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Muehl

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[54] **TANK VENT AND PRODUCT VALVE SYSTEM**

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[51] **Int. Cl.** **F16k 45/00**

[58] **Field of Search** 137/267, 587; 251/144

[56] **References Cited**

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[57] **ABSTRACT**

A vent and product valve system for tanker trucks and the like. Prior to opening of the product valve the vent valve is automatically opened by a system whose operation is based in part upon spring loading and differential pressure areas in the valves. Filling pressure alone is insufficient to operate the product valve, enabling a plurality of product valves to be connected in parallel and sequentially operated to provide sequential filling of associated tanks. The power unit for operating each product valve is completely isolated from the product in the tank so that the valve components are not damaged by the product.

5 Claims, 4 Drawing Figures

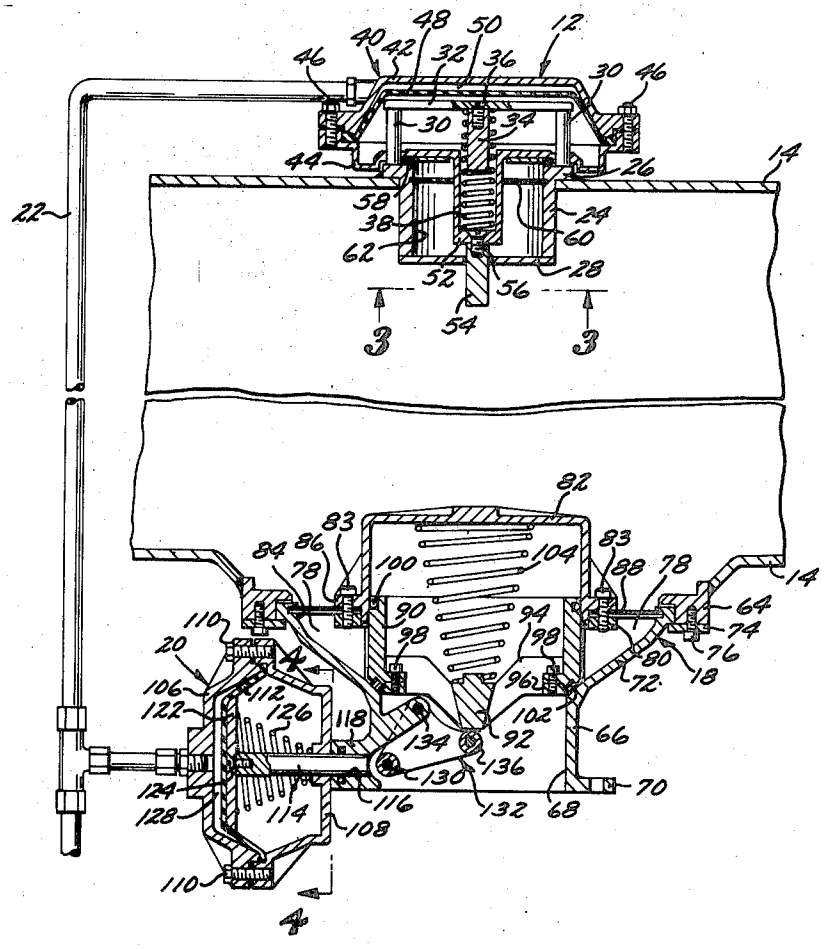


FIG.1

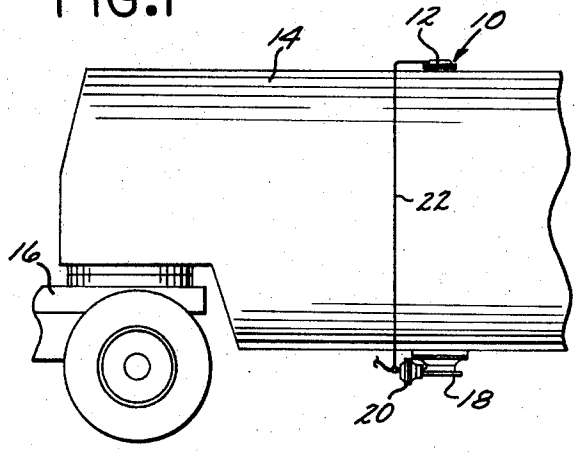


FIG.3

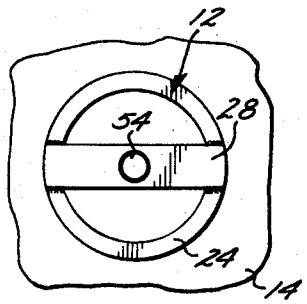
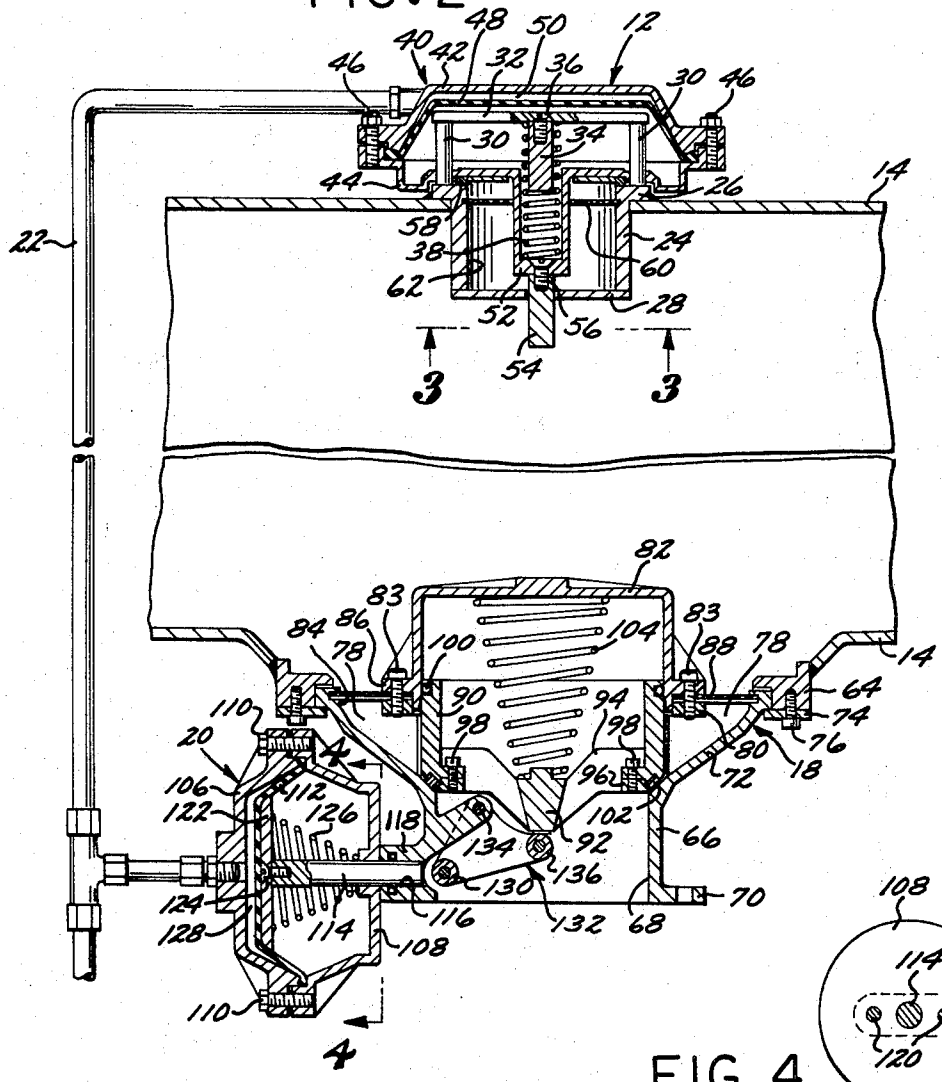


FIG.2



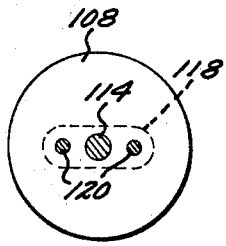


FIG.4

TANK VENT AND PRODUCT VALVE SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a tank vent and product valve system, and particularly to a fluid operated system for a tanker truck or the like.

2. Description of the Prior Art

Heretofore, vent and product valves for tanker trucks were usually mechanically interconnected so that the vent valve would operate at or prior to the operation of the product valve. This assured that excessive tank pressure would be vented on filling of the tank, and that any negative pressure developed during product discharge would be relieved in time to prevent tank collapse. However, such mechanical systems were often prone to failure because their diaphragms and sealing elements were exposed to the product. Also, the valves of such systems were often not readily accessible or removable from the tank, making maintenance difficult.

In many prior art systems the mechanical interconnection between the top-mounted vent valve and the bottom-mounted product valve was such that the vent valve could not be laterally offset to any significant extent relative to the discharge valve without adversely affecting operation of the linkage. This placed an undesirable limit on tank design.

Another problem with prior art systems arose with those tanks that were divided into separate compartments and parallel connected by a common line in communication with the product valves for the various compartments. The product valves of such systems had to be positively shut off when the associated compartment was full so that line pressure would not re-open the valve when the next compartment was being filled. Ideally, whenever a product valve is not being operated to an open position it should automatically remain closed, regardless of the level of pressure in the common line.

SUMMARY OF THE INVENTION

According to the present invention, a tank vent and product valve system is provided which includes a vent valve mountable to a tank for automatically opening and venting excessive pressure in the tank. The vent valve includes a fixed guide assembly and a vent cover actuable for movement on the guide assembly between open and closed positions. The vent cover is actuated by fluid pressure developed against a diaphragm which is located in the vent cover and which is engageable with the guide assembly.

The present valve system also includes a product valve having a valve body mountable to the tank, and a valve cap which houses a piston movable between open and closed positions to open and close a passage to the tank interior. A power valve is operative to open and close the product valve. This is done by fluid pressure developed on one side of a diaphragm located inside the power valve. The diaphragm acts upon a piston to move it into engagement with a linkage to operate the product valve.

The power valve is completely isolated from the product or contents of the tank, and sealing means are provided in the vent and product valves which are normally effective to isolate the internal components of the valves from the tank contents.

The configuration of the product valve defines effective pressure areas which prevent line pressure at the filling part of the valve from opening the valve. Accordingly, if a common conduit is parallel connected to a plurality of such product valves, each product valve must be positively actuated to open it, line pressure alone being incapable of effecting such opening. This is because the line pressure enters the interior of the product valve and acts upon an internal effective pressure area which is greater than the external effective pressure area against which the line pressure in the filling conduit acts.

The effective pressure areas and level of bias of the power, product, and vent valves are adjusted such that several times as much force is required to open the product valve compared to the force required to open the vent valve. Consequently, simultaneous application of fluid at a particular pressure to both the product and vent valves automatically results in prior opening of the vent valve.

Since fluid pressure is utilized to actuate the product and vent valves, laterally offsetting these valves does not adversely affect their operation. It only requires simple rearrangement of the common fluid pressure line.

Other objects and features of this invention will become apparent after consideration of the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a partial side elevational view of a tanker truck, illustrating the general location and configuration of the present vent and product valve system mounted thereon;

FIG. 2 is an enlarged longitudinal cross sectional view of the vent and product valve system of FIG. 1, with portions of the tank and connecting conduit being omitted for brevity;

FIG. 3 is a view taken along the line 3—3 of FIG. 2; and

FIG. 4 is a view taken along the line 4—4 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is illustrated a tank vent and product valve system 10 according to the present invention and comprising, generally, a vent valve 12 mounted to the top of a tank 14 of a tanker truck 16; a product valve 18 mounted at the bottom or underside of the tank 14; a power valve 20 mounted to the product valve 18 for actuation thereof; and a flexible conduit, fluid pressure or air line 22 connected to the power valve 20 and vent valve 12 for actuation thereof.

As is well known, tanker vehicles or trucks carry various kinds of products such as gasoline from storage dumps or tanks to distribution points such as a gasoline filling station.

The tank of a typical tanker truck is divided into several compartments which are each provided with some kind of a vent valve at the top and product valve at the bottom. The vent valve is required to be operative to vent any explosive pressures which may develop in the tank, and also vent the tank during tank filling and discharge through the product valve. Thus, in a typical filling operation, a common conduit (not shown) is paral-

lel-connected to the filling ports of the product valves of the several tank compartments. One of the product valves is opened and a high rate pump (not shown) is next operated to quickly fill the first compartment. The vent valve must also be operated in time to vent the tank interior to make room for the incoming fuel. When the first compartment is filled, the product valve is closed and the other compartments are then filled in a similar manner in serial order, the product valves being consecutively or sequentially operated to allow this. The system **10** of the present invention is particularly adapted for use in this type of situation and the following disclosure is made in that context.

The vent valve **12** includes a vertically oriented cylindrical welding ring **24** having a circumferential flange **26** at its upper extremity and an elongated, horizontally oriented, and centrally apertured guide strap **28** welded to its lower extremity. The flange **26** is preferably permanently welded to the upper wall of the tank **14**, as best illustrated in FIG. **2**.

The welding ring **24** forms part of a fixed structure which includes a plurality of support posts **30** secured at their lower ends to the flange **26** in circumferentially spaced relation. A circular retaining plate **32** also forms part of the fixed structure and is attached to the upper ends of the support posts **30**. An elongated depending rod or spring guide **34** is attached at its upper end to the center of the plate **32** by a screw **36**, the guide **34** being disposed within the upper extremity of a bias means or compression spring **38**. As will be seen, the fixed structure thus far described is the structure against which thrust is developed to raise a vent cover **40** of the valve **12**.

The vent cover **40** is generally circular and includes an upper wall or portion **42** and a lower wall or portion **44** which are each characterized by circumferential flanges bolted together by a plurality of fastener assemblies **46**. The flanges also mount the outer edge of a flexible circular diaphragm **48** interposed between the vent cover portions **42** and **44**.

The cover upper portion **42** is upwardly dished to form a concavity which receives the retaining plate **32**, as well as the central portion of the diaphragm **48**. The diaphragm **48** is interposed between the portion **42** and the plate **32** and defines a chamber **50** with the cover portion **42**. The chamber **50** opens to the conduit **22** so that fluid under pressure, such as compressed air, can be admitted to chamber **50** to urge the diaphragm **48** downwardly and into engagement with the fixed retaining plate **32**. When this occurs the vent cover **40** tends to move upwardly.

The cover portion **44** includes a plurality of circumferentially spaced openings which are adapted to slidably receive the lower extremities of the support posts **30**, the posts **30** thereby serving as guides for the cover **40** during its upward movement. In addition, the central section of the cover lower portion **44** includes a downwardly extending hollow spring receiver **52** whose cylindrical socket receives the lower extremity of the spring **38**. A depending shaft or guide **54** is attached to the lower end of the receiver **52** by a screw **56** and extends through the central aperature in the fixed guide strap **28**. Thus, the guide **54**, as well as the posts **30**, serves to guide the vent cover **40** during its vertical movement.

In the fully raised or open position of the vent cover **40**, the interior of the tank **14** is in communication with atmosphere along a path comprising the interior of the welding ring **24**, constituting a vent port **62**, and the spaces between the posts **30**. Upon movement of vent cover **40** from its open position to the closed position illustrated, a circumferential sealing means or gasket **58** mounted to the underside of the valve lower portion **44** engages the upper surface of the welding ring flange **26** in sealing relation. This closes off the tank interior from atmosphere and also prevents gasoline or gasoline vapors in the tank **14** from reaching and adversely affecting the diaphragm **48** and other internal components of the vent valve **12**, as will be apparent.

A usual fire screen **60** is disposed across the vent port **62**, the screen **60** serving to prevent flame propagation out of the tank **14** in the event of a fire.

The product valve **18** includes a circular flange **64** which is welded to the underside or lower wall of the tank **14**. As will be seen it serves as a means for removably mounting the product valve **18** in position on the tank **14**. The valve **14** also includes a valve body having a generally cylindrical lower portion **66** whose central opening defines a product port **68** through which gasoline is pumped into or out of tank **14**.

The base of valve body portion **66** includes a circumferential flange **70** to which a usual filling conduit or hose (not shown) which can be attached to pump gasoline into or out of the tank **14**, as the case may be.

The upper portion **72** of the product valve body is of enlarged cross-section, extending upwardly and outwardly and terminating in a circumferential flange which underlies a lip of the fixed flange **64**. An annular mounting ring **74** engages the underside of the valve body flange and is secured to the fixed flange **64** by a plurality of circumferentially spaced studs **76** to retain the valve body flange in position.

A plurality of vertically disposed and radially oriented ribs or webs **78** integral with the valve body upper portion **72** integrally mount an annular ring **80**. The ring **80** is secured to a circumferential flange **86** of a cylindrical valve dome or cap **82** by a plurality of circumferentially spaced studs **83**.

The outer periphery of the valve cap **82** is of lesser diameter than the inner periphery at the top of the body upper portion **72**. This defines an annular valve passage **84** which is covered by a usual filter screen **88** supported at its outer edge by the upper portion **72**, and at its inner edge between the flanges **80** and **86**.

A cylindrical valve piston **90** is mounted for slidable vertical movement within the hollow interior of the fixed valve cap **82**. The piston **90** comprises a lower central portion **92** from which radiate a plurality of spokes or ribs **94**. Those have a common outer flange **96** which is secured by a plurality of studs **98** to the cylindrical skirt of the piston **90**. An O-ring **100** is interposed between the piston **90** and the valve cap **82** to provide a sealing relation.

The spaces between the ribs **94** permit gasoline to pass through the product port and into the hollow interior of the valve cap **82**, and the O-ring **100** defines an effective pressure area against which this gasoline acts. Another and lesser pressure area is defined by a circumferential sealing means or gasket **102** which is carried by the lower extremity of the piston skirt. The gasket **102** rests against the upper terminus of the body lower portion **66** when the piston **90** is in the lower position illustrated. Because the effective pressure area defined by the gasket **102** is less than the effective pres-

sure area defined by the O-ring 100 any line pressure in a filling conduit attached to the flange 70 will tend to move the piston 90 downwardly to its lower position regardless of the magnitude of the line pressure.

A conical bias means or compression spring 104 is interposed between the piston portion 92 and the upper wall of the valve cap 82 to bias the piston 90 toward its lower position.

Because of the unbalanced effective pressure areas defined by the O-ring 100 and the gasket 102, the piston 90 remains in its lower position until it is positively actuated to an upper position. This is accomplished by the power valve 20, as will be seen. With this arrangement, a common filling conduit can be attached to a plurality of the product valves 18 associated with a plurality of compartments in a single tank 14, and only that compartemnt whose valve 18 is actuated will be filled.

The power valve 20 comprises a circular operator cover 106 and an operator body 108 which are each characterized by confronting flanges secured together by a plurality of circumferentially spaced studs 110. The cover 106 and body 108 define an internal space across which is disposed a flexible diaphragm 112 whose circumferential edge is clamped between the opposed flanges of the cover 106 and the body 108.

The hollow interior of the power valve houses an elongated horizontally disposed operator shaft 114 which is slidably disposed at its outer extremity through a central opening provided in the operator body 108. The projecting end of the shaft 114 is slidably and sealingly received within a bore 116 of a lateral projection 118 forming an integral part of the product valve lower portion 66. The power valve operator body 108 is rigidly secured to the projection 118 by a pair of studs 120 which extend through suitable openings in the projection 118 into threaded openings in the operator body 108.

The inner end of the shaft 114 is secured to a circular spring retainer plate 122 by a screw 124. The shaft 114 and plate 122 constitute a piston biased toward the inoperative or inner position illustrated in FIG. 2 by a conical compression spring 126 interposed between the retainer plate 122 and the operator body 108.

One side of the flexible power valve diaphragm 112 bears against the retainer plate 122, while the opposite side of the diaphragm 112 defines a chamber 128 with the operator cover 106.

The operator cover 106 includes a threaded central opening which receives a fitting attached to the flexible air line 22. This allows air pressure to be developed in the chamber 128 at the same time it is developed in the vent valve chamber 50. Although not shown, air is derived from any suitable source, such as an air compressor operated by the tanker truck engine, as will be apparent.

Upon introduction of air into the chamber 128, the diaphragm 112 is urged to the right, as viewed in FIG. 2, which moves the operator shaft 114 outwardly and into engagement with a roller 130. The roller 130 forms part of a generally triangular shaped coupling or linkage 132 which is pivotally mounted by a pin 134 to the product valve body portion 66 for pivotal movement about a horizontal axis defined by the pin 134.

On engagement of the roller 130 by the shaft 114, the linkage 132 rotates about the pin 134, and a second roller 136, forming a part of the linkage 132, is thereby moved upwardly into engagement with the lower end of the piston central portion 92. Continued outward movement of the shaft 114 thus causes the piston 90 to move upwardly to an open position in which communication is provided between the product port 68 and the tank interior through the valve passage 84.

On release of air pressure in the conduit 22, the operator shaft 114 is moved inwardly to the inoperative position illustrated under the bias of spring 114, and the piston 90 is moved downwardly by its spring 104. If the tank 14 is being filled at this time, the differential effective pressure areas defined by the O-ring 100 and the gasket 102 also causes the piston 92 to move downwardly to the closed position illustrated.

During either a filling or a discharging operation, air pressure is developed in both chambers 128 and 50. It is an object of the present invention to open the vent valve 12 before the product valve 18. Consequently, the diaphragm 48 is preferably made larger in area than the diaphragm 112 so that its effective pressure area is larger. In addition, the spring rates of the springs 38 and 126 are made such that the bias force exerted by spring 138 is less. In this regard, the spring rate of spring 28 is also selected low enough that it will allow the vent valve 12 to open at approximately 3 pounds per square inch in order to provide adequate internal venting of the tank 14 at all times, as required by Federal and many state regulations.

It is also desirable to select a product valve spring 104 having a spring rate great enough to assure that the piston 90 will not open prior to opening of the vent valve 12.

It will be apparent that actuation of the vent valve 12 prior to actuation of the piston 90 can be provided by adjustment of one or more of the foregoing parameters, but it is primarily accomplished by the provision of differential pressure areas in the diaphragms 48 and 112. In an actual embodiment, satisfactory results were achieved by providing for opening of the vent valve 12 at approximately 5 to 7 pounds per square inch, and opening of the product valve 18 at approximately 35 pounds per square inch.

Various modifications and changes may be made with regard to the foregoing detailed description without departing from the spirit of the invention.

I claim:

1. A tank vent and product valve system for a tanker truck or the like, said system comprising:

a vent valve including a guide assembly for fixed attachment to the tank and defining a vent port for venting the tank interior; a vent cover carried by said guide assembly for movement thereon between a closed position shutting said vent port and an open position opening said vent port, said vent cover having a first pressure responsive means engageable on one side with said guide assembly defining a chamber on the opposite side; and first bias means positioned to exert a first bias urging said vent cover toward said closed position;

a product valve including a valve body for attachment to the tank and defining a product port for communication with the tank interior; a valve cap mounted to said valve body and defining an annular product valve passage with said flange; a product piston carried by said valve body for movement between a closed position shutting said product port and an open position opening said product

port; and second bias means positioned to exert a second bias urging said product piston toward said closed position;

a power valve mounted to said valve body and including a power piston; a second pressure responsive means on one side with said power piston and defining a chamber on the opposite side; and third bias means positioned to exert a third bias urging said power piston inwardly;

linkage means engageable by said power piston to move said product piston to said open position; and

means for applying fluid under pressure to said chambers of said vent and product valves to urge said vent cover and said power piston against the bias of said first and third bias means, respectively, to open said vent port and said product port, the effective pressure area of said first pressure responsive means being greater than the effective pressure area of said second pressure responsive means whereby the same level of fluid pressure effects opening of said vent port prior to said product port.

2. A tank vent and product valve system according to claim **1** wherein said first pressure responsive means and said second pressure responsive means each comprise a flexible diaphragm.

3. A tank vent and product valve system according to claim **1** wherein said vent cover includes sealing means engaged upon said guide assembly in said closed position of said vent cover and preventing the product in said tank from reaching said first pressure responsive means.

4. A tank vent and product valve system according to claim **1** wherein said last-mentioned means comprise a compressed air line parallel-connected to said chambers of said vent and product valves.

5. A tank vent and product valve system according to claim **1** and including a first seal engaged between said product piston and said valve cap in said closed position of said product piston and defining a first effective pressure area; and a second seal engaged between said product piston and said valve body in said closed position of said product piston and defining a second effective pressure area less than said first effective pressure area.

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