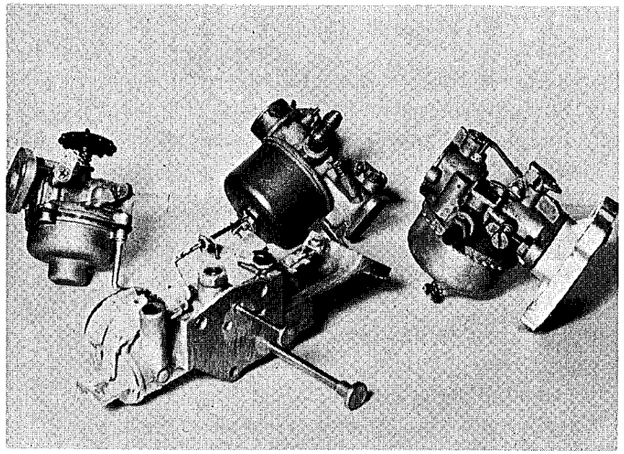


CHAPTER 7

CARBURETION

Watch for These Words

governor
throttle
gravity
vent
solvent
mesh
filter
jet
venturi
diaphragm
suction

How to Use These Words

1. The *governor* controls the *throttle* in a carburetor.
2. When the fuel tank is above the carburetor, the force of *gravity* will make the fuel flow down into the float bowl.
3. Most fuel tank caps have a *vent* hole to allow air to enter as the fuel is used up.
4. Use a *solvent* to clean the fine wire *mesh* in an oil bath air *filter.*
5. The main fuel *jet* is always located in the *venturi* of a carburetor.
6. The *diaphragm* in a fuel pump causes *suction* in the fuel line to draw fuel from the tank.

Look for Answers to These Questions

1. What is the purpose of a carburetor?
2. What is a venturi?
3. What prevents gasoline from overflowing into the throat of a gravity feed carburetor?
4. What style of carburetor would be the least expensive to manufacture and repair?
5. Why does the idle circuit need its own separate fuel and air supply?
6. What part of the carburetor controls the speed of the engine?
7. How does the choke change the fuel/air mixture for easier starting of a cold engine?
8. Why is the air cleaner such an important part of the engine?
9. Name three styles of carburetor air cleaners.

Be careful: Never work around gasoline or gas-soaked rags if there is danger of fire. Do not smoke, light matches, or strike sparks.

Be careful: Do not leave gasoline-soaked rags around in a pile; a fire could result.

GASOLINE

Liquid gasoline is a substance that burns in air with a cool yellow flame and much black smoke. Compared to some chemicals, gasoline burns slowly. However, when this same gasoline is broken up into a fine spray and mixed with the right amount of air, it becomes very explosive and produces great heat and power.

Carburetors

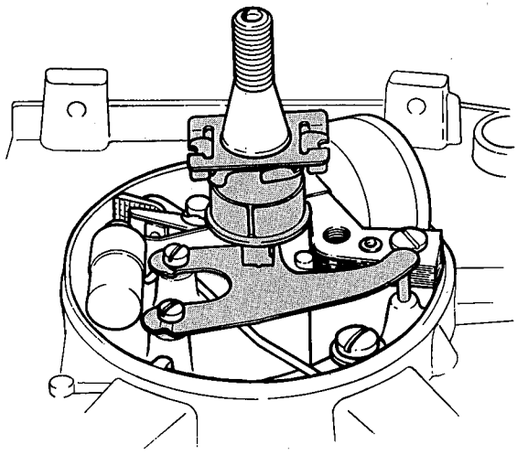
The carburetor of a small engine must be able to take liquid gasoline and break it up into a fine mist. It must mix the mist with the exact amount of air needed for complete combustion in the engine cylinder. It must do this at all operating speeds from idle to wide-open throttle, and at all operating temperatures from cold start to full operating. The correct mixture is *one part* of gasoline, by mass, to about *fifteen parts* of air.

Look at the carburetor closely. To do all the things described above, the carburetor must be divided into four separate systems of fuel and air passages and valves. These are:

(a) The supply system
(b) The high speed system
(c) The choke system
(d) The idle speed system

Governor: a speed control for an engine.

Many small engines are controlled at a particular operating speed by a governor and have no idle speed system in their carburetors. Governors are described in the next chapter.

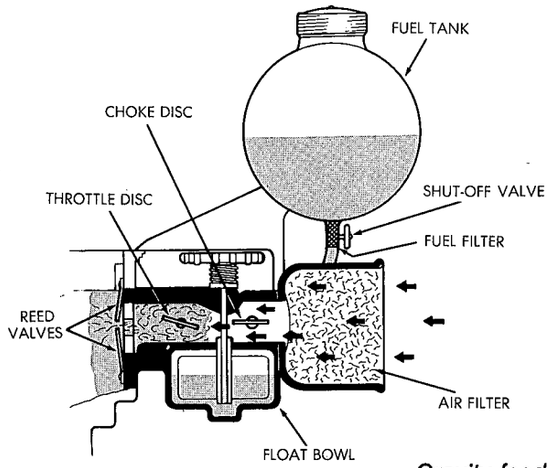


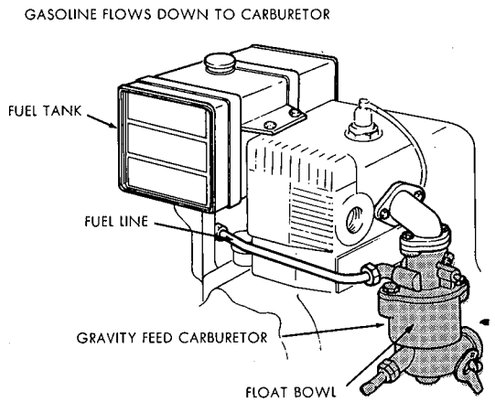
Mechanical governor

THE SUPPLY SYSTEM

Carburetors for use on small engines are described by the method by which they draw fuel from the fuel tank. The drawings below show gravity feed carburetors. Gravity feed carburetors have their fuel tank mounted above them. The gasoline runs down to a small container on the carburetor called the float bowl.

Gravity: the natural force that pulls everything down towards the centre of the earth.



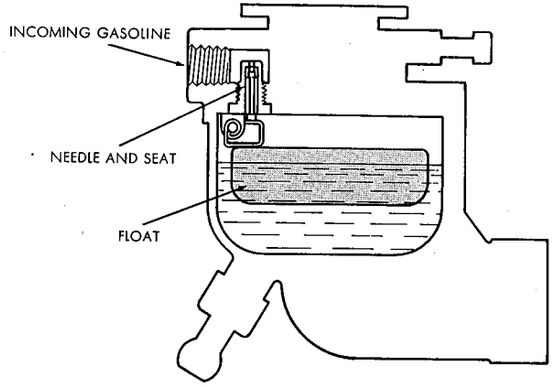


Gravity feed carburetors

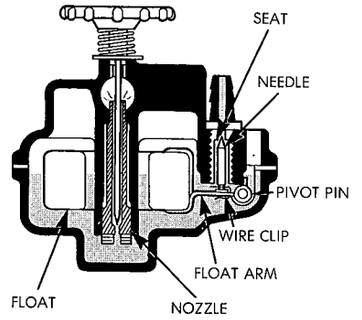
Be careful: Gasoline fumes are hazardous to breathe. Work with good ventilation.

The level of fuel in the bowl is controlled by a small float connected to a needle valve. When the float rises it closes the needle valve, and stops the flow of fuel from the tank.

The float and needle valve work together to keep the right amount of gasoline in the float bowl at all times. The main fuel jet draws fuel from the float bowl.



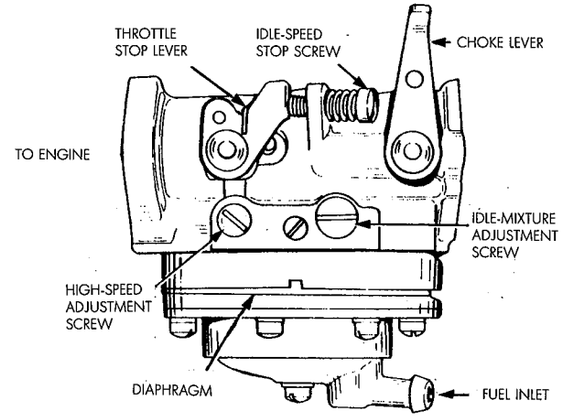
Cutaway of float chamber and needle assembly



Cutaway of gravity feed carburetor

Be careful: Gasoline fumes are explosive. Gasoline should be stored in a sturdy, sealed gasoline can and kept outside.

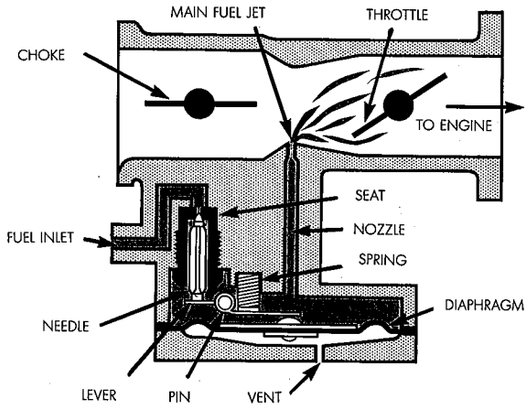
The carburetors used on the engines that power machines such as chain saws must be able to work in any position. They need a diaphragm fuel supply system that will not spill when the carburetor is tipped. This style of carburetor is called a diaphragm carburetor. The diaphragm and its spring take the place of a float to control the supply of gasoline to the carburetor.



A gravity fed diaphragm carburetor

Suction: a force that causes a gas or liquid to move from an area of high or normal air pressure to an area of low air pressure.

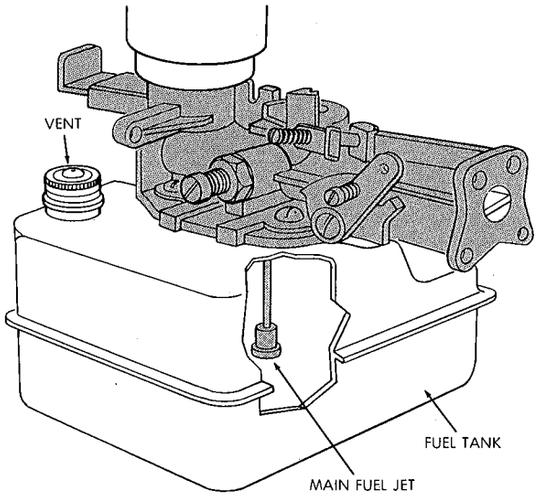
Jet: a tube with a small opening to allow a liquid to rush through.



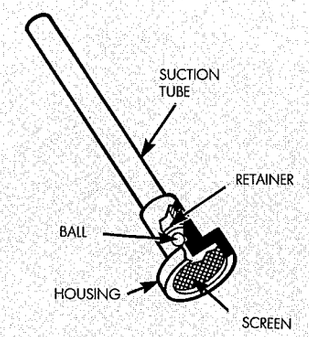
The intake vacuum that draws fuel from the main jet also pulls the diaphragm against spring pressure and opens the inlet needle.

Another type of small engine carburetor is the suction feed carburetor. It is fastened to the top of the fuel tank. The main fuel jet hangs down into the fuel tank, so that no float bowl is needed.

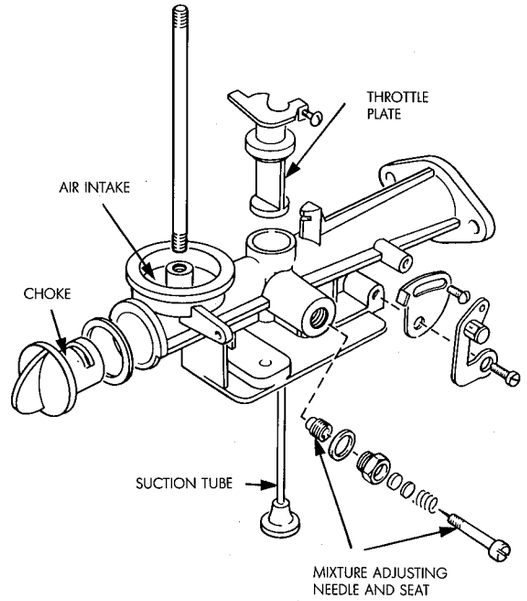
Carburetors of the suction feed style must be adjusted while the tank is half full. Carburetors of this type tend to provide an over-rich fuel/air mixture with a full tank, and a lean mixture when the fuel level is low. The engine first gets too much gasoline and later "starves".



Suction feed carburetor

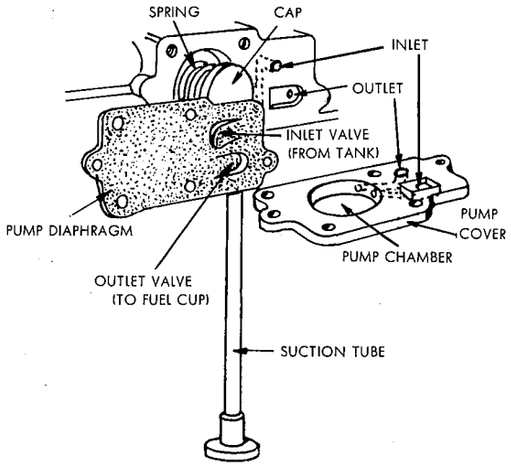


The screen must be clean and the check ball free to move.

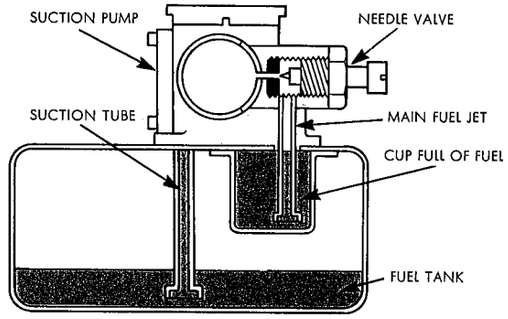


Exploded view of suction feed carburetor

An improvement on this carburetor uses a built-in diaphragm fuel pump operated by intake vacuum. The pump keeps a small cup in the fuel tank full of gasoline. The carburetor draws fuel from the cup so it is not affected by the level of gasoline in the tank. Excess fuel pumped into the cup spills over into the tank.

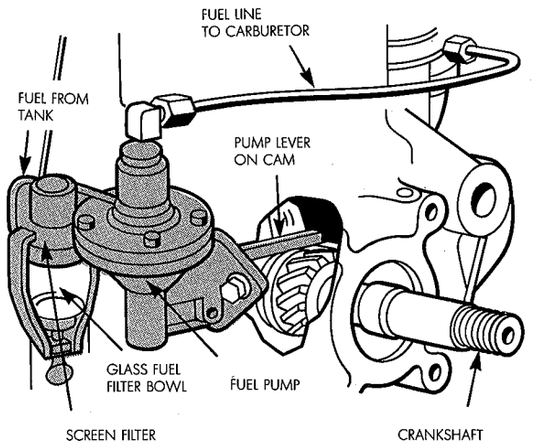


Parts of a vacuum operated fuel pump on the side of a carburetor

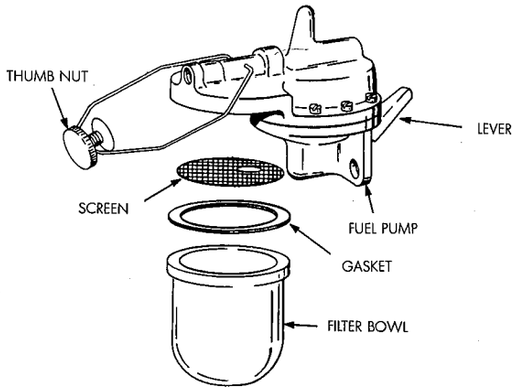


Cutaway of a carburetor with built-in fuel pump

Some of the larger engines have a small fuel pump to supply gasoline to the carburetor float bowl. The fuel tank does not have to be above the carburetor in this case. The diaphragm of the pump is moved by a lever resting on a cam on either the crankshaft or camshaft of the engine.



A cam and lever operated fuel pump



Details of a fuel filter as used on a lever operated fuel pump

THE HIGH SPEED SYSTEM

Venturi: the narrow spot in a carburetor that causes a low air pressure area around the fuel jet.

Vent: a hole that allows air to move in or out of a container

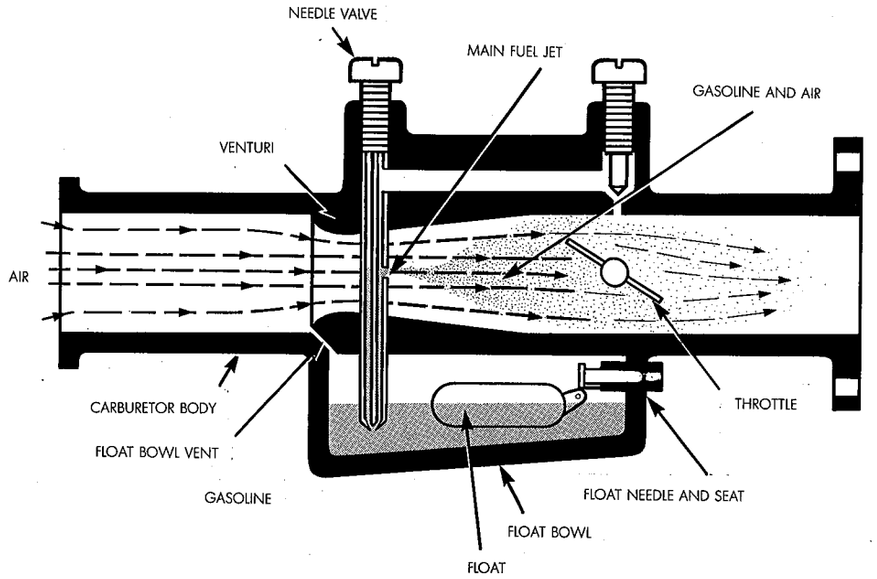
When the piston is moving down on the intake stroke, it sucks both gasoline and air into the cylinder through the carburetor. If the fuel were allowed to pour directly into the throat of the carburetor, the engine would always be flooded with too much gasoline. This is why all carburetors draw the fuel up from the float bowl or tank through a nozzle called the main fuel jet.

The faster the air is sucked past the main fuel jet, the more gasoline will be drawn from the supply. You will notice from the drawings in this chapter that the main fuel jet enters the carburetor throat at a narrow spot called the venturi. This narrow opening causes the air to speed up past the fuel jet, just as wind moves faster through a narrow alley between two buildings.

As the air speeds up through the venturi, an area of low air pressure is created around the main fuel jet. This makes the gasoline flow up the jet to get to the low pressure area. When the gasoline leaves the jet, the rushing air breaks the liquid into a fine spray in the carburetor throat.

The float bowl must have an air vent to let normal air pressure act on the fuel.

The flow of gasoline is adjusted by turning a screw called the



Cutaway of carburetor showing the high speed system in use

Needle valve

Throttle: a valve that controls the amount of fuel and air entering the cylinder of an engine.

r/min: revolutions per minute.

needle valve in or out of the main jet. With an engine running at the usual operating speed, turn this needle valve screw in slowly until the engine stalls, and then turn the screw back about half a turn. This is the right place for it to be.

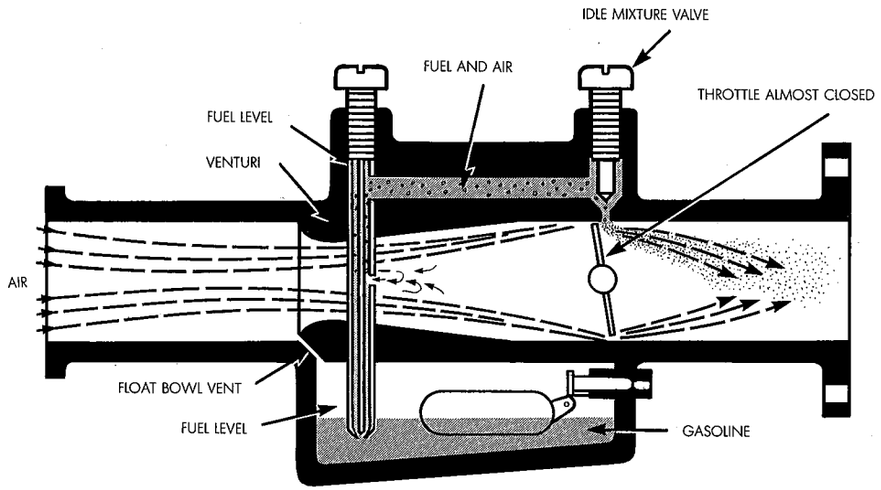
A round disc of metal, called the throttle, is mounted on a shaft after the venturi to open or close off the throat of the carburetor. By opening or closing the throttle, the amount of fuel/air mixture that gets to the cylinder can be controlled, making the engine go faster or slower.

THE IDLE CIRCUIT

When the throttle closes off the carburetor throat, none of the fuel/air mixture can get to the cylinder from the high speed system. To allow the engine to run at a slow idle speed when the throttle is almost closed, air and fuel are sucked through a small passage to a jet in the carburetor throat. This jet is past the edge of the almost closed throttle.

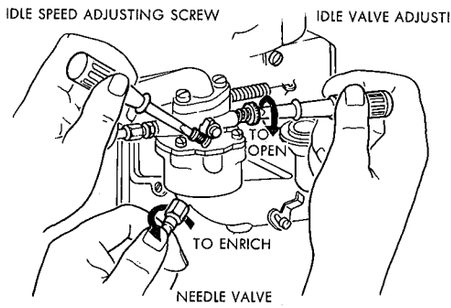
You can adjust the mixture of fuel and air for the smoothest idle. Turn the idle valve adjustment screw in slowly until the engine stalls, then back the screw out about half a turn.

The idle speed can be set to the desired r/min by turning a screw on the throttle shaft. When the screw is turned in against a stop, the throttle is held open slightly to allow some air to slip by the throttle. The idle mixture adjustment should then be changed to give the smoothest idle at the new speed.



The idle speed circuit

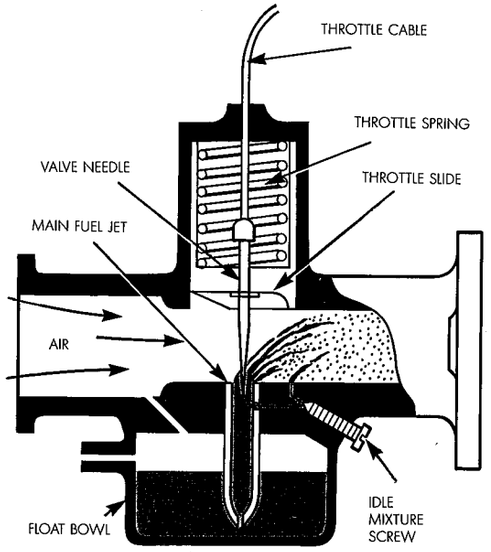
Be careful: Gasoline fumes are explosive. Do not smoke while filling a fuel tank.



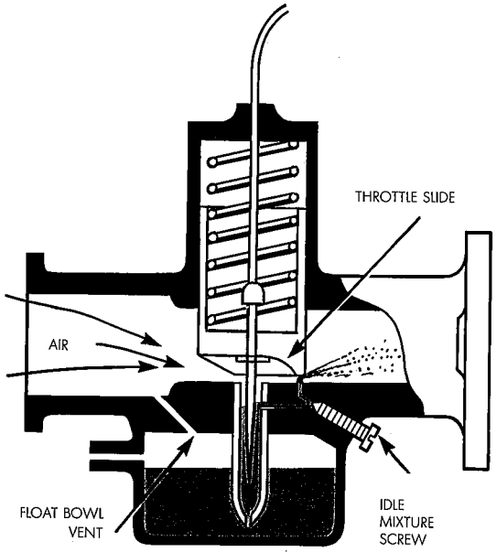
Adjusting the carburetor

SLIDE THROTTLE CARBURETORS

Many carburetors used on snowmobiles, motorcycles and ultra light aircraft have slide throttles which actually change the size of the venturi as they open and close. This feature plus its adjustable needle valve allows more accurate mixture control at all speeds.



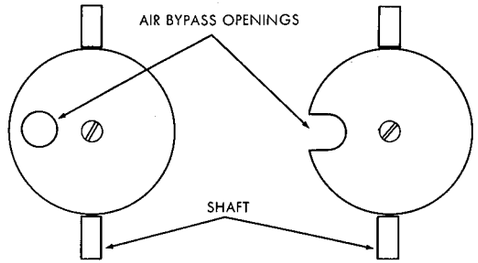
The high speed circuit of a slide throttle carburetor. The throttle is in the wide open position.



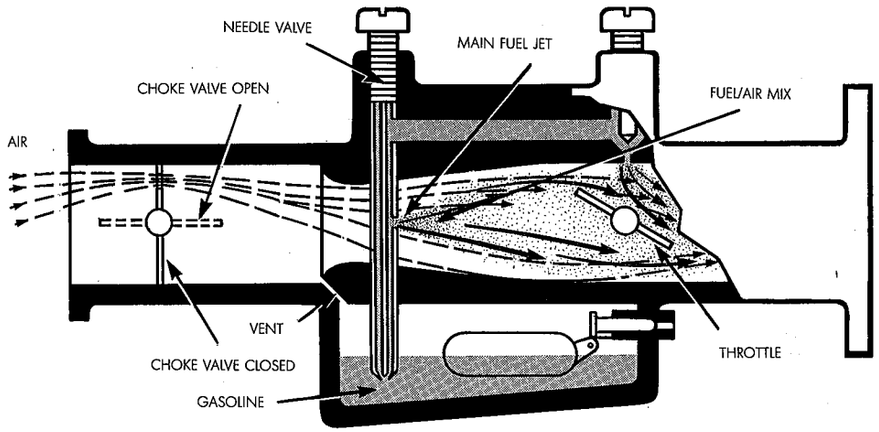
A slide throttle closed to idle position. The bottom of the throttle slide is shaped to position the smallest venturi passage above the idle jet.

THE CHOKE CIRCUIT

A cold engine needs a rich mixture in order to start and run for the first few minutes. A rich mixture is one that has more fuel and less air than a normal mixture. The choke valve, placed in the carburetor throat before the venturi, cuts down on the amount of air entering the carburetor and causes more gasoline to be sucked from the main fuel jet. As you can see, the choke valve does not cut off all the air to the carburetor. It has a hole or notch in it to let some air through. When the choke valve is closed, fuel and air are also drawn through the idle circuit.

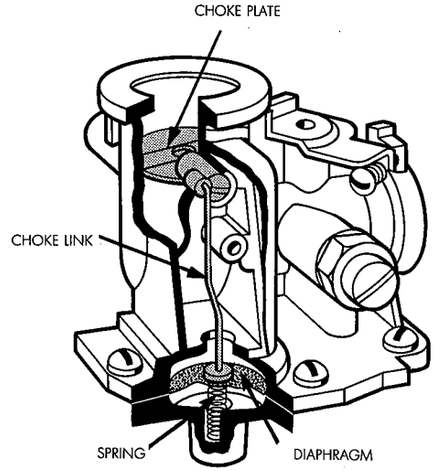


Example of choke valves



The choke circuit

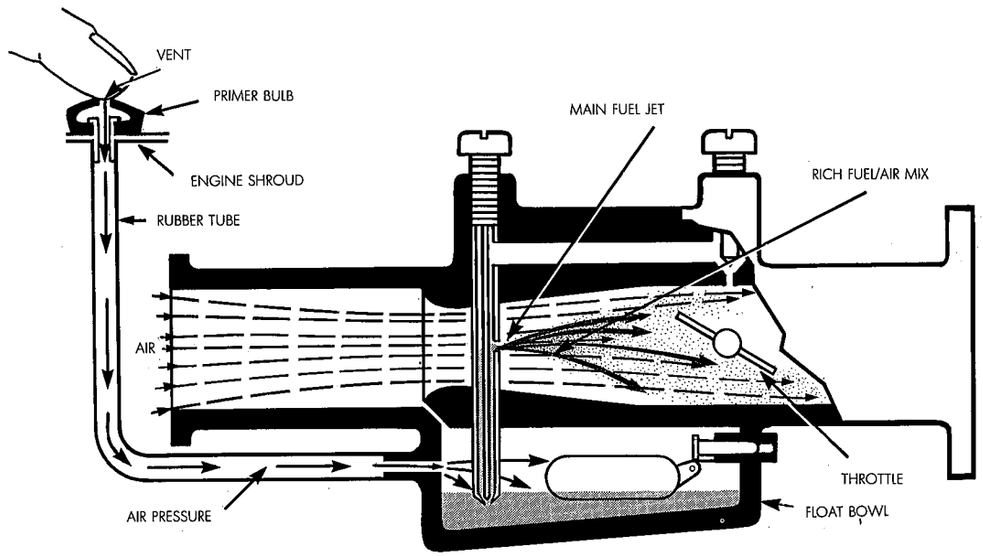
The carburetors on some small engines have automatic chokes that are held closed by a light spring when the engine is stopped or is cold. The drawing shows a choke plate that is attached to a diaphragm. A small passage connects the diaphragm housing to the intake manifold. When the engine starts, vacuum in the intake manifold pulls on the diaphragm and opens the choke. This type of automatic choke tends to behave like a governor. Another type has the choke lever attached to a thermostat and as the engine temperature increases, the thermostat gradually opens the choke. The thermostat must be fastened to the cylinder wall of the engine and adjusted to open the choke fully at a certain temperature.



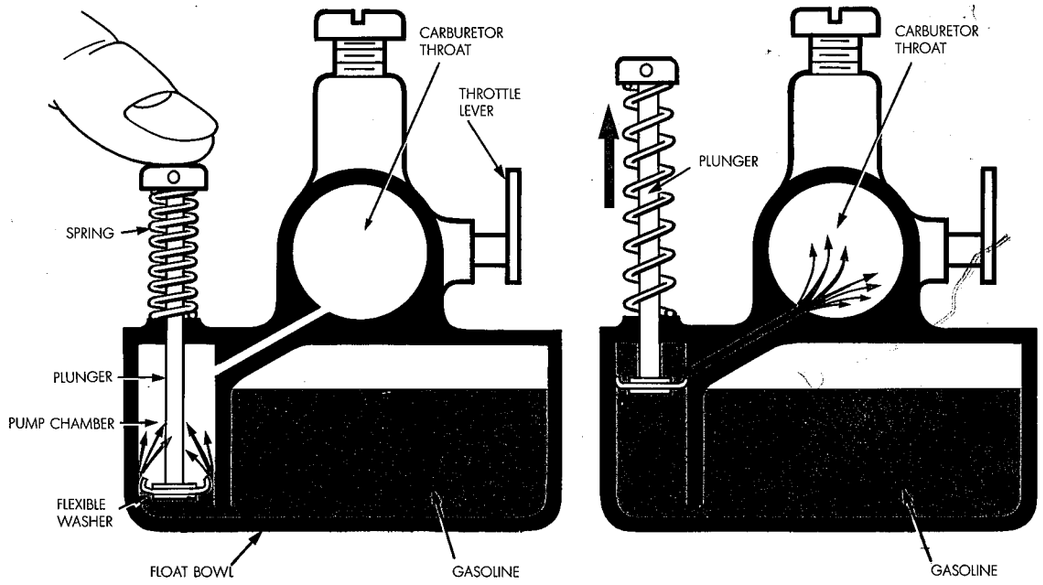
A vacuum operated automatic choke

PRIMERS

Instead of a choke valve, some carburetors use a primer to make a rich starting mixture. The primer lifts or pushes a quantity of gasoline into the carburetor throat. A choke reduces the amount of air mixing with the fuel. A primer increases the amount of fuel mixing with the air.



Finger pressure on the rubber primer bulb causes air pressure on the fuel in the float bowl and pushes gasoline through the main fuel jet.



This style of primer works like a pump. When the plunger is pushed down, the edge of the cup-shaped washer flexes and lets gasoline into the pump chamber. When finger pressure is removed, the spring lifts the plunger and gasoline is pumped into the carburetor throat.

Filter: a special paper, cloth, metal mesh or wire screen with very small openings in it. Air can get through the openings but dirt specks are too big.

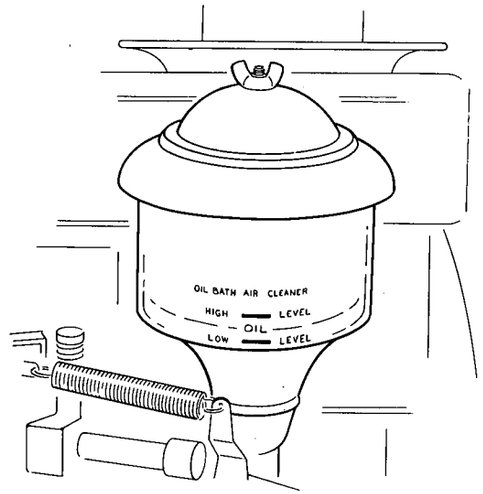
Safety First: Be sure to dispose of used oil properly. Always keep your workshop free of slippery floors or tools.

Mesh: the threads or fine wire of a net or screen.

CARBURETOR AIR CLEANERS

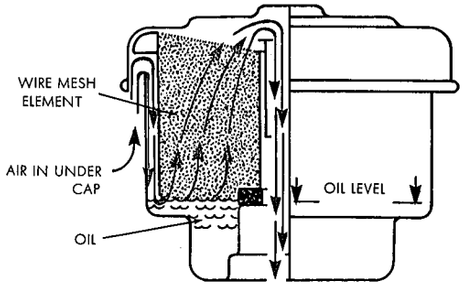
The biggest enemy of both the carburetor and the engine is dirt. Dirt in the gasoline slowly plugs the fuel jets. Dirt in the air can cause scratched and worn piston rings and cylinder walls. When dirt gets mixed with the oil, it causes the bearings to wear rapidly. An engine that is used in dirty, dusty conditions will have a very short life if the owner forgets regular air cleaner service and oil changes, and does not use clean gasoline from a clean container.

Even a small, single cylinder engine needs large amounts of clean air. The makers install one of three types of air cleaners on each carburetor, to make sure the air is clean when it reaches the engine. The air cleaners filter out dirt from the air. This dirt gradually plugs up the air cleaner and cuts off the flow of air to the carburetor. The engine begins to act as though the choke is closed all the time because it cannot get enough air. It is then time to clean or replace the filter.

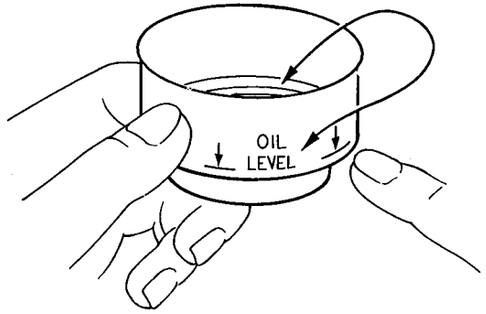


Oil bath air cleaner

The drawing above shows an **oil bath** air cleaner. Air passing through this type of cleaner must flow across the surface of an oil sump and then through metal mesh to the carburetor throat. Bits of dirt and dust become trapped in the oil and the mesh and should be cleaned out regularly. Pour out the old oil and clean the oil bowl with a wiping cloth. Wash the mesh in solvent and let it drain dry. Refill the bowl with oil to the oil level mark, and fasten the cleaner to the carburetor.



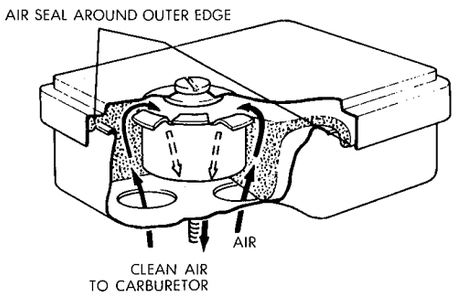
Air passing through an oil bath air cleaner



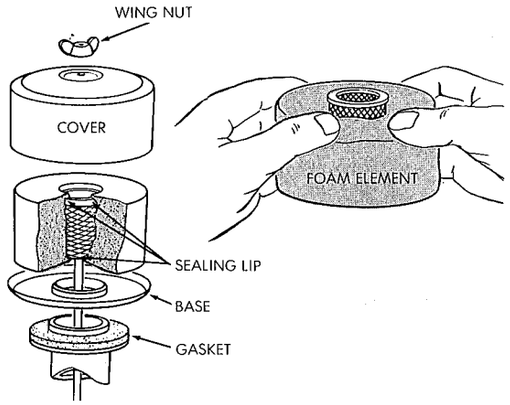
Refill bowl to oil level mark.

Solvent: a liquid, such as varsol, used as a cleaner.

Oil wetted air cleaners trap dirt in an element of foam rubber, wire mesh or crumpled foil that has been wetted with a few drops of oil. Wash the element in solvent regularly and apply a few drops of clean oil.

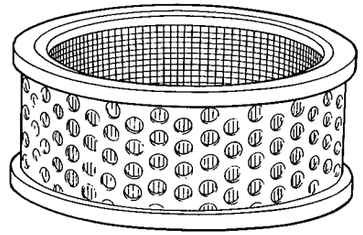


Air passing through an oil wetted air cleaner

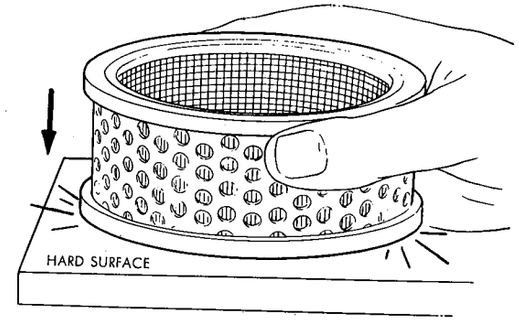


Parts of an oil wetted air cleaner

Dry element air cleaners are the newest type of air cleaner available. The element is made of folded paper, enclosed in a screen. All air to the carburetor must pass through the paper element. When the element gets dirty it can be thrown away and replaced with a new one at little cost. It is possible to clean some of the dirt out by tapping the element on a hard flat surface, as shown.



Dry element air cleaner

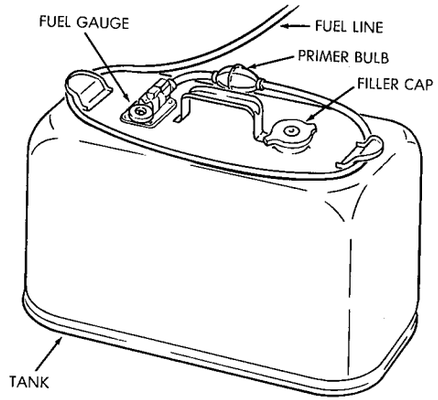


Cleaning a dry element air cleaner

Be careful: When filling a gasoline can or tank, touch the fuel nozzle to the tank first to let any static electricity flow to ground. Then hold the nozzle against one side of the filler neck while filling the container.

Pressurized Fuel Tanks

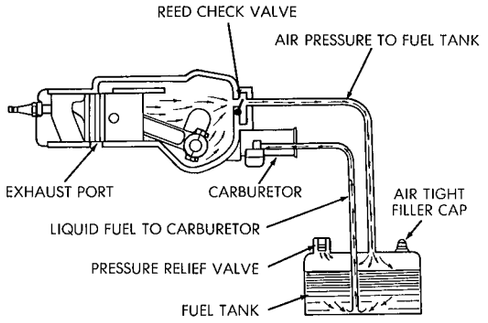
In order to use outboard boat engines for long cruises, a large fuel tank is used. This tank is separate from the engine and sits on the bottom of the boat. Either crankcase pressure or vacuum suction is used to move fuel from the tank to the carburetor.



Fuel tank for outboard boat engines

For the fuel to flow from the tank to the carburetor, some of the crankcase pressure is used to push on the fuel in the tank and force it through the fuel line to the float bowl. You can see how this works in the picture on the next page.

A small reed valve on the crankcase opens on the *down* stroke of the piston and closes on the *up* stroke. The fuel tank must be air tight. When the carburetor fuel bowl is full and the float has closed the needle against its seat, any extra tank pressure escapes through a relief valve.



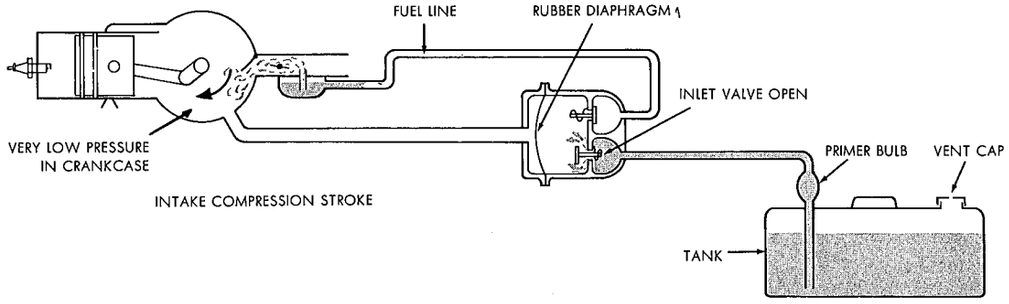
Pressure fuel system

Fuel Pumps

Some of the larger outboard engines use a small suction pump to lift fuel from the tank and push it into the carburetor fuel bowl. A hand-operated rubber squeeze bulb in the fuel line must be used to supply the carburetor with fuel for starting. A rubber tube connects the fuel pump to the crankcase of the engine.

When the piston moves up in the cylinder, the crankcase vacuum pulls on the rubber pump diaphragm. This causes a small poppet valve to open, and fuel is drawn into the fuel pump.

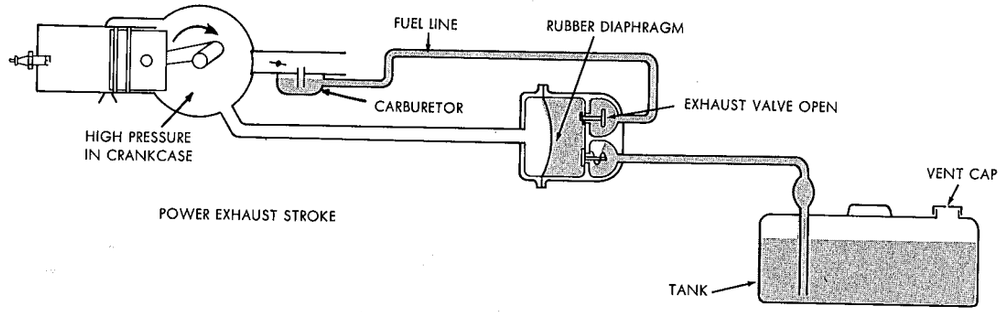
Diaphragm: a flat disc of cloth and rubber in a fuel pump. It separates the fuel tank side of the pump from the engine side.



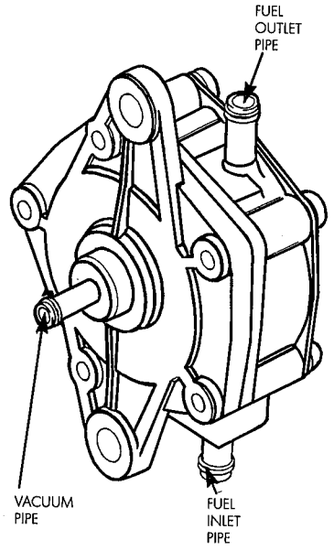
Fuel pump drawing fuel from tank

When the engine piston moves down in the cylinder, crankcase pressure pushes on the pump diaphragm. The intake poppet valve closes, and the fuel is pushed out of the pump through a second poppet valve to the carburetor.

This system must have an air vent in the fuel tank.



Fuel pump pushing fuel to carburetor



A vacuum operated fuel pump

Chapter 7: Carburetion

1. What is the purpose of a carburetor?

2. What part of the carburetor controls the speed of the engine?

3. How does the choke change the fuel/air mixture for easier starting of a cold engine?

4. Name three styles of carburetor air cleaners.