June 15, 1965 R. E. KALERT, JR., ETAL 3,189,333

CARBURETOR

Filed June 29, 1962 2 Sheets-Sheet 1

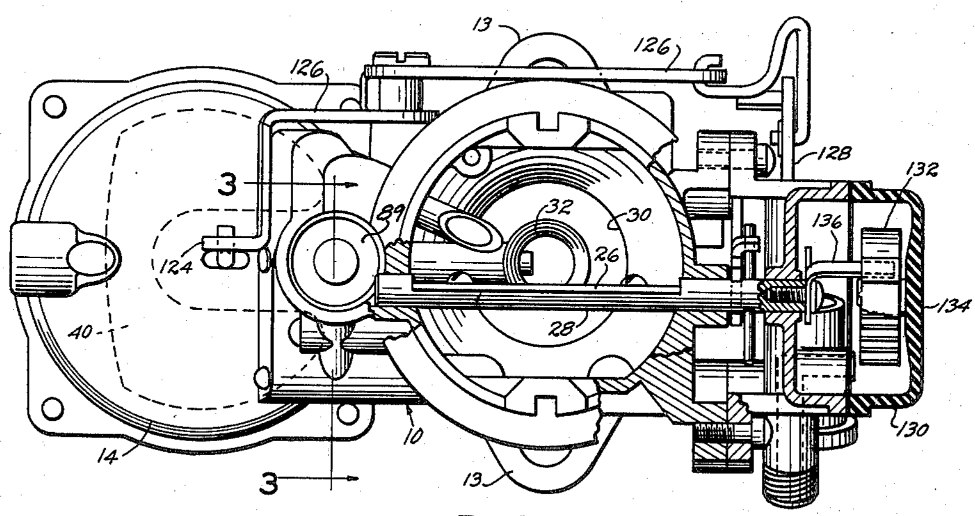

FIG. 1.

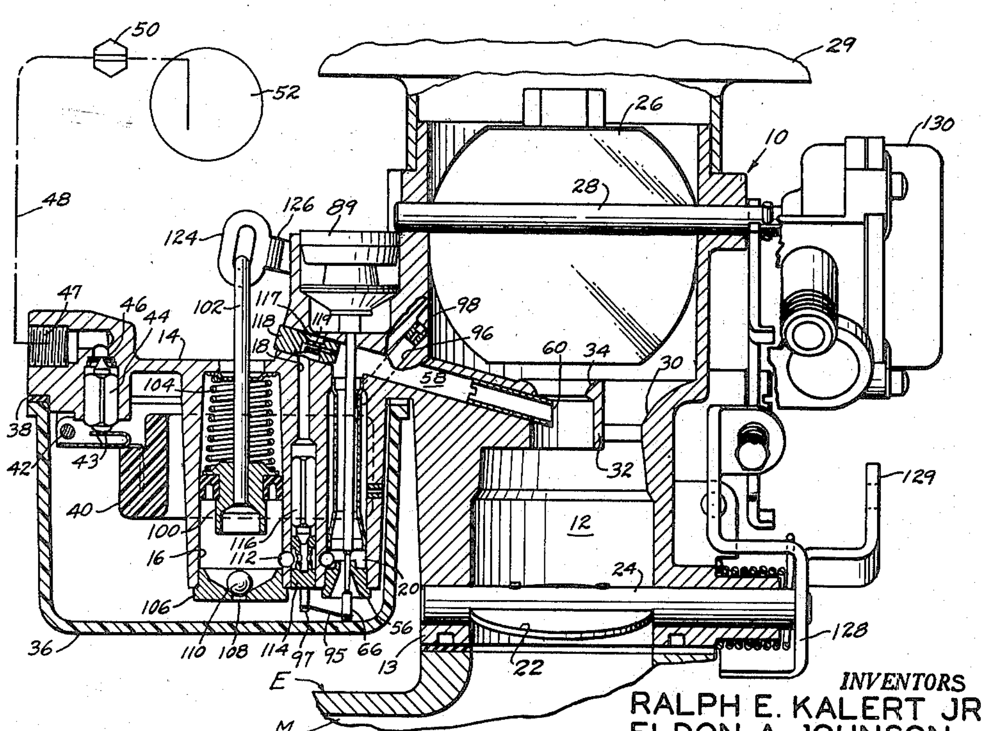

FIG. 2.

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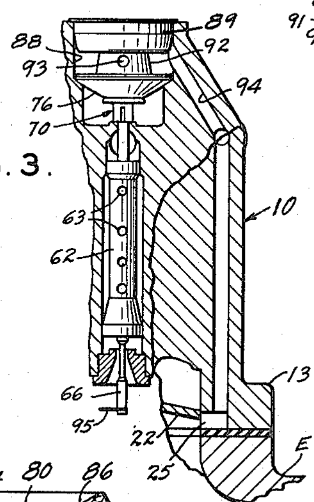

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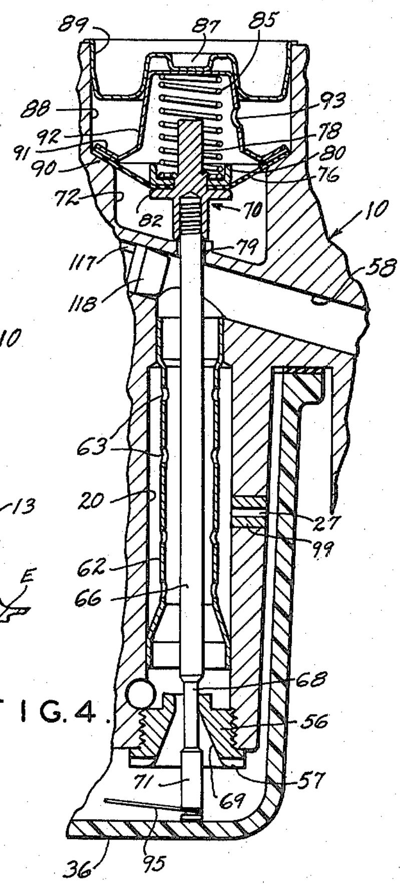

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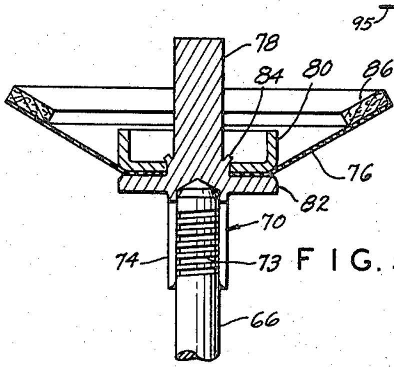

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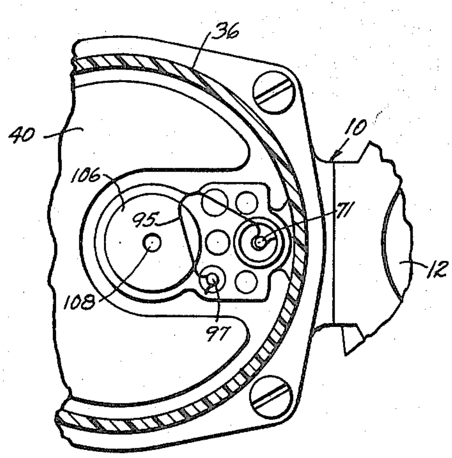

F I G. 6.

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3,189,333

CARBURETOR

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3 Claims. (Cl. 261—69)

This invention is directed to the fuel system for supplying fuel to an internal combustion engine and particularly to novel carburetor structure used in such a system.

In one type of carburetor the fuel passage from the source of fuel to the air and fuel mixing conduit of the carburetor includes a metering jet such as a predetermined restricted orifice to meter fuel to the mixing conduit. The fuel flow through this jet is metered or controlled in accordance with the demands of the engine. The type of carburetor described utilizes a metering rod with one end having a thickness of varying amounts. This end of the rod is arranged to be adjustably moved within the restricted orifice to provide more or less fuel, depending upon the demand of the engine. The metering rod is operated by an air motor connected to the mixing conduit of the carburetor downstream of the throttle, so that it is responsive to the pressure conditions of the intake manifold which vary during engine operation. The air motor consists of a diaphragm connected to the metering rod which moves the tapered end of the metering rod through the fuel metering jet to permit more or less fuel to pass through the jet in accordance with engine demands.

It is desirable in carburetors of this type that the diaphragm of the air motor be mounted and arranged to provide a maximum stroke or movement of the metering rod through the metering jet so that the metering of the fuel is not critical and sensitive to small movements of the metering rod. It is also desirable that the air motor be of an inexpensive design yet sufficient for proper operation of the carburetor.

It is another object of this invention to provide a fuel and air mixing device utilizing a novel carburetor structure including a metering rod in a fuel passage thereof which is designed for ease of fabrication and to minimize cost of production.

The invention is directed to a carburetor utilizing a fuel metering rod in the fuel passage thereof in which the fuel metering jet is at the base of a fuel well, which in turn is a portion of the body casting. This well portion of the body is suspended within the fuel bowl of the carburetor. The metering rod is arranged such that the tapered or metering end of the rod is operatively positioned within the fuel metering jet. The upper end of the metering rod is held within a releasable retainer for adjustment and replacement. The retainer forms a means for connecting the metering rod to a diaphragm actuated air motor movably operated by a spring in one direction and by atmospheric pressure in the other direction in response to manifold vacuum. The diaphragm is preformed and mounted within the carburetor to provide maximum movement of the metering rod.

FIGURE 1 is a plan view of a carburetor embodying the novel features of this invention.

FIGURE 2 is substantially a longitudinal sectional view of the carbuertor of FIGURE 1, which is shown mounted on an engine manifold and with an air filter partially in section.

FIGURE 3 is a partial sectional view of the carburetor of FIGURE 1 and along section lines 3—3 of FIGURE 1.

FIGURE 4 is an enlarged sectional view of a portion of FIGURE 3 illustrating the features of the invention.

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FIGURE 5 is a partial view of one end of a metering rod and metering rod retainer in accordance with the invention.

FIGURE 6 is a plan view from below of the metering rod assembly of FIGURE 2 with the fuel bowl removed.

The carburetor shown in FIGURES 1 and 2 consists essentially of a single casting 10, which is formed with a fuel and air mixture conduit 12 and a fuel bowl cover portion 14 from which is integrally formed a depending accelerating pump cylinder 16, an accelerating fuel passage 18 and a fuel well structure 20. As shown, the mixture conduit 12 is arranged and aligned vertically during operation and is connected by a flange 13 to the intake manifold M of an internal combustion engine E. In the lower part of the conduit 12 there is rotatably mounted a throttle valve 22 fixed to a throttle shaft 24 journaled in appropriately aligned apertures of the body casting 10. In the upper portion of the fuel-air mixture conduit 12 there is similarly mounted for rotational movement an unbalanced choke valve 26 fixed to a choke valve shaft 28, which is also journaled in aligned apertures through the body casting 10. To the top of the mixture conduit 12 is connected an air filter 29, partially shown in section in FIGURE 2. Between the upper and lower portions of the mixture conduit 12 is formed a venturi or air flow restricting surface portion 30. A small booster venturi 32 is formed integrally with the body casting 10 and has an inner venturi surface 34 coaxially aligned with the mixture conduit 12 and the primary venturi surface 30.

A plastic fuel bowl 36 is fixed beneath the fuel bowl cover 14 and is held with its rim tightly against a gasket 38 fitted between the rim of the fuel bowl 36 and matching portions of the fuel bowl cover 14. A float structure 40 is pivotally mounted from pin 42 journaled in a depending portion of fuel bowl cover 14. A lever arm of the float lever 43 fixed to float 40 abuts the lower end of a needle valve 44 having an upper tapered end extending into a valve seat 46 of the inlet 47 to the fuel bowl 36. A fitting may be threaded into inlet 47 to connect the carburetor to a fuel line 48. Fuel is forced under pressure by a pump 50 from a fuel tank 52, both schematically shown, through the fuel line 48 and into the carburetor inlet 47. With the fuel level in bowl 36 low, the float 40 is lower and lever arm 43 allows valve 44 to be pressed by fuel pressure and gravity to an open position. Fuel flows into the bowl 36 and when it reaches a predetermined level, the float lever 43 presses upwardly against the needle valve 44 to close the inlet to the fuel bowl.

The lower end of the fuel well 20 is closed by a threaded fitting 56 having a central orifice 69 (FIGURE 4) therethrough which is carefully formed to provide a metering jet for the flow of fuel from the fuel bowl 36 to the mixture conduit 12. A screw driver slot 57 is provided in the bottom of fitting 56 to provide for its removal. The upper end of the fuel well 20 intercepts a cross fuel passage 58 directed downwardly into the secondary venturi structure 32. A nozzle fitting 60 is press-fitted into the end of passage 58 and has one end thereof extending into the center of the secondary venturi surface 34. Press-fitted within the well 20 is a fuel emulsion tube 62 having apertures 63 therethrough along its length, as shown in FIGURE 4.

A metering pin 66 is suspended within the fuel well 20. Pin 66 has at its lower end 71 an intermediate reduced portion 68 positioned within the main fuel jet orifice 69 for operation in response to engine requirements. Flow of fuel through the main jet 56 is controlled by the metering rod 66 and in accordance with the rod portion 68 or 71 within the jet 56, as described below. The metering rod 66 is supported from a retainer 70 in which the upper end of rod 66 is frictionally engaged.

As shown in FIGURES 2 and 4, the metering rod 66 extends upwardly across the main fuel passage 58 and into a recess 72 formed in the upper portion of the carburetor body casting 10. The upper end of the metering rod 66 is threaded, as shown at 73 in FIGURE 5, and the retainer 70 has a bifurcated lower end 74 into which the threaded portion 73 of the rod is inserted. The threaded end of rod 66 together with the resilient bifurcations of the retainer portion 74, permits a tight frictional grip between these two structures, as well as a means for adjusting the position of the rod 66 relative to the retainer 70. In accordance with the invention, a diaphragm 76 is held on the retainer 70 by threading a central aperture of the diaphragm over the upper rod-shaped end portion 78 of the retainer 70. A cup washer 80 (FIG. 5) is pressed tightly down over the end 78 of retainer 70 to tightly fix the center portion of diaphragm 76 against a flat flanged portion 82 of the retainer 70. Small portions 84 of retainer 70 are struck out from the body of the retainer and bent over to lock the washer 80 tightly down against the flange retainer portion 82 with the diaphragm 76 in between.

As shown in FIGURE 5, diaphragm 76 is preformed in the shape shown in the figure from a substantially flat diaphragm material such as synthetic rubber coated nylon fabric. The preforming is done by placing the retainer and diaphragm assembly within a die having a conical surface of the shape shown by the portion of diaphragm 76 extending from its center. A paper washer or gasket 86 is formed into the conical configuration shown in FIGURE 5 and cemented around the upper periphery of the diaphragm 76. This is done by placing the cement on the under surface of the paper gasket 86 and placing the gasket around the upper peripheral edge of the conical diaphragm portion. Then a tool is brought down on top of the paper gasket 86 with a force of between 25 to 35 pounds per square inch and the temperature of the assembly is maintained between 175° and 225° F. for a curing time of substantially 5 seconds. This tightly bonds the gasket 86 to the upper periphery surface of diaphragm 76 and the pressure of the tool against the conical surface of the die with the diaphragm and gasket in between forms of the gasket and diaphragm assembly into the conical configuration shown in FIGURE 5.

A cylindrical bore (FIG. 4) is formed in the upper surface of the carburetor casting 10 and forms a continuation of the cavity 72. There is formed between bore 88 and cavity 72 an annular shoulder 90 having a conical surface conforming to the conical surface of the preformed diaphragm 76. In assembling the diaphragm and metering rod structure, the diaphragm and retainer assembly with the metering rod 66 attached is dropped through the bore 88 and the peripheral portion of the diaphragm, to which the gasket 86 is attached, fits down onto the annular conical surface of shoulder 90. One end of a coil spring 85 is fitted into the cup washer 80 and encloses the retainer end 78. A sheet metal thimble-shaped retainer 92 is placed within the bore in a position shown in FIGURE 4 with the upper end of spring 85 against the bottom of the retainer 92. The thimble retainer has a conical flanged rim 91 formed to match the surface of the shoulder 90. When the thimble-shaped retainer is placed within the bore 88, its flanged rim 91 fits around and over the surface of gasket 86. A sheet metal eyelet-cup 89 is press-fitted into the top of bore 88 and has a central re-entrant portion 87 which telescopes over the end of retainer 92 and tightly presses the retainer 92 downwardly into the bore 88 so that the flanged rim 91 of the retainer will force the gasket 86 and diaphragm 76 onto the surface of shoulder 90 with sufficient pressure to form a fuel-tight fit. Spring 85 is slightly compressed and will press the diaphragm and metering rod retainer assembly downwardly into its lowest position, as shown in FIGURE 4

To adjust the metering rod 66 within the jet 56 at the proper position, the metering rod is pressed upwardly from its lower end until the rod end 78 of the retainer 70 contacts the bottom of the thimble-shaped retainer 92, then, by additional pressure on rod 66, the threaded end 73 is moved upwardly within the bifurcated end 74 of the retainer 70 an amount necessary to provide the proper positioning of rod 66 in jet 56. In a carburetor successfully used with an internal combustion engine the bottom shoulder between the reduced portion 68 and portion 71 of rod 66 is positioned approximately 15 mils above the top surface of the metering jet 56. This then provides the proper position of the metering rod in jet 56 when the diaphragm is positioned upwardly to its highest extent during engine operation, such as during an idling condition of engine operation. In the carburetor described, the smallest metering portion of aperture 69 has a diameter of 0.089″ and the diameters of rod portions 68 and 71 are 0.062″ and 0.072″, respectively.

As shown in FIGURES 2 and 6, a light, thin, single strand hair pin spring 95 is fixed between the end of rod portion 71 and a fixed stud 97 extending from the suspended portion of the casting 10. Spring 95 has both ends formed with a loop with one of the ends fitted around a groove in the rod end 71 and the other end fixed around a grooved end of the stud 97. The bias of the spring is such as to move the end 71 of rod 66 away from stud 97 and against one side of the metering jet 56, as shown in FIGURE 4. The purpose of this is to provide a uniform flow of fuel through the jet at all times. It has been found that, if the metering rod 56 is allowed to move freely from side to side in the passage 69 of the jet 56. the flow curve varies from carburetor to carburetor and from point to point in the operation of the engine because of a non-uniformity of fuel flow to the engine. However, with the metering rod pressed in one position against the side of the jet, the opening in the jet apparently is maintained constant for like conditions and provides a uniform flow of fuel during engine operation.

An aperture 93 through the wall of thimble retainer 92 provides access from bore 88 to the inside of retainer 92. As shown in FIGURE 3, in particular, a passage 94 is formed through the body casting 10 to the flange portion 13 of the carburetor and opens at 25 into the mixing conduit and manifold M below or downstream of the throttle 22. In this manner, passage 94 connects the space above the diaphragm 76 to the manifold pressure of the engine.

A passage 96 (FIGURE 2) is formed between the mixing conduit 12 from a region between the choke valve 26 and the throttle valve 22 to extend downwardly into the upper portion of well 20. Within the passage 96 is press-fitted a restriction element 98 for controlling air flow through passage 96 into the well 20. As shown in FIGURE 4, well 20 is also connected to the fuel in bowl 36 by a passage 27. Fuel flow through this passage is controlled by a jet 99 of predetermined size in the order of 0.030 inch.

Mounted within the cylindrical recess 16 formed in body casting 10 is a pump piston 100 (FIGURE 2), which is connected to a pump piston rod 102. A spring 104 is fitted between the upper end of the pump cylinder 16 and the piston 100. The lower end of the pump cylinder 16 is closed by a fitting 106 having a central aperture 108 therethrough above which, biased by gravity, is a ball valve 110. A fuel passage 112 extends between the pump cylinder 16 and the cylindrical passage 18 formed in the body casting 10. Passage 112 permits fuel flow into a fitting 114 closing the lower end of cylindrical passage 18 and having at its upper end a valve seat in which the pointed end of a gravity biased check valve 116 is fitted. The cylindrical passage 18 extends upwardly and intercepts the main fuel passage 58, at which point a closure fitting

118 is fixed. Fitting 118 forms an annular channel 117 with passage 58. Channel 117 is connected with a small aperture 119 through which fuel can be ejected from the cylindrical passage 18 into the main fuel passage 58 under pressure from the pump piston 100. Aperture 119 is formed off axis relative to passage 58 so that the ejected fuel will not strike rod 66 and be directed into the well 20.

The operation of the structures described are as follows: Fuel from the fuel bowl 36 flows into both the pump cylinder 16 and the well structure 20, to fill these recesses to the level of the fuel in the bowl. Upon the turning over of the engine, air is sucked through the air filter 29 into the mixture conduit 12 and the intake manifold M. The flow of air through the booster venturi 32 provides a sub-atmospheric pressure within the venturi surface 34 which extends back through the fuel passage 58 to the upper end of fuel well 20. The atmospheric pressure on the surface of the fuel within bowl 36, as is conventional and as shown in Carlson et al. Patent No. 2,394,663, raises the fuel within the well 20 and simultaneously air is sucked through the restriction 98 and the bleed passage 96 into the upper portion of the fuel well. This air passes around and through the apertures 63 in the emulsion tube 62 to mix with the fuel and its vapor and to form an air-fuel emulsion. The emulsion is carried upwardly from the fuel well into the main fuel passage 58 and out the nozzle 60 to form a fuel and air mixture with the air passing through the mixture conduit 12. At high speeds, the flow of air through the apertures 63 in the emulsion tube 62 tends to remove all the fuel from between the well wall and tube 62 so that more apertures 63 are uncovered and an excessive amount of air passes into tube 62 to provide too lean a mixture. The provision of the fixed jet 99 and passage 27 from fuel bowl 36 allows the fuel level between the well wall and tube 62 to be maintained with the provision of a sufficiently rich mixture.

At low speeds, the throttle 22 is partially closed so that the manifold vacuum in the intake manifold M below the throttle 22 is relatively high. This vacuum is effective through the passage 94 upon the upper surface of diaphragm 76 so that atmospheric pressure against the under surface of diaphragm 76 will press the diaphragm upwardly and carry the metering rod and its retainer 70 with it in an upward direction. Atmospheric pressure is communicated from the fuel bowl 36 through the emulsion tube 62 through the clearance between the metering pin and the metering pin opening 79 into the lower portion of the cavity 72. This brings the thicker portion 71 of the metering rod end into the narrow top of jet orifice 69 to cut down the flow of fuel through this orifice in accordance with the lower engine speed. As the throttle 22 is opened progressively from low speed to high speed, the vacuum pressure in the manifold drops and spring 85 biases the diaphragm 76 and the metering rod 66 downwardly and retains the reduced portion 68 of the rod 66 in the jet orifice to provide a greater flow of fuel into the mixing conduit 12.

The accelerating pump rod 102 is connected with a lost motion connection 124 (FIGURES 1 and 2) by a linkage 126 to the throttle lever 128 which is fixed for simultaneous movement with the throttle shaft 24. Throttle lever 128 has an arm 129 adapted to be connected to any means for manual operation of the throttle 22. Any opening of the throttle by lever 128 will allow spring 104 through the lost motion connection 124 to press accelerating pump piston 100 downwardly and force fuel out of the lower portion of the pump cylinder 16 through passage 112 upwardly past the gravity biased valve 116 and into the annular portion 117 of the fitting 118. This accelerating fuel under pressure will spurt out of the passage 119 and will be directed into the nozzle structure 60 to provide additional fuel for the increased air flow due to the opening of the throttle 22. This provides rapid response of the engine upon opening of the throttle.

A low speed or idle fuel circuit is provided in the carburetor leading from well 20 to the idle port adjacent to throttle 22. This circuit is not shown in this application as it does not constitute a part of the invention. However, it may be similar to that described and disclosed in the copending application of Ralph E. Kalert, Jr. and Jesse L. Szwargulski, Serial No. 146,896, filed October 23, 1961.

The choke valve 26 is controlled during cold weather and during cold starts by a thermostatic choke control device enclosed in a housing structure 130. The choke control consists of a thermostatic coiled bi-metallic spring 132 having one end fixed to a stationary stud 134 mounted on the housing 130. The other end of the thermostatic spring rests against one arm 136 of a lever fixed to the choke shaft 28. When the engine is cold, the thermostatic spring is tensioned in one direction to press against the end of the lever 136 and rotate the choke valve 26 toward a closed position. The flow of air through the mixing conduit 12 at this point will partially open the unbalanced choke valve 26 to permit sufficient air to pass on into the intake manifold M. As the engine heats up, the spring 132 relaxes and releases the end of lever 136 so that after a predetermined temperature has been reached the thermostatic coil 132 has no effect on the choke 26, which now will remain open by gravity, due to its unbalanced construction. The details of the choke are shown and described in the copending application of Jesse L. Szwargulski, Serial No. 140,371, filed September 25, 1961.

The novel design and construction of the metering pin support and diaphragm assembly is one which provides an inexpensive yet operatively effective construction. The diaphragm by being prestressed and assembled in its lowest extreme position permits an upward movement of maximum stroke. This permits the reduced portion 68 of rod 66 to be of sufficient length that its movement through the jet 56 is not critical and small displacements of rod portion 68 in the jet will not be sensed by a change in flow of fuel through the jet. When the engine is at low speed or idling such that the manifold vacuum is high, in the order of 18 inches of mercury, the diaphragm is forced by atmospheric pressure to its uppermost position. This places the larger portion 71 of the rod 66 in the upper metering portion of jet 56. Any drop in manifold vacuum reduces the force of atmospheric pressure on diaphragm 76 and spring 85 presses rod 66 downwardly to place the reduced rod portion 68 within the jet to increase fuel flow. As the shoulder between the rod portions 68 and 71 falls below the upper metering part of the jet passage 69, the fuel flow through the jet begins to increase. Manifold vacuum tends to drop as the throttle is opened from a closed position and thus the movement of the reduced portion 68 of rod 66 into the jet coincides with greater need for fuel as the throttle opens. This longer stroke of the metering rod between its lower and upper positions permits the shoulder between rod portion 71 and 68 to pass through the jet quickly, so that the transition from low fuel flow conditions to high fuel flow conditions is accomplished without any critical delay or effect. A diaphragm and rod assembly having a small range of movement would necessitate a critical adjustment of rod 66 and one in which the transition from the reduced portion of the rod to the large portion of the rod must be made within a very critical distance.

Thus, the metering rod 66 substantially operates as an off and on construction. That is, the fuel flow is either restricted by the large portion 71 of the rod or is less restricted by the reduced portion 68 of the rod and with little or no effect produced by the shoulder between the rod portions. The mounting of the diaphragm and holder assembly within the recess 72 and bore 88 is done effectively by the use of inexpensive sheet metal constructions consisting of the thimble-shaped retainer 92 and the sheet metal cup 89. The cup itself being resilient can be thus press-fitted with sufficient force into the bore 88, where it is retained effectively to seal the diaphragm 76 against the shoulder 90. These sheet metal constructions eliminate the necessity of threaded fittings of solid metal which are more expensive to provide and to fabricate. Furthermore, the use of a diaphragm air motor instead of a piston and a cylinder arrangement further reduces costs yet is effective because of its novel design and assembly. The design then of the invention is such as to provide an effective operating motor for metering rod control and one which is inexpensive and easy to fabricate and assemble.

What is claimed is:

1. A carburetor for an internal combustion engine, said carburetor comprising a fuel reservoir, a body formed with an air and fuel mixture conduit adapted to be connected to the intake manifold of said engine, said body including a fuel passage extending between said fuel reservoir and said mixture conduit, a throttle movably mounted within said mixture conduit, said fuel pasage including a portion having a predetermined restriction, a metering rod having one end thereof shaped with a varying thickness and positioned within and for movement through said passage restriction, a metering rod retainer fitted to the other end of said metering rod, said body formed with a cavity and an annular conical shoulder within said cavity, a generally cone-shaped diaphragm mounted across said cavity with the periphery of said diaphragm fitted to said shoulder and the central portion of the diaphragm extending toward said restriction, a sheet metal thimble-shaped retainer mounted within said cavity, said retainer having a rim portion thereof pressing the periphery of said diaphragm against said shoulder, said metering rod retainer fixed to the center of said diaphragm, a spring between the bottom of said thimble-shaped retainer and one side

of said diaphragm to bias said diaphragm in one direction, said body formed with a passage extending from said cavity on said one side of said diaphragm to said mixture conduit downstream of said throttle to connect said cavity to low air pressure within said engine intake manifold whereby said diaphragm may be moved against the bias of said spring, and a sheet metal cup pressed into said cavity against the bottom of said thimble-shaped retainer and forcing the rim of said thimble-shaped retainer onto the periphery of said diaphragm to form a fuel-tight seal of said diaphragm on said shoulder.

2. The combination as defined in claim 1 in which the upper face of the periphery of the cone-shaped diaphragm has fixed thereto an annular gasket which is engaged by the rim portion of the sheet metal thimble-shaped retainer to effect a seal between the parts.

3. The combination as defined in claim 1 in which the sheet metal cup is press fitted into the top of the cavity and includes a central re-entrant portion which telescopes over the end of the thimble-shaped retainer to provide stop means to prevent displacement of the latter.

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