CARBURETTOR

It is pretty fundamental to the operation of internal combustion engines to know howfuel-air mix is formed. The fuel and air are mixed in one of two main ways. The old-school method is to use a carburettor, whilst the new-tech approach is to use fuel injectors. The basic purpose is the same: to mix the fuel and air together in proportions that keep the engine running. Too little fuel and the engine runs lean which makes it run not. Too much fuel and it runs 'rich' which conversely makes the engine run cooler. Running rich can also result in fouled up spark plugs, flooded engines and stalling, not to mention wasting fuel. Finding the right balance normally involves about 10 milligrams of petrol for each combustion stroke.

A carburettor is basically a shaped tube. The shape of the tube is designed to swirl the incoming air and generate a vacuum in a section called the venturi pipe (or the venturi). In the side of the venturi is a fuel jet which is a tiny hole connected to the float chamber via a pipe. If’s normally made of brass and has a miniscule hole at the end of it which determines the flow of fuel through it In more complex carburettors, this is an adjustable needle valve where a screw on the outside of the carburettor can screw a needle in and out of the valve to give some tuning control over the fuel flow. The fuel is pulled through the jet by the vacuum created in the venturi. At the bottom of the tube is a throttle plate (throttle butterfly) which is a flat circular plate that pivots along its centreline. It is connected mechanically to the accelerator pedal (twist-grip throttle) via the throttle cable. The more you push on the accelerator or twist open the throttle, the more the throttle butterfly opens. This allows more air in which creates more vacuum, which draws more fuel through the fuel jet and gives a larger fuel-air charge to the cylinder, resulting in acceleration.

When the throttle is closed, the throttle butterfly in the carburettor is also dosed. This means the engine is trying to suck fuel-air mix and generating a vacuum behind the butterfly valve so the regular fuel jet won't work. To allow the engine to idle without shutting off completely, a second fuel jet known as the idle valve is screwed into the venturi downwind of the throttle butterfly. This allows just enough fuel to get into the cylinders to keep the engine ticking over.

To make sure a carburettor has a good, constant supply of fuel to be sucked through the fuel jets, it has a float chamber or float bowl. This is a reservoir of petrol that is constantly topped up from the fuel tank. Petrol goes through an inline filter and a strainer to make sure it's clean of contaminants and is then deposited into the float chamber. A sealed plastic box is pivotted at one end and floats on top of the fuel. This is called the float. A simple lever is connected to the float and controls a valve on the fuel intake line.

As the fuel drops in the float chamber, the float drops with it which opens the valve and allows more fuel in. As the level goes up, the float goes up and the valve is restricted. This means that the level in the float chamber is kept constant no matter how much fuel the carburettor is demanding through the fuel jets. The quicker the level tries to drop, the more the intake valve is opened and the more petrol comes in to keep the fuel level up. This is why carburettors don't work too well when they're tipped over — the float chamber leaks or empties out resulting in a fuel spill — something you don't get with injectors. To combat this, another type of chamber is used where carburettors can't be guaranteed to be upright (like in chainsaws). These use diaphragm chambers instead. The principle is more or less the same though. The chamber is full of fuel and has a rubber diaphragm across the top of it with the other side exposed to ambient air pressure. As the fuel level drops in the chamber, the outside air pressure forces the diaphragm down. Because it's connected to an intake valve in the same way that the float is in a float chamber, as the diaphragm is sucked inwards, it opens the intake valve and more fuel is let in to replenish the chamber. Diaphragm chambers are normally spill-proof.

One of the problems with the spinning, compressing, vacuum-generating properties of the venturi is that it cools the air in the process. Whilst this is good for the engine (colder air is denser and bums better in a fuel-air mix), in humid environments, especially cool, humid environments, it can result in carburettor icing. When this happens, water vapour in the air freezes as it cools and sticks to the inside of the venturi. This can result in the opening becoming restricted or cut off completely. When carbs ice up, engines stop.

In cars there's normally a heat shield over the exhaust manifold connected via a pipe to a temperature-controlled valve at the air filter. When its cold, the valve is open and the air filter draws warm air from over the exhaust manifold and feeds it into the carburettor. As the temperature warms up, the valve closes and the carburettor gets soft, air because the risk of icing has reduced.