side draft
- Up draft
- Semi-down draft

Types	Functionality
Downdraft Carburettors	The air enters from the top of the carburettor and leaves from the bottom. We can also call it as a gravity-assisted carburettor. Due to this up-down characteristic of a carburettor, it usually installed at a level higher than the intake manifolds. This carburettor allows the proper flow of mixture at high and low engine speed.
Side-draft Carburettor	The air enters form one side of the carburettor and leaves from another side of carburettor. This type carburettor used when we have the constraint of space for assembly. In horizontal or side draught carburettor, as a name suggest, the jet tube is placed in a horizontal direction. One more advantage of this type of carburettor is that it reduces the resistance of the flow due to the absence of the right-angle mechanism in the intake area.

Up draft Carburettor	The air enters from the bottom of the carburettor and leaves at the top. In this carburettor, a cross-section of the jet tube is small and thus, the carburettor cannot supply the air-fuel mixture at rapid speed during the high speed of the engine. This big disadvantage makes this carburettor defunct or obsolete.
Semi-down draft carburettor	The direction of air flow is inclined from top to bottom.

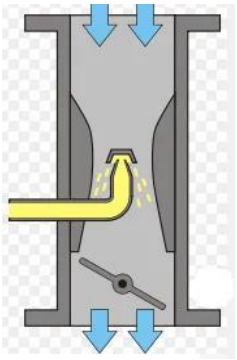

Fig 1.3(b) downdraft

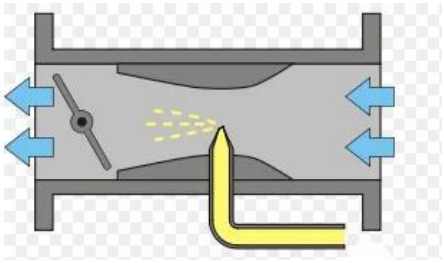

Fig 1.3(c) side draft

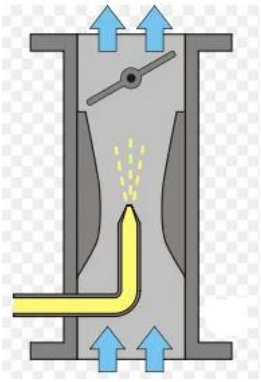

Fig 1.3(d) up draft

In most of the passenger cars downdraft is use. This type of carburettor gravity assists the flow of mixture. Thus, the engines suck better at lower speeds under load. The highest volumetric efficiency of the engine is achieved. The location of the carburettor above the engine is more accessible for inspection change or repair. An air entering the carburettor is cooler.

3.Carburettor according to the number of units

- Single-barrel.
- Dual-barrel.
- Four-barrel.

Types	Functionality
Single barrel	Has only one barrel
Dual barrel	Has two barrels, each containing a fuel jet, venturi tube idling system, choke and throttle. It may have a single air inlet, choke and float chamber, although it frequently has two floats one for each jet. It has only an accelerating pump.
Four barrels	Is made up of two dual carburettors in one unit. The primary side to a complete dual carburettor containing a choke, an accelerating pump, a power valve and a complete main metering and idle system. The secondary unit has its one float bowl and a dual carburettor main metering system and idle system.

Fig 1.3(e) Single Barrel

Fig 1.3(f) Double Barrel

Fig 1.3(g) Four Barrel

4. Carburettor according to the type of metering system

- Air-bleed jet.
- Metering rod type.

Types	Functionality
Air-bleed jet	• Fuel is supplied to the main discharge nozzle through the main metering jets at low speeds • The air bleeds are connected to the vent tube located inside the main discharge nozzle so that air is mixed into fuel as it is drawn into the carburettor venturi. • As the suction of the main discharge nozzle increases at higher speeds, more air is drawn through the main air bleed and the correct air fuel mixture is maintained
Metering rod type	• The amount of fuel is controlled by the rod which extends into the jet. Metering rods has three steps of different diameters. Which opens the space in the jet through which the fuel passes • The metering rod is connected to the throttle shaft by the suitable linkage. So, it is raised when throttle valve is opened and lowered when throttle valve is closed. • When the rod is raised up, it provides more area between the jet and the rod and more fuel passes to match the flow of air at high speeds.

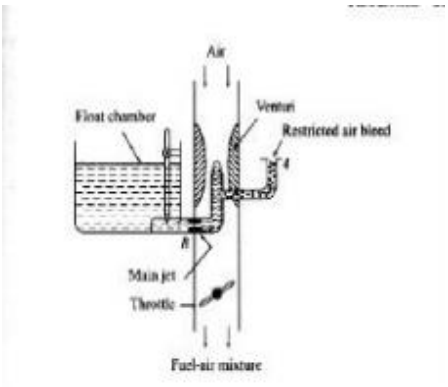

Fig 1.3(h)Air bleed Carburettor

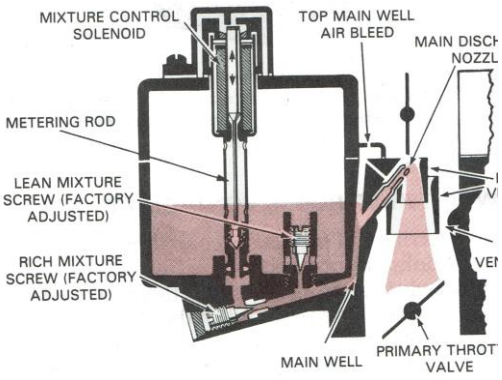

Fig 1.3(i)Metering bleed carburettor

5.Carburettor according to the type of venturi

- Plain venturi
- Double venturi
- Vane venturi
- Nozzle-bar venturi
- Triple venturi

- Different types and number of venturies are used in the carburettor design, according to which the Carburettors are classified.
- The carburettor may have plain, double, vane, nozzle-bar and triple venturi.
- Each type of the venturi is designed to provide the decreased pressure of air flow so that it may draw fuel from the discharge jet.
- Multiple venturies help to keep the fuel away from the carburettor walls to reduce condensation

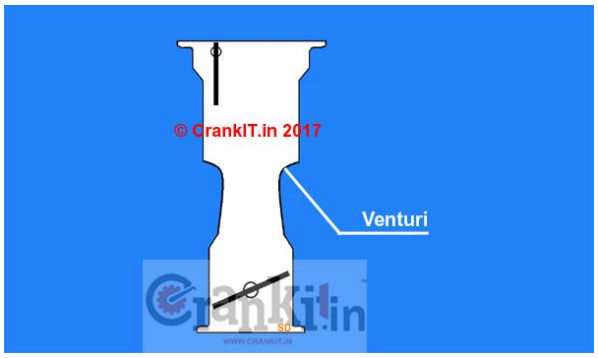

Fig 1.3(j) Plain venturi

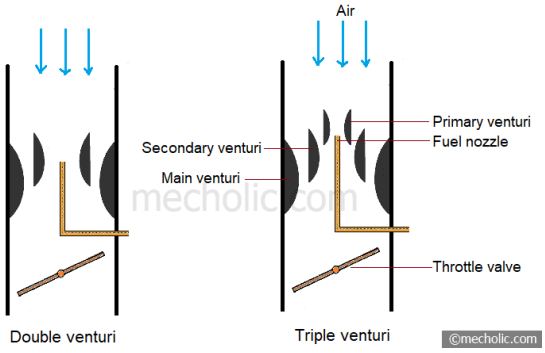

Fig 1.3(k) Double and triple type venturi

6.Carburettors according to the fuel above the float chambers

- Un balanced
- Balanced

Types	Functionality
Unbalanced	If the pressure above the fuel in the float chamber is atmospheric pressure. The carburettor is said to be unbalanced.
Balanced	If the pressure above the fuel in the float chamber is equal to the air intake in the air horn, the carburettor is said to be balanced. The balanced carburettor contains a balance tube and passages that connect the air-horn with the top of the float chamber so that the pressure in the air horn and the float chamber remains the same. In the case, if the air intake is restricted by a clogged air cleaner. the mixture ratio of the carburettor is not affected. Also, it prevents discharge of the fuel through the pump discharges jet at high speeds.

7.Carburettor according to the types of power systems.

- Manually operated.
- Vacuum controlled.

Types	Functionality
Manually operated carburettor	The power jets for enriching the mixture are operated by mechanical linkage to the throttle shaft.
Vacuum Controlled Carburettor	Vacuum controlled power jet well known as step-up system is used for enriching the mixture. When the engine is operating normally at cruising speed, no-load, a high vacuum is produced in the vacuum passages connected to the intake manifold. It pulls the vacuum piston down against the spring so that it holds the step up the rod in the step-up (power) jet to keep it closed. When the engine is operating on load the intake manifold vacuum falls off, and the spring pushes the piston up which raises the step up the rod out of the jet to allow extra fuel to flow from the float chamber to the discharge nozzle. The extra fuel supplements the normal supply furnished by the main metering jet. Thus, enriching the mixture.

8.carburettor according to the varying of mixture strength

- Constant choke carburettor.
- Constant vacuum Carburettor.

Types	Functionality
Constant choke Carburettor	The mixture strength is determined by varying of a fixed tube or venturi Ex: Solex or zenith Carburettors
Constant vacuum Carburettor	In this depression in the choke tube is reasonably constant. And the size of the jet is varied to provide the correct mixture for all engine operating condition. Ex: SU and carter carburettor

1.4. Carburettors Based on Manufacturers:

AMAL:

- A throttle valve is fitted in carburettor body, to which a tapered needle is attached. The combination of the throttle valve and a tapered needle is operated by means of operating cable.
- To set the air-fuel ratio, the position of this tapered needle can be adjusted with respect to the throttle valve.
- The tapered end of the needle regulates the area of the passage in the main jet, supplies fuel to a chamber that has the pilot outlet and bypass outlet.
- An adjustable auxiliary air intake is also supplied air to this chamber. The pilot outlet and bypass are situated in front and back side of the throttle valve respectively. The float chamber is connected with a jet block, which contains main and pilot jet. This governs the level of fuel in the float chamber.
- The float chamber receives petrol from the oil tank through the needle valve, attached to the float with the help of a clip. The air valve, which can be operated independently by an Operating cable, to obstruct the main air passage.
- An adjusting screw is provided on the wall of carburettor body, by which the position of the throttle valve can be present independent of operating cable adjustment for idling purpose.

Construction:

- A throttle valve is fitted in Carburettor body, through which a trapped needle is attached. The combination of a throttle valve and a trapped needle is operated by means of operating cable.
- To set the air fuel ratio, the position of the trapped needle can be adjusted with respect to the throttle valve.
- The trapped end of the needle regulates the area of passage in the main jet, supplies the fuel to a chamber has the pilot outlet and bypass outlet.
- An adjustable auxiliary air intake is also supplied air to this chamber. The piolet outlet and bypass are situated in front and back side of the throttle valve respectively.
- The float chamber is connected with a jet block, which contains main and piolet jet. This governs the level of fuel in the float chamber.
- The float chamber receives the petrol from the oil tank through the needle valve attached to the float with the help of a clip.
- The air valve which can be operated independently by an operating cable, yo obstruct the main air passage.
- An adjusting screw is provided on the wall of carburettor body, by which the position of the throttle can be present independent of the operating cable adjustment of idling purpose.

Fig 1.4(a) **AMAL CARBURETTOR**

Working:

- The throttle valve remains closed at starting of the engine. The engine draws the mixture of air-fuel through the pilot outlet.
- This mixture carries excess fuel; such mixture is not desirable for normal running of the engine. Hence, the throttle valve is to be slightly raised for admitting supply of air from the main air passage.
- The more the throttle valve opened, the less will be the depression on the pilot outlet.
- But a higher depression will be created on the by-pass and now the mixture flows from this by-pass as well as the pilot outlet to compensate for accelerating period.
- The function of air valve is to obstruct the main air passage at the time of the start. Hence, enriching the mixture by increasing depression of the main jet.
- The mixture provided by the pilot outlet and the by-pass system is supplemented by the fuel from the main jet. At this point approximately at 13% of the throttle valve open.
- After the 75% of the opening of the throttle, the main jet only provides the fuel regulation.
- At the time of idling, the throttle stop screw provides a definite throttle opening for idling purpose.
- By this way, the air-fuel mixture is supplied to the engine cylinder of a motorcycle at various operating conditions.

Advantages	**Disadvantages**
The main advantage of Amal carburettor is ease of fitting. The cables, mounting flanges, intake rubbers, air filter and fuel lines all attach easily with no modifications needed	Rapid ware of the slide and body. The fit of the slide in the bore can become excessively sloppy within 10 to 12 thousand miles on high vibration machines
Ease of turning	Clogging of the pilot circuit often due to modern fuels and dirty fuel tanks.

	Much of the bad reputation of the concentric comes from frustrated owners dealing worn out carbs on worn and badly turned bikes.

Deviations of Amal carburettor from simple carburettor:

The main object of the carburettor is to supply the required quantity of fuel and air mixture of the correct strength as dedicated to the load condition of the engine. Ease of turning is very easy compared to simple carburettor.

ZENITH:

Construction:

- In this, float chamber is supplied with fuel from the fuel tank through a pipe.
- Whenever the float chamber falls short of fuel, the fuel from the fuel tank flows into the chamber at the fastest speed.

- The speed of fuel will match the requirement of an engine. Hence the float rises up, till it reaches a certain level.
- At this time, a needle valve moves down and rest against the seat. So, it resulting the stoppage of fuel supply from the fuel tank.
- The main jet is directly connected to the float chamber. While the auxiliary jet which is also called as compensating jet draws fuel from an auxiliary chamber (Reservoir).
- This auxiliary chamber is connected to the float chamber through an orifice. Both, main and auxiliary jet is opened up in the venturi.
- The air to the carburettor is supplied through the passage. The throttle valve is located at the end of the carburettor and connected to the engine suction pipe.
- The opening and the closing of the throttle valve controls the quantity of air-fuel mixture supplied to the engine suction manifold.
- An auxiliary nozzle from an auxiliary chamber (Reservoir) is located at one end of the by-pass. The other end of this nozzle opens up near the throttle valve.

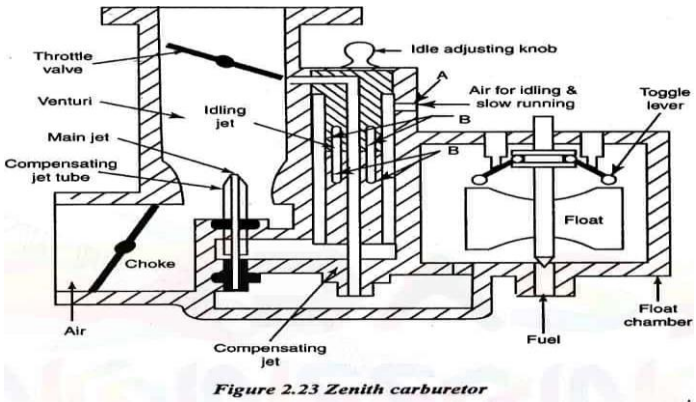

Figure 2.23 Zenith carburetor

Fig 1.4(b)Zenith Carburettor

Working:

At low speeds:

- Because of lower velocity of air at the time of starting or slow speed of the engine, the suction produced at the venturi is quite insufficient to operate the main and the auxiliary jet in a nozzle.
- To improve the velocity of air, the throttle valve is closed to such an extent that there is only a small contracted passage is provided near the end of by-pass.
- By this, the velocity of air, passing through the region increases, producing the high suction. This operates the nozzle at the auxiliary chamber and the air-fuel mixture supplied through the holes.
- There is starting and slow running device is fitted in the reservoir (Auxiliary Chamber).
- To vary the supply of air to the nozzle, the set screw given is slackened and the whole assembly is taken out.
- By the suitable number of rotations of screw joint, the position of an auxiliary nozzle is set.
- The whole device is then again fitted to the carburettor and tightened the screw

Normal Running Conditions:

- At this condition, the throttle valve is opened about 66% and as the air entering through the passage.
- It passes through the venturi its velocity increases due to smaller area consequently its pressure drops. Hence resulting in the suction effect.
- The fuel is sprayed in the venturi by a main and auxiliary nozzle.
- As the speed of the engine increases, thereby producing the greater suction.
- Due to this, greater fuel being supplied by the main nozzle.
- Since the compensating jet (Auxiliary Jet) draws fuel from a reservoir (Auxiliary Chamber), which is subjected to atmospheric pressure, through the air, the quantity of fuel supplied by it to the venturi does not change to an appreciable extent.
- This has the effect of supplying a weaker solution than if only one jet were a provider in which case, the air-fuel mixture supplied at high speed will be richer than desired.
- Thus, the compensating jet enables the air-fuel mixture of the desired strength to be supplied.
- In fact, with the correctly proportioned design of various parts of this carburettor, the fuel supplied by the main and compensating nozzle can be made to bear almost a constant ratio to the air supplied.

Deviations from simple carburettor: The main object of the zenith carburettor is to supply the required quantity of fuel and air mixture of the correct strength as dedicated by the load condition of the engine. At a very low speed, the mixture supplied by a Simple Carburettor is so weak that it will not ignite properly. And for its enrichment, at such conditions, some arrangement in the carburettor is required to be made. At different speeds zenith carburettor

acts as different configurations of air fuel mixture in order to keep them in stoichiometric ratio. **13**

SOLEX:

- Solex carburettor is a modification of simple carburettor. The simple carburettor works well in normal working conditions but it does not work well in conditions like winter and summer season, idle condition and high acceleration condition. In these conditions, Solex carburettor works well.
- The main work of carburettor is to create air-fuel mixture in the right ratio.
- Solex carburettor is known for its ease of starting the engine and the best performance of the engine.
- Solex carburettor is a downdraught carburettor. In downdraught carburettor, the air enters from the top and leaves from the bottom.
- The main drawback of simple carburettor is that it cannot maintain different air-fuel mixture for different driving conditions but the Solex carburettor can provide different mixtures for different driving conditions.
- This variation in air-fuel mixture for different conditions can be achieved by using Solex Carburettor.
- This Solex Carburettor can provide the rich mixture engine start and provide a lean mixture when traveling in economical speed with the vehicle. It can also provide different mixtures for different conditions like Engine Idling, Low-Speed operation, Acceleration etc.

Construction:

- In Solex Carburettor, the Fuel chamber is the part that collects fuel from the fuel tank and stores it to create air-fuel mixture in the carburettor. This fuel chamber has a float that is used to maintain the level of fuel in the fuel chamber.
- There is a main line through which the fuel reaches the venturi throat tube. The fuel enters the venturi throat tube from the main jet which is located at the end of the main line.
- The fuel from the main jet gets air when the choke opens. Fuel from the main jet mixes with air which comes when the choke is opened to form air-fuel mixture and this air-fuel mixture reaches the engine cylinder when the throat valve opens.
- Apart from the main jet, there are three more pipelines through which the engine cylinder gets fuel, they are pilot jet, pump jet, and starting passage.
- Pump jet gets fuel from the acceleration pump and the pilot jet gets fuel from main jet. The pipeline of the pilot jet is separated from the main line.
- The acceleration pump is operated using an acceleration pedal. This acceleration pump is used during acceleration.
- A pilot jet is used during the idle or no-load condition. It has a pilot bleed orifice from which the pilot jet gets air to form an air-fuel mixture. Near the end of the idle condition pipeline, there is an Idling Screw which is used to control the amount of air-fuel mixture to be passed to the Engine Cylinder.

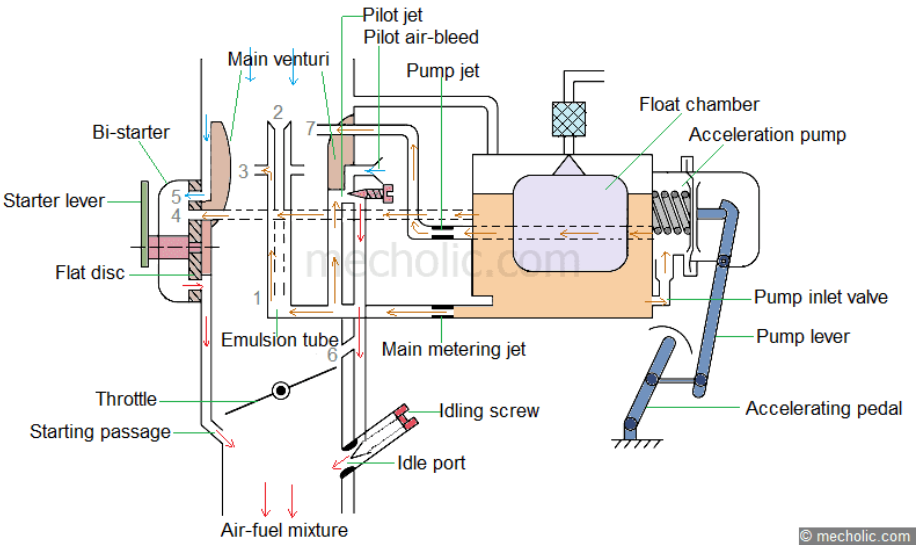

Fig 1.4 (c) Solex carburettor

- Starting passage gets its fuel from Starting Circuit or Bi-Starter. This starting circuit is used to supply the air-fuel mixture during the starting time. This starting circuit has a flat disc that has holes of different radius which is used to control the amount of fuel supply during starting.
- This starting circuit also has Air venturi which supply air in the starting circuit to create an air-fuel mixture. The air-fuel mixture from starting circuit is supplied to the engine cylinder through starting passage which is present below the throttle valve.

Working:

- At first fuel from the fuel chamber enters fuel chamber through a passage that is blocked by a float when the required amount of fuel enters the fuel chamber.
  The float which blocks the fuel tank and fuel chamber passage rises above as the level of fuel rises in the fuel chamber and it blocks the passage when fuel in the fuel chamber reaches its maximum level.

Working at the time of starting:

- At the time of starting, a rich mixture is needed by the engine. To provide a rich mixture at the time of starting Solex Carburettor has a starting circuit or Bi-Starter. The main function of the Bi-Starter is to compensate for the problem that occurs while starting the engine, particularly in the winter season.
- It provides a rich mixture to the engine at the time of starting. A rich mixture of air and fuel has a ratio of 11:1 where 11 part is air and 1 part is fuel. Normally air to fuel ratio required by the engine is 15:1 but at the time of starting it requires a ratio of 11:1 to start. This Bi-Starter has a flat disc and it has holes of different diameters.
- The starter petrol jet and starter air jet are connected near the holes of the disc and the air-fuel mixture passes through the different holes of the starter disc to reach the engine in the suction stroke.
- Through these holes the fuel and air pass from the Bi-Starter to the engine. This disc can be rotated manually using a starter lever so that it can be adjusted according to the

fuel and air requirement. For example, a large hole of the disc will be used in the winter as more fuel will be required to start the engine in winter.

Working during Idling and Slow running of the engine:

- Idling is the condition when the vehicle engine is running but the vehicle is not in motion. This situation normally occurs when the vehicle is stopped at red light and the engine is still on. At idle condition, there is no load on the engine but all the engine friction needs to be removed to keep the engine running.
- During the idling condition or slow running condition, the throttle valve is completely closed. Since the throttle valve is closed, the suction created by the suction stroke is acted on a pilot jet directly.
- Pilot jet is the jet that gets its fuel from the main line. The pilot jet pipe is connected to the main line and gets its fuel from it.
- At the idling condition, the throttle valve is closed and proper pressure is not built to suck fuel from the main jet. So the suction stroke of engine directly sucks the air-fuel mixture from the pilot jet.
- The fuel will be inducted from the pilot jet and it will be mixed with the air sucked from the pilot air-bleed orifice from the outside atmosphere.
- The rich mixture from the pilot jet will be directly sent to the engine by a tube located just below the throttle valve.
- There is an idling screw present near the opening of the pilot jet to control the speed of the engine by controlling the amount of air-fuel mixture to the engine.
- A by-pass arrangement is also provided just above the throttle valve so that if the pressure is enough near the throttle valve to suck the air-fuel mixture from the by-pass arrangement. When this by-pass arrangement will be used the throttle valve will open a little bit.
- A less rich air-fuel mixture will be provided by by-pass arrangement so that the engine can run smoothly with the full movement of the air-fuel mixture.
  The idle running condition works from 0 to 30 kmph speed and after that, it automatically stops.

Working during acceleration:

- During the acceleration, there is load on the engine. Extra air-fuel mixture is required by the engine during the acceleration to give proper acceleration to the engine.
- An additional acceleration pump injector is provided on the right side of the float chamber to provide the extra air-fuel mixture required during the acceleration.
  An extra jet is provided on the top of the main jet to supply extra fuel supplied using the acceleration pump.
- This acceleration pump is a diaphragm pump which is connected to a pedal. This acceleration pedal is also connected to the throttle valve through linkage.
- When we will press the acceleration pedal, the acceleration pump will operate as well as the throttle valve will also open simultaneously.
- As soon as the acceleration pedal is pressed, the acceleration pump will operate and will provide the extra fuel through the extra jet.
- When the acceleration pedal is released the acceleration pump will suck fuel from the fuel chamber and store it to provide extra fuel for the next acceleration.

Advantages of Solex Carburettor:

- All circuits for different conditions work separately.
- It minimizes waste and reduce carbon formation.
- Throttle response is high as compared to other carburettors. **16**
- It works perfectly under sudden heavy acceleration requirements.
- It starts very easily.

Deviations from simple carburettor:

- Solex carburettor provides proper mixture strength for various engine speeds and loads. thus, it suits for the engine is running at variable speed and load.
- It provides extra fuel on sudden throttle opening because of the accelerating pump provided.
- At very low speed the, idling system controls inline the mixture strength thus no starting problem arises.
- Change in atmospheric pressure and temperature does not affect the working of the solex Carburettor.
- Change in altitude affects the change in density of air which is compensated by the altitude control provided.
- It does not require resetting of the mixture strength when there is a change of season.

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Carter:

It was first founded by William Carter for the jeeps run by four-cylinder engines. Carter Carburettor is a downdraught type Carburettor. It is having multiple jets, a plain tube with only one adjustment for the idling or low speed running of the engine.

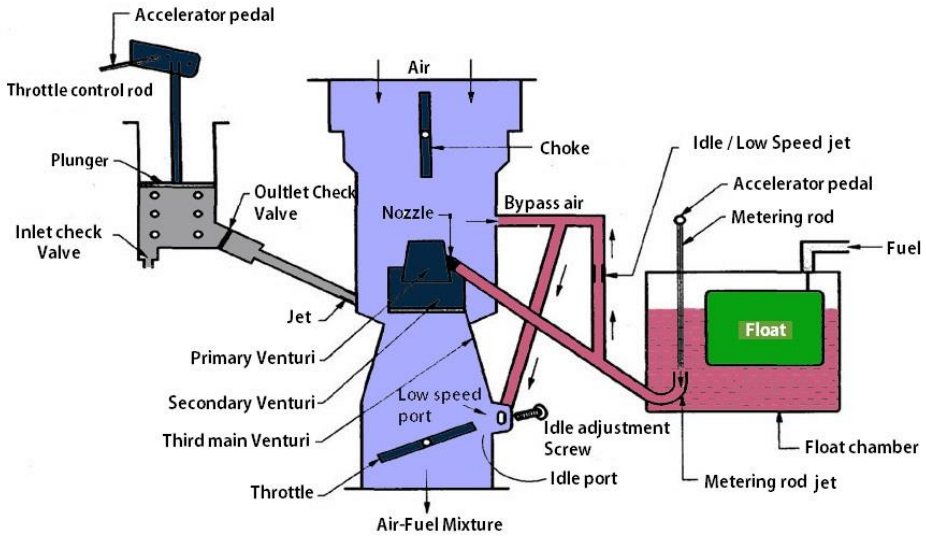

Fig 1.4(d) Carter Carburettor **17**

Construction:

- A float with a tapered valve at the top face of the float is arranged in the float chamber to take care of the fuel level in it.

- The air enters at the top of the tube operated by the choke valve. During normal

  operation, the choke valve will be fully opened. This Carburettor is comprised of 3 venturi tubes. Among these, the smallest one is maintained a little bit above to the level of fuel in the float chamber. The other two will be below the level of the fuel in the float chamber.

- The fuel nozzle injects the fuel at the primary venturi and throws the fuel against the air flow coming from the top. The air and the fuel mixed at the primary venturi and flow thru the secondary venturi and exposed to some more air steam and further flow thru the third venturi as well. After this, the fuel mixture enters into the engine during the suction stroke.

- There is a metering rod provided at the float chamber, which controls the quantity of fuel supply to the engine.

Engine starting circuit

During the engine starting a richer mixture need to be provided. The suction created by the piston during the engine starting is exerted on to the nozzle to provide the correct quantity of the fuel. The choke valve also provides less air. So that correct quantity of the richer mixture is prepared and inducted into the engine cylinder to start the engine smoothly. After the engine starts, the spring-controlled choke valve is open to allow the correct quantity of the air during the period of warm up.

Idle and Low-speed (Cruising) circuit

For the idle speed, the richer mixture is required in small quantity. In this operating condition, the throttle valve is slightly open. So that the suction created by the piston downward movement is exerted on to the ideal port. This is how the rich mixture is provided by the idle/slow speed jet. The air-fuel ratio can be controlled by the idle adjustment screw. For the low-speed operation, the throttle can be further open to run the engine smoothly above the idle speed operation.

Acceleration of Cater Carburettor:

- There is an acceleration pump arrangement as shown in the above diagram. This will help to accelerate the engine by supplying the additional amount of fuel with the help of jet at the direct throat.

- This acceleration pump consists of non-return inlet check valve and the outlet check valve, plunger and a spring-operated accelerator pedal. When we push the accelerator pedal, this will push a small amount of petrol to the throat by means of non-return inlet check valve to the outlet check valve and to the jet as shown in the above diagram. Now when you release the pedal, it will suck some amount of fuel from the float chamber**.**

S.U:

Construction:

- S.U Carburettor consists of a sliding piston and the tapered needle inserted into the main jet.
- Along with the piston upward and downward movement, the needle and the main jet also moves.
- There is a suction disc attached to the upper end of the piston.
- Piston rod and the piston rod guide help to guide the piston and the suction disc as shown in the schematic diagram.
- The piston is loaded with the helical spring.
- There is this portion above the suction disc is called the suction chamber which will be connected by the air passage by means of a slot provided in the piston.
- And there is an ordinary butterfly throttle valve as shown in the above fig.
- There is an air rectifier hole provided at the lower portion of the suction disc and the upper portion of this disc will be connected to the throttle air passage.

Working principle

- This Carburettor does not have different engine operating condition such as the idling and the slow running(cruising), normal running, accelerating.As the piston is loaded with the helical spring and the weight of the piston will be also supported by the vacuum in the suction chamber. The position of the piston will be balanced by maintaining the constant vacuum in the suction chamber. If any deviation occurred, the piston gets moved up/down.

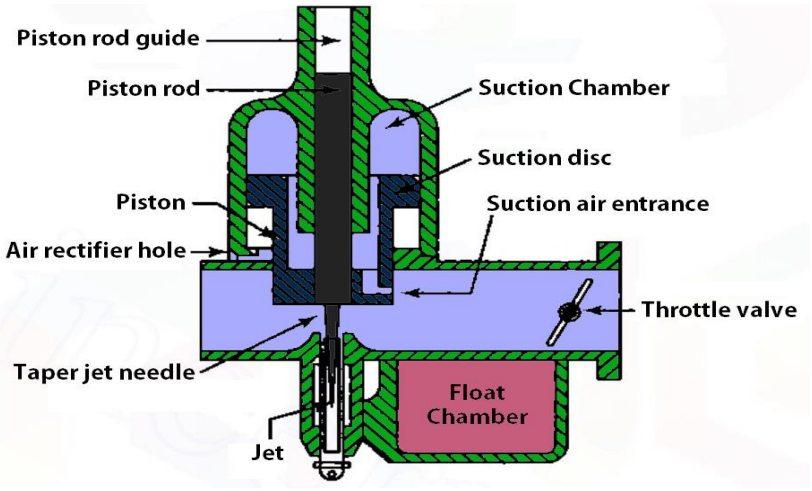

Fig 1.4(e) SU

- There will be a lever attached to the main jet to control the fuel flow while the engine needs to start. Because the engine starting needs a richer mixture.

- The throttle is opened more the more air is allowed to pass thru through the inlet due to the upward movement of the piston. the upward movement of the tapered needle also ensures the more fuel flow from the main jet. This is how the air and the fuel passages are varied with the different engine speeds and velocities of the fuel and the air remains constant. in this system.

Advantages:

- The main advantage of SU carburettor is the rapid response during accelerating. Hence it is fitted with racing cars and in most of the scooters and motorcycle.

- These are also used in aircraft engines including the early versions of the Rolls Royce.

Deviations from simple carburettor: SU carburettors featured a variable venturi controlled by a piston. This piston has a tapered, conical metering rod (usually referred to as a "needle") that fits inside an orifice ("jet") which admits fuel into the airstream passing through the carburettor. Since the needle is tapered, as it rises and falls it opens and closes the opening in the jet, regulating the passage of fuel, so the movement of the piston controls the amount of fuel delivered, depending on engine demand. The exact dimensions of the taper are tailored during engine development.

Two stroke engine carburettors:

1. **concentric carburettors:**

Models:

- **Mark1(1968):** To reduce the technical and manufacturing of previous carburettors and with pending emission controls required more accurate fuel metering, a new carburettor, the concentric was introduced a hemispherical chamber type was introduced below the concentric with the main jet to eliminate differences in the fuel height during cornering. There was no jet block the jet was mounted directly to the body. The piolet jet reverted to a drilling instead of removable jet. Right- and left-hand carburettors were available with flange mountings only.
    - Three body sizes were initially produced:
        - 400 series -12-20mm bore diameters
        - 600 series -22-27mm bore diameters
        - 900 series -28-32mm bore diameters

- Premier: later an updated version of the mark 1, the premier version was introduced, the castings of the body and flout bowl were in aluminium alloy and the side was made of hard anodised aluminium. A new float was introduced that was resistant to the ethanol in modern fuels. The piolet jet was removable and the idle circuit was improved.
- **Mark 1.5(1973):** To supply the demand for OEM (Original Equipment Manufacturer) carburettors. Amal and Talleres Arreche jointly designed modifications to the concentric to provide a separate enrichment circuit. These were available in both Flange and spigot mountings
- **Mark 2(1974):** the mark 2 used aluminium alloy for the main castings rather than zinc alloy previously used. Whilst the float chamber was still concentric with the main jet, it was now a square section. The pilot jet reverted to being removable and could be inserted in an alternate position for higher downdraught applications. Flange mounting was discontinued and the Mark 2 was only available in spigot mounting.
    - Three body sizes were available:
        - 2600 series -22,24,25,26 and 27mm bore diameters.
        - 2900 series -28,30,32 and 34mm bore diameters.
        - 2000 series -34,36 and 38mm bore diameters.
- **Type 27(1924):** It is designed for racing machines and it was based on AMAC's TT carburettor. A jet block and then hallow slide was used. The body, jet block and slide were assembled and then machined as one unit to ensure perfect matching and unobstructed flow through carburettor. No needle and no needle jets were fitted. For starting a piolet and bypass were used. To reduce fuel surge when concerning, two float chambers were used with the 27, one mounted on either side of the carb.
- **TT (1932):** It was the progression of the type 27. A needle and needle jet were incorporated to provide additional turning for road machines and the carburettor was used with alcohols as a fuel.
    - Three body sizes were made:
        - 25TT -3/4'' and 7/8 bore diameters.
        - 15TT -15/16'',1'' and 11/16'' bore diameters.
        - 10TT -1 1/16'',1 3/32, 1 1/8'' and 1 5/32'' bore diameters
- **RN (1937):** It was introduced as a development of TT. The needle and jets were moved to the side of the carburettor bore to give the less obstacle flow through the carburettor.
- **GP (1954):** It was introduced and replaced both TT and RN, Air from the piolet was taken from the outside of the carburettor through drilling.
        - 15GP - 7/8, 15/16", 1" and 11/16" bore diameters
        - 10GP - 1 1/16", 1 3/32", 1 1/8", 1 5/32" and 1 3/8" bore diameters
        - 10GP - 1 7/32" and 1 3/8" bore diameters
        - 10GP - 1 3/8", 1 13/32", 1 7/16 and 1 1/2" bore diameters

- **GP2 (1972):** There was some problems in GP to overcome that GP2 has been introduced. The piolet circuit was moved to the inlet side. The air bleed was taken from the inlet air rather than outside, reducing the possibility of dirt ingress to the circuit.

- **Mark 2 Smooth bore concentric:** A smoothbore version of the 2000 series Mark Concentric was made available for racing used. To obtain the "smoothbore", a jet block and hollow slide were fitted. Although the carb was never used as an OEM part, it was popular with smaller specialist racers.

Four stroke engine Carburettors:

Caster Carburettors:

- **Cast Brass Carburettor (1909):** It metered and delivered fuel more accurately than many competing units.
- **Four-barrel Carburettors:** It was made of thermo-Quad, which used a light weight thermoplastic float bowl.
- **Holly Double pumper:** Carburettors feature all aluminium construction and are equipped with metering blocks and a base plate made from 6061-T6 billet aluminium. They weigh in at approximately 5 lbs. less than a comparable zinc carburettor. The new Ultra Double Pumper Carburettors have an enhanced fuel curve for optimum performance, with many more features such as aluminium construction; anodized billet aluminium metering blocks and base plate; 4 corner idle for precise idle control; dual accelerator pumps for additional fuel under initial acceleration; mechanical secondaries for great performance; clear fuel level sight plugs for easy, no mess fuel level adjustments; Ford automatic transmission kickdown for use on popular Ford transmissions; four vacuum ports for all necessary vacuum accessories; and for the first time on a Double Pumper, factory pre-set electric choke for easy, fast cold start-ups.
- Ultra-Double Pumpers feature an Optimized Street/strip calibration that works out-of-the-box.
- Aluminium construction for a 43% weight savings
- Holly Dominator: Classic Dominator carburettors feature an aluminium main body with a contoured venturi inlet for balanced airflow and increased horsepower, screw in air bleeds for easy fine tuning, high flow metering system with race calibrations and annular boosters. Other features include Dominator fuel bowls to allow plumbing from either side, high flow needle and seats, 50cc accelerator pumps, and 4 corner idle.
- Annular Boosters deliver excellent signal and throttle response
- Screw in air bleeds offer precision tuning capabilities.

Summary:

- Small engines have one of the following types of carburettors:
  - Natural or side draft
  - Updraft
  - Downdraft
- The natural or side draft carburettor is used when there is little space on the top of the engine. The air flows horizontally into the manifold.
- The updraft carburettor is placed low on the engine and uses a gravity fed fuel supply.
- The air fuel mixture is forced upward into the engine.
- The downdraft carburettor operates with lower air velocities and larger passages.
- It provides a larger volume of fuel when needed.
- Some of the carburettors are float type or diaphragm carburettors.
- The float type uses a float to maintain a constant level of fuel in the fuel chamber.

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