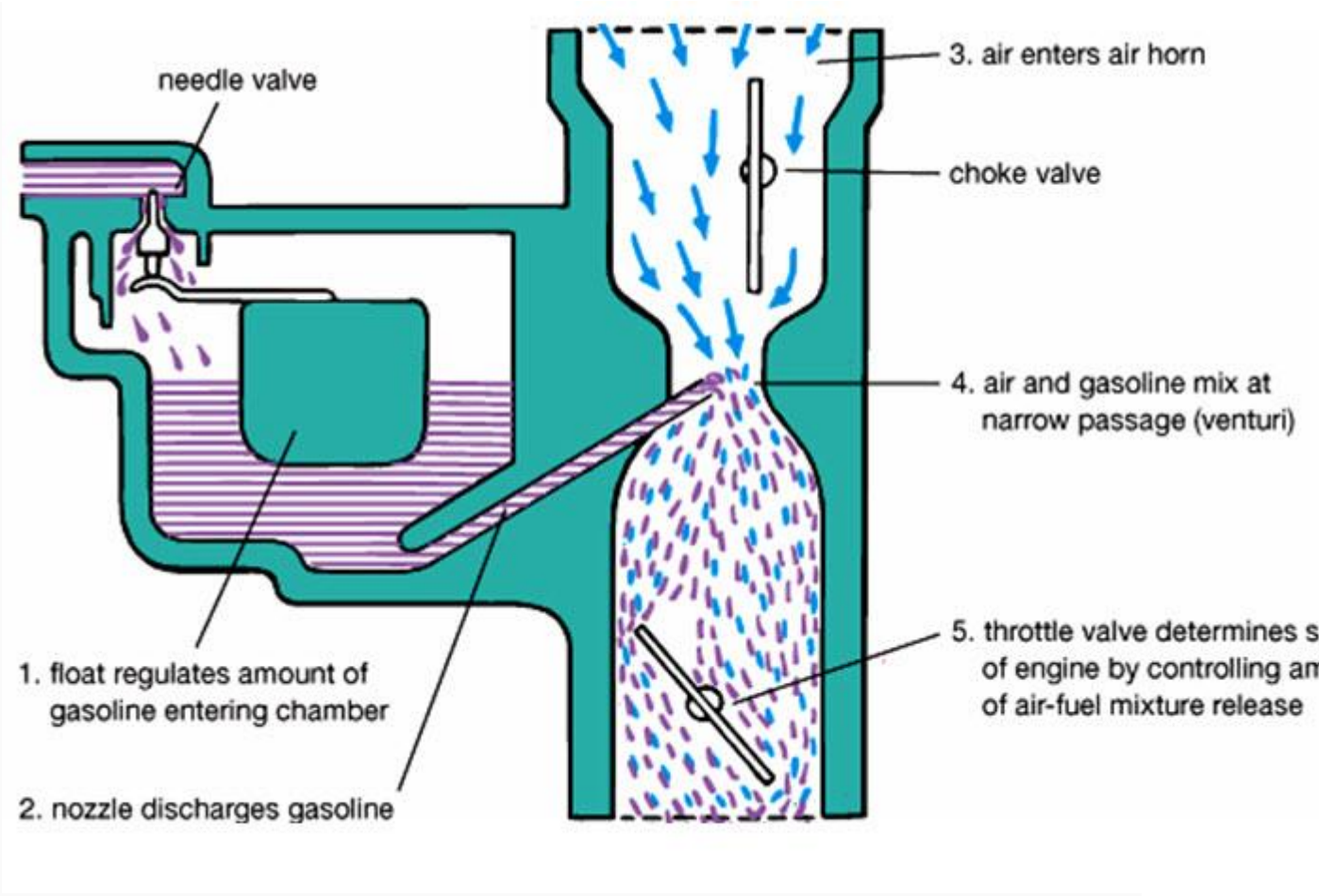
Carburetor:

Carburetor is the device which works on Bernoulli's Principle and is used in petrol engines to controls the amount of atomized fuel and air in the air fuel mixture to be supplied to engine combustion chamber. Carburetor is provided with the throat in which the air stream flows. The velocity of air is more in the throat as compared to velocity at the entrance and this high velocity reduces the pressure inside the throat which makes the fuel to enter in the throat due to pressure difference and gets mixed with the air stream. Under all conditions, the engine carburetor must perform the following:

- Regulate the airflow in the engine
- Supply the required amount of fuel to maintain the level of fuel/air mixture
- Prepare the exact fuel and air mixture



Following are the components of carburetor :

- Float chamber and float

- Venturi

- Nozzle

- Throttle valve

- Fuel jet

- Choke

Float Chamber and float : Special purpose light weight brass metal is used in the float chamber to maintain the constant level fuel in the float chamber. The float is attached to the stopper like mechanism to allow and restrict the entry of fuel in the chamber as it moves down and up. The metallic floats have tendency to get damaged and leak from the joints. So to avoid this, plastic or rubber material is used for manufacturing float. The level of fuel in the float chamber is maintained lower than the nozzle outlet.

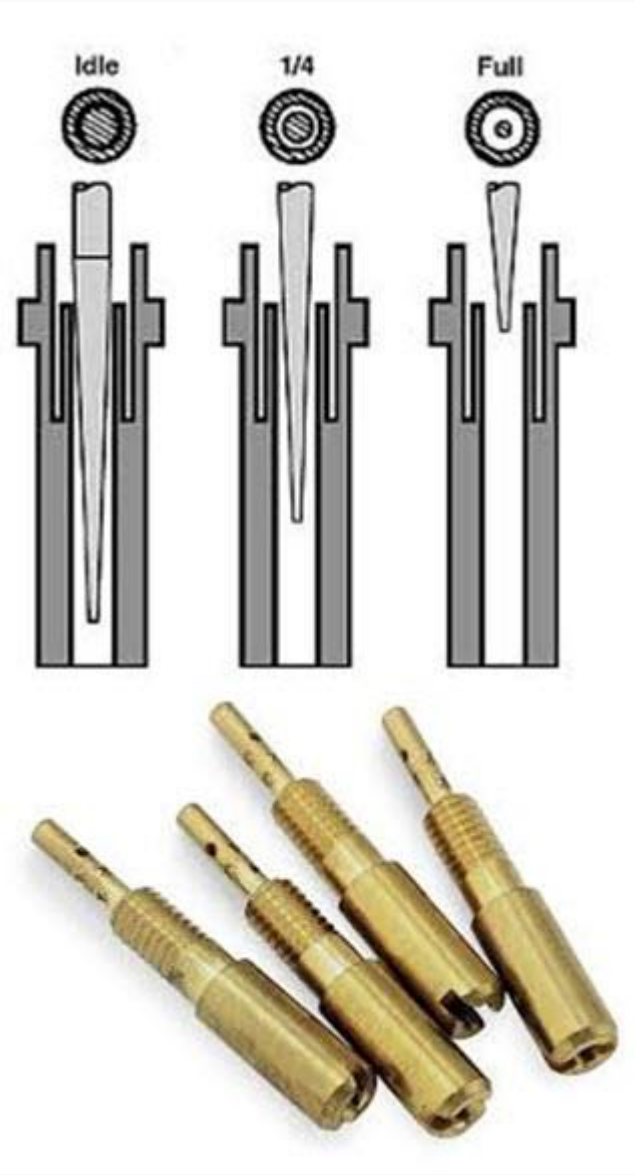
Venturi : The fuel from the nozzle flows into the venturi, which is simply a restriction in the air passage. Venturi is the area where this passage area in the direction of air flow is minimum. As the passage for area decreases, it increases the air velocity and hence decreases the air pressure. Due to this depression in the pressure, the fuel comes out from the nozzle and gets mixed with the air and converted into fuel vapours. Then, this air fuel mixture is entered into the engine cylinder through inlet manifold. The quantity of fuel entering into the engine cylinder depends upon the jet size, float level and venture vacuum.

Nozzle : It is used in the venturi to discharge the fuel and get mixed with the air stream. The nozzle outlet is place above the level fuel in the float chamber to avoid spilling of fuel from the nozzle when vehicle is running on slope and highly cambered roads.

Throttle valve : It is used to control the quantity of flow of air fuel mixture. Throttle valve is attached to the accelerator pedal through lever mechanism. Butterfly or cylindrical valves are used but butterfly type is most commonly used valve for controlling the air fuel mixture. Butterfly type is simply a disc type mechanism hinged at the centre. Although it is easy use and operate, but it restricts the flow even when it is fully opened. No suction is applied to the nozzle when the throttle valve is fully closed.

Fuel jet : The flow of fuel from the float chamber to the venture through the nozzle is metered by fuel jet. It regulates the fuel supply. Fuel jets are made of special brass material and should have anti corrosive material. The engine idle speed and corresponding idling mixture is adjusted with the help of stop screw provided on the top of jet. Idle speed of an engine is adjusted by stop screw at the point where engine runs smoothly on the slowest speed at no load. Main jet adjustments are done after the engine is warmed up and put on load. When engine

runs at full throttle, the main jet is turned until the full power is regained and engine runs smoothly. The jet screw is rotated further (to almost half turn more) to avoid engine stalling due to load variations.



Choke : It is a butterfly valve operated by hand lever or sometimes automatic to restrict the air flow and hence increasing the proportion fuel in air fuel mixture. The choke is generally applied for initial starting purposes. The choke is to be opened immediately when the engine gets started otherwise the flooded fuel would result into engine stall. Carburetor can be of following three types on the basis of direction of air-fuel mixture is supplied :

i) Up-Drought

ii) Down-Drought

iii) Horizontal

Out of above mentioned types of carburetors, down-drought is the most commonly used type due to following advantages :

i) Fuel flows dues to gravity which helps the engine under load to run smoothly at lower speed

ii) Volumetric efficiency can be enhanced and it is easy to access

fuel properties:

Engine needs to run on fuel of high quality to produce maximum work output. Several fuel properties have been identified and defined as following.

i) Heat value or Calorific value

ii) Specific gravity

iii) Volatility

iv) Flash point

v) Fire point

vi) Pour point

vii) Viscosity

viii) Octane number

ix) Cetane number

x) Carbon residue

xi) Sulphur content

xii) Gum content

Heat value or Calorific value

It is the indicative of heat energy being produced by the fuel when it is burnt inside the cylinder/combustion chamber of an engine. It is expressed in J/kg of fuel and is measured in the device which is known as calorimeter. The impurities in the fuel leads to decrease in its heat value.

Specific gravity

It is expressed as the ratio of the density of fuel to the density of water. The specific gravity affects the fuel atomization in the nozzles and spray penetration/injection in the engine cylinder/combustion chamber. Fuels which are

relatively heavier have usually greater heat value. The specific gravity is measured by the hydrometer.

Volatility

It is the property of the fuel to get converted into vapours on burning at a specific temperature. The volatility is measured by means of distillation. In diesel fuel, volatility is indicated by 90% distillation temperature (temperature at which 90% of the fuel is distilled off). Lower volatility in fuels leads to increase in carbon deposits, smoke content and also wear of engine components.

Flash point

It is the temperature at which the fuel must be heated to get flammable vapours and is driven off to ignite when brought into contact with the flame.

Fire point

It is the higher temperature at which the vapours will continue to burn after being ignitied. Generally, the fire point is 10^0 to 21^0 C higher than the flash point and it is the indicator of fire hazards. The lower the flash point, the greater is the fire hazard. In general, the flash point should be high enough to avoid producing flammable vapours.

Pour point

It is the temperature at which the fuel becomes insoluble to pevent flow under specified conditions. In cold weather conditions, this becomes very important parameter as wax crystals start forming even when temperature is slightly over the pour point. A higher pour point implies that in cold weather the fuel will not flow easily through the filters and fuel system and also the atomization/spray characteristics are affected.

Engine detonation:

Engine detonation is an engine refers to inappropriate combustion of fuel in the combustion chamber/cylinder of the engine. Either the compressed air fuel mixture is burnt in the cylinders with help of a spark (in SI petrol engines) or the air alone is compressed during the compression stroke and fuel is injected and burnt due to compression (in CI diesel engines). To get maximum power from the engine it is required that proper of air fuel mixture or fuel is supplied to the engine and ignited at proper time. Sometimes, where preignition of fuel can happen in the engines, it is also observed that whole of the fuel or air fuel mixture is not burnt at once. Due to this, a pressure wave is set up in the combustion chamber which travels to and fro and hits to the cylinder walls. This disturbance

in the cylinder forces the walls at the frequency of gases which produces a very peculiar sound which is known as engine detonation or knocking.

Engine detonation can also be illustrated as it can also occur due to sudden and instantaneous ignition of the unburnt charge when the temperature and pressure is so high and sufficient to ignite the fuel or air fuel mixture. The factors affecting engine detonation can be classified as follows :

i) Engine factors

ii) Air, Fuel and Air-Fuel mixture factors

Engine factors

There are engine characteristics which can affect engine detonation include :

- **Compression ratio :** Engine detonation increases with increase in compression ratio as it increases the gas temperature and pressure thus lowering the reaction time for charge to get ignited. Every engine is designed for a particular maximum compression ratio and any compression ratio beyond this, causes engine detonation.

- **Engine size :** Engine detonation increases with increase in cylinder size (bore).

- **Spark advance :** Retarded spark helps in lowering the detonation whereas over-advance in spark leads to more detonation as pressure gets higher than the normal maximum pressure.

- **Design of combustion chamber :** The design which produces more turbulence in the combustion chamber, it helps in rapid combustion of the charge and hence decrease the chances to knock or detonate.

- **Defective cooling system :** If engine cooling system is not working properly due to fault in engine thermostat, water pump etc., it can also increase the engine detonation.

- **Engine speed :** At higher engine speeds which may also lead to fall in volumetric efficiency, the engine detonation is decreased.

- **Valve timing :** As the valve timing increases the volumetric efficiency which increases the air-fuel mixture intake and increase the cylinder pressure, the tendency to engine detonation is also increased.

Air, Fuel and Air-Fuel Mixture factors

It has been observed that charge characteristics mentioned below can also be significant factors which can cause engine detonation.

- Octane number

Effects of detonation

The main effects of detonation are:

1. Inefficient combustion.

2. Loss power.

3. Local overheating.

4. Mechanical engine failure.

Prevention of Detonation

The different methods used for the prevention of detonation are:

1. Anti-knock agents.

2. Cooling of the charge.

3. Reducing the time factor.