Understanding the BMW Constant-Velocity Carburetor

In recent years several BMW models have come equipped with a unique and sophisticated new carburettor: the Bing Constant-Velocity (or CV) Carburetor. Many motorcyclists have been impressed by its reliability and the unusually smooth transition in power it produces when twistgrip throttle openings are changed. But few riders understand the principles by which it operates.

The single greatest advantage of a CV carburetor is that it feeds the engine only as much fuel/air mixture as the engine demands, never more. Whacking open the throttle of a conventional slide-type carburetor often causes an engine to stumble and falter - just when maximum acceleration is needed. On a CV carb, opening the twistgrip merely opens a butterfly valve, exposing the carb to the full demands of the engine. The carburetor adjusts itself to meet those demands. The response is quick but never overmuch.

In simplified form, the CV carb works by varying the pressure differential above and below a piston, which in turn varies the venturi opening like a conventional slide. The engine presents the carburetor with a vacuum, which draws air (and/or mixture) under the slide. The motion of the air under the slide create a partial vacuum (pressure drop) there, and this is transmitted through passages to the enclosed volume above the piston. The volume below the piston is vented to the main intake tract, which is at a higher pressure. The greater the differences between pressures below and above, the higher the piston rises, the larger the venturi opening, and the more mixture the cylinder receives.

Seen in the diagrams on these pages the Bing CV carburetor begins at the left at the cylinder intake manifold. Then comes the butterfly valve connected to the twistgrip by a cable, then the venturi-slide piston. A flexible diaphragm separates the low-pressure (vacuum) volume above from the higher pressure volume below. At the bottom of the slide is a tapered needle which passes through the needle jet and stops just above the main jet. To the right of the piston venturi is the air-intake passage.

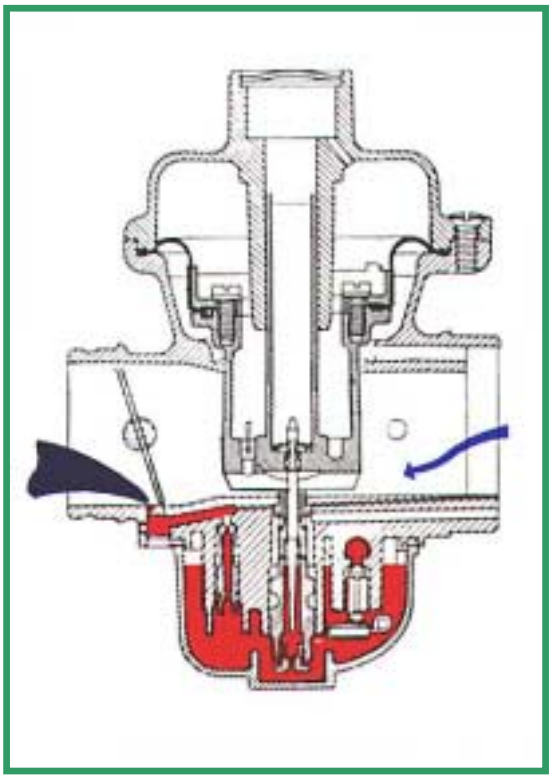
The three sketches illustrate the three main air/fuel metering systems at work in the Bing CV carb; the idle system, the needle-jet system, and the main-jet system. A fourth, the cold-start system (not shown) is centered in an enclosure at the side of the carb.

The idle system (extreme left-hand sketch) operates completely independently of the main-jet system. Fuel is drawn from the float-bowl through the idle jet to pre-mix with air from the tiny idle air passage. This mixture is mixed again with air that slips under the butterfly valve in the main airflow through the venturi (almost closed). A transition passage is uncovered when the butterfly is just partially opened to smooth out the transition from idle to the needle-jet system.

The needle-jet system operates at part-load and part throttle. The tapered needle exposes an increasingly larger annular area as the slide rises. Eventually the area is larger than the main jet itself (at the bottom) and the main jet then controls mixture. The volume of air, the volume of fuel and the resulting volume of mixture drawn by the engine all depend on engine speed and load. The butterfly valve simply allows the rider to superimpose his needs for engine performance on those of the engine itself, by limiting the amount of engine vacuum "seen" by the carb.

In the sketches, red represents fuel, which is concentrated in the floatbowl, and blue represents air. Purple represents atomized fuel/air mix. Note that for all three systems there is at least some pre-mix of fuel and air before this pre-mix hits the main venturi passage.

Unlike some slide-type carburetors the Bing



CV carb has no accelerator pump. Accelerator pumps generally provide a brief mixture enrichment during sudden throttle openings for increased power and hence acceleration. They are usually mechanically operated rather than vacuum operated. But the principle of the CV carb produces an effect very similar to that of the more traditional pump.

Because of inertia, the piston of the CV carb does not rise as quickly as air velocity increases when the venturi is suddenly exposed to greater vacuum (throttle opening). The temporarily disproportionate air speed therefore creates an even lower pressure in the venturi, which draws off more fuel from the needle/main-jet, enriching the mixture. The result is a very satisfying surge of acceleration without the mechanical complexity of an accelerator pump.

In practice, the CV principle has proven to be one of the best working carburetor concepts ever for motorcycles. This Bing CV carb stays in adjustment, wears extremely well without changes in mixture strength, is fully up to the rigors of the motorcycle environment, and is mechanically simple and almost impervious to breakdown.

About the only service question that arises in the use of CV carbs is the need for re-adjustment when an inexperienced person attempts to "tune" them. For the most part, as we have seen, they self-adjust to the needs of the engine. But, because their four metering systems overlap to some degree, tampering with one can affect the others.

One situation that can develop in use, however, is the inadvertent introduction of moisture into the carburetor. This happens when water is sprayed or splashed on vent or overflow orifices. It can also happen when the moisture content of the air in a cold crankcase condenses in the interior of the right-hand carburetor. The moisture can mix with fuel elements to form a milky substance, usually in and around the needle jet. The result is balky carburetor and engine performance and the cure is to disassemble and clean the carburetor, wiping the parts with solvent, blowing jets and passages clear, and drying it thoroughly before reassembly.

Prevention is, of course, the best cure. Owners should avoid spraying the Bing CV (or any other) carburetor directly with a water jet. In cold weather, short trips that do not permit thorough warming of all engine components should be avoided. Like the rest of a BMW, the Bing CV carburetor thrives handily on hard work and will perform tirelessly if well treated.

An occasional imbalance between the left and righthand carburetors is usually the result of unavoidable throttle-cable stretching. Balance is re-established by cable adjustment and (sometimes) idle adjustment. Your BMW dealer has the right equipment and know-how to get the job done spot-on. Dealers in high-altitude areas can also adjust the Bing CV carb for optimal performance in thinner atmosphere.