

Oct. 14, 1952

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2,613,658

CHARGE FORMING DEVICE

Filed Jan. 15, 1946

4 Sheets-Sheet 1

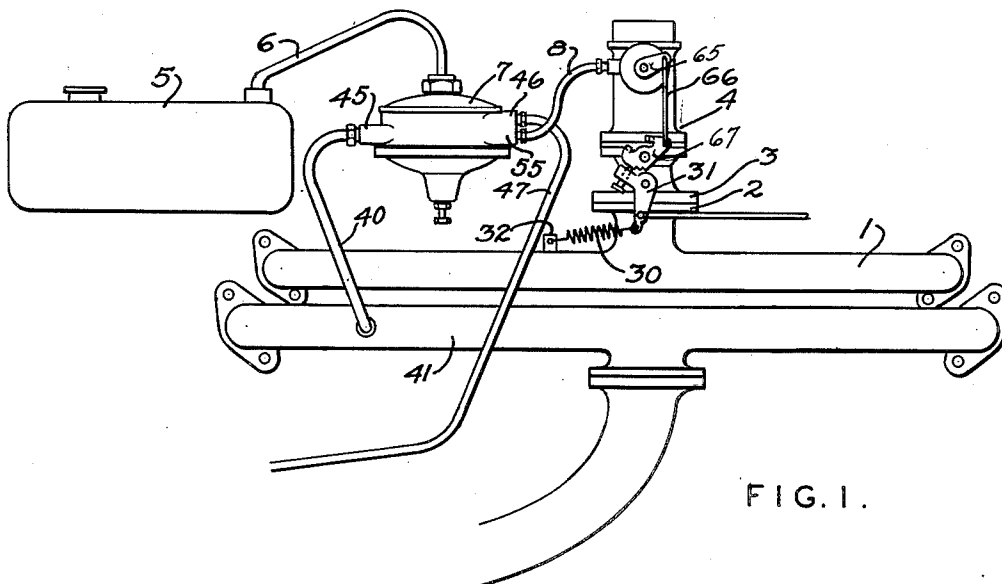


FIG. 1.

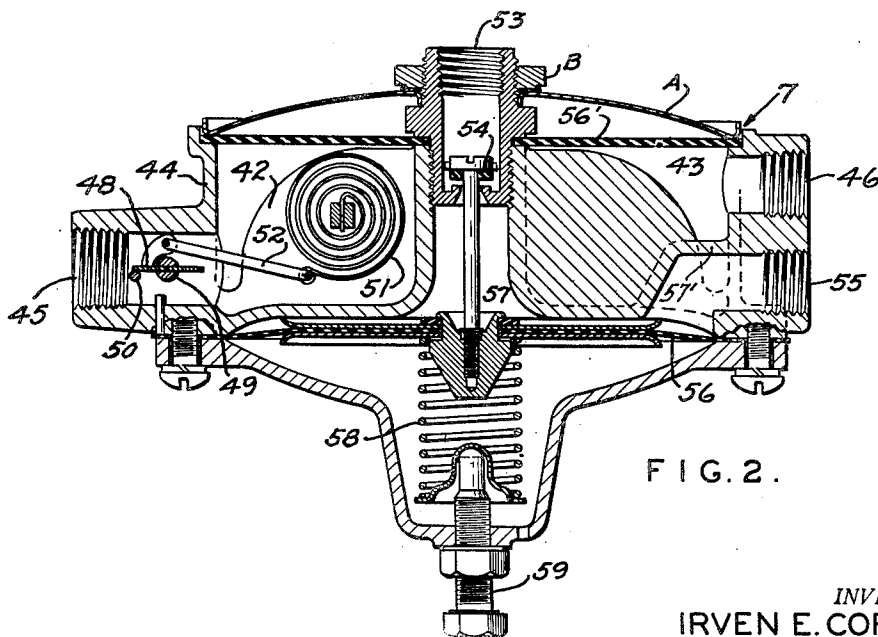


FIG. 2.

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4 Sheets-Sheet 2

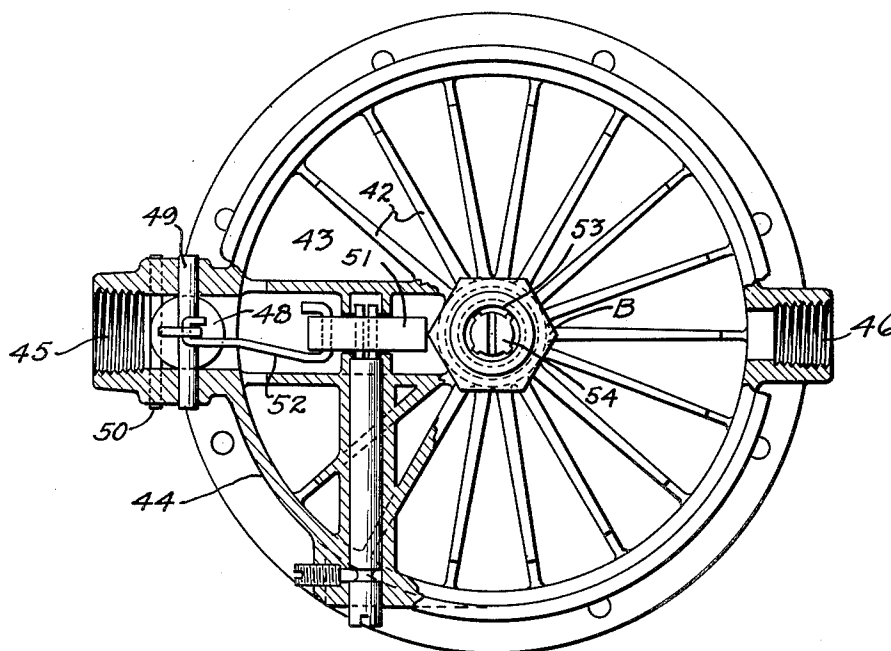


FIG. 3.

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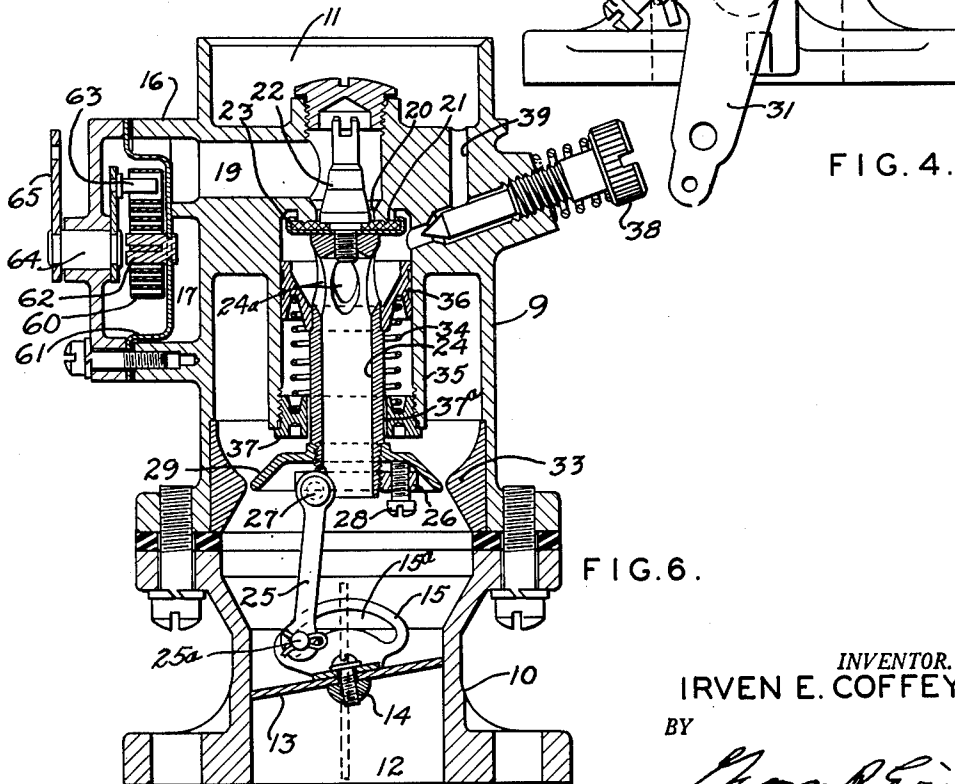
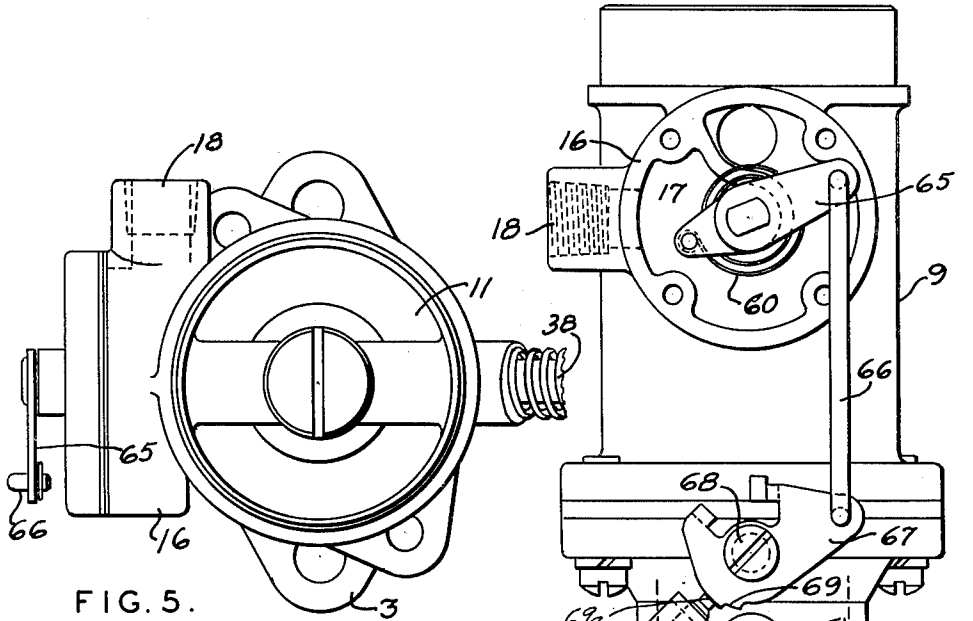
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CHARGE FORMING DEVICE

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4 Sheets-Sheet 3



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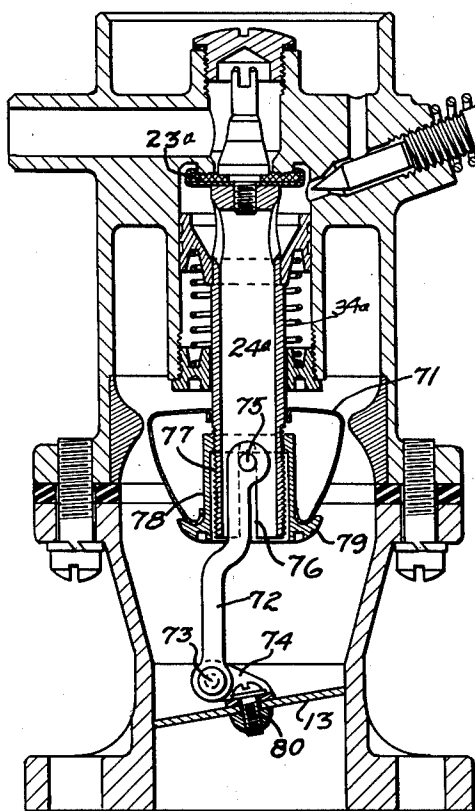
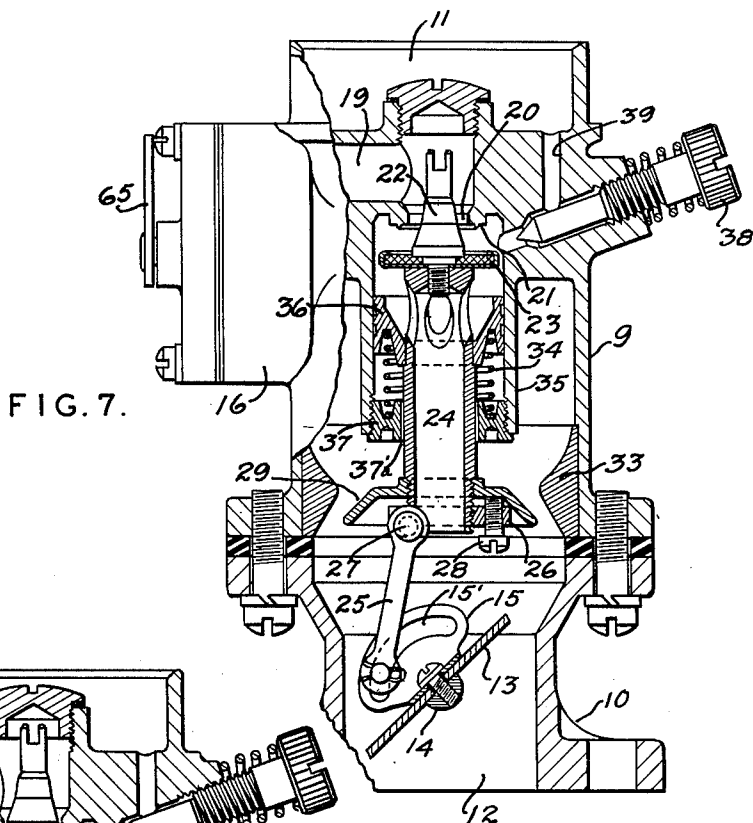
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CHARGE FORMING DEVICE

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4 Sheets-Sheet 4



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CHARGE FORMING DEVICE

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4 Claims. (Cl. 123—133)

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This invention relates to charge forming devices for internal combustion engines and particularly to devices for preparing and metering fuels that are highly volatile or gaseous at normal atmospheric temperatures and pressures, such as propane or butane. Such fuels must be stored in heavy tanks under pressure so that they can be conveniently transported or carried by the motor vehicle in which they are to be used. They cannot be used in an ordinary carburetor, because of the extreme volatility and also because of the frosting which occurs when the gas is discharged into the air stream.

It is the general object of this invention to produce a new and improved charge forming device capable of handling highly volatile or gaseous fuels.

Another object is to provide novel means for preventing or reducing frosting within the carburetor.

Other objects and advantages of the invention will be apparent in view of the following description and accompanying drawings, referring to which:

Fig. 1 is a diagram showing the application of the device to the manifold of an internal combustion engine.

Fig. 2 is a sectional elevation of the fuel heater and pressure control device.

Fig. 3 is a plan view of the fuel heater with the cover removed and portions broken away and sectioned.

Fig. 4 is a side elevation of the carburetor or charge forming device, the thermostat cover being removed.

Fig. 5 is a plan view of the device shown in Fig. 4.

Fig. 6 is a sectional elevation of the charge forming device.

Fig. 7 is a partial sectional elevation corresponding generally to Fig. 6, but with the parts in different operating positions.

Fig. 8 is a sectional elevation corresponding substantially to Fig. 6 but showing a modified form of the invention.

The reference numeral 1 indicates the intake manifold of an internal combustion engine. This manifold is provided with an inlet opening surrounded by flange 2 upon which is mounted the lower flange 3 of the carburetor 4. The carburetor is supplied with gaseous fuel such as propane stored under pressure in a main tank 5 from which it is conducted through conduit 6 to a fuel heating vaporizing and pressure regulating device 7 from which it is conveyed in gase-

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ous form and at regulated pressure through conduit 8 to the carburetor.

The carburetor comprises a main body member 9 carried by lower flanged member 10. Air is admitted at the inlet 11 and the fuel mixture is discharged through the outlet 12, the flow being regulated by throttle 13 carried by shaft 14 to which is fixed a quadrant 15 having an arcuate, concentric slot 15a. The carburetor is provided with a housing 16 having chamber 17 to which the gas is initially admitted from the connection 18. The interior of the housing is connected to a cross passage 19 terminating in a vertical passage or orifice 20 surrounded by valve seat 21. The passage 20 is accurately calibrated with respect to a metering valve 22 and the valve seat 21 is controlled by the valve 23. Metering rod 22 and valve 23 are carried by a tubular stem 24 which is connected to the quadrant 15 by means of link 25 and pivot pins 25a and 27. The link is directly connected to the screw threaded adjusting member 26, a lock screw 28 being mounted in member 26 and arranged to lock against the air operated skirt 29 at the base of tube 24. Link 25 and quadrant 15 are so arranged as to permit slight opening of valve 23 when the throttle 13 is closed and to limit downward movement of valve 22 in accordance with the throttle position. Gas enters tube 24 through ports 24a in the upper part thereof. When the throttle is opened, valve 23 may be opened by the air flow or suction acting on skirt 29 so as to vary the position of fuel valve 22 and, consequently, the effective size of the fuel metering orifice.

The throttle valve is normally held in closed position by means of the return spring 30 which has one end connected to the throttle control lever 31 and the other anchored to a part of the engine as at 32. The carburetor is provided with a restriction or Venturi tube 33 which cooperates with the air valve 29 in such a manner as to insure opening of the gas valve 23 in accordance with the air flow but not necessarily to the full extent permitted by the position of the throttle 13. The gas valve is normally held in closed position by means of a spring 34 bearing against a piston 35 working in a cylinder 35, the piston and cylinder acting as a dash pot for air valve 29. The dash pot is nearly but not entirely sealed at the lower end by the screw plug 37, as indicated at 37a, for the purpose of insuring a slight resistance to rapid fluttering of the valve which might otherwise occur.

In order to provide a manual adjustment for

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the fuel mixture, a regulating screw 38 is provided to control the by-pass 39 which permits a small amount of air to be added to the gas before it enters the tube 24.

Regardless of the fact that the compressed gas is extremely volatile, heat must be supplied to insure its rapid conversion to gaseous condition so that it can be handled and regulated or metered by the carburetor. The use of the cooling water of the engine has previously been suggested for this purpose but this has been unsatisfactory because it takes it too long to warm up when the engine is started.

In accordance with my invention the heat exchange device 7 (Figs. 2 and 3) is connected to a conduit 40 receiving heated gases from the exhaust manifold 41 and carrying it between fins 42 radially mounted in the chamber 43 formed in the body casting 44 of the heat exchange device. The exhaust is led in at 45 from the conduit 40 and discharged to the atmosphere through connection 46 and conduit 47. Its flow is controlled by a butterfly valve 48 pivoted on a shaft 49 in passageway connection 45. A stop member comprising a transverse pin 50 limits the opening movement of valve 48 and a bi-metallic, heat-responsive coil 51 is mounted in the path of the exhaust gas at the inlet of the device and connected to the valve 48 by means of the link 52 so as to maintain a predetermined temperature in the heat chamber.

The liquid fuel which is contained under pressure in the tank 5, is admitted through tube 6 and fitting 53 past a control valve 54 and out through the outlet 55 and conduit 8 to the carburetor. Chamber 57 is sealed from exhaust chamber 43 by a web 57'. A synthetic rubber diaphragm 56, responsive to the pressure in the chamber 57 posterior to valve 54, controls this valve in such a manner as to maintain a predetermined pressure in the chamber 57 and conduit 8. Whenever this predetermined pressure is reached, diaphragm 56 moves downwardly and closes valve 54 and keeps it closed until the pressure is again reduced. Valve 54 is normally held in open position by a spring 58 which is adjustable by means of a screw 59 so as to cause the valve 54 to close at the predetermined pressure. The upper wall of the regulating device is formed of diaphragm 56' clamped in position by the spring plate A secured by the nut N threaded on the inlet nipple 53.

In order to insure the maintenance of carburetor or throttle 13 in a sufficiently open position for starting and warming up, a bi-metallic thermostatic coil 60 is mounted in housing 16 but separated from the chamber 17 by a rigid metallic diaphragm 61. Coil 60 has its center rigidly mounted on the post 62 and its outer end operates an arm 63 mounted on a shaft 64 which also mounts a lever 65 connected by a link 66 to a cam 67. This cam is mounted on pivot 68 and has a low point 69 and a high point 69a which selectively underlie the throttle adjusting screw 70. At low temperatures, screw 70 engages high point 69a to limit throttle closing to the cold starting and fast idle position. As the engine approaches normal temperature, low point 69 moves beneath the screw so that the throttle may close to its normal idling position.

The modified form of the device shown in Fig. 8 is generally similar to that shown in the other figures except that the flow responsive element 71 is hollow and has a different shape or formation from element 29 of Fig. 6. In this modification the element is generally of inverted frusto-conical

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shape with its widest diameter positioned in the area of the restricted portion of the venturi during closed throttle position. The link 72, which connects the throttle 13 with the tube 24a, includes a medial, off-set portion which positions its lower extremity for connection with the off-set pivot 73 at the end of lug 74 on the throttle, and the upper end of the arm extends centrally of the tube 24a where it mounts the pivot pin 75 which slides in the open ended slot 76 formed in the tube. By this construction movement of the throttle permits movement of the gas valve 23a against spring 34a in response to the flow of air, this movement being controlled by the position of the throttle. It will be noted that the lower end portion of tube 24a is provided with screw threads 77 and the collar 78 is threaded on the tube and supports at its flared bottom portion 79 the hollow valve structure 71. By this arrangement, element 71 may be adjusted with respect to the venturi by adjusting collar 78 on the threaded extremity of the tube 24a. To permit convenient connection of the link 72 to throttle 13, lug 74 is secured in position by the bolt 80, lug 74 extending laterally to provide essential leverage for proper operation of the parts.

In operation, highly volatile fuel such as propane, butane, or the like is stored in the tank 5 under sufficient pressure to keep it in liquid form at atmospheric temperatures. This pressure will vary and may be 200 pounds per square inch on a hot day or may fall to substantially atmospheric pressure when the temperature is below zero. However, it is assumed that sufficient pressure will be maintained in the tank to insure flow to the carburetor and if this pressure is not sufficient, any suitable fuel supply means such as a pump may be used. Fuel is supplied from the tank 5 through conduit 6 to the vaporizing and pressure control device 7 shown in detail in Figs. 2 and 3. The main control diaphragm 56 is exposed to fuel pressure on the upper side and atmospheric pressure on the lower side through a vent in the bottom of the housing so that whenever the pressure in the chamber 57 tends to rise, the diaphragm is moved downwardly carrying the valve 54 towards closed position. The spring 58 is calibrated and adjusted by means of the screw 59 to maintain the desired pressure normally in the order of two pounds per square inch.

The complete vaporization of the fuel in the chamber 57 is assured by exhaust gas conduit 40 which is connected to the exhaust manifold and leads into the heat chamber 43 by means of the connection 40. The heated exhaust gas flows through chamber 43 in which it is exposed to a series of heating fins 42 which receive heat from the exhaust gas and apply it to the fuel contained in the chamber 57. A predetermined temperature in chamber 43 is maintained by thermostat 51 which is connected to valve 48 so as to cut down the flow of exhaust gas when the temperature is high.

Back-fire pressure is relieved in the structure of Fig. 8 by having the conical air valve 71 mounted for free sliding movement on the supporting structure, the limit of movement of the air valve under back-fire pressure being determined by the screw plug 37 against which the upper face of the air valve abuts.

The gasified fuel flows under the predetermined pressure out of heater chamber 57 through outlet 55 and conduit 8 into the carburetor connection 18. Passageway 19 conveys the gas to the calibrated passage 20 which is normally sealed by valve 23 when the engine is not run-

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ning. When the engine is cranked, valve 23 is opened by the action of the suction on skirt element 29 to permit the gas to flow through passage 20 subject to the restricting action of the metering valve 22 so that a mixture is formed posterior to the valve 29 and at ports 24a of tube 24. Since the position of the metering rod 22 is varied in accordance with the position of the skirt 29, a mixture of correct ratio may be maintained at varying rates of air flow through the carburetor.

When the engine is cold it will not develop sufficient power with the throttle in idling position to keep the engine in operation. For that reason, I provide thermostat 60 which adjusts arm 65 and link 66 (Fig. 4) to bring stop cam 69 into the path of throttle stop screw 70 so that when the throttle is once moved to partially open position, as it should be for starting, it cannot fully return to the idling position under the action of the throttle closing spring 30 but will rest on the thermostatically positioned cam 69 permitting sufficient flow of mixture to the engine to develop power necessary for operating at such low temperature.

In order to insure the closing of the valve 23 when the throttle 13 is closed without the danger of straining the link or throttle, a slight clearance is provided between pin 25a and the left hand end of slot 15a (Fig. 6) when the throttle is closed. The throttle may be moved to fully open position without opening valve 23 because of the lost motion action of the quadrant 15 or the slotted connection of Figure 8.

Thus, fully vaporized fuel is mixed with the air in accurately metered quantities under all conditions for practical and efficient use of highly volatile fuels such as propane or butane. The invention may be modified in various respects as will occur to those skilled in the art and the exclusive use of all modifications as come within the scope of the appended claims is contemplated.

I claim:

1. In a gas carburetor, a mixture conduit, a gas admission valve therefor, a manually operable throttle in said conduit, a restriction in said conduit mounted to be shifted in response to change of rate of fluid flow therein, a connection between said restriction and said gas valve, and a lost motion mechanical connection between said throttle and said gas valve for causing closing of said gas valve when said throttle valve is closed while permitting said throttle valve to be moved to at least partially open position without opening said gas valve.

2. The method of supplying a highly volatile fuel to an internal combustion engine which includes vaporizing said fuel in quantities determined by the fuel pressure, feeding said vaporized fuel to a mixing chamber and automatically regulating the quantity of vaporized fuel in accordance with air flow in said mixing chamber as determined by engine suction and temperature of said vaporized fuel.

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3. In a charge forming device for normally gaseous fuels, means forming a mixture conduit having a mixing chamber and a constriction, a throttle valve in said conduit, a fuel inlet and an air inlet for said chamber, metering means operably associated with said fuel inlet for varying the amount of fuel entering said mixing chamber, a body movably mounted in said conduit adjacent said constriction and shiftable toward open position upon increase in air flow in said conduit, a mechanical connection between said metering means and said movably mounted body for operating said metering means by movement of said body, and a part movable with said throttle and positioned to obstruct and limit the movement of said body in accordance with the throttle position.

4. In a charge forming device for normally gaseous fuels, means forming a mixture conduit having a mixing chamber and a constriction, a fuel inlet and main and auxiliary air inlets for said chamber, metering means operably associated with said fuel inlet for varying the amount of fuel entering said chamber, an element movably mounted in said conduit adjacent said constriction and normally restricting the flow through said constriction, said element being shiftable toward a less restricting position upon increase in air flow, a throttle valve, mechanical means operatively connecting said metering means and said element, and a manually adjustable valve in said auxiliary inlet for adding a predetermined amount of air to said fuel while it is being metered.

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