Feb. 14, 1967 C. L. MARTIN 3,304,047

CARBURETOR

Filed May 22, 1964

FIG. 1.

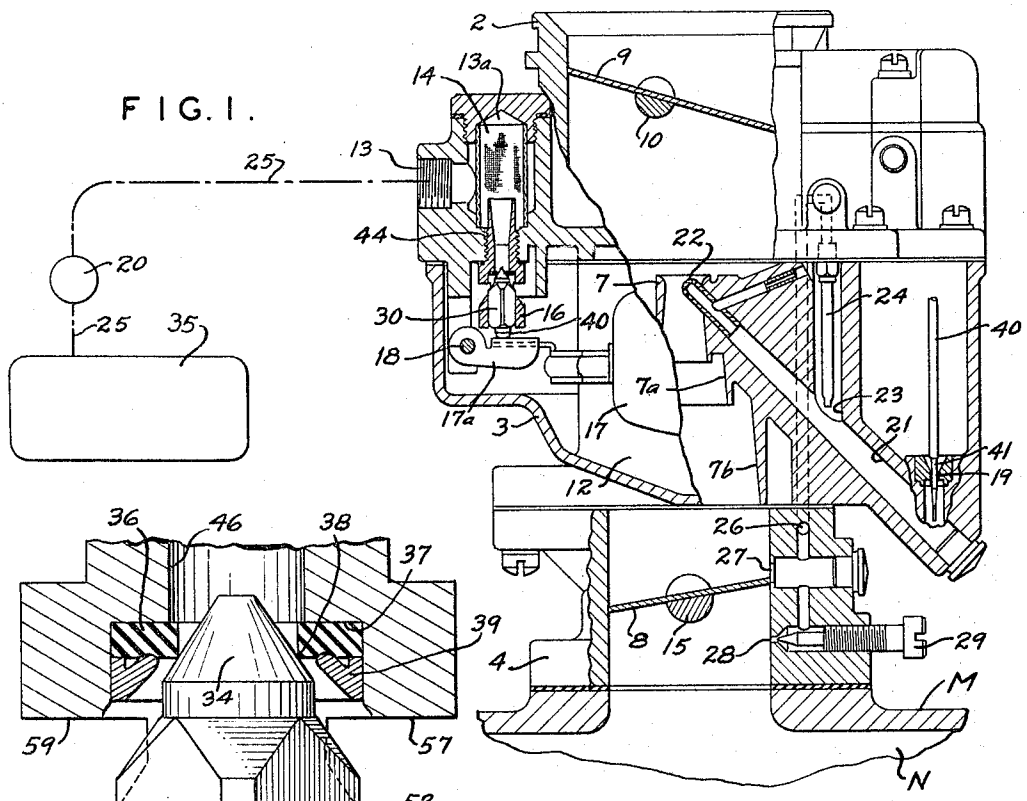






FIG. 2.

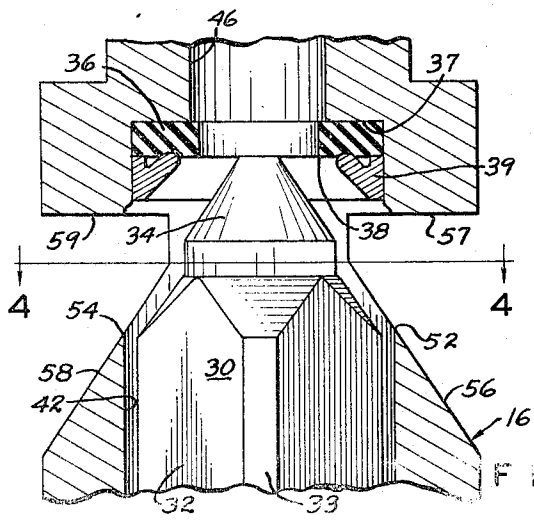



FIG. 3.

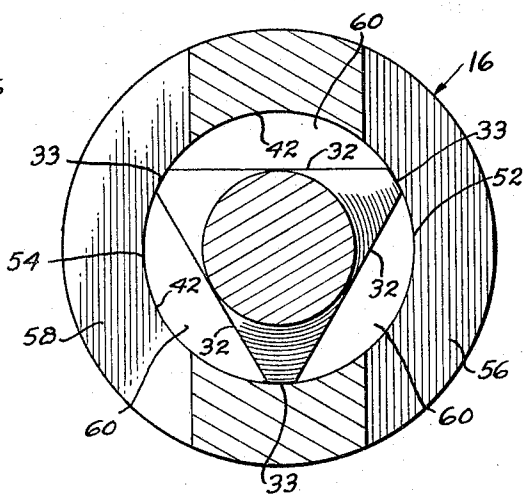



FIG. 4.

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# CARBURETOR

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5 Claims. (Cl. 251—118)

This invention relates to carburetors for internal combustion engines, and particularly to float actuated needle valves for maintaining a predetermined constant fuel level within a fuel bowl.

Foal actuated needle valves for carburetors have historically comprised a valve body having a metallic seat for engagement by the tapered end of a metallic needle to control the flow of fuel into the fuel bowl. Recently valve needles having elastomeric sealing tips have been introduced for seating against a metallic seat to control the flow of fuel into the fuel bowl as disclosed in Patent No. 3,086,750 to Carlson et al. Elastomeric materials have also been employed as seat members in carburetors and are engaged by a metallic needle to control the flow of fuel. To prevent leakage and flooding of the carburetor, the needle and seat must be manufactured to exact tolerances, and the fuel must be free from particles of foreign material which might interfere with proper seating of the needle. Regardless of the type of valve needles or the type of valve seats which are utilized to control the flow of fuel, the flow path followed by the fuel, as it flows past the valve seat and the valve needle and through the valve body into the float chamber of the carburetor, is generally tortuous and turbulence is induced into the fuel flow at several points along the flow path. Turbulence in the flow of fuel causes back pressure to be induced which opposes the flow and thereby restricts the amount of fuel which will flow through the valve. Where needle seat structures are employed utilizing flared elastomer tipped needles, the flare formed immediately below the tip induces a severe turbulent condition in the fuel flow, which causes back pressure directly against the lower surface of the needle flare, thus inducing a force which opposes the direction of free needle travel and which limits the amount of needle travel away from the seat. Restricted valve movement limits the effective size of the valve seat opening and also limits the amount of fuel which will flow through the valve. Excessive turbulence also causes the valve needle to vibrate or to oscillate during high fuel flow so that the flow of fuel may become erratic and the engine may be starved during high speed maximum full demand periods.

Since larger and more powerful automotive engines are being developed, which utilize larger portions of the available engine compartment space of the automobile, a need has developed for accessories such as fuel pumps, carburetors, and the like, to be more compact in design so that more space is available for the engine and all of the many accessories which are powered by the engine. Since more powerful automobile engines generally require a greater quantity of fuel than that required by smaller engines, a need has developed for carburetor design for larger engines to incorporate a reduction in overall dimension and yet an increase in the amount of fuel flow capacity, as compared to present carburetors. In order to effect an increase in the flow of fuel into the fuel bowl of a carburetor without increasing the overall dimension of the carburetor to satisfy the increased fuel demands of these more powerful automobile engines, it was assumed that merely enlarging the needle valve seat and providing a larger conical surface on the needle would provide sufficient fuel flow. It was discovered, however, that an increase in the diameter of the cylindrical end portion of the needle would require an increase in the diameter of the



triangular stock, from which the needle is formed, thereby resulting in a needle of increased size and weight and increasing the cost of the needle by such an amount that such an increase would be impractical. It was further discovered that an increase in the size of the triangular stock would result in a decrease in the size of the flow passages defined between the needle and the bore in which the needle reciprocates, thereby restricting the volume of fuel flow. The bore in which the needle reciprocates, therefore, must be enlarged to allow sufficient fuel flow past the enlarged needle valve. An increase in the size of the bore in which the needle reciprocates would not only require an increase in the size of the triangular needle stock but would also require lengthening of the bearing surfaces of the needle to control the alignment between the needle and the seat. Lengthening of the needle and seat would result in a need for moving the pivot point of the float and for increasing the length of the float arm to establish an optimum engagement between the float arm and the needle vlave. It is, therefore, seen that merely changing the diameter of the cylindrical portion of the needle valve would result in a series of necessary design changes which would increase the overall size and cost of the carburetor, thereby rendering such changes impractical.

It is, therefore, an object of this invention to provide a novel carburetor needle valve structure which requires a minimum of space and which is adapted to provide a maximum of fuel flow through a given size orifice.

Another object of the invention resides in the provision of a novel carburetor needle valve which promotes a smooth flow of fuel during pressure reduction of the fuel as the fuel leaves the fuel inlet recess and passes through the valve seat.

A further object of this invention resides in the provision of a novel carburetor needle valve body having side openings therein which are larger than the dimension of the orifice and yet which maintain optimum needle guide surface.

An even further object of this invention contemplates the provision of a novel carburetor needle seat wherein the surface tension forces between the needle and the seat are effectively reduced.

Another object of this invention resides in the provision of a novel carburetor needle valve structure which is adapted for efficient and smooth needle movement and thereby allowing a maximum of fuel flow at all flow conditions.

Other and further objects of this invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein;

FIGURE 1 is a side elevation in several partial sections, illustrating a carburetor provided with a float actuated needle valve, embodying features of the invention.

FIGURE 2 is an enlarged fragmentary longitudinal section illustrating the needle valve structure of FIGURE 1.

FIGURE 3 is a transverse plan view of the needle structure of FIGURE 2, taken along lines 3—3 of FIGURE 2.

Briefly, the invention comprises a carburetor needle valve assembly generally comprised of a valve body formed with a fuel passage and a valve needle mounted for reciprocation within the fuel passage to control the flow of fuel into the fuel bowl of the carburetor. The valve body structure is so formed that the flow of fuel

through the needle valve structure is accomplished with a minimum of turbulence, thereby achieving a maximum rate of fuel flow through a given size valve orifice.

Referring now to the drawing for a better understanding of the invention, a down-draft carburetor is shown in FIGURE 1 as comprising an air horn section **2**, a main body section **3** and a throttle outlet section **4**. Said sections being secured together and forming a mixture conduit **6**, having a stack of venturies **7**, **7***a* and **7***b* in the main body section. The carburetor is mounted on the intake manifold M of a conventional internal combustion engine N, adapted for use in driving a vehicle.

A choke valve **9**, operable responsive to intake air flow, is rotatably mounted in an unbalanced manner on a valve shaft **10** in the air horn section **2**, which forms the air inlet end of the mixture conduit **6**. A throttle valve **8** is rotatably mounted on a shaft **15** in the outlet end of the mixture conduit **6**.

The main carburetor body section **3** is provided with a fuel bowl **12** having a fuel inlet **13** provided with a screen filter **14**, fixed within an inlet recess **13***a*. A fuel inlet valve **16**, includes a needle valve **30** having a tapered point **34** in contact with a valve seat of a valve body structure **16** to control fuel flow from the inlet **13** into the fuel bowl **12**. A float **17** carries an arm **17***a* pivotally mounted at **18** within the fuel bowl to actuate the needle valve **30** for maintaining a substantially constant fuel level within the bowl **12**. Fuel is supplied to the bowl from a fuel tank **35** by means of a conventional engine operated fuel pump **20** interposed in a fuel conduit **25** leading to the fuel inlet **13**.

A fuel metering orifice **19** leads from the fuel bowl **12** to an upwardly inclined main fuel passage **21**, having a main fuel nozzle **22**, discharging into the primary venturi **7**. Fuel flow from bowl **12** through the orifice **19** and into the fuel passage **21** is controlled by a metering rod **40**, having a stepped end **41** positioned in the metering orifice **19**. Movement of the rod **40** to position a different stepped portion in the orifice **19** provides a change in fuel flow through the orifice **19**. An idle fuel system is shown as comprising a fuel well **23**, leading upwardly from the main fuel passage **21**. The well **23** has a metering tube **24** therein, communicating with the idle passage **26** provided by idle ports **27** and **28**. The well **23** has a metering tube **24** therein, communicating with an idle passage **26**, provided with the idle ports **27** and **28**. An idle adjustment screw **29** is provided for the idle port **28**.

The fuel inlet valve **16** includes a valve needle **30** formed with a body **32** of noncircular cross section, as illustrated in detail in FIGURES 2 and 3. One end of the needle **30** is formed with a conical tip **34** and the other end of the needle **30** is formed with a rounded head **40**, for engagement by a float arm **17***a*, as illustrated in FIGURE 1. The needle **30** is formed with a plurality of ribs **31**, each having a partial cylindrical surface **33** formed thereon which is in guiding engagement with a cylindrical bore **42** formed in the valve body **16**, whereby the needle **30** is positioned for free reciprocal movement within the cylindrical bore **42**. The upper end of the valve body **16** is formed with external threads **44**, FIGURE 1, for detachable engagement within a threaded aperture leading through a wall of the carburetor to the inlet recess **13***a*.

The valve body **16** is formed with a second cylindrical bore **46** coaxially aligned with the bore **42** and of smaller diameter. As illustrated in FIGURES 2 and 3, an annular seat ring **36** formed of elastomer material is held against a shoulder **37** formed by the bore **42** by a retainer ring **39** and defines a valve seat **38** for the tip **34** of the needle **30**.

The tip **34** of the needle valve **30** may be formed by turning a generally conical surface on one end of the needle **30**, as illustrated in FIGURES 2 and 3, or the conical tip **34** of the needle valve may be formed of a synthetic rubber material which is not effected by contact with fuel. Reference may be had to Patent No. 3,086,750 to Carlson et al. for the teaching of providing a needle with an elastomer tip. The specific valve needle and valve seat structure set forth above is, therefore, merely illustrative and must not be taken in a limiting sense. Various needle and seat structures may be incorporated into this invention without departing from the spirit or the scope thereof.

In operation, fuel is forced by pump **20** from the fuel source or fuel tank **15** through fuel connections **25** into the inlet **13** of the carburetor. Fuel will flow through the screening **14** and the fuel passages **46** and **52** past the needle valve **30** when the float structure **17** of the carburetor is in a downward position to release the needle **30** from its fuel passage closing position. When the fuel bowl **12** is filled to the desired predetermined level, a float lever **17***a* will force the needle valve **30** against the valve seat **38** and close off further fuel to the carburetor. During engine operation, fuel fills the fuel passage **21** to the same level as within the bowl. Air flow through the mixture conduit **6** passes through the venturi stack **7–7***a*, causing a low pressure area at the mouth of the fuel nozzle **22**. Atmospheric pressure on the fuel level in the fuel bowl forces fuel up to the fuel passage **21** and out of the nozzle **22** to mix with the air in the mixture conduit **6**. The flow of air and fuel mixture into the manifold M of the engine is controlled in a well-known manner by the manually operated throttle valve **8**.

As the fuel flows from the fuel bowl **12** through the fuel passage **21** and the fuel nozzle **22**, the level of fuel in the bowl **12** is lowered, with a resulting lowering of the position of the float **17**. The downward movement of float arm **17***a* in response to lowering of the float **17** permits the fuel valve **30** to drop downwardly under the combined forces of gravity and fuel pressure to permit the flow of fuel from the inlet **13** into the fuel bowl **12** to replenish the fuel consumed by the engine.

In accordance with the invention, as illustrated in detail in FIGURES 2, 3 and 4, opposing portions of the wall structure of the valve body **16** are cut away, such as by milling or the like, to define opposed openings **52** and **54**, the combined area of which is greater than the area defined by the valve seat **38**. A pair of opposing substantially planar surfaces **56** and **58** are formed on the valve body **16** and are disposed transverse to the axis of the valve body **16**. The planar surfaces **54** and **56** are inclined with respect to an axis of the bore **42** to substantially the same degree as is the conical surface **34**. For example, if the conical surface **34** is formed with a 60° angle relative to the axis of the bore **42**, the surfaces **56** and **58** will also be inclined substantially 60° relative to the axis of the bore **42**.

A pair of opposed substantially planar surfaces **57** and **59** are formed in the valve body **16** below the valve seat **38** and are disposed substantially normal to the axis of the bore **42**. The pairs of planar surfaces **56–57** and **58–59** cooperate to define a pair of opposed outwardly diverging passages for conducting the fuel from the openings **52** and **54** into the fuel bowl **12**.

Forming the outwardly diverging passages in the wall structure of the valve body **16**, achieves a number of results which effectively provide improved fuel flow. The turbulent condition which is generally found immediately below the valve seat **38** in most needle valve structures is effectively reduced thereby allowing a smoother flow of fuel past the valve seat and into the fuel bowl. This turbulent condition is caused by a reduction in the fuel pressure which causes violent agitation of the fuel. As fuel under pressure developed by the fuel pump **20** flows through the bore **46** past the valve seat **38**, the pressure of the fuel is suddenly reduced from approximately nine pounds per square inch above atmospheric pressure to atmospheric pressure. Since volatile fuel which as gasoline is normally utilized in automotive engines, the fuel flowing

past the valve seat **38** will tend to vaporize as its pressure is reduced to atmospheric pressure causing the formation of vapor bubbles. The vapor bubbles tend to expand the volume of the fuel and cause violent agitation of the fuel immediately below the valve seat. This agitation adds to the natural tendency for the flow of fluid past the valve seat to swirl or eddy and to produce a back pressure opposing the flow of fuel. As illustrated in FIGURES 2 and 3 the outwardly diverging surfaces forming the openings **52** and **54** allow the vapor bubbles immediately below the valve seat **38** to quickly dissipate outwardly into the fuel bowl **12**. This prevents the development of excessive back pressure which would otherwise tend to oppose the flow of fuel and allows a smooth flow of fuel past the valve seat and into the fuel bowl. As the fuel flows past the valve seat **38** it is directed by the conical surface of the tip **34** and by the outwardly diverging surfaces **56** and **58**, as illustrated in FIGURE 3, to flow smoothly into the fuel bowl **12**.

The invention effectively prevents excessive restriction of needle valve movement by the vapor bubbles which form in the fuel at the instant of pressure reduction. In most needle valve structures currently being manufactured, the vapor bubbles which form immediately below the valve seat within the valve body must flow with the fuel along the needle body to the outlet at the free extremity of the valve seat. Surface tension developed between the vapor bubbles and the needle valve walls and valve body walls tends not only to restrict the flow of fuel in the flow channels of the valve but also to restrict the amount of needle travel from the valve seat, which adversely affects the flow of fuel through the valve. As illustrated in FIGURE 4, a plurality of fuel flow channels **60** defined between the body **32** of the needle **30** and the bore **42** serve to conduct the flow of fuel through the valve body **16**. The vapor bubbles, which form immediately below the valve seat **38** (FIGURES 2 and 3) along with the turbulent fuel will dissipate quickly outwardly into the fuel bowl **12**. The remaining fuel which flows through the channels **60** (FIGURE 4) and into the fuel bowl **12** at the free extremity of the valve body **16** will be smooth, constant and substantially bubble-free. The substantially bubble-free flow of fuel through channels **60** of the valve will allow maximum needle movement without the back pressure or restriction caused by the bubble laden fluid.

Back pressure which would otherwise tend to restrict fuel flow is effectively relieved through the opposed openings **52** and **54**. The combined cross sectional dimension of the openings **52** and **54**, being greater than the cross sectional dimension of the valve seat **38**, effectively prevent the formation of excessive back presure which would oppose fuel flow through the valve seat **38**. The opposed outwardly diverging passages formed by the opposed surfaces **56–57** and **58–59** tend to allow further pressure reduction during the flow of fuel thereby preventing any tendency to retard the flow of fuel.

The novel construction of this invention also involves a minimum of direction change in the flow of fluid which also aids in the prevention of excessive back pressure and turbulence and thereby further aiding the flow of fuel. As the fuel flows past the conical tip **34** of the valve needle, the fuel will flow along the surfaces **56** and **58** thereby involving very little flow direction change and promoting more efficient fuel flow.

From the foregoing, it is seen that I have produced a novel needle valve structure for a carburetor which is of a minimum overall dimension and yet which is capable of a much greater flow of fuel than has been obtained heretofore. The invention also promotes a smooth flow of substantially bubble-free fuel through the flow channels between the valve needle body and the valve body bore thereby preventing excessive back pressure which would tend to restrict fuel flow and needle movement. The invention effectively provides for quick dissipation of vapor bubbles which are formed during reduction of the fuel pressure and eliminates excessive back pressure and turbulence in the valve body which would otherwise restrict fuel flow and needle travel. The flow of fuel through the valve is subjected to a minimum of direction change which effectively promotes smooth and rapid fuel flow while inducing a minimum of turbulence in the fuel. The invention, therefore, is one well adapted to attain all of the objects hereinabove set forth, together with other advantages which are obvious and inherent from the description of the apparatus itself.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

**1.** A carburetor for an internal combustion engine having a fuel inlet, a valve structure for controlling the flow of fuel through the inlet, said valve structure including a valve body having a fuel passage therethrough connected to the fuel inlet and an annular valve seat formed within the fuel passage, a valve needle mounted for longitudinal movement within the fuel passage, a conical tip on one end of the valve needle adapted to engage the valve seat to block the flow of fluid through the valve, at least one pair of outwardly diverging substantially planar surfaces formed intermediate the length of the valve body and defining at least one outwardly diverging passage which communicates with the fuel passage through an opening having a greater area than the area defined by the annular valve seat.

**2.** A carburetor for an internal combustion engine having a fuel inlet, a valve structure for controlling the flow of fuel through the inlet, said valve structure including a valve body having a fuel passage therethrough connected to the fuel inlet and an annular valve seat formed within said fuel passage, a valve needle mounted for longitudinal movement within the fuel passage, a conical tip on one end of the valve needle adapted to engage the valve seat to block the flow of fuel through the valve, opposing pairs of outwardly diverging substantially planar surfaces formed intermediate the length of and in transverse relation to the valve body and defining a pair of opposed outwardly diverging passages which communicate with the fuel passage through openings having a combined area greater than the area defined by the annular valve seat.

**3.** A carburetor for an internal combustion engine having a fuel inlet, a valve structure for controlling the flow of fuel through the inlet, said valve structure including a valve body having a fuel passage therethrough connected to the fuel inlet and an annular valve seat formed within said fuel passage, a valve needle mounted for longitudinal movement within the fuel passage, a conical tip on one end of the valve needle adapted to engage the valve seat to block the flow of fuel through the valve, opposing pairs of outwardly diverging substantially planar surfaces formed intermediate the length of the valve body and defining a pair of opposed outwardly diverging passages which communicate with the fuel passage through an opening having a greater area than the area defined by the annular valve seat, one of the planar surfaces of each of said pairs of outwardly diverging surfaces being disposed substantially normal to the fuel passage and the other surface of each of said pairs being of substantially the same angular relation with the fuel passage as the angular relation between the conical tip and the fuel passage.

**4.** A needle valve assembly adapted to be mounted within the fuel inlet passage of a carburetor having a fuel

bowl, said assembly comprising; a valve body having a flow passage formed therethrough for communicating said inlet passage with said fuel bowl, means defining a valve seat within said flow passage, a valve needle having a conical surface formed on one extremity thereof being positioned within the flow passage and movable from a closed position, where the conical surface engages the valve seat to prevent the flow of fuel through the flow passage, to an open position where the conical surface is spaced from the valve seat to allow fuel to flow through the flow passage, means for imparting movement to said valve needle, at least one outwardly diverging passage formed in the valve body intermediate the length thereof and communicating the flow passage with the fuel bowl, said outwardly diverging passage being defined by a first substantially planar surface disposed substantially normal to the flow passage and a second substantially planar surface disposed in substantially the same angular relation with the flow passage as the angular relation between the conical surface of the valve needle and the flow passage, whereby, upon cooperation of the conical surface and the second surface, a smooth flow of fuel will be induced through the needle valve assembly and into the fuel bowl.

5. A needle valve assembly for a carburetor having a fuel bowl, said assembly comprising a valve body having a flow passage and a valve seat intermediate the length of the flow passage, a valve needle having a conical surface formed at one extremity thereof disposed within the flow passage and being movable between open and



closed positions relative to the flow passage to control the flow of fuel into the fuel bowl, at least one pair of outwardly diverging substantially planar surfaces formed in the valve body and disposed transverse to the flow passage, one of said planar surfaces being disposed substantially normal to the flow passage and the other of said planar surfaces having substantially the same angular relation with the flow passage as the angular relation between the conical surface of the valve needle and the flow passage, said surfaces defining at least one outwardly diverging passage for communicating the flow passage and the fuel bowl, the outwardly diverging passage cooperating with the conical surface of the valve needle to prevent excessive turbulence in the flow of fluid into the fuel bowl.

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