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CARBURETOR DEVICE

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This invention relates to carburetors for internal combustion engines and consists particularly in novel means for varying the effective area of the communication between the constant level chamber and mixture conduit.

Modern automotive carburetors are frequently provided with means for varying the ratio of fuel and air supplied to the mixture conduit and intake manifold, according to the demands of the associated engine. Thus, when the engine is subjected to a relatively heavy load, a richer mixture is supplied, than is the case when the engine is subjected to relatively light loads and the carburetor is operating in its so-called part-throttle or economy range. In some cases, a stepped or otherwise graduated metering pin is associated with the main or an auxiliary fuel metering orifice and connected mechanically to the throttle valve so as to increase the effective area of the orifice during opening of the throttle and correspondingly decrease this area during closing of the throttle. In other instances a suction operated device controls a metering orifice, usually auxiliary to the main orifice, so as to enrichen the mixture when the suction in the intake manifold drops below a certain value, the affected orifice being closed or substantially limited when higher suction prevails in the intake manifold.

Both the mechanical and suction operated metering or "step up" devices, as described above, have disadvantages in that, in the one case, the mixture requirements of the engine do not necessarily vary directly in accordance with the throttle position and, in the other case, although the suction operated device may be theoretically more desirable, it has proven rather difficult to calibrate the suction mechanism accurately and such an arrangement is more expensive and less positive and rugged than the mechanically controlled metering pin or step up.

Another difficulty has been experienced in some carburetors due to excessive surging or tilting of the liquid fuel in the constant level chamber, resulting, at least momentarily in excessive enrichment or leaning out of the mixture delivered, which may cause noticeable hesitation or even stalling of the engine. Metering devices, as described, do not ordinarily limit the effective orifice area below that necessary for economy range operation and, accordingly, these are ineffective to substantially lessen the undesirable effects due to surging.

One object of the present invention is to provide a fuel metering device for carburetors which

is jointly controlled by a suction device and a mechanical connection with the throttle valve so as to combine functions of both types of control.

Another object is to provide means for minimizing disruption of the mixture delivered due to surging or sudden tilting in the fuel bowl.

A more detailed object is to provide a combination suction and manually controlled metering device which also embodies an anti-surge feature for limiting the effective area of the metering orifice to the minimum required for operating the associated engine when the throttle valve is substantially fully closed.

These objects and other more detailed objects hereafter appearing are attained substantially by the structure illustrated in the accompanying drawings, in which:

Figure 1 is a vertical sectional view showing a carburetor in general of a well known type.

Figure 2 is a view from the opposite side of the carburetor and showing the fuel bowl and contents in section, parts being broken away for clearer illustration of inventive features.

Figures 3, 4 and 5 are sectional views of a modification showing operative parts only in various positions.

The carburetor in Figures 1 and 2 includes a downdraft mixture conduit formed by air inlet horn 1, venturis 2, mixing chamber 3, and outlet portion 4, flanged as at 4a for attachment to the intake manifold (not shown) of an associated engine. A choke valve 5 and throttle valve 6 are mounted in the mixture conduit and provided with suitable control means (not shown).

Adjacent the mixture conduit is a bowl 7 within which fuel is maintained at a substantially constant level by needle valve mechanism 8, controlled by float 9. Near the lower portion of bowl 7 is a calibrated metering orifice member 10 communicating through passages 11 and 11a with an inclined chamber 12 in the wall of the mixture conduit and threadedly mounting main fuel discharge nozzle 13. Also communicating with chamber 12 are idling passages 14 terminating in idle port 15 adjacent the edge of the throttle. As is known, the idling system alone furnishes fuel when the throttle is substantially fully closed. Cooperating with metering orifice member 10 is a metering pin 16 having a tapered portion 17 and a reduced end portion 18, these portions selectively cooperating with the orifice member to vary the effective area thereof for so-called economy and power range operation.

Located within fuel bowl 7 is a cylinder 19 slidably receiving a pump piston 20 constantly urged upwardly by coiled spring 21. Cylinder 19 is preferably provided with the usual inlet and outlet check valves (not shown) and communicates with the mixture conduit through passages 22, 22a, and 23 and accelerating nozzle or jet 24 discharging adjacent the venturis. Piston 20 is connected to an arm or crank 25, rigid with the throttle valve shaft 6a, by means of a lever 26, permanently pivoted at 27 above the fuel bowl, and a link 28. Rotation of the throttle valve in the clockwise or opening direction, Figure 2, depresses piston 20 against spring 21, causing a stream of fuel to be ejected through the accelerating nozzle 24. Rotation of the throttle in the opposite direction lifts piston 20, drawing a fresh supply of fuel into the pump cylinder. The above described structure, in general, is well known in the art in itself does not constitute the present invention.

Extending vertically into the carburetor body, adjacent the inner wall of bowl 7, is a chamber 29 communicating through passage 30 with the interior of the mixture conduit posterior to the throttle and slidably receiving piston or plunger 31 constantly urged upwardly by coiled spring 32. A gooseneck rod 33 extends upwardly from plunger 31 beyond the level of the bowl cover and at its upper extremity carries a lateral pin 34 which extends into a notch 35 in the upper edge of pump lever 26. Metering pin 16 has an eye 36 at its upper extremity encircling pin 34 whereby movements of plunger 31 are transmitted to the metering pin.

In practice, coiled spring 32 beneath the suction plunger 31 is of sufficient strength to insure desired positioning of the metering pin relative to orifice member 10, as determined by suction conditions within the mixture conduit. The movement of plunger 31 is sufficient to elevate pin 16 from the economy position shown in Figure 2 in which the pin constitutes a maximum restriction, to its minimum restricting or power position with all except lower step 18 withdrawn from the orifice. Between the extreme positions of pin 16, tapered portion 17 thereof cooperates with the metering orifice.

In a practical embodiment of the invention, spring 32 is calibrated to maintain plunger 31 and the metering pin in their most elevated positions until the suction in the mixture conduit exceeds a value corresponding with a manometric read of $3\frac{1}{2}$ or 4 inches of mercury. For suction values above this to, say, from perhaps 7 to 10 or 12 inches of mercury, the effective area of the metering orifice will be controlled by tapered portion 18 of the metering pin. When the manifold suction exceeds these values, the largest portion of pin 16 will be drawn downwardly into orifice member 10, the lowermost position of the metering pin being limited by engagement of collar 16a thereon with the top of the fuel bowl.

The above described suction control of the metering pin is not necessarily dependent on the position of the throttle valve, although ordinarily the valve would be substantially opened whenever the engine is subjected to an increased load and relatively low suction prevails in the intake manifold. However, the engine may be subjected to substantial loads with the throttle only partly open and, to insure the delivery of the proper mixture proportions in such cases, metering pin 16 may be varied by the suction

plunger 31 between its economy position, shown in full in Figure 2, and its power position indicated in dotted lines. When the throttle has been opened a predetermined extent, pin 34 is engaged by the bottom of recess 35 in the pump lever 26 so as to positively prevent further lowering of the metering pin. During further opening of the throttle, pin 16 will be lifted from the metering orifice, the pin, however, still being free to respond to an elevation of suction plunger 31, due to decreased suction in the mixture conduit, until the throttle valve is substantially fully opened.

Figures 3, 4 and 5 are fragmentary views of a modification showing only the parts which directly affect the fuel metering orifice. Accelerating pump piston 20 is connected to throttle valve 6 through an arm 25a on the throttle shaft, link 28a, and lever 26a pivotally supported at 27, as in the previous form. Suction plunger 31 has an upwardly projecting stem with a gooseneck part 33a carrying lateral pin abutment 34 at its upper extremity. Pin 34 extends through eye 36 at the upper end of metering pin 16a and into recess 35 in pump lever 26a. This portion of the structure functions substantially as the arrangement previously described.

Metering pin 16a has three steps 37, 38 and 39 at its lower extremity, the last two mentioned being preferably calibrated, respectively, for economy, and power range operation. The largest step 37, which, in the present instance, is the same size as the main portion of the metering pin, is accurately calibrated to restrict the effective area of the metering orifice to the minimum size necessary for operation of the associated engine with the throttle substantially fully closed or, in other words, during idling or when the engine is acting as a brake for the vehicle.

Projecting from the suction plunger stem, opposite to the gooseneck portion thereof, is an arm 40 having a lateral pin abutment 41 at the extremity thereof. This pin is disposed to be engaged by the outer extremity of accelerating pump lever 26a, when the throttle valve 6 is substantially closed, to positively force metering pin 16a to its lowest position with its largest step 37 within the metering orifice. Thus when the engine is idling or acting as a brake, the size of the metering orifice is reduced to the minimum necessary to supply the idling system and keep the engine running. This, in turn, greatly minimizes any momentary variation in the mixture quality due to sudden change of momentum, or direction or angle of travel by preventing too rapid surging of liquid fuel either into or out of the passages leading to the mixture chamber.

Located between the suction piston 31 and the bottom of its chamber 29 is a small coiled spring 42 which is engaged by the suction plunger near the lower extremity of its stroke so as to prevent the largest or anti-surge step of the metering pin from being drawn into the metering orifice by the action of the suction alone. In other words, the metering pin can be forced into its anti-surge relationship with orifice member 10 only by positive engagement between pump lever 26a and pin abutment 41 which occurs when the throttle valve is substantially fully closed.

Due to the different distances of abutment pins 34 and 41 from the pivotal mounting of pump lever 26a, the portions of this lever which cooperate with these abutments have different vertical movement relative thereto. The effect of this is to provide for lost motion between these abutments and the pump lever when the throttle

valve has been slightly opened, as in Figure 4. Thus, with the throttle valve in this position, (Figure 4) the metering pin is free for substantial movement under the influence of suction plunger 31 so as to selectively move the power and economy steps of the metering pin into the metering orifice, as required. Figure 5 illustrates the position of throttle valve 6 when the metering pin has been forced into its power step by engagement between the accelerating pump lever and pin 34 so that with the throttle in the illustrated position, or in any more open position, a power mixture will be supplied.

The relationships of the various parts shown in Figures 3, 4 and 5 are merely illustrative and these may be varied as desired to provide for any desired operation of the metering pin. Figure 4 shows the throttle in such position that the metering pin is just about to be forced into its economy stop by engagement of pin 41 and lever 26a so that in any more closed position of the throttle, the metering pin cannot be raised to its power position by the suction piston. Obviously, this relationship may be varied by merely changing the distance between pin 41 and pivotal center 27 of pump arm 26a. Also the point during opening of the throttle in which pin 34 is engaged by pump lever 26a may be varied by providing more or less lost motion between this pin and the lever. In Figure 3, pins 34 and 41 are shown as both engaging the pump lever with the throttle substantially closed, but, in this throttle position, pin 34 may be located substantially above the bottom of recess 35a so as to increase the angularity of the throttle valve before engagement of pin 34 by the pump lever. Additional adjustment may be effected by variation of the distance between pivot 27 and pin 34.

The anti-surge feature, shown in Figures 3, 4 and 5, may be conveniently combined, as shown, with the combination mechanical and suction controlled metering pin, but obviously this part of the invention may be used individually. The working out of the various linkage and leverage relationships may be readily accomplished by the mechanism in order to attain desired metering results. The exclusive use of all such modifications as come within the scope of the appended claims is contemplated.

I claim:

1. In a carburetor for an internal combustion engine, a fuel bowl, a mixture conduit, a throttle valve in said conduit, a branched passage leading from said bowl to said conduit, a main metering orifice element in said passage beneath the normal fuel level in said bowl, said passage having a main fuel supply branch extending upwardly from said orifice element and an idling branch, a metering pin device having a relatively large portion movable into said orifice to limit the effective area thereof to the minimum necessary for effective operation of said idling branch, suction operated means for controlling said device, and throttle operated mechanism for engaging said device only when said throttle valve

is substantially fully closed to move said portion into said orifice.

2. In a carburetor, a fuel bowl, a mixture conduit, a throttle in said conduit, a passage connecting said bowl and said conduit including a metering orifice, a metering pin device cooperable with said orifice to vary the effective area thereof, suction operated means for controlling said device, and a throttle operated member disposed to engage said device when said throttle is substantially opened to urge said device toward its least restricting position.

3. A carburetor as specified in claim 2 in which said throttle operated member is constructed and arranged to engage said pin device, when said throttle is substantially closed, to urge said device toward its most restricting position in said orifice.

4. The combination of elements specified in claim 1 in which said suction responsive means is ineffective to move the relatively large portion of said pin device into operative relationship with said orifice.

5. In a carburetor, a mixture conduit, a throttle therein, a fuel passage discharging into said conduit and having a metering orifice, a metering pin device having a graduated portion cooperating with said orifice, suction operated means for controlling the position of said portion in said orifice, and a throttle operated member constructed and arranged to engage said device to positively move said device toward its least restricting position upon opening of said throttle valve irrespective of said suction operated means.

6. In a carburetor, a mixture conduit, a throttle therein, a fuel passage discharging into said conduit and having a metering orifice, a metering pin device having graduated portions for cooperating with said orifice, suction operated means for urging said device in one direction, means yieldingly resisting movement of said pin device in said direction and of sufficient strength to prevent full movement of said device in said direction by suction, and a throttle operated member constructed and arranged to engage said device to enforce the last part of the movement of said device in said direction.

7. In a carburetor, a mixture conduit, a throttle therein, a fuel passage discharging into said conduit and having a metering orifice, a metering pin device for varying the effective size of said orifice, a throttle operated member having a lost motion operative connection with said device to enforce movement thereof toward its least restricting position when said throttle is opened, and suction operated means for controlling said device within the limits of said lost motion connection.

8. A carburetor as specified in claim 7 in which said throttle operated member is constructed and arranged to force said device to its least restricting position when said throttle is substantially fully opened.

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