Sept. 21, 1965 W. G. KINGSLEY ETAL 3,207,491

FUEL METERING DEVICE FOR CARBURETORS

Original Filed July 7, 1961 3 Sheets-Sheet 1

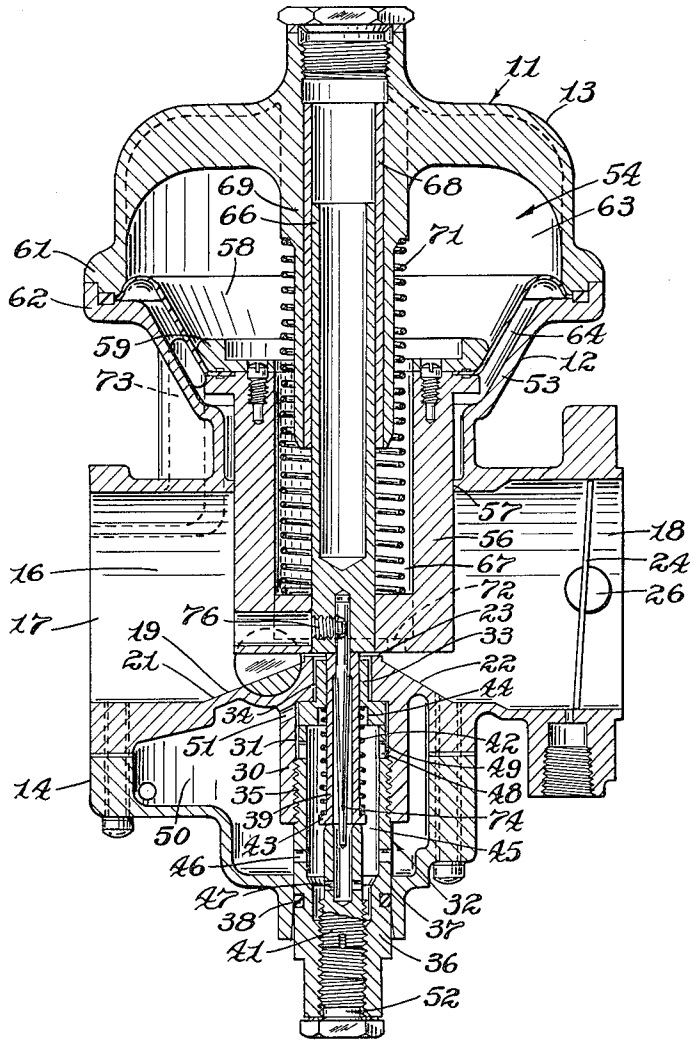


Fig. 1

WITNESS:

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FUEL METERING DEVICE FOR CARBURETORS

Original Filed July 7, 1961 3 Sheets-Sheet 2

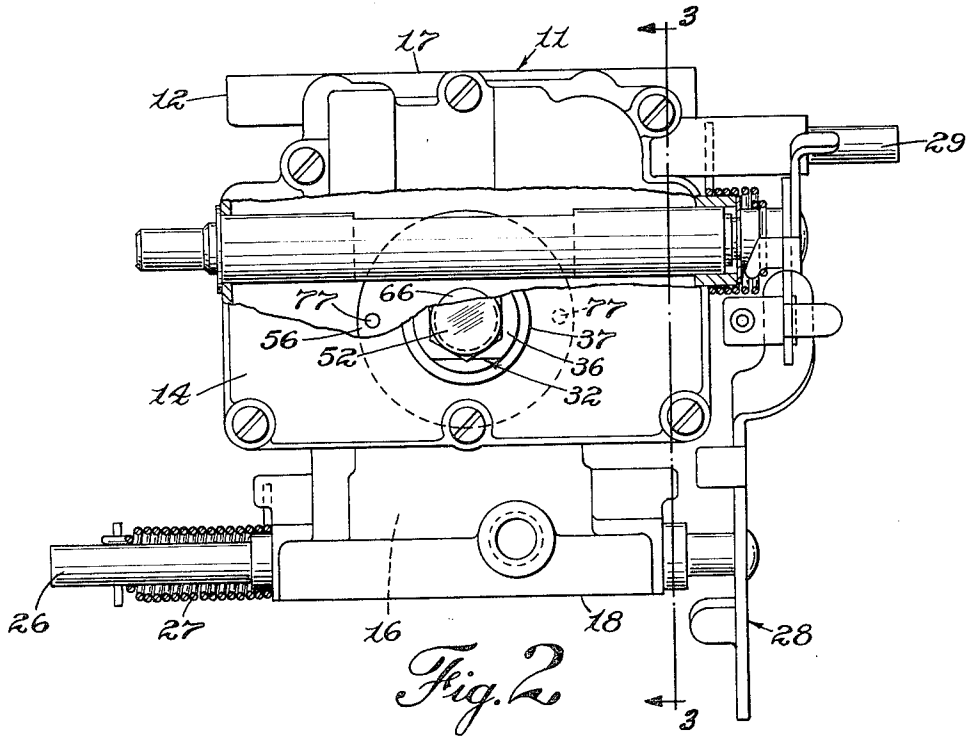


Fig. 2

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FUEL METERING DEVICE FOR CARBURETORS

Original Filed July 7, 1961 3 Sheets-Sheet 3

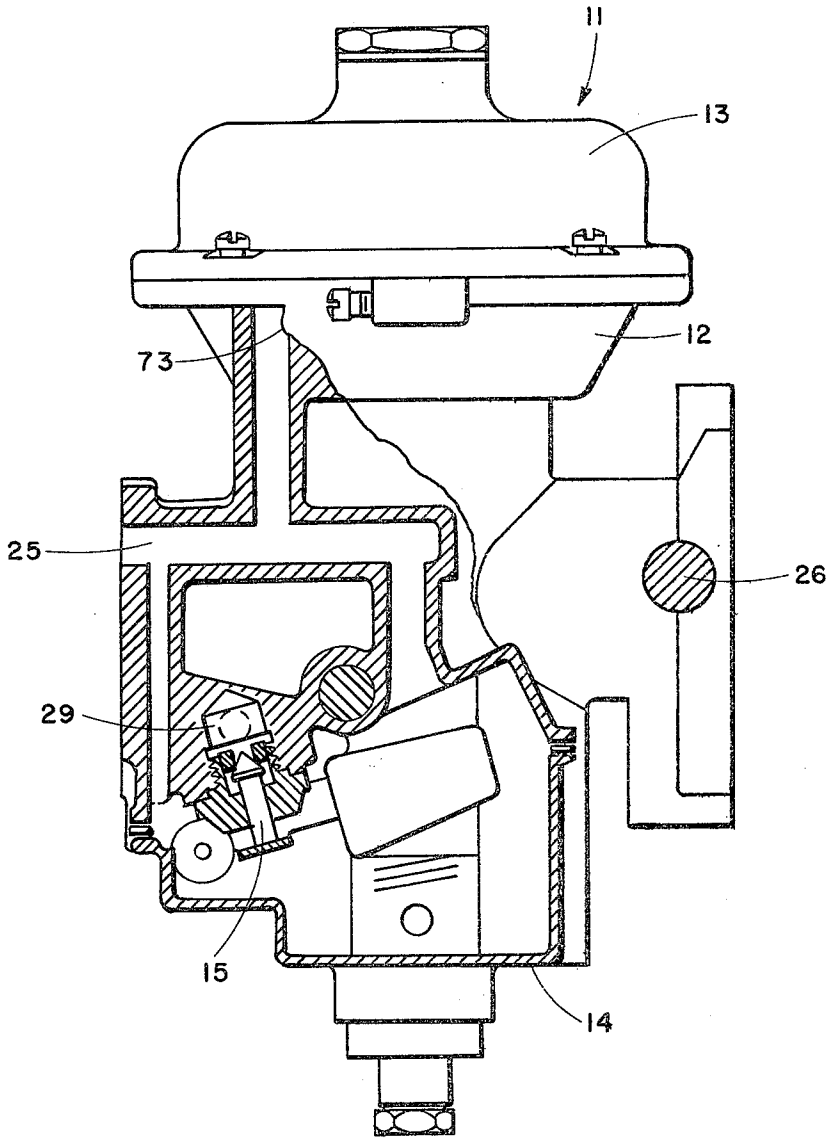


FIG. 3

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FUEL METERING DEVICE FOR CARBURETORS

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Original application July 7, 1961, Ser. No. 122,462. Divided and this application June 18, 1962, Ser. No. 203,162

3 Claims. (Cl. 261—44)

This application is a division of the copending Kingsley application, Serial No. 122,462, filed July 7, 1961.

The present invention relates to an improvement in a carburetor for internal combustion engines and, in general, relates to an improvement in the air valve type of carburetor. More particularly, the invention relates to fuel metering means for air valve carburetors which are adapted for controlling fuel vapor and percolation occurring between the fuel chamber and the fuel discharge orifice.

An air valve carburetor may include either a piston, poppet, butterfly, etc., type of valve that is responsive to air flow changes. In the case of a piston type air valve the piston is mounted in the body and a compartmentized chamber articulates the piston for reciprocal movement in the mixture passage to provide an approximately constant air velocity over the metering orifice of a fuel jet assembly. A tapered needle valve carried by the piston projects into the orifice disposed in a bridge portion of a contoured restriction in the mixture passage to provide the fuel metering means. The piston and needle valve in combination are frequently referred to as the air valve. Posterior of the contoured restriction a throttle valve controls the introduction of the fuel-air mixture to the engine manifolding. Reciprocal piston movement to vary the air flow responsive to throttle valve position changes results from the pressure differentials existing between the pressure in a portion of the mixture passage and a reference pressure usually atmospheric. The piston thus serves to vary the air flow in the mixture passage so as to maintain a substantially constant air velocity and a substantially constant vacuum between the air valve, the bridge and the fuel orifice. Differences in the vacuum existing in the mixture passage between the bridge and throttle valve are communicated to the compartmentized chamber and will cause piston movements so as to vary the air flow and maintain the value of vacuum asserted on the orifice at a substantially constant value. Since the needle valve is connected to the piston, any movement of the piston will necessarily vary the needle valve-jet assembly orifice restricting characteristics by varying the effective orifice area and allowing a greater or lesser amount of fuel to be atomized.

Air valve carburetor constructions, as heretofore used or proposed, have one very definite limitation, that being poor vapor control characteristics. The prior art structures use a separately located fuel chamber and an associated fuel metering means both of which are exposed to ambient heat, a construction which tends to be highly susceptible to the creation of fuel vapor and percolation. The fuel vapor difficulties are generally known to occur between the fuel chamber and the metering orifice opening into the induction or mixture passage. It is, therefore, a primary object of the present invention to provide an air valve type of carburetor with a fuel chamber and fuel jet assembly having desirable fuel vapor and percolation control characteristics.

It is an object of the present invention to provide a fuel metering means for carburetors which is simple in construction, efficient and reliable in operation, and economical to manufacture and fabricate.

It is an object of the present invention to provide a fuel jet assembly, including vapor and percolation controlling means therein, for an air valve carburetor.

It is another object of the present invention to provide an air valve carburetor using an attached fuel chamber supported by the carburetor body adjacent a contoured restriction in the mixture passage, and having a fuel jet assembly communicating between the mixture passage and the fuel chamber, said jet assembly including vent means within its structure adapted to circulate fuel vapor back into the fuel chamber and away from the fuel metering orifice of the fuel jet assembly.

It is still another object of the present invention to provide an air valve carburetor having a fuel jet assembly which is surrounded by a cooling fuel supply to thereby assist in the prevention of fuel vapors and percolation.

The invention further resides in certain novel features of construction and combinations and arrangements of parts, and further objects and advantages thereof will be apparent to those skilled in the art to which it pertains from the following description of the preferred embodiment thereof described with reference to the accompanying drawings in which similar reference characters represent corresponding parts throughout the several views, and, in which:

FIGURE 1 is a longitudinal sectional view illustrating an air valve carburetor embodying the present invention;

FIGURE 2 is a bottom view, partly broken away and in section, illustrating an air valve carburetor embodying the present invention; and,

FIGURE 3 is a longitudinal view partly in section taken along the section line 3—3 of FIGURE 2, illustrating in particular a float operated valve mechanism for maintaining normal fuel level. FIGURE 3 shows a conventional float-operated valve mechanism. No part of said fuel valve detail constitutes part of the invention.

Now referring to the drawing and more particularly to FIGURE 1, there is illustrated an air valve carburetor generally designated **11** consisting of a body **12**, a cover assembly **13** and a fuel chamber **14**. A mixture passage **16**, providing at its extremities an air intake **17** and a mixture outlet **18**, is formed in the body **12**. There is provided intermediate the passage extremities a contoured restriction **19** having inclined anterior and posterior approaches **21** and **22**, respectively, separated by a substantially flat rectangular median portion **23** commonly referred to as a bridge. The bridge portion **23** is substantially parallel to and spaced from the axis of the passage. A throttle valve **24** in the mixture passage adjacent the outlet extremity **18** is supported on the throttle shaft **26** journalled in the body to control the introduction of the fuel-air mixture to the engine manifolding (not shown). A throttle return spring **27** (FIGURE 2), anchored to one extremity of the throttle shaft, tends to maintain the throttle valve in a closed position while linkage members, generally designated **28**, operable by the engine operator, control and limit the throttle valve opening and closing movements.

The fuel chamber **14** depends from the body **12**. Fuel is supplied to the fuel chamber through the inlet **29** (FIGURE 2) and is controlled in a normal manner by a float actuated valve **15** (FIGURE 3) which provides a normal fuel level within the fuel chamber. A vent in the body **25** communicates atmospheric pressure from the passage **73** to the interior of the fuel chamber. A hollow member **30** formed as a depending portion of the body extends downwardly into the fuel chamber. The upper extremity of the member **30** opens into the induction or mixture passage through the aperture **34** which is centrally disposed in the bridge. The lower extremity of member **30** is threaded as at **35**. Supported by the threaded extremity in the cylindrical cavity **31** of the hollow member **30** is

the fuel jet assembly generally indicated as **32**. The jet assembly extends into the fuel chamber **14** with the major portions of the assembly being surrounded by fuel and, of course, being below the normal fuel level.

The jet assembly **32** consists of a hollow bushing **33** extending upwardly through the aperture **34** of the hollow member **30**. The hollow bushing retaining screw **36** is threadedly received in the threaded extremity of the member **30** and has portions thereof extending upwardly into the cylindrical cavity **31** to maintain the bushing **33** in contact with the underside of the body adjacent the bridge. The hollow bushing retaining screw extends downwardly through an appropriately located opening **37** formed in the bottom of the fuel chamber **14** with an O ring **38** providing a sealing means therebetween. The hollow bushing **33** and the hollow bushing retaining screw may be broadly defined as hollow means. A tubular orifice member **39** slidably positioned in the bushing **33** extends therethrough to the surface of the bridge **23** to provide the mixture passage metering orifice. The tubular orifice member is maintained in proper positional relationship relative to the bridge surface **23** by an orifice adjusting screw **41** threadedly received in the hollow bushing retaining screw **36** and a spring **42** is compressively confined between a flange **43** on the tubular orifice member **39** and a recess **44** formed in the hollow bushing **33** to properly bias the orifice member. A plug **52** closes the exterior opening of the bushing retaining screw. The tubular member **39** and its adjusting means **41** may be broadly defined as tubular means.

Fuel from the chamber **14** will flow through the fuel passages or openings **46** which are formed in the hollow bushing retainer **36** below the normal fuel level, thence through the channel means **47** located in the orifice adjusting screw locating below the passages **46** and thence through the tubular orifice member **39** to the mixture passage discharge orifice in the bridge. The exterior of the fuel chamber is exposed to great amounts of heat generated by the engine and generally trapped under the hood or bonnet surrounding or covering the engine. Even greater amounts of heat are transferred to the carburetor through the carburetor mounting flange connecting the device to the engine. Consequently, the fuel chamber serves as a heat sink to transfer much heat to the fuel within the chamber itself.

Fuel vapor and percolation difficulties generally arise when the engine ceases to operate and the fuel movement through the chamber is stopped or when the engine is operated at low speeds and light loads immediately after a hard hot run. Under such circumstances the fuel when becomes very warm due to the absorbed heat with the consequential result that the light ends of the fuel vaporize. When the engine is inoperative and this vaporization occurs then localized instantaneous pressure differentials are generated within the metering system notwithstanding the pressure equalizing vent between the fuel chamber and passage **73**. This instantaneous pressure will cause fuel to be discharged from the metering orifice into the mixture passage **16** if the fuel metering system does not incorporate the subject inventive features which provide proper ventilation and insulation for the fuel. Fuel discharged into the induction passage by such instantaneous pressure will cause hard starting due to an overly rich mixture.

In the case where the engine is operated at low speeds and light loads immediately after a hard hot run and the subject inventive features are not incorporated in the fuel metering system, the fuel as it flows through the metering system will absorb sufficient heat to vaporize the light ends of the fuel thereby creating vapor bubbles in the jet assembly **32**. If the vapor bubbles are not separated from the liquid fuel, then the vapor bubbles will affect the fuel output at the metering orifice in the mixture passage and a leaner mixture which is deterimental to smooth engine operation will result.

The aforesaid vapor problems can be eliminated through the use of the hereinafter described invention. The trapped air or fuel vapor created as above described within the jet assembly **32** will rise to the spatial separation **45** defined by the interior walls of the hollow means and the exterior walls of the tubular means. The vapors then pass through vent orifices **48** locating in the hollow bushing retainer **36** above the fuel passage means **46**. The vent orifices **48** open into another spatial separation **49** defined by the upper portion of the cylindrical cavity **31** and the exterior wall portions of the hollow means. A vent means **51** communicates the vapors between the spatial separation **49** and the area **50** of the fuel chamber. The vent means **51** is adjacent the body and locates well above the normal fuel level. In this manner vapor occurring within the fuel jet assembly is effectively eliminated. Vaporized fuel is thus circulated within the fuel chamber and the upper portions of the jet assembly, however, the vapor is directed away from the central portion of the fuel chamber containing the tubular means. Since the fuel channel means **47** are lower than the fuel passage means **46** generally most of the vapor entrained fuel and the liquid fuel will be separated in the spatial separation or chamber **45**. The vapor will rise within the chamber while the liquid fuel will flow through channel means **47** into the tubular means. Due to the jet assembly's structure the tubular means which provides the mixture passage metering structure is located in a position remote from the heated portions of the carburetor and, therefore, it is least susceptible to the fuel vaporization problem. Initially a small but not detrimental amount of vapor may form in the tubular means when the light ends of the fuel therein are vaporized but the heavier fuel (the fuel that has already given up its light ends in the spatial separation **45**) when they enter the tubular means have fewer tendencies to vaporize. The fuel in the spatial separation **45** also reduces the temperature of the fuels within the tubular means and hence further reduces any vaporizing tendencies of the fuel therein. While the fuel supply within the tubular means will be somewhat reduced, a sufficient amount will nevertheless remain in a liquid state to assure a sufficient fuel supply for starting. Simultaneously, the vaporized fuel is circulated through the chambers **45** and **49** and vents **48** and **51** back into the fuel chamber without detrimentally affecting the fuel supply in the tubular means of the jet assembly.

The remainder of the carburetor construction is not particularly pertinent to the subject invention but will be hereinfater briefly described. Formed as a part of the body **12** and opening upwardly from the mixture passage **16** is a substantially inverted conical structure which combines with the cover assembly **13** to provide the compartmentized chamber generally designated as **54**. Slidably supported within the chamber **54** and the mixture passage **16** is a piston **56**. The piston slidably engages in the opening **57** between the mixture passage and the conical structure. The opening **57** is juxtaposed above the bridge **23**. A flexible diaphragm at its inner periphery is clamped between the piston **56** and a diaphragm retaining washer **59**. The outer periphery of the diaphragm is clamped between the mating flanges **61** and **62** of the cover assembly **13** and the conical structure **53**, respectively, thus dividing the chamber **54** into a suction chamber **63** and a reference pressure chamber **64**.

A piston shaft **66** press fitted into the piston extends upwardly through the piston cavity **67** into sliding engagement with the bushing **68** and the guide member **69** formed in the ribbed cover **13** to accurately guide the piston movements toward and away from the bridge. A light piston compression spring **71** confined between the cover **13** and the bottom wall of the piston cavity **67** urges the piston toward the bridge. The pressure drop created by the air flow between the bridge and the base of the piston is communicated to the suction chamber **63** by an opening **72** formed in the base of the piston. Thus the induction pressures existing in mixture passage **16** be-

tween the throttle valve **24** and the bridge **19** are communicated via the opening **72** and the piston cavity **67** to the suction chamber **63**. A reference pressure, usually atmospheric, is communicated to the reference chamber **64** by a passage **73**. This passage in the present embodiment is vented to the air entrance through air filter means (not shown) to prevent the ingress of undesirable foreign matter. The passage **73** may, if desired, be vented directly to the atmosphere, or into the air intake passage **17**.

Operatively connected to the piston is a tapered metering needle valve **74** which projects into the fuel orifice **39** to regulate the effective orifice area subject to the substantially constant vacuum created by the constant air velocity to restrict the fuel flow therefrom. The needle valve is secured to the piston by any convenient means such as the set screw **76**. The piston **56** and the needle valve **74** in combination are generally referred to as the air valve.

Means in the form of punctiform detents **77**, best illustrated in FIGURE 2, are provided on the bottom face of the piston in a position to contact the bridge and establish a minimal spatial separation between the piston **56** and the bridge **23**. The function served by the detents **77** could, of course, be accomplished by other means (not shown) positioned in the body or in the conical structure of the body which are adapted to engage the piston during its reciprocal movement so as to establish a lower limit of piston travel.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings since the invention is capable of other embodiments and of being practiced or carried out in various ways. It is also to be understood that the phraseology or terminology employed is for the purpose of description and not of limitation, and it is not intended to limit the invention herein claimed beyond the requirements of the prior art.

I claim:

1. An air valve carburetor comprising, in combination,

a body means including air induction passage means adapted for connection to an engine;

an air valve means including a variable choke piston means and a needle valve means, supported by the body means for movement within the induction passage means, said choke piston means adapted to control the air flow through the induction passage means;

air valve adjusting means for actuating the air valve means;

a fuel chamber means supported by the body means including means providing a normal fuel level within the chamber means;

fuel jet means communicating between the induction passage means and the fuel chamber means, said needle valve means being adapted to cooperate with the fuel jet means for controlling the fuel flow drawn into the air flow;

said fuel jet means including an outer hollow cylindrical means fixed at its upper end to the body means

and extending below the surface of the fuel in the fuel chamber means;

an intermediate hollow cylindrical means fixedly mounted coaxially within said outer means, so dimensioned as to leave a primary cylindrical space therebetween;

an inner hollow cylindrical means mounted coaxially within said intermediate means, so dimensioned as to leave a secondary cylindrical space therebetween, and having at its upper end a jet opening admitting said needle valve means into its interior space;

said intermediate hollow cylindrical means having an opening below the level of the fuel in the fuel chamber means for admitting fuel to said secondary space between the intermediate and the inner cylindrical means,

said inner hollow cylindrical means having an opening below the level of the fuel in the fuel chamber means for admitting fuel from said last-mentioned space into the interior space of said inner cylindrical means,

said intermediate hollow cylindrical means having an opening connecting said secondary space between the intermediate and the inner cylindrical means with said primary space between the intermediate and the outer cylindrical means, and

said outer hollow cylindrical means having an opening above the level of the fuel within the fuel chamber means serving as a vent for the last-mentioned space into the fuel chamber means.

2. An air valve carburetor as set forth in claim **1** in which the opening into the interior of the inner hollow cylindrical means is below the level of the opening in the intermediate hollow cylindrical means for admitting fuel into said secondary space between the intermediate and the inner cylindrical means.

3. An air valve carburetor as set forth in claim **2** in which the opening in the intermediate hollow cylindrical means connecting said secondary space between the intermediate and the inner cylindrical means with said primary space between the intermediate and outer cylindrical members is adjacent the upper end of said secondary space.

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