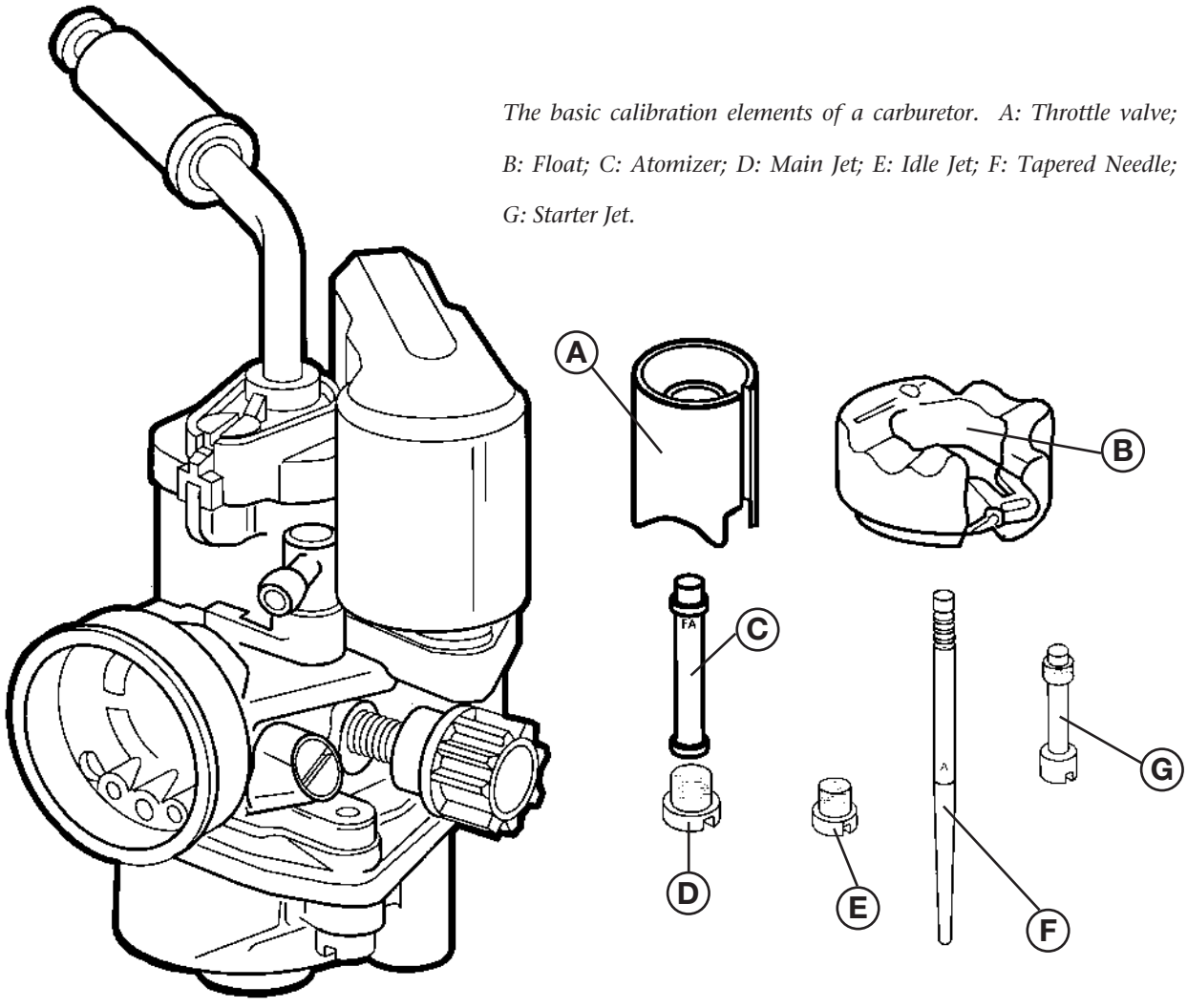
THE MAIN CIRCUIT

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

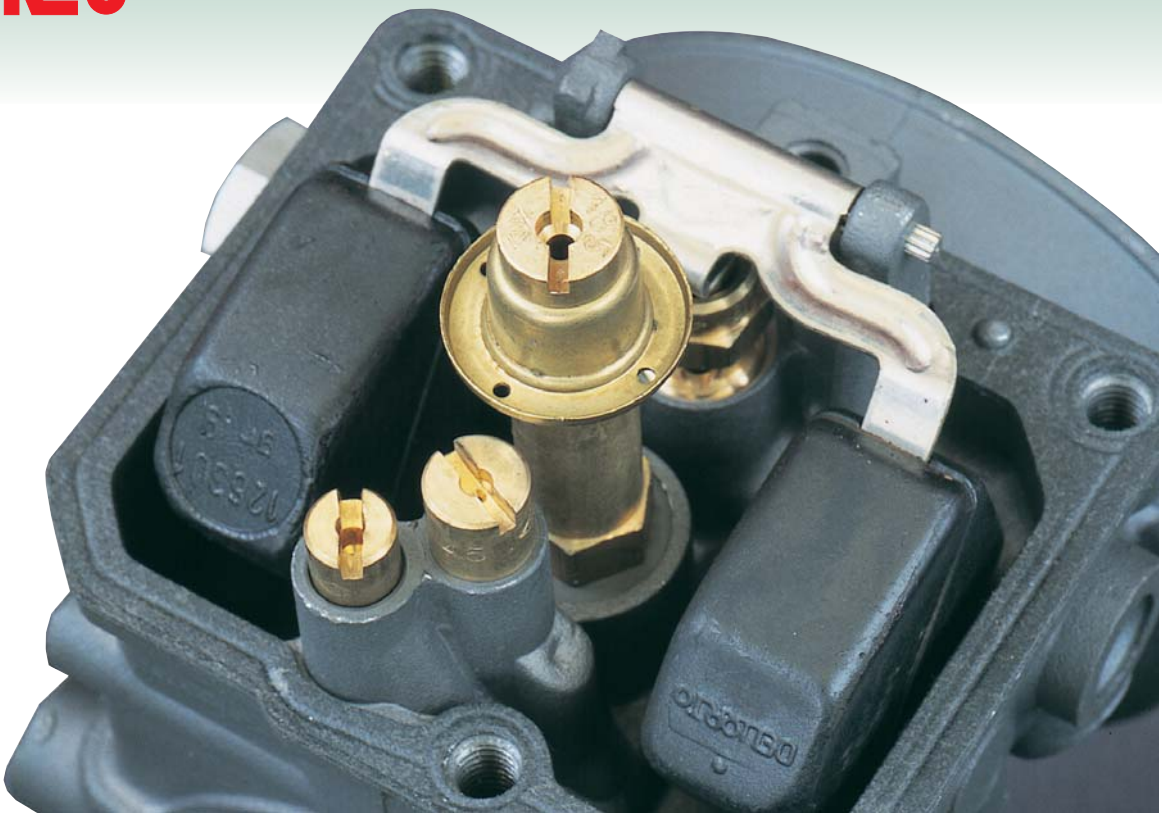
Modern carburetors used on motorcycle engines are defined as "needle type"due to the mechanical configuration of the main delivery system. The tapered needle assures the correct mixture ratio for all operating conditions of the engine corresponding to openings of the accelerator from 1/4 up to wide open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

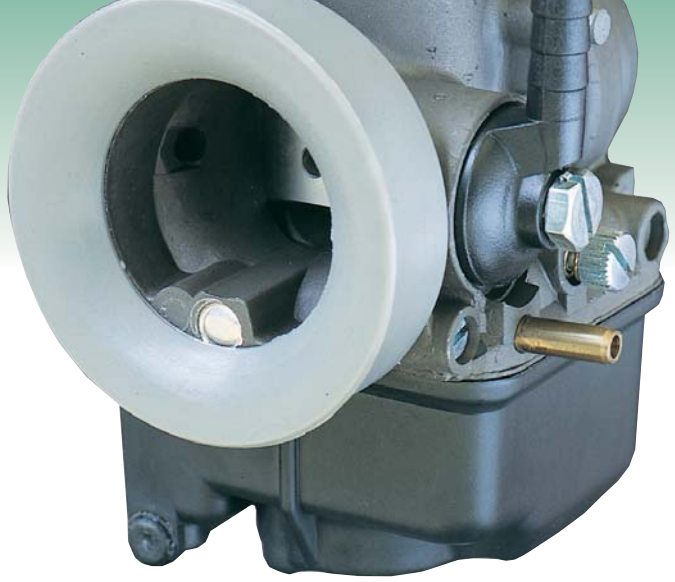
ATOMIZER DESIGN FOR TWO-STROKES

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.