

[54] **METERINGROD CARBURETOR**
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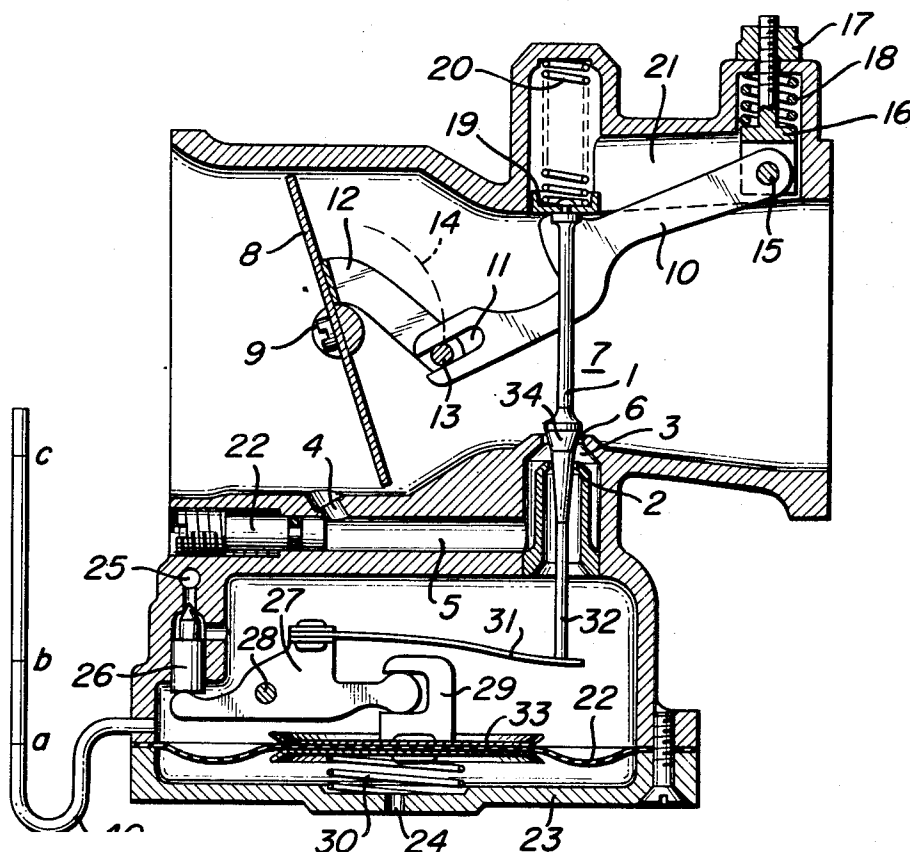
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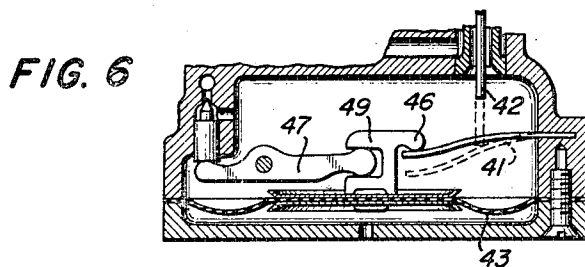
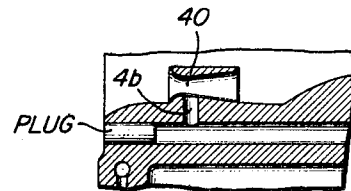
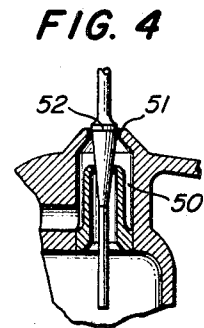
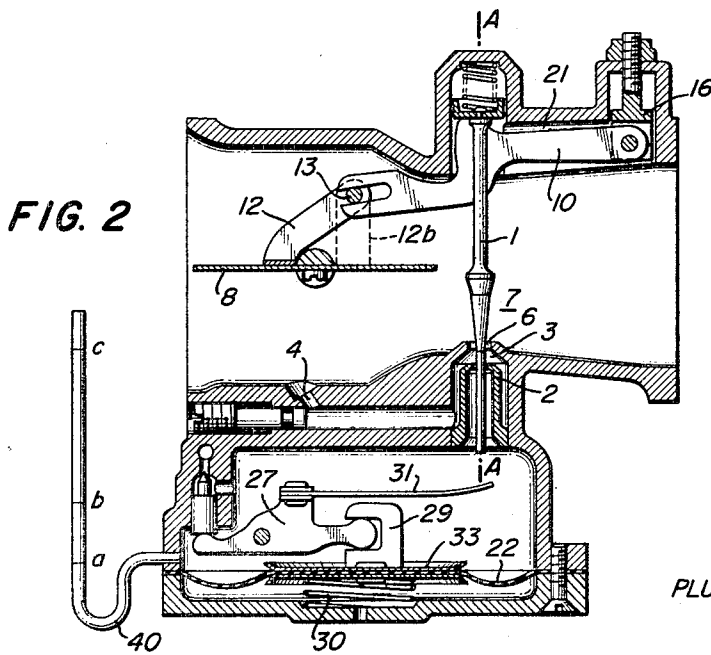
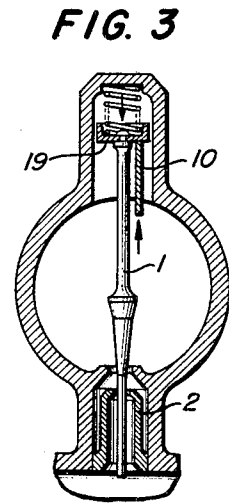
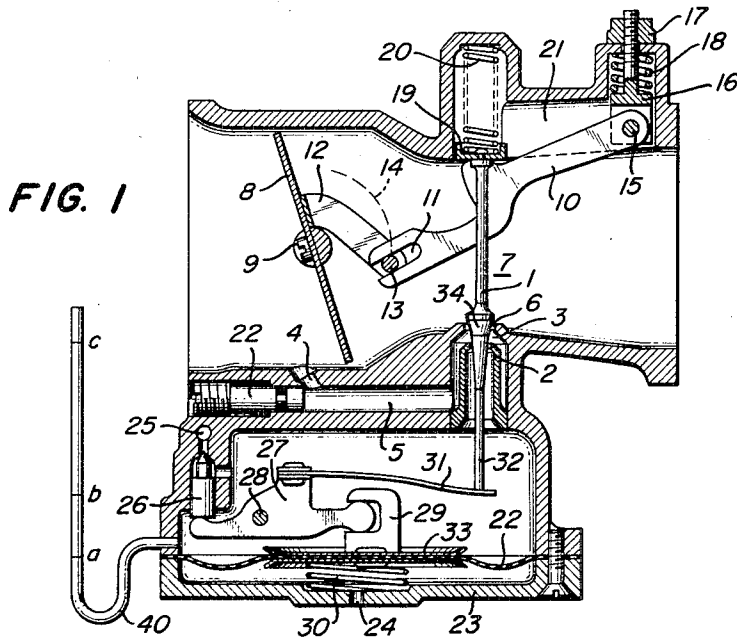
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[57] **ABSTRACT**

Interior discharge carburetor with a meteringrod controlling a fuel orifice (2). Throttleplate and meteringrod (1) mechanically linked by means of a thin lever (10) arranged inside the carburetor main passage. Displacement of lever-pivotpoint (15), attached to body, adjusts idle position of meteringrod. Fuel mixed with bleedair and discharged into Venturi through second foam orifice, this bleedair coming from an airinlet which is subjected to a high percentage of Venturi suction at open throttle.

11 Claims, 6 Drawing Figures





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METERINGROD CARBURETOR

BACKGROUND OF THE INVENTION

Carburetors can be divided into exterior discharge and interior discharge systems.

The most commonly used exterior discharge carburetors have the fuel metering orifices discharging into a venturi upstream of the throttle. This offers the advantage of making the use of a fixed orifice for the largest part of the metering range possible, but has the disadvantage that, near idle and small part loads, the metering suction generated by the venturi becomes so small that a second, interior discharge idle orifice has to be added; that is, an idle orifice deriving metering suction from the manifold suction which prevails downstream of the throttle. The transition of the idle to the main orifice creates well-known metering difficulties.

These difficulties are avoided in single orifice Interior discharge carburetors. In these carburetors the fuel metering orifice is subjected to the suction behind the throttle plate. Since this manifold suction increases with closing of the throttle, a variable orifice becomes necessary, which commonly is formed by a tapered meteringrod coupled to the throttle.

The main difficulty with this device is created by the magnitude of the manifold suction. When the full manifold suction acts on the metering orifice, the meteringrod has to close the orifice to an extremely minute ring area, which causes difficulties due to the very high precision needed here and due to the laminar flow conditions occurring in this narrow ring opening.

In order to work with reasonably large ring areas at idle and part load, the manifold suction has to be reduced to a metering suction amounting only one-fourth to one-twentieth of the manifold suction.

The most commonly used solution to accomplish this part loading metering suction reduction consists of arranging the meteringrod in the center of a piston slide throttle, this piston slide having an inclined cut off on the inlet side which at part load ducts atmospheric air to the orifice exit; thus reducing the manifold suction which otherwise would prevail there. These piston slides are expensive and in many cases too space consuming.

Interior discharge meteringrod carburetors have been built where the needle is directly activated from a conventional throttle plate and throttle shaft and where the metering suction has been reduced to usable magnitude by means of air bleed arrangements. These devices work well at part load. At full load, however, these air bleed arrangements have the great disadvantage to decrease the metering suction in the same percentage. If, at full load, small pressure drops through the carburetor are required, this results in metering suction which are too small for accurate metering.

It follows that for the interior discharge meteringrod carburetor it is advantageous to employ a variable air bleed system, which cuts the metering signal down to a fraction of the manifold suction at part load only and which changes the air bleed at full load so that the air bleed exerts here only a relatively small influence.

It is one aim of the invention to accomplish such a variable air bleed system without adding to mechanical complexity. The invention teaches how the same meteringrod accomplishes two tasks simultaneously; namely, the changing of the flow area of the fuel metering orifice and the changing of the influence of the air bleed system, both in dependence of the throttle position.

Another aim of the invention is to create a simplified linkage connection between the throttle and the meteringrod. According to the invention this is accomplished by arranging the mechanical connections inside the carburetor main passage in such a manner that this device creates no disadvantageous flow restrictions and pressure drops.

The proper axial positioning of the meteringrod in relation to the fuel orifice is extremely critical when the ring area is very narrow at idle. This adjustment problem has always led to great complications. The invention also shows a simple solution for this problem, and combines it with an idle adjustment.

Still another aim of the invention concerns the combination of an interior discharge meteringrod carburetor with a diaphragm fuel level holding device.

Diaphragm carburetors usually employ a bias spring acting on the diaphragm, which lowers the fuel level $\frac{1}{2}$ to 1 inch under the fuel discharge in order to prevent fuel spillage out of the main orifice at idle. The great disadvantage of this lowered level is a tendency to make the mixture lean at low-r.p.m., open throttle.

The diaphragm meteringrod carburetor according to the invention uses a variable bias load on the diaphragm which is changed directly by means of an extension of the meteringrod. This arrangement switches to a positive bias, which raises the fuel level at open throttle. The open throttle, low-r.p.m. performance is thus greatly improved, without the cost of complicated linkage connections.

SUMMARY OF THE INVENTION

The invention relates to interior discharge carburetors in which a meteringrod (1) controls a fuel metering orifice (2), this meteringrod being mechanically coupled to the throttle. The mechanical coupling is simplified by arranging all components inside the main passage, in such a way that this has only negligible aerodynamic disadvantages.

From the solid fuel orifice the metered fuel passes first into a foam chamber (3) which receives bleed air from an inlet (4) upstream of the throttle. From this foam chamber the resulting foam passes through a second "foam" orifice (6) into the venturi or main passage fuel mixing region. One feature of the invention is the use of the same meteringrod to also control this second orifice, in such a manner that both orifices are narrowed down simultaneously at part load.

At part load the bleed air entrance (4) is large against the foam orifice (6), thus establishing a metering suction in the foam chamber (3) which is only a fraction of the manifold suction acting on the foam orifice.

At wide open, (FIG. 2) on the other hand, the foam orifice (6) assumes about the same size as the bleed air entrance. Since, furthermore, the bleed air entrance itself is located in a suction creating high-speed zone (and is not, as in conventional carburetors, subjected to impact pressure), the metering suction in this chamber is hardly smaller than the venturi suction.

In one form of execution the metering suction receives the fuel from a fuel level establishing device consisting of a diaphragm regulator. These diaphragm carburetors are commonly fitted with a spring biased, which lowers the fuel level to prevent fuel spillage from the orifice at standstill, when the engine is lying on the side, or the tank is pressurized. This lowered level severely limits the wide-open, low-r.p.m. performance.

The carburetor according to the invention employs a bias load which changes with the throttle position and raises the fuel level at open throttle. This is accomplished without additional complication by fitting the meteringrod with an extension (32) which actuates a bias spring (31).

The new meteringrod carburetor provides the simple throttle plate design with all the advantages previously only found in piston slide carburetors. Furthermore, in the combination with a diaphragm chamber, the doubling up of the meteringrod as a bias spring changing device gives low-r.p.m., wide-open performance not before reached in carburetors with large venturis and small pressure drop.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 shows the new carburetor in a sectional view with a throttle position close to idle.

FIG. 2 shows the same carburetor in the wide-open throttle position.

FIG. 3 represents the section A—A across FIG. 2.

FIG. 4 shows a modified design of the meteringrod.

FIG. 5 shows a booster venturi for an air bleed.

FIG. 6 shows a variation of the variable bias spring device.

DETAILED DESCRIPTION OF INVENTION

The meteringrod 1 controls the flow area of the single solid fuel metering orifice 2, which discharges into a foam chamber 3, in which the solid fuel is mixed with bleed air coming from the air bleed orifice 4 through the bleed duct 5. The resulting foam is discharged through the foam orifice 6 into the venturi throat or fuel mixing region 7.

The throttle 8 with the throttle shaft 9 is arranged upstream of the venturi and the fuel foam discharge 6, thus creating a carburetor of the interior discharge type. A direct mechanical coupling between the throttle and the meteringrod is provided, so that the flow area of the orifice is enlarged when the throttle is opened.

In the form of execution shown in the drawing this mechanical coupling consists of the following components:

1. A lever 10 which is formed by a stamped, and preferably hardened, thin steel strip (FIGS. 1 and 3). This lever carries a forked slot 11 and operates partly in the slot 21, which is provided in the carburetor passage.

2. An arm 12, attached to the throttle 8 on one end and carrying a drive pin 13 on its free end which describes the arc shown by the dashed line 14. The drive pin 13 engages the slot 11.

3. A shaft 15 which serves as pivot for the lever 10. This shaft is attached to the carburetor body by means of an adjustment mechanism consisting of a slotted holder 16 for the shaft 15, the adjustment nut 17, and the counter spring 18. The part 16 can be adjusted roughly parallel to the axis of the meteringrod.

This serves as idle mixture adjustment since, by turning the adjustment nut 17, the correct ring area at the fuel orifice for the idle mixture adjustment can be established. It also serves to eliminate the necessity to manufacture to close tolerances, since the correct positioning of the meteringrod for the correct idle mixture automatically also gives the correct position relation for the rest of the range. Since the axial displacement is much more sensitive at idle than at higher loads, with their larger ring areas, an adjustment of the idle mixture has only a practically negligible effect on the mixture strength further up the load range.

4. The plate 19 which is attached to the meteringrod 1, and which serves as a spring plate for the return spring 20. The underside of this spring plate may be hardened and is, as FIG. 3 shows, acted upon by the suitably formed lever 10. FIG. 3 shows that the lever acts sideways on the spring plate. Since the spring acts along the axis, this sideways counter pressure sets up a force-couple shown in FIG. 3 by the arrows, tending to push the meteringrod into the shown leaning position, which is important for reasons discussed later.

The orifice can receive the fuel from a conventional float chamber, or a spill dam arrangement, or, as shown in the example of FIG. 1, from a diaphragm chamber.

The diaphragm 22 is clamped to the carburetor body by means of the cover 23. This cover is either vented to the atmosphere through the opening 24, or to impact air, picked up at the carburetor inlet which is ducted into this chamber. The fuel coming from the fuel tank is connected to the duct 25, from where it enters the fuel side of the diaphragm chamber through the fuel inlet needle 26. This needle is acted upon by the two armed lever 27 which pivots around the fixed shaft 28. This lever, in turn, is operated by the diaphragm 22, by means of a hinged connection 29 which is connected to the diaphragm over the diaphragm disk 33.

A positive bias spring 30 is arranged under the diaphragm. A second leaf spring 31, which exerts a variable negative bias pressure, is attached to the lever 27 or directly to the parts 29 or 33. This negative spring bias is varied by an extension 32 of the meteringrod.

The show glass 40 is shown only for the purpose of explanation, in order to demonstrate the pressure established by this diaphragm chamber. The operation of the diaphragm chamber in conjunction with the variable bias will be explained later.

Interior discharge carburetors, with a meteringrod controlled orifice directly exposed to the full manifold suction, show the difficulty of having to operate with extremely minute openings at idle and closed throttle. Aside of the cost of building to the extreme precision which such small openings require, the very narrow ring area meters the fuel according to laminar flow relations which creates mixture enriching distortion with rising r.p.m.

In order to achieve good metering precision combined with reasonable manufacturing tolerances, the metering suction acting on the fuel orifice must be cut down from for instance 18 inches hg. to for instance 1 inch hg. at idle. This can easily be accomplished by means of an air bleed which connects the foam chamber 3 with atmosphere pressure. As shown in FIG. 1, the air bleed inlet 4 must have a large area compared to the foam exit 6 in order to accomplish this large reduction of the metering suction.

With the conventional fixed air bleed system, such a depreciation of the metering suction in the foam chamber to a fraction of the suction prevailing in the venturi would, however, make wide-open throttle operation all but impossible. At full load the air bleed orifice 4 should be very small and possess only a fraction of the area of the exit 6. In other words, with interior discharge meteringrod carburetors a variable air bleed is required, that reduces the metering suction to a fraction of the manifold suction at part load, but which, at high loads, causes only a minor metering suction reduction.

The invention relates to an extremely simple and accurate method to accomplish this change in the air bleed. It is based on the observation that the influence of the air bleed is not only dependent on the size of the air bleed orifice 4, but on the ratio of the air bleed inlet 4 to the foam exit 6. By making the exit variable, it is possible to leave the inlet 4 constant, and yet accomplish the sought-for variable influence of the air bleed.

According to the invention this is accomplished by arranging the solid fuel orifice 2 and the foam exit orifice 6 coaxially, and by using the same meteringrod to steer the area of both orifices.

The meteringrod possesses an additional upper tapered section 34 which greatly reduces the area of the foam orifice 6 at idle and low load, as FIG. 1 demonstrates. The consequence of this restriction is that the area of the bleed orifice 4 is large against the ring area of orifice 6, thus cutting the metering suction in the foam chamber 3, which controls the fuel discharge through the solid fuel orifice 2, to a fraction of the manifold suction in the closed throttle position shown in FIG. 1.

FIG. 2 shows the wide-open position. The foam orifice 6 and the solid fuel orifice 2 are both opened. Orifice 6 is now larger than the air bleed inlet 4. Consequently, the metering suction in the foam chamber 3 assumes now almost the full value of the suction in the venturi throat 7. The ratio of the bleed inlet area 4 to the foam exit area 6 is now reversed against that of the closed throttle position in FIG. 1, and the suction decreasing influence of the air bleed becomes comparatively minor.

In order to further reduce the influence of the air bleed, a second novel measure is taken: The air bleed is not, as in conventional carburetors, located in a place where it picks up ambient atmospheric pressure, or even impact pressure by means of a pitot tube, but opens almost perpendicular to the air flow, into the carburetor wall of the inlet section, where the air already attains a fairly high speed, and consequently a suction is exerted on this air bleed inlet 4.

This generation of a suction at the air bleed inlet further helps to reduce the metering-suction depreciation which would otherwise be caused by an atmospheric air bleed in the wide-open throttle position.

At idle and part load (FIG. 1), however, when the air velocity ahead of the throttle is greatly reduced, the air bleed 4 receives nearly the full atmospheric pressure.

It follows that the simple measure of placing the air bleed inlet into a suction creating wall area upstream of the throttle, creates an additional discrimination between closed and open

throttle, which adds to the influence of the area change of the foam orifice 6, and which further enlarges the desired variation of the influence of the air bleed from a maximum at idle down to a minimum at wide-open throttle.

The FIG. 5 shows a variation of the air bleed inlet 4. It represents a cutout of the carburetor inlet in the region of the inlet 4 of FIG. 1. Here the air inlet 4b is fed from a small booster venturi 40. This suction creating device further increases the just described discrimination between closed and open throttle.

The feeding of the air bleed inlet from a suction point is in marked contrast to the usual arrangement of ducting the maximum impact pressure into air bleeds. The interior discharge, and the variable foam orifice, combined with the suction subjected air bleed inlet ahead of the throttle, creates the variable air bleed system which is a characteristic of the invention. It promotes excessively strong airbleeding at part load and switches to negligible airbleeding at open throttle.

The double-task-meteringrod shown in FIG. 1 creates difficulties for accurate, repeatable manufacturing. The vertical distance between the two orifices 2 and 6 has to be extremely accurate in order to achieve the correct relation of the opening of the ring areas of these two orifices at idle.

FIG. 4 shows a solution for this problem. The solid fuel orifice 50 is again the same as in FIG. 1. However, the foam orifice 51 is arranged in a greater vertical distance from the fuel orifice than in FIG. 1, and the meteringrod is shaped cylindrically in its section 52 where it enters the foam orifice at idle (rather than tapered as in FIG. 1). The foam orifice therefore remains on a constant ring area all through the first small part of the throttle opening, thus becoming in the critical idle range independent of the accurate vertical distance between the two orifices.

The idle adjustment by means of the nut 17 affects here only the solid fuel metering ring area of the orifice 50 while the ring area of the foam orifice 51 remains of a constant value, predetermined by the cylindrical diameter 52.

In the example shown in the drawing the meteringrod possesses a straight taper. It was proven to be indeed possible to achieve accurate metering with such a straight taper, by suitable selection of the vertical distance between the two orifices, in combination with proper selection of the ratio of the air bleed inlet area to the foam orifice area.

In many cases it is, however, preferable to replace the straight conical taper with a profiled taper, in order to achieve the desired fuel air ratio for each throttle position.

Especially in its application to two cycle engines it is sometimes desirable to provide the carburetor with a mixture adjustment which is effective in the part load range only.

The new carburetor gives a unique opportunity to achieve such an adjustment by means of the plug 22 which is designed to partly shear off the air bleed orifice 4 and therewith change its flow area.

It was previously explained that the influence of this air bleed is strong at part load and tapers off, until it becomes negligible, at full load.

It follows that an adjustment of the flow area of the air bleed inlet 4 by means of the plug 22 will have its strongest influence near idle, then, further up the range, exert a moderate influence in the middle range and finally become almost inconsequential at wide open.

Two cycle engines with their tendency to suffer at part load from condensation of fuel in the crankcase, which varies with different temperatures, are in great need for such an adjustment which effects the entire lower range without disturbing the correct mixture setting for full load. Therefore, the air bleed inlet adjustment by means of the plug 22, or other devices of similar effect, gives a new freedom of adjustment which is not as limited to idle only as the usual idle adjustment.

The main object of the invention is to create a variable air bleed system which makes an interior discharge meteringrod carburetor in conjunction with a simple throttle plate practical. The dual function of the meteringrod, controlling simul-

taneously two coaxially located orifices of which one meters solid fuel, while the second one meters fuel foam which is composed from metered fuel and bleed air, fulfills this aim. This metering system gives all the advantages of piston-slide meteringrod carburetors without the expenses and space requirements of the piston-slide.

The new metering system requires a coupling between the throttle 8 and the meteringrod 1.

Carburetors are known where this coupling or connection is achieved by means of cumbersome and complicated linkages between the throttle shaft and the meteringrod, which are arranged outside the carburetor body. The detour outside the carburetor body makes these devices complicated, so that they defeat the purpose of achieving greater simplicity than the piston slide carburetor.

It is therefore a second aim of the invention to create a mechanical connection with a minimum of parts and a minimum of high precision requirements.

The already briefly described internal leverage system, as shown in FIG. 1, fulfills this demand. A lever system inside the mixture duct has ordinarily the disadvantage of creating additional air resistance. The mechanism according to the invention avoids this by, among other things, using a lever 10 made from thin hardened steelstrip or similar material which extends in the direction of the mixture flow.

Flow resistance must be minimized in the open throttle position only, which is shown in FIG. 2. This drawing demonstrates that the major part of the lever 10 disappears in a slot 21 in the wall which forms the venturi. The arm 12 is also formed from a thin metalstrip. In the open position it swings entirely into the large diameter, slow speed, zone ahead of the venturi, where minor obstruction do not cut down the air flow.

The pivot holder and idle adjustment device 16 is completely removed from the air passage and buried in the carburetor body.

It follows that the internal mechanical connection between the throttle plate and the meteringrod, according to the invention, fulfills both the demands of simplicity and minimum air resistance.

Furthermore, the combination of this leversystem with the adjustable pivot holder 16 creates, as already described, a simple and handy idle adjustment which is much cheaper than the movable orifice known from other meteringrod carburetors.

The arm 12, connecting the drive pin 13 with the throttle plate 8, presents an assembly problem. The throttle plate has to be mounted on the shaft in the open position of FIG. 2.

The simplest shape of this connecting arm is represented by the dashed line, designated 12b. It is apparent that a throttle plate, with this arm 12b attached to it, could not be introduced into the carburetor inlet, past the shaft.

The arm 12, shown in the drawing, with its detouring bend, solves this assembly problem.

It has already been explained that the sideways pressure of the lever 10 against the springplate 19, as shown in FIG. 3, causes the meteringrod 1 to lean sideways in the orifice 2.

Meteringrod carburetors with a needle loosely hanging in the orifice suffer from two disadvantages. First, the free swinging needle can assume penduling vibrations and wear out the walls of the orifice. Secondly, any deviation from a concentric position changes the flow resistance, since with a partly laminar and partly turbulent flow, a sickle shaped area has a different flow resistance than a ring area, of equal area.

The usual remedy is to hold the meteringrod rigidly concentric inside the orifice. This measure demands very great precision and is very costly. The solution, according to the invention, is always to promote a rubbing against one side of the orifice. If this condition always prevails, the carburetor can be calibrated accordingly. Furthermore, it was found that the slight friction against the orifice wall is far less harmful than a vibrating beating of a free hanging needle against this wall.

The diaphragm chamber shown in the drawing provides the advantage of operation in all positions and gives furthermore little sensitivity to engine vibrations.

In combination with the application of a diaphragm chamber to the new carburetor, still another innovation is used, which concerns an increase of the fuel level, which is established by this diaphragm chamber, when the throttle is opened.

To understand the function of this new device it should first be assumed that the diaphragm chamber shown in FIG. 1 does not have the bias springs 30 and 31 and is completely filled with fuel. It is well known that under these conditions it establishes a fuel pressure, which can be measured as a fuel level, in the sideglass 40, and which will be established at point *a*; that is, just about at the level of the diaphragm 22.

For full throttle operation at low r.p.m. the fuel level must, however, be near the point *c*; that is, close to the level of the discharge of the fuel orifice 2, especially if this carburetor is used for two cycle engines. Here the pressure drop through the carburetor has to be kept extremely small and the venturi throat accordingly large. A venturi suction of only 8 inches H₂O at maximum power is sometimes required. Then, at wide-open throttle and low r.p.m. the venturi suction may drop to only 1.5 inch H₂O. If the fuel level is at point *a*, this negative head will make operation at low r.p.m. impossible, since the negative head cancels all or part of the venturi suction.

It is known to remedy this situation by using a positive bias spring, such as the helical spring 30 under the diaphragm. This spring keeps the inlet valve 26 open until a fuel column as, for instance, that extending to point *c*, overcomes the spring, pushes down the diaphragm, and closes valve 26. In other words, the equivalent of the float level of a float bowl will be established by a diaphragm chamber, and the vertical location of this level can be freely selected according to the tension of a bias spring.

For many two cycle engine applications, such as chain saws, it is, however, not permissible to raise the fuel level to point *c* since, with standing engine and a fuel tank pressurized from a heatsoak, fuel would steadily leak out of the orifice. A negative head, such as that at point *b*, is the limit in order to prevent this leaking. The consequence of this lowered level *b* is leaning out at open throttle and low-r.p.m. operation. Indeed, most diaphragm carburetors do not permit a two cycle engine to operate properly at less than 2,500 r.p.m. with wide-open throttle.

According to the invention, perfect wide-open throttle-low-r.p.m. operation is obtained by using a variable spring bias load on the diaphragm.

FIGS. 1 and 2 illustrate an example of this device. A constant bias spring 30 is pushing the level to the desired high location of point *c* but only in the wide-open position of FIG. 2. A second leaf spring 31, which is attached to the lever 27, is not loaded at open throttle and therefore inactive.

However, in the part load position shown in FIG. 1, an extension 32 of the meteringrod activates the variable bias spring 31 for downwards negative pressure on the diaphragm, thus cancelling out part of the upwards positive pressure of spring 30. This lowers the fuel level to point *b* which, due to the higher metering suction of an interior discharge carburetor at part load, still permits good metering at idle and part load.

In other words, the variable bias spring, the tension of which is changed according to the throttle position, permits to use a high fuel level at open throttle and a lowered level at part load and idle and closed throttle.

The connection between the throttle and a variable bias spring loading the diaphragm at its air side, can be accomplished by means of linkages connecting the throttle shaft to the dry side of the diaphragm. Such linkages are, however, necessarily cumbersome and complicated.

The arrangement of the variable spring on the fuel side of the diaphragm, combined with the variation of its tension by means of an extension on the meteringrod, creates a uniquely simple solution for this linkage problem. Since the extension 32 reaches through the orifice right into the wet side of the diaphragm chamber, the location of the variable bias spring on

top of the diaphragm is made possible, and all complicated detours for outside linkages are eliminated.

Instead of the leaf spring arrangement shown in the drawing it is also possible to attach the spring 31 directly to the connecting hinge 29 or the diaphragm plate 33.

It is also possible to use a bias spring attached to the extension of the meteringrod 32. Also, helical springs can be used.

FIG. 6 shows still another arrangement of a variable bias spring which is also activated and deactivated by the extension 42 of a meteringrod.

The hinge part 49, which links the diaphragm 43 to the lever 47, carries a hook 46. The variable bias spring 41 is here attached to the diaphragm chamber wall.

In FIG. 6, as in FIG. 2, the retracted position of the meteringrod extension 42 occurs at full load. The spring is here disengaged from the meteringrod and exerts freely an upwards tension on the nose 46 and therewith the diaphragm 43, which raises the effective float level.

The dashed line shows the meteringrod extension 42 in its idle position. Here it pushes the spring 41 away from the nose 46, as the dashed outline of the leaf spring shows. The effective level, therefore, sinks at idle back to the level of the diaphragm. (*a*)

It can be seen that in FIG. 6 the variable spring is a positive bias spring activated at full throttle and deactivated at idle. In contrast to this, the variable spring shown previously in FIG. 2, is a negative bias spring which is deactivated at full load and activated at idle. In combination with the constant positive bias spring 30, it serves the same purpose as the single variable spring of FIG. 6.

These examples show that the effect of a variable bias spring, which lowers the effective fuel level at idle and increases it at open throttle, can be obtained by means of many variations of spring designs in combination with an arrangement which connects these springs to the extension of the meteringrod entering the wet side of the diaphragm chamber through the orifices.

The form of execution shown in the drawings shows a venturi for creating the metering suction.

The variable positive bias spring which raises the effective fuel level to, or even above, the fuel orifice at open throttle makes it possible to operate this carburetor with extremely small metering suction. It is therefore possible to eliminate the venturi throat completely and use a straight bore which, due to the air velocity prevailing in it, delivers a reduced metering suction still sufficient for perfect metering with this new system.

Therefore, the discharge region 7 is referred to as the fuel mixing region, which covers both a venturi throat and a straight bore.

I claim:

1. A carburetor for Otto cycle engines comprising:

- a. a carburetor body including at least one main passage, said passage beginning with an air inlet which connects to a fuel mixing region (7) which leads to a mixture outlet,
- b. a throttle disposed in said passage between said air inlet and said mixing region,
- c. a solid fuel metering orifice (2) connecting to said mixing region,
- d. a diaphragm chamber comprising a diaphragm, a fuel inlet valve and means linking said diaphragm to said fuel inlet valve, said diaphragm chamber feeding fuel to said fuel metering orifice,
- e. a second larger foam metering orifice (6) shunted between said fuel metering orifice and said fuel mixing region, this orifice being coaxial with said first orifice,
- f. a foam chamber shunted between said fuel metering orifice and said foam metering orifice,
- g. an air bleed passage (5) with an air bleed orifice (4) disposed therein ducting air from an inlet opening upstream of said throttle to said foam chamber,
- h. a tapered meteringrod (1) including means to couple said meteringrod to said throttle in such a manner that said

meteringrod is displaced substantially along its axis when the throttle is rotated,

- i. said meteringrod and said orifices being arranged in such a manner that said meteringrod reaches through both orifices, constricting both orifices at part load and enlarging both orifices at higher loads, said meteringrod and said orifices being so dimensioned that said foam orifice is narrowed down at idle to a fraction of the flow area of the air bleed orifice,
- j. the improvement comprising at least one spring acting upon said diaphragm, means to change the spring tension of at least one spring acting on said diaphragm, said means being connected to said throttle in such a manner that the effective fuel level established by said spring tension will be displaced towards said fuel metering orifice with increased throttle opening.

2. The carburetor of claim 1 in which said means to change the spring tension comprise an extension of said meteringrod (32) reaching into said diaphragm chamber and acting upon said spring.

3. The carburetor of claim 2 in which said spring (31) acted upon by said extension of said meteringrod is attached to said means linking said diaphragm to said fuel inlet valve.

4. The carburetor of claim 2 in which said spring (41) acted upon by said extension of said meteringrod is attached on one end to the wall of said diaphragm chamber and acts with its free end upon said means linking said diaphragm to said fuel inlet valve.

5. A carburetor for Otto cycle engines comprising:

- a. a carburetor body including at least one main passage, said passage beginning with an air inlet which connects to a fuel mixing region (7) which leads to a mixture outlet,
- b. a throttle disposed in said passage between said air inlet and said mixing region,
- c. a fuel-metering-orifice (2) connecting to said mixing region,
- d. a fuel-level-holding device feeding said fuel-metering-orifice,
- e. a tapered meteringrod (1) extending with its tapered part into said fuel-metering-orifice, including means to couple said meteringrod to said throttle in such a manner that said meteringrod is displaced substantially along its axis when the throttle is rotated,
- f. wherein the improvement concerns said means to couple said meteringrod to said throttle, said means comprising a lever, said lever having three linkage points, one being connected to the throttle, one being connected to said meteringrod, and the third one being connected to said carburetor body (15), said third linkage point being adjustable in its position relative to said body in such a manner that adjustment of said position results in changing the flow area of said orifice.

6. The carburetor of claim 5 in which said means to couple said meteringrod to said throttle are disposed inside said main passage, one of said linkage points (13) being attached to said throttle by means of an arm (12), said lever (10) being formed by a flat strip and being partly removed from said passage at wide-open throttle position by being swung into a slot (21) which is open to said passage, in such a manner that said lever offers a minimum of aerodynamic resistance to the flow inside said mixture passage.

7. The carburetor of claim 6 in which said linkage point (13) linking said throttle to said lever (10) is attached to said throttle by means of an arm (12) which is shaped so to detour to that side of said throttle which swings towards said air inlet when said throttle is opened.

8. The carburetor of claim 6 in which said meteringrod is loaded by a spring acting substantially in the direction of the axis of said meteringrod, and in which said linkage point connecting said lever and said meteringrod is displaced to one side of the axis of said meteringrod so that said spring and said linkage point from a force couple which tends to tilt said meteringrod towards one wall of said fuel metering orifice.

9. A carburetor for Otto cycle engines comprising:

- a. a carburetor body including at least one main passage, said passage beginning with an air inlet which connects to a fuel mixing region (7) which leads to a mixture outlet,
- b. a throttle disposed in said passage between said air inlet and said mixing region,
- c. a solid fuel-metering-orifice (2) connecting to said mixing region,
- d. a fuel-level-holding device feeding said fuel-metering-orifice,
- e. a second larger foam-metering-orifice (6) shunted between said fuel-metering-orifice and said fuel mixing region, this orifice being coaxial with said first orifice,
- f. a foam chamber shunted between said fuel-metering-orifice and said foam-metering-orifice,
- g. an air bleed passage (5) with an air bleed orifice (4) disposed therein ducting air from an inlet opening upstream of said throttle to said foam chamber,
- h. a tapered meteringrod (1) including means to couple said meteringrod to said throttle in such a manner that said meteringrod is displaced substantially along its axis when the throttle is rotated,
- i. said meteringrod and said orifice being arranged in such a manner that said meteringrod reaches through both orifices, constricting both orifices at part load and enlarging both orifices at higher loads, said meteringrod and said orifices being so dimensioned that said foam orifice is narrowed down at idle to a fraction of the flow area of the air bleed orifice,
- j. the improvement comprising the connection of said air-bleed (4) to the region of said main passage between said air inlet and said throttle (8) in such a manner that at least half of the Venturi suction is generated in said air bleed passage (5) at open throttle positions.

10. The carburetor of claim 9 in which said air bleed suction is increased by means of a booster Venturi (40).

11. A carburetor for Otto cycle engines comprising:

- a. a carburetor body including at least one main passage, said passage beginning with an air inlet which connects to a fuel mixing region (7) which leads to a mixture outlet,
- b. a throttle disposed in said passage between said air inlet and said mixing region,
- c. a solid fuel-metering-orifice (2) connecting to said mixing region,
- d. a fuel-level-holding device feeding said fuel-metering-orifice,
- e. a second larger foam-metering-orifice (6) shunted between said fuel-metering-orifice and said fuel mixing region, this orifice being coaxial with said first orifice,
- f. a foam chamber shunted between said fuel-metering-orifice and said foam-metering-orifice,
- g. an air bleed passage (5) with an air bleed orifice (4) disposed therein ducting air from an inlet opening upstream of said throttle to said foam chamber,
- h. and a tapered meteringrod (1) including means to couple said meteringrod to said throttle in such a manner that said meteringrod is displaced substantially along its axis when the throttle is rotated,
- i. said meteringrod and said orifices being arranged in such a manner that such meteringrod reaches through both orifices, constricting both orifices at part load and enlarging both orifices at higher loads, said meteringrod and said orifices being so dimensioned that said foam orifice is narrowed down at idle to a fraction of the flow area of the air bleed orifice,
- j. said means to couple said meteringrod to said throttle comprises a lever, said lever having three linkage points, one being connected to the throttle, one being connected to said metering rod, and the third one being connected to said carburetor body (15), said third linkage point being adjustable in its position relative to said body in such a manner that adjustment of said position results in changing the flow area of said first mentioned orifice.

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