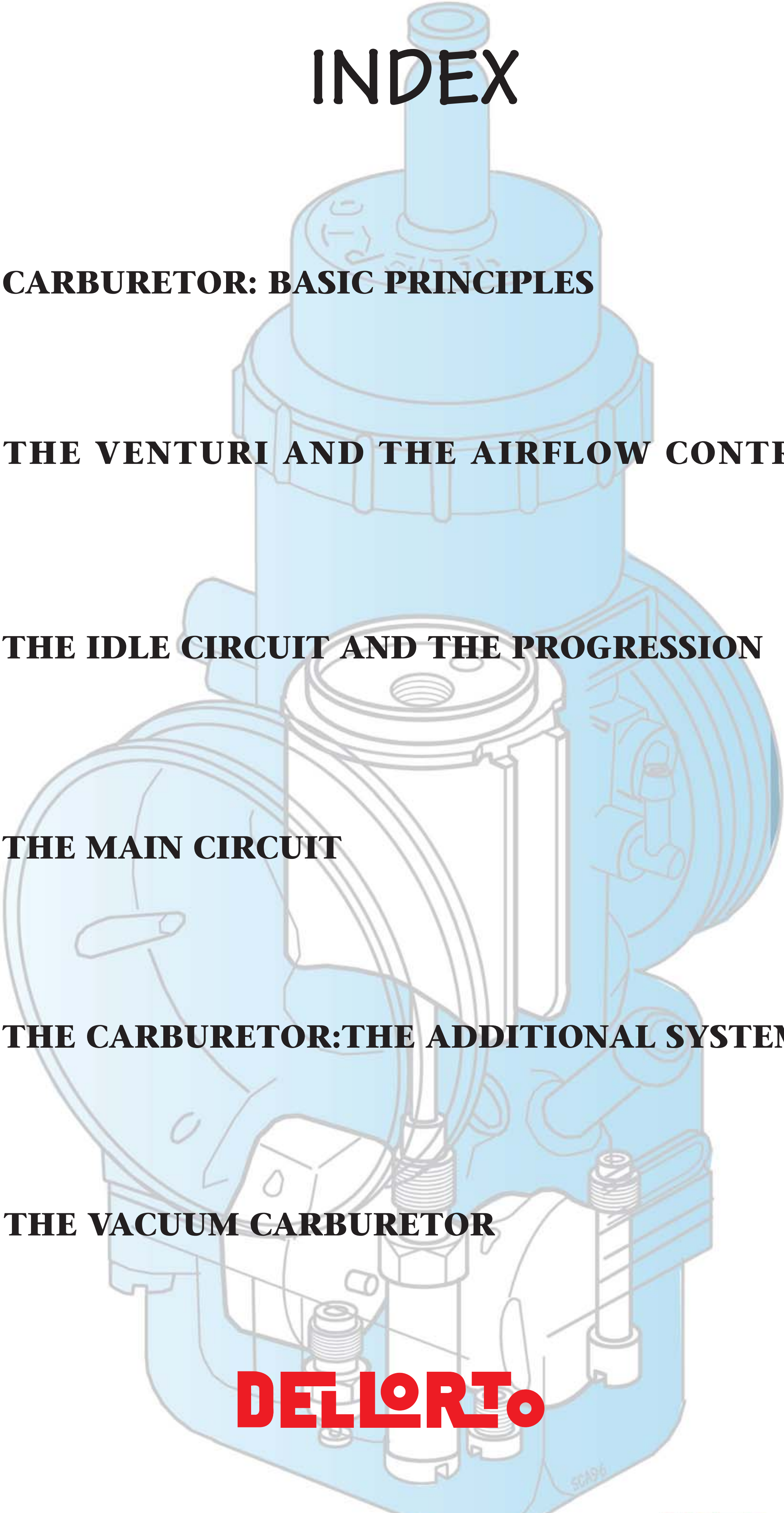
INDEX



DELLORTO

THIS MANUAL HAS BEEN WRITTEN IN CO-OPERATION WITH THE MAGAZINE MOTO TECNICA

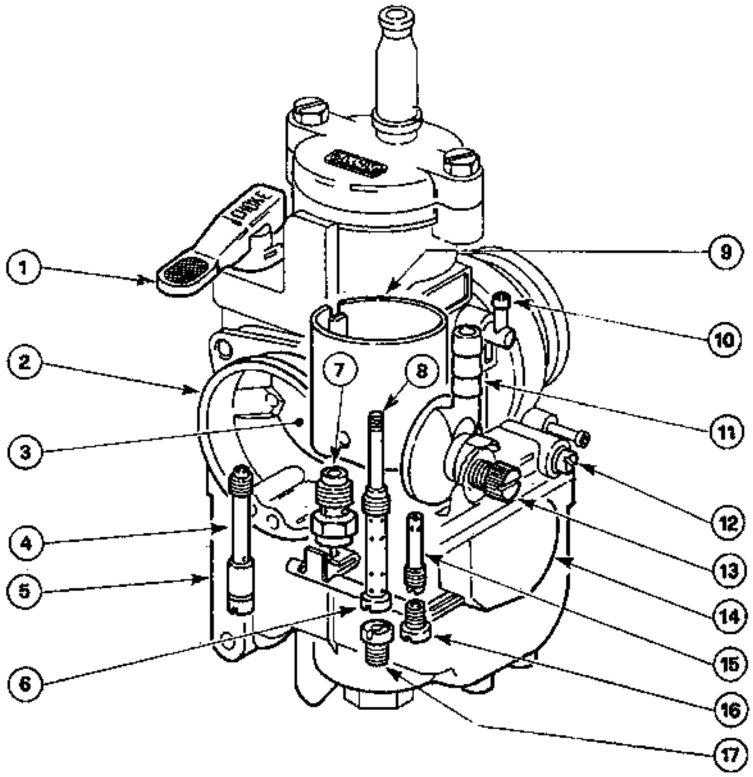
CARBURETOR: BASIC PRINCIPLES

This article will discuss a very interesting subject: the operation and adjustment of different types of carburetors used on motorcycles.

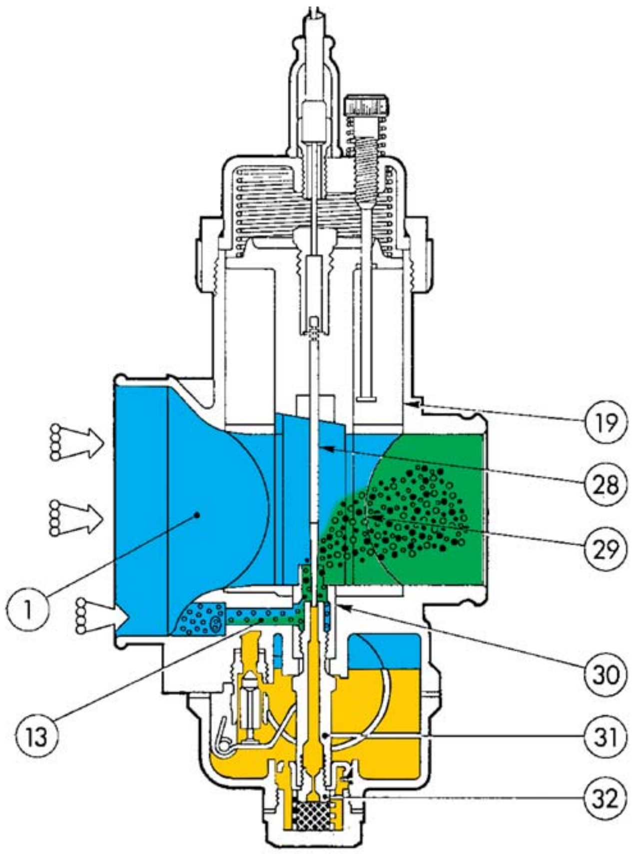
Otto cycle engines used to power both two and four stroke motorcycles are fed with fuel (normal gasoline, special gasolines for some competition needs or, in some uncommon cases, methyl and/or ethyl alcohol), which is sufficiently volatile and has ignition properties which allow it to be premixed with the combustion air before the combustion is initiated by the spark plug. On the other hand, in Diesel cycle engines, the fuel is less volatile and has ignition properties which require that it be mixed with air only inside the combustion chamber, where the pressure and temperature conditions are such to induce natural ignition. For this reason, the power delivery of diesel engines may be adjusted by fuel delivery alone, without the need to control the airflow.

In Otto cycle engines, when the fuel is pre-mixed with the air, it is necessary to control the airflow and therefore, indirectly, the fuel flow. In automobile engines, fuel injection systems are used in most models, controlled by a central unit that adjusts the duration of time during which the injectors remain open to deliver fuel into the air stream. As everyone knows, analogous systems have been adopted on some high range motorcycle engines. In most cases, however, carburetors are widely used, where the fuel is introduced according to the vacuum generated on various systems of fuel jets. The carburetor is therefore designed to perform three

On the right, the main components of a Dell'Orto motorcycle carburetor are shown: 1. starting lever; 2. air intake; 3. venturi; 4. starter jet; 5. float chamber; 6. atomizer; 7. fuel valve; 8. needle; 9. throttle valve; 10. float chamber air intake; II. fuel connection; 12. Idle mixture adjusting screw; 13. throttle valve adjusting screw; 14. float; 15. idle emulsion tube, 16.idle jet; 17. main jet.



This is a diagram of the gasoline delivery in the inducted airflow: the fuel inside the float chamber rises in the atomizer (31), going through the jet (32) which adjusts the delivery together with the needle (28); the liquid is emulsified first with the air arriving from the channel (13) inside the nozzle (30) then going into the venturi (29) it mixes with the air coming from the intake (1).



basic functions:
1. to control the power delivered by the engine, adjusting the airflow inducted according to driver demand.
2. to meter the fuel flow into the inducted air stream, while keeping the air/fuel ratio in the optimum range over the engine's entire working range.
3. to homogenize the air and fuel mixture in order to make the ignition and combustion proceed properly.

THE MIXTURE RATIO

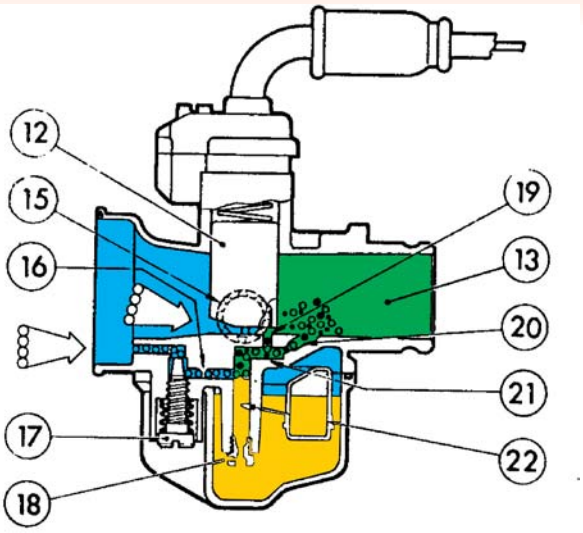
The air/fuel ratio (A/F) is the ratio between the air and fuel mass inducted by the engine. It is defined as:

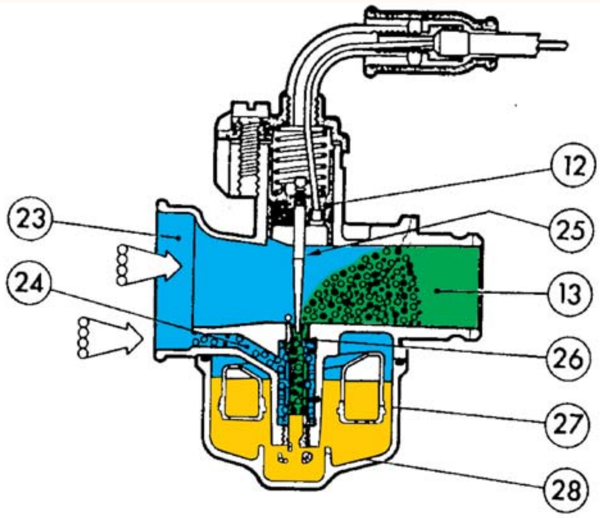
$$A/F = M_{air}/M_{fuel}$$

If we consider this ratio from a chemical point of view, the value of the stoichiometric A/F ratio is the one that allows complete combustion, without leaving either excess air (lean mixtures) or unburned fuel (rich mixtures)

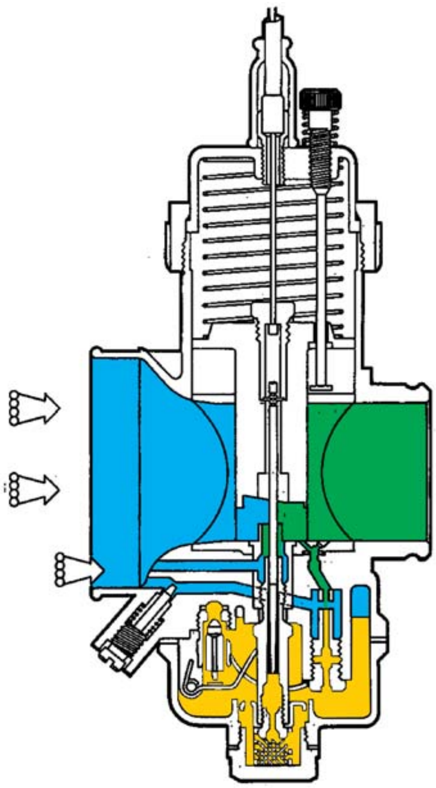
Stoichiometric A/F

The stoichiometric A/F ratio depends on the fuel type. For commercial gasoline this varies from about 14.5 to 14.8, meaning that 14.5-14.8 pounds of air are needed for the complete combustion of 1

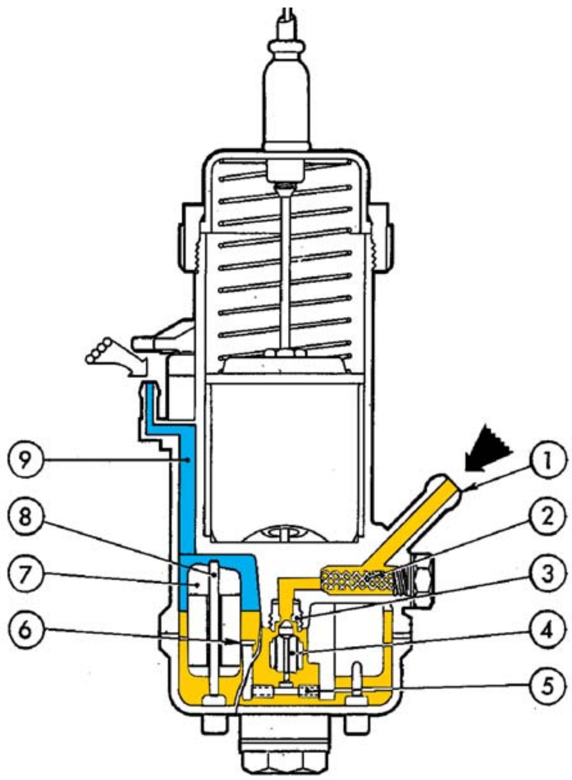




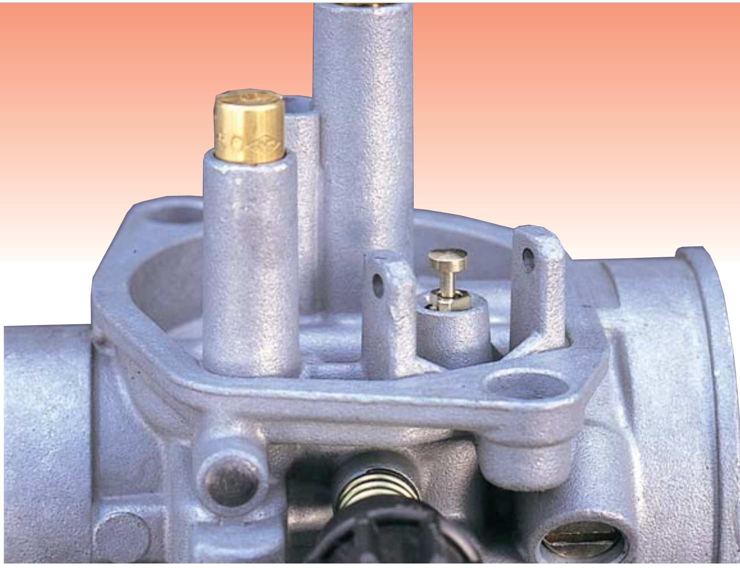
The fuel mixes with the air inducted by the engine by means of different circuits according to the throttle opening. Here above on the left hand side, we can see the operation at idle, with the liquid that is metered by the jet (18) and arrives in the fuel trap (22) before it emulsifies with the air arriving from the channel (16) and adjusted by the screw (17). This emulsion goes under the throttle valve (12) and into the aspiration channel (13) from the ports (19 and 20). On the right hand side, the same carburetor at wide open throttle with the fuel flow adjusted by the main jet (28) that it emulsifies with the air (24) in the atomizer (27) before exiting from the nozzle (26).

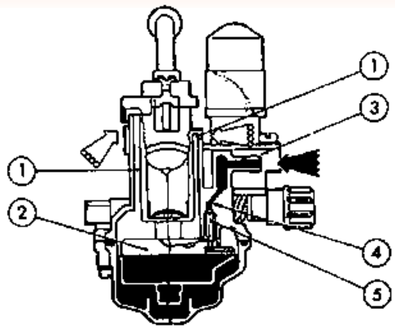


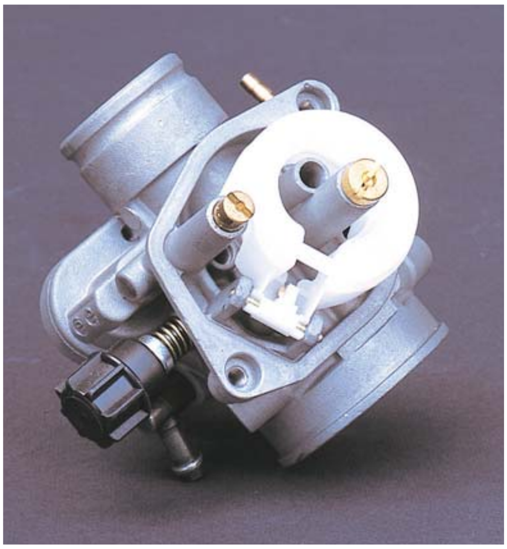
A modern needle type carburetor (Dell'Orto VHSB) is equipped with different circuits with relevant calibration jets to assure proper fuel delivery under all conditions. As we can see from the section diagram, each fuel circuit leads to the constant level float chamber.



Section of the fuel feed circuit in a Dell'Orto VHSB carburetor: 1. Fuel line from the tank; 2. Screen filter; 3 fuel valve seat; 4 valve needle; 5 float arm pin; 6. float holder on the arm; 7. float; 8. float driver; 9. float chamber air intake.





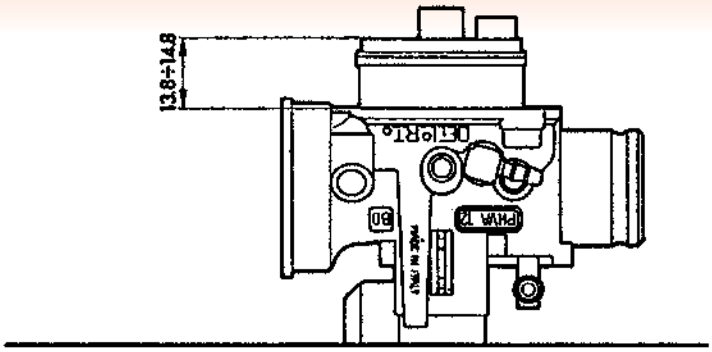


On the left hand side above, the section of an annular float can be seen here above, used on some types of carburetors: 1. Float chamber air intake; 2. Float; 3. Fuel connection; 4. Fuel inlet channel; 5. Valve needle. In the center, a detail of a removable Dell'Orto valve; we can see that the synthetic rubber needle tip is a sprung type. Below a detail of a fuel valve, machined directly in the carburetor's body; in this case the needle is sprung.

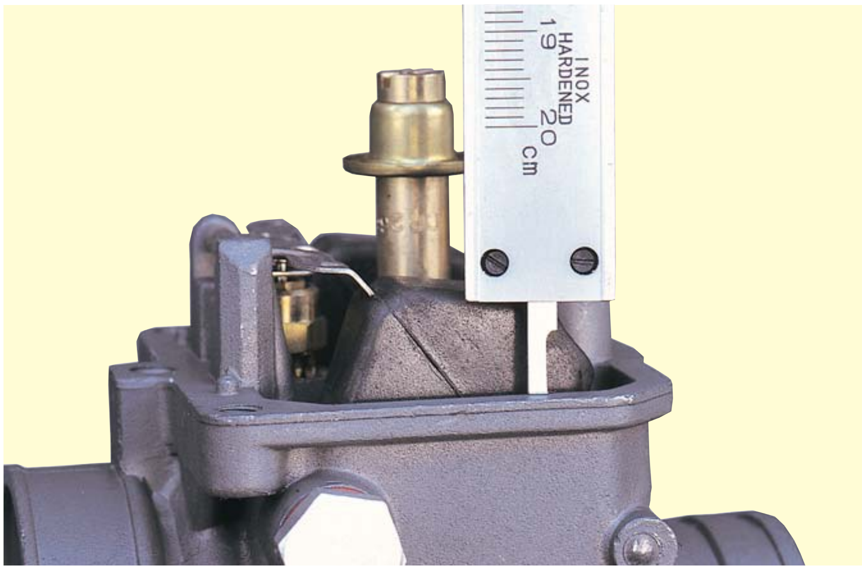
pound of fuel. For engines powered with methyl alcohol, this ratio decreases to 6.5 while for ethyl alcohol it is 9.

A/F ratio produced by the carburetor

The mixture delivered by the carburetor during the engine's operation doesn't necessarily correspond to a stoichiometric A/F value. According to the engine design and its operating conditions (r.p.m. and load) a portion of the delivered fuel may not be burned because it doesn't reach the combustion chamber or because the combustion itself is not perfect. Some charge dilution can also occur from residual exhaust gas remaining in the cylinder, as well as some loss of fresh charge at the exhaust. These effects are particularly sensitive in two stroke engines. If we consider that the appropriate A/F ratio must be that of the charge taking part in the combustion, we can assert that the mixture delivered by the carburetor must be richer (A/F < stoichiometric) to compensate the above phenomena.



Checking the position of the float inside the float chamber is prescribed. According to different carburetor models, the distance of the float from the contact surface of the float chamber needs to be measured

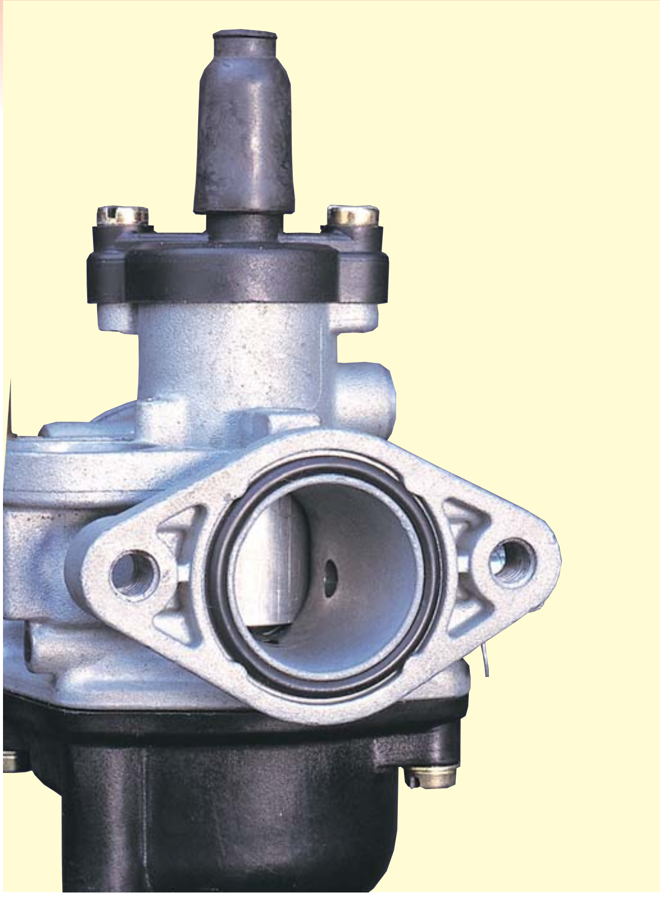


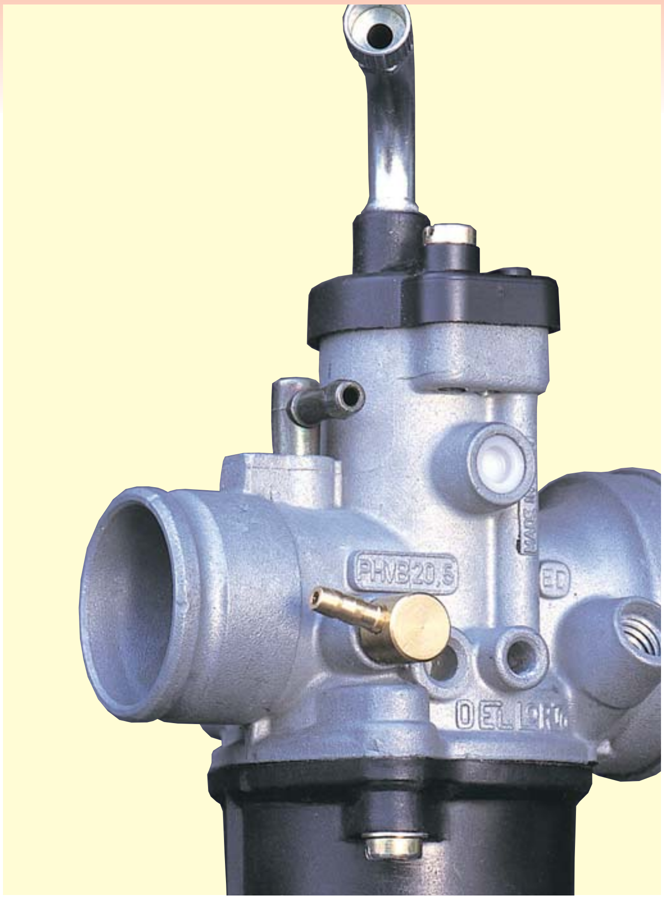
A/F ratio requirement under different conditions

The A/F ratio must vary within certain limits, depending on the engine operating conditions. Generally we can expect that the air/fuel mixture must be richer (A/F lower) at idle, in the acceleration mode, and at full power. On the contrary, at constant load the mixture may be lean, meaning that the A/F ratio can increase compared to the previous conditions. In two stroke engines, the words "rich" and "lean" referring to the mixture, have relative value under different specific operating conditions of the engine, and the stoichiometric mixture is not often referred to, since in these engines the mixtures are always richer that stoichiometric. This may also be partially true in many four-stroke engines, but in general, these engines use leaner mixtures than two stroke engines

OPERATING PRINCIPLES OF THE BASIC CARBURETOR: THE FUEL DELIVERY CIRCUITS

Liquid fuel is fed to the nozzle of the carburetor venturi, and flows due to the vacuum generated by the air flowing past the venturi itself, and from airflow pulsations generated by the piston movement. The calibrated jets placed upstream of the spray nozzle itself control the fuel flow reaching the spray nozzle. Motorcycle carburetors are nearly always of the needle type and have a structural architecture as shown in the accompanying illustrations. The fuel arriving from the tank is held inside a constant level float chamber. The liquid pressure head on the various jets is relatively constant. The difference between the float chamber fuel level and the level that the fuel must be raised to by the inducing vacuum remains constant. The float chamber level is kept constant by means of a fuel inlet valve, actuated by a float that follows free surface of the liquid in the float chamber. When the float chamber level drops, due the fuel used by the engine, the float drops and opens the valve, so that additional fuel can flow from the tank. The level of the fuel and float then increases, and at a certain point, closes the valve until the sequence is repeated. The level in the float chamber is therefore a calibration element of the carburetor, since the metered fuel delivery changes with float level, and therefore affects the mixture ratio. By having a high float level, a greater fuel quantity is delivered compared to the case with a low float level, under all operating conditions and for all of the carburetor's circuits. Adjustment of the float chamber level is affected by two elements: the weight of the float (or of the floats) and the configuration of the lever arm that connects the float with the valve. By installing a heavier float, the free surface of the float chamber liquid must rise before the float buoyancy force balances the increased weight making the float rise. The result will be a higher float chamber level and a richer delivered mixture under the same conditions. On the contrary if we install a lighter float, a lower liquid level will cause sufficient buoyant force to actuate the valve and therefore the carburetor calibration will become leaner. That is why floats are classified according to their weight (printed on them) and calibration standards for their position inside the float chamber are prescribed in order to assure correct operation. To modify the float chamber level, if necessary and when it's not possible to change the





Carburetors can have different types of flange connections to the engine, according to their use. On the left we can see a flat flange with a seal O-ring; on the right we see a male sleeve required for mounting inside a flexible coupling.

float weight, in some cases it's possible to change the angle of the lever that operates the valve.
In this way, the float closes the valve in advance (for a lower level) or later (for a higher level) at equal weight.
We must note, however, that too low a level in the float chamber can result in an insufficient liquid head on the jets and therefore lead to the risk of dangerous enleanment of the delivered mixture.
This can occur when the fuel moves inside the float chamber due to the accelerations the vehicle undergoes.
In these cases (which mainly happen on off-road motorcycles or on the track, in the bends or under violent braking), if the level is too low, one of the jets leading to the carburetor's circuits may be temporarily exposed to air instead of liquid.
In some versions, special screen baffles are applied near the jets.
These are called bottom traps and their purpose is to maintain the maximum liquid quantity around the jets under all possible conditions. A needle that closes on a seat, which is inserted or screwed into the carburetor's body, forms the fuel valve. The needle is equipped with a synthetic rubber element on the tip.
This material is perfectly compatible with normal commercial gasoline but in the case of special fuels such as those containing alcohol, it is necessary to verify the compatibility of the fuel and the seals in order not to compromise the carburetor's functionality.
Different versions of the needles are equipped with a sprung tip in the connection with the float, in order to reduce the needle's vibration induced by the motion of the liquid in the float chamber and from the motorcycle's movements.
The diameter of the needle valve is a calibration element since it determines the maximum fuel delivery rate.
If the diameter is too small to accommodate the fuel quantity that the engine requires under certain conditions (generally at full load) the float chamber empties faster than it can be replenished through the needle valve! If this condition should continue for some time, the engine suffers from reduced fuel delivery due to the fact that the level in the float chamber is decreased and therefore the carburation has become too lean.

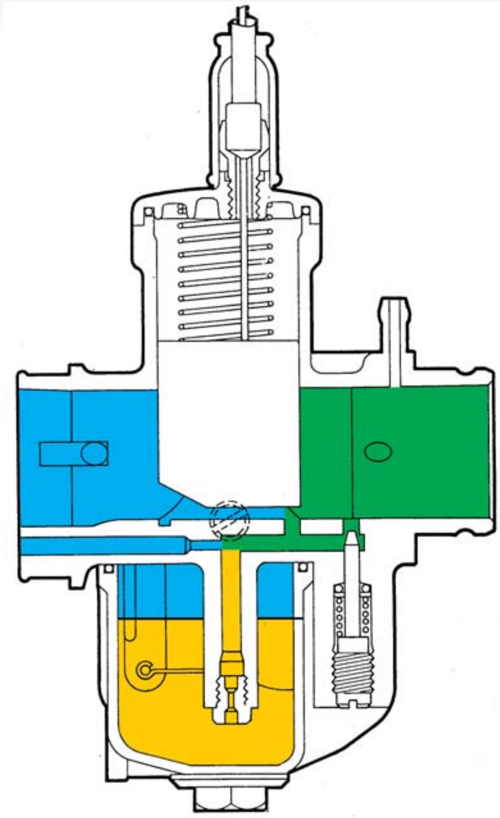
THE VENTURI AND THE AIRFLOW CONTROL

Let's explain in detail the operation of a motorcycle's carburetor, examining the relationships between the elements which regulate fuel delivery.

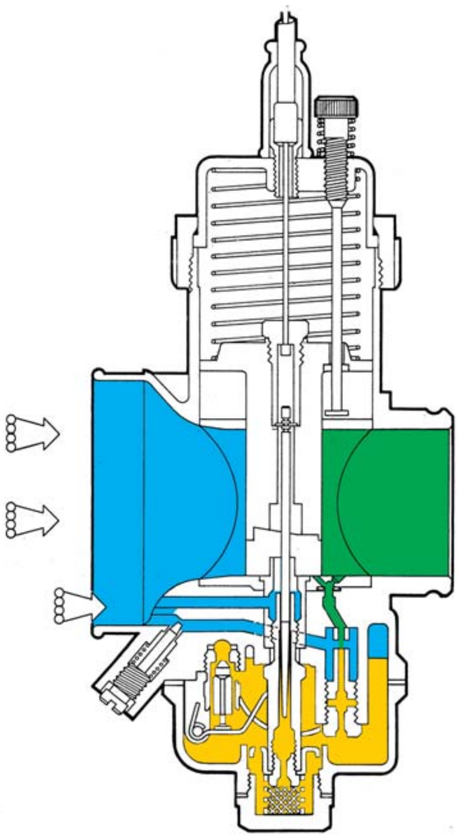
Motorcycle carburetors are mainly needle type with the air flow adjusted by means of a sliding valve that, depending on the different versions, can have a cylindrical or flat profile.
Even in vacuum carburetors, also called at constant speed, we find such a valve that works together with the throttle valve actuated by the driver. We will talk about these carburetors later on due to their peculiar working features.

THE VENTURI
The venturi is one of the elements that define the carburetor, since a basic dimension is the diameter of the venturi itself, generally expressed in mm.The diameter choice is strictly related to the engine requirements, which must be satisfied.
For motorcycle engines, a separate carburetor feeds each cylinder; therefore the problem of flow distribution from a single carburetor to different cylinders is avoided.
From a numerical point of view the critical dimensions are selected

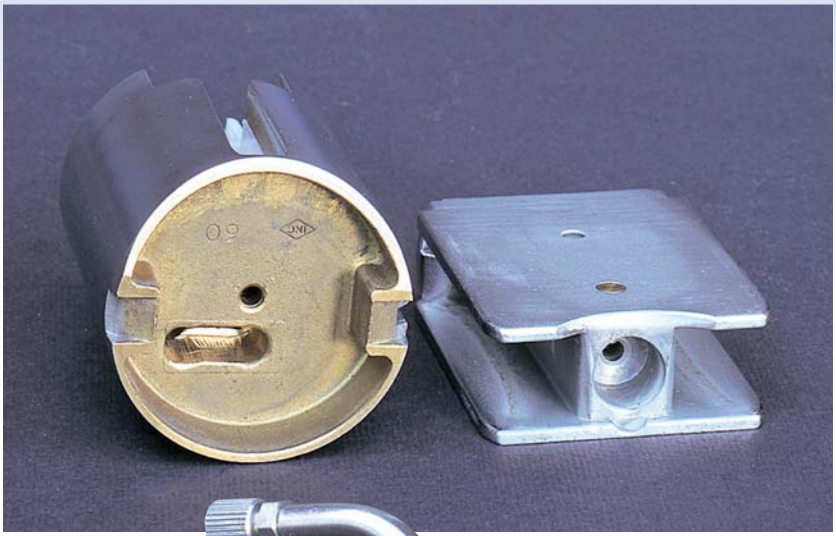
The venturi of the modern motorcycle carburetor is carefully developed to reduce disturbances in the flow around the throttle valve and its seat.
On the left-hand side, we see the venturi fitted on a Dell'Orto VHSD carburetor with two thin slits where the guillotine runs to adjust the airflow.
Below, left hand side the section of a VHSB carburetor where the reduced thickness of the flat throttle is emphasized. On the right is the cylindrical valve of a carburetor series PH, showing a dimension in the flow direction, higher than in the first case. In both drawings we can see, under the venturis, the passages which lead to the idle and progression circuits, which we will discuss later in this article.

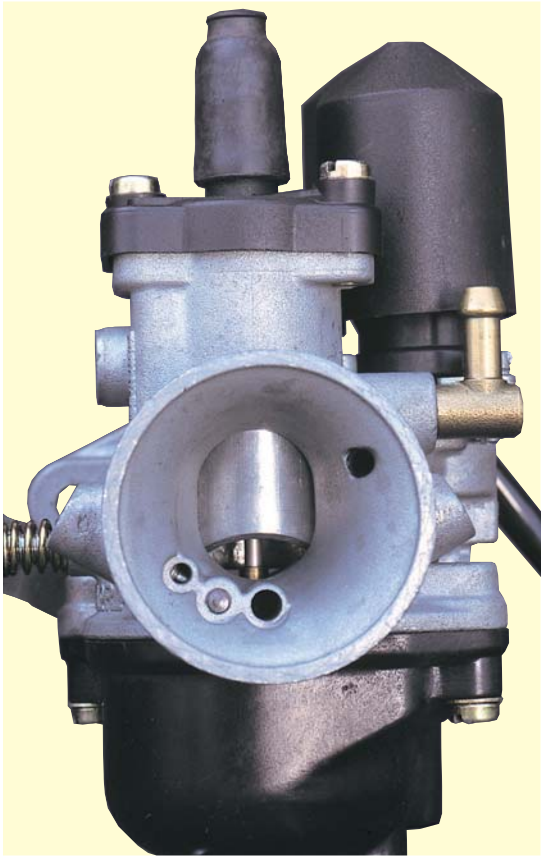


according to constructive practice and from the experience accumulated on a wide range of motorcycles and engine types.
The diameter determination is then made through tests on the engine.
For instance, small two-stroke en-



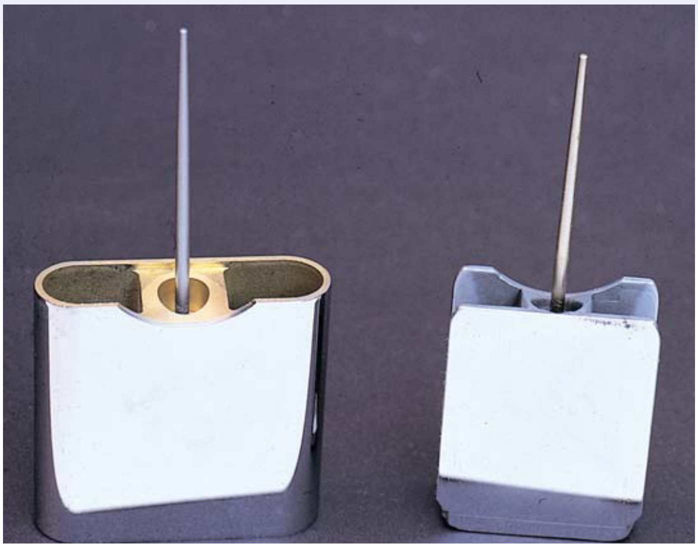
gines used in cycles and scooters are equipped with carburetors having a venturi with a diameter from 12 to 14mm.On 125cm³ displacement two stroke engines used in competition, we use venturis with diameters which can vary from 36 up to 40 mm and over, as is common on powerful rotary valve units used in racing.
When performance is the main consideration, the venturi diameter determines the resistance that the aspiration system (the carburetor's venturi is part of this system) offers to the aspirated flow.
Large diameter venturis obviously introduce a lower resistance than we usually have with smaller diameter venturis, therefore in order to improve the efficiency of this component, inserts inside the venturi itself are used, which eliminate steps and shape variations, while keeping the diameter value.
The inserted venturis of Dell'Orto VHSB series carburetors are shown in the illustrations.
On the contrary, a venturi with reduced diameter results in higher air speed at an equal flow induc-

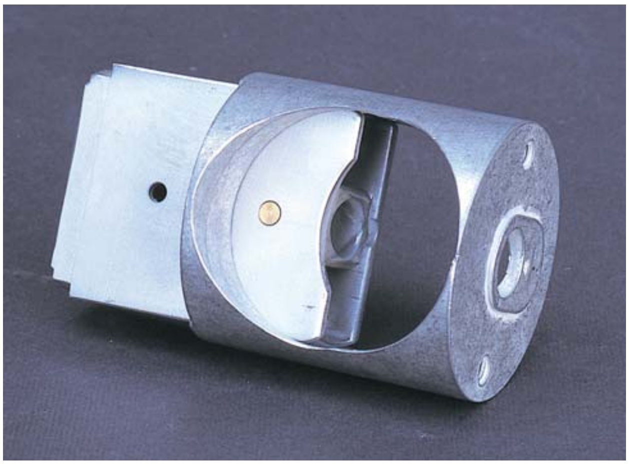


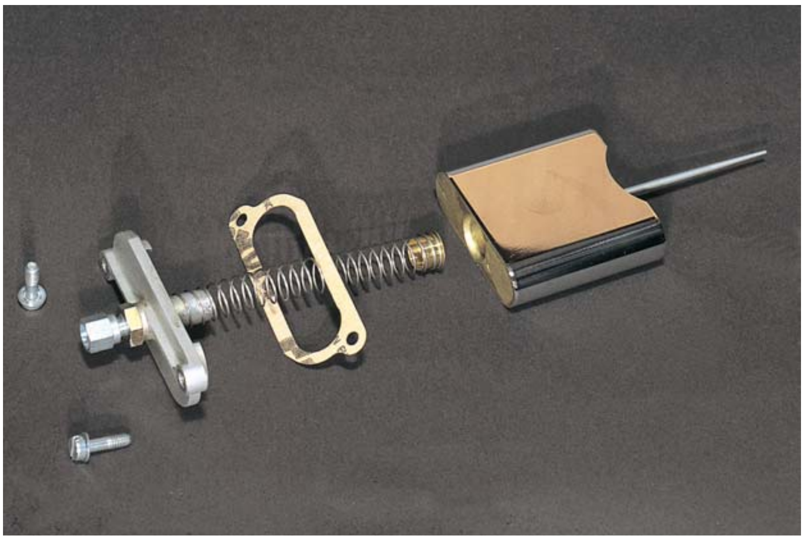


Shown above are two different shapes of the venturi's opening. On the left we have the classic oval section while on the right the one called "badge (shield)" which shows a smaller area portion on the lower side, close to the small fuel ports that results in better modulation as required by some engine types.
Below, a comparison between a round piston throttle valve and a plane valve, also called guillotine. In the center we have the guiding hole for the conical needle.

Above, on the left: valves often have a hardened surface with chrome plating in order to assure high resistance to wear. The shape of both edges is very important to assure there is no leakage when the valve is closed. On the right is a valve introduced in the insert-venturi that is assembled in the carburetor's body (Dell'Orto VHSB) Below, the valve and spring assembly of a competition Dell'Orto VHSD carburetor. The spring is of small dimensions, but sufficient to shut off the airflow, thanks to the low friction of the sliding guillotine.







ted by the engine and, therefore, results in a higher vacuum signal on the nozzles which deliver the fuel.
In some conditions and for engines that have to work over a wide range of r.p.m., such a feature can become very important, with less consideration to the need for lower resistance.
On this matter we can assert that the power loss introduced by the carburetor depends, in addition to the diameter of its venturi, on its profile in the direction of the airflow.
Beyond the configuration of the throttle valve area, the connections with the air intake and the area downstream of the venturi, where the carburetor connects with the aspiration channel, are very important.

THE SHAPE OF THE VENTURI SECTION

Once the area is determined, according to the supply requirements of the engine, there are design choices to be made on the shape of the venturi section.
For competition engines or engines which have to offer high performance without any particular concern regarding other operating modes, the most favorable section with regard to power loss

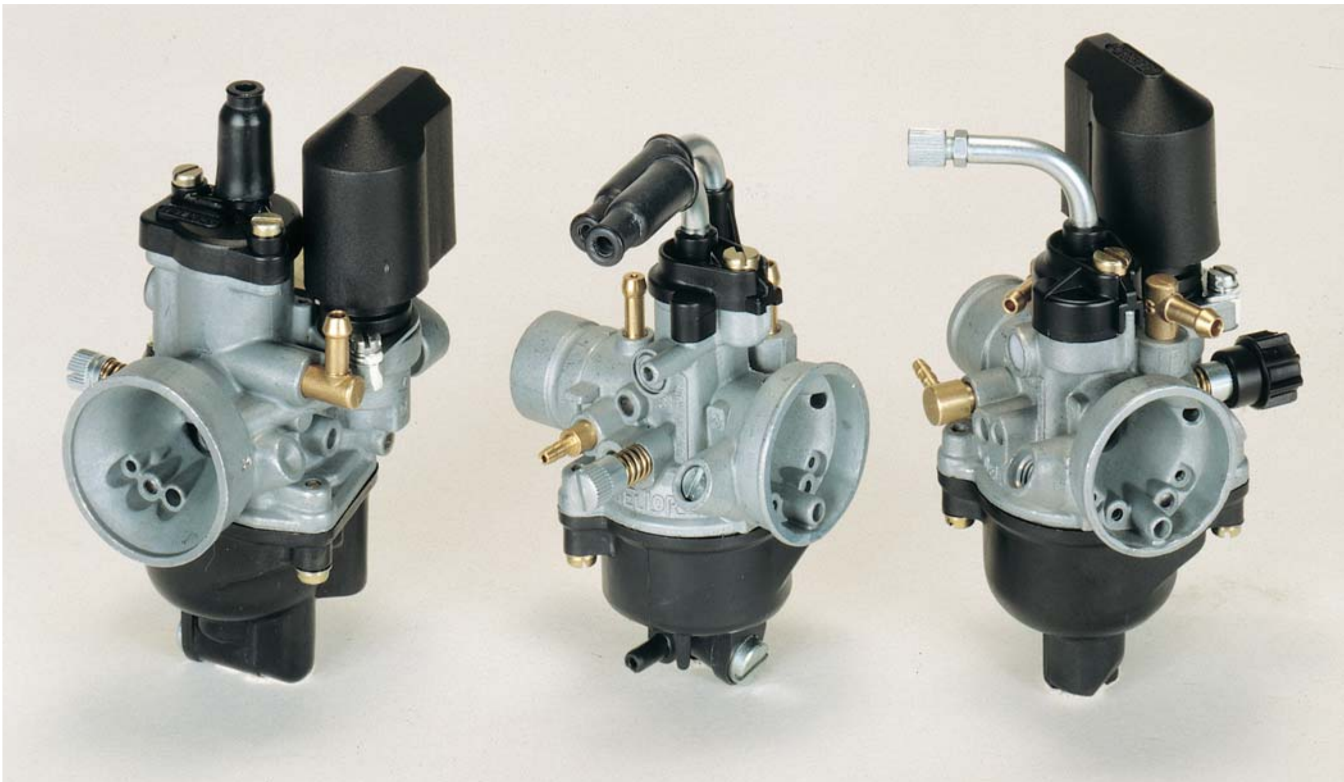
The throttle valve of "needle" carburetors has a chamfered edge (measured in tenths of mm: for example, .30) which influences the carburation at small throttle openings. A valve with low chamfer (as above) enriches the mixture up to 1/4 throttle, while if the carburation is too rich, we can use a valve with a higher chamfer (as below).

The influence of this calibration element is mainly in transient operation at small throttle openings and even limited changes (i.e. from .30 to .40) may strongly influence the delivered mixture.

is the round section, since it has the minimum perimeter (at equal areas) to resist inducted flow.
For engines which have to provide a smooth modulation of power, we use generally carburetors with a venturi having an extended shape section, called "oval" or even a more complex shape such as the one Dell'Orto engineers called "badge (shield)" and which represents an evolution of the concept of the oval section venturi. As we have seen, a small diameter venturi improves the engine's responsiveness, since it keeps the flow velocity high. An oval venturi presents a smaller section, because it has a reduced diameter when the throttle valve is lifted slightly.
At small openings, then, the carburetor behaves as it had a reduced diameter.
This provides a good solution to transient operation and wide power range, and gives a good relationship of proportionality between the driver's action and response in terms of delivery from the carburetor. When the throttle opening increases, the shape of the venturi section recovers the area necessary to aspirate the flow without introducing any high fluidynamic resistance. The badge (shield) venturi has a triangular shape at small throttle openings, and therefore in this region, the opening area is very reduced, to enhance the features of response which are necessary on some kinds of engines with automatic transmissions.

THROTTLE VALVE

In traditional non-vacuum carburetors, this is the adjustment component connected to the accelerator by means of a flexible cable.
This valve slides transversely to the venturi determining the effective area of the flow passage.
In different carburetor models (such as Dell'Orto series PH, where P means "Piston" referring to the valve, and H means "Horizontal" referring to the channel orientation), the valve is a cylindrical element which slides with very little clearance in a seat, machined into the carburetor's body.
In other versions (Dell'Orto series VH, where V means "valve") the element is plane, with driving flyers or rounded edges developed to reduce air leakage, as for example in Dell'Orto VHSD.
For carburetors used in 4 stroke engines, the vacuum in aspiration, at closed position, can reach extremely high values and keep the valve pressed against its seat.
In order to eliminate wear (and therefore leakage) and sticking, these components undergo surface treatments which improve the hardness of the material and operating smoothness, similar to chromed brass valves.



Together with these designs, some slightly stiff return springs are used, in order to assure a positive return to the closed valve position.
However, since the stiffness of the spring determines the opening effort from the driver, it's a good rule to choose valves which slide more smoothly before increasing the return spring force.
The valves called "plane" reduce the turbulence affecting the air flow that goes under the valve itself since this design provides a shorter impediment in the direction of the flow itself.
Even for this kind of valve we must carefully understand all the issues related to sealing at the closed condition, providing surfaces with chrome plating to reduce wear.
The advantages we gain in terms of deflection of the flow path with a reduced width valve are however counterbalanced by the need to solve the problem of location of the progression holes.
These holes are needed to deliver fuel when the throttle opening changes, during the progressive-transition from operation of the idle circuit to the main one and vice-versa.
These holes are machined downstream the main atomizer, but in order to work, as we will see later on, they have to be below the throttle valve edge.
If the valve is very tight, these holes will obviously be very close to the main atomizer (also located under the valve) making the design approach more complex.
Once it has been solved, however, this design will assure the best functionality.

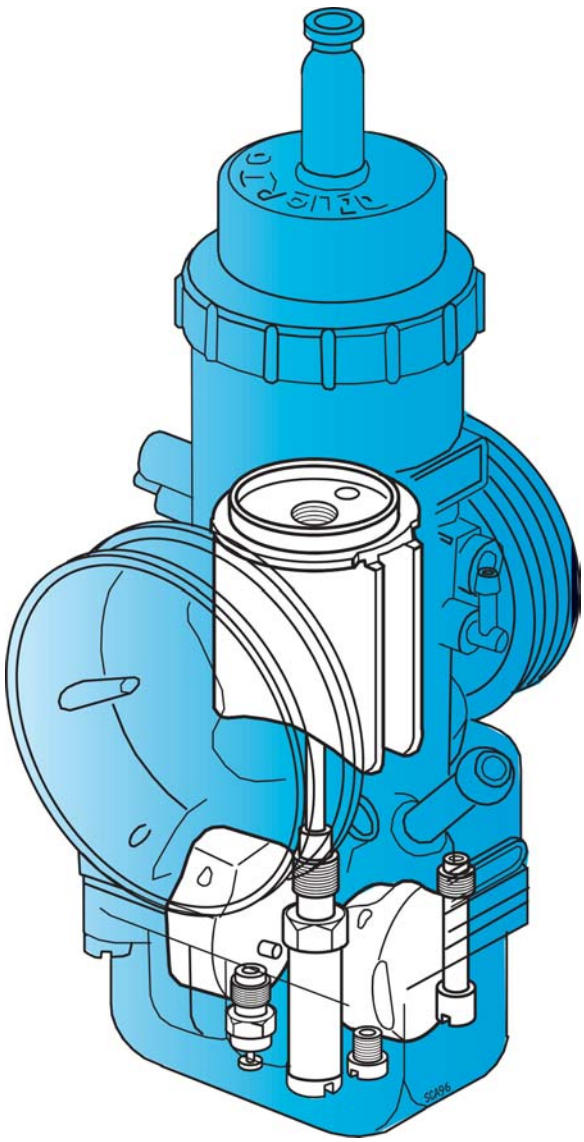
Some of the carburetors Dell'Orto has developed for modern, small displacement motorcycles.
In this case, some tricks have been in this case adopted: elaborate shape venturis and automatic starting circuit, which provide for the best operation of the engine under all conditions.

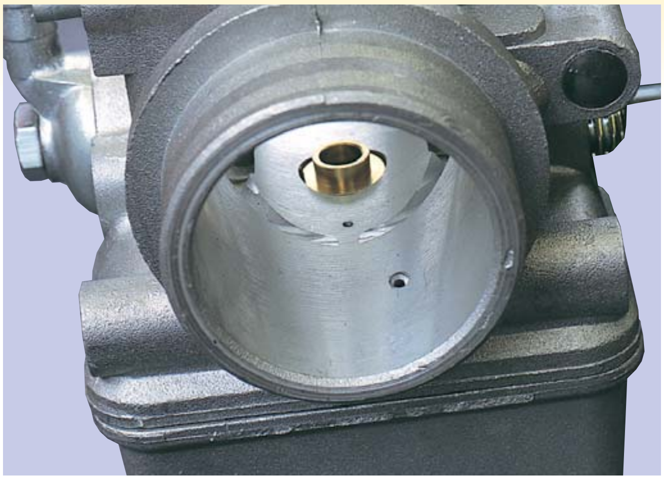
THE IDLE CIRCUIT AND THE PROGRESSION

Manufacture and operation of two very important systems, which allow the practical use of a carburetor for motorcycles

We have seen how in a "basic" (simplified) carburetor, the fuel is drawn into the venturi from the float chamber. This occurs as a result of the vacuum created by the airflow, which passes through the venturi, drawn by the engine itself.
In reality, a modern carburetor comprises more than a fuel supply system, since using only the main circuit the correct delivery of fuel could not be obtained (and therefore a correct mixture ratio) at all possible operating conditions that occur during the practical use of an engine.
The working principles of each of the auxiliary systems stems from the same physical principle. The principle is that the fuel responds to a vacuum signal generated by the induction action of the engine.
The auxiliary systems are, however, separated from one another, because the supplying nozzles are located in places appropriately designed into the carburetor's venturi.

THE IDLE CIRCUIT
When the throttle valve is closed, or nearly completely closed, the inducted air flow which draws on the main spray nozzle is very low, and therefore is not sufficient to draw fuel from the float chamber. For this reason the carburetor is equipped with a second supply circuit which comes into play in these circumstances (at idle, precisely) allowing the engine to operate normally. If it were not for the idle circuit, the engine would stop running, even in the transition stages





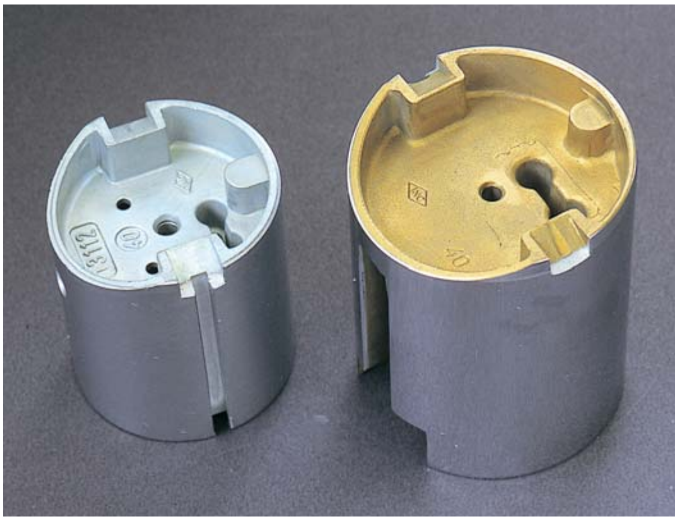
Above are two details of the supply ports of the idle and progression circuits, which can be seen slightly downstream of the main spray nozzle.
We can notice how the progression port is always placed below the throttle valve and that its distance from the main nozzle depends on the shape of the valve itself (cylindrical, on the left, or flat on the right).

Below, with the throttle valve partially lifted, we can notice the arrangement of the progression port.

when the driver starts to open the throttle.
The idle circuit is equipped with a supply port placed immediately downstream of the throttle valve, at a point such that once the valve is closed, it experiences strong vacuum conditions and therefore is in the best condition to supply fuel from the float chamber.
The duct, which leads to this port, connects with a proper jet (idle), that permits calibration of the idle fuel flow.
During calibration, the choice of idle jet is very important not only for the operation in this condition, but also for the engine response during transitions, since even the progression stage is affected by the idle jet, in addition to the other calibration elements such as the chamfer of the throttle valve or the needle nozzle fit, and when present, the small milling performed on the edge downstream of the valve, or even the projection (the engineers call it "stake"), that projects in this same area, whose functions are explained in the relevant pictures.

On the left, a throttle valve with a notch on the rear edge. In the center, two valves with a "stake" needed to interact at different modes the progression circuit.

Below, two possible locations for the idle jets are shown. The calibration element can be single and machined into the emulsion tube, or it can be formed by two separated elements, where the second is the emulsion tube, or an emulsion jet that works in series with the first one to keep a higher quantity of liquid on the calibrated passage.



PROPER SELECTION OF THE IDLE JET

Generally, if the selected idle jet is too big, the engine may tend to stall and responds to the accelerator slowly with a deaf and feeble sound, usually overcome by closing the throttle temporarily.

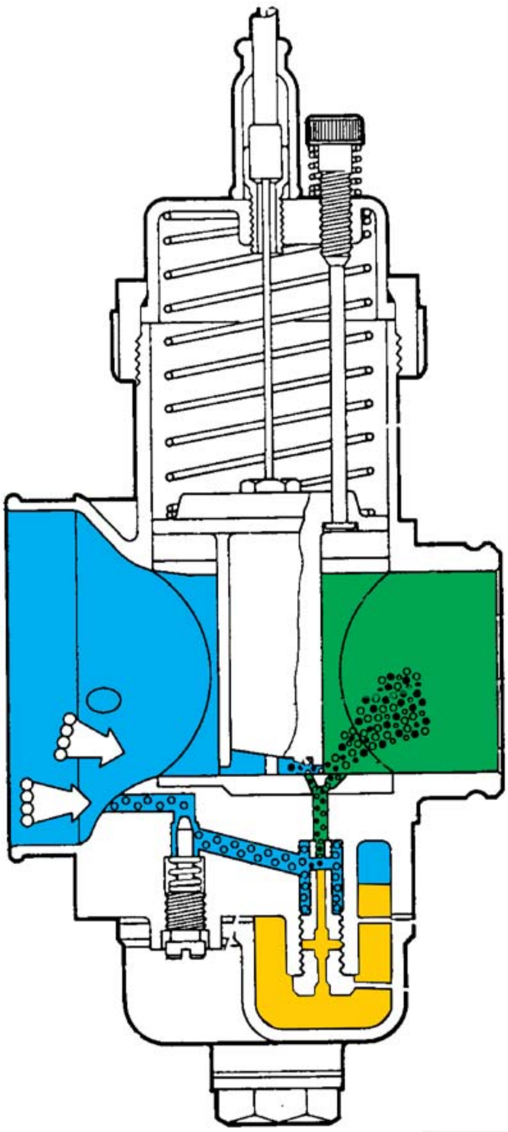
If, on the contrary, the jet is too small, the engine responds better to the accelerator (except when it stalls when the jet is much too small), but when the throttle is closed, the speed (rpm) doesn't decrease immediately, and the speed remains high for few seconds before settling down to idle.

Installation of an idle jet that is too small on a two stroke engine can be dangerous since there is the risk of engine seizure during throttle closing, especially when the engine has run at wide open throttle for a long time. Under these conditions, when the throttle closes, the engine keeps on running at high speed and therefore if the idle circuit creates too lean a mixture, the thermal load due to the overly lean combustion presents the risk of damage the engine from overheating and subsequent seizure.

THE EMULSION AIR CIRCUIT

The fuel supplied by the idle circuit is mixed with a small quantity of air (thanks to a diffuser expressly placed for that purpose) that flows into the fuel passage (liquid) from the idle air channel. From there, the passage leads to the progression

On the left, the idle jet, whether or not connected to a diffuser, is often screwed inside the emulsion tube and not outside as is common in other versions of carburetors.
On the right, the illustration of the idle circuit of a Dell'Orto VHSB carburetor, with the air adjustment by means of a screw. In the section we note the progression passage immediately below the throttle valve.

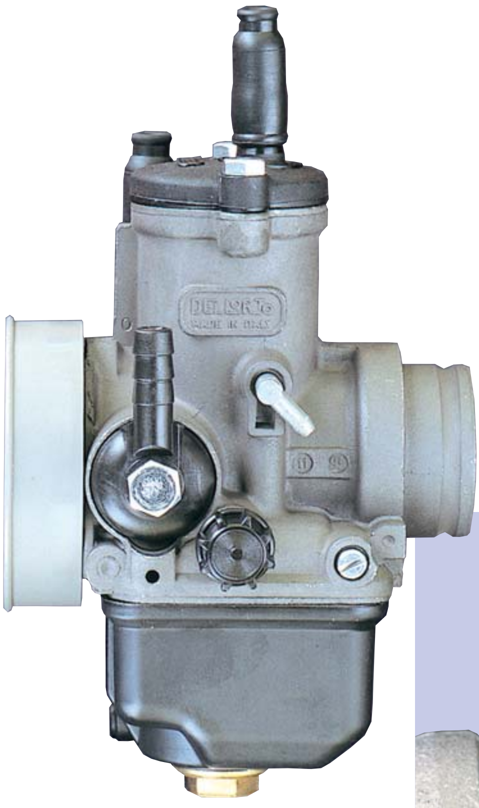


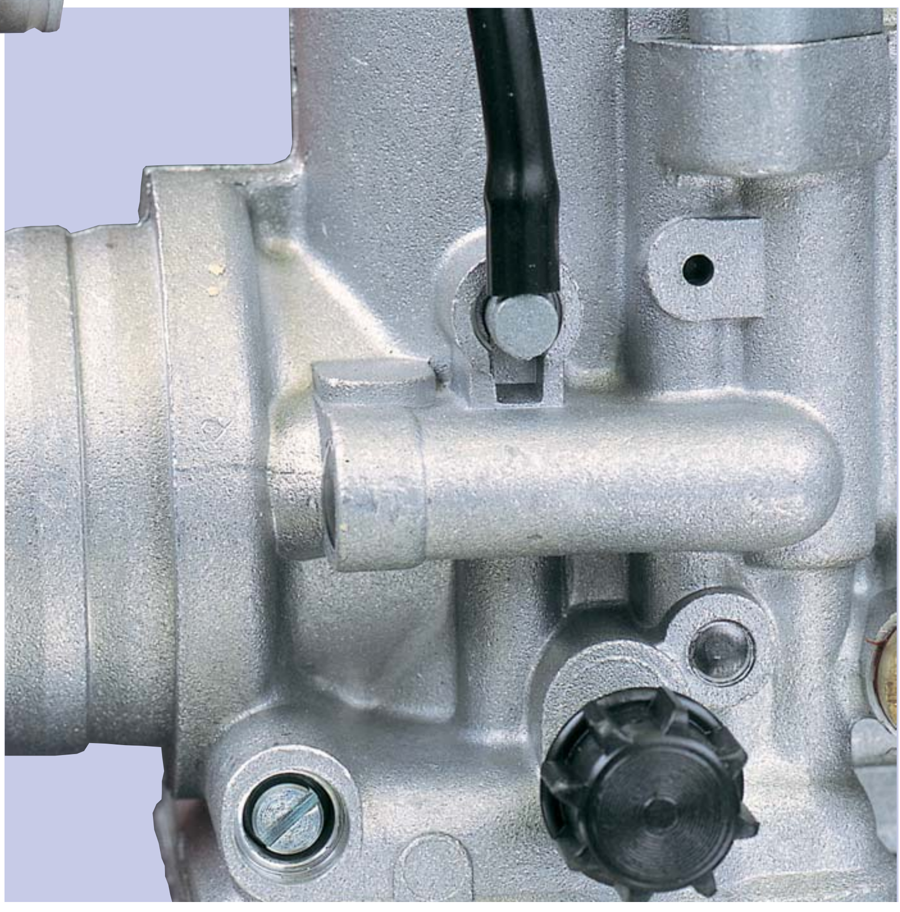
port. This progression port is placed upstream of the rear edge of the valve, just before the idle port (with respect to the direction of the airflow in the diffuser).
When the idle circuit is working, a small quantity of air is inducted by this port, and bypasses the valve (which is quite completely closed) and mixes with the fuel supplied by the jet. As the valve lifts, the contribution of this element decreases as far as the idle circuit is concerned, while it becomes important for the progression circuit.
The other air flow comes directly from the carburetor's mouth where it's previously controlled by a calibrated passage that, in some models, can be removable and takes the shape of an actual jet, sometimes called "idle air break".

THE IDLE AIR AND MIXTURE ADJUSTMENT SCREWS

The fine adjustment, while setting up, is done by means of the idle air screw with a conical tip that modulates the passage in the idle air channel.
Some carburetor models are, on the contrary, equipped with a mixture adjusting screw which intervenes on the fuel and airflow already emulsified and directed to the delivery port.
As the idle air screw adjusts only the air, while the mixture adjustment acts on the fuel flow, we have to operate them in the opposite manner according how the carbure-

Here above we see two of the same model of carburetors, but with two different idle circuit adjustment systems. The one on the right is equipped with an air adjustment screw, while the one on the left has a mixture adjustment screw, recognizable because it is placed on the engine side and on other carburetors with the mixture adjustment screw placed soon before the engine sleeve connection.

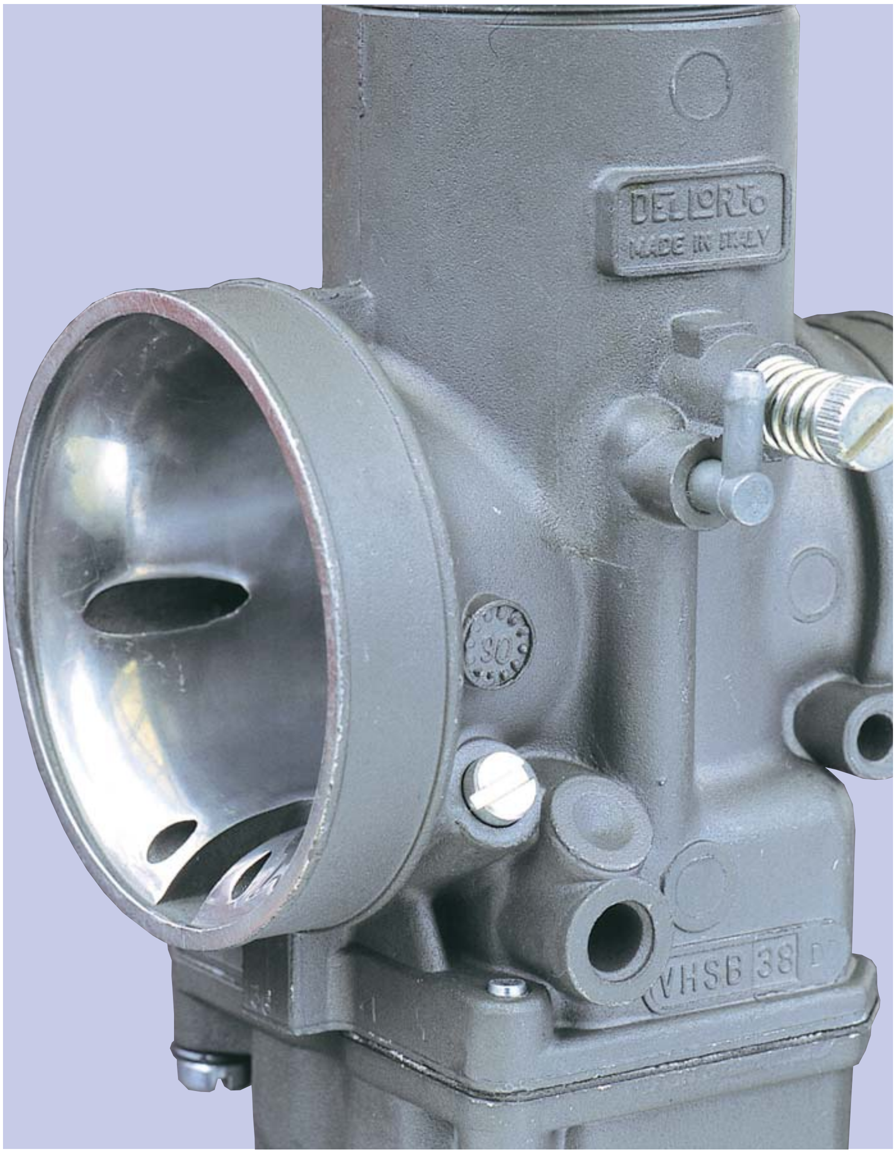




tor is equipped. To enrich we have to close the air screw (by closing the airflow) or open the mixture screw. To lean the mixture, one has to open the air screw or close the mixture screw.
The elements are easily recognizable on the carburetor since the air adjustment screw is placed by the front plug, which connects to the filter, while the mixture screw is placed on the side towards the engine.

TRANSITION CIRCUIT
When the driver starts to open the accelerator, the throttle valve lifts and therefore decreases the vacuum that in the closed condition, activa-

On the left side we see a VHSC with the air adjustment screw near the aspiration mouth.
On the right, the air adjustment screws (the two on the left) have a smallerpoint than the mixture screws (on the right) since they are required to control a different fluid and therefore allow a finer adjustment. By controlling the air, this system has its own influence on the progression circuit, while the mixture screw acts only on the idle delivery.



ted the idle circuit.
The delivery of fuel from the idle circuit is reduced, and therefore it is necessary to introduce another system, which is able to handle the transition of functions from the idle circuit to the main circuit.
We described above the progression system as far as the idle air contribution is concerned.
When the valve is lifted slightly (up to about 1/4 throttle) the vacuum generated by the inducted airflow begins to be consistent, and stops drawing fuel from the idle nozzle. Under these conditions, the vacuum is sufficient; however, to draw fuel from the progression port, which is always fed by the idle jet placed in the float chamber.
It's clear then, how the progression port is traversed first by air that goes towards the idle circuit, and later, while the throttle is opened partially, is traversed in the opposite direction by a fuel flow (or better, of air/fuel emulsion coming from the idle circuit). This explains the importance of the idle jet, even in the first stages of throttle opening.
The position of the progression port, between the main and idle nozzles, is very important for the correct operation of the carburetor and is the subject of careful development.

THE MAIN CIRCUIT

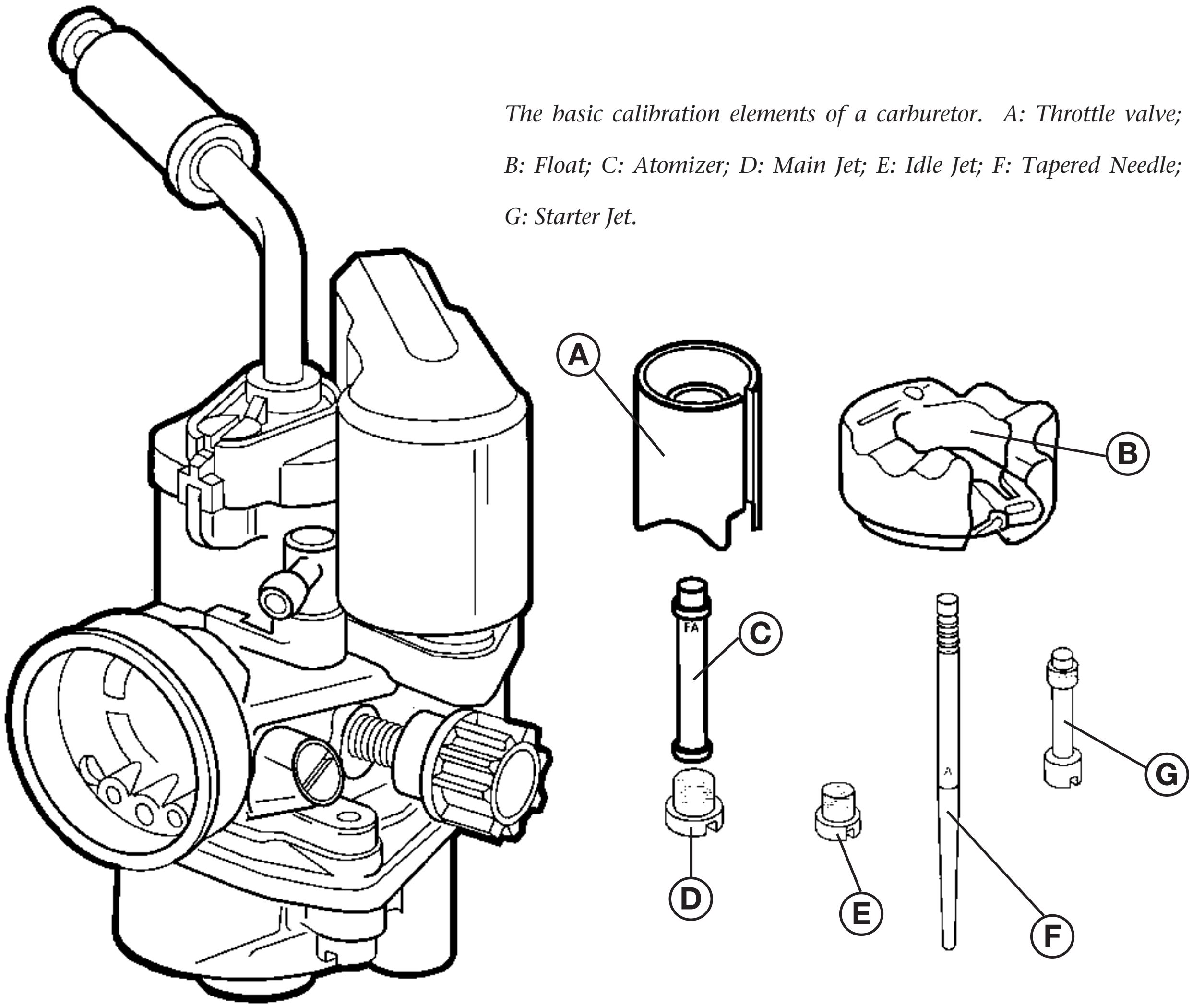
Operation layout and guideline for setting the main delivery system of the carburetor

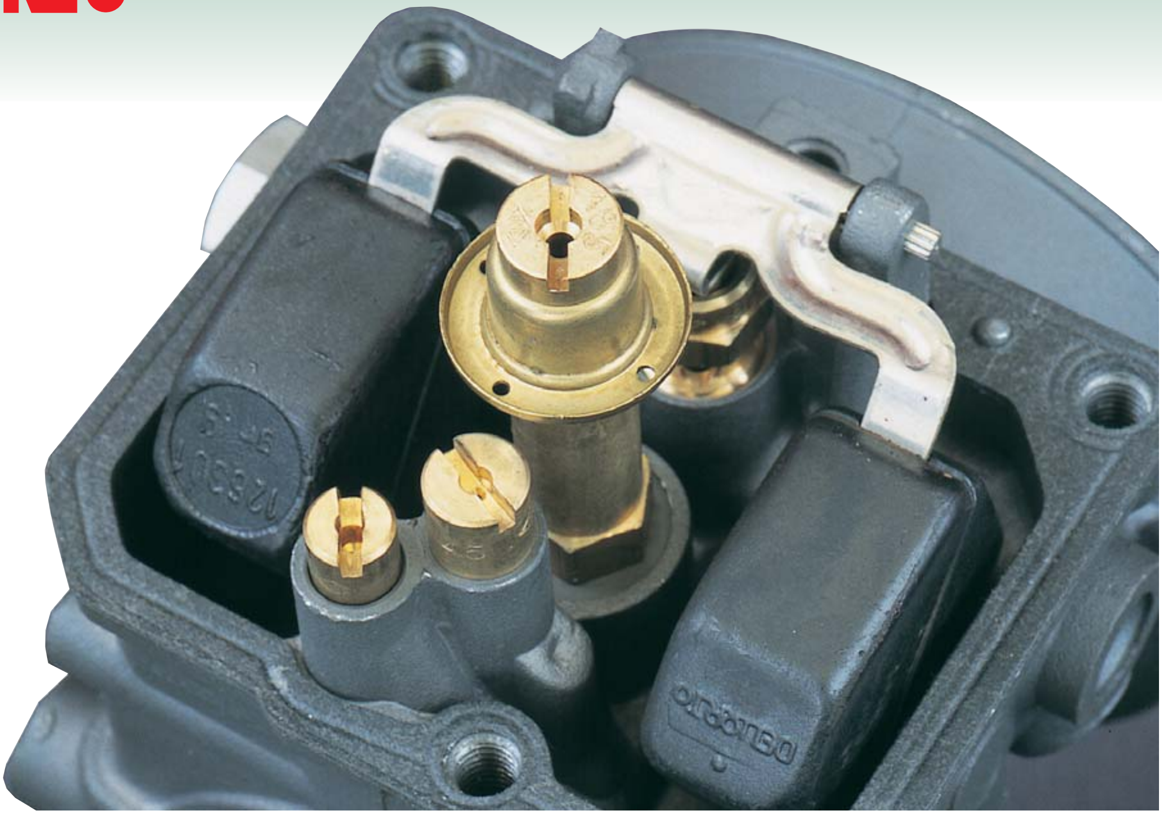
Modern carburetors used on motorcycle engines are defined as "needle type"due to the mechanical configuration of the main delivery system. The tapered needle assures the correct mixture ratio for all operating conditions of the engine corresponding to openings of the accelerator from 1/4 up to wide open throttle.

THE TAPERED METERING ROD

As usual, the fuel is drawn into the venturi from the vacuum generated by the induced airflow, but from the moment that the throttle valve closes, the same vacuum changes within very wide limits. For small throttle openings the engine vacuum level is generally higher than when the valve is partially or fully lifted and subsequently, the fuel delivery from the nozzle of the main circuit changes proportionally.
By responding only to the vacuum signal, a main circuit comprised of only the nozzle would deliver a lot of fuel at small and intermediate throttle openings, maintaining a rich mixture strength. At large openings, the delivery would decrease at the worst time, risking engine damage from a lean mixture.

The basic calibration elements of a carburetor. A: Throttle valve; B: Float; C: Atomizer; D: Main Jet; E: Idle Jet; F: Tapered Needle; G: Starter Jet.





That is why the system with a conical needle has been adopted, with a configuration well known to everyone and clearly visible in the illustrations.
The needle runs inside the metering section of the atomizer, and when the valve is lifted only slightly, the passage available for the fuel is small.
As a result, in spite of the high vacuum, the delivery is low and therefore the mixture ratio is generally correct.
At wide throttle openings, the smaller diameter conical part of the needle reaches the atomizer and therefore increases the passage area. It is true that the vacuum, within certain limits, is decreased but the increase in the available area of the fuel metering passage keeps the mixture ratio at optimum value and, therefore, the engine is able to run properly all throttle openings.
Once the operating principle is clear, it becomes simple to understand the adjustment of the conical needle system, which involves two adjustment elements; the needle itself and the calibrated section of the atomizer.
In Dell'Orto carburetors the needle

Above, the group of main and starting jets inside the float chamber. We can note the baffle that keeps fuel in the chamber of the main jet even when the motorcycle is subjected to acceleration that would tend to move the liquid mass in the float chamber.
Below, the conical needle and atomizer placed in their relative working positions.

Two photos of the 4-stroke atomizer: Above, the atomizer mounted inside the nozzle that keeps it in the carburetor's body; below some atomizers (all having the same shape and diameter of the calibrated hole, but with different drilling of the tube.

is fixed in the valve by means of a spring clip which engages in one of the notches on the rod. Conventionally, the notches are numbered starting from the top.
Attaching the clip in the higher notches, the needle (relative to the atomizer) is lower; meaning that to reach the conical area, the valve has to be lifted more. Conversely, if we wish to introduce the arrival of the conical zone earlier in the throttle's travel, we have to lift the needle, attaching the clip to the lower notches (second, third and so on).
Practically, if at equal opening of the accelerator there is the need to lean the mixture, we have to lower the needle moving the clip towards the top, while if the engine has carburation which is too rich (slowness in reaching the correct r.p.m. and dull and deep sound) we have to lower the needle, placing the clip in the higher notches.
The variables introduced from the shape of the needle, (meaning its taper ratio and the length of its conical section) are absolutely essential for the carburation calibration since they have a strong influence on the general response of the engine.
Very often, however, it is not possible to correctly adjust the carburetor by modifying only the needle position and, therefore, it becomes necessary to replace it with another part with different features.
For each family of carburetors, Dell'Orto has a wide range of conical needles with different dimen-

sions as we can see in the attached table. According to the needs which may arise during adjustment, we select the necessary needles and proceed with testing.
If, for example, we can not manage to get sufficient enrichment in a certain area by lifting the needle to its highest position, it's clear that we will have to install one with the same taper (it's always better to introduce just one variable at a time) but with the conical part starting higher on the rod.
Different needles are installed having a conical area with different tapers to better match the needs of various engines.

THE METERING ROD AND ATOMIZER

The atomizer end closest to the venturi contains the calibrated diameter.
This component is available in various dimensions.
By increasing the atomizer's diameter, the mixture is enriched, while it will be the contrary when the diameter is decreased. Obviously we can get the same effect by changing the calibrated diameter the conical needle, at the expense of some other of its features. Sometimes a needle with the appropriate diame-

On this page we see two stroke type atomizers: above on the left a view from the top of the nozzle that surrounds the actual atomizer on the right.

Below are four different configurations of the step that projects inside the venturi.

Below on the right, the atomizers may be recognized by the height of the edges and by the dimension of the hole where the conical needle operates.

ter in the conical area is not readily available.
In this case it's much easier, once the need has been established, to replace the atomizer, even though Dell'Orto carburetors are supplied with calibrations already optimized according to the category of the engine where they will be used. The calibration will probably an adjustment of the jets, the position, and eventually of the conical needle type while, generally, the atomizer and the valve chamfer don't require any change even though spare parts are available for most models.

THE ATOMIZER AND ITS EMULSION HOLES

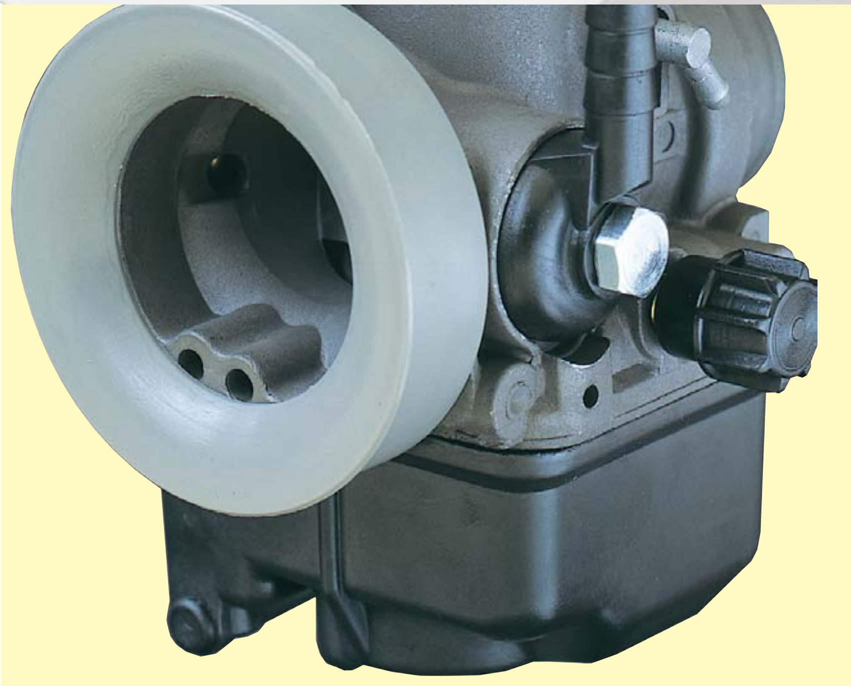
The atomizer, in its simplest shape, is a tube that connects the main jet to the venturi.
For this element there are two possible configurations that, traditionally, the engineers call "two stroke type" or "four stroke type".
Some have with a series of holes placed along the whole area and in communication with the main circuit channel (four-stroke type).

ATOMIZER DESIGN FOR TWO-STROKES

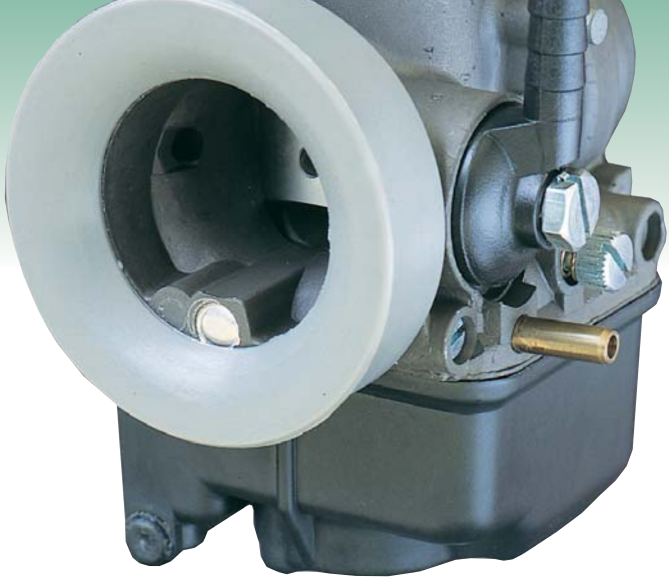
The atomizer is screwed into the delivery nozzle fitted in the carburetor's body.
As we can see in the illustration, the edge of the tube projects inside an annular chamber open to the venturi and at the same time in communication with the air intake by means of the main area channel. Due to the vacuum in the venturi then, from the atomizer tube the liquid fuel is drawn, metered by the main jet and by the conical needle, while a certain airflow is delivered from the channel, going into the annular chamber.
In this area air and fuel are mixed together forming a finely atomized spray inducted by the engine.
In addition to the atomizer's hole diameter, the variables are therefore the diameter of the air channel (by increasing it, the mixture leans), the height of the atomizer's side that projects in the chamber and the "step" of the delivery nozzle that projects into the venturi.
Let's start with the atomizer.
Under the same conditions, if the edge is short, the fuel has to travel a shorter distance from the float chamber and therefore the delivery will be more immediate. The "low" atomizer is as a matter of fact a typical feature of competition motorcycle carburetors.
If, vice versa, the atomizer is high, the mixture will be leaner in acceleration.
The same is true for the step in the venturi. This creates an impediment to the airflow inducted by the engine and therefore downstream of it there is a strong vacuum area, which activates the delivery of the circuit. By increasing the step, such vacuum increases and therefore the mixture enriches, while using a carburetor with a lower step, we can get leaner deliveries.

ATOMIZER DESIGN FOR FOUR-STROKES

This system is presently widely used in two stroke engines, since it permits leaner and better-controlled mixtures under all conditions.
The atomizer tube is equipped with a series of holes and the annular chamber that surrounds it is always in communication with the main area, but not in direct communication with the venturi.
The air is then mixed together with the liquid fuel and the emulsion is done inside the tube, before the mixture reaches the nozzle in the venturi, which for this reason has no steps.
The arrangement of the holes and their diameter influences the delivery.
Holes machined in the lower part of the atomizer are bathed in the fuel of the float chamber, while the holes in the upper part are exposed to the air.
Subsequently, by working with the variables of the drilling one can manage to optimize the mixture ratio under all conditions.
When the upper drilling is preferred, the mixture is made leaner, while if we increase the number and/or the diameter of the lower holes, the flow of fuel increases and goes to emulsify itself with the air.
The drilling even influences the transition in acceleration, since by placing the holes at a different height, the annular chamber is full of fuel at the start of a transition, and empties when the speed increases due to the liquid drawn through the same holes. In this way, the delivery starts with a very rich mixture and then becomes leaner.



The main circuit is also supplied with air that goes to emulsify the fuel in the atomizer (four-stroke) or in the nozzle (two-stroke). The main emulsification air intake is usually placed in the main plug on the carburetor's mouth, as we see in this picture. The second hole is for idle emulsion air.



To eliminate the influence of pressure pulses present in the filter box, sometimes the main emulsion air inlet is drawn from the outside by means of a connection in which we see the feed tube on the right of the carburetor. In this case the hole in the air intake is plugged.

THE MAIN JET

The basic element of the carburetor's adjustment, at full power and for wide throttle openings, is the main jet, which controls the calibration of fuel delivered from the main system.
The main jet is mounted in the lowest part of the float chamber to ensure that it is always covered with liquid, even when the motorcycle makes excessive maneuvers.
In many cases, to ensure the presence of liquid fuel, a perforated baffle is installed that keeps a proper quantity of liquid fuel around the jet.
The choice of main jet has a strong influence on the performance of the engine and is selected experimentally.
It's therefore better to start by mounting a larger jet with respect to the engine requirements to work safely.
A rich carburation doesn't produce the best performance, but at least there is no risk of damage the engine by performing tests with overly lean carburation (seizure or piston drilling).
We proceed by attempts, performing bench tests and/or acceleration tests.
After a run at wide-open throttle at maximum rpm the spark plug appearance can help to determine the best calibration choice. The insulator of the central electrode must be light brown.
If it's darker, the jet is too big, if it's clear, quite white; the jet is too small. To "read" the central insulator, the spark plug must have run for a long time, while examining the ground electrode it's possible to work with a new spark plug. The root of the electrode towards the spark plug housing should be at least half-black next to the bend in the electrode itself; the rest should be a natural metalcolor.
If the ground electrode is all black and sooty, the carburation is rich, while on the contrary if we find it perfectly clean, the main jet is too small with the risk of heavy damage to the engine.
After having chosen the proper jet, If we are not using a competition motorcycle, it's better to increase the jet by two or three sizes as a precaution and for protection in case of possible calibration drift induced, for example, by temperature changes.
When we use very big jets, it's better to check with a simple calculation that the passage area of the jets doesn't become smaller than the one (of an annulus) created by the tip of the conical needle inside the atomizer.
The following relationship must occur so that the main jet is always in control of the fuel supply. We have to remember, however, that this jet has an important role in acceleration, when the driver suddenly opens the throttle and the main circuit (needle and well of the atomizer) must start working quickly. The fuel that feeds the system, as a matter of fact, is calibrated from the main jet.
At this moment, what is called "lean peak" occurs, meaning that in the first moment of throttle opening the carburation leans, to return soon after to the optimal value (rich) necessary for the operation of the engine.

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

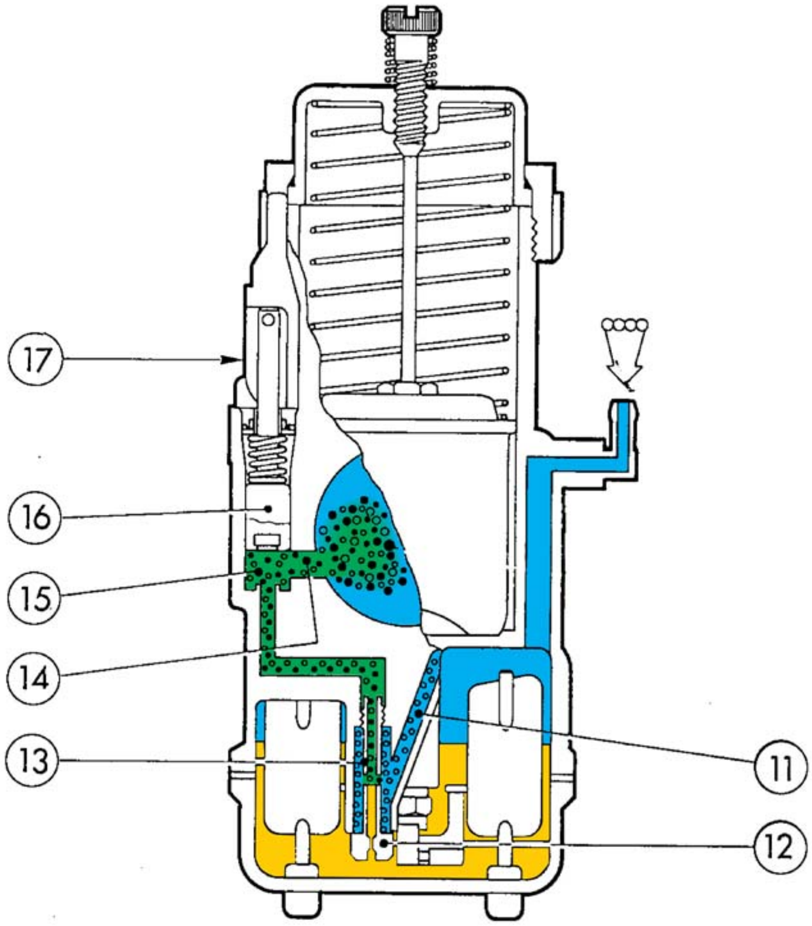
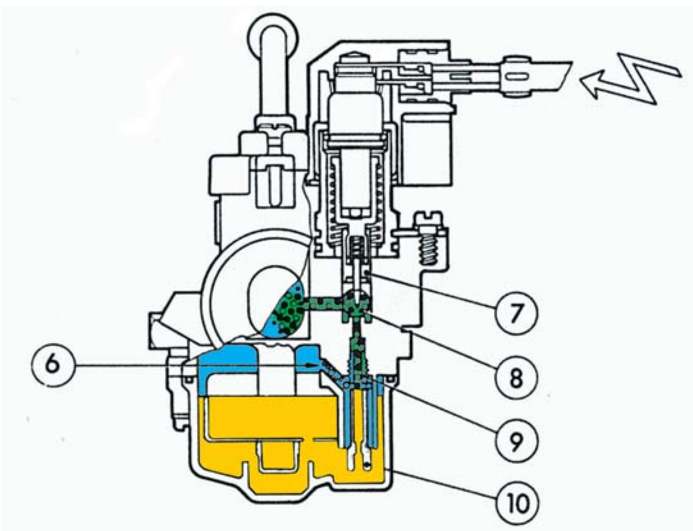


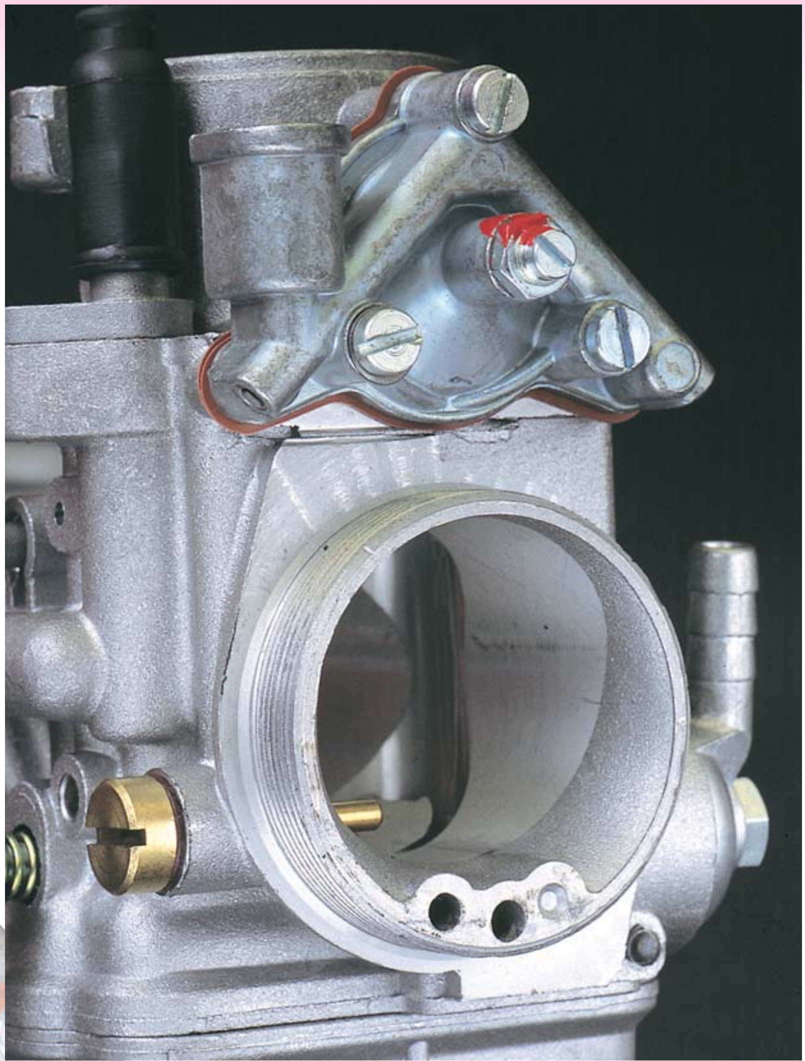
Illustration of the starting circuit of a Dell'Orto VHSB carburetor: the circuit is opened and closed by a valve 16 actuated by means of lever 17; the fuel is delivered in channel 14 from the nozzle 15, after emulsification with air coming from channel 11 inside the atomizer 13. The starting jet is n°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

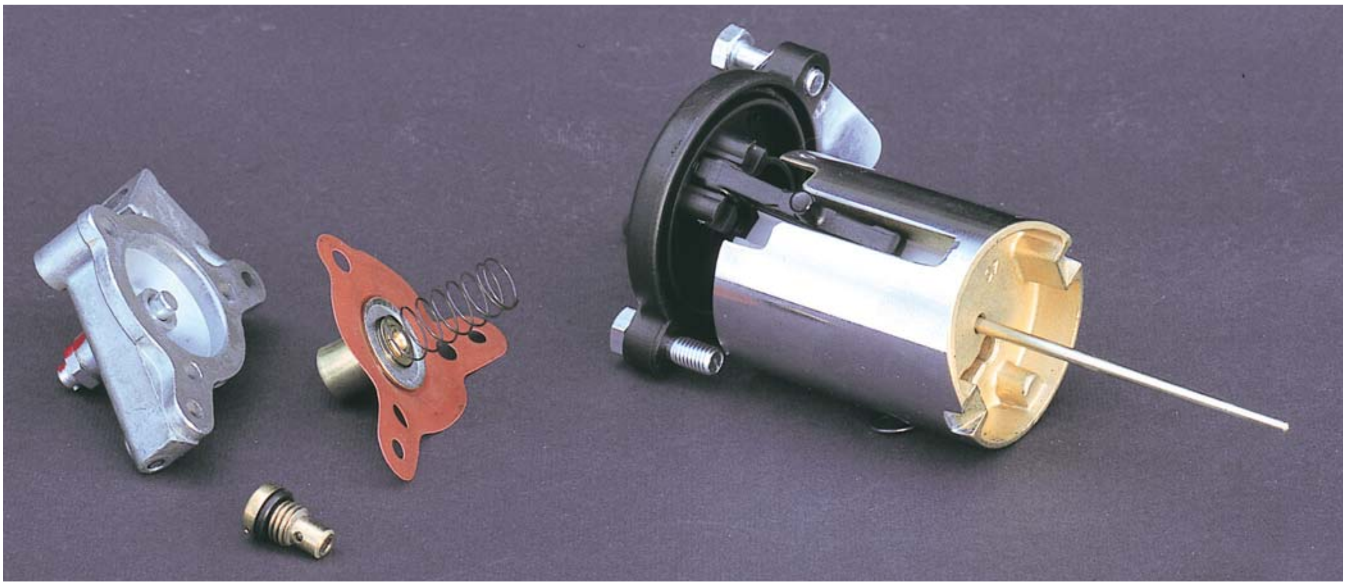
On the left, the starting system with automatic starter is shown. The fuel drawn by the jet 10 mixes with the air coming from the channel 6, inside of the emulsion tube 9 and reaches the channel 8 controlled by the valve with the conical needle 7, linked up to the electric actuator. On the right, in 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.



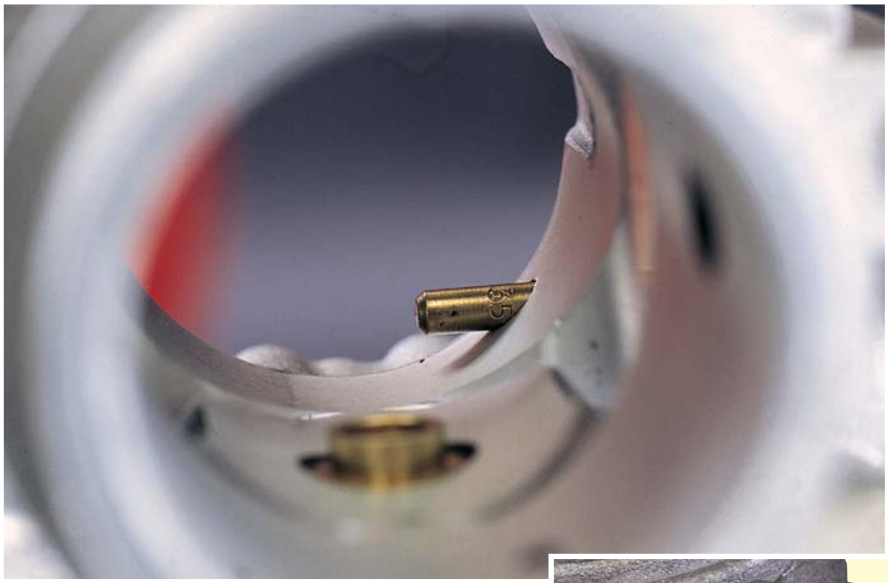
bad driveability, until the engine warms up to a normal operating temperature.
The carburetors are equipped with a starting circuit, completely separated from an operating point of view from the other delivery systems, and designed to correctly enrich the mixture.
This is provided in order to allow that 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

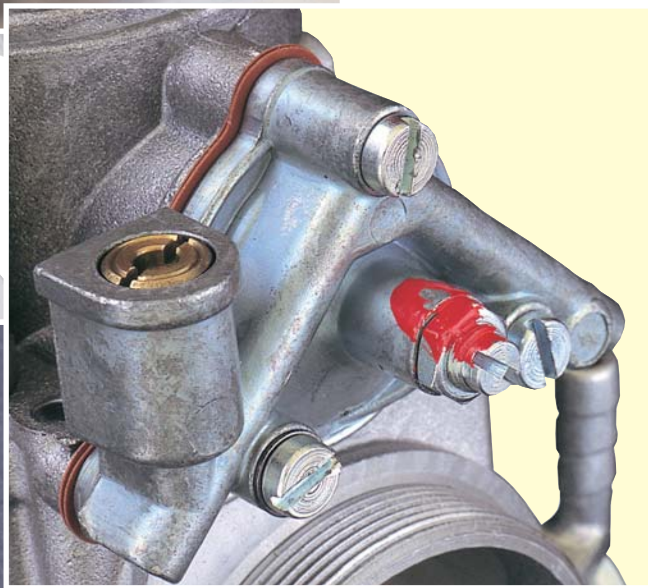




The acceleration pump fitted on a PHF carburetor and below, the same disassembled: we see the actual diaphragm pump and the lever system that is actuated by the inclined profile (cam) introduced in the Valve.



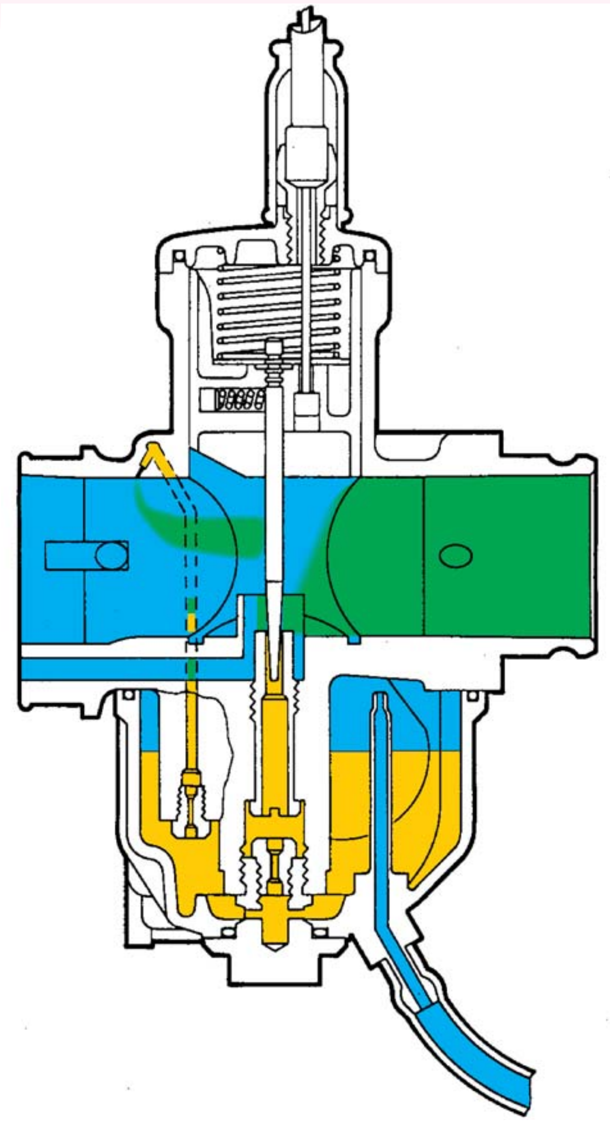
Below, the adjustment screw for the pump discharge allows adjustment of the flow. By turning clockwise the flow decreases, by turning



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-

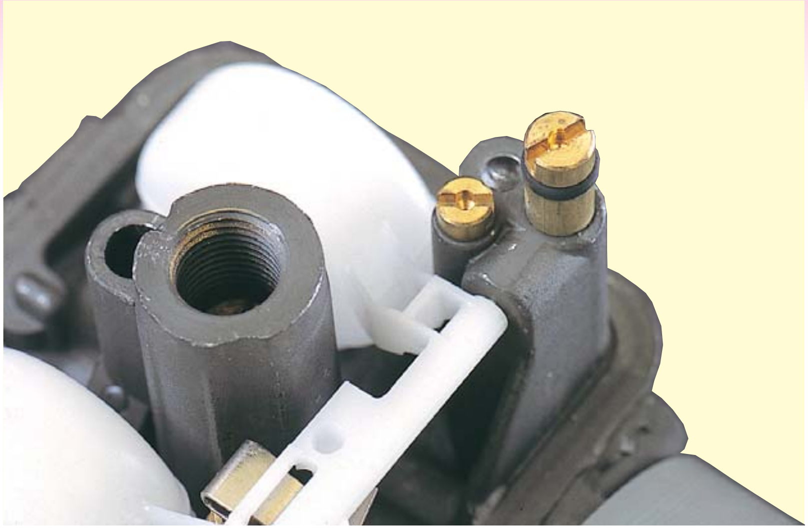
Sketch of the power jet circuit: from the jet in the float chamber, the fuel is drawn directly into the venturi through an ascending channel; the delivery occurs only when the slide valve is above the opening of the nozzle.



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 register 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

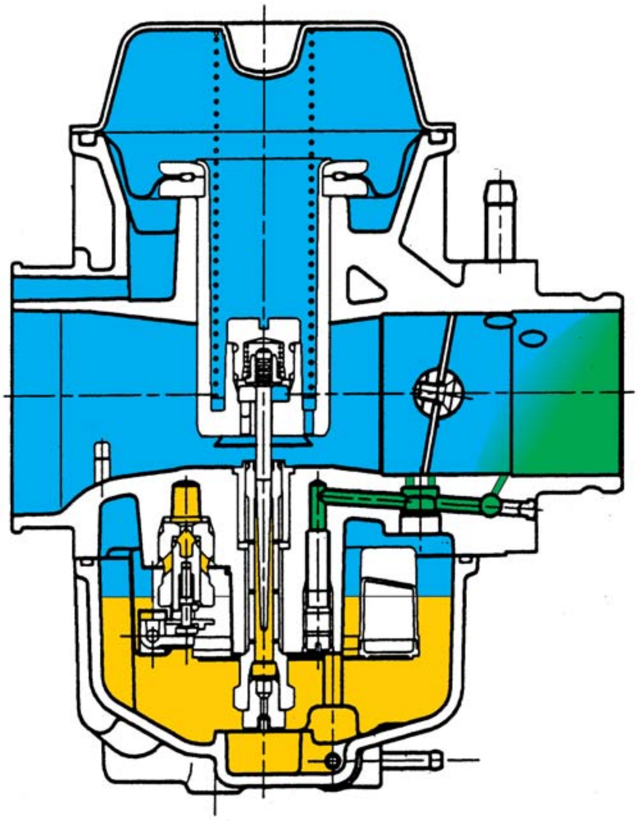
gines, there is a need to keep a mixture quite lean for the small and medium throttle openings, when a fast engine response is necessary. As we have seen before, at medium throttle openings, while the atomizer and conical needle system have an influence on the mixture, the main jet has the strongest 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.

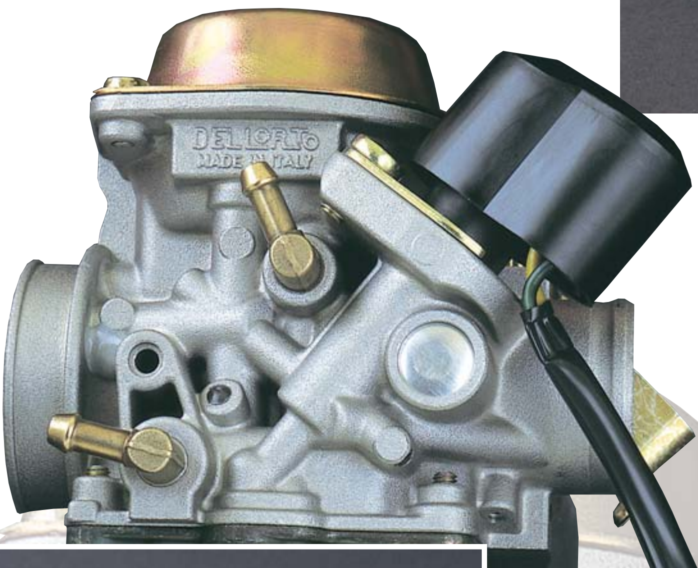
THE VACUUM CARBURETOR

The operating principles and the constructive aspects of the fuel supply system, universally widespread on 4 stroke engines

This kind of carburetor is called "constant vacuum" but that does not mean that the absolute vacuum is really constant.
The modulation problem of the carburetor, meaning the response of the engine which is function of the throttle opening, is constrained as a matter of fact to the vacuum value which controls aspiration of fuel from the main circuit.
In a traditional carburetor, when the throttle opens wide quickly (without "following" the engine progression with the throttle opening) the venturi area increases suddenly. At the same time, the rate of flow induced by the engine has not increased proportionally, since the engine rpm does not increase as quickly.
By increasing the area exposed to a virtually constant rate of flow, the flow speed decreases and therefore the pressure increases.
That is why the vacuum signal on the fuel circuit is missing, the signal which is needed to draw fuel past the atomizer in increasing quantities necessary to feed the engine.
The result is that this vacuum signal is weak or is missing so that we must often return to part throttle to get a decent progression.
With the vacuum carburetor we have two elements to adjust the rate of flow: the throttle valve, of automotive type, driven by the driver, and the traditional piston valve, with conical needle actuated by the vacuum system.
This valve is connected to a vacuum chamber by means of a flexible diaphragm.
The vacuum chamber is connected by one or more passages with the narrow section of the venturi, under the piston valve.

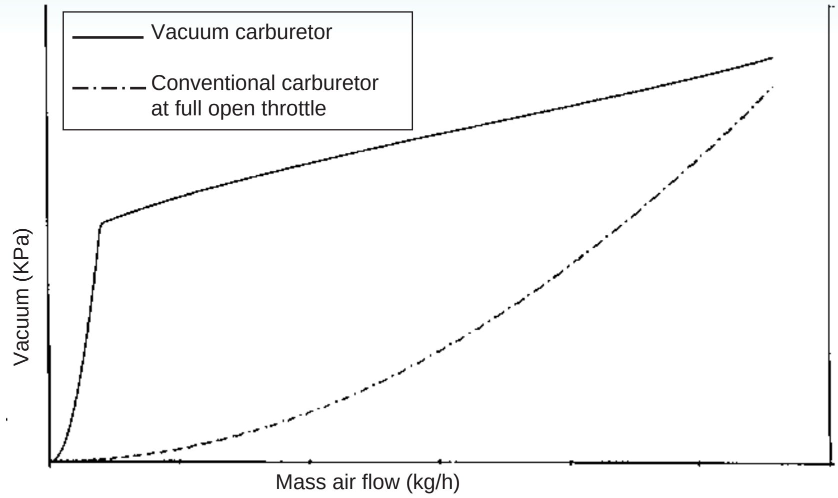


This is the area where the vacuum needed to draw fuel through the nozzle is generated. In our case the vacuum communicates with the chamber which oversees the valve through a passage.
The lower part of the chamber is exposed to atmospheric pressure because it's connected to the air intake of the carburetor.
The venturi vacuum pulls the valve towards the top by overcoming the contrast spring. This spring becomes an adjustment component, just as the diameter of the holes of the valve's vacuum intake which influence the transient response of the piston valve.
As the vacuum increases, the piston valve will be lifted higher.



Three views of the Dell'Orto vacuum carburetor: we can see the piston accelerator pump assembled in the float chamber and the automatic starting system with the compact type actuator shorter than the traditional ones.

At partial throttle and closed throttle, the vacuum under the piston valve is low and therefore the valve is lifted only slightly.
When the throttle opens wide, the speed of the inducted flow increases and the valve starts to lift proportionally.
If the throttle is suddenly wide-open, the guillotine doesn't lift equally, but follows on its own the effective progression of the engine, making it independent of the driver's action. With this device the engine is always fed always with an optimum rate of flow, because the same aspiration signal actuates the fuel circuit and modulates the



In the middle, the valve that affects the aspiration under the driver's control, while the actual inducted rate of flow is adjusted by the piston valve actuated by a barometric capsule. Below, the air intake with the section that feeds the barometric capsule on the high portion and the sprayer of the acceleration pump. Left, a comparative chart where we see the vacuum value present in the venturi (wide open) according to the airflow inducted by the engine. In the vacuum carburetor, the venturi vacuum that activates the fuel delivery circuit remains more or less constant as the flow changes, since the flow depends only on the engine speed. In a traditional carburetor, on the contrary, the vacuum is very low at small flow rates, then increases proportionally.

power.

If we wish to think of this in a simplified analytical approach, we can demonstrate that the height (h) of the valve (that we have to distinguish from the throttle) in a vacuum carburetor is dependent on just a couple of variables.

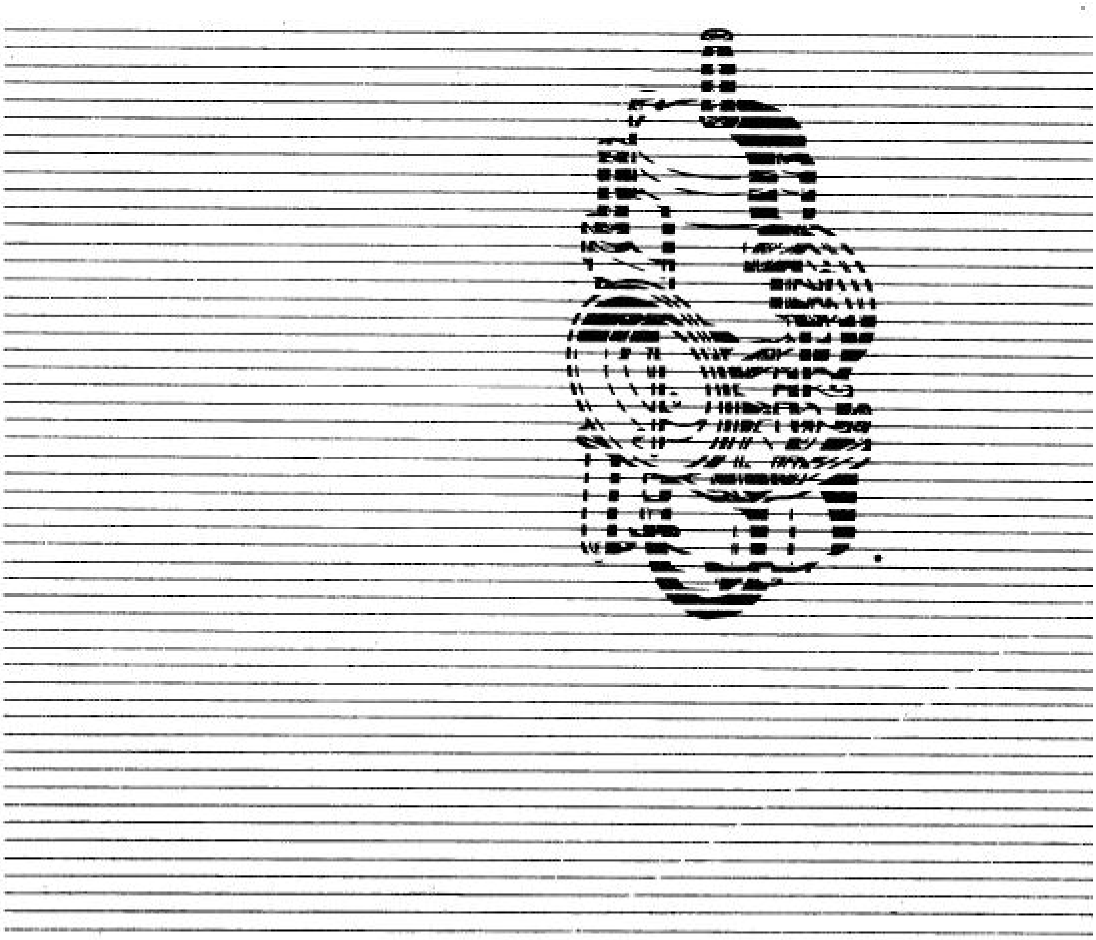
One variable is the rotation angle of the throttle (a) and the other is the engine speed (n). This means that the lifting of the valve, and therefore the action of the main circuit, is a function of the same parameters that determine the delivery in an electronic injection device (a-n).

Depending on these two parameters, the passage areas both of the air (venturi) and of the fuel (conical needle) are managed, by letting the mixture ratio change according to the operating condition.

It is then clear how the vacuum carburetor operates independently from the throttle opening set by the driver.

The fuel delivery and the air passage are not only functions of the throttle opening, but of the engine speed, while in a traditional carburetor the only control parameter is the throttle stroke and the engine speed has no effect.

DELLORTO CARBURATORI



A GUIDE TO THE CHOICE, SETTING AND USE OF TAPERED NEEDLE MOTORCYCLE CARBURETTORS

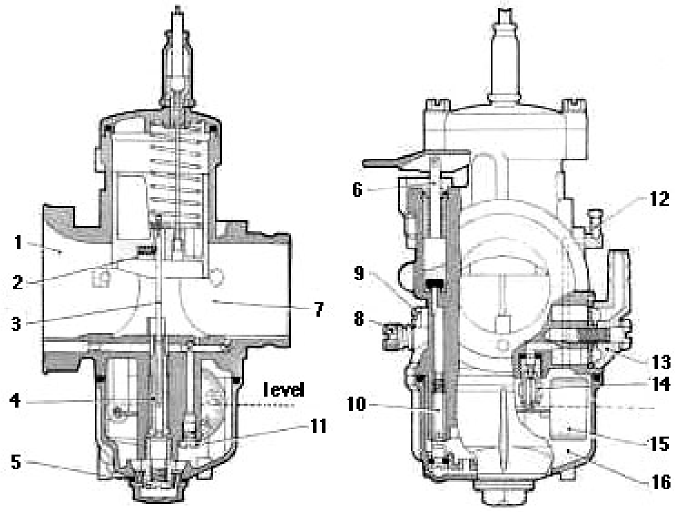
1 FUNCTIONS OF THE CARBURETTOR

The main carburettor functions are:
- To form a proper homogeneous inflammable mixture of fuel and air
- To supply the engine with varying amounts of this mixture

The fuel-air mixture is formed through vapourising and by uniformly spraying fuel into the airstream or at least by atomising it into very small droplets.
Atomisation takes place in this way: liquid fuel from the atomiser nozzle meets the flow of air which carries it, broken into very fine droplets, to the combustion chamber.
We have spoken of a "proper" mixture because the mixture strength, defined as the amount of air in weight mixed with a fuel unit of weight, must have a precise value,ie it must be within the limits of inflammability so that the mixture can be easily ignited by the spark in the combustion chamber.
lnflammmability limits for commercial petrol are: 7:1 (rich limit ie. 7 kgs of air and 1 kg of petrol), down to 20:1 (lean limit ie. 20 kgs of air and 1 kg of petrol).
To obtain optimum combustion between these inflammability limits, a value very close to the so-called stoiciometric value is needed ie. about 14.5 - 15.0 kgs of air to 1 kg of petrol.
A stoiciometric mixture ratio is one which ensures complete combustion of fuel with only the formation of water and carbon dioxide.
The stoiciometric mixture ratio depends on the kind of fuel used, so if the fuel is changed, this fuel-air ratio will also change (see SECTION 5.1).
The selection of the fuel-air ratio is therefore very important both for engine performance and for exhaust emission levels.
The throttle valve (usually a flat or piston-type gate valve, also called a slide) is the main part by which the engine is tuned ie. the engine power output is varied by controlling the amount of mixture being drawn into the cylinder.
During bench tests,the engine is usually run in top gear in two characteristic conditions: full throttle and part throttle.
The full throttle test simulates conditions for a vehicle on a progressive climb with the throttle wide open.
In the bench test, this condition is reproduced by running the engine with the throttle fully open; from this maximum horsepower condition, the engine is braked at various speeds and the specific power and consumption figures are taken.
On the test bench, this condition is simulated by running the engine again from the maximum engine power conditions, but progressively closing the throttle valve of the carburettor.
At various speeds, specific power and consumption figures are taken again.
The part throttle test simulates the conditions for vehicle on a level road at varying speeds.

2 FEATURES

2.1 CARBURETTOR DIAGRAM AND PRINCIPAL PARTS



1. air intake
2. throttle valve
3. tapered needle
4. atomiser and needlejet
5. main jet
6. starting device
7. venturi
8. idle speed adjusting-screw
9. idle mixture adjusting-screw
10. starter jet
11. idle jet
12. float chamber vent
13. fuel inlet banjo union
14. needle valve
15. float
16. float chamber

fig. 1

2.2 OPERATING RANGES. SCHEME OF PHASES WHILE RUNNING

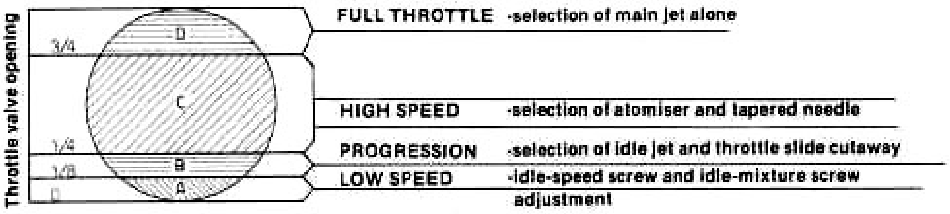


fig. 2

Figure 2 shows the section of a venturi according to the operating periods regulated by the throttle valve opening. In every phase of operation, it is possible to vary and select the optimum setting.

In the idle stage (**A**) the idle circuit and idle adjustment is set with the mixture screw and idle-speed screw.

In the (**B**) progression phase, fuel mixture delivery from the idle hole is steadily replaced by mixture delivery from the progression hole, drawing emulsion mixture from the idle circuit, and in this range, choosing the correct idle jet and throttleslide cutaway is necessary. The throttle valve cutaway slightly affects the carburation up to about half throttle.

In the (**C**) high-speed period, mixture delivery from the idle circuit and from the progression hole is replaced by mixture from the main circuit and selection of both the atomiser and the tapered needle should then be made.

In the (**D**) period of full throttle and, with all the circuits of the earlier periods operating correctly, the size of the main jet is now finally selected.

2.3 INSTALLATION ANGLES

The tapered-needle-type carburettors with concentric, central float chambers have a horizontal main barrel and can be mounted up to a maximum inclination of 40 degrees from the horizontal (**figure 3**).
For applications on motocross and trials engines, etc, this inclination should be 30 degrees or less.

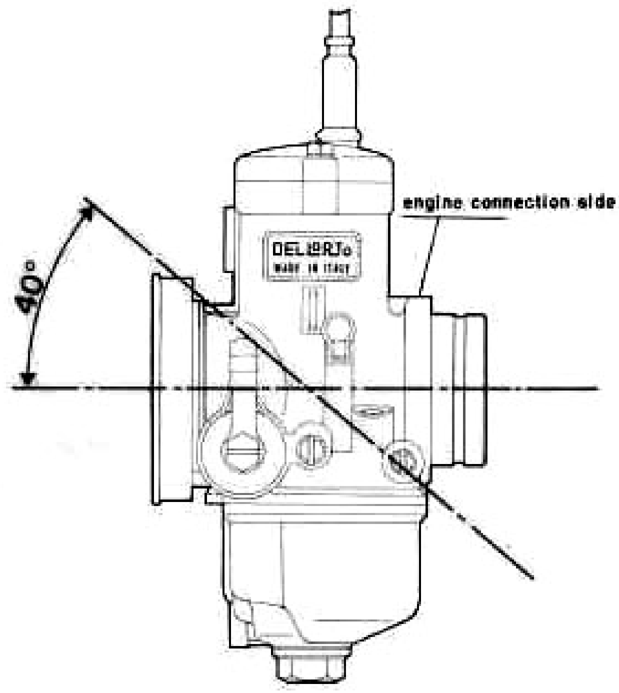


fig. 3

2.4 ENGINE CONNECTIONS

The carburettor is usually connected to the engine with one of the following:

A- male clamp fixing (**figure 4**)
used for the flexible fixing of the carburettor to the engine is usually recommended on motorcycles for motocross, trials, etc or fitted to engines which run to high rpm or those which produce strong vibrations.

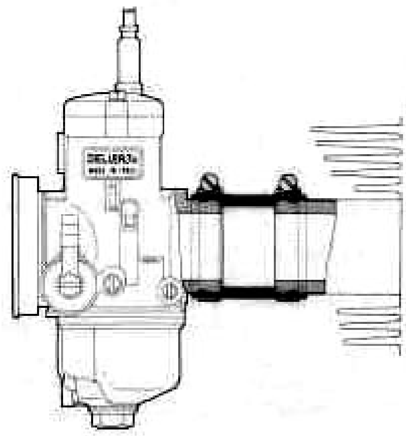


fig. 4

B- female clamp fixing (**figure 5**)
with a rigid fitting to the engine, are usable on road motorcycles or fitted to engines which do not generate very strong vibrations

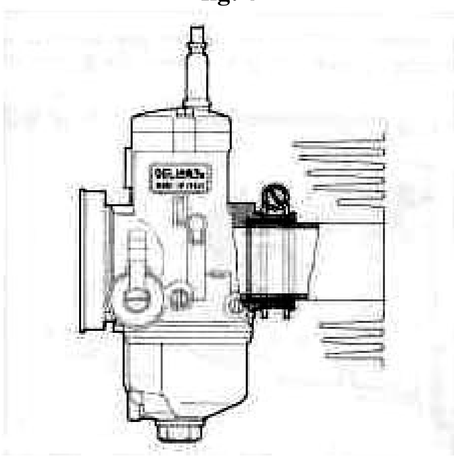


fig. 5

C-flange fixing (**figure 6**)
with a rigid fitting to the engine, are usable on road motorcycles or fitted to engines which do not generate very strong vibrations

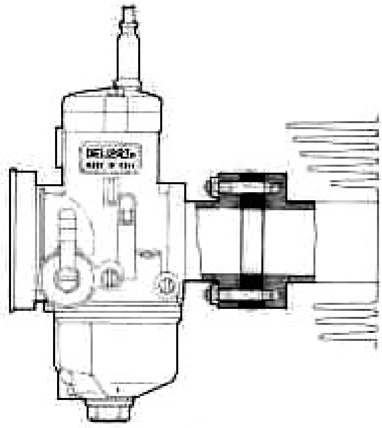


fig. 6

Note that with the female clamp fixing and the flange connection, as you can see in figure 5 and 6, there is also the need to provide both effective heat insulation and a perfect airtight seal.

2.5 AIR INTAKES

Different air intake arrangements are possible for each type of carburettor:
Open air intakes; Trumpets of various shapes and lengths; Aircleaners and filter-silencers
As far as the lengths of the trumpets is concerned, remember that short trumpets are usually used on carburettors for two-stroke engines and longer ones on carburettors for four-stroke engines.
For particular requirements, such as on some racing engines, carburettors with air intakes having a special shape are available eg PHBE H and PHM H models.
On motorcycles with simple aircleaners or air filter-silencers, it is extremely important to check on the efficiency of the filter and for perfect sealing of the filter box to prevent damage to the engine and to the carburettor.
Any change in the filter-silencer may produce a change in the carburation and consequently fresh adjustment and tuning of the carburettor may then become necessary.
Remember also that replacing the filter or silencer with a trumpet usually results in an increase in the amount of air drawn into the engine and consequently there should also be a suitable increase in the size of the main jet fitted.

2.6 CONSTRUCTION MATERIALS

The carburettor bodies are diecast in **aluminium** or **zamak** alloys.
For special weight-conscious requirements, there are some small-volume carburettors in **elektron magnesium alloy**.
All the setting parts such as the jets, atomisers, needle-valve seats, etc are made of **brass**.

3. OPERATION, SELECTION OF CORRECT PARTS, TUNING AND USE

3.1 THE VENTURI EFFECT

In the carburettor, the venturi is the part which allows the conversion of some of the kinetic energy of the air passing through into pressure energy.
Usually the choke is shaped like a tube with a converging-diverging venturi section; in the restricted section or throat, the air pressure becomes lower, causing an influx of fuel upwards through the jets and orifices.
In tapered-needle type carburettors, there is no real choke and it has become customary to call the main intake barrel the choke.
The throttle slide is fitted in the main barrel and fuel is delivered by the various circuits during the different operating periods.
It is very important that the carburettor supplies a fuel-air mixture which remains constant during the changes in throttle opening and under the different load conditions of the motorcycle engine.

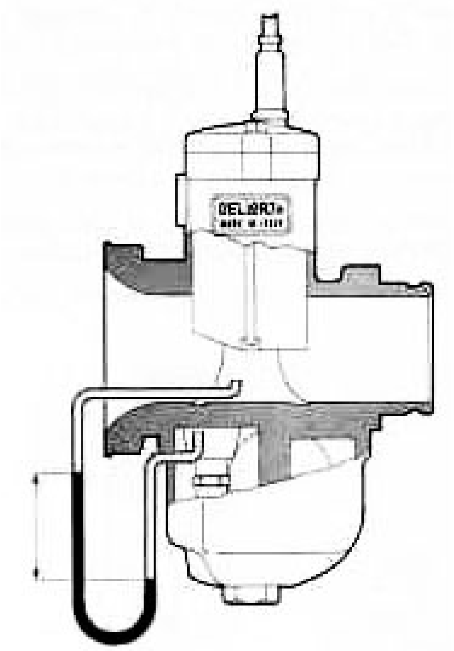
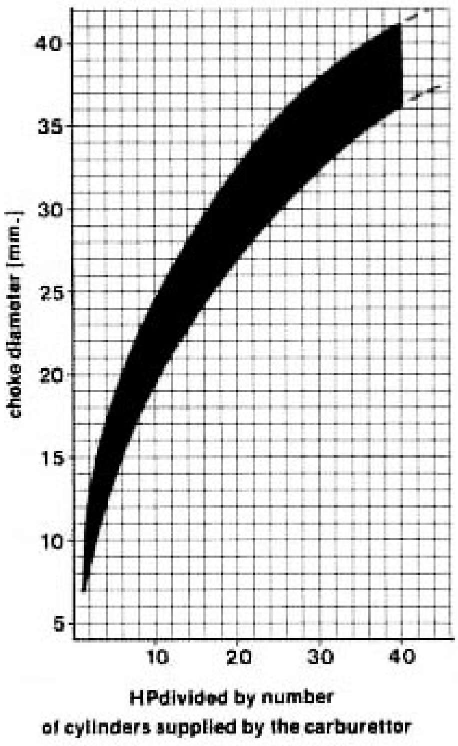


fig 7

Passage of fuel from the float chamber to the main barrel is brought about by the pressure difference existing between the float chamber and in the barrel itself; this fuel movement takes place because the float chamber is at atmospheric pressure while, as previously mentioned, the pressure is lower in the choke (**figure 7**)

3.1.1 SELECTION OF THE CORRECT CARBURETTOR CHOKE SIZE

In the tapered-needle type carburettor, the choke size is the diameter of the section immediately upstream or downstream of the throttle valve and its size is cast on the nameplate together with the model type of carburettor eg PHBE 36BS signifies a 36 mm venturi carburettor.



An initial selection of the optimum choke size can be made with the help of the graph in figure 8, where a range of possible carburettor sizes in relation to the anticipated power output per cylinder of the engine is suggested.
For example, for a two-cylinder 60 HP engine ie. 60/2=30 HP per cylinder, the suggested size range is between 32 and 38mm.

fig. 8

- a larger-size carburettor generally allows more power at high rpm ie. a higher maximum speed. However, simply fitting just a larger carburettor may not bring about the desired increase in power output as this often only follows from several additional engine modifications, each designed to improve some other aspect of the engine's performance.
- a smaller carburettor will give better pickup and therefore in selecting a choke size, you should always balance your power and acceleration requirements. — usually in conversions an increase in the carburettor size also requires an increase in the main jet size of about 10 % for each 1 mm increase in the choke size, without changing the other setting parts.
- on a modified engine, whenever you require a carburettor larger than the original, it is preferable to use one which has already been set up for a similar engine ie. an engine having the same operation (two or four stroke), a similar power output and similar cylinder displacement, in order to have a good comparable base for subsequent tuning.
- tuning of racing engines is best carried out on the racing circuit with well run-in engines which are thoroughly warmed up.

3.2 FUEL SYSTEM

First of all, ensure that, with the engine running, fuel flows continuously from the tank to the carburettor as vibrations from the engine or from the road surface could reduce fuel flow.
It is therefore advisable to use fuel taps and pipes of adequately large size.

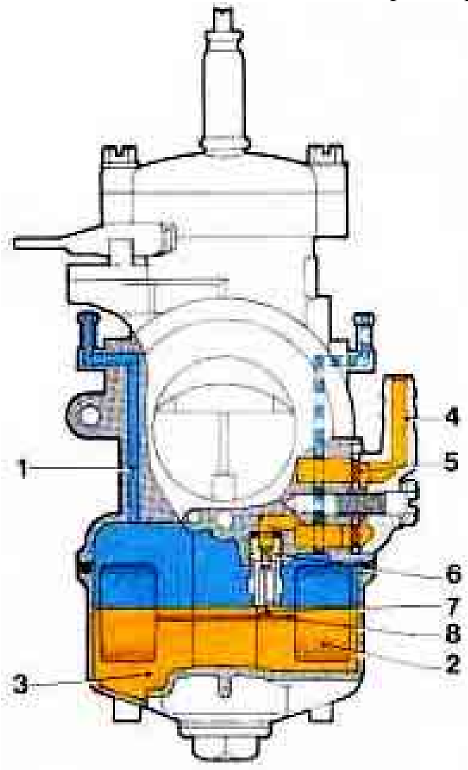


fig.9

Further, check that fuel filter (5) in the union banjo (4) of the carburettor is clean. Fuel from the tank supplies the carburettor (**fig.9**) through a valve in which a float-controlled needle operates (2).
The inlet valve has a brass valve seat inserted (6) where the needle-valve (7) regulates the entry of fuel, pushed upwards by the float by means of the float fork (8) until fuel has reached the specified level.
During engine operation, this provides a constant fuel level in the float chamber so that the distance fuel has to rise to reach the venturi from the various circuits is also constant.
It is important that this level is always constant throughout the operating range because, with a constant depression in the venturi,a rise in the float chamber level would cause an increase in fuel delivery and consequently enrich the mixture; conversely, lowering of the float level causes a weakening of the mixture.
Fuel in the float chamber (3) is always at atmospheric pressure because of the vent holes (1).

3.2.1 SELECTION OF THE NEEDLE VALVE SIZE

For a motorcycle with gravity feed from a fuel tank, the fuel inlet valve size, stamped on the seat of the needle-valve itself, should always be 30 % greater than the main jet size.
In case of malfunctioning, you may find that the needle valve size is too small when running the engine at full throttle for a long stretch and that the engine rpm falls, due to the progressive weakening of the carburation.
Conversely, you may get repeated flooding in use where the needle valve seat size is too large.
On a motorcycle where fuel is supplied to the carburettor via a fuel pump, a needle valve of smaller size than the main jet is required because the boost pressure is much greater than the pressure head obtainable with the gravity tank.
To avoid the troubles which could be caused by excessive pressure produced by the pump ie. from flooding, it is possible to fit a two-way union to the carburettor thus permitting excess fuel to return to the tank.
However, it is advisable then to insert a restrictor in the return pipe which reduces the return flow, assuring an adequate supply of fuel to the carburettor still.
Different types of needle valve are available: metal or viton-rubber-tipped, rigid or spring-loaded needle valve for different applications.
For carburettors for motocross, trials, etc, or for engines subject to strong vibrations, spring- loaded valves are required. Needle valve assemblies are supplied individually packed and tested, so it is not advisable to interchange needles and seats with other different sizes and types.

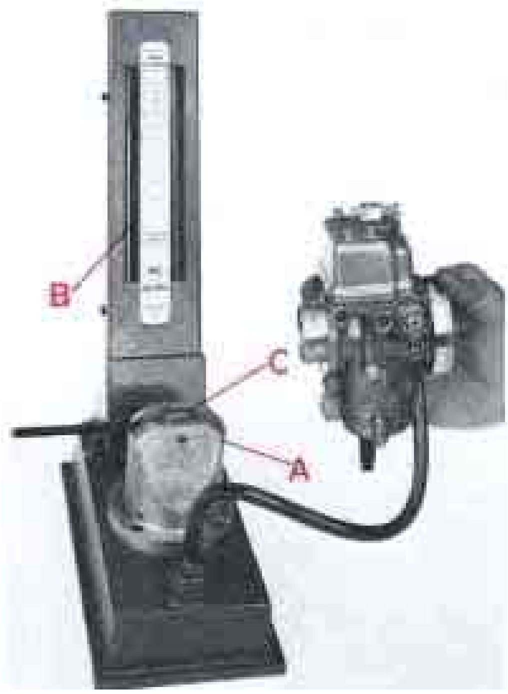


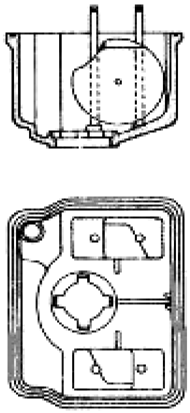
fig.10

Check the needle valves for leakage with a vacuum gauge (**fig.10**), consisting of an air pump A and a mercury manometer B.
Connect the vacuum gauge pipe and the fuel union firmly and hold the carburettor in the position shown In the picture.

After having primed the air pump of the vacuum gauge by means of the cam C, you will see the mercury in the column rising due to the action of air compressed by the pump; if the mercury column tends to go down, check the complete fuel circuit for leakage; if the fuel circuit is in good working order, the pressure leakage is due to the needle-valve and therefore check it for wear or obstruction and, if necessary, replace it with a complete new assembly of the appropriate size and type.

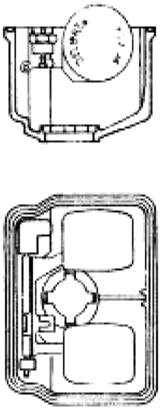
3.2.2 SELECTION OF THE FLOAT

The floats currently used are :



Dual floats connected together (**figure 11**)
In this type, the floats operate together, while in the second type they can move independently along two guides in the float chamber.

fig. 11



Floats with separate parts (**figure 12**)
This type is particularly suitable for carburettors on racing motorcycles because it maintains a constant level even in the most arduous conditions of use.

fig. 12

Both types are usually available with two different weights:
- a light float to obtain a low level (for two-stroke engines)
- a heavy float to produce a higher level (for four stroke engines)

For all floats connected together and floats with independent parts, check the weight marked on them is correct and check that the first type is free to rotate on its pivot pin and is undamaged and that the second ones move freely along their guides and that the separate float arm is undamaged and is free to rotate on its pivot pin.

Check the correct float level position as follows :

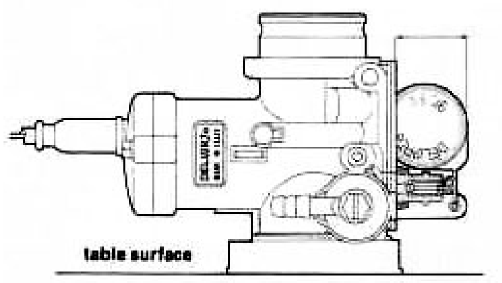


fig. 13

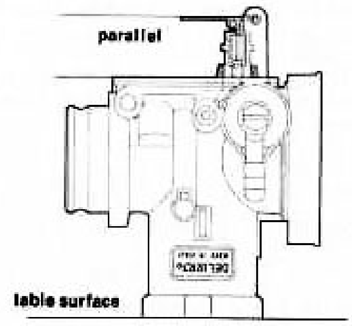


fig. 14

- for connected floats, hold the carburettor body in the position shown in **fig. 13** and check that the float is at the correct distance from the carburettor body face as specified in the table.

Carburettor	Float position (mm)
PHBG	16,5 à 15,5
PHBL	24,5 à 23,5
PHBH	
VHB/Z/T	
PHBE	18,5 à 17,5
PHF	
PHM	
PHSB	11,5 à 10,5
VHSA	
VHSB	

- for the floats with independent parts, hold the carburettor upside down (**fig. 14**) and check that the float arm is parallel to the carburettor face.

Whenever the float or float-arm position does not correspond to the proper specified level setting or is not parallel to the float chamber face, bend the float arms carefully to set the correct position.

3.3 STARTING FROM COLD

Although there are normally no difficulties starting the engine when it is hot, it is necessary to alter the carburation somewhat when the engine is cold.

When starting from cold, the carburettor has to deliver a fuel mixture rich enough to produce in the cylinders a mixture ratio very close to the stoichiometric ratio; due to the low engine temperature, a large part of the fuel does not atomise completely or condenses on the cold portions of the in let tracts and the cylinders themselves.

It should therefore be clear that, at the moment of ignition, it is the actual fuel-air ratio which reaches the cylinder that is important and not the amount of fuel, atomised or not, delivered by the carburettor.

3.3.1. Independent starting circuit

It is called independent because the starting device operates with its own circuit including a starter jet, emulsion tube and a starter valve (**fig. 15**).
Start the engine from cold with the throttle closed (7) and the starter valve (2) opened by pulling up the lever (1). If a remote cable control is fitted in stead of a lever on the carburettor, the lever should be operated fully.
Vacuum present in the barrel (8) downstream of the throttle valve (7) draws mixture to be delivered through passage (9) from the duct (4) and then it further mixes with the main airflow drawn from the intake (3). This mixture is formed by fuel metered through the starter jet (6) mixed with air from channel (10) and drawn through the emulsion tube holes (5).

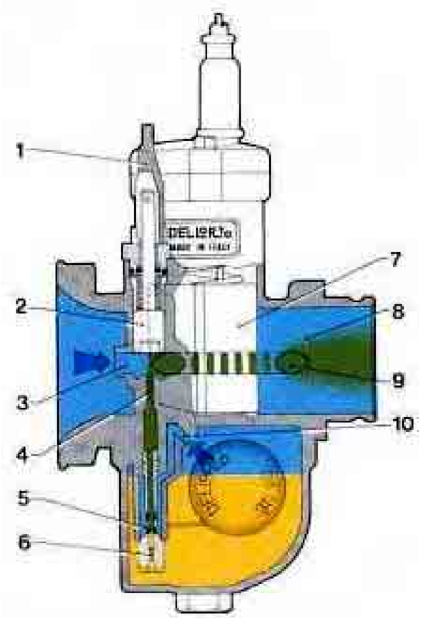


fig. 15

Figure 15 shows the mixture strength delivered through the emulsion tube depends on the size of the starter jet (6) and on the size of the air duct (10).
The channel size (4) is such that it creates an optimum vacuum in the starter valve chamber, at the emulsion tube outlet both for starting up and for the mixture required by the engine for its running and warming up. Therefore, varying the position or the size of the starter emulsion tube holes will change the amount of fuel delivered; the mixture ratio is controlled by the starter jet size and therefore a larger jet causes enrichment and vice-versa.
Difficulties in starting the engine can occur when this mixture is too rich or too lean and you can see this from the spark plugs. After some starting attempts, remove the spark plugs and, if these are wet, the mixture is too rich and you will therefore need an emulsion tube with holes higher up.
Conversely, if the spark plugs are found to be dry, the mixture is too lean and an emulsion tube with holes lower down is therefore needed.

If the engine stalls when the engine is first started from cold before it has been running for at least a minute with the starting device on, you will need to reduce the starter jet size because of an over-rich mixture or increase it if the engine stalls because of a lean mixture.
Check that the starter valve closes completely afterwards to avoid any mixture blow-by which may later disturb the carburation.
Therefore check that with the starting device off, the control lever is free to move a little on its pivot pin or that, where a remote cable control is fitted, the cable has at least 1-2 mm of free play.

3.3.2. Selection of emulsion tube and starter jet

The operation of the independent circuit starting device can be divided into two parts:
Initially when starting, during the first few turns of the crankshaft on the kick-starter or the starter motor, the device delivers a very rich mixture.

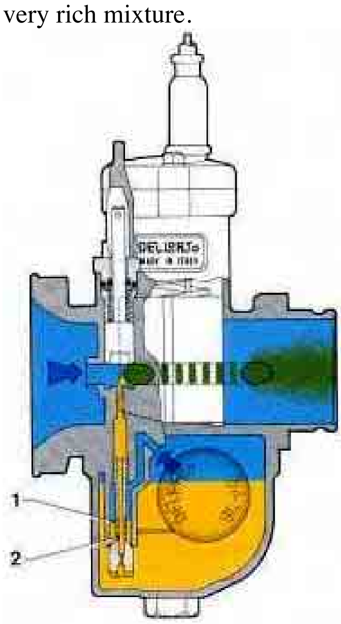


fig.16

Figure 16 shows the mixture ratio depends entirely on the variety of drillings in the emulsion tube, because air passing through holes (2) draws up fuel which is standing in the jet well (1). In this period, the mixture strength is not determined by the starter jet size but only by the amount of fuel contained in the well above the holes located below the float-chamber fuel level.
After this, a mixture leaner than previously is delivered and this mixture reaching the combustion chamber produces the first proper running of the engine.

3.3.3 - THE FLOODING-PLUNGER COLD STARTING DEVICE

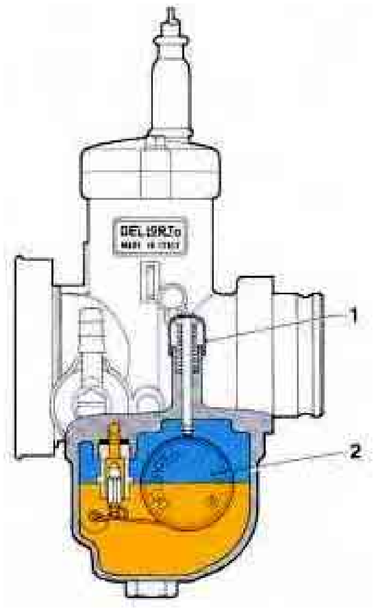


fig. 17

The starting device with a flooding plunger, or tickler, is shown in **figure 17** and uses the normal main and idle circuits.
It is composed simply of a push button (1) which, when manually operated, holds down the float (2).
This forces the fuel inlet valve open causing an influx of fuel which raises the float chamber fuel level above normal and consequently enriches the mixture. This enrichment gradually decreases as the fuel is used up and stops when the float chamber level has returned to normal.

This device requires quite a lot of care from the operator because if the chamber fuel level is raised insufficiently, the engine may not start because the mixture is still excessively weak; alternatively, if the chamber level is raised too much, the resulting over-rich mixture may also prevent the engine starting.

3.4. IDLE SYSTEMS

At idle the carburettor supplies only the mixture required to keep the engine running at very moderate rpm. The engine needs only a small amount of air when idling and the throttle slide should therefore be almost completely closed.
Upstream of the slide there is only a weak vacuum, insufficient to cause the main circuit to deliver any fuel emulsion, while downstream of the slide there is a stronger vacuum which activates the idle circuit; idle circuits are designed with either a mixture-adjusting screw or with an air adjusting screw. Check that the throttle cable has about 1 mm free play when the slide is fully closed. Always adjust the idle setting with the engine fully warm.
Screw in the idle-speed screw (4) to obtain a slightly-higher idling speed than normal (about 1200 rpm for a four-stroke engine or about 1400 rpm for a two-stroke); Then adjust the air- adjusting screw (1) to obtain the most even running.
Then unscrew the idle-speed screw again until you obtain the normal idling speed. Finally, to obtain the best engine running, it is worth rechecking by very carefully readjusting the air-adjusting screw.

3.4.1 IDLE SETTING WITH A MIXTURE-ADJUSTING SCREW

The adjusting screw meters the amount of mixture of a strength predetermined by the metering effect of the idle jet and the air corrector, and there fore on screwing in the mixture screw, idle fuel de livery decreases and vice-versa.

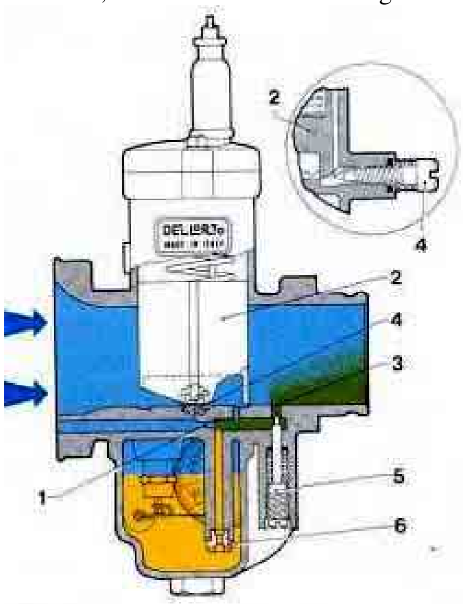
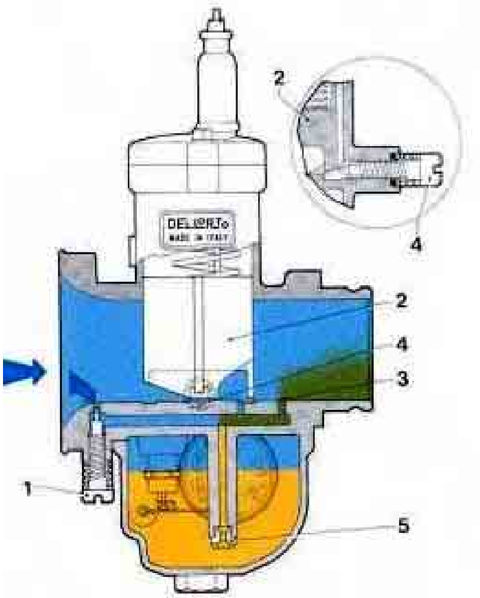


fig. 18

In **figure 18** the throttle slide 2 is shown in the idling position, adjusted by the idle speed screw (4). In this position the vacuum present down stream of the throttle valve causes mixture to be delivered via the hole (3), regulated by the tapered tip of the mixture adjusting screw.
Mixture formed from fuel metered through the idle jet (6) and air metered by the calibrated passage (1) further mixes with air regulated by the throttle slide opening.
The idle mixture adjusting-screw is always located downstream at the throttle.
Check that the throttle cable has about 1 mm of free play with the slide closed. Always adjust the idle setting with the engine fully warmed up. Proceed as follows:
Screw in the idle speed screw (4) to get a slightly- higher speed than normal (about 1200 rpm for four-stroke engines and about 1400 rpm for two- stroke engines); then screw the mixture adjusting screw (5) in or out until you obtain the most even running. Then unscrew the throttle-stop screw (4) until you get the desired idle speed again.
To obtain the best engine running, it is worth finally rechecking by carefully readjusting the idle mixture screw (5).

3.4.2 Idle Setting with an air-adjusting screw

An idle circuit with an air adjusting-screw adjusts the amount of air required to produce the mixture that the idle circuit has to supply during idling.
The air adjusting screw varies the mixture strength delivered by the idle circuit; screwing in results in a richer idle mixture and vice-versa.



In **figure 19** the throttle slide (2) is shown in the idle position adjusted by the idle-speed screw (4). In this position, the vacuum existing downstream of the throttle valve causes mixture to be delivered the hole (3).
Mixture formed from fuel metered through the idle jet (5) and air regulated by the idle air screw (1) further mixes with air metered by the throttle slide opening.
The idle air-adjusting screw is usually located up stream of the throttle slide.

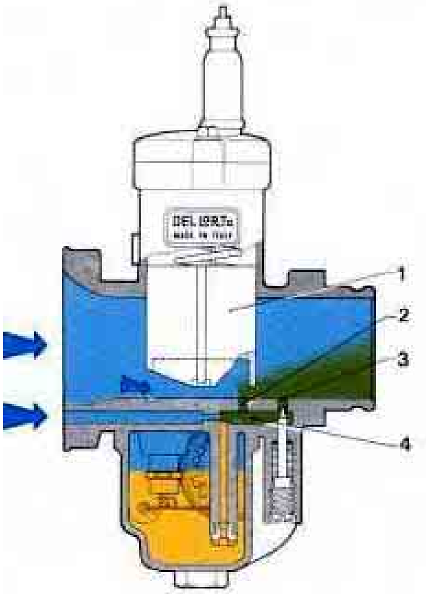
fig 19

3.4.3 - Selection of the correct size of idle jet

To select the proper size of idle jet, slowly open the throttle with the twistgrip (opening should not exceed a quarter throttle): a slow and uneven increase in rpm indicates that the idle jet is too small. This effect can also be observed when the idle mixture screw is open too much or when the idle air screw is closed too much and therefore not properly responsive to the engine's running.
If you observe smoke in the exhaust gas and a dull noise, it means that the idle jet size is too large; this can also occur when the mixture-adjusting screw is screwed in too much and oversensitive or when the air-adjusting screw is screwed out too much.
Usually with racing motorcycles, after having adjusted the idle as above, unscrew the idle- speed screw to allow the throttle to close completely so that you will obtain the maximum engine braking on closing the throttle. In this case however, do not readjust the mixture screw or air- screw setting because any further mixture screw closure or air-screw opening may cause two-stroke engines to seize on the overrun.

3.5 PROGRESSION SYSTEM

By progression we mean the transition period between mixture delivery from the idle circuit and the beginning of mixture delivery from the main jet circuit.
On first opening the throttle, the air drawn into the engine increases and therefore, in order to have an inflammable mixture still, the fuel supply must also be increased.

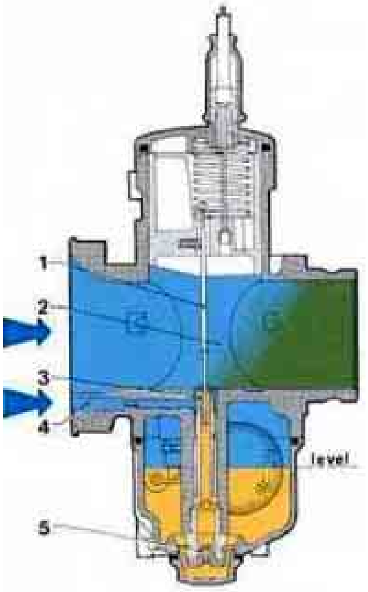


As previously noted, the idle hole(3) shown in **figure 20**, only delivers sufficient fuel for engine idle operation and the main circuit still does not deliver any fuel because of insufficient vacuum up stream of the throttle. The progression hole (2) is therefore necessary to deliver the fuel required during this transition period. The progression hole draws fuel from the idle circuit (4) and is positioned immediately upstream of the closing edge of the throttle slide (1) for the promptest response to fuel demand when the airflow suddenly increases. It is interesting to note that the progression hole serves a dual purpose: When the engine is idling, air from the main barrel passes into the progression hole and weakens the mixture flowing through the idle circuit; When the throttle is opened slightly, the idle circuit mixture flows into the main barrel through the progression hole.
The progression hole therefore first feeds air in one direction and then feeds mixture in the opposite direction.

fig. 20

3.6 FULL-THROTTLE OPERATION

Following the progression phase, on further opening of the throttle, the full-throttle circuit begins to operate. By opening the throttle valve beyond progression, a partial vacuum is created in the mixture chamber, due to the speed of the air being drawn through to the engine, and this vacuum is sufficient to cause fuel to be sucked out of the atomiser nozzle.



In this situation (**figure 21**), fuel metered by the main jet (5) and further regulated by the atomiser outlet (3) (the atomiser outlet area varies according to the position of the tapered-needle moving up and down through it) is mixed with air from channel (4) and air from the main barrel (2).
The amount of fuel which comes out in the first quarter of the throttle slide movement is determined by the throttle slide cutaway, by the size of the atomiser and by the diameter of the cylindrical part of the tapered-needle at the opening.
From here up to three-quarter throttle, it is deter mined by the atomiser-needlejet size and by the diameter of the tapered-needle at the opening.
From three-quarter throttle to full throttle the amount of fuel depends solely on the size of the main jet.

Therefore you should change the following parts to vary the full throttle circuit delivery:

- the throttle slide cutaway
- the tapered needle
- the atomiser-needlejet size and type
- the main jet

There are two different full-throttle systems; one is used on two-stroke engines and the other on four-strokes, although some special applications do not conform to this.

fig. 21

3.6.1 FULL-THROTTLE SYSTEM USUALLY USED ON TWO-STROKE ENGINES

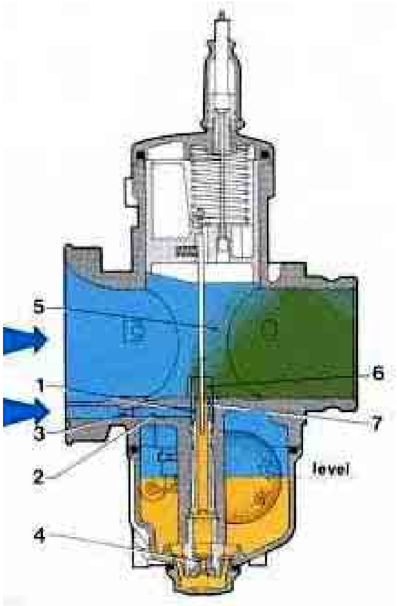


fig. 22

Figure 22 shows the full-throttle mechanism used on two-stroke engines which features an extended nozzle (6) at the end of the atomiser (7); this produces better performance during acceleration.
Air from the inlet (3) passes through channel (2) and flows into the round extension (1) formed by the upper outer end of the atomiser and by the inner part of the nozzle (6). It then mixes with fuel metered through the main jet (4) and coming from the atomiser (7) and then flows into the venturi (5).

A larger atomiser-needlejet size produces an increase in fuel delivery at all throttle positions and, conversely, a smaller size will produce a decrease in fuel delivery at all throttle openings.

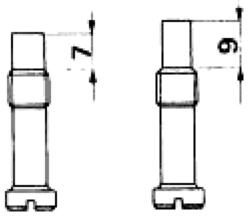


fig. 23

Usually the atomisers on carburettors intended for two-stroke engines are manufactured in two types: with either long or short upper parts (**figure 23**). The atomisers with longer upper parts cause a weakening of the mixture at low speeds and du ring acceleration from low speed; on the other hand, atomisers with shorter upper parts produce extra enrichment. Carburettors for racing motor cycles use atomisers with short upper parts.

3.6.2. FULL-THROTTLE SYSTEM AS USUALLY USED ON 4-STROKE ENGINES AND ALSO ON 2-STROKE ENGINES IN SPECIAL APPLICATIONS.

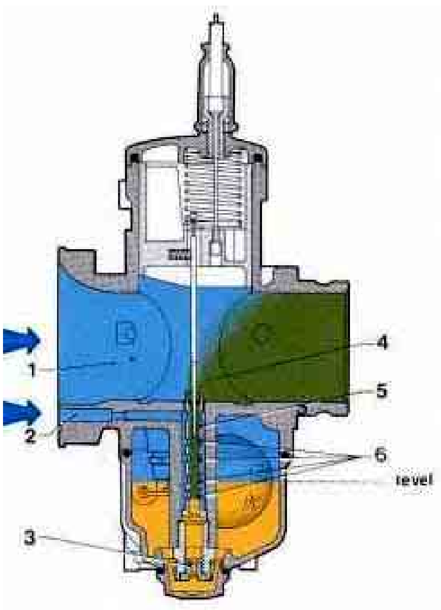


fig. 24

Figure 24 shows the full-throttle system used on four-stroke engines which utilises air to change the amount of fuel delivered by atomiser following sudden throttle openings.
There are several side holes (6) in the atomiser (5), communicating with the air intake (2). On opening the throttle fuel metered by the main jet (3) flows into the atomiser where it mixes with air drawn through the side holes of the atomiser and the resulting fuel-air emulsion flows into the barrel (4) where it further mixes with air coming from the main intake (1).

A larger internal diameter of the needlejet atomiser produces an increase in fuel delivery at all throttle valve positions while a smaller size results in a decrease in fuel delivery at all throttle valve openings.

The atomisers fitted to carburettors intended for four-stroke engines are manufactured with different types of side drillings because the positions of these holes affect acceleration response.

Atomiser holes positioned high up cause a weakening in the mixture since they are above the float chamber fuel level and only let air in; conversely, holes lower down cause mixture enrichment because they are below the chamber fuel level and draw fuel from the well to the barrel.
The result is that, to weaken the mixture under acceleration, atomisers with holes drilled higher up are required, while to enrich the mixture, atomisers with holes lower down are needed. The holes' diameter determines how long the well takes to empty and it is therefore also necessary to select a suitable size.

3.6.3. SELECTION OF THE THROTTLE VALVE CUTAWAY.

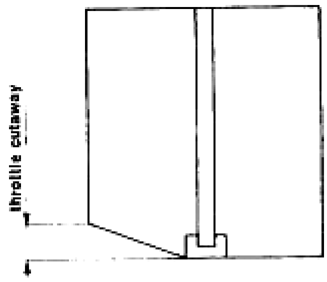


fig. 25

Following progression and on opening the throttle further up to approximately one-quarter, the partial vacuum present in the mixture chamber draws fuel up through the atomiser. In this operating phase the effective fuel passage area is determined by the atomiser-needlejet internal diameter and by the varying section of the tapered-needle moving up and down inside it. The deciding factor which regulates the air flow in this phase is the throttle valve cutaway (**figure 25**).

A small cutaway creates a greater vacuum and consequently causes a larger amount of fuel to be drawn up through the atomiser ; on the other hand, a larger cutaway would lower the vacuum and therefore reduce the fuel delivered.

Because of this, fitting a lower slide cutaway results in enrichment and vice versa.

3.6.4 SELECTION OF THE TAPERED NEEDLE

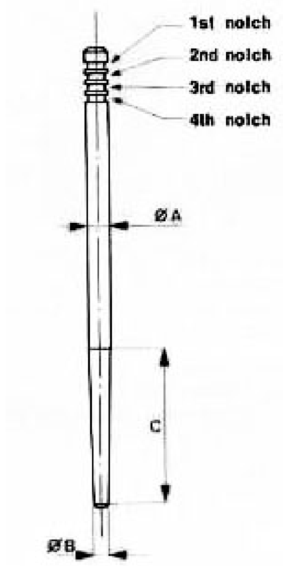


fig.26

The determining features of the tapered needles are (figure 26) :

- the diameter A of the cylindrical part
- the length C of the tapered part
- the diameter B of the tip

You should select the tapered needle considering the elements above in the complete operating range.

The cylindrical part of the needle affects the mixture strength in the first throttle valve movement, up to about a quarter throttle; therefore, in this operating phase, a reduction in the diameter of this cylindrical part produces a mixture enrichment and vice versa.

The tapered part of the needle affects the operating period between a quarter and three-quarter throttle; therefore, for any given tapered part length and cylindrical part diameter, increasing the tip diameter results in the mixture weakening and vice versa.

With the diameter of the tips and the cylindrical parts the same, an increase in the tapered part's length results in an advance of the enrichment of the mixture. By changing the notch positions, therefore, it is possible to raise or to lower the needle in order to obtain mixture enrichment or mixture weakening over the range regulated by the needle taper.

When major changes in the mixture strength are necessary, change the needle according to the elements and features mentioned above.

In most cases the tapered needle is always held pressed against the atomiser-needlejet's upper edge by a spring located in the throttle slide.

In this way, the position of the needle and the atomiser, and consequently also the fuel delivery, are maintained constant, and thus avoiding excessive wear both of the needle and the needlejet due to vibration.

3.6.5 Selection of the correct size of main jet

The correct main jet size should be selected by running on the road, preferably by first starting with an over-large size jet and gradually reducing it.
At full throttle, turn the starting device (choke) on, thus further enriching the mixture and, if this produces a worsening in engine running ie. it reduces engine rpm, it is advisable to reduce the main jet size until you finally get satisfactory operation.
Other signs revealing the main jet is too big are a very dark exhaust pipe, dark exhaust gases and damp spark plugs and an improvement in engine running when the fuel supply is temporarily shut off. In a case where too small a main jet has been fitted at first, and the running with the choke on makes a noticeable improvement, you should increase the main jet size until the conditions mentioned above occur.
In selecting the correct main jet, the engine running temperature should be taken into consideration, quite apart from increases in power and top speed, because lean mixtures cause higher running temperatures.
In a situation where a very large increase in the main jet size is required, remember that the main jet flow cross-sectional area should not exceed the effective area for fuel flow between the needlejet and the tapered-needle tip.
Check this with the following formula:

$$\left[\left(\frac{Dm}{2}\right)^2 \cdot 3{,}14\right] < \left[\left(\frac{Dp}{2}\right)^2 \cdot 3{,}14 - \left(\frac{Ds}{2}\right)^2 \cdot 3{,}14\right]$$

where :

- Dm is the main jet size
- Dp is the atomiser-needlejet size
- Ds is the tapered needle tip diameter

All measured in hundredths of a millimeter

For example:

- main jet 180
- needlejet 264
- tapered needle tip 170:

$$\left[\left(\frac{180}{2}\right)^2 \cdot 3{,}14\right] < \left[\left(\frac{264}{2}\right)^2 \cdot 3{,}14 - \left(\frac{170}{2}\right)^2 \cdot 3{,}14\right]$$

$$[90^2 \times 3{,}14] < [132^2 \times 3{,}14 - 85^2 \times 3{,}14]$$

$$[8100 \times 3{,}14] < [17420 \times 3{,}14 - 7220 \times 3{,}14]$$

$$25430 < 54700 - 22670$$

giving the result 25.430 < 32.030 ie. the needle - needlejet clearance is adequate here.

3.7 Acceleration

Every time the throttle is opened suddenly, the air speed in the barrel drops.
In two-stroke engines this does not upset good engine running, but in four-stroke engines this drop in air speed causes the atomiser to deliver insufficient fuel.
For this reason, on large-diameter carburettors for four-stroke engines, an accelerator pump enrichment device is fitted.

3.7.1 DIAPHRAGM ACCELERATOR PUMP

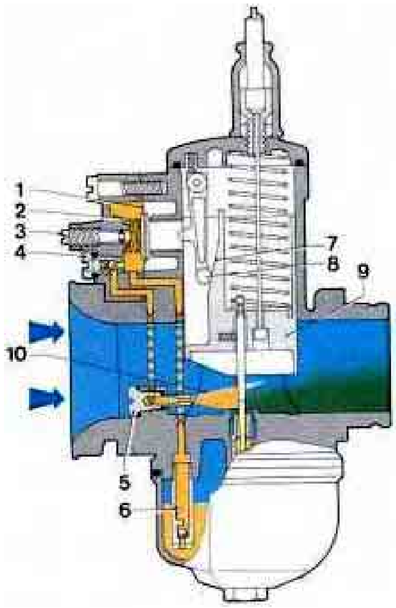


fig. 27

As shown in **figure 27**, on opening the throttle slide (9), lever (8) controlled by a special cam (7) cast into the front of of the throttle slide, acts directly on the pump diaphragm (1), I held out by the spring (2).
This diaphragm, through the delivery valve (4) and pump jet (5), pumps fuel into tne main barrel (10).
On closing the throttle, the diaphragm returns to its original position, pushed by the spring and drawing fuel up from float chamber through the inlet valve (6).
The pump injection amount can be changed by adjusting the screw (3) which controls the travel of the diaphragm and consequently the volume of fuel pumped out.
The start of pump operation is determined by the particular configuration of the cam (7) cast in the front of the slide (9).

3.7.2 SELECTION OF CORRECT PUMP JET AND SLIDE PUMP CAM

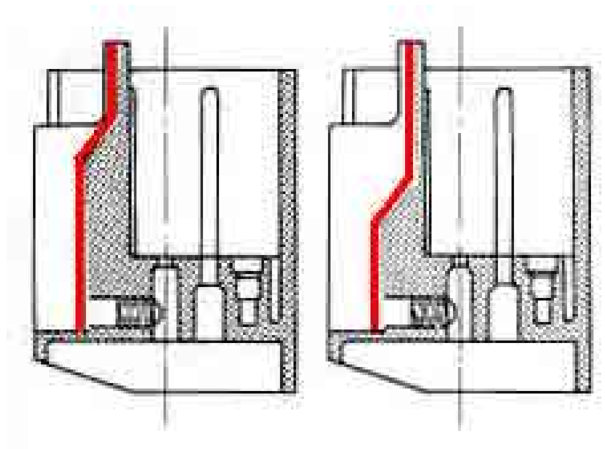


fig. 28 fig. 29

The profile of the cam in the throttle slide controls the action of the accelerator pump.
For example, cams having the operating ramp high up in the throttle valve (see **figure 28**) make the pump start to work immediately the throttle opens.
Operating ramps lower down in the slide delay the spraying action of the pump.
Having selected the cam type, to produce immediate or delayed pickup from engine idle, the pump jet size can then be chosen.
The size of pump jet selected determines the duration of fuel delivery, so the larger the pump jet used the shorter the pump spraying interval and vice versa. The quantity of fuel sprayed out has already been fixed.
Pump jet selection must be effected with the engine running with rapid full-throttle acceleration; under these circumstances the optimum jet size should allow the engine to pick up regularly and promptly, rapidly increasing engine speed in every acceleration-speed range.

3.7.3 PISTON-TYPE ACCELERATOR PUMP

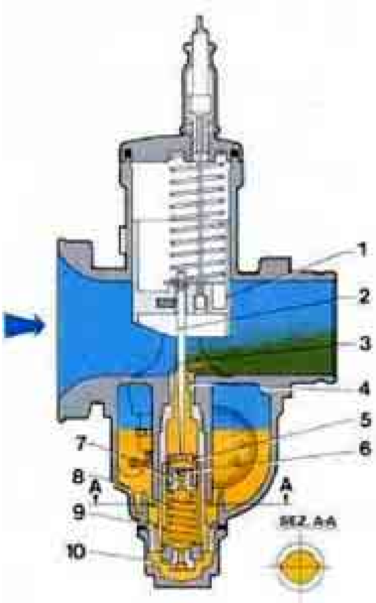


fig. 30

Figure 30 shows a simpler pump system than the one previously described, used on some other carburettor models.
As shown in the figure, on opening the throttle (1), the tapered-needle (2) integral with it, releases the piston (5) with its perforated top, which rises, pushed by the spring (8), squirting fuel through the atomiser (4) directly into the main barrel (3). In the upstroke, the ball-bearing valve (6) closes and seals the hole (7).
On the downstroke, the needle pushes the piston (5) down, compressing the spring (8), while the ball valve (6) rises, unblocking hole (7) so that more fuel can again fill the chamber which has been formed above the piston.
The length of the chamber where the piston (5) moves, determines the amount of fuel which is pumped up into the main barrel (3).
The pump action is also affected by the length of the grooves (9) machined in the internal walls of the cylindrical chamber, where the pump piston moves (see figure 30).
When the throttle slide stops moving in any open position, the piston (5) also stops, stopping the pump action; the carburettor therefore then works in the usual way. Fuel, which rises continuously from the float chamber by the normal partial- vacuum action and flows first through the main jet (10) and then up into the atomiser-needlejet (4) to tlg. 30 the main barrel (3), keeps the ball valve (6) open.

4. MULTI-CYLINDER ENGINES

Supplying fuel mixture to multi-cylinder engines usually involves fitting one carburettor to each cylinder. This is because high-performance motorcycle engines have camshaft timing which would up set the carburation provided by just a single carburettor.
This does not happen with less sophisticated engines and, in these cases, it is possible to provide an efficient fuel supply to one or more cylinders with only a single carburettor.
Depending on the particular engine layout, installation of carburettors on multi-cylinder engines is generally accomplished in two ways:

- with carburettors **separated** (**figure 31**) and the refore with a throttle cable each.
- with carburettors **mounted together** in a rigid group by means of a suitable flange (**figure 32**) and with a single control cable.

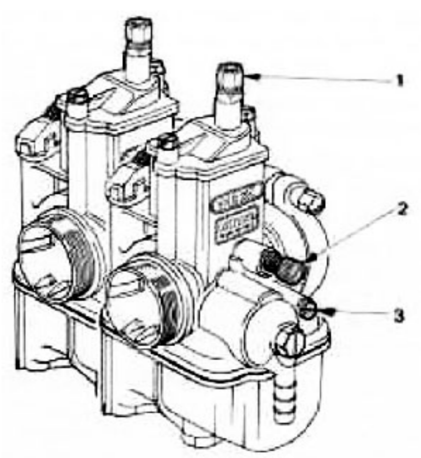


fig. 31

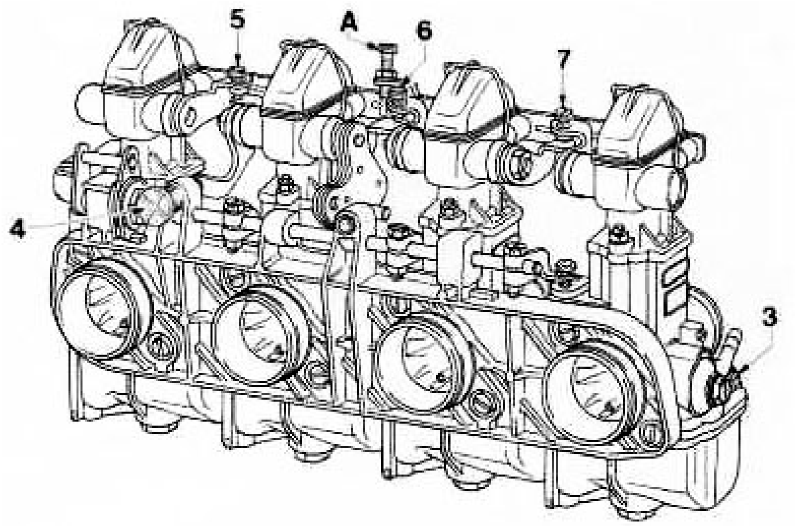


fig. 32

All the adjustment procedures for multiple carburettors are the same as those described for single carburettors.

4.1 - IDLE TUNING AND ADJUSTMENT

Idle adjustments on a multi-cylinder engine with several carburettors should be carried out with a mercury manometer having a column for each carburettor.
Make sure, both for independent (**figure 31**) and grouped carburettors (**figure 32**), that each throttle cable has about 1mm free play at idle.
Now you can adjust the idle as follows :

- Connect each barrel to the mercury manometer, taking off the blanking plugs provided on the vacuum intakes and fitting instead the proper vacuum connectors. If a compensator is fitted, dismantle it and connect the compensator connections to the mercury manometer.
- Unscrew each idle mixture screw (3) about two turns from the fully-closed position.
- Start the engine and when it has reached normal running temperature, adjust the idle speed to about 1000 rpm using the throttle adjusting screw (2) in **figure 31** or screw (4) in figure 32.
- Or independent carburettors (**figure 31**) align the mercury column levels using the throttle adjusting screws (2) on each carburettor.
- For carburettors mounted together in a group (**figure 32**) align the mercury column levels with the level of the carburettor connected directly to the throttle control, adjusting the balance- adjusting screws (5), (6), (7).
- Then adjust the mixture screws (3) of each carburettor to obtain the fastest even running.
- Recheck the alignment of the mercury columns and then reset the engine to the desired idle speed using the throttle adjusting screw (2) in figure 31 or screw (4) in figure 32.
- For independent carburettors (**figure 31**) check that the alignment of the mercury columns is unaffected by slightly opening the throttle. If it is, adjust the individual cable-adjuster screws (1) to correct this.
- Finally, disconnect the manometer unions and refit the blanking plugs or the compensator piping.

Where the carburettor group has been dismantled for servicing, some approximate synchronisation will be helpful before reassembling; see that all the slides are opened 1mm and that the idle mixture screws are opened two turns from the fully-closed positions.
The throttle valve opening securing-screw (A) should be adjusted is such a way that it allows full opening of the throttle slides up to a maximum of 1mm beyond complete clearance of each carburettor barrel.

5. FACTORS WHICH CAN AFFECT CARBURATION

In some cases, carburation which has been properly set up in particular conditions can then be upset by certain factors ie.

- a change of fuel used
- a change in atmospheric pressure
- a change in air temperature

5.1 CHANGE OF FUEL

When a different fuel other than commercial petrol is used, it is necessary to estimate theoretically the new stoiciometric mixture ratio and consequently change all the jet sizes to suit.
If the stoiciometric mixture ratio decreases, larger jets are required and vice versa. Any such changes should,.of course, be made on a percentage basis ie. when the stoiciometric ratio in creases by a certain percentage, the jet sizes should be reduced by that percentage.
For example, if commercial petrol (stoiciometric ratio 14.5) is replaced by methyl alcohol (methanol, with chemical formula CH_3OH - stoiciometric ratio 6.5) the jet sizes should be increased by about 50 % ie. double the flow rate. If fuel consisting of 25% petrol and 75% methanol is used, jet sizes should all be increased by 30 % with fuel composed of 50 % petrol and 50 % methanol, the jet sizes need only be increased by 18% compared to when using straight petrol.
You should also replace the needlevalves, increasing the seat sizes accordingly.
When using special fuels such as methanol, it is very important that all the component materials of the carburettors have been treated, wherever necessary, to resist chemical attack. For example, nylon components should be removed, and replaced by other parts resistant to the new fuel.

5.2 CHANGES IN ATMOSPHERIC PRESSURE AND IN AIR TEMPERATURE

Variations in pressure or temperature cause a change in the air density and consequently a change in the fuel-air ratio and further tuning may therefore become necessary.
A decrease in atmospheric pressure with consequent decrease in air density causes a mixture enrichment and smaller jets will therefore be required.
Altitude variations also produce changes in the carburation and they too cause changes in the air density; prolonged use of a vehicle at an altitude higher than 1500 metres, the carburation of which was originally set up for operation at around sea level, would require a change of jet sizes in proportion to the pressure change.
In this case too, a decrease in pressure should be compensated by a reduction of the jet sizes. Furthermore, a lowering of air temperature produces an increase in air density and consequently a mixture weakening; therefore an increase in the jet sizes is required.
Summarising, we can say that any decrease in air pressure, any increase in altitude or in air temperature should be compensated for by a decrease in the jet sizes.
Conversely, any increase in pressure or any decrease in altitude or in temperature should be compensated by an increase in the jet sizes.

CARBURATEURS POUR MOTO GUZZI

Moto		Carburateur			Réglages															
Type	Cyl.	Type		Montage	Diffuseur	Boisseau	Aiguille		Cran	Puits d'aiguille		Emuls. ralenti	Gicleur principal	Gicleur ralenti	Gicleur starter	Gicleur pompe	Pointeau	Flotteur	Poids	Puiss. de pompe
V850 T5 /83	850	**VHBT 30 CS/CD**	03742/43	-	30	07454 40	07455 09	V	2	07878 265	-	-	01486 130	01486 50	07746 80	-	09436 200	07450 01	10,0 gr.	-
V35 Imola II /84	350	**PHBH 28 BS/BD**	03389/90	A-G-H-I-L-S-V-Y	28	09374 30	09477 24	X	2	10575 262	CE	-	06413 112	01486 45	07746 60	-	09436 200	09010 01	9,5 gr.	-
V65 Lario /84	643	**PHBH 30 BS/BD**	03391/92	A-G-H-I-L-S-V-Y	30	09374 40	09477 08	X	2	07972 268	T	-	06413 110	01486 38	07746 60	-	09436 200	09010 01	9,5 gr.	-
1000 SP II /84	948	**VHBT 30 CS/CD**	03747/48	-	30	07454 40	07455 09	V	2	07878 265	-	-	01486 125	01486 50	07746 80	-	09436 200	07450 01	10,0 gr.	-
T5 /84	850	**PHF 30 DS/DD**	04621/22	A-D-G-I-O-U	30	11570 503	08530 23	K	3	08540 264	AB	-	06413 130	01486 50	07746 75	07851 38	08649 250	07450 01	8,5 gr.	-
1000 LM IV /84	950	**PHM 40 NS/ND**	04879/80	A-B-C-D-E-F-G	40	11790 605	08530 19	K	3	08540 268	AB	-	06413 145	01486 57	07746 60	07851 35	08649 300	07450 01	8,5 gr.	5
V75 /85	744	**PHBH 30 BS/BD**	03424/25	A-G-H-I-L-S-T-Y	30	09374 40	09477 08	X	3	07972 268	T	-	06413 105	01486 38	07746 60	-	09436 200	09010 01	9,5 gr.	-
V35 "Custom" /85	350	**PHBH 28 BS/BD**	03443/44	A-G-H-I-L-S-V-Y	28	09374 30	09477 19	X	2	10575 262	CE	-	06413 112	01486 42	07746 60	-	09436 200	09010 01	9,5 gr.	-
V65 Florida /86	643	**PHBH 30 BS/BD**	03457/58	A-G-H-I-L-S-T-Y	30	09374 40	09477 08	X	2	07972 268	T	-	06413 105	01486 38	07746 60	-	09436 200	09010 01	9,5 gr.	-
V35 NTX /86	350	**PHBH 28 BS/BD**	03468/69	A-G-I-L-S-V-Y	28	09374 30	09477 19	X	2	13102 262	EH	-	06413 112	01486 42	07746 60	-	09436 200	09010 01	9,5 gr.	-
V65 NTX /86	643	**PHBH 30 BS/BD**	03470/71	A-G-I-L-S-U-Y	30	09374 40	09477 08	X	2	07972 268	T	-	06413 100	01486 38	07746 60	-	09436 200	09010 01	9,5 gr.	-
1000 SP II /86	1000	**PHF 30 DS/DD**	04661/62	A-D-G-I-O-U	30	11570 503	08530 23	K	3	08540 264	AB	-	06413 125	01486 50	07746 75	07851 38	08649 250	07450 01	8,5 gr.	2
1000 California II /86	1000	**PHF 30 DS/DD**	04663/64	A-B-G-I-N-U	30	11570 503	08530 23	K	3	08540 264	AB	-	06413 125	01486 50	07746 75	07851 38	08649 250	07450 01	8,5 gr.	2
1000 California III /86	1000	**PHF 30 DS/DD**	04667/68	A-C-G-I-O-U	30	11570 503	08530 23	K	3	08540 264	AB	-	06413 125	01486 50	07746 75	07851 38	08649 250	07450 01	8,5 gr.	2
V75 /87	748	**PHBH 30 BS/BD**	03485/86	A-G-H-I-L-S-T-Y	30	09374 45	09477 08	X	3	07972 268	T	-	06413 105	01486 38	07746 60	-	09436 200	09010 01	9,5 gr.	-
V65 Florida /87	643	**PHBH 30 BS/BD**	03488/89	A-G-I-L-S-T-Y	30	09374 45	09477 08	X	3	07972 268	T	-	06413 105	01486 38	07746 60	-	09436 200	09010 01	9,5 gr.	-
1000 California III 1000 GT SP II /88	949	**PHF 30 DS/DD**	04674/75	A-D-I-N-V	30	10352 503	08530 27	K	2	11860 261	AB1	09980 2	06413 135	01486 48	07746 75	07851 38	08649 250	07450 01	8,5 gr.	8
1000 SP III /88	948	**PHF 36 DS/DD**	04676/77	A-D-I-G-N-U	36	11570 603	08530 18	K	3	09593 268	AR	-	06413 130	01486 50	07746 70	07851 33	08649 300	07450 01	8,5 gr.	8
1000 LM C.I. /88	1000	**PHM 40 NS/ND**	04895/96	A-B-C-D-E-F-G	40	11790 605	08530 19	K	3	08540 268	AB	-	06413 145	01486 57	07746 60	07851 35	08641 300	07450 01	8,5 gr.	5

Tableau issu de : http://www.swmeuropa.com/dellorto/technique/reglages/index.html
SWM Europa
Rue des Ailes Volantes
43320 CHASPUZAC (FRANCE)
Tél: +33 (0)4 71 08 03 08
Fax: +33 (0)4 71 08 03 00

COTES DES AIGUILLES DE CARBURATEUR DELL'ORTO

Tableaux issus du site http://www.swmeuropa.com

SWM Europa
Rue des Ailes Volantes
43320 CHASPUZAC (FRANCE)
Tél: +33 (0)4 71 08 03 08
Fax: +33 (0)4 71 08 03 00
hughes.caro@swmeuropa.com

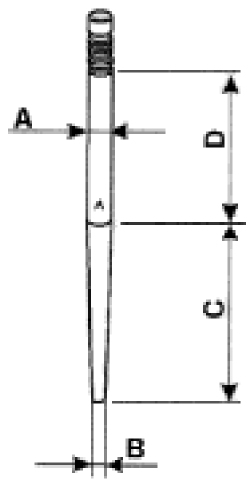
Avec corrections issues du site http://www.dellorto.co.uk/
Certaines erreurs peuvent subsister : merci de prévenir Sergio (california@free.fr)

RÉF: 13680 ..

CES AIGUILLES SONT UTILISÉES POUR LES CARBURATEURS PHVA ET PHBN

AIGUILLES A

Type	Valeurs en mm			
	Ø A	Ø B	C	D
A2	2,00	0,60	20,00	12,00
A7	2,00	1,00	18,00	14,00
A8	2,00	1,00	20,00	12,00
A10	2,02	0,60	18,00	14,00
A11	2,02	0,60	20,00	12,00
A12	2,00	1,79	20,00	12,00
A13	2,00	1,79	22,00	10,00
A14	2,02	1,00	18,00	14,00
A15	1,98	1,77	20,00	12,00
A18	2,04	0,61	21,90	10,07
A19	1,98	1,77	20,30	11,70
A20	2,00	1,60	20,00	12,00
A21	1,99	1,79	18,10	13,80
A22	2,00	1,80	20,00	12,00
A23	1,98	1,00	18,00	14,00
A24	1,99	1,00	20,00	12,00
A25	2,02	1,40	20,00	12,00
A26	2,00	1,90	20,00	12,00
A27	1,98	1,80	20,00	12,00
A28	1,99	1,80	20,00	12,00
A29	2,02	1,20	20,00	12,00
A30	1,99	1,40	20,00	12,00
A31	1,98	1,40	20,00	12,00
A32	1,98	1,70	20,00	12,00
A33	2,00	1,00	21,00	11,00

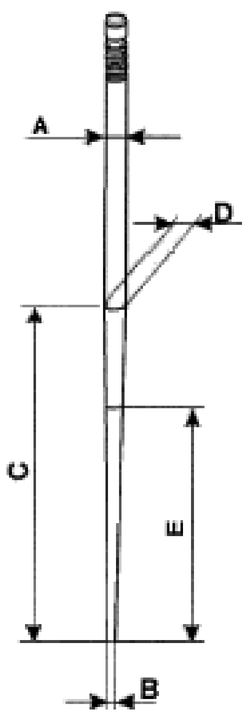


RÉF: 02265 ..

CES AIGUILLES SONT UTILISÉES POUR LES CARBURATEURS PHBL

AIGUILLES D

Type	Valeurs en mm				
	Ø A	Ø B	C	Ø D	E
D1	2,45	1,50	15,40	-	-
D3	2,42	1,50	14,00	-	-
D21	2,50	1,80	20,20	-	-
D22	2,50	1,40	18,00	-	-
D23	2,46	1,00	22,00	-	-
D24	2,50	0,60	20,00	-	-
D25	2,50	1,40	16,00	-	-
D26	2,50	1,40	20,00	-	-
D27	2,50	1,80	16,00	-	-
D28	2,50	1,80	18,00	-	-
D29	2,50	1,80	20,00	-	-
D30	2,50	0,60	18,00	-	-
D31	2,50	0,60	22,00	-	-
D32	2,50	1,00	18,00	-	-
D33	2,50	1,00	20,00	-	-
D34	2,50	1,00	22,00	-	-
D35	2,46	1,40	18,00	-	-
D36	2,50	1,40	22,00	-	-
D37	2,50	1,40	24,00	-	-
D40	2,48	1,00	24,00	-	-
D41	2,52	1,00	24,50	-	-
D42	2,46	0,60	24,00	2,295	18,00
D43	2,50	0,60	26,00	2,227	18,00
D44	2,48	1,60	24,00	-	-
D45	2,50	0,60	26,00	2,227	18,00
D46	2,50	1,00	24,00	-	-



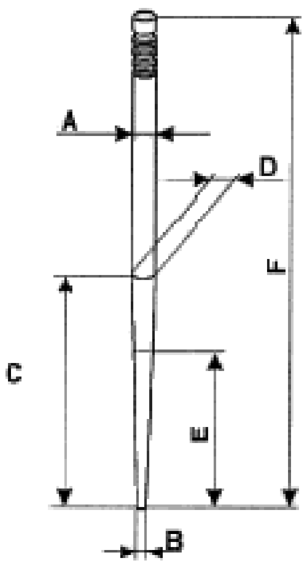
D45 .... en aluminium anodisé

RÉF: 02343 ..

CES AIGUILLES SONT UTILISÉES POUR LES CARBURATEURS VHBZ ET PHSA

AIGUILLES E

Type	Valeurs en mm					
	Ø A	Ø B	C	Ø D	E	F
E1	2,45	2,00	19,00	-	-	65,00
E2	2,42	1,30	20,00	-	-	65,00
E3	2,50	1,30	23,00	-	-	65,00
E4	2,45	1,30	22,00	-	-	65,00
E5	2,43	1,30	21,50	-	-	65,00
E6	2,42	2,00	18,00	-	-	65,00
E7	2,40	2,00	17,00	-	-	65,00
E8	2,50	0,50	23,00	-	-	65,00
E9	2,50	0,50	20,00	-	-	62,00
E10	2,45	0,50	19,50	-	-	62,00
E11	2,42	0,50	19,20	-	-	62,00
E12	2,45	1,25	19,20	-	-	62,00
E13	2,50	1,30	25,00	-	-	65,00
E14	2,45	0,50	21,50	-	-	62,00
E15	2,43	1,30	22,50	-	-	65,00
E16	2,45	0,50	22,50	-	-	65,00
E17	2,45	1,70	20,00	-	-	65,00
E18	2,50	1,30	26,00	-	-	65,00
E19	2,42	1,00	21,00	-	-	65,00
E20	2,45	1,70	17,00	-	-	62,00
E22	2,42	1,70	17,00	-	-	65,00
E23	2,45	1,70	17,00	-	-	65,00
E24	2,45	1,70	21,50	2,13	18,00	65,00
E25	2,45	0,75	19,00	2,15	18,00	65,00
E26	2,45	1,25	18,00	-	-	65,00
E27	2,42	1,25	18,00	-	-	65,00
E28	2,45	0,75	22,00	-	-	65,00
E29	2,48	1,25	23,00	-	-	65,00
E30	2,40	1,90	17,00	-	-	65,00
E31	2,42	1,50	18,00	-	-	65,00
E32	2,45	1,00	21,00	-	-	65,00
E33	2,50	1,70	21,00	-	-	65,00
E34	2,42	0,75	21,00	-	-	65,00
E35	2,42	0,75	18,00	-	-	65,00
E36	2,45	1,60	24,50	-	-	70,00
E37	2,45	1,50	17,00	-	-	65,00
E38	2,50	1,00	24,00	-	-	65,00
E39	2,50	0,95	25,00	-	-	65,00
E40	2,42	1,25	24,00	-	-	65,00
E41	2,45	1,50	32,00	-	-	65,00
E42	2,50	1,50	18,00	-	-	65,00
E43	2,45	1,25	20,00	-	-	65,00
E51	2,45	1,50	20,00	-	-	65,00
E52	2,50	1,70	29,00	2,19	13,00	65,00

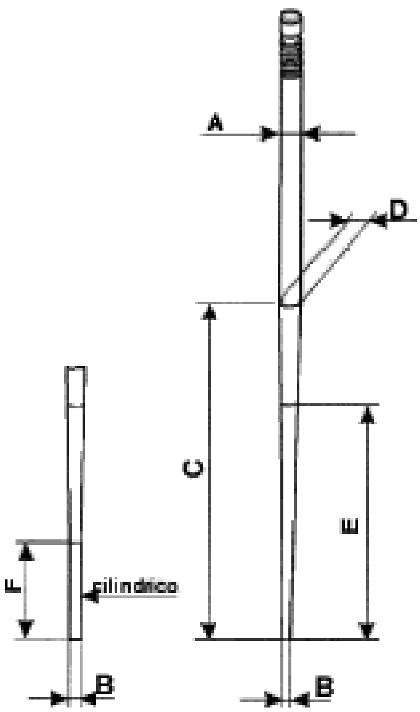


RÉF: 08530 ..

CES AIGUILLES SONT UTILISÉES POUR LES CARBURATEURS PHBE, PHF, PHM, PHSB ET VHSB

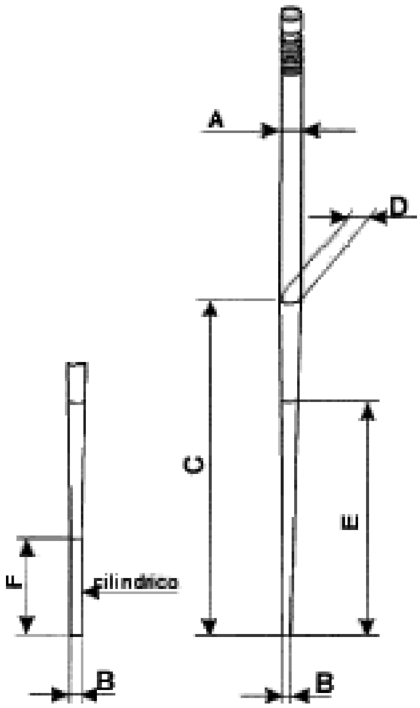
<u>AIGUILLES K</u>

Type	Valeurs en mm					
	Ø A	Ø B	C	Ø D	E	F
K1	2,45	1,75	37,00	-	-	-
K2	2,45	1,75	42,00	-	-	-
K3	2,50	1,50	39,00	-	-	-
K4	2,45	1,50	39,00	-	-	-
K5	2,45	1,50	37,00	-	-	-
K6	2,45	1,75	39,00	-	-	-
K7	2,45	1,25	39,00	-	-	-
K8	2,50	1,50	37,00	-	-	-
K9	2,45	1,50	42,00	-	-	-
K11	2,50	1,25	39,00	-	-	-
K12	2,48	1,75	32,00	-	-	-
K13	2,45	1,25	38,00	-	-	-
K14	2,48	1,75	33,00	-	-	-
K15	2,50	0,60	36,00	-	-	-
K16	2,50	1,75	39,00	-	-	-
K17	2,42	1,75	40,00	-	-	-
K18	2,50	1,40	38,00	-	-	-
K19	2,50	1,40	40,00	-	-	-
K20	2,50	1,40	42,00	-	-	-
K21	2,50	1,80	38,00	-	-	-
K22	2,50	1,80	40,00	-	-	-
K23	2,50	1,80	42,00	-	-	-
K24	2,50	1,20	38,00	2,13	18,00	-
K25	2,50	1,00	36,00	2,15	18,00	-
K27	2,50	1,80	44,00	-	-	-
K28	2,50	1,80	41,00	-	-	-
K29	2,45	1,25	42,00	-	-	-
K30	2,50	1,40	36,00	2,15	18,00	-
K31	2,45	1,50	36,00	-	-	-
K32	2,48	1,70	44,00	-	-	-
K33	2,50	1,80	44,00	-	-	-
K34	2,50	1,40	40,00	2,11	18,00	-
K35	2,50	1,40	43,00	-	-	-
K36	2,50	1,40	38,00	2,17	20,00	-
K37	2,50	1,40	39,00	2,12	18,00	-
K38	2,50	1,40	38,00	2,13	18,00	-
K39	2,48	1,45	36,00	2,28	26,00	-
K40	2,50	1,40	40,00	2,18	22,00	-
K41	2,50	1,40	40,00	2,14	22,00	-
K42	2,50	1,40	38,00	2,16	22,00	-
K43	2,50	1,40	42,00	2,16	26,00	-
K44	2,50	1,40	39,00	2,06	20,00	-
K45	2,48	1,30	36,00	2,28	26,00	-
K46	2,50	1,40	40,00	2,15	20,00	-
K48	2,48	1,60	36,00	2,25	25,00	11,00
K49	2,50	1,40	39,00	2,20	26,00	-
K50	2,50	1,40	39,00	2,27	26,00	-
K51	2,52	1,40	43,00	-	-	-
K52	2,50	1,60	36,00	2,25	25,00	11,00
K53	2,52	1,60	36,00	2,25	25,00	11,00
K54	2,48	1,50	40,00	2,108	18,00	-



K33 .... en aluminium anodisé

Type	Valeurs en mm					
	Ø A	Ø B	C	Ø D	E	F
K56	2,50	1,20	38,00	2,17	20,00	-
K58	2,46	1,60	36,00	2,25	25,00	11,00
K59	2,50	1,40	39,00	2,23	24,00	-
K60	2,46	1,60	39,00	2,13	25,00	11,00
K61	2,44	1,60	39,00	2,13	25,00	11,00
K62	2,48	1,60	39,00	2,13	25,00	11,00
K63	2,46	1,60	39,00	2,10	25,00	11,00
K65	2,46	1,60	39,00	2,16	25,00	11,00
K66	2,44	1,60	39,00	2,16	25,00	11,00
K67	2,44	1,60	39,00	2,10	25,00	11,00
K68	2,42	1,60	39,00	2,07	25,00	11,00
K69	2,48	1,60	39,00	2,10	25,00	11,00
K70	2,42	1,60	39,00	2,04	25,00	11,00
K71	2,44	1,60	39,00	2,07	25,00	11,00
K72	2,50	1,20	38,00	2,20	22,00	-
K75	2,50	0,60	38,00	2,00	18,00	-
K76	2,46	1,55	39,00	2,10	25,00	11,00
K77	2,46	1,60	39,00	2,07	25,00	11,00
K78	2,48	1,60	39,00	2,07	25,00	11,00
K79	2,48	1,60	36,00	2,07	25,00	11,00
K80	2,40	1,60	39,00	-	-	-
K81	2,44	1,55	39,00	2,07	25,00	11,00
K82	2,48	1,55	39,00	2,10	25,00	11,00
K83	2,44	1,55	39,00	2,04	25,00	11,00
K84	2,48	1,50	39,00	2,10	25,00	11,00
K86	2,46	1,50	39,00	2,07	25,00	11,00
K87	2,48	1,45	39,00	2,10	25,00	11,00
K88	2,56	1,43	32,40	2,12	16,20	-
K89	2,48	1,50	39,00	2,07	25,00	11,00
K90	2,50	1,75	42,00	-	-	-
K91	2,47	1,40	39,00	2,27	26,00	-
K92	2,50	1,60	38,00	-	-	-
K93	2,50	1,60	40,00	-	-	-
K94	2,50	1,65	38,00	-	-	-
K95	2,50	1,65	40,00	-	-	-

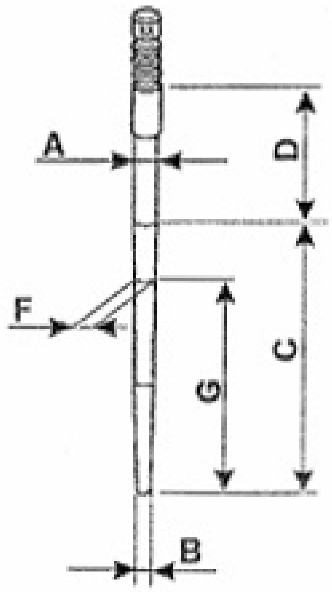


RÉF: 15377 ..

CES AIGUILLES SONT UTILISÉES POUR LES CARBURATEURS PHVB

AIGUILLES M

Type	Valeurs en mm					
	Ø A	Ø B	C	D	Ø F	G
M1	2,00	1,10	19,50	19,90	-	-
M2	2,02	1,10	26,00	13,40	1,97	20,00
M3	2,02	1,10	20,50	18,90	-	-
M4	2,02	1,10	21,50	17,90	-	-
M5	2,00	0,60	19,50	19,90	-	-
M6	2,02	1,10	22,50	16,90	-	-
M7	2,02	0,60	23,00	16,40	1,97	21,00

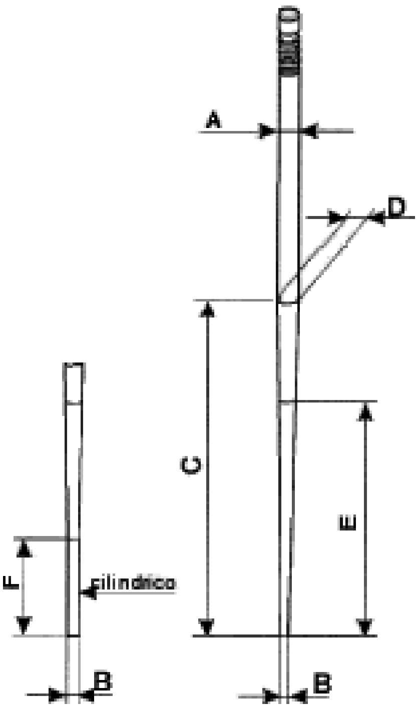


RÉF: 09713 ..

CES AIGUILLES SONT UTILISÉES POUR LES CARBURATEURS PHBE.... P-VHSA

AIGUILLES U

Type	Valeurs en mm				
	Ø A	Ø B	C	Ø D	E
U1	2,46	1,40	40,00	-	-
U2	2,50	1,80	40,00	-	-
U3	2,50	1,40	34,00	-	-
U4	2,50	1,40	38,00	-	-
U5	2,50	1,40	40,00	-	-
U6	2,50	1,40	42,00	-	-
U7	2,50	1,80	38,00	-	-
U8	2,50	1,80	42,00	-	-
U9	2,48	1,00	28,00	2,16	18,00
U10	2,50	1,00	30,00	2,06	18,00
U11	2,50	1,00	28,00	2,11	16,00
U12	2,50	1,40	32,00	-	-
U13	2,45	1,20	28,00	-	-
U14	2,48	0,60	28,00	2,23	18,00
U15	2,50	1,20	32,00	-	-
U16	2,50	1,80	32,00	-	-
U17	2,50	0,60	36,00	-	-
U18	2,48	1,00	34,00	-	-
U19	2,44	1,00	32,50	-	-
U20	2,44	1,00	34,50	-	-
U21	2,44	1,00	36,00	-	-
U22	2,50	1,00	36,50	-	-
U23	2,46	1,00	36,50	-	-
U24	2,46	1,00	34,00	-	-
U25	2,48	1,00	36,50	-	-

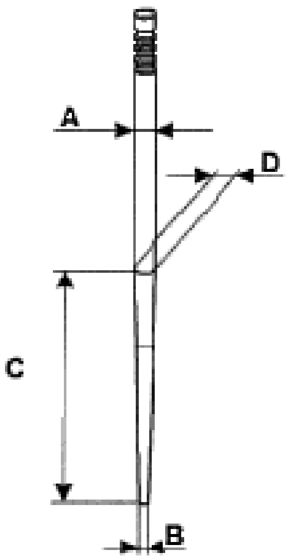


RÉF: 09595 ..

CES AIGUILLES SONT UTILISÉES POUR LES CARBURATEURS PHBG

AIGUILLES W

Type	Valeurs en mm		
	Ø A	Ø B	C
W1	2,46	0,60	24,00
W2	2,46	0,60	22,00
W3	2,48	1,40	20,00
W4	2,48	1,40	18,00
W5	2,46	1,40	18,00
W6	2,50	1,00	24,00
W7	2,50	1,40	18,00
W8	2,50	1,40	16,00
W9	2,50	1,40	20,00
W10	2,50	1,80	16,00
W11	2,50	1,80	18,00
W12	2,50	1,80	20,00
W13	2,50	0,60	22,00
W14	2,50	0,60	24,00
W15	2,50	0,60	26,00
W16	2,50	1,00	22,00
W17	2,50	1,00	26,00
W18	2,48	0,60	24,00
W19	2,50	1,80	20,00
W20	2,50	1,60	24,00
W21	2,50	1,60	24,00
W22	2,50	0,60	26,00
W23	2,50	0,60	26,00
W24	2,50	1,80	24,00
W25	2,50	1,80	22,00



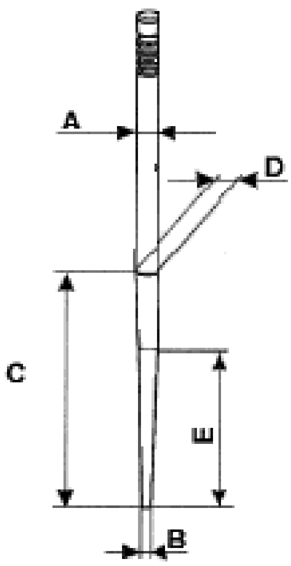
W15, W19, W21, W22 .... en aluminium anodisé
W22 .... Idem W15 mais longueur de 42,6 mm

RÉF: 09477 ..

CES AIGUILLES SONT UTILISÉES POUR LES CARBURATEURS PHBH

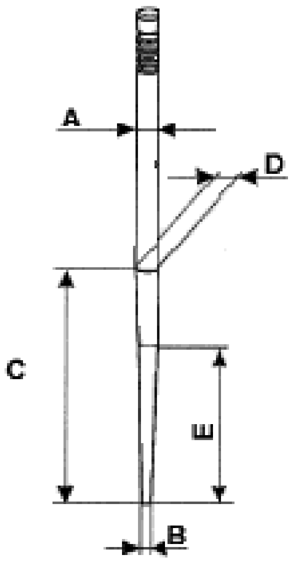
AIGUILLES X

Type	Valeurs en mm				
	Ø A	Ø B	C	Ø D	E
X1	2,48	1,20	26,00	-	-
X2	2,50	1,80	24,00	-	-
X3	2,46	1,60	22,00	-	-
X4	2,48	1,80	20,00	-	-
X5	2,46	1,80	24,00	-	-
X6	2,50	1,20	26,00	-	-
X7	2,50	1,80	20,00	-	-
X8	2,50	1,40	26,00	-	-
X9	2,50	1,40	18,00	-	-
X10	2,50	1,40	20,00	-	-
X11	2,50	1,40	22,00	-	-
X12	2,50	1,80	18,00	-	-
X13	2,50	1,80	22,00	-	-
X14	2,50	0,80	24,00	-	-
X15	2,50	0,80	26,00	-	-
X16	2,50	0,80	28,00	-	-
X17	2,50	1,20	24,00	-	-
X18	2,50	1,20	28,00	-	-
X19	2,48	1,00	28,00	-	-
X20	2,42	1,00	22,00	-	-
X21	2,50	1,00	20,00	-	-
X22	2,48	1,20	28,50	-	-
X23	2,46	1,20	26,00	-	-
X24	2,50	1,00	30,00	-	-
X25	2,50	1,80	25,00	-	-
X27	2,48	1,40	20,00	-	-
X28	2,50	1,20	26,00	2,38	20,00
X29	2,50	0,60	30,00	-	-
X30	2,50	1,00	28,00	2,30	20,00
X31	2,48	1,20	28,00	-	-
X32	2,48	1,80	24,00	-	-
X33	2,50	1,00	32,00	-	-
X34	2,48	1,20	29,00	2,34	15,00
X35	2,48	0,80	26,00	2,32	20,00
X36	2,53	0,60	30,00	-	-
X37	2,53	0,60	30,00	-	-
X38	2,48	1,20	28,00	2,28	20,00
X39	2,50	0,80	26,00	2,33	20,00
X40	2,50	0,80	27,00	2,33	24,00
X41	2,48	1,00	29,00	2,43	27,00
X42	2,53	0,65	29,25	-	-
X43	2,50	0,80	24,00	2,38	18,00
X44	2,46	1,80	22,00	-	-
X45	2,48	0,80	24,50	2,30	18,00
X46	2,50	1,20	23,00	-	-
X47	2,50	1,80	30,00	2,35	15,00
X48	2,47	1,80	29,00	-	-
X49	2,50	1,20	22,00	-	-
X50	2,50	1,20	25,00	-	-
X51	2,50	1,20	24,00	2,37	18,00
X52	2,52	0,98	29,46	-	-



X37 .... idem X36 mais longueur 56,2 mm

Type	Valeurs en mm				
	Ø A	Ø B	C	Ø D	E
X53	2,53	0,60	28,00	2,40	24,00
X55	2,51	0,98	29,25	-	-
X56	2,50	0,80	26,00	2,36	22,00
X57	2,50	0,98	29,05	-	-
X58	2,50	0,60	30,00	-	-
X59	2,50	1,00	21,00	-	-
X60	2,54	1,00	28,00	-	-
X61	2,46	1,80	20,00	-	-
X62	2,50	1,00	30,00	2,31	22,00
X63	2,50	1,20	27,00	-	-
X64	2,50	1,30	30,00	2,31	22,00
X65	2,52	1,00	34,00	-	-
X66	2,53	0,98	29,65	-	-
X67	2,52	1,00	32,00	-	-
X49	2,50	1,20	22,00	-	-
X68	2,45	1,80	28,14	-	-
X69	2,52	0,98	29,46	-	-
X70	2,52	0,65	29,09	-	-
X71	2,48	1,00	29,00	-	-
X72	2,52	1,02	29,55	-	-
X73	2,52	1,02	29,55	-	-
X74	2,52	1,60	30,00	-	-
X75	2,52	1,60	29,00	-	-
X76	2,52	1,60	29,36	-	-
X77	2,48	0,80	26,00	-	-
X78	2,52	1,11	29,22	-	-
X79	2,51	1,01	28,17	-	-
X80	2,50	1,20	26,00	-	-
X81	2,48	1,00	24,00	-	-
X82	2,53	0,98	29,46	-	-
X83	2,53	0,98	28,86	-	-
X84	2,52	0,98	29,46	-	-
X85	2,48	1,00	32,00	-	-
X86	2,50	1,60	29,00	-	-
X87	2,54	1,40	30,00	-	-
X88	2,50	1,20	28,00	-	-



X58, X69, X72..en aluminium anodisé

DELL'ORTO CARBURATORI

features and tunings of some parts of the new range of carburettors

DELL'ORTO PH.... CARBURETTORS

type	choke ⌀	engine connection	air intake
PHBG....A	15-16-17-18-19-20	• ⌀ 24 - 26	⌀ 32 - M 32x1,25
PHBG....B		● ⌀ 25	
PHBL....A	21-22-23-24-25	• ⌀ 28,57 - 31,75	⌀ 38 - M 38x1,25
PHBL....B		● ⌀ 31	
PHBH....A	26-27-28-29-30	• ⌀ 35 - 37 - 40	⌀ 42 - M 42x1,25
PHBH....B		● ⌀ 38	

• clip fitting ● flexible fitting

PHBG...

PHBL...

PHBH...

PHBE...

type	choke ⌀	engine connection	air intake
PHBE....A	30-32-34-36	• ⌀ 42 - 45	M 48x1,25
PHBE....B	30-32-34-36	● ⌀ 44	⌀ 48 - M 48x1,25
PHBE....H	30-32-34-36	● ⌀ 44	⌀ 64
PHBE....P	30-32-34-36	● ⌀ 40	⌀ 64

• clip fitting ● flexible fitting

type	choke ⌀	engine connection	air intake
PHF....A	30-32-34-36	* ⌀ 42 - 45	M 48x1,25
PHF....B	30-32-34-36	● ⌀ 44	⌀ 46,5 - M 48x1,25

* clip fitting ● flexible fitting

PHF...

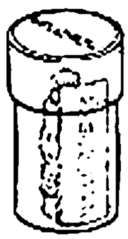
PHM...

type	choke ⌀	engine connection	air intake	pump
PHM....B	38-40	* ⌀ 45 - 48	M 52x1,25	yes
PHM....E	38-40	● ⌀ 46	M 52x1,25	no
PHM....H	38-40-41	● ⌀ 46	⌀ 64 - 83	no
PHM....N	36-40	● ⌀ 46	M 52x1,25	yes

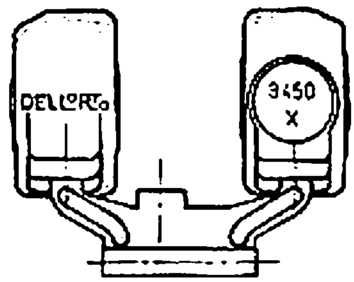
* clip fitting ● flexible fitting

NEEDLE VALVES

carburettor	code No.	x value (seat ø) (measured in hundredths of a mm.)
PHBL-PHBH	9436 x 33	200
PHBE-PHF-PHM	8649 x 33	250-270-300
PHF	8982 x 33	420



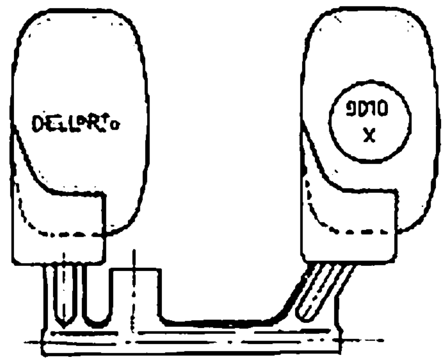
9436 x 33
8649 x 33
8982 x 33



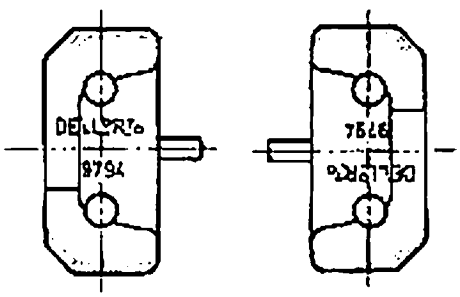
9450 x 80

FLOATS

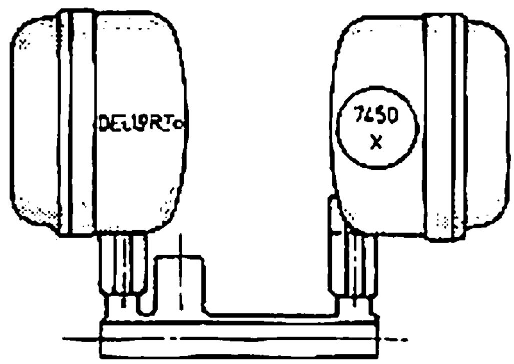
carburettor	code No.	weight (gr.)
PHBG	9450.01.80 9450.02.80	4 5
PHBL-PHBH	9010.01.80 9010.02.80	11 8
PHBE-PHF-PHM	7450.01.80 7450.02.80	10 14
PHBE-PHM	n. 2 9794.01.80	3.5



9010 x 80



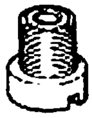
9794 x 80



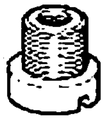
7450 x 80

JETS

1488 x 02

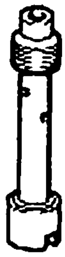


1486 x 02

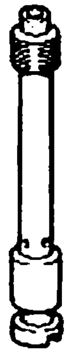


6413 x 02

7851 x 02



9501 x 02



7746 x 02

code No.	carburettor	x value (measured in hundredths of a mm.)
1488 x 02	PHBG	30-32-35-38-40-42-45-48 50-52-55-60-65-70
1486 x 02	PHBG-PHBL PHBH-PHBE PHF-PHM	35-38-40-42-45-48-50 52-55 185-188-190
6413 x 02	PHBL-PHBH PHBE-PHF PHM	70-72-75-78-80-82-85 88-90 .... 192-195-198-200 205-210 .... 290-295-300 310-320-330
7851 x 02	PHF-PHM	30-33-35-38-40-42-45 48-50-55-60
9501 x 02	PHBG	35-40-45-50-55-60-65-70
7746 x 02	PHBL-PHBH PHBE-PHF PHM	45-50-55-60-65-70-75 80-85-90-100-110-120

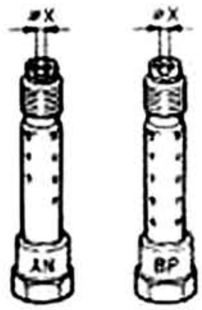
ATOMIZERS

2 stroke engines | 4- and 2-stroke engines

PHBG carburettors

code No.	type	x value measured in hundredths of a mm.
9654 x 28	AV	258-260-262-264-266
9511 x 28	AN	258-260-262-264-266
10245 x 28	BP	258-260-262

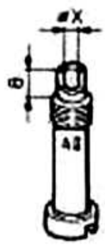
9654 x 28



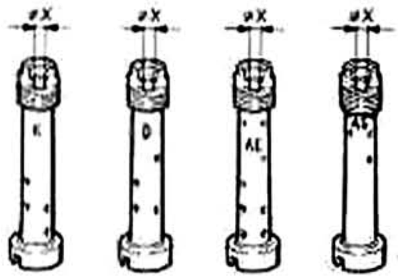
9511 x 28 10245 x 28

PHBL carburettors

code No.	type	x value measured in hundredths of a mm.
9564 x 28	AQ	260-262-264-266-268
8358 x 28	K	266-268-270
8566 x 28	D	268-268-270
8935 x 28	AE	266-268-270
9143 x 28	AG	260



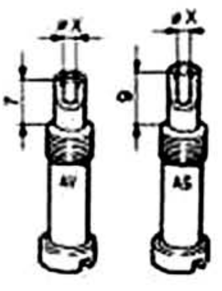
9564 x 28



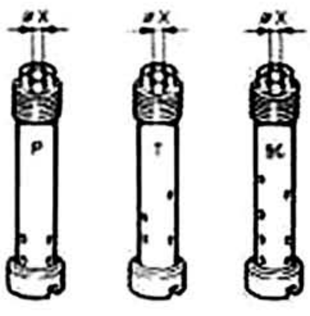
8358 x 28 8566 x 28 8935 x 28 9143 x 28

PHBH carburettors

code No.	type	x value measured in hundredths of a mm.
9695 x 28	AV	264-266-268-270
9423 x 28	AS	260-266-270
7790 x 28	P	266-268-270
7972 x 28	T	260-262-264-266-268-270
9979 x 28	BC	262



9695 x 28 9423 x 28

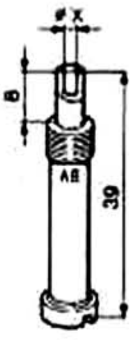


7790 x 28 7972 x 28 9979 x 28

PHBE – PHF – PHM carburettors

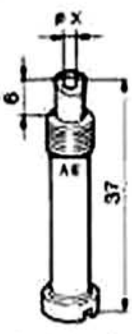
code No.	type	x value measured in hundredths of a mm.
8540 x 28	AB	260-262-265-268-270 272-275
8979 x 28	AF	330-340-350-360
9593 x 28	AR	260-262-265-270

2- and 4-stroke engines



8540 x 28

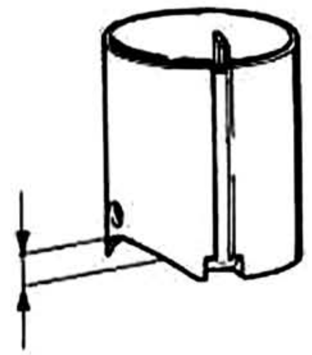
8979 x 28



9593 x 28

THROTTLE SLIDES

carburettor	code No.	x value measured in tenths of a mm.
PHBG	9475 x 64	30-40-50-60
PHBL	9645 x 64	30-40-50-60
PHBH	9374 x 64	30-40-50-60-70
PHBE	9309 x 64	40-50-60-70

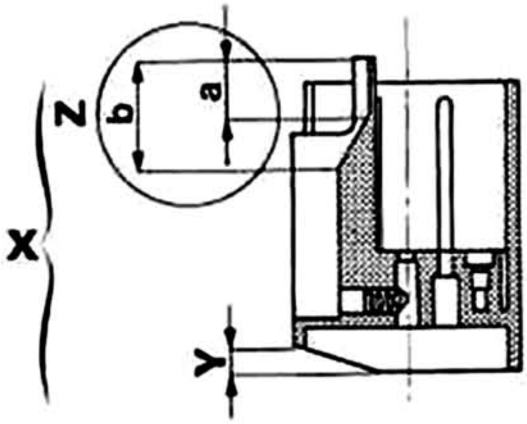


THROTTLE SLIDES FOR PHF AND PHM CARBURETTORS

Throttle slides for PHF carburettors have the part-number 8553 x 64 produced in different sizes (X) – 401-402-501-503-601-602-603-604-701-702.

Throttle slides for PHM carburettors have the part-number 8639 x 64 produced in different sizes (X) – 401-501-503-601-603-605-701.

These sizes are marked 40/1, 40/2, etc. on the lower part of the throttle valve castings.



As you can see from the figure, the size value, 501, 601, etc., of these slides is formed by two elements Y and Z.

Y represents the cutaway size and Z in a symbol which is similar for both PHF and PHM slides and which determines the position and the variation of the pump operating cam.

The values of Z are:

z values	a	b
1	10	20
2	13	23
3	2	30
4	13	26
5	2	20

A throttle slide 8553.602.64 is therefore for a PHF carburettor and has a 60 cutaway (60 mm) and with a pump control cam with the start of operation at 13 mm (dimension a) and the end of the pump action at 23 mm (dimension b).