

THE CARBURETOR: THE ADDITIONAL SYSTEMS

From the acceleration pump to the power jet: the special configuration of circuits that apply to some carburetor models

As stated in the previous article, a carburetor would be able to run perfectly if it had only the idle, progression and main circuits, since the fuel delivery would be properly proportioned to all the engine's requirements. What is missing from these features, however, is the cold starting stage, when thermal conditions make it necessary to provide a richer mixture than the usual one, delivered by an appropriate circuit called the starting circuit or starter device. All carburetors have it, except for some particular models used on competition motorcycles where the starting procedure is something special. Additionally, specific delivery systems have been developed for other needs, in order to allow a correct response to the peculiar features of some types of engines: we have therefore acceleration pumps for some 4 stroke engines and a power jet for some 2 stroke engines.

THE STARTER DEVICE.

When the engine is cold and the outside air temperature is rather low, some of the air/fuel spray delivered by the carburetor nozzles does not reach the thermal unit (combustion chamber), since part of it condenses and settles on the cold walls of the aspiration channel. For this reason, the effective mixture strength that feeds the engine is often too lean and therefore there might be some combustion problems that cause starting difficulties (the engine doesn't start) or in the best cases, operating irregularities and

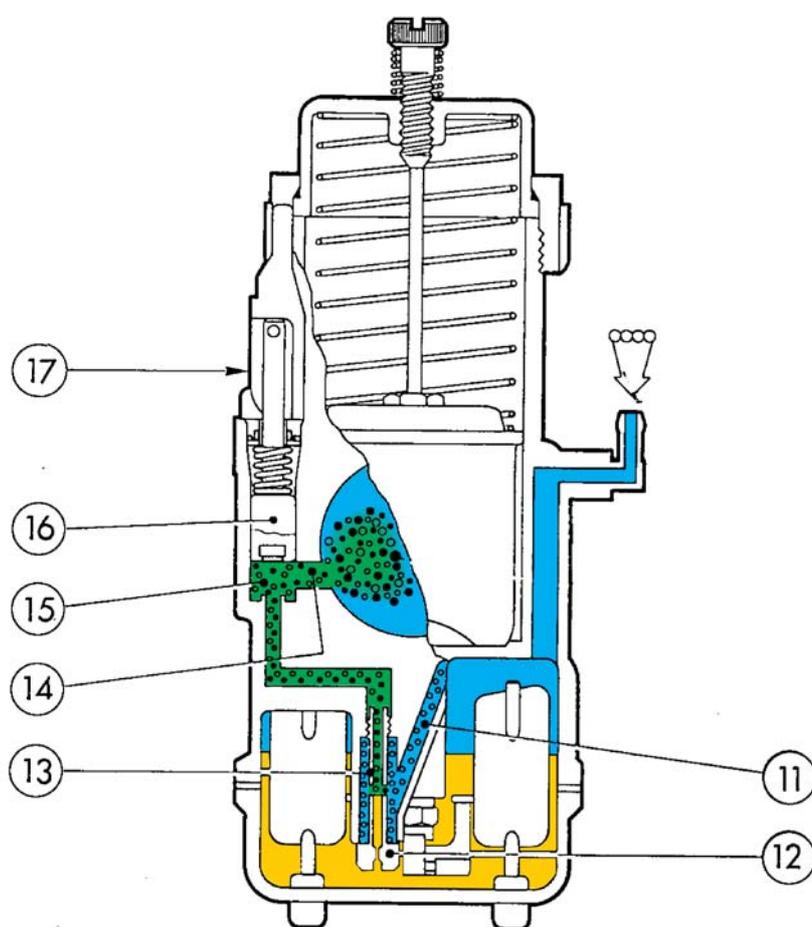
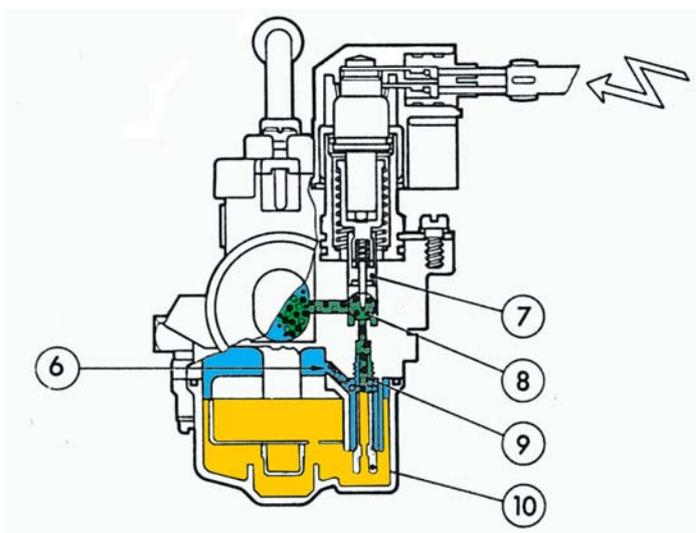


Illustration of the starting circuit of a Dell'Orto VHSB carburetor: the circuit is opened and closed by a valve 16 actuated by means of lever 17; the fuel is delivered in channel 14 from the nozzle 15, after emulsification with air coming from channel 11 inside the atomizer 13. The starting jet is n° 12.

On the left, the starting system with automatic starter is shown. The fuel drawn by the jet 10 mixes with the air coming from the channel 6, inside of the emulsion tube 9 and reaches the channel 8 controlled by the valve with the conical needle 7, linked up to the electric actuator. On the right, in a section of the Dell'Orto automatic starter we see an electrical winding that warms the thermally sensitive element, that then gradually closes the needle of the circuit. Below, a starting jet that incorporates an emulsion tube, where the air passes through holes placed near the threads.



bad driveability, until the engine warms up to a normal operating temperature.

The carburetors are equipped with a starting circuit, completely separated from the other delivery systems, and designed to correctly enrich the mixture.

This is provided in order to allow that even if part of the fuel from the other circuits doesn't reach the engine, the addition of fuel from the starting circuit is sufficient for starting, and for maintaining regular operation in the first minutes of running.

The simplest system is the manual rich mixture control, sometimes called "primer" or "mixer" and currently used only occasionally because more refined configurations are available.

The mixer consists of a switch, or lever, that allows the driver to manually lower the float in the float chamber, thereby raising the fuel level. As a consequence, the carburation is enriched under all conditions and then it may be returned to the normal position after the engine has been started.

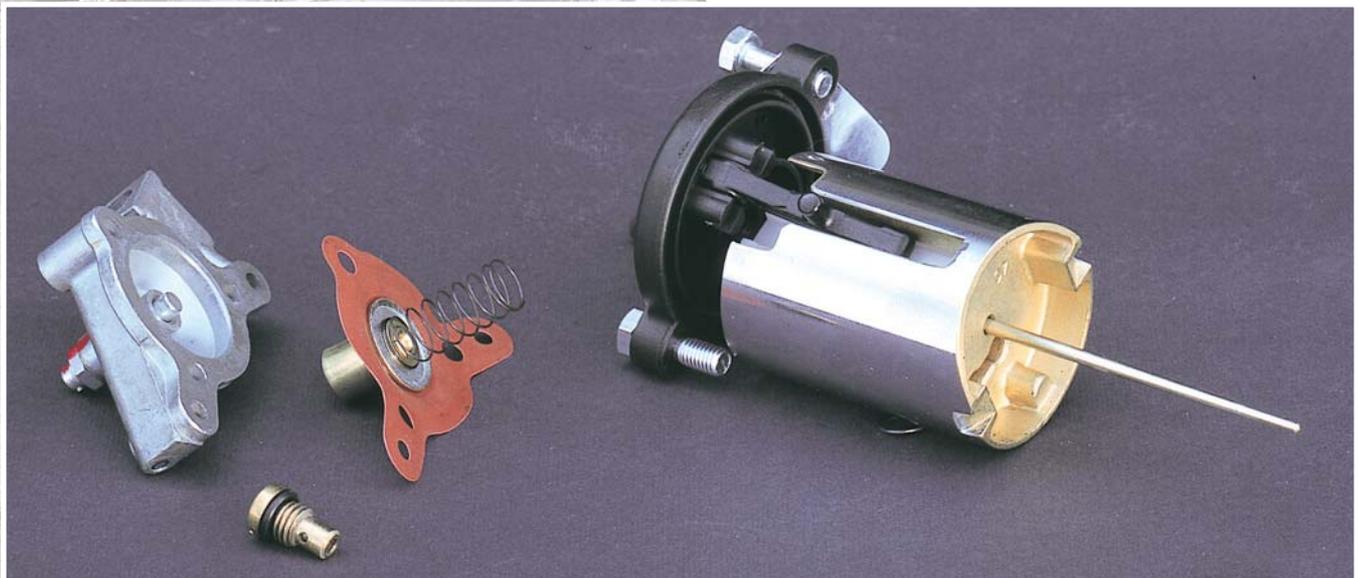
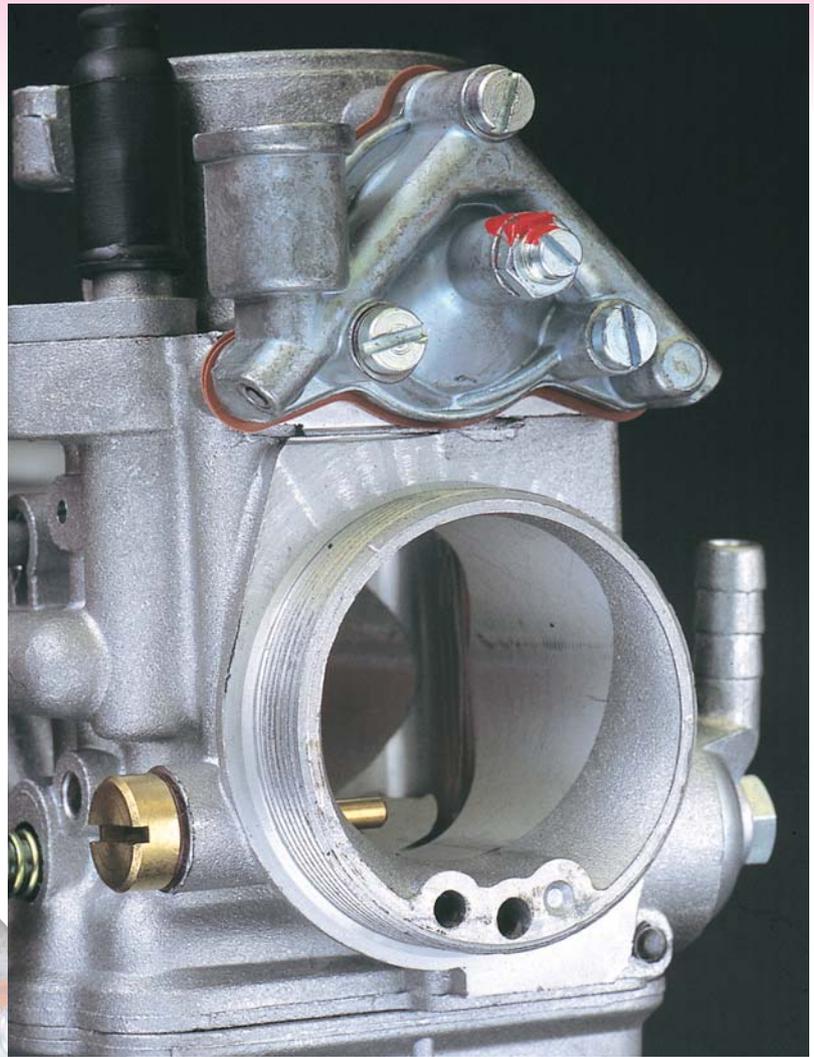
Since this system requires the operator to control the mixer, the efficiency of the system is dependent on the driver's experience and, in addition, the carburetor must be physically accessible on the motorcycle.

There are more refined and functional starter circuits equipped with their own channel, with a jet and

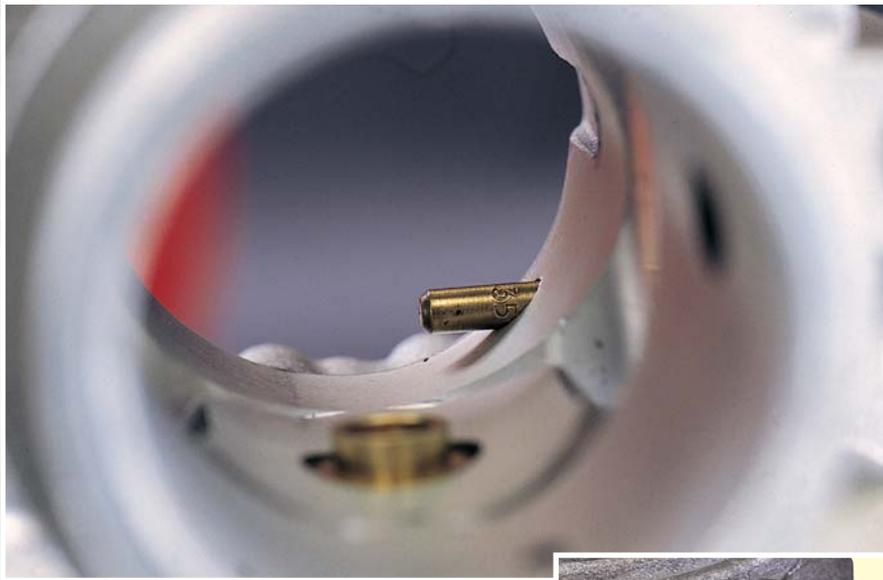
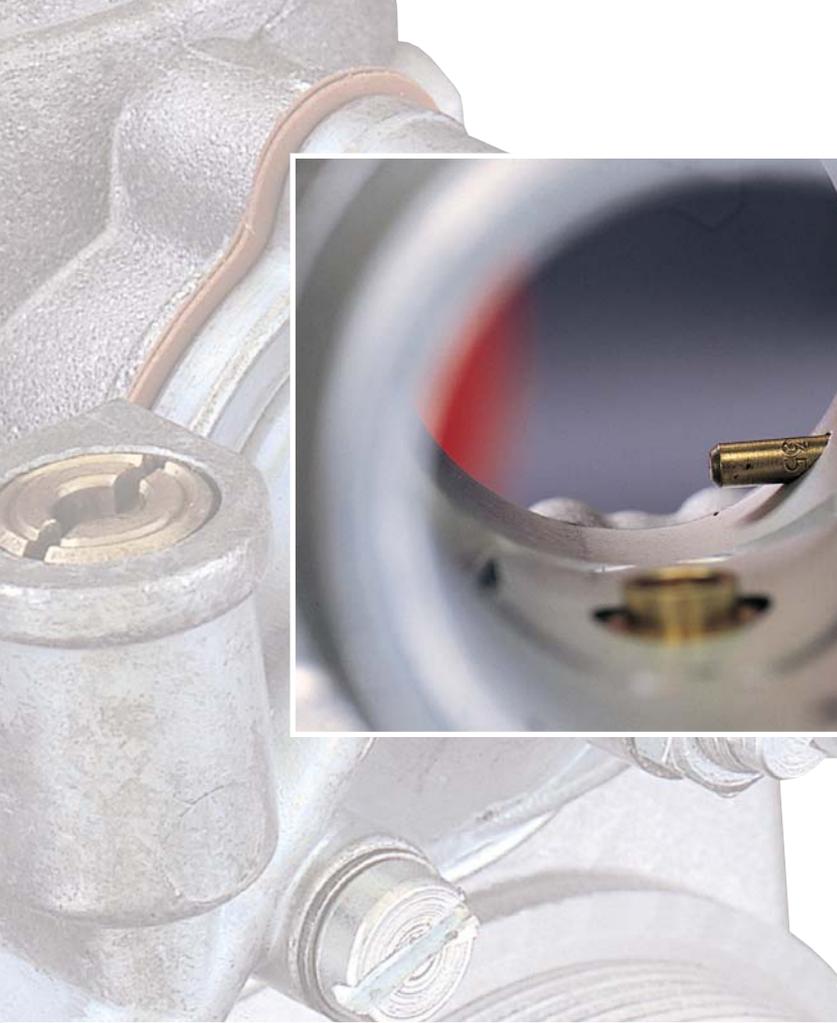
with a flow control device. These can be a small piston valve manually actuated by the driver (directly, or through a flexible cable) or can be controlled automatically by an electric actuator by means of a thermo-sensitive element. These actuators are called "wax motors" due to the heating of wax produced by an electric circuit.

The wax expands when heated, moving the valve of the starter circuit. Since thermal expansion is a function of the initial temperature, it's clear how the adjustment of these circuits is completely automatic and adapts itself to the temperature at which the engine is started, and to the rate at which the engine warms up once operating.

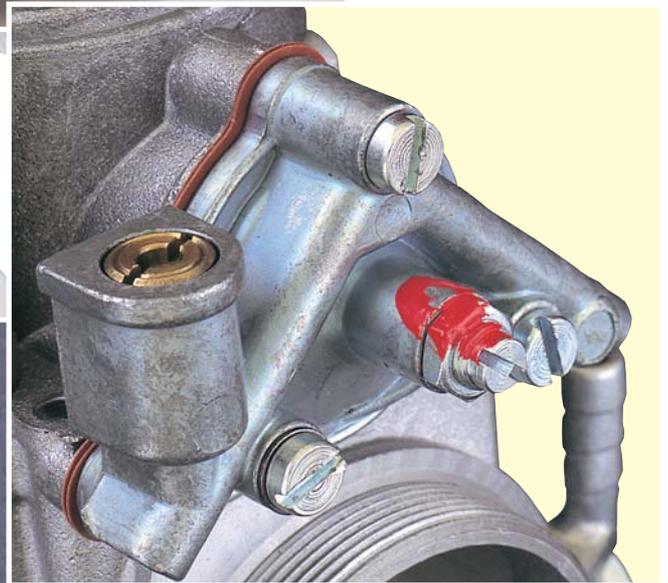
Whether the valve is opened or closed, and controlled by an automatic



The acceleration pump fitted on a PHF carburetor and below, the same disassembled: we see the actual diaphragm pump and the lever system that is actuated by the inclined profile (cam) introduced in the Valve.



Below, the adjustment screw for the pump discharge allows adjustment of the flow. By turning clockwise the flow decreases, by turning



Above, the nozzle spraying fuel into the venturi is controlled by a calibrated hole machined into the body of the nozzle itself. This component is kept in the seat by a plug (cap), therefore in Dell'Orto's carburetors it is easy to reach from the outside.

system or not, the system operation is analogous, with a specific jet adapted to calibrate the level of the enrichment mixture.

According to the condition of the jet seat, we can then describe the operation in two stages.

When the engine is stopped, the emulsion tube surrounding the jet is full of fuel, standing at the level of the float chamber.

When the engine starts, the weak vacuum generated by the first rotations of the shaft is enough to draw a considerable fuel quantity, since there is only a small difference in fuel liquid level to overcome.

The mixture, in this special case, is therefore very rich and allows the engine to start easily.

In a second stage, the emulsion tu-

Sketch of the power jet circuit: from the jet in the float chamber, the fuel is drawn directly into the venturi through an ascending channel; the delivery occurs only when the slide valve is above the opening of the nozzle.

be empties progressively since the starting jet doesn't allow for complete filling: the mixture supplied from the circuit becomes progressively leaner but is however sufficiently rich to support the operation of the cold engine until it reaches operating temperature.

At that time, the driver (or the electric actuator) disables the starting system.

Another automatic starter circuit configuration involves a check valve equipped with a conical needle that closes the nozzle in proportion to the engine's temperature.

ACCELERATION PUMP

Also called an acceleration pump, it compensates for sudden mixture enleanment, which some 4-stroke engines experience when the accelerator opens very quickly.

Under these conditions, as a matter of fact, the vacuum value on the supply circuits decreases abruptly, because the passage length for fuel flow increases in a very short time. As a consequence, we have a marked hesitation in engine response.

To get around such inconvenience, the carburetor is fitted with a pump that injects a well-calibrated fuel quantity directly in the venturi anytime the driver opens the throttle abruptly.

Acceleration pumps can be of piston (plunger) type or diaphragm type, and they are actuated by a lever system connected to the control of the throttle valve, or directly

from the throttle valve itself.

In this case (Dell'Orto PHF and PHM carburetors) the diaphragm pump is actuated by a lever that runs on an inclined surface contained on the body of the throttle valve.

When the valve rises, the inclined surface moves the lever and therefore compresses the pump diaphragm. By carefully choosing the inclined surface shape on the throttle valve, one can modify both the beginning of the slope of the throttle valve where the supply starts, and the time of the supply itself, by using a more or less inclined ramp.

The fuel quantity supplied for each pumping, on the other hand, is adjusted by acting on the stop regi-

ster of the diaphragm: by screwing in inward, the diaphragm stroke is reduced, and therefore will send a reduced quantity of liquid to the sprayer and vice versa.

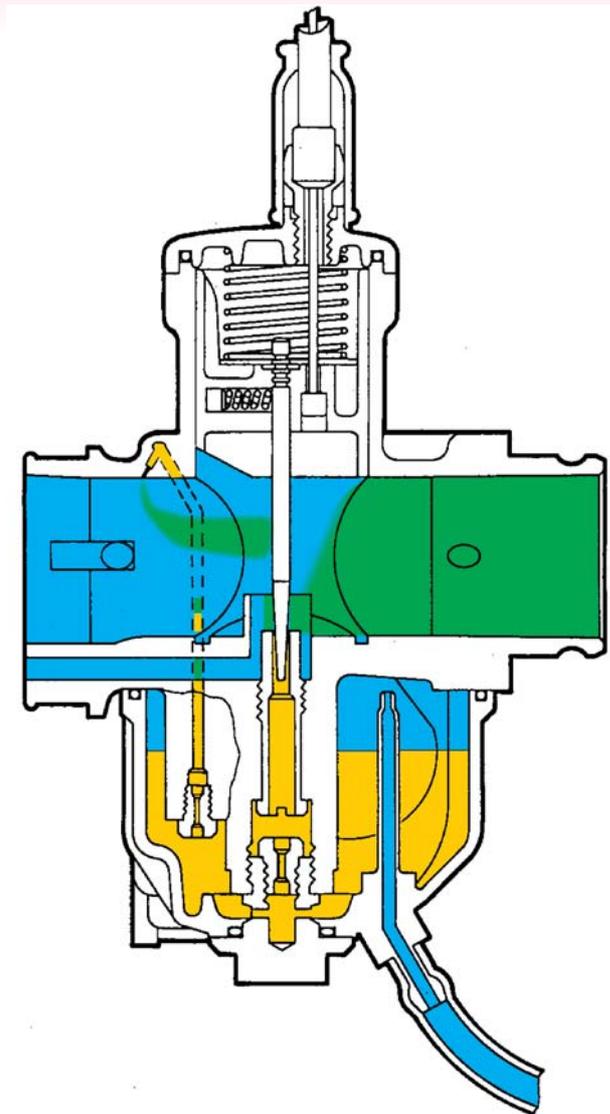
At equal conditions of pump adjustment, the duration of the spray can be adjusted by acting on the jet placed just downstream the sprayer.

A big jet will give a short spray, and vice versa, in order to adapt the supply of the pump to the engine's requirements.

The engine may require a strong enrichment only in the first stages of acceleration or an enrichment that lasts for a longer time.

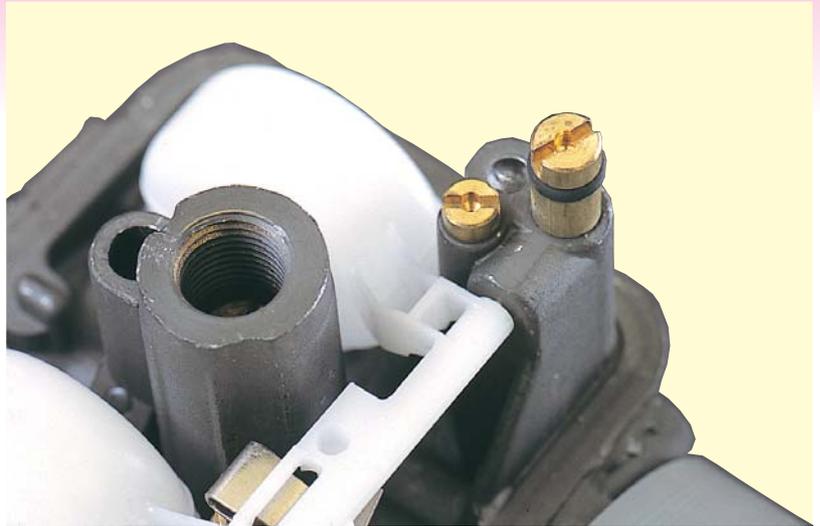
POWER JET

In carburetors for some 2-stroke en-



On the left, the power jet (smaller) assembled in the float chamber of a PHBH Dell'Orto carburetor next to the starter jet.

On the right, the delivery hole of the power jet machined in the venturi



gines, there is a need to keep a mixture quite lean for the small and medium throttle openings, when a fast engine response is necessary. As we have seen before, at medium throttle openings, while the atomizer and conical needle system have an influence on the mixture, the main jet has the strongest influence. If we use a main jet of reduced size to accommodate small and medium throttle requirements, the mixture may become unsuitable at large throttle openings.

Vice versa, in assembling a big jet we would provide too much enrichment in the intermediate stages with negative effects on the engine response. The power jet permits us in many cases to overcome such a problem, since the circuit is in the condition to supply fuel directly in the venturi only when the inducted air flow is high (full load) and wide open, or when the throttle valve is raised considerably.

The jet is placed, like all the others, in the float chamber, when the-

sprayer is placed upstream of the throttle valve and supplies the liquid only when the vacuum signal is sufficiently high.

That means it operates when it is exposed by the edge of the valve. If this nozzle is then machined on the top of the venturi, it will deliver fuel only at wide-open throttle and therefore will enrich the mixture compensating for the reduced size of the main jet. When the power jet is present, adjustment of the carburation at full throttle requires that we have to act both on the relevant jet and on the power jet, since the amount of fuel in this condition are distributed in two circuits and not only one.

