AUTOMATIC FUEL DISPENSING NOZZLE

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ABSTRACT

An automatically operating fuel dispensing nozzle adapted to function within a sealed fuel system. In particular a signal system incorporated within said nozzle which functions to permit a topping-off operation for filling a fuel tank, or for automatically discontinuing a filling operation in response to an excessive pressure which might build up within the fuel tank or other parts of the closed system.

2 Claims, 13 Drawing Figures
AUTOMATIC FUEL DISPENSING NOZZLE

BACKGROUND OF THE INVENTION

In the ordinary filling of a fuel tank by means of a nozzle attached to a fuel source, the nozzle is usually provided with means for automatically discontinuing flow when the tank becomes filled. This is achieved without the attention of an attendant to monitor the operation.

In the usual arrangement, the fuel dispensing nozzle is provided with means to sense the surge and rising of the fuel level within a fuel tank filler spout. At such time as fuel initially covers the sensing means a vacuum signal established in the fuel path is utilized to adjust the nozzle's flow control valves.

In one form of nozzle this initial vacuum signal will cause the main fuel flow control valve to be released thereby completely discontinuing flow of fuel to the tank. However, an improvement on this type of nozzle includes the feature for reducing the fuel flow upon reception of the initial vacuum signal. At the reduced flow rate, the tank will continue to be filled or topped off to a predetermined level, at which time a second vacuum signal will be transmitted. This second signal will then further adjust the control valves to completely shut off fuel flow.

In an attempt to reduce the amount of fuel vapor discharged into the atmosphere during a refueling operation, means have been devised for collecting or retaining such fumes during the operation. One such means includes the use of a closed fuel system such that the latter is not actually communicated with the atmosphere. However, in lieu of the fuel vapors being discharged into the air, they are collected either through the dispensing nozzle or through ancillary equipment. In either instance, the collected fumes are treated, or more preferably returned to the storage tank after being condensed into liquid form.

To properly function in such a closed system, a fuel dispensing nozzle must be designed such that it will not only shut off under full tank conditions, but will automatically discontinue operation when a malfunction occurs in the system. The latter shut off is effective particularly in preventing an internal pressure build-up. In brief, should the means for drawing or venting off the vaporous fumes become inoperative, the possibility exists that a sudden pressure build-up within the system could precipitate a dangerous circumstance.

In the instant dispensing nozzle, valve means is provided for automatically regulating fuel flow in response to conditions within the fuel receiving tank. A sensing system embodied in the nozzle signals the regulatory mechanism to provide a topping-off fuel flow, a final shut off, and also an emergency shut off in response to an excessive pressure build-up.

A fuel nozzle embodying the above mentioned features for automatically providing the basic fuel tank topping-off, as well as shut off operation, is shown in U.S. Pat. No. 3,688,813. In said patent the manually operated dispensing nozzle includes a primary or main flow valve together with a secondary valve. A vacuum sensing means incorporated into the nozzle includes a conduit disposed within the nozzle spout and communicated with a valve release mechanism. The latter is in turn connected to the respective valves to adjust their settings.

A manually actuated flow control lever is connected likewise to the valve release mechanism which, upon actuation, will cause the flow control lever to assume a neutral position thereby completely shutting off the flow of fuel through the nozzle. To illustrate the invention, the instant sensing and control arrangement will be illustrated into the above noted fuel nozzle of U.S. Pat. No. 3,688,813.

In accordance with the present invention, means is provided within the signal sensing system, such that the manual actuating lever will be released to discontinue fuel flow through the nozzle in spite of the conditions of the other flow control mechanisms. Further, this event will occur so long as there is a predetermined pressure build-up within the closed fuel system.

DESCRIPTION OF THE DRAWINGS

In the drawings,

FIG. 1 represents a schematic flow diagram of the elements incorporated into the instant fuel dispensing nozzle.

FIG. 2 is a side elevation of the nozzle which embodies the herein disclosed features.

FIG. 3 constitutes a front elevation view of the nozzle viewer shown in FIG. 2, the portion of the center housing being broken away to show the internal structure.

FIG. 4 is a sectional view taken centrally through the nozzle along the line 4—4 in FIG. 3.

FIGS. 5 and 6 are detailed sectional views substantially identical with those of FIG. 4, but showing the internal parts in different operating positions.

FIG. 7 is a sectional view taken along line 7—7 of FIG. 3.

FIG. 8 is similar to FIG. 7.

FIG. 9 is a detailed sectional view taken along the line 9—9 of FIG. 7.

FIG. 10 is a segmentary view in cross section taken along line 10—10 of FIG. 4.

FIG. 11 is a segmentary view in cross section taken along line 11—11 of FIG. 4.

FIG. 12 is a segmentary sectional view taken along line 12—12 of FIG. 8.

FIG. 13 is a segmentary view in cross section similar to FIGS. 5 and 6.

GENERAL STRUCTURE

FIG. 1 illustrates diagrammatically a schematic arrangement of the present nozzle including the various valves and their relationship whereby they interfunktion to provide the desired flow characteristics. As shown, nozzle body 10 comprises a fuel inlet means 11 which connects to a pressurized source of fuel through a flexible conduit 12. A main fuel passage 13 communicates said conduit 12 with a supplementary flow control valve 14.

Fuel flow through the nozzle in accordance with the operation of said valve 14, is conducted through a main flow control valve 16 and thence to the nozzle spout 17. In the alternative, flow will be directed around said supplementary control valve 14, into a diverter valve 18 and thereafter passed to the main flow control valve 16 and to nozzle spout 17.

Each of said valves 14 and 16 is operably connected to a first release mechanism 19 comprising in essence a closed chamber provided with a movable diaphragm. Similarly, a nozzle actuating lever 21 is operably connected with a second release mechanism 22 whereby
reception of a signal from the nozzle spout 17 will cause the respective valves to be closed.

The signal mechanism embodied in the nozzle comprises in brief a signal selector valve 23 adapted to selectively transmit a signal to one of the release mechanisms 19 or 22. Further, said signal selector valve 23 is provided with an overriding mechanism, to be herein more fully described, to permit the flow of fuel to be discontinued through the nozzle at such time as an excessive pressure is realized within the fuel system into which the nozzle is scalably coupled.

Referring to FIG. 2, the nozzle structure is characterized by a cast housing or body 10 having a handle inlet 11 which receives fuel from a pressurized source by way of hose or conduit 12. Supplementary valve 14, and main valve 16 to be herein described more fully, are disposed within the main portion of housing 10 and are actuated by hand lever 21 acting on elongated valve stem end 24.

Lever 21 is pivoted on the lower end of a lock-out plunger 26, the lever is latched in the maximum operative position shown in FIG. 2, or in an alternate position, by a spring biased latch 27. Spout 17 extending from one end of body 10 is adapted to extend into inlet pipe 28 of a fuel tank.

Externally, spout 17 is provided with an appropriate sealing mechanism 31 to permit the nozzle to removably engage inlet pipe 28. Said seal mechanism 31 can be of the resilient collar type adapted to slidably fit within pipe 28, or it can merely engage the pipe 28 outer lip. Alternatively the seal member can be controllably expandable to form an annular fluid barrier with the pipe at such time as the nozzle is inserted therein.

Spout 17 is further provided internally with a venting means which comprises a portion of the signal system. Vent tube 127 extending along spout 17, is communicated with the nozzle main fuel passage whereby a flow of fuel through a constriction 106 will create a source of vacuum which is normally vented.

When, during a filling operation fuel rises about and enters orifice 29, the vacuum sharply rises. In the conventional automatic nozzle control system, said vacuum signal will be directed to, and actuate the diaphragm of the first release mechanism 19 to in turn adjust supplementary valve 14.

Further in the conventional system, selective valve 23 will be actuated to redirect any further vacuum signal onto the diaphragm of the lever release mechanism 22. Thus, upon the event of fuel again rising in filler pipe 28 a second vacuum signal will cause lever release mechanism 22 to be adjusted and free lever 21 thereby closing main flow valve 16.

FIG. 4 of the drawings illustrates the interior of the instant nozzle in cross section, with the various valves set to permit maximum flow fuel to a tank being refilled. The body of the nozzle is provided with interior cavities and passages to define the respective fuel flow passage as well as to accommodate the various operable elements therein.

Valves 14 and 16 as shown are mounted to operate along a common axis. Valve 16 includes a movably element 33 having a lower surface adapted to engage a circular seat 34 when in the closed position, and to be spaced from said seat in the open position. When in the latter position, fuel flows into lower chamber 36 and thence to nozzle spout 17.

Said moving element 33 is positioned on a lower stem 37, the latter being slidably mounted in body 10 for reciprocal movement therethrough and registered in circular sealing ring 38.

Movable element 33 includes a central cavity in the upper end adapted to slidably receive a downwardly depending upper stem 39 from a cage 41. Said cage 41 includes a center longitudinal bore having a sufficient opening diameter to slidably receive the guide portion of a locking pin 42 and encloses spherical balls 43.

The latter are disposed coaxially with the respective valves 14 and 16, and function to lock said valves in the open position at such time as actuating lever 21 is set to provide maximum fuel flow through the nozzle.

Valve 14 comprises a sliding member 46 having a peripheral seating surface which is movable to engage ring seat 47 to close the valve. A compression spring 48 disposed between the respective members 33 and 46 maintains a separating force therebetween.

The plurality of spherical balls 43 held within cage 41 bear against the shallow conical segment of locking pin 42. When, as shown in FIG. 4, the latter is in the downward position, said balls are urged outwardly and engage peripheral shoulder 49. Compression spring 50 is mounted externally of cage 41, bearing against a wall of body 10 to normally urge valve 14 into the downward or closed position against seat 47.

The upper end of valve 14 is provided with an outwardly radiating heat 52 adapted to slidably fit within cavity 53. A trip lever 54 is positioned adjacent to said cavity 53 and includes an outward projecting portion positioned to engage the edge of head 52 when the latter enters cavity 53.

The upper end of locking pin 42 is slidably received in cylindrical sleeve 51, which is a part of valve 14, and further carries a retaining plate 56 having a relatively smooth outer edge to engage diaphragm 57. The latter is peripherally fastened along a shoulder of the body wall and receives a cap 58 which is fixed in position to clamp diaphragm 57 and form chamber 59. A spring 61 carried within chamber 59 on the upper side of diaphragm 57, bears against the spring retainer plate 56, urging the locking pin 42 into a normally downward position.

As above mentioned, with respect to FIG. 4, valves 14 and 16 are both shown in the open position to permit maximum flow through the nozzle. In such an instance lower stem 37 is urged upwardly by actuating lever 21.

At the reception of a first signal from the nozzle signal sensing means, the vacuum or reduced pressure signal is sent to chamber 59 of release mechanism 19. Signal selector valve 23 is closed, thereby preventing the signal from reaching chamber 59. Because of the pressure differential thereby affected across diaphragm 57, the latter will be displaced in an upward direction against the force of spring 61.

The consequent withdrawal of locking pin 42 by diaphragm 57 will thus permit the respective balls 43 to fall inwardly into a non-locking position thereby permitting valve 14 to close and in effect blocking a segment of the fuel flow passage.

Diverter valve 18 is positioned adjacent valve 14. Said valve 18 includes a movable valve stem 66. Said element 66 as shown, includes a center shank together with a spring 67 mounted thereon to normally bias said valve into a closed position against peripheral seating ring 68.
Valve 18 includes an actuating mechanism 69 including cap 71 formed across the valve defining a chamber 72. The latter is provided with a diaphragm 73 together with a reinforcing plate 74 against which a positioning spring 76 acts. Said spring 76 engages a wall of body 10 and normally urges diaphragm 73 into a displaced position when valve 14 is open and the pressure gradient across said valve is in effect zero, such that the diverter valve 18 is normally closed. A by-pass connection 111 communicates chamber 72 with the main fuel flow passage. Thus, with valve 14 in the closed position, fuel flow will proceed through said connecting passage 111 and enters chamber 72. The fuel pressure difference across diaphragm 73 acting against the outer side of the diaphragm, will open diverter valve 18. Thereafter, valve 18 is communicated with the main fuel passage 13 thus permitting fuel to be metered through valve 18 or be metered through adjacent constricted passage 78 to valve 16.

The fuel stream has thus in effect been passed around the closed supplementary valve 14, and its flow throttled to a minimum by passage through the restricted opening of diverter valve 18 and passage 78. This minimum flow is continued during the topping-off period of a filling operation. Further, said flow continues until such time as a second signal is registered in the signal sensing means to completely discontinue flow through the nozzle by closing valve 16.

Release mechanism 22 functions to displace lever 21 and permit valve 16 to adjust to a closed position. Said mechanism 22 comprises a lock-out plunger 26 which is slidably mounted within body 10 and connected at its lower end at a pivotal joint 82 to lever 21. Said plunger is biased by spring 83 normally into an upward position. Plunger 26 includes a center passage adapted to slidably receive locking pin 84. The latter includes a substantially cylindrical locking surface 86 having tapered or conical segments 87 and 88 immediately adjacent thereto. A series of balls 89 held within a cage section of lock-out plunger 26 functions to establish the retracted position of the latter when locking pin 84 is as shown in FIG. 4. Thus, the respective balls 89 are outwardly urged into contact with shoulder 91 by locking surface 86.

Lever release mechanism 22 will maintain plunger 26 in the retracted position shown so long as the pressure differential across the diaphragm 92 remains constant. A cap 93 clamps the periphery of diaphragm 92 in place to define closed chamber 96. Said diaphragm 92 is acted upon by oppositely positioned retaining plates 97 and 98, which retain upper and lower balancing springs 99 and 101 respectively.

At such time as a second vacuum signal is registered in the nozzle spout 17 by fuel rising in the latter, said signal will be directed through signal selector valve 23 and passage 127 to chamber 96. With this differential pressure across diaphragm 92, the latter will be drawn upwardly into chamber 96 thereby simultaneously drawing locking pin 84 upwardly, permitting the respective spherical balls 89 to move inwardly and release locking plunger 26, as shown on FIG. 6. The latter will therefore be free to act under the urging of spring 48 to move downwardly and concurrently release valve 16 to engage sealing seat 34. This action will terminate all fuel flow through the nozzle.

Referring to FIG. 13, in the instance of a positive pressure build-up within the closed fuel system, said pressure, rather than a vacuum will be transmitted to diaphragm 92. The latter will therefore be depressed downwardly into chamber 102 such that balls 89 will engage tapered surface 87. As in the above instance, said balls will move inwardly thus permitting lock-out plunger 26 to be urged downwardly by spring 48.

**Signaling System**

Referring to FIGS. 1 and 4, the nozzle signaling system comprises, as noted, a network of conduits adapted to transmit either a vacuum, or a positive pressure signal whereby to control fuel flow. Line 105 of said signal system is communicated with constricted annulus 106 which in turn, guides the main flow to nozzle spout 17. Said line 105 is communicated with vent tube 107 and orifice 109 such that normally, annulus 106 and orifice 29 are vented to the fuel tank interior. Thus, as fuel flows through the constricted annulus 106 the reduced pressure or vacuum created by the fuel flow will be vented into the fuel tank.

Line 105 is further communicated with passages 107 and 109, and thence to actuating mechanism 19. Since the vacuum will normally be vented by way of orifice 29, diaphragm 57 in chamber 59 will maintain a neutral position.

However, as fuel rises at a rapid rate in tube 28 to eventually fill the orifice 29, the vacuum created will be transmitted to chamber 59. The resulting pressure differential across diaphragm 57 will cause the latter to be drawn upwardly into said chamber, as shown in FIG. 5, thereby drawing locking pin 42 upwardly. With said movement, spherical balls 43 will be displaced inwardly thus releasing cage 41 to permit valve 14 to close under the influence of spring 50.

**Topping-Off Flow**

Referring to FIGS. 5 and 6, with valve 14 closed, the pressure in fuel passage 13 will be transmitted by way of passage 111 to chamber 72. Said fuel pressure acting against diaphragm 73 will displace the latter inwardly thereby displacing valve 18 from its seat 68. Fuel flow through valve 18 will then enter constricted passage 78 which is in turn communicated with compartment 112. Thereafter the throttled or topping-off fuel stream will continue through open valve 16 and to nozzle 17.

With the downward actuation of valve 14 to the closed position, the outer edge of head 52 will contact and rotate trip lever 54. The latter is fixedly mounted to rotatable shaft 117. Tab 118 also carried on shaft 117 slidingly engages center plunger 119 of valve 23 to form an overriding mechanism to the latter.

Referring to FIG. 12, valve 23 includes plunger 119 which is slidable guided at one end in vented bushing 121 and diaphragm 123 to form a vapor tight sealing seal therewith. The opposite end of plunger 119 opens into chamber 122. Said plunger opposite end includes a flexible diaphragm 123, the periphery of which is sealably fixed to the walls of chamber 122 thus permitting reciprocatory movement of plunger 119 therethrough. A spring 125 on plunger 119 biases the latter to in effect maintain valve 23 in the closed position.

A resilient ring 124 carried on plunger 119 adjacent to diaphragm 123, co-operates in the act of sealing engagement with the latter (FIG. 7), or to be displaced therefrom (FIG. 8) to communicate passage 107 with passage 127 and thence with release lever mechanism 22.
During the initial or rapid filling flow to the fuel tank, valve 23 will be closed (FIG. 7) so that there is no communication between passages 107 and 127. However, with the closing valve 14 for the low velocity topping-off operation valve 23 will be longitudinally shifted as above noted to the open position shown in FIG. 8.

The latter valve adjustment is achieved by engagement of downwardly moving head 52 to contact lever 54, thereby rotating the shaft 117 and thus withdraw diaphragm 123 from contact with its mating seating surface 126.

In accordance with the invention, an excessive pressure will normally build up within the fuel tank being filled during the period of the preliminary filling operation. Thus, main valve 16 and supplementary valve 14 will initially be in the open position. At this time selector valve 23 is closed.

Since it is desirable to immediately discontinue flow by way of main valve 16 when a predetermined positive pressure is reached in the closed system, valve 23 is so designed to override the closing force exerted by spring 125, and go to an open position by the pressure differential across diaphragm 123.

In brief, a predetermined pressure build-up within the fuel system will be detected first at orifice 29. Said pressure will be transmitted by way of passage 107 to chamber 122 whereby to actuate the lever release mechanism of chamber 22.

The diameter of diaphragm 123 is thus of sufficient size such that the force exerted thereon by the pressure within the closed fuel system will be adequate to overcome the opposing force of spring 125. Thus, the diaphragm and valve will be displaced into the open position as shown in FIG. 8, in response to the pressure build-up.

Said pressure will then be communicated directly by way of passage 127 to chamber 96. In the latter the positive pressure acting against diaphragm 92 causes the latter, as well as locking pin 84, to move downwardly. As the respective balls 89 pass from surface 86 to conical surface 87 they move radially inward thereby releasing plunger 26 to its lower position.

Release of the plunger in turn permits the lever valve stem to be similarly released such that spring 48 will urge valve 16 into the closed position in which this latter movement is achieved as noted without consideration for the phase of the filling operation. That is, the overriding closing action will be effected in the system even though the nozzle be set to either maximum flow or topping flow conditions.

Other modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore, only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. An automatic fuel dispensing nozzle communicated with a source of fuel, said nozzle having a spout (17) adapted to engage a fuel tank filler tube (28) thereby to form said nozzle, fuel tank and fuel source into a closed fuel system; a fuel conduit (13) in said nozzle, main (16) and secondary (14) flow control valves positioned in said conduit (13), an actuating arm (21) operably connected to said main (16) and secondary (14) flow control valves respectively, and being movable to adjust and lock said respective flow control valves (14 and 16) in an open position to permit a rapid flow of fuel through said nozzle to said fuel tank, first valve release means (19) connected to said secondary flow control valve (14), being operable to automatically adjust the latter to a closed position in response to a vacuum condition created at said nozzle spout by a rise of fuel in the latter thereby adjusting said rapid fuel flow to a slower, topping-off fuel flow, second valve release means (22) connected to said main flow control valve (16), being operable to automatically adjust the latter to a fully closed position in response to a second occurring vacuum condition at said spout in response to the rise of fuel in the latter, whereby to achieve complete shut off of fuel flow through said nozzle, and pressure sensing means including a sensing passage (29) opening into said spout, and communicating the latter with said first and second valve release means (19) and (22) respectively, said sensing passage (29) including a selector valve (23) operable when in the open position during said topping-off fuel flow to communicate said second valve release means (22) with said nozzle spout (17), whereby to actuate said second valve release means to close said main valve (14) in response to a vacuum condition at said spout (17), and being further operable when in the closed position during said rapid fuel flow, to be adjusted to an open position in response to an excessive pressure at said nozzle (17) caused by a pressure accumulation in said fuel tank during the filling operation whereby to actuate said second valve release means to close said main valve and discontinue fuel flow to said tank.

2. A fuel dispensing nozzle as defined in claim 1, wherein said selector valve (23) includes spring means in said selector valve positioned to hold said selector valve in the closed position and yieldable to permit opening of said selector valve in response to a predetermined pressure exerted on said selector valve.

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