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**Wood**

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[54] **AUTOMATIC SHUT-OFF NOZZLE RESPONSIVE TO MORE THAN ONE CONDITION IN A TANK BEING FILLED**

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[52] **U.S. Cl.** .................. **141/208,** 141/209, 141/215, 141/225

[51] **Int. Cl.** .................. **B65b 1/30**

[58] **Field of Search** .................. 141/39–42, 141/46, 59, 52, 97, 198–229, 292, 392

[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,603,359 | 9/1971 | Belue | 141/208 |
| 3,674,061 | 7/1972 | Calisher et al. | 141/226 |

FOREIGN PATENTS OR APPLICATIONS

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|---|---|---|---|
| 1,220,938 | 1/1960 | France | 141/226 |

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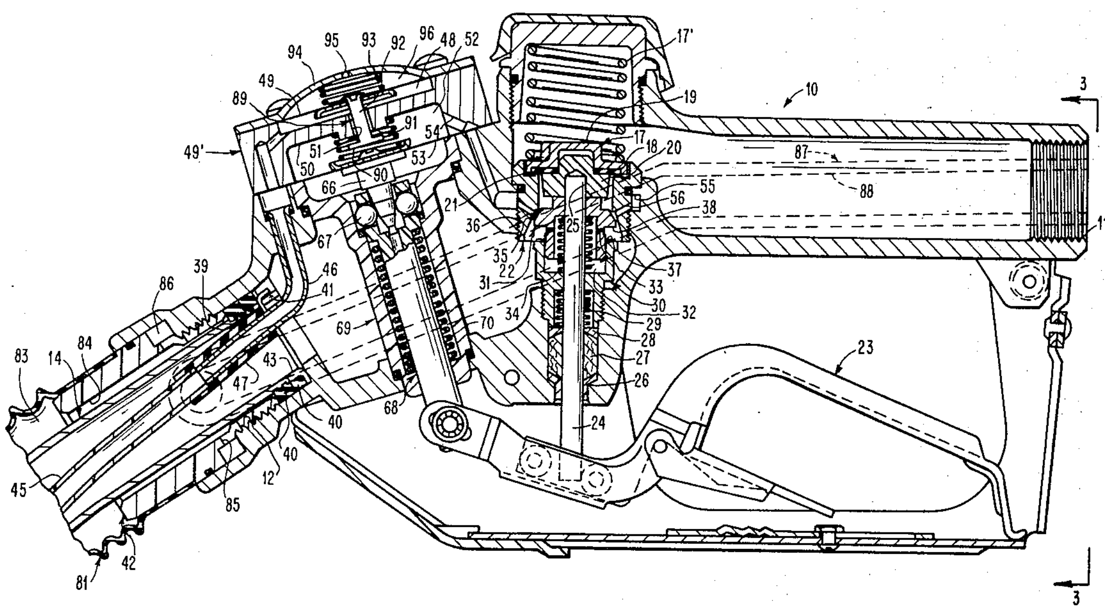
*Attorney, Agent, or Firm*—John G. Schenk

[57] **ABSTRACT**

An automatic shut-off nozzle has a pair of diaphragms with a first diaphragm being responsive to the vapor pressure in the tank which is being filled exceeding a predetermined pressure so as to block communication with a second diaphragm, which is subjected to a partial vacuum, with the tank being filled whereby the second diaphragm moves due to an increase in the partial vacuum acting on said second diaphragm to cause closing of a manually operated valve which stops flow through the nozzle. When the liquid in the tank reaches a predetermined level, the second diaphragm moves due to the partial vacuum acting on said second diaphragm being increased so as to cause the valve to again be closed.

**9 Claims, 7 Drawing Figures**



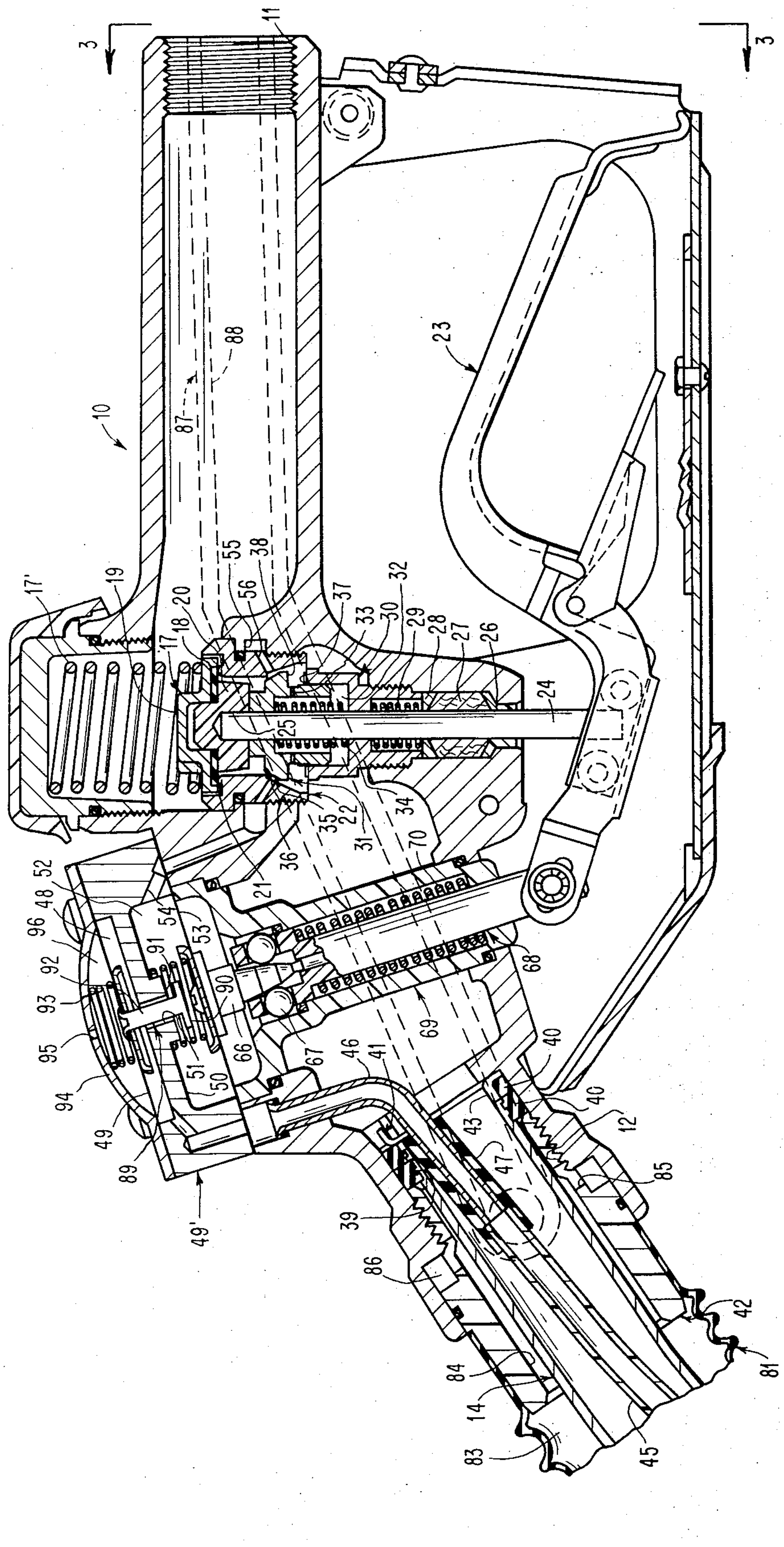

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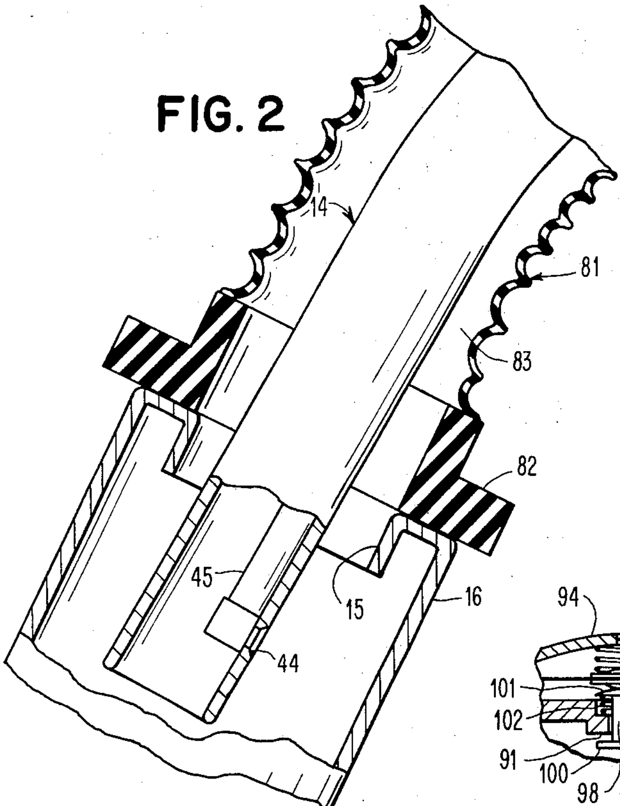
FIG. 1

FIG. 2



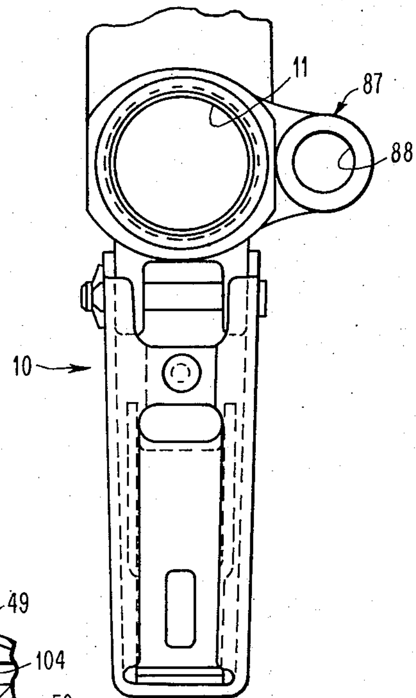




FIG. 3

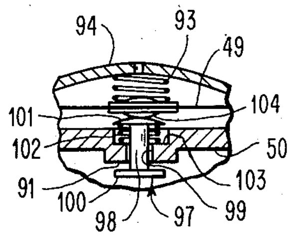
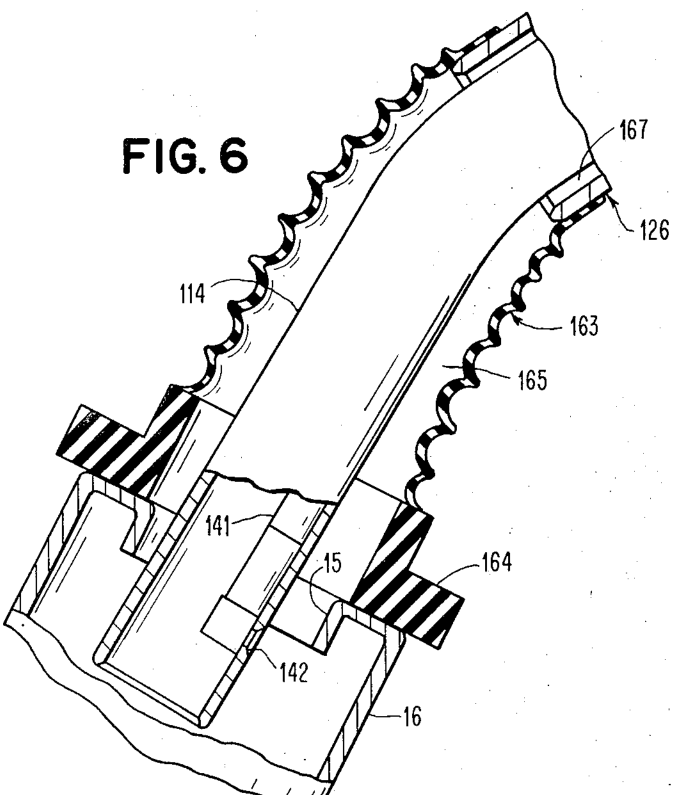



FIG. 4

FIG. 6



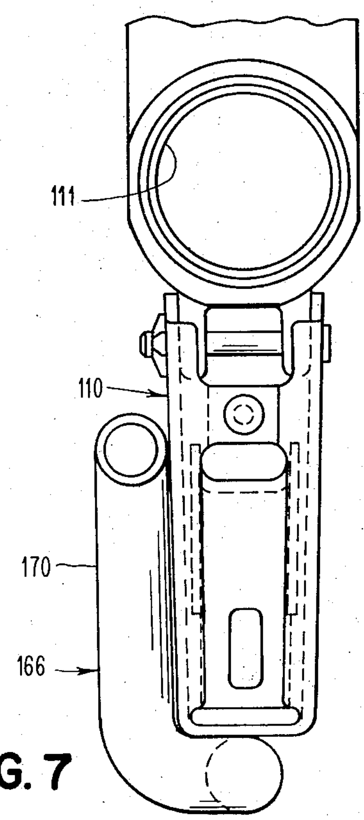




FIG. 7

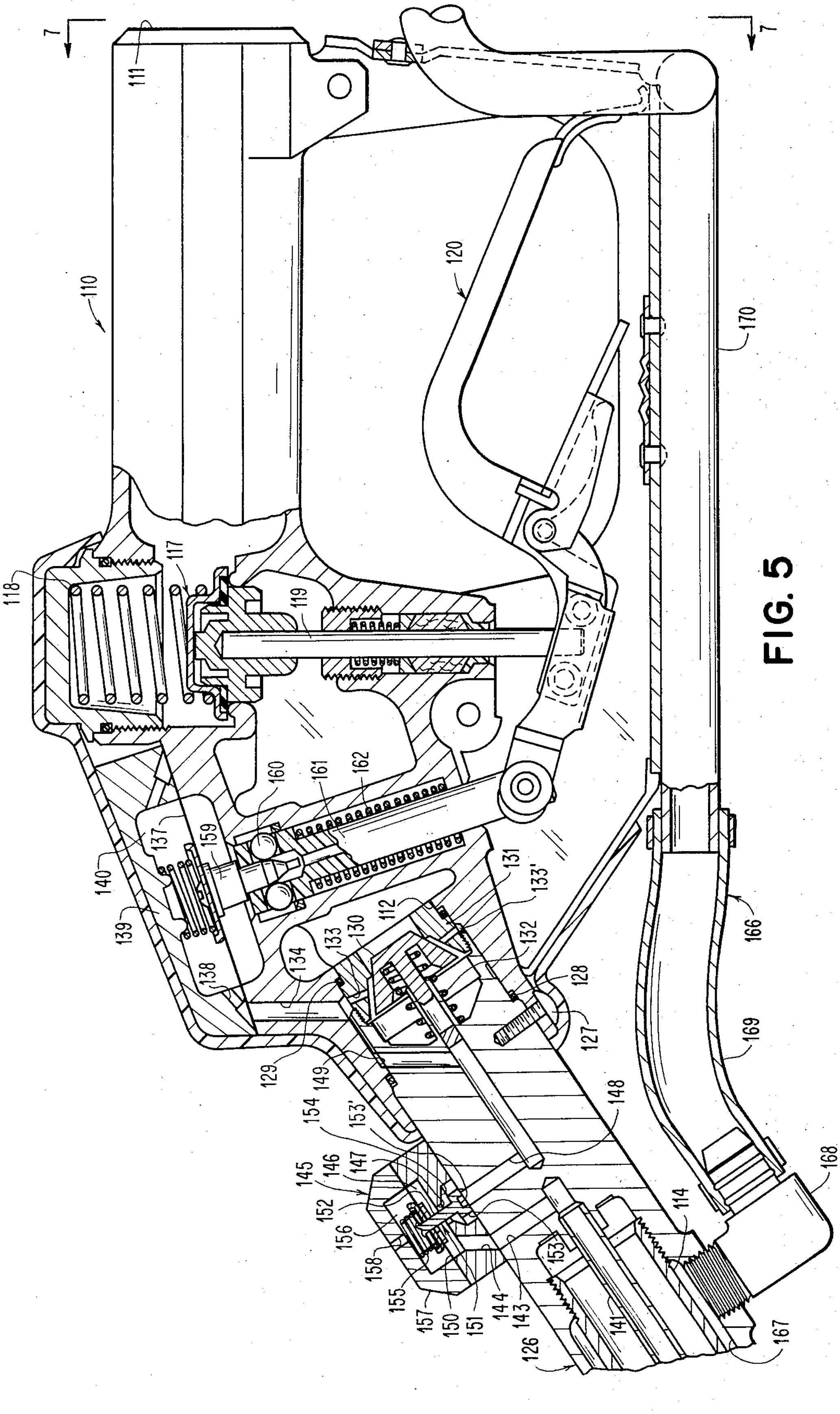

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FIG. 5

## AUTOMATIC SHUT-OFF NOZZLE RESPONSIVE TO MORE THAN ONE CONDITION IN A TANK BEING FILLED

### SPECIFICATION

When filling a vehicle tank with gasoline through a dispensing nozzle, vapors from the gasoline within the tank can be prevented from escaping through the opening in which the spout of the nozzle is inserted by sealing the opening. Thus, the escape of the gasoline vapors into the atmosphere is prevented so that pollution of the atmosphere is decreased. The vapors within the tank can be recovered through vapor recovery equipment utilized in conjunction with the nozzle.

However, the sealing of the vehicle tank to insure that the vapors of the gasoline being supplied thereto do not escape into the atmosphere makes it necessary that the pressure within the tank not exceed a safe value. While the vapor recovery system of the nozzle normally prevents the pressure within the tank exceeding the safe value, the possibility exitsts that there could be a blockage in the vapor recovery passages in the nozzle or in the passage in the vapor recovery equipment, which condenses the vapor to a liquid form, connected to the nozzle vapor recovery passages. If this blockage should occur, the pressure in the tank could exceed a safe value whereby the tank could rupture.

The present invention satisfactorily solves this problem by automatically stopping the flow of gasoline through the spout to the vehicle tank when the pressure within the vehicle tank which is being filled exceeds a predetermined pressure. Thus, the present invention enables a tank to be sealed during filling without danger of rupture.

Additionally, the mechanism of the present invention enables automatic shut off of the flow of gasoline to also occur when the liquid in the tank reaches a predetermined level. With the tank being sealed, there is no way in which the operator of the nozzle could ascertain that the tank was filled so that automatic shut off of the flow of gasoline to the tank when the tank reaches a predetermined level is a requisite.

U.S. Pat. No. 3,603,359 to Belue discloses a shut-off nozzle in which a normally operated valve to stop flow to a tank being filled is closed in response to either the liquid exceeding a predetermined level or the pressure in the tank exceeding a predetermined pressure. However, the aforesaid Belue patent utilizes a slidable piston to stop communication between the vehicle tank and a diaphragm, which actuates a release mechanism to close the manually operated valve, when the pressure in the tank exceeds a predetermined pressure. The piston is relatively small in comparison with the area of the diaphragm so that it is not sensitive to slight changes in pressure in the tank being filled.

Furthermore, dirt can easily become lodged between the piston of the aforesaid Belue patent and the chamber in which it slides. If this were to occur, the piston will not block the passage connecting the tank to the chamber having the diaphragm at the desired tank pressure since the dirt would prevent the piston from moving to a closed position at the desired pressure.

The present invention satisfactorily overcomes the foregoing problems of the aforesaid Belue patent by utilizing a diaphragm, preferably of the same area as the actuating diaphragm, so that the mechanism is responsive to relatively small changes in the pressure within the tank being filled. Thus, the present invention enables stopping of the flow due to a smaller pressure differential than can be obtained with the aforesaid Belue patent. Furthermore, by using the diaphragm, there is no possibility of dirt causing a significant variation in the response of the diaphragm to the pressure in the tank being filled as in the aforesaid Belue patent.

Additionally, the slidable piston of the aforesaid Belue patent has openings to provide communication from the tank through the piston to the chamber having the actuating diaphragm. If these should become slightly misaligned, then the desired partial vacuum will not exist in the chamber of the aforesaid Belue patent having the actuating diaphragm.

The present invention satisfactorily solves this problem by utilizing a throttling valve of smaller size than the passage in which it is disposed. The present invention throttles the air flow by cooperation between a valve seat and a portion of the valve so that an effective throttling is obtained in response to various pressures in the tank.

With the arrangement of the present invention, the desired partial vacuum exists in the chamber having the actuating diaphragm even though the tank which is being filled is pressurized. Thus, the throttling valve of the present invention insures that the desired partial vacuum exists under normal operating conditions with the tank which is being filled being pressurized.

An object of this invention is to provide an automatic shutoff nozzle for automatically stopping flow of liquid to a tank which is being filled when the pressure in the tank exceeds a predetermined pressure or the liquid in the tank reaches a predetermined level.

Another object of this invention is to provide an automatic shut-off nozzle having a pair of diaphragms with one being responsive to the vapor pressure in the tank exceeding a predetermined pressure to change the vacuum acting on the other diaphragm so that the other diaphragm always responds to a vacuum increase irrespective of whether it is due to an increase in the pressure in the tank of the liquid in the tank reaching a predetermined level.

Other objects, uses, and advantages of this invention are apparent upon a reading of this description, which proceeds with reference to the drawings forming part thereof and wherein:

FIG. **1** is a sectional view, partly in elevation, of a portion of the nozzle of the present invention.

FIG. **2** is a sectional view, partly in elevation, of the remainder of the nozzle of FIG. **1** and showing its spout entering the filler pipe of a vehicle tank.

FIG. **3** is an end elevational view of the nozzle of FIG. **2** and taken along line **3—3** of FIG. **1.**

FIG. **4** is a fragmentary sectional view of a portion of the nozzle of FIG. **1** and showing a modification of the connection between one of the diaphragms and the throttling valve of the present invention.

FIG. **5** is a sectional view, partly in elevation, of a portion of another embodiment of the nozzle of the present invention.

FIG. **6** is a sectional view, partly in elevation, of the remainder of the nozzle of FIG. **5** and showing its spout entering the filler pipe of a vehicle tank.

FIG. **7** is an end elevational view of the nozzle of FIG. **5** and taken along line **7—7** of FIG. **5.**

Referring to the drawings and particularly FIGS. 1 and 2, there is shown a nozzle body 10 having an inlet 11 to which a hose is connected to supply liquid such as gasoline, for example, to the interior of the body 10. The body 10 has an outlet 12 with which a spout 14 communicates to receive liquid from the interior of the body 10. The spout 14 is adapted to be inserted within an opening 15 (see FIG. 2) in a filler pipe 16 of a vehicle tank such as an automobile fuel tank, for example.

The body 10 has a first or main poppet valve 17 (see FIG. 1) supported therein for controlling the flow of liquid from the inlet 11 to the interior of the body 10 and from the interior of the body 10 to the outlet 12. A spring 17′ continuously urges the poppet valve 17 to its closed position on which flow from the inlet 11 to the outlet 12 is stopped or prevented.

The first poppet valve 17 includes a sealing disc 18, which is formed of a resilient material such as rubber, for example, a retainer or holder 19, and a skirt 20, which is preferably formed of a suitable plastic. The sealing disc 18 of the first poppet valve 17 engages a first valve seat 21 of a seat ring 22, which is supported within the body 10 by being threaded thereto, when the first poppet valve 17 is in its closed position.

The first poppet valve 17 is moved to an open position by a pivotally mounted handle 23 moving a stem 24, which has its upper end disposed within a passage 25 in the skirt 20. The amount of upward movement of the first poppet valve 17 determines the rate of flow through the seat ring 22 since the skirt 20 has its side surface machined with a specific contour for cooperation with the wall of the seat ring 22.

The stem 24 passes through the body 10 for cooperation with the handle 23 but not in contact with the body 10 because of a guide 26 being disposed in surrounding relation to the stem 24 as it extends exteriorly of the body 10. The guide 26 is formed of a suitable plastic material such as acetal resin, for example. This material has a relatively low coefficient of friction that minimizes the sliding friction between the stem 24 and the body 10. The guide 26 also eliminates wear on the stem 24 so as to not affect the sliding action of the stem 24.

Liquid cannot flow from the body 10 to the exterior thereof through the passage in the body 10 for the stem 24 due to a packing 27, which is disposed in surrounding relation to the stem 24 and above the guide 26. A gland 28 is disposed above the packing 27 and has a spring 29 acting thereon. A retainer 30, which is threaded in the body 10, acts against the spring 29 and retains the packing 27 in a position to prevent any leakage of liquid from the body 10 through the stem 24.

The retainer 30 slidably supports the lower end of a second or secondary poppet valve 31. The second poppet valve 31 and the retainer 30 cooperate to form a chamber 32 therebetween having communication to the interior of the body 10 through passages 33 in the second poppet valve 31.

A spring 34 is disposed within the chamber 32 and continuously urges the second poppet valve 31 into engagement with the bottom surface of the skirt 20 of the first poppet valve 17. The stem 24 extends through the second poppet valve 31 so that there is a sliding relation therebetween whereby the second poppet valve 31 can move axially relative to the stem 24. When the first poppet valve 17 is closed, a surface 35 of the second poppet valve 31 engages a second valve seat 36 of the seat ring 22.

Accordingly, when the first poppet valve 17 is moved upwardly by pivoting the handle 23, flow of the liquid starts through the seat ring 22 due to the first poppet valve 17 being moved upwardly against the force of the spring 17′ to remove the sealing disc 18 from contact with the first valve seat 20 of the seat ring 22. When the sealing disc 18 ceases to engage the first valve seat 20 of the seat ring 22, the pressure of the liquid moves the second poppet valve 31 downwardly so that the surface 35 of the second poppet valve 31 does not engage the second poppet valve seat 36 of the seat ring 22. As a result, liquid flows through the body 10 to the outlet 12 and then through the spout 14 to the container to be filled.

Because of the flow of liquid through the body 10 and the passages 33 in the second poppet valve 31 providing communication between the chamber 32 and the interior of the body 10, a venturi effect is created by the liquid flowing over the lower edge of the surface 35 of the second poppet valve 31 to provide a vacuum within the chamber 32. This decreases the total pressure acting upwardly on the second poppet valve 31 whereby the second poppet valve 31 is moved further away from the second valve seat 36 of the seat ring 22 to allow an increased flow of the liquid through the body 10 for a particular pressure of the liquid.

The upper end of the retainer 30 has four protruding portions 37 for cooperation with a lower annular surface 38 of the second poppet valve 31 to limit the downward movement of the second poppet valve 31. This insures that the passages 33 always communicate with the interior of the body 10 even when the second poppet valve 31 is in its lowermost position to allow maximum flow between the seat ring 22 and the second poppet valve 31.

The spout 14 is releasably connected to the body 10. The spout 14 has its upper end formed with projections 39 for cooperation with packings 40, which are preferably formed of rubber. The packings 40 are retained between a lock washer 41 and a retainer 42, which is preferably formed of a suitable plastic, threadedly disposed in the outlet 12 of the body 10. The lock washer 41 has a portion 43 cooperating with a slot in the end of the spout 14 to prevent the spout 14 from rotating relative to the body 10.

If the spout 14 should be retained in a vehicle tank when the vehicle is moved, the projections 39 on the spout 14 will be pulled out of the packings 40 without any damage to the body 10, to the pump to which the body 10 is connected by a hose, or to the hose. To replace the spout 14 in the body 10, it is only necessary to remove the retainer 42 and insert the end of the spout 14 so that the projections 39 embed in the packings 40.

Whenever the spout 14 is pulled loose, a vacuum tube 45, which is supported in the spout 14 and has one end communicating with an opening 44 (see FIG. 2) in the spout 14, also is disconnected from its connection with an elbow tube 46 (see FIG. 1), which is supported in the body 10. The vacuum tube 45 is connected to the elbow tube 46 by a coupling 47, which is preferably formed of rubber.

The vacuum tube 45 and the elbow tube 46 form a passage leading from the tank of the vehicle being filled to a chamber 48, which is formed between a diaphragm

49 and portions of a spacer 49′ including a wall 50. The wall 50 has a passage 51 connecting the chamber 48 with a chamber 52, which is formed between a diaphragm 53 and portions of the spacer 49′ including the wall 50. The spacer 49′ is fixed to the nozzle body 10 and may be considered part of the body 10.

The chamber 52 communicates through a passage 54 in the spacer 49′ and the body 10, an annular chamber 55 in the body 10, and four passages 56 (two shown in FIG. 1) in the seat ring 22 to the interior of the seat ring 22. Accordingly, when the liquid flows from the inlet 11 to the outlet 12, a venturi effect is created in the passages 56 in the seat ring 22.

Thus, as long as the opening 44 is not closed due to the fuel in the tank reaching a predetermined level to indicate that the tank is filled, the venturi effect created by the flow of the liquid between the seat ring 22 and the second poppet valve 31 draws air through the vacuum tube 45. However, as soon as the opening 44 is blocked, the chamber 52 has its pressure reduced due to the air therein being drawn therefrom because of the venturi effect in the passages 56 in the seat ring 22. This venturi effect is more particularly described in U.S. Pat. No. 3,085,600 to Briede.

The diaphragm 53 has a latch retaining pin 66 secured thereto for movement therewith and disposed between three balls 67 (two shown), which are positioned within passages in a latch plunger 68. When the latch retaining pin 66 is in the position shown in FIG. 1, the balls 67 prevent downward movement of the plunger 68, which is slidably mounted within an insert 69. The insert 69, which is preferably formed of a plastic, is supported in the body 10.

When the diaphragm 53 is moved upwardly due to the tank being filled, the latch retaining pin 66 is moved upwardly therewith. The upward movement of the retaining pin 66 disposes a tapered portion of the retaining pin 66 between the balls 67 whereby the balls 67 may move inwardly to allow the plunger 68 to be moved downwardly against the force of its spring 70. The correlation between the tapered portion of the pin 66 and the latch plunger 68 is more specifically shown in U.S. Pat. No. 2,582,195 to Duerr.

The lower end of the plunger 68 is connected to the handle 23 as more particularly shown and described in the copending patent application of Paul R. Wilder for "FLUID DISPENSING NOZZLE" application Ser. No. 161,571, filed July 12, 1971, and assigned to the same assignee as the assignee of this application. Thus, when the liquid in the tank being filled reaches the predetermined level so that the diaphragm 53 moves upwardly to pull the latch retaining pin 66 and release the latch plunger 68 from the balls 67, the force of the spring 17′ closes the first poppet valve 17 as more particularly shown and described in the aforesaid Wilder application.

The spout retainer 42 has one end of a bellows 81, which is preferably formed of rubber, secured thereto. The other end of the bellows 81 has a sealing ring 82 (see FIG. 2), which is preferably formed of rubber, mounted thereon. The bellows 81 and the sealing ring 82 are spaced from the spout 14 to form an annular passage 83 therebetween.

The upper end of the annular passage 83 communicates with an annular passage 84 (see FIG. 1), which is formed between the spout retainer 42 and the spout 14. The spout retainer 42 has openings 85 formed therein to provide communication from the annular passage 84 to an annular chamber 86, which is formed between the spout retainer 42 and a portion of the body 10.

The chamber 86 communicates with an end of a vapor recovery tube 87 (see FIGS. 1 and 3) which is supported on the nozzle body 10. The vapor recovery tube 87 has its passage 88 communicating at its other end with a hose (not shown) to vapor recovery equipment in which the gasoline vapor is condensed so as to be supplied as gasoline again.

Accordingly, when the sealing ring 82 abuts the filler pipe 16 of a vehicle tank as shown in FIG. 2, the tank is sealed so that all vapors will pass therefrom through the annular passages 83 and 84 (see FIG. 1), the openings 85 in the spout adapter 42, the annular chamber 86, and the passage 88 in the vapor recovery tube 87. Thus, the vapors can flow to the vapor recovery equipment.

With the tank sealed by the sealing ring 82, vapor pressure can build up inside the tank if the passage 83 or 84, the openings 85 in the spout adapter 42, the annular chamber 86, or the passage 88 in the vapor recovery tube 87 should be blocked. Likewise, if there should be a failure in the vapor recovery equipment so as to prevent the escape of the vapor from the vapor recovery tube 87 to the vapor recovery equipment, then the pressure in the tank also would build up.

Any increase in the vapor pressure in the sealed tank beyond the predetermined pressure, which is about 1 to 1½ p.s.i., will cause the diaphragm 49 to move upwardly against a spring 93. When this occurs, a valve 89, which is secured to the diaphragm 49, moves towards a seat 91, which is formed by a downwardly projecting portion of the wall 50 of the spacer 49′ and surrounds the passage 51 in the wall 50, to stop flow through the passage 51.

The valve 89 includes a cylindrical body 92 having the head 90 at its lower end. The cylindrical body 92 has a smaller diameter than the passage 51 so that communication between the chambers 48 and 52 is blocked only when the head 90 of the valve 89 engages the seat 91.

However, there is a continuous throttling effect through the passage 51 due to the position of the head 90 of the valve 89 relative to the seat 91. This enables the desired partial vacuum to exist within the chamber 52 even though the tank is sealed and under pressure.

The upper surface of the diaphragm 49 has the spring 93 acting thereagainst to exert a predetermined pressure on the diaphragm 49. A cap 94, which holds the spring 93 against the diaphragm 49, has an opening 95 to vent a chamber 96, which is formed between the cap 94 and the upper surface of the diaphragm 49.

Considering the operation of the nozzle of the present invention, the tank being filled is sealed by engagement of the sealing ring 82 with the filler pipe 16 in the tank. Then, actuation of the handle 23 opens the first poppet valve 17 to allow gasoline to flow through the body 10.

When flow begins, the pressure within the sealed tank positions the valve 89 through the diaphragm 49 so that the valve head 90 of the valve 89 is spaced from the valve seat 91 and the desired partial vacuum exists within the chamber 52 due to the venturi effect at the seat ring 22. Any fluctuation in the pressure in the sealed tank causes movement of the valve **89** to a slight extent so that the partial vacuum in the chamber **52** remains substantially constant even though there are variations in the pressure within the tank. However, when the pressure in the tank exceeds the safe value, which is the predetermined pressure at which it is desired to stop flow to the tank, the diaphragm **49** is moved upwardly sufficiently against the spring **93** to cause the valve head **90** to engage the valve seat **91** and block flow between the sealed tank and the chamber **52.** When this occurs, the partial vacuum within the chamber **52** quickly increases, and the diaphragm **53** moves upwardly to lift the latch retaining pin **66** so that the plunger **68** is released from the balls **67.** As previously mentioned, this causes the valve **17** to close to stop flow.

Even if the pressure in the tank does not exceed the predetermined pressure, liquid flow in the tank is stopped when the level of the liquid in the tank blocks the opening **44** (see FIG. **2**). When this occurs, the partial vacuum in the chamber **52** (see FIG. **1**) again increases to cause the diaphragm **53** to move upwardly. When this occurs, the valve **17** is again closed due to the release of the plunger **68** from the balls **67** by the upward movement of the latch retaining pin **66** with the diaphragm **53** to which it is connected.

Referring to FIG. **4**, there is shown a modification in which a valve **97**, which replaces the valve **89**, is utilized with the diaphragm **49** without being connected thereto. The valve **97** includes a cylindrical body **98**, which has a smaller diameter than a passage **99** in the wall **50**, and a head **100** for cooperation with the valve seat **91** on the wall **50** of the body **10.** The upper end of the valve **97** has a head **101** with which one end of a spring **102** cooperates. The other end of the spring **102** engages against a flat, annular surface **103** of the wall **50.**

The spring **102** holds the upper end of the valve body **98** of the valve **97** against a buttom **104** of the diaphragm **49.** Accordingly, when the diaphragm **49** moves upwardly, the valve **97** will follow its movement due to the spring **102.** When the diaphragm **49** moves downwardly, the force of the spring **102** is overcome so that the valve **97** can be moved downwardly.

Referring to FIGS. **5** and **6**, there is shown another form of the present invention which can easily be added to an existing nozzle in the field, for example. The nozzle includes a body **110** having an inlet **111** to which a hose is connected to supply a liquid such as gasoline, for example, to the interior of the body **110.** The body **110** has an outlet **112** with which a spout **114** communicates to receive liquid from the interior of the body **110.** The spout **114** is adapted to be inserted within the opening **15** (see FIG. **6**) in the filler pipe **16** of a vehicle tank.

The body **110** has a first or main poppet valve **117** (see FIG. **5**) supported therein for control of the flow of liquid from the inlet **111** to the interior of the body **110** and from the interior of the body **110** to the outlet **112.** A spring **118** continuously urges the poppet valve **117** to its closed position in which flow from the inlet **111** to the outlet **112** is stopped or prevented.

A stem **119** is connected to the poppet valve **117** and has its lower portion extending exteriorly of the body **110.** The valve stem **119**, which is slidably disposed within the body **110**, is moved by a manually operated lever or handle **120.** The stem **119** passes through the body **110** in the same manner as described for the stem **24** of the nozzle body **10** of FIGS. **1** and **2.**

A spout adapter **126** is connected to the outlet **112** of the body **110.** The spout adapter **126**, which has the spout **114** threaded in its end, is fixed to the body **110** by a screw **127.** The screw **127** is preferably formed of a material that will break or shear when subjected to a predetermined force. Thus, if the spout **114** should be retained in a vehicle tank when the vahicle is moved, the screw **127** breaks or shears and allows the spout adapter **126** to be pulled from the body **110** without any damage to the body **110** or to the pump to which the body **110** is connected by a hose.

Sealing rings **128** and **129** are disposed between the spout adapter **126** and the body **110.** Thus, liquid cannot escape between the body **110** and the spout adapter **126.**

A second poppet valve **130** is slidably mounted on the spout adapter **126** and is continuously urged into engagement with a seating ring **131**, which is secured to the spout adapter **126** and has the sealing ring **129** cooperating therewith, by a spring **132.** Thus, only the pressure of fuel flowing from the inlet **111** and past the valve **117** can overcome the spring **132** and move the poppet valve **130** to an open position.

As the fuel flows between the poppet valve **130** and the seating ring **131**, a venturi effect is created in radially extending passages **133** in the seating ring **131.** The outer ends of the passages **133** communicate with an annular chamber **133'**. The passages **133** communicate through the chamber **133'**, a passage **134** in the body **110**, an opening in a diaphragm **137**, and a passage **138** in a cap to a chamber **140**, which is formed between the diaphragm **137** and the cap **139.**

The passage **134** also communicates with a vacuum tube **141**, which is connected with an opening **142** (see FIG. **6**) in the spout **114** adjacent the discharge end of the spout **114.** The tube **141** communicates through a first passage **143** (see FIG. **5**) in the spout adapter **126** and a passage **144** in a control member **145** to a chamber **146** within the control member **145**, which is carried by the spout adapter **126.** The chamber **146** communicates through a passage **147** in the control member **145**, a second passage **148** in the spout adapter **126**, and a passage **149**, which is formed between the spout adapter **126** and the body **110**, to the passage **134** in the body **110.**

The chamber **146** in the control member **145** has one wall formed by a diaphragm **150** to which a valve **151** is connected. The valve **151** includes a cylindrical body **152** and a head **153.** The body **152** has a smaller diameter than the diameter of the passage **147** in the control member **145** through which it extends.

The head **153** has a slot **153'** in its bottom surface to permit communication between the passages **147** and **148** when the head **153** engages the spout adapter **126** as shown in FIG. **5.** Thus, communication of the chamber **140** with the sealed tank occurs unless the head **153** of the valve **151** engages a valve seat **154**, which is formed by a tapered wall of the control member **145.** The head **153** of the valve **151** engages the valve seat **154** when the diaphragm **150** moves upwardly as will be explained hereinafter whereby communication of the chamber **140** with the sealed tank is stopped.

A spring **155**, which is disposed within a chamber **156** formed between the diaphragm **150** and a cap **157** on the control member **145**, acts against the diaphragm

150 to urge the valve 151 to its open position as shown in FIG. 5. The cap 157 has an opening 158 therein to vent the chamber 156 to atmosphere.

Accordingly, as long as the opening 142 (see FIG. 6) is not closed due to the fuel within the tank reaching a predetermined level that indicates that the tank is filled, the venturi effect created by the flow of the liquid between the seating ring 131 (see FIG. 5) and the poppet valve 130 draws air through the tube 141 to create a partial vacuum within the chamber 140. However, as soon as the opening 142 is blocked, the chamber 140 has its pressure reduced due to the air therein being drawn therefrom because of the venturi effect in the passage 133 whereby the diaphragm 137 moves upwardly since the partial vacuum in the chamber 140 is increased. This venturi effect is more particularly described in the aforesaid Briede patent.

The diaphragm 137 has a latch retaining pin 159 connected thereto for movement therewith. The latch retaining pin 159 is disposed between three balls 160, which are positioned within passages in a latch plunger 161. When the latch retaining pin 159 is in the position shown in FIG. 5, the balls 160 prevent downward movement of the plunger 161, which is slidably mounted in the body 110.

When the diaphragm 137 is moved upwardly due to the fuel in the tank reaching the predetermined level, the latch pin 159 is moved upwardly therewith. This disposes a tapered portion of the latch pin 159 between the balls 160 whereby the balls 160 may move inwardly to allow the plunger 161 to be moved downwardly against the force of its spring 162 as more specifically described with respect to the modification of FIGS. 1 and 2.

The spout adapter 126 has one end of a bellows 163 (see FIG. 6), which is preferably formed of rubber, secured thereto. The other end of the bellows 163 has a sealing ring 164, which is preferably formed of rubber, mounted thereon. The bellows 163 and the sealing ring 164 are spaced from the spout 114 to form an annular passage 165 therebetween. The upper end of the annular passage 165 communicates with a vapor recovery tube 166 (see FIG. 5), which is supported on the nozzle body 110, through an annular passage 167, which is formed between the spout adapter 126 and the spout 114. Accordingly, when the sealing ring 164 abuts the filler pipe 16 of a vahicle tank as shown in FIG. 6, the tank is sealed so that all vapors can pass therefrom through the annular passage 165, the annular passage 167, and the vapor recovery tube 166.

The vapor recovery tube 166 includes an elbow 168, which is threaded to the spout adapter 126, a flexible tube 169, and a tube 170, which is supported by the nozzle body 110. The vapor recovery tube 166 has the tube 170 connected by a suitable hose to vapor recovery equipment in which the gasoline vapor is condensed so as to be supplied as gasoline again.

With the tank sealed by the sealing ring 164, vapor pressure can build up inside of the tank if the annular passage 165 or 167 or the passage in the vapor recovery tube 166 should be blocked. Likewise, if there should be a failure in the vapor recovery equipment so as to prevent the escape of the vapor from the vapor recovery tube 166 to the vapor recovery equipment, the pressure in the tank also will build up.

Accordingly, an increase in the vapor pressure in the sealed tank beyond the predetermined pressure will cause the diaphragm 150 to move upwardly against the force of the spring 155. When this occurs, the valve head 153 engages the tapered valve seat 154.

As a result, the partial vacuum in the chamber 140 increases to cause the diaphragm 137 to move upwardly. This results in the poppet valve 117 being moved to its closed position.

Any variation in the pressure in the sealed tank below the predetermined pressure causes the head 153 of the valve 151 to move toward or away from the tapered valve seat 154 whereby there is throttling of the air flow. Thus, the partial vacuum within the chamber 140 remains substantially constant irrespective of the pressure within the sealed tank unless the pressure in the sealed tank exceeds the predetermined pressure.

While the body of the valve has been shown as being cylindrical with a head on the end, it should be understood that the valve body could be tapered with an enlarged end so as to create a throttling effect between the tapered valve body and the seat. In this arrangement, the seat would be formed in the passage within which the body is disposed rather than at the end thereof.

An advantage of this invention is that it enables a substantially constant partial vacuum to be maintained within a sensing chamber irrespective of the pressure in the sealed tank unless the pressure exceeds the predetermined pressure. Another advantage of this invention is that it may be readily adapted for use with a presently existing nozzle.

For purposes of exemplification, particular embodiments of the invention have been shown and described according to the best present understanding thereof. However, it will be apparent that changes and modifications in the arrangement and construction of the parts thereof may be resorted to without departing from the spirit and scope of the invention.

What is claimed is:

1. An automatic shut-off nozzle comprising a body having an inlet and an outlet, a valve in said body controlling flow of liquid from said inlet to said outlet, manual operated means controlling the operation of said valve, a spout communicating with said outlet, said spout being insertable into a tank through an opening therein to allow the liquid to be dispensed therein, release means movable in one direction to release said manual operated means in response to either of tow conditions existing in the tank and acting on said manual operated means to allow closing of said valve and stoppage of liquid flow, the conditions being build-up of vapor pressure to a predetermined pressure and the liquid in the tank reaching a predetermined level, a first diaphragm communicating with the tank and responsive to the conditions in the tank, throttle valve means responsive to movement of the first diaphragm, a chamber, a second diaphragm forming a wall of said chamber, said second diaphragm having said release means connected thereto, means communicating said chamber with the tank, means to create a partial vacuum in said chamber when liquid is flowing through said body, said throttle valve means controlling said communicating means to regulate the partial vacuum created in said chamber by said creating means, said throttle valve means including a valve member movable in response to movements of said first diaphragm and a seat formed in said communicating means, said first diaphragm having an area several times the area of

said valve member, said valve member blocking said communicating means by engaging said seat when said first diaphragm moves in response to one of the conditions existing in the tank so that the partial vacuum in said chamber is increased to cause said second diaphragm to move said release means in the one direction, and said second diaphragm being movable by the other of the conditions existing in the tank to move said release means in the one direction.

**2.** The nozzle according to claim **1** including means to connect said valve member of said throttle valve means to said first diaphragm.

**3.** The nozzle according to claim **2** in which the direction of motion of said valve member of said throttle valve means is aligned with the direction of motion of said release means.

**4.** The nozzle according to claim **3** in which said chamber has a wall formed with a passage therein, said passage being part of said communicating means, and said valve member having a portion smaller than said passage and disposed in said passage to allow communication between said chamber and the tank when the one condition does not exist in the tank.

**5.** The nozzle according to claim **2** in which said communicating means includes a passage, said valve member includes a first portion disposed in said passage of said communicating means and being smaller than said first passage of said communicating means to allow communication between said chamber and the tank when the one condition does not exist in the tank, and said valve member includes a second portion cooperating with said seat to block said communicating means when the one condition exists in the tank.

**6.** The nozzle according to claim **1** in which the direction of motion of said valve member of said throttle valve means is aligned with the direction of motion of said release means.

**7.** The nozzle according to claim **6** in which said chamber has a wall formed with a passage therein, said passage being part of said communicating means, and said valve member having a portion smaller than said passage and disposed in said passage to allow communication between said chamber and the tank when the one condition does not exist in the tank.

**8.** The nozzle according to claim **1** in which said chamber has a wall formed with a passage therein, said passage being part of said communicating means, and said valve member having a portion smaller than said passage and disposed in said passage to allow communication between said chamber and the tank when the one condition does not exist in the tank.

**9.** The nozzle according to claim **1** in which said communicating means includes a passage, said valve member includes a first portion disposed in said passage of said communicating means and being smaller then said passage of said communicating means to allow communication between said chamber and the tank when the one condition does not exist in the tank, and said valve member includes a second portion cooperating with said seat to block said communicating means when the one condition exists in the tank.

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