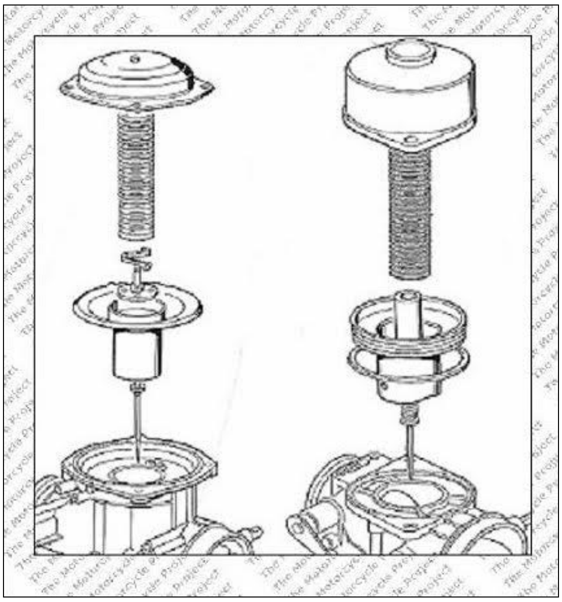
The Motorcycle Project®

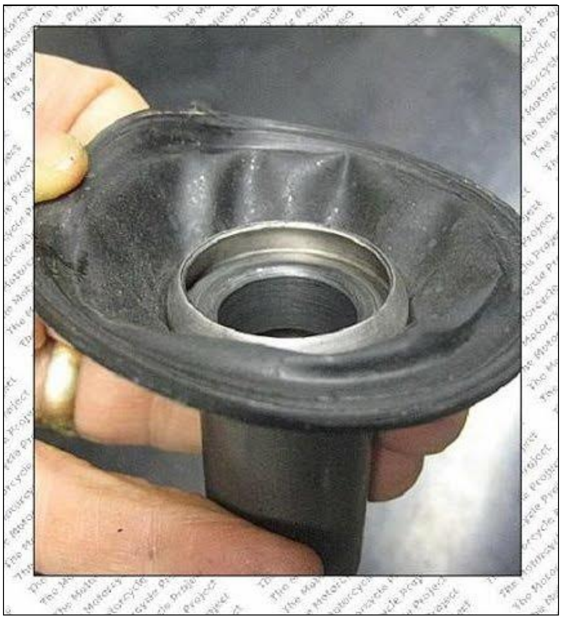
How CV carburetors work

The constant velocity carbburetor is mystifying even to the professional mechanic. Hopefully, this article will take some of the mystery out.

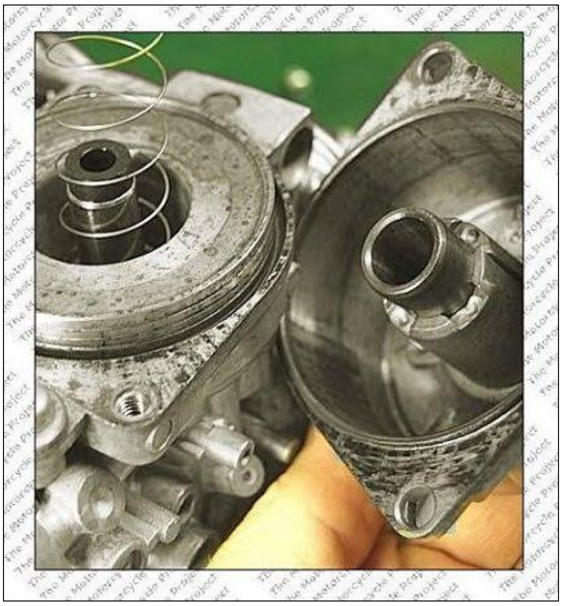


History

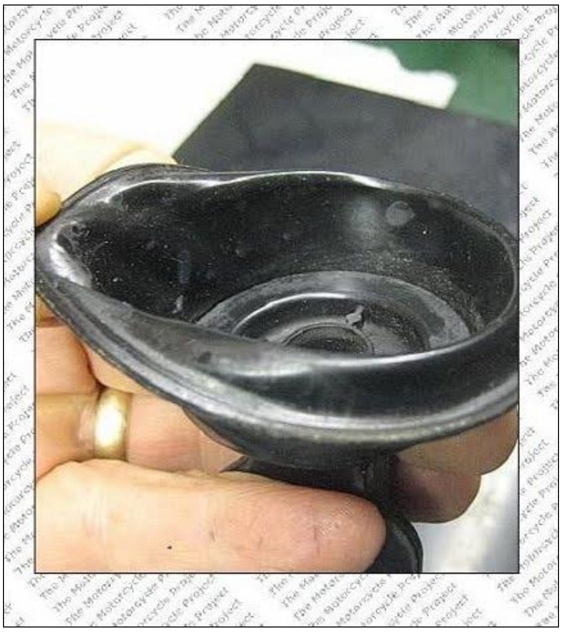
Virtually all of the last series of streetbike carburetors that appeared before fuel injection became standard were of a design called "constant velocity". There are actually two kinds of CV carbs: the rubber diaphragm and the labyrinth. Both have been used by a number of different manufacturers. You vintage Honda twin guys should recognize the two earliest Honda CV carbs here, the 350 and 450 carbs (though the 450 did not come stock with a slide spring).



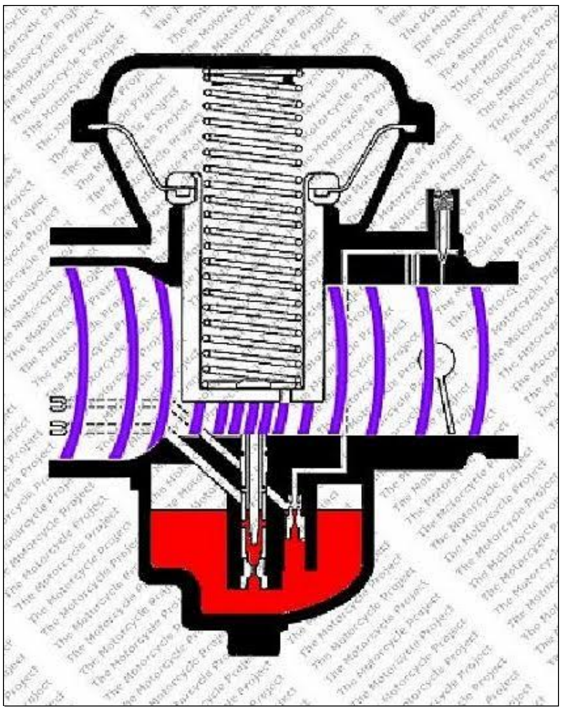
The rubber diaphragm type CV represented the genre early on but was later replaced by the labyrinth type, and later still the rubber diaphragm came back to dominate. The rubber diaphragm shown here is a very early one. It is not very stretchy. This early rubber diaphragm was prone to cracking and rupturing, which of course negatively affected engine performance.



The labyrinth type uses a machined labyrinth seal instead of a diaphragm. It had its own issues, not the least of which was it collected dirt and grime around the labyrinth seal, and elsewhere, which affected its operation.

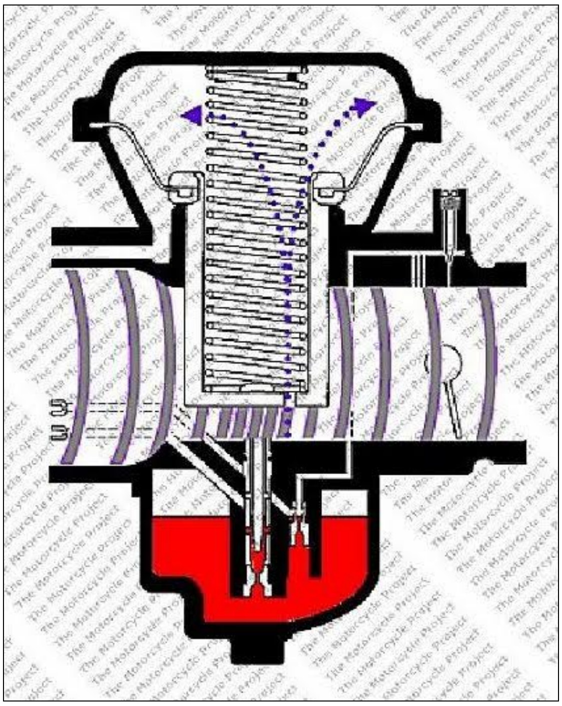


When he rubber diaphragm reemerged much later it was made of a superior material that did not rupture easily and was much more responsive. All of the Hondas and many other models benefitted from this revised design.

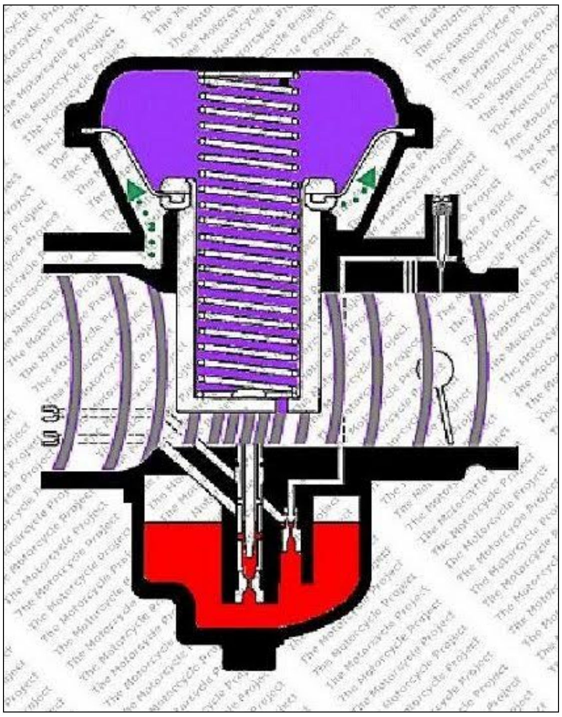


Function

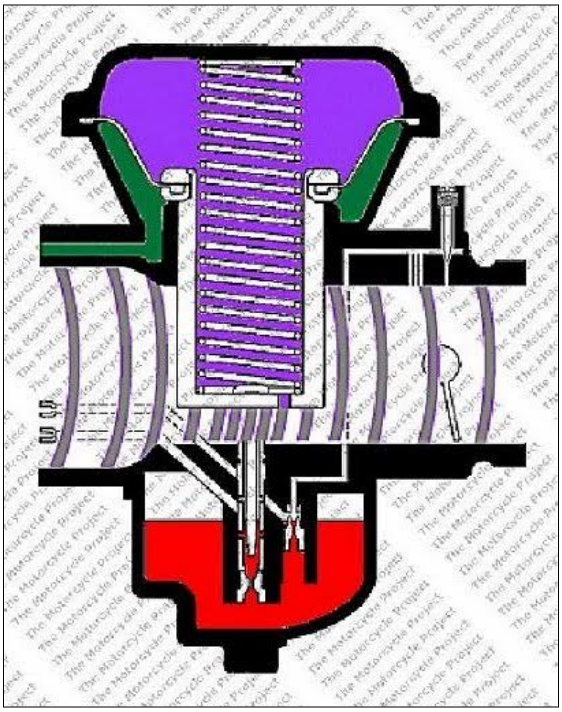
Whether rubber diaphragm or labyrinth type, the seal divides the top of the CV carburetor into two chambers. One chamber contains atmospheric air pressure while the other is at somewhat lower pressure. As with every carburetor, airflow through the CV carb creates a low pressure zone inside the carburetor bore. The engine is idling at this point. The purple waves represent airflow.



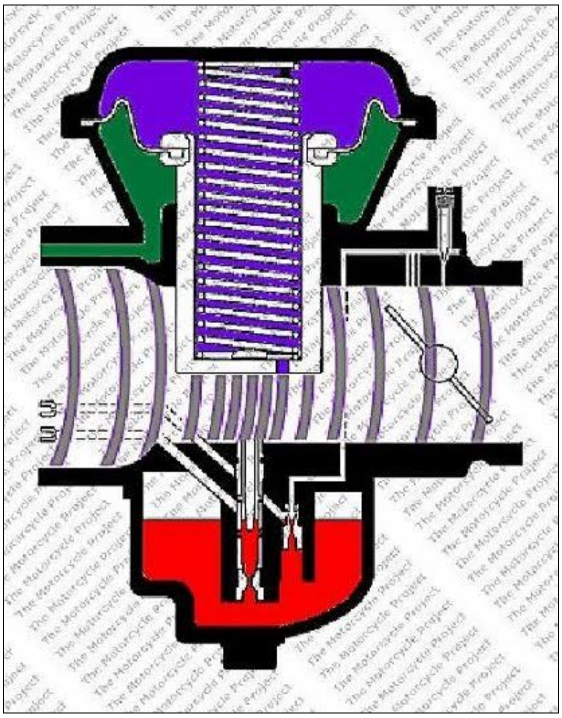
This low pressure has access through a hole in the bottom of the slide to the area above the slide's seal. Thus this upper chamber contains low pressure air.



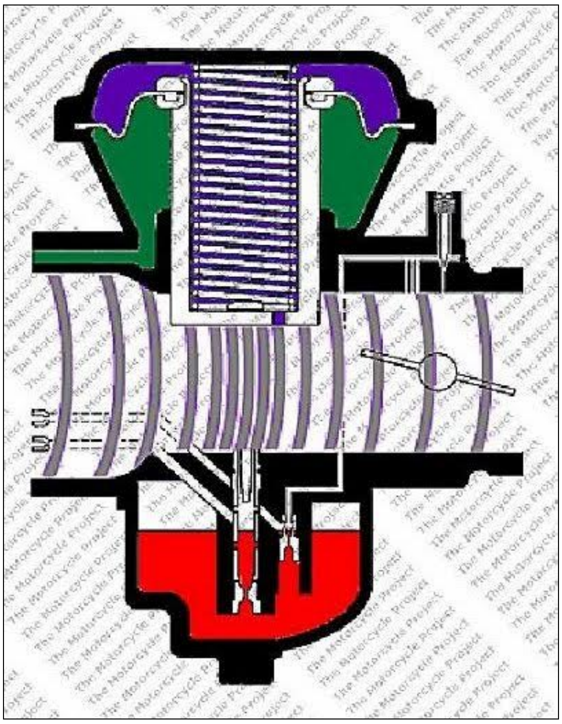
The chamber below the seal however, through vents in the carburetor body, maintains atmospheric pressure. Consequently there is an imbalance of pressures.



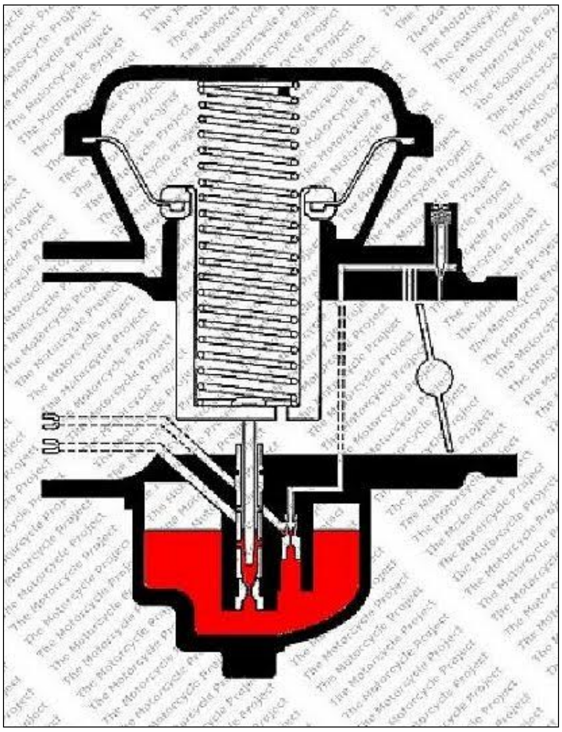
The potential exists for the higher pressure to overcome the lower and the slide rise, should the imbalance get strong enough to overcome the weight of the slide and the force of the spring, if present.



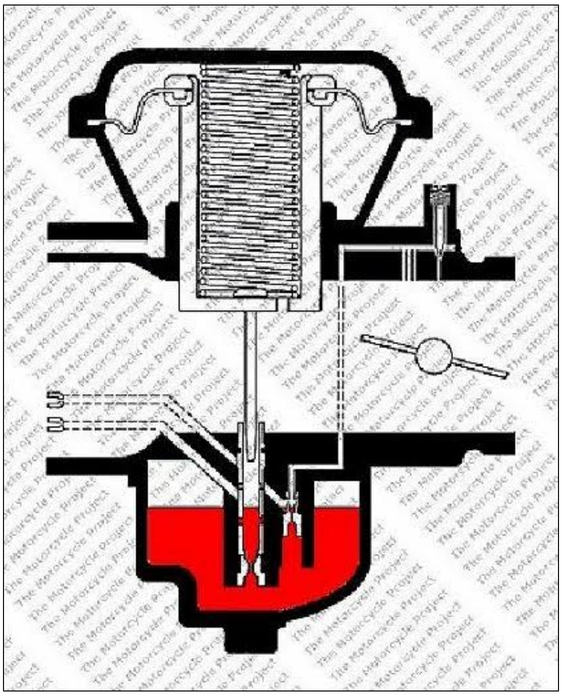
When the rider opens the throttle, the airflow through the carburetor increases, making the pressure in the carb drop, and the pressure above the slide also drops, and the slide begins to rise.



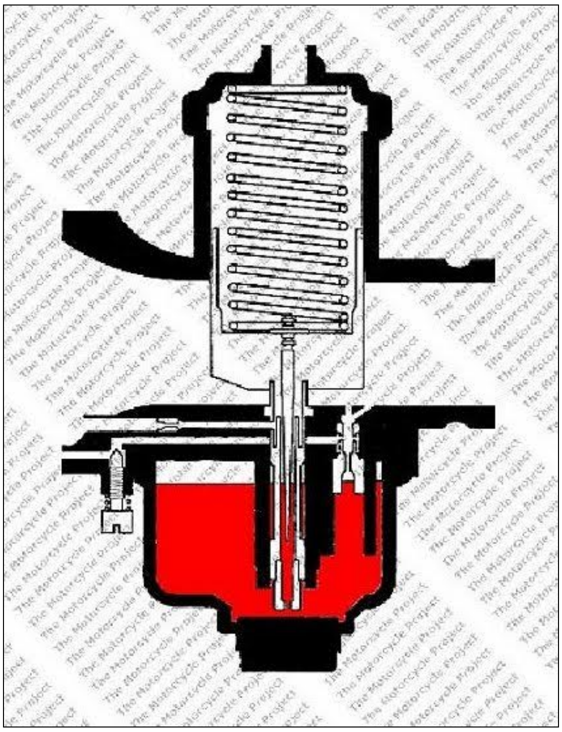
Still more throttle and the slide will rise yet more. Remember there is no mechanical connection between the throttle grip and the slide, though there is one between the throttle grip and the carburetor throttle plate (butterfly).



This then is how the CV slide lifts. When the throttle is closed, there is no slide movement.

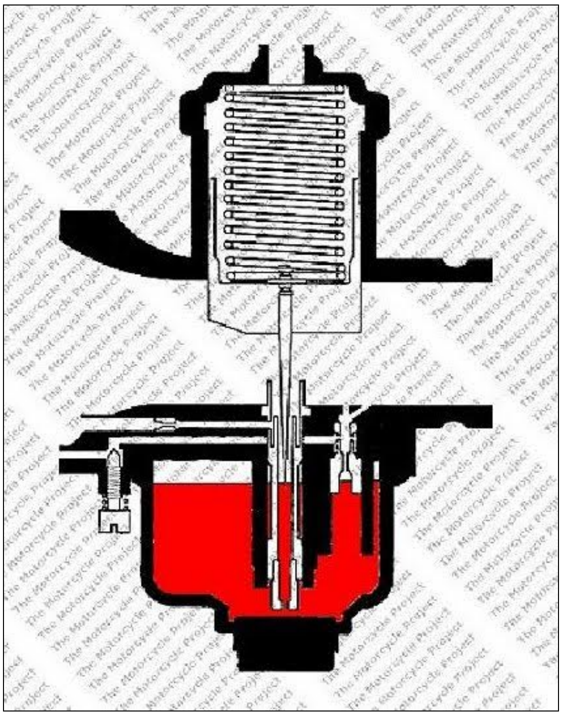


When the throttle is opened, the slide lifts.

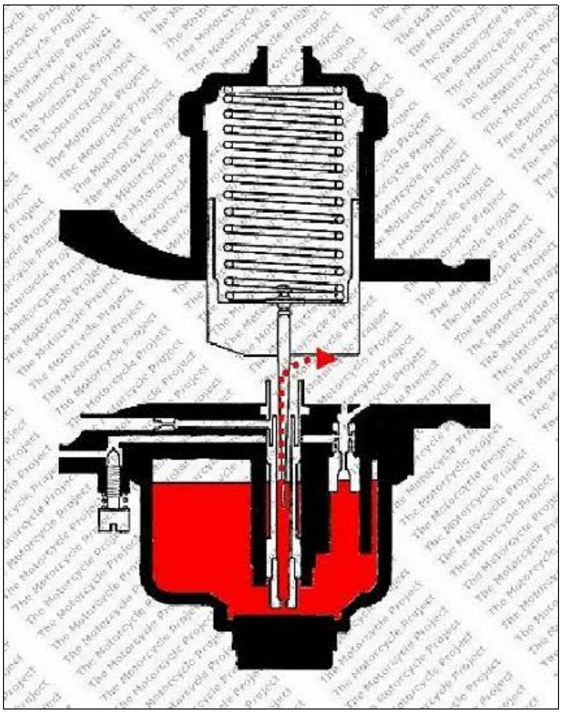


Purpose

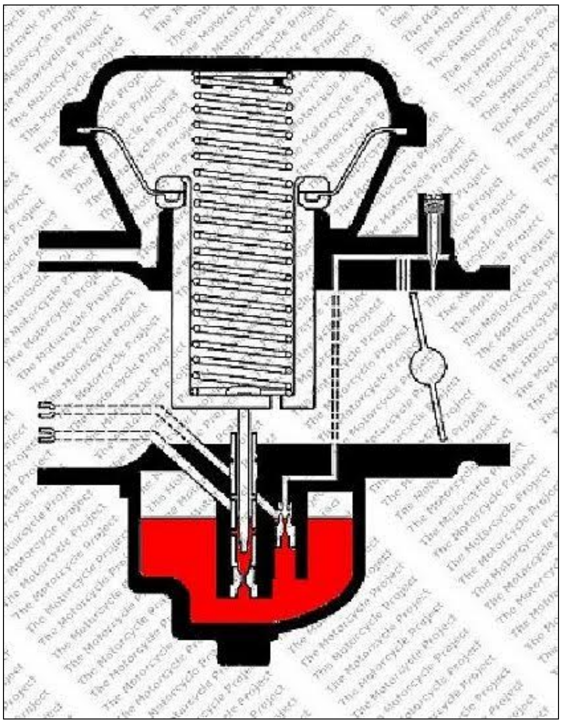
What is the point then of the CV carb? To understand, we should think about the non-CV carb, otherwise known as the variable venturi carburetor. In this carburetor the slide and the throttle are the same part. That is, the throttle grip is connected to the slide.



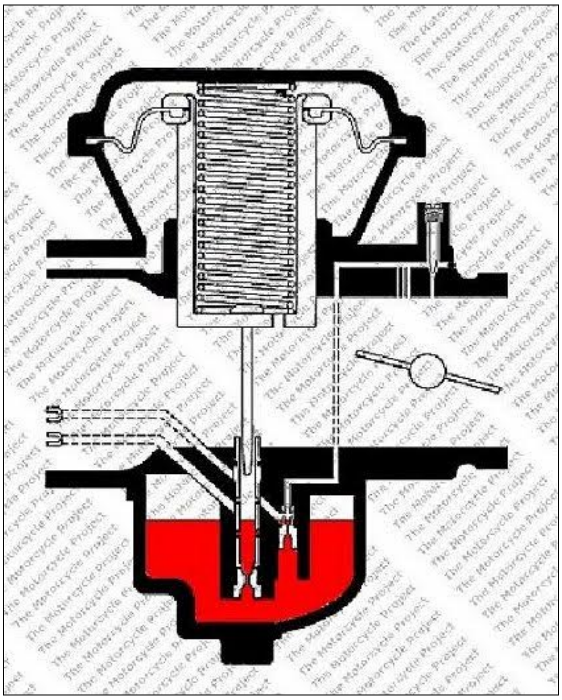
Consequently, when the throttle is opened, the slide rises, because the slide is the throttle. The problem with this is, each time the slide rises there is an air pocket underneath it that has to adjust its pressure and this causes a momentarily weak fuel discharge signal, resulting in engine hesitation.



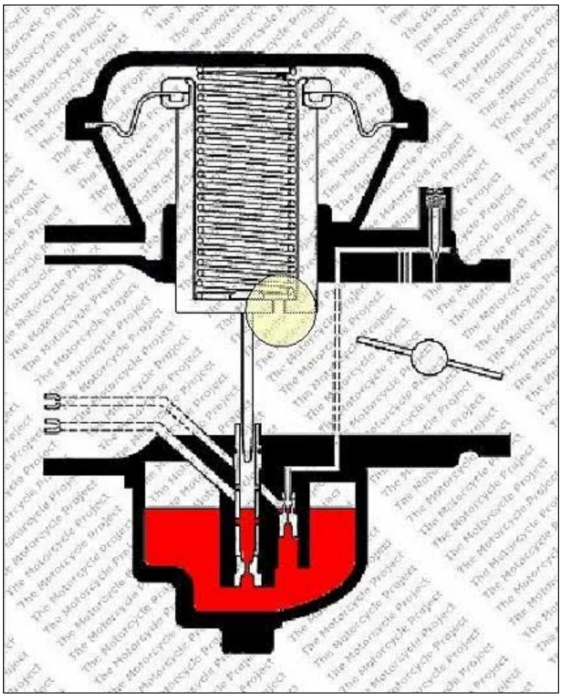
And when the throttle is lowered again, the reverse happens. The signal is momentarily too strong and too much fuel is discharged. The wholly mechanical slide type carb is prone to this kind of fuel delivery.



The CV carb solves this by not allowing the slide to rise when the throttle is deployed until the pressure drop has stabilized. In this way, that area beneath the slide where the fuel discharge tubes reside is kept at an optimum and more importantly a consistent negative pressure. Most CV carbs don't in fact lift their slides until the throttle is at least 1/4 opened. Meaning, the CV carb is two carburetors in one. At low throttle openings it acts like a fixed venturi carburetor...

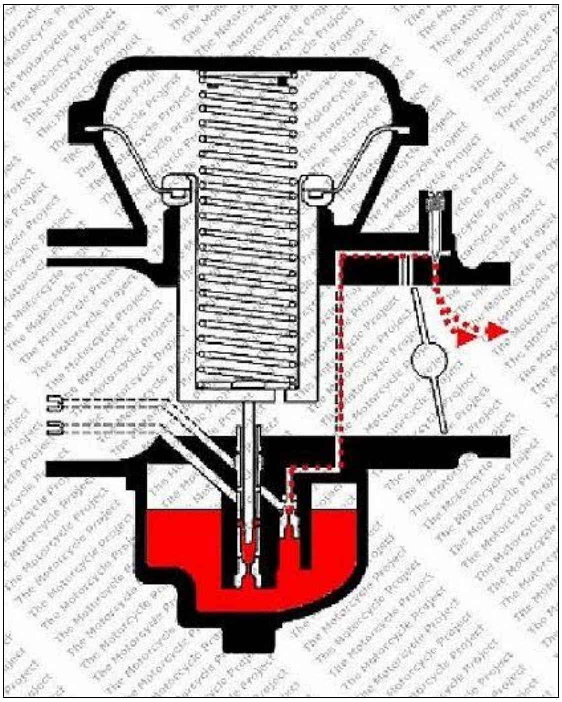


...and at higher ones it acts like a variable venturi carburetor. The result is that the rider can never over-thottle this carburetor. Because the carburetor carefully matches throttle to airflow, it is never caught not ready to immediately discharge fuel. The very best CVs perform almost like fuel injection in effect.



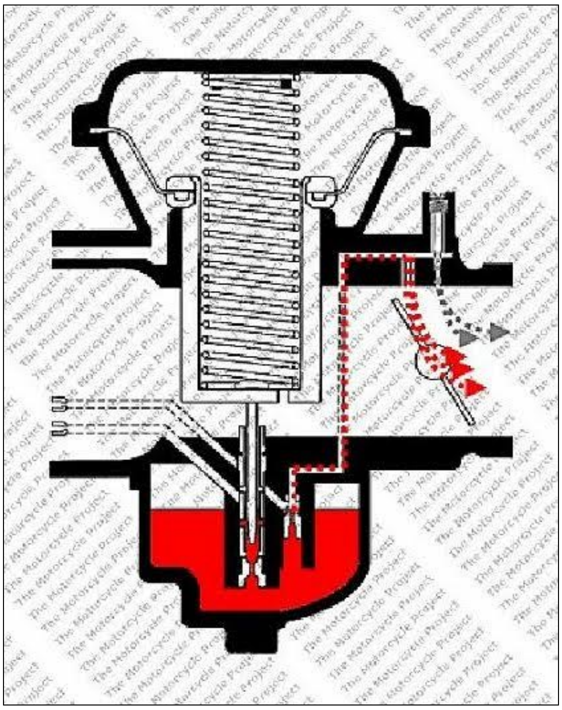
Misconceptions

In addition to better throttle response, CV carbs also reduce exhaust emissions. But it is a mistake to think of them only in that role. The CV was developed long before emssions regulations affected motorcycles, and Honda has used CV carbs in racing. Nor is increasing the size of the hole at the bottom of the slide a very good thing to do. While it has the potential of causing the slide to rise faster (actually, earlier), theoretically making the CV carb act more like a non-CV for racing purposes, it plays a very small role in slide movement and the result is neglible in any context and actually imperceptible on the street.

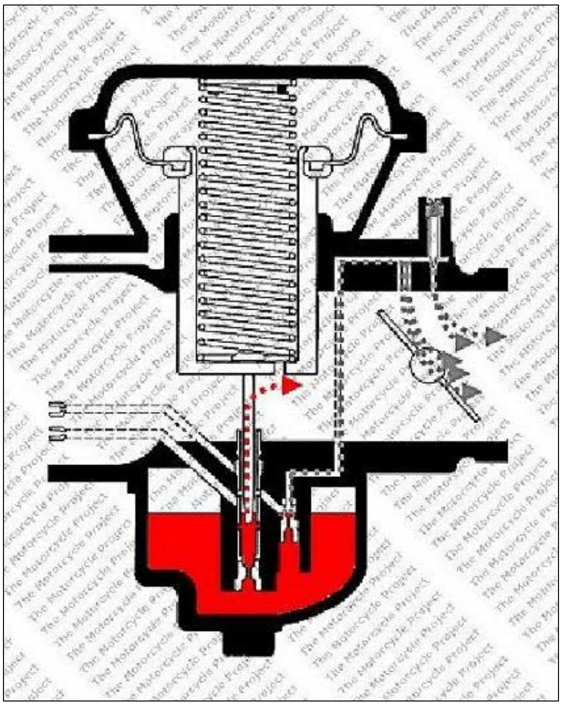


Circuits

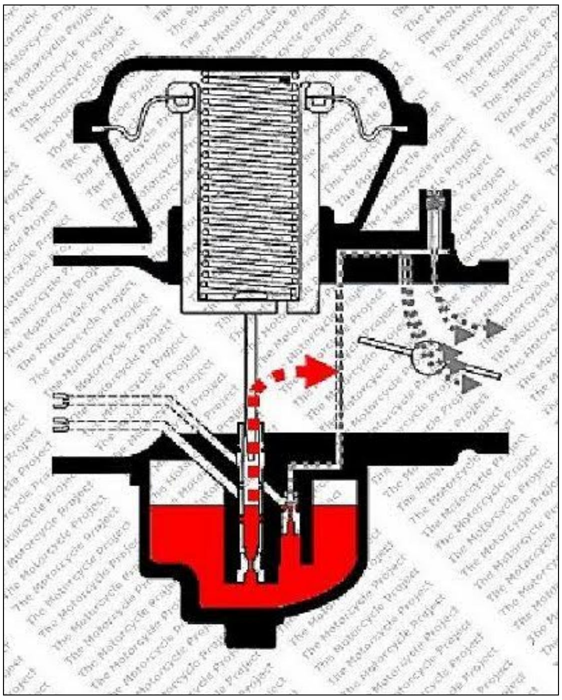
The carburetor has circuits. Just as with electricity, all of them have a single source. At idle, with the throttle not yet opened, all that is exposed to the engine's vacuum is the idle outlet port. The idle mixture or "pilot" screw meters the idle discharge.



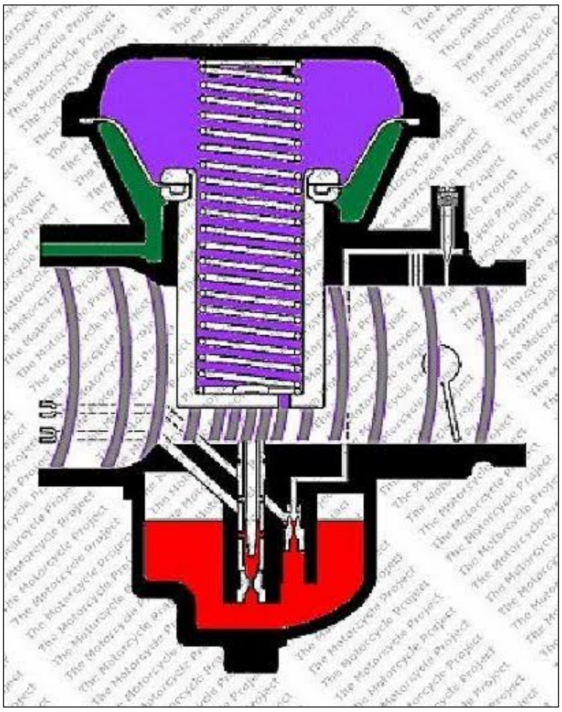
As soon as the throttle is opened, similar ports near the idle port are exposed and they discharge also. These are transitional fuel outlets. They transition between the idle and the next circuit, the needle jet.



When the throttle is opened enough to create a signal strong enough, the slide lifts and the needle jet in the center of the carb bore is exposed, and fuel exits there also. Note that the idle and transition ports continue to discharge.

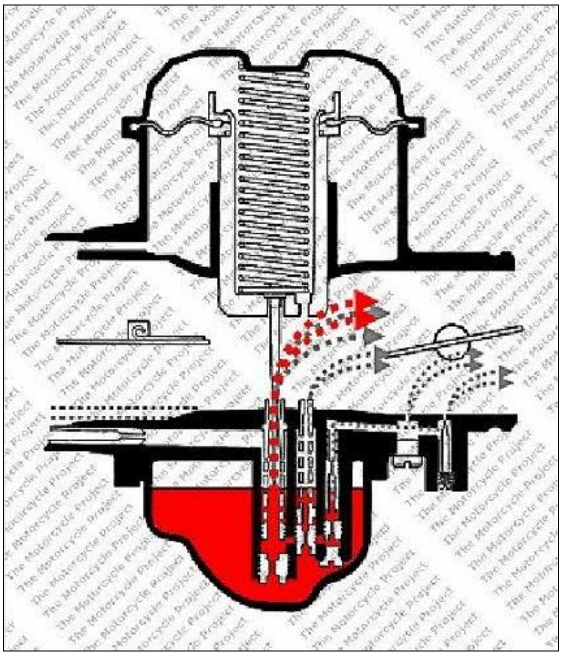


Finally, when the throttle is opened all the way, and the slide rises even further, note that the jet needle is so far out of the needle jet that the final restriction to fuel flow is the main jet, and now it is flowing full-force. All of these circuits add together.



Altitude

CV carbs are to a great degree altitude compensating. Although all carburetors' air fuel mixtures are non-self-adjusting and thus become out of step with the reduced oxygen at higher elevations, the constant velocity carb self-adjusts throughout 90 percent of its operating range. That is, every throttle range except the very beginning and the very end--i.e. idle and wide open--due to the slide rising only when the pressure in the carb bore is ideal. The slide is operated not by the throttle grip but by pressure differentials. And those differentials are the same no matter the altitude. That is, although the pressure in the carb bore changes with altitude, so does the atmospheric pressure, leaving the pressure differential the same regardless.



3-Jet CVs

A small number of CV carbs, nearly all of Honda's earliest examples, are what are called "3-jet" type. This means they have a dedicated midrange circuit. Because of this extra circuit, 3-jet CVs are more adaptable to modifications in the engine. The 3-jet system is observable only in the earlier carbs.