United States Patent

Moore et al.

[15] **3,646,974**

[45] **Mar. 7, 1972**

[54] AUTOMATIC SHUTOFF DISPENSING NOZZLE VENTURI

[72] Inventors: **Glenn E. Moore**, Cincinnati, Ohio; **Fred A. Wilson**, Florence, Ky.; **Chester W. Wood**, Cincinnati, Ohio

[73] Assignee: **Dover Corporation**, Cincinnati, Ohio

[22] Filed: **Mar. 23, 1970**

[21] Appl. No.: **21,618**

[52] **U.S. Cl.** **141/392**, 137/604, 261/62, 417/189, 261/DIG. 56

[51] **Int. Cl.** **B67d 5/373**

[58] **Field of Search** ..... 137/540, 604; 141/206–211, 214, 215, 217, 218, 225, 226, 392; 261/44, 53, 62, DIG. 54, DIG. 56; 138/45; 417/189

[56] **References Cited**

UNITED STATES PATENTS

817,721	4/1906	Lewis	261/62
1,250,373	12/1917	Smith	261/53
2,279,002	4/1942	MacNeil	137/540
3,224,472	12/1965	Ehlers	141/209
2,320,033	5/1943	Davis, Jr.	141/209
3,085,600	4/1963	Briede	141/225 X

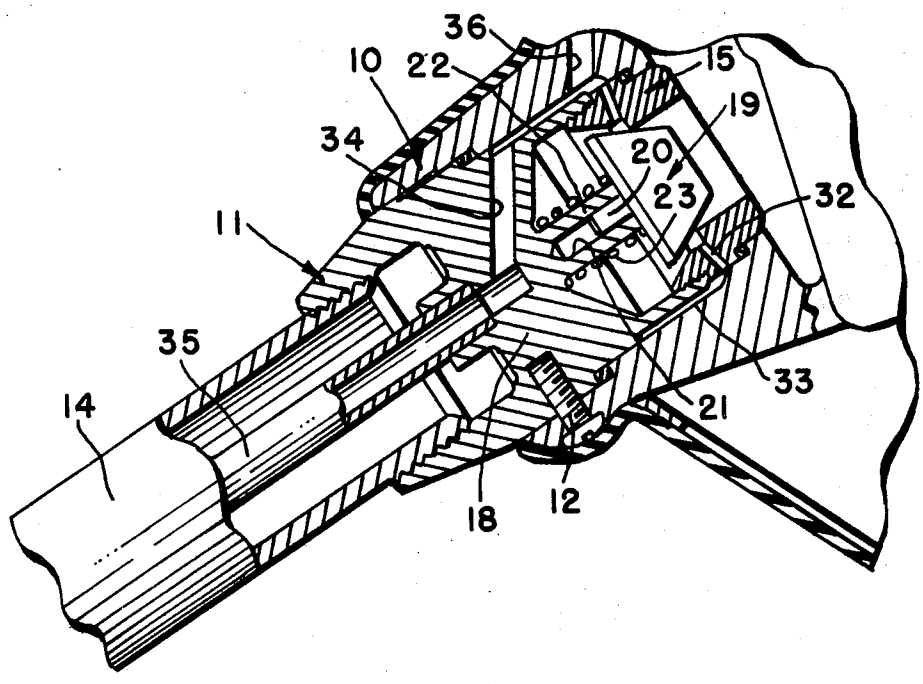
Primary Examiner—Edward J. Earls

Attorney—Kinney and Schenk

[57] **ABSTRACT**

A continuous groove is formed in the conical bore of a variable venturi body to increase the area in which the liquid flowing therethrough can expand to produce an enlarged low-pressure area. This enlarged low-pressure area enables a diaphragm to be moved to close a main valve even when the flow rate through the venturi is as low as one gallon per minute.

10 Claims, 5 Drawing Figures



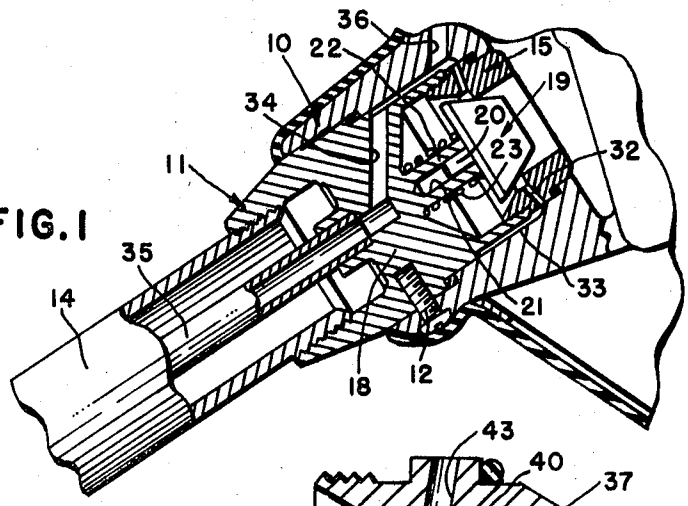


FIG. 1

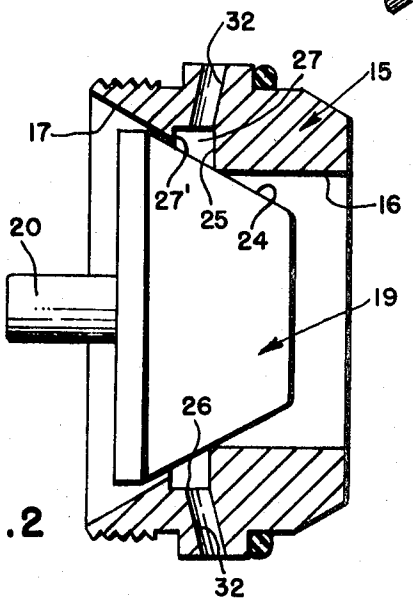


FIG. 2

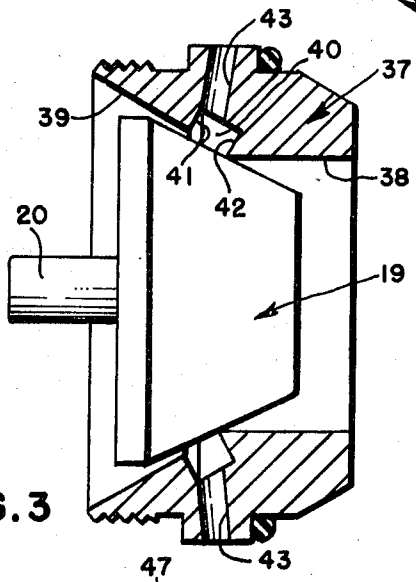


FIG. 3

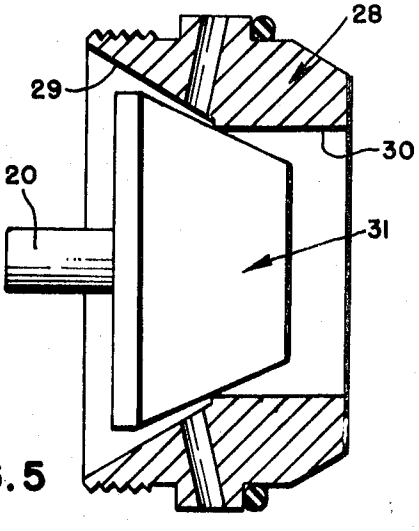


FIG. 5

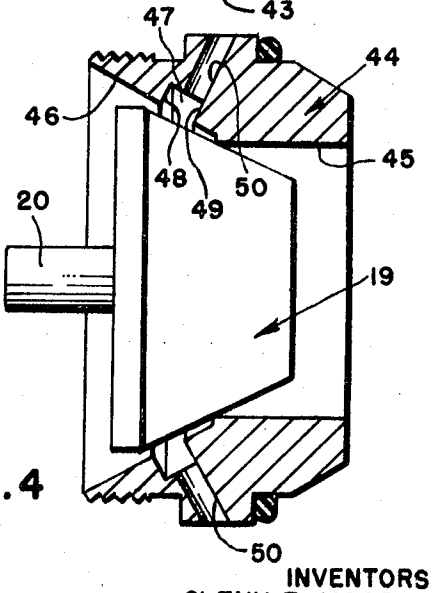


FIG. 4

INVENTORS
GLENN E. MOORE
FRED A. WILSON
CHESTER W. WOOD
BY Kinney & Schenk.
ATTORNEYS

AUTOMATIC SHUTOFF DISPENSING NOZZLE VENTURI

In automatic shutoff nozzles of the type shown in U.S. Pat. No. 3,085,600 to Briede, a variable venturi is employed downstream from a main valve, which is operated by a handle lever. This variable venturi has its orifice connected to both a diaphragm suction chamber and the atmosphere. The connection to the atmosphere is through a tube, which is disposed in a spout of the nozzle and has its end communicating with the atmosphere through an opening in the spout. When the level of liquid in the tank being filled by the nozzle covers the opening in the spout for the tube, the orifice creates a suction in the diaphragm suction chamber to cause the main valve to be closed automatically to stop flow through the nozzle.

While the variable venturi of the aforesaid Briede patent operates satisfactorily at medium and high flow rates, this variable venturi does not always operate satisfactorily at a flow rate of less than 2.5 gallons per minute of the liquid. In some instances, this low flow rate of the liquid has not been capable of creating a vacuum in the suction chamber of sufficient power to move the diaphragm to close the main valve. When this occurs, the diaphragm is not moved sufficiently to cause the main valve to close automatically whereby the liquid such as fuel, for example, is lost from the tank being filled and manual actuation of the handle lever must be made by the operator to stop the flow.

Since that flow rate is relatively low, a large quantity of fuel is not lost. However, any fuel on a driveway of a service station, for example, is a fire and explosive hazard. Therefore the variable venturi of the aforesaid Briede patent has presented problems at flow rates under 2.5 gallons per minute.

The present invention satisfactorily overcomes the foregoing problems by providing a variable venturi in which the venturi positively operates at very low flow rates such as one gallon per minute, for example. Thus, the present invention satisfactorily solves the problem of automatically shutting off the flow through the nozzle by moving the diaphragm. This is because the variable venturi of the present invention functions satisfactorily at all times at a low flow rate.

In order for a variable venturi to function satisfactorily, it must not produce a running vacuum in the suction chamber for the diaphragm beyond a predetermined limit. If this limit should be exceeded, then the diaphragm is actuated to prematurely shut off the liquid flow through the nozzle. Therefore, it is a requisite that the variable venturi not produce a running vacuum exceeding the predetermined limit. However, the variable venturi must still produce a predetermined vacuum in the suction chamber for the diaphragm when the tank becomes full even if the liquid flow rate is low.

The present invention satisfactorily meets the foregoing requirements by employing an enlarged area in communication with a conical bore, which cooperates with the surface of the poppet valve to form the venturi. This enlarged area enables the substantially noncompressible liquid to expand after it leaves the throat bore with which the conical bore communicates. This expansion area reduces the velocity of the liquid whereby it has a relatively low pressure.

As a result of the low pressure created in the enlarged area by the expansion of the liquid therein, the airflow to this enlarged area increases because of the low pressure. Thus, even though the flow rate of the liquid may be relatively low, this enlarged area produces a sufficiently low pressure to draw a large quantity of air from the tube communicating with the atmosphere through the opening in the spout.

Because this enlarged area creates a greater orifice effect, a sufficiently low pressure is created in this enlarged area even at a low flow rate. Thus, there is still a relatively large suction created at a low flow rate.

Accordingly, when the liquid level in the tank covers the opening in the spout whereby no additional air can be drawn from the atmosphere, this low-pressure area draws a sufficient amount of air from the suction chamber for the diaphragm very quickly to produce increased power for moving the diaphragm because of the rapid pressure reduction in the suction chamber. This enables the diaphragm to cause the main valve to close faster. Furthermore, it insures that the diaphragm is positively actuated even when the liquid flow rate is very low such as one gallon per minute, for example, because of the low pressure created in the enlarged area due to the expansion of the fluid flowing through the variable venturi construction.

Furthermore, because of the relatively low pressure created by the enlarged area in the conical bore of the variable venturi of the present invention, there is sufficient airflow through the tube from the atmosphere to prevent the vacuum within the suction chamber for the diaphragm from increasing beyond the predetermined limit. This occurs even when the flow rate is relatively low such as one gallon per minute, for example.

Tests have been made to determine the effectiveness of the variable venturi of the present invention in comparison with the variable venturi of the aforesaid Briede patent. With a vacuum of 1¾ inches of mercury required to actuate the diaphragm to shut off the main valve of the nozzle in the aforesaid Briede patent, the variable venturi of the aforesaid Briede patent, the variable venturi of the aforesaid Briede patent requires a flow rate of two gallons per minute to produce the vacuum of 1¾ inches of mercury in the suction chamber. In the variable venturi of the present invention, the vacuum of 1¾ inches of mercury in the suction chamber was produced with a flow rate of one gallon per minute. Thus, the low flow rate may be reduced in half by the use of the variable venturi of the present invention while still obtaining positive actuation of the diaphragm to close the main valve. Accordingly, the present invention not only enables the main valve of an automatic shutoff nozzle to be positively controlled at a low rate of flow but also insures that the main valve is not shut off prematurely when the nozzle has high flow rate therethrough. Thus, the variable venturi of the present invention produces through a large range of liquid flow rates positive shutoff at the desired time when the tank is filled.

While is would seem that increasing the number of passages providing communication from the conical bore to both the tube in the spout and the suction chamber would produce greater airflow to the conical bore during filling of a tank without requiring the enlarged area of the present invention, increasing the number of the passages would increase the running vacuum in the suction diaphragm chamber beyond the predetermined limit during high flow rates. Accordingly, this would produce premature shutoff of the main valve at high flow rates.

An object of this invention is to provide a variable venturi capable of causing automatic shutoff of liquid flow through a nozzle at a relatively low flow rate of the liquid.

Another object of this invention is to provide a variable venturi that obtains a maximum orifice effect from the liquid flowing therethrough.

A further object of this invention is to provide a variable venturi that positively shuts off flow through a nozzle in a large range of flow rates without any premature shutting off before a tank, which is being filled by the nozzle, becomes full.

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

FIG. 1 is a sectional view of a portion of a body of an automatic shutoff nozzle in which one form of the variable venturi of the present invention is employed.

FIG. 2 is an enlarged sectional view of the variable venturi shown in FIG. 1.

FIG. 3 is an enlarged sectional view, similar to FIG. 2, of another embodiment of the variable venturi of the present invention.

FIG. 4 is an enlarged sectional view, similar to FIGS. 2 and 3, showing still another form of the variable venturi of the present invention.

FIG. 5 is an enlarged sectional view of the variable venturi used in the aforesaid Briede patent.

Referring to the drawing and particularly FIG. 1, there is shown a nozzle body 10 of an automatic shutoff nozzle of the

type more particularly shown and described in the copending patent application of W. Donald Boudot, Chester W. Wood and Charles A. Holder for "Automatic Shut-Off Dispensing Nozzle," Ser. No. 882,028, filed Dec. 4, 1969, and assigned to the same assignee as the assignee of the present application. While the nozzle body **10** is that shown in the aforesaid patent application Ser. No. 882,028, it should be understood that the variable venturi of the present invention may be readily employed with any automatic shutoff nozzle having a pressure responsive means for actuating a main control valve to its closed position on filling of the container by the nozzle. Thus, the variable venturi of the present invention may be readily used with the aforesaid Briede patent, for example.

The nozzle body **10** has a spout adapter **11** connected to its outlet by a shearable screw **12**. The spout adapter **11** has a nozzle **14** threaded into one end thereof.

The spout adapter **11** has a bleeder seat ring **15**, which is an annular body, threaded in the other end of the spout adapter **11**. The bleeder seat ring **15** has a throat bore **16** (see FIG. **2**), which communicates with the inlet of the nozzle body **10** through the main control valve that is operated by a handle lever or the like in the manner more particularly shown and described in the aforesaid application Ser. No. 882,028.

The bleeder seat ring **15** has a conical bore **17** communicating with the throat bore **16** and disposed on the same axis as the throat bore **17**. The conical bore **17**, which increases in diameter from its intersection with the throat bore **16**, communicates with the spout **14** through longitudinal passages (not shown) formed in a spider portion **18** of the spout adapter **11**.

A poppet valve **19** controls the flow of liquid from the throat bore **16** to the conical bore **17**. The poppet valve **19** is slidably supported on the spider portion **18** of the spout adapter **11** by having a stem **20** disposed within an axial passage **21** in a projecting portion **22**, which extends from the spider portion **18** of the spout adapter **11**.

A spring **23** is disposed in surrounding relation to the projecting portion **22** of the spout adapter **11** and continuously urges the poppet valve **19** to its closed position. As a result, the poppet valve **19** opens only when the main control valve is opened by the operator to allow liquid to flow through the nozzle body **10** and act on the poppet valve **19** to overcome the force of the spring **23**.

As shown in FIG. **2**, the poppet valve **19** has its surface **24**, which engages the bleeder seat ring **15** to close the throat bore **16**, diverging away from the surface or wall of the bleeder seat ring **15** defining the conical bore **17**. Tests have indicated that the desired orifice effect is obtained when the surface **24** of the poppet valve **19** is at 26° to the axis of the conical bore **17** while the surface or wall of the bleeder seat ring **15** defining the conical bore **17** is at an angle of 30° to the axis of the conical bore **17**.

As shown in FIG. **2**, the bleeder seat ring **15** is formed with a flat annular surface **25** adjacent the point at which the throat bore **16** terminates. This also is the point at which the surface **24** of the poppet valve **19** engages the bleeder seat ring **15** to stop liquid flow from the throat bore **16** to the conical bore **17**.

The bleeder seat ring **15** has a circular surface **26** formed in the wall defining the conical bore **17**. The surfaces **25** and **26** cooperate to form a continuous enlarged area **27**, which is adjacent the intersection of the throat bore **16** with the conical bore **17**. This continuous enlarged area **27** is an annular groove, which has one of its walls defined by the surface **25** while the other of its walls is defined by a flat annular surface **27'**, which is parallel to the surface **25**. The surfaces **25** and **27'** are perpendicular to the axes of the throat bore **16** and the conical bore **17**.

Accordingly, the groove is formed in the wall or surface of the bleeder seat ring **15** defining the conical bore **17**. If the groove were not formed in the wall or surface of the bleeder seat ring **15** defining the conical bore **17**, the conical bore **17** would extend to adjacent the throat bore **16**.

This arrangement is shown in FIG. **5** wherein a bleeder seat ring **28**, which is utilized in the aforesaid Briede patent, has its conical bore **29** extending to adjacent the end of its throat bore **30**. As a result, the bleeder seat ring **28** has practically no increased area at the end of the throat bore **30** to allow expansion of the liquid when it leaves the throat bore **30** whenever a poppet valve **31** is opened.

The enlarged area **27** communicates through a plurality of radially extending passages **32** in the bleeder seat ring **15** to the exterior of the bleeder seat ring **15**. While two of the passages **32** are shown, it should be understood that the present invention functions satisfactorily with only one of the passages **32**. However, it is preferred that four of the passages **32** be employed.

As shown in FIG. **1**, the passages **32** communicate with an annular passage **33**, which is formed between the nozzle body **10** and the spout adapter **11**. The annular passage **33** communicates through a passage **34** with a tube **35**, which extends through the spout **14**. The other end of the tube **35** is disposed at the lower end of the spout **14** and communicates with the atmosphere through an opening in the spout **14** in the manner more particularly shown and described in the aforesaid application, Ser. No. 882,028.

The annular passage **33** also communicates with a passage **36** in the nozzle body **10**. The passage **36** communicates with a suction chamber, which is formed between a diaphragm and a cap on the body **10** in the manner more particularly shown and described in the aforesaid application, Ser. No. 882,028.

Accordingly, in the manner more particularly shown and described in the aforesaid application, Ser. No. 882,028, the flow of the liquid between the surface **24** of the poppet valve **19** and the conical bore **17** of the bleeder seat valve ring **15** creates an orifice effect to suck the air from the atmosphere through the tube **35**. Because of the enlarged area **27**, the expansion of the substantially noncompressible liquid after it leaves the throat bore **16** takes place within the enlarged area **27**. This produces the very low-pressure area within the bleeder seat ring **15** and adjacent the passages **32**.

This low-pressure area creates a void in the enlarged area **27** whereby an increasing quantity of air flows through the passages **32** into the enlarged area **27** for mixing with the fluid flowing therethrough. Thus, the enlarged area **27** creates a greater orifice effect on the passages **32**.

With the poppet valve **19** held open due to the flow of liquid through the body **10** and filling of the tank not completed, the air continues to flow through the tube **35**. However, as soon as the tube **35** is blocked from communication with the atmosphere due to closing of the opening in the spout **14** by the level of the liquid within the tank being filled, the low pressure created by the enlarged area **27** causes the air within the diaphragm chamber to be sucked therefrom through the passage **36**, the annular passage **33**, and the passages **32** into the conical bore **17** for mixture with the liquid flowing therethrough.

Because of the very low pressure within the enlarged area **27**, this air within the suction chamber is removed very quickly. This sudden drop in the pressure increases the vacuum within the suction chamber rapidly. This exerts a greater force on the diaphragm to cause a quicker movement thereof whereby the main control valve is closed in the manner more particularly shown and described in the aforesaid application, Ser. No. 882,028.

Because of the increased flow of air through the tube **35** as long as the tank is not filled, the running vacuum, which is produced in the suction chamber due to the liquid flowing through the bleeder seat ring **15**, is maintained below the predetermined limit at which the diaphragm could be actuated. This situation exists even for the maximum flow rate through the nozzle body **10**. This maximum flow rate is 25 gallons per minute.

Referring to FIG. **3**, there is shown another form of the present invention in which a bleeder seat ring **37**, which is an annular body, has a throat bore **38** and a conical bore **39** com-

municating with each other with the poppet valve **19** controlling the flow of liquid therethrough in the manner described for the bleeder seat ring **15**. In this embodiment, a continuous annular groove **40** is formed in the surface wall of the bleeder seat ring **37** defining the conical bore **39**.

The groove **40** has its surfaces or walls **41** and **42** formed perpendicular to the wall of the bleeder seat ring **37** defining the conical bore **39**. Thus, in this embodiment, the groove **40**, which constitutes the enlarged area, is again adjacent the end of the throat bore **38**.

The groove **40** allows the expansion of the liquid in the same manner as the enlarged area **27**. The groove **40** communicates with the annular passage **33** through radially extending passages **43** in the bleeder seat ring **37** in the same manner as the passages **32** in the bleeder seat ring **15** communicate with the annular passage **33**.

Referring to FIG. **4**, there is shown another form of the present invention in which a bleeder seat ring **44**, which is similar to the bleeder seat rings **15** and **37**, and has a throat bore **45** and a conical bore **46** in communication with each other. The bleeder seat ring **44** has a continuous annular groove **47**, which forms the enlarged area in which expansion of the liquid may occur, disposed downstream from the end of the throat bore **45**. The groove **47** has its walls or surfaces **48** and **49** disposed perpendicular to the wall of the bleeder seat ring **44** defining the conical bore **46**.

While tests have indicated that the maximum efficiency of the groove or enlarged area is at the intersection of the conical bore with the throat bore, it has been found that the present invention functions satisfactorily if the wall or surface **48** of the groove **47** is positioned from the intersection of the conical bore **46** with the throat bore **45** a distance no greater than 0.2 of the diameter of the throat bore **45**.

The groove **47** communicates with the annular passage **33** through radially extending passages **50** in the same manner as the groove **40** and the enlarged area **27** do. The flow through the bleeder seat ring **15** is controlled by the poppet valve **19** in the manner described for the bleeder seat ring **15**.

While the groove **47** has been shown as having the walls or surfaces **48** or **49** disposed perpendicular to the wall or surface of the bleeder ring **44** defining the conical bore **46**, it should be understood that the walls or surfaces **48** and **49** could be disposed perpendicular to the axes of the throat bore **45** and the conical bore **46** in the manner shown in FIG. **2**. Furthermore, in any of the embodiments of the present invention, the walls or surfaces of the groove may be disposed at any angle relative to the wall or surface of the body defining the conical bore. It is only necessary that the enlarged area be adjacent the area at which the liquid begins to expand. If the enlarged area is too far downstream from the intersection of the conical bore with the throat bore, the liquid will have completed its expansion before it reaches the enlarged area whereby the desired orifice effect from the expansion of the liquid will not occur. As the flow rate decreases, the expansion of the liquid occurs closer to the intersection of the conical bore and the throat bore of the bleeder seat ring.

While the present invention has been described as actuating a diaphragm to cause closing of the main control valve for the nozzle body, it should be understood that the variable venturi of the present invention may be employed with any pressure responsive means that causes closing of the main control valve. It is only necessary that some type of a suction chamber be provided with which the pressure responsive means is in communication.

An advantage of this invention is that it creates more power on the pressure responsive means from the same flow rate than previously available devices. Another advantage of this invention is that fuel pumps for service stations can be operated for a longer period of time with an automatic shutoff nozzle utilizing the variable venturi of the present invention because of its capability of automatically shutting off the fuel flow at low flow rates.

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. A variable venturi for an automatic shutoff nozzle including a body having a cylindrical throat bore and a conical bore smoothly merging with said throat bore, said conical bore being disposed on the same axis as said throat bore, a valve to close said throat bore to prevent communication between said throat bore and said conical bore, the outer surface of said valve and the surface of said conical bore diverging from each other away from said throat bore to provide an annular diverging passage therebetween when said valve is open, said body having an enlarged area in said body formed in said conical bore, said enlarged area being in communication with said conical bore to allow expansion of liquid flowing from said throat bore to said conical bore to create a reduced pressure area in said enlarged area, said enlarged area having its surface furthermost from said throat bore located no greater than 0.2 of the diameter of said throat bore along the wall of said body defining said conical bore from the intersection of said throat bore and said conical bore, and said body having means to provide communication between said enlarged area and the exterior of said body for communication with the atmosphere, the flow of liquid through the diverging annular passage between said valve and said conical bore when said valve is open creating a suction effect in said communicating means.

2. The venturi according to claim **1** in which said enlarged area is formed at the intersection of said throat bore and said conical bore.

3. The venturi according to claim **1** in which said communicating means comprises at least one passage extending from said enlarged area to the exterior of said body.

4. The venturi according to claim **1** in which said enlarged area is a continuous groove in said body.

5. The venturi according to claim **4** in which said groove is formed at the intersection of said throat bore and said conical bore.

6. The venturi according to claim **5** in which the walls defining said groove are perpendicular to the axis of said throat bore.

7. The venturi according to claim **5** in which the walls defining said groove are perpendicular to the wall of said body defining said conical bore.

8. The venturi according to claim **4** in which the walls defining said groove are perpendicular to the axis of said throat bore.

9. The venturi according to claim **4** in which the walls defining said groove are perpendicular to the wall of said body defining said conical bore.

10. The venturi according to claim **4** in which said communicating means comprises at least one passage extending from said groove to the exterior of said body.

* * * * *