United States Patent [19]

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[11] **3,722,837**

[45] **Mar. 27, 1973**

[54] CARBURETOR UTILIZING SURFACE TENSION AND CAPILLARY ACTION

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[22] Filed: **Apr. 12, 1972**

[21] Appl. No.: **243,403**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 7,201, Jan. 30, 1970, abandoned.

[52] **U.S. Cl.**.....**261/34 A**, 261/105, 261/107, 261/70, 261/DIG. 6, 55/240

[51] **Int. Cl.**.....**F02m 17/28**

[58] **Field of Search**.....261/105–107, 97, 261/99, 100, DIG. 6, 70, 34 A, 66; 55/240

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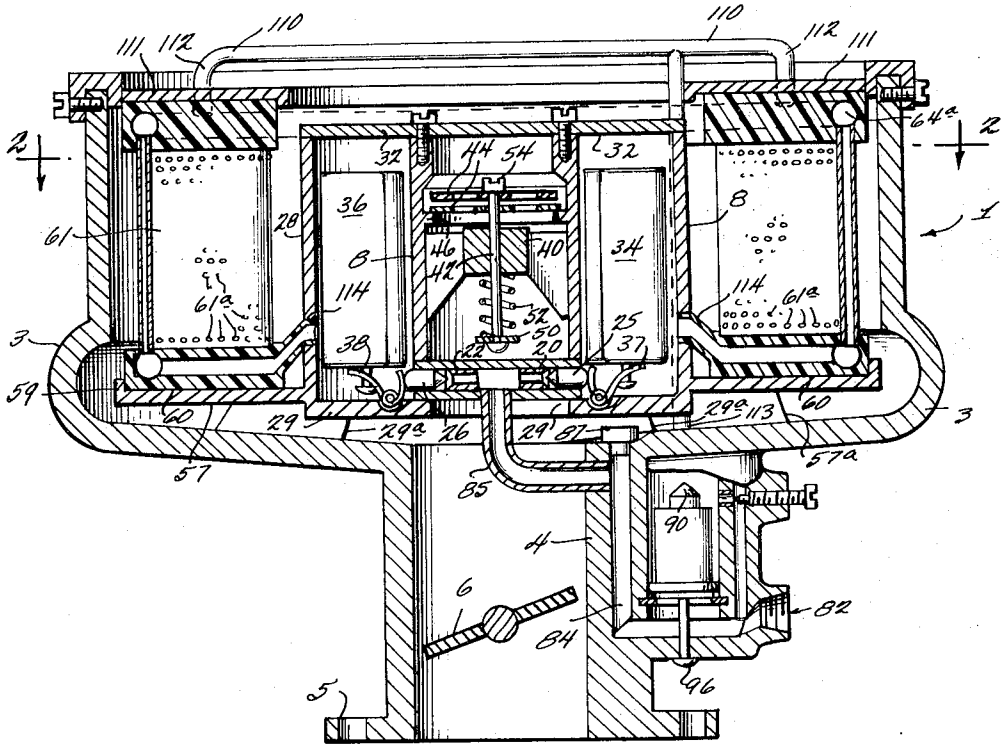
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[57] **ABSTRACT**

Wet plates or grids with minute perforations are so positioned as to utilize the fuel property of surface tension and capillary action to allow the fuel to form a film over the apertures so that the air pressure differential between the manifold side of the grid and the atmospheric pressure side will stretch the fuel film and encapsulate sufficient air to burn the fuel in the film.

10 Claims, 4 Drawing Figures



Patented March 27, 1973

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3 Sheets-Sheet 1

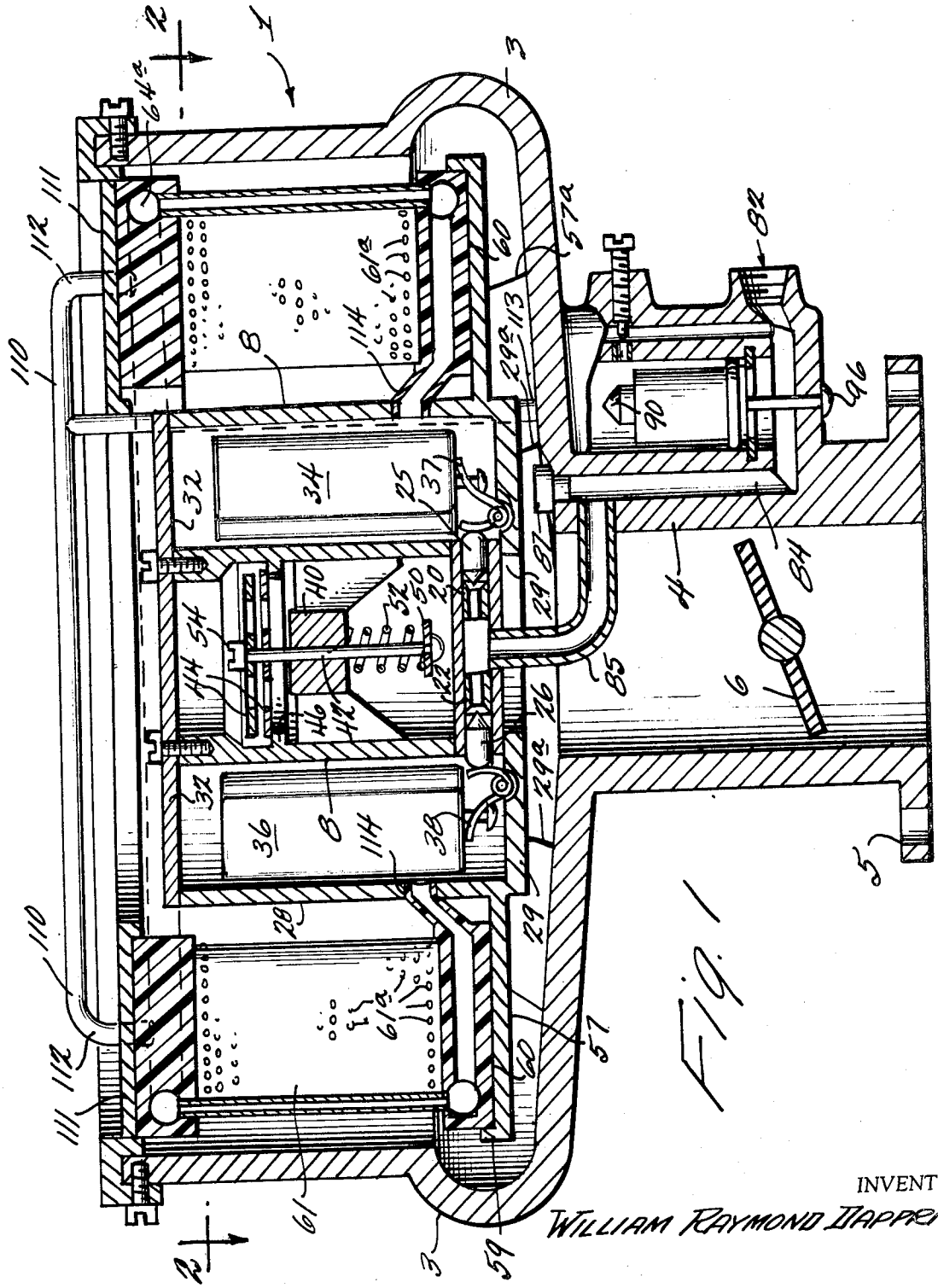
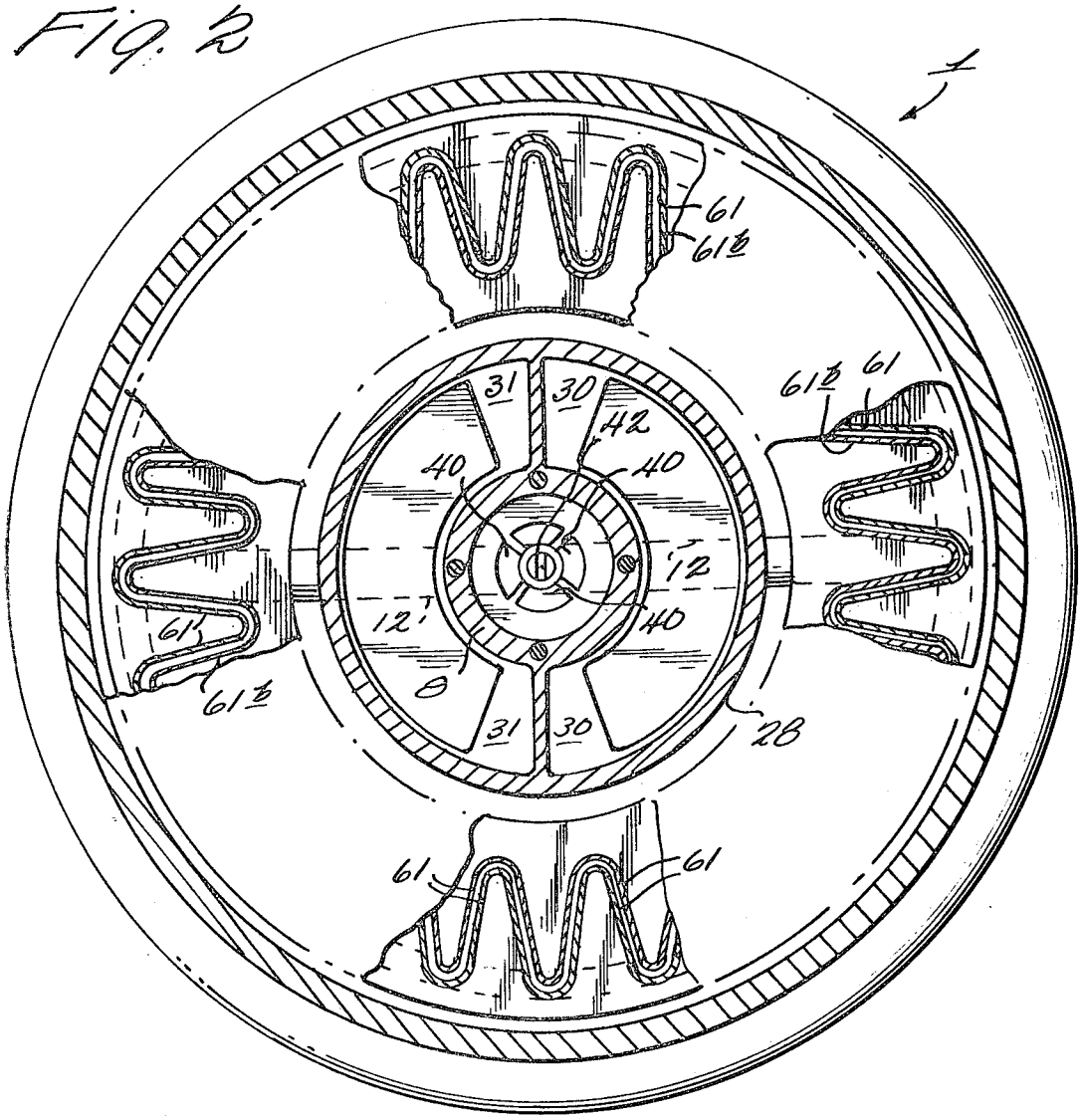


Fig. 1

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Fig. 2



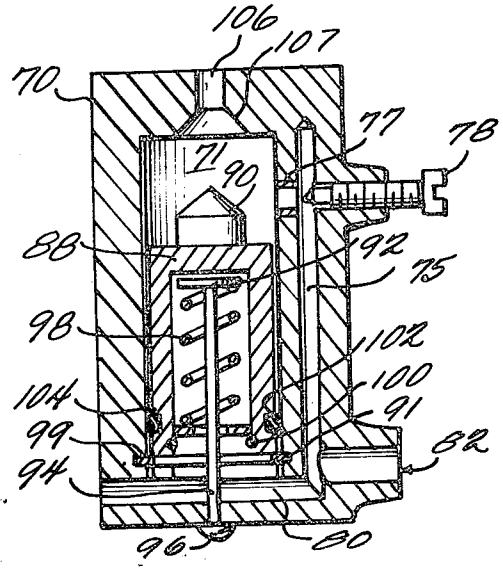


Fig. 3

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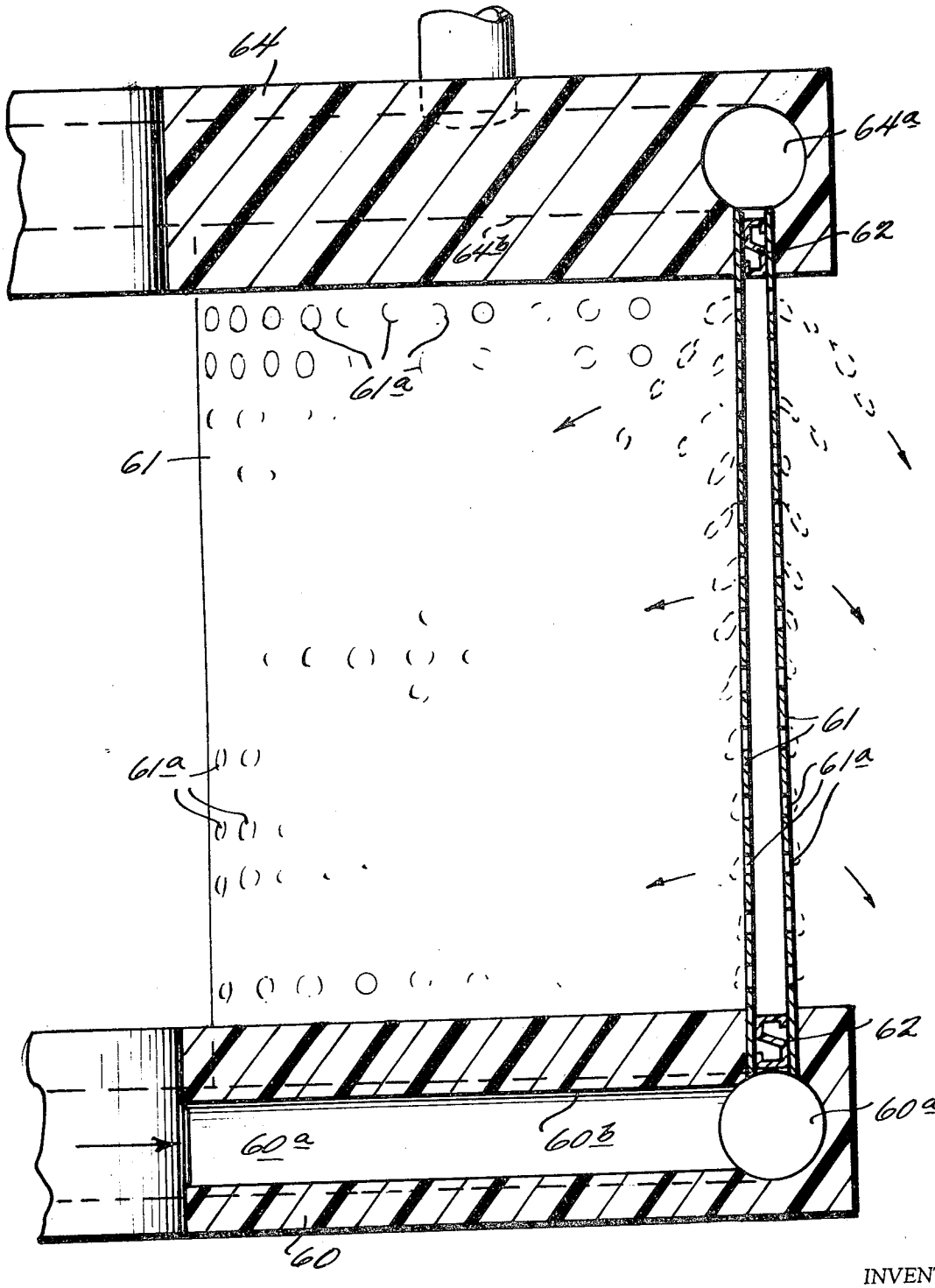


Fig. 4

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CARBURETOR UTILIZING SURFACE TENSION AND CAPILLARY ACTION

The present application is a continuation-in-part of my presently pending patent application Ser. No. 7,201, entitled "Carburetor Utilizing Surface Tension and Capillary Action," filed Jan. 30, 1970, now abandoned.

The present invention relates to carburetors for internal combustion engines, and particularly to a carburetor of the so-called "wick" type wherein the incoming air is passed over the surfaces of plates which are wet with liquid drawn up by capillary attraction.

In the usual wick-type carburetor, the effect is to change the fuel from liquid to vapor state, whereas in the present invention the effect is to produce by combined surface tension and capillary attraction liquid bubbles which encapsulate air cores or centers and which are introduced in this state as a fuel charge to the engine.

It is among the objects of the invention to eliminate many of the complicated structural features found in present day carburetors, provide a more complete utilization of the air-entrained fuel, the versatility of multiple fuel usage without adjustment, a more rapid flame front propagation regardless of fuel, and generally a higher degree of engine efficiency, i.e. more power with less fuel.

Another object is the ability to utilize any one of a wide variety of hydrocarbon fuels without external or internal adjustment.

Another object is to circumvent the problem of slow combustion of a solid droplet of fuel as introduced into an internal combustion engine by conventional carburetors by providing means for surrounding the approximate amount of air necessary for its combustion in a thin film, very nearly of mono-molecular film thickness. With the countless tiny explosive bubbles being inducted through the intake manifold system into the combustion chamber of the engine, the requirements of antiknock compounds are greatly reduced or eliminated, together with the attainment of much improved combustion rate.

According to an embodiment which is preferred at the present time, the formation of fuel bubbles with their cores of air takes place by means of a double, minutely perforated and substantially vertically extending grid with the inner and outer grid closely disposed to each other with clearances in the thousands of an inch. However, the surfaces of the two perforated vertically extending grids, while close and apparently parallel to each other are not actually parallel surfaces. The close positioning of the grids is to utilize the fuel property of surface tension and capillary action, as mentioned earlier herein, to allow the fuel to rise between these two surfaces, form a film over the small (and carefully sized) holes in the grids so that the air pressure differential between the manifold side of the grid and the atmospheric pressure side of the other grid will stretch the fuel film and encapsulate sufficient air to efficiently burn the fuel in the film. Instead of being exactly parallel, the space between the grid surfaces is tapered, being narrower at the top than at the base of the grid which is based in a fuel trough where it picks up its fuel by capillarity and lifts it to the top and narrow part of the grid spacing. The reason for this is that instead of using smaller metering jets for reduced fuel consumption (for example, at higher mountainous elevations) with the present invention, almost all of the fuel charge will be drawn through the top third of the grid where, because of the reduced film thickness a greater proportion of air to fuel will be introduced into the combustion chamber. At sea level, on the other hand, the entire surface of the grid will produce fuel bubbles because of increased density and weight of the atmosphere.

Other objects and the nature and advantages of the invention are made clear in the following description, and the drawings present the best form of the invention now known to me. However, this disclosure is by way of example only, and changes not shown herein may be made without deviation from the principle of the invention or material alteration of any of the essential characteristics as defined in the appended claims.

In the drawings:

FIG. 1 is an elevational view, partly in section, of a carburetor which embodies the teachings of the invention;

FIG. 2 is a sectional view taken on the line 2—2 of FIG. 1;

FIG. 3 is an elevational view, partly in section and illustrating in further detail the fuel entry portion of the carburetor of FIG. 1; and

FIG. 4 is an enlarged, fragmentary, elevational view illustrating in greater detail the annual serpentine dual-plate fuel grid and the fuel grid seals at the lower and upper edges thereof.

Referring more particularly to the drawings, the numeral 1 designates the main body portion of the carburetor of the invention, the same comprising a vertical cylindrical wall with a bowl shaped portion 3 therebelow, the latter having a substantially flat, but inwardly tapering bottom, which communicates with a cylindrical sleeve 4 of smaller diameter.

This cylindrical sleeve 4 constitutes the throat of the carburetor and it is provided with the usual flange 5 by means of which it is bolted to the intake manifold of an internal combustion engine; and within said sleeve there is the usual butterfly valve 6.

Centrally disposed within the main body portion 1 is a vertically extending cylindrical sleeve 8, of considerably smaller diameter, which is supported in a manner to be later described; the same being provided adjacent its lower extremity with a horizontally disposed straight tube 12 the ends of which extend through the sidewall of said cylindrical sleeve. The straight tube 12 houses a frusto-conical valve seat adjacent each of its ends, as shown at 20 and 22.

Cooperating with the frusto-conical valve seats 20 and 22 are needle valves 25 and 26 respectively.

Disposed concentrically with respect to the centrally disposed cylindrical sleeve 8 is a large cylindrical cup 28 having large inwardly extending annular flange 29 adjacent its lower end, said flange being shown as extending slightly beneath and in supporting contact with the lower extremity of the cylindrical sleeve. In the manner described the centrally disposed cylindrical sleeve 8 and the cylindrical cup 28 of substantially larger diameter form an annular chamber the top of which is closed by a removable closure plate 32.

By the use of a pair of diametrically opposed partition walls 33 this annular chamber is made to comprise

a pair of float chambers **30** and **31** of half-moon shape when viewed in plan.

Within the half-moon float chambers **30** and **31** is a pair of oppositely disposed curvilinear carburetor floats **34** and **36** which, upon rising above a predetermined level close the needle valves **25** and **26** through levers **37** and **38** which are pivotally mounted on the upper surface of the large inwardly extending annular flange **29** at the bottom of the cylindrical cup **28**.

Within the centrally disposed cylindrical sleeve **8** is a centrally apertured spider **40** which receives the shaft **42** of a vertically movable backfire valve comprising an apertured twin-plate valve head **44**, the lower plate of which seats against a ledge **46** which is disposed slightly therebelow on the inner surface of the cylindrical sleeve **8**.

The lower end of the shaft **42** of the backfire valve **44** is provided with a head **48** against which there rests a washer **50**, the upper surface of which rests against the bottom of a coil spring **52**, and the top of this coil spring makes contact with the underside of the centrally apertured spider **40**. With the upper end of the shaft **42** in screw-threaded engagement with a nut **54** the pressure of the apertured twin-plate valve head **44** against the ledge **46** may be suitably adjusted; and the pressure with which said valve head opens is adjusted by changing the extent to which the apertures therein come into registration.

Extending outwardly from the periphery of the large outer sleeve **28**, and adjacent the bottom thereof is a continuous horizontally extending radial flange **57** having a continuous upwardly extending lip **59**. The bottoms of the flanges **29** and **57** are maintained in properly spaced relationship with respect to the bottom of the bowl **3** of the carburetor by spacer legs **29***a* and **57***a*. The radial flange **57** with its upwardly extending lip **59** serves as a pan to support a continuous annular fuel grid seal **60** of substantially rectangular cross-section which is formed of suitable plastic material and provided with an interior compartment **60***a* which communicates with a continuous serpentine slot **60***b* on its upper surface.

Disposed atop the continuous annular fuel grid seal **60** is a continuous and vertically extending annular double fuel grid **61** which is correspondingly serpentine to fit on its lower edge in the aforementioned serpentine slot **60***b* of the fuel grid seal, its lower extremity being spaced from the bottom of the interior compartment **60***a* and the two components of the fuel grid from each other, by suitable spacer elements **62**.

The serpentine vertically extending fuel grid **61** may be formed of a suitable metal, plastic or sintered material and comprises a pair of spaced complementarily formed sheets with a large number of small apertures **61***a* formed therein; said sheets being disposed to slightly converge upwardly, whereby the space between them is larger at the bottom than at the top, and the sizes of the holes or apertures increase from the upper edge to the lower edge.

The shape and cross-sectional area of the holes or small apertures **61***a* may vary somewhat, so long as the cross-sectional areas thereof are adequate to provide the phenomena of capillary action whereby a film of liquid fuel extends over the areas described, said film being caused to burst into tiny bubbles which encapsulate the air which is needed to support combustion. Although not limited thereto, such holes or apertures **61***a* may be round and between approximately 0.016 inch and approximately 0.0625 inch in diameter.

As shown in FIGS. **2** and **4**, the upper extremities of the two-sheet complementarily curved serpentine fuel grid **61** are received in the serpentine slot **64***b* on the underside of an upper fuel grid seal **64** being properly positioned with respect to the interior compartment **64***a* by spacer elements **62** and the two components of the fuel grid from each other as in the case of the lower fuel grid **60**.

The function of the fuel grid **61** and its lower and upper fuel grid seals **60** and **64** will be described hereinafter.

Referring to FIG. **3**, and the lower right-hand portion of FIG. **1**, a housing or charging valve body **70** is disposed immediately adjacent, and in parallelism with, the throat **4** of the carburetor, the same providing a cylindrical chamber **71** the top of which is closed by the bottom of the bowl **3**. Parallel with the cylindrical chamber **71** there is an adjacent vertical fuel charging channel **75** which is provided adjacent its upper end, with a transverse aperture provided with a valve seat **77** which is adapted to be opened and closed by an oppositely disposed fuel charging screw **78**.

Below, and communicating with the cylindrical chamber **71**, is a well **80** which communicates with the fuel charging channel **75** and also with the fuel entry port **82** of the carburetor.

As shown in FIG. **1**, the side-wall of the housing or charging valve body **70** which is immediately adjacent the cylindrical throat **4** has a vertical passage **84** which communicates at its lower end with the well **80** and constitutes a fuel gallery. The upper end of this fuel gallery **84** communicates with the lower end of a curved pipe **85**, the upper end of the latter extending upwardly to communicate with the middle of the horizontally disposed straight tube **12**; said curved pipe constituting the main fuel feed pipe as will be more fully described hereinafter.

The upper extremity of the fuel gallery **84** is shown as extending through the bottom of the bowl **3** of the carburetor, and it is closed by a plug **87**.

Disposed within the cylindrical chamber **71** of the housing or charging valve body **70** is a hollow piston **88** which is closed at its upper end and provided thereat with an upwardly extending coniform valve **90**.

The lower end of the hollow piston **88** is open, as shown in FIG. **5**, and it is prevented from dropping downwardly into the well **80** by a snap-ring retainer **91**.

Within the cylindrical chamber **71** is a disc **92** of slightly smaller diameter which is screw-threadedly attached at its center to the upper end of a vertically disposed bolt **94** which extends through the bottom of the housing or charging valve body **90** with its head **96** bearing thereagainst.

Disposed in the cylindrical chamber **71**, and surrounding the bolt **94**, is a coil spring **98** which makes contact at its upper end with the underside of the disc **92**; and at its lower end with a centrally apertured spring retainer **99**, the latter being secured in position by a snap ring **100** which seats in a groove on the wall of the cylindrical chamber.

The exterior of the hollow piston **88** has a peripheral groove **102** adjacent its lower end which receives an O-ring **104** that makes contact on its periphery with the side-wall of the cylindrical chamber **71**.

That portion of the bottom of the bowl **3** of the carburetor which forms the top of the charging valve body **70** is apertured, as at **106**, and communicates with the cylindrical chamber **71** through an inverted frusto-conical valve seat **107**.

A vertical tube **113** communicates with the aperture **106** at its lower end, and at its upper end with the intermediate portion of an overhead horizontally extending manifold **110**.

The upper fuel grid seal **64**, which is inverted with respect to the lower fuel grid seal **60**, is engaged by a detachable annular ring **111** which is of inverted U-shape in cross-section; said ring constituting the carburetor cover.

The two ends of the horizontally extending manifold **110** curve downwardly, as at **112**, and extend through the annular ring **111** and the wall of the upper fuel grid seal **64** to communicate with the interior compartment **64a** and the upper edges of the two-sheet complementarily curved serpentine fuel grid **61**, and a vertical pipe **113** communicates at its lower end with the aperture **106** at the top of the cylindrical chamber **71** and at its upper end with the horizontally extending overhead manifold **110**.

The continuous, annular lower fluid grid seal **60** is provided, at each of two diametrically opposite points, with a short tube **114** which extends diagonally upward to communicate with an aperture in the sidewall of the outer cylindrical cup **28**, thus establishing communication with the two float chambers **30** and **31** of half-moon shape, and providing two oppositely disposed main fuel galleries which are supplied through the curved pipe **85** which constitutes the main fuel line of the carburetor.

FUNCTION OF CARBURETOR

Fuel enters the fuel entry port **82** from a conventional fuel pump (not shown) under a pressure of say 2.5 pounds per square inch, moving through well **80**, upwardly through the vertical passage or lower fuel gallery **84**; continuing on upwardly through the curved pipe **85**, into the middle of the horizontally disposed straight tube **12**, through needle valves **25** and **26**, and into the twin float chambers **30** and **31** until the floats **34** and **36** are elevated sufficiently to close said needle valves.

In this manner, the fuel enters the main fuel galleries provided by the short tubes **114** and communicating float chambers **30** and **31**; and flows into the interior compartment **60*a*** of the lower fuel grid seal **60** from which the fuel rises by capillarity between the two-sheet complementarily curved fuel grid body **61**, providing a thin film which substantially closes the perforations **61*a*** in said fuel grid body. The excess fuel then backs up into the half-moon float chambers **30** and **31** and continues to raise the carburetor floats **34** and **36**, thus causing the pivoted levers **37** and **38** to close the needle valves **25** and **26** and stop the flow of fuel therethrough.

At this point the pressure of the fuel pump is transferred into the vertical fuel charging channel **75** from which it passes through the fuel metering valve **77** in the upper side-wall thereof to flow into the cylindrical charging valve chamber **71** ahead of the top of the hollow piston **88**. Since only a small quantity of the fuel can move through the orifice in the fuel metering valve **77**, the balance of the fuel pump pressure is exerted against the base of the charging valve hollow piston **88**. Because of the large area of the charging valve hollow piston **88** the basic fuel pump pressure of 2.5 pounds per square inch is raised above piston **88** to 5.0 pounds per square inch.

This increased fuel pressure moves the hollow piston **88** against the spring **98**. The fuel which has flowed through the charge metering valve **77** is now trapped in front or ahead of the hollow piston; and it forces this charge of fuel through the frusto-conical valve seat **107**. After this, the coniform valve **90** moves into contact with the valve seat **107**.

The metered fuel charge moves upwardly through the aperture **106** and vertical pipe **113** and into the overhead horizontally extending manifold **110** and is conveyed at 5 pounds pressure through its downwardly curved ends **112** into the interior compartment **64*a*** of the upper fuel grid seal **64** from which it is forced downwardly between the capillary fuel-filled twin-plates of the fuel grid body **61**.

This forces fuel out of the apertures **61*a*** in the complementarily curved serpentine fuel grid body **61** to provide a continuous uninterrupted fuel film. The fuel now spans all of the apertures **61a** in the plates of the fuel grid bodies as the engine continues its operation.

Since the air-fuel grid **61** places a perforated barrier in which the perforations are spanned by variable thicknesses of fuel film the intake stroke of the internal combustion engine while being cranked creates a negative pressure on the intake manifold side of the carburetor. This pressure differential between manifold and atmospheric pressure pulls air through the capillary-fed fuel film in proper quantity and proper mixture balance depending upon the position of the butterfly (throttle) valve **6**. The fuel charge in air-filled bubble form is slightly under compression because of the measurable force of the constricting surface tension of the hydrocarbon fuel. Because of their light weight, these bubbles are inducted, via the intake manifold, into the combustion chamber of the internal combustion engine where they are compressed during the compression stroke of the engine. When the spark plug flashes the compressed charge fires and because the fuel bubble has air around it as well as inside of it the combustion is instantaneous and complete.

ALTITUDE COMPENSATION FEATURE

As shown in FIG. **4**, the two perforated plates of the fuel grid body **61** are set at a small converging angle, separated by spacers **62** at top and bottom. This creates a thicker film at the base of the fuel grid body. The air passing through the thicker film at the base creates fuel bubbles with more fuel and less air than the thinner film at the top of the fuel grid body. Because of the difference in density or weight of the air between sea level and say 10,000 foot elevation at the higher altitude more of the fuel bubbles will be made at the upper end of the fuel grid body since the thicker film at the base offers greater resistance to the thinner air. With more

air contained in the thinner bubbles a leaner mixture will result. As the vehicle operates at sea level more of the total surface of the fuel grid body **61** will be utilized, resulting in a richer fuel/air mixture from the bubbles made by the air passing through the thicker fuel film.

The automatically operating charging valve **70** forces coverage of the holes or apertures **61***a* of the fuel grid body **61** which are not accomplished by capillarity.

Regulated rich starting mixture is assured by the charging valve **70** and the fuel metering screw **78**.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is:

1. A carburetor comprising, in combination,

a casing having an air inlet which is exposed to the atmosphere and an air outlet which communicates with the inlet manifold of an internal combustion engine;

a substantially vertically extending double-grid carried by said casing and disposed between the air inlet and the air outlet;

said double-grid including a pair of closely adjacent parallel walls with unoccupied space therebetween and having a large number of minute apertures therein which are exposed to the air inlet of said casing;

the majority of the minute apertures in each of said double-grids being sufficiently small as to permit capillary action to form a film thereover which will burst into minute bubbles which encapsulate successive charges of air passing said double-grids;

means for supplying measured amounts of hydrocarbon fuel to the lower portion of said double-grid; and

means for supplying measured amounts of hydrocarbon fuel to the upper portion of said double-grid.

2. The combination of claim **1** wherein the sheet-like walls of said double grid are closer together at their upper edges than at their lower edges.

3. The combination of claim **1** wherein the double grid is continuous and generally annular.

4. The combination of claim **1** wherein the double grid is continuous and generally annular but serpentine.

5. The combination of claim **1** wherein the first-named means comprises a generally annular trough and the second-named means comprises a generally annular cap which is in substantial parallelism with said trough.

6. The combination of claim **1** wherein the first-named means comprises a float chamber, float valve means in said float chamber, and means connecting said float chamber with said trough.

7. The combination of claim **1** wherein the last-named means comprises a charging valve connected with the fuel inlet.

8. The combination of claim **1**, together with a centrally disposed back-fire prevention valve, and wherein the first-named means comprises a float chamber which surrounds the back-fire prevention valve and wherein the double-grid surrounds the float chamber.

9. The combination of claim **1**, together with a centrally disposed back-fire prevention valve, wherein the first-named means comprises a float chamber which surrounds the back-fire prevention valve, wherein the double-grid surrounds the float chamber; and wherein the last-named means comprises a charging valve connected with the fuel inlet.

10. The combination of claim **1** wherein the apertures of the double grids are between approximately 0.016 inch and approximately 0.0625 inch in diameter.

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