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S. L. SUNDSTROM

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FILLER VALVES

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Fig. 2

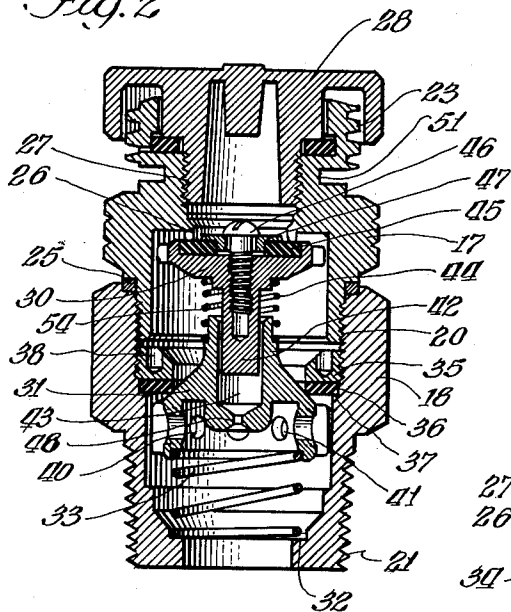


Fig. 3

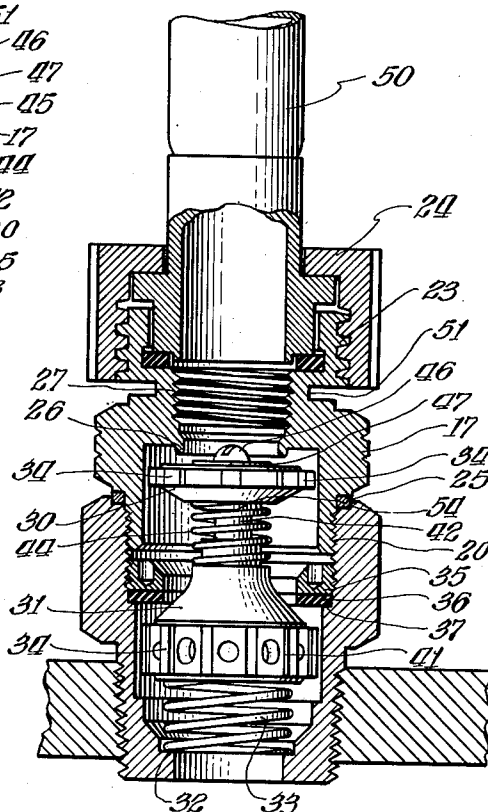


Fig. 4

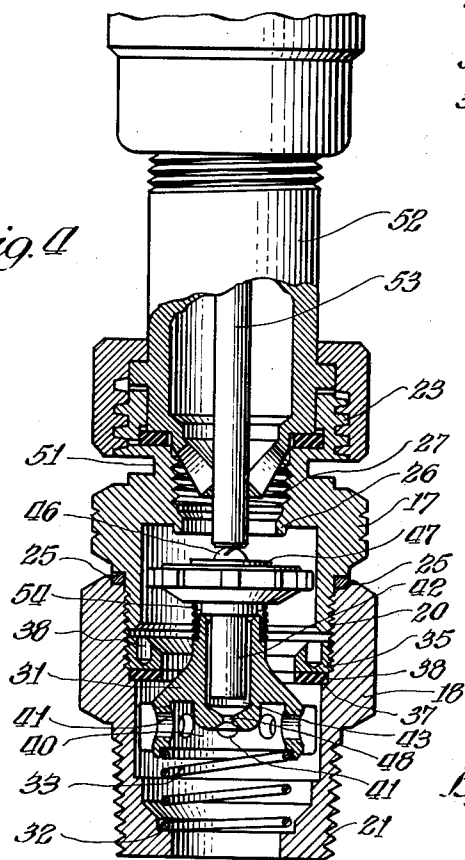
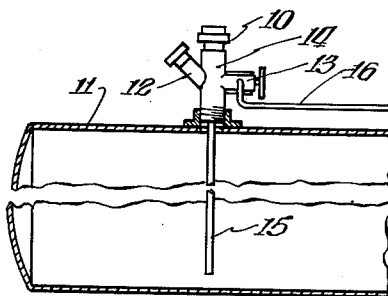


Fig. 1



Inventor:
Savin L. Sundstrom
By: *Robert D. Harbaugh*
Atty.

2,713,874

FILLER VALVES

Savin L. Sundstrom, Chicago, Ill., assignor to The Bastian-Blessing Company, Chicago, Ill., a corporation of Illinois

Application June 6, 1950, Serial No. 166,407

10 Claims. (Cl. 137—513)

This invention relates generally to valves and more particularly to an improved filler valve intended primarily for use in conjunction with liquefied petroleum gas storage tanks.

In home installations, liquefied petroleum gas such as butane or propane is commonly stored under pressure in large tanks. A service line provided with appropriate pressure reducers extends from the tank to the gas consuming appliances in the home. Either vapor or liquid which is subsequently vaporized is educted from the storage tank through the service conduit as required. From time to time as the fuel is consumed, the supply of liquefied gas in storage tanks is replenished, in most cases liquid fuel being delivered under pressure in a tank truck. The valve of this invention is intended primarily for use in the filling conduit of such storage tanks. It may also be used, however, to good advantage on the tank trucks and in the primary storage tanks from which the tank trucks are filled, as well as in storage tanks for other fluids than liquefied petroleum gases.

Because of the relatively high vapor pressures of liquefied petroleum gas fuels it is essential that the pressure storage tanks remain completely sealed at all times, and the customary practice is to provide a vapor return line which connects the tops of the two containers in addition to the liquid filling conduit. Thus the liquid is pumped or flows by gravity from the filling container to the tank being filled, and the vapor which it displaces flows back through the vapor return line to the filling container.

To provide a means of quickly emptying the storage tank of liquid should such be necessary, the usual practice is to provide a permanent dip tube in the tank which extends the filling conduit to a point adjacent to the bottom of the storage tank. Then liquid may be pumped out of the tank through the dip tube, or allowed to flow out under superior pressure into another container.

The valve of this invention is intended primarily for use at the upper end of the dip tube at the point where it enters the storage tank to seal the tank as a check valve when the filling hose is disconnected. The valve may be a unitary fitting or may be one element of a multiple purpose fitting which may also have incorporated therein the liquid or vapor eduction conduit, a liquid level gauge, excess fill indicator, vapor return valve, safety valve, etc. The valve may also be used on systems not equipped with a dip tube, being merely mounted in the wall of the tank.

Since liquefied petroleum gases are highly inflammable, it is imperative that the filler check valve be tightly sealed at all times when the filling hose is not connected thereto, and to effect such a seal the usual practice has been to provide a resilient sealing element which seats against a mental seat. From time to time, however, the resilient element must be replaced as it becomes worn or deteriorates under the action of the fuel. To avoid the necessity of emptying the storage tank during re-

placement of the sealing element, double check valve arrangements have been employed in which two check valves were provided in the line, one of which sealed the conduit during the time that the sealing element in the other was replaced. Several forms of valves of this class are disclosed in Patents Nos. 2,361,865 and 2,361,866 for Liquefied Petroleum Gas System and for Valve Construction, respectively, granted October 31, 1944 to H. L. Norway. The valve of this invention is an improved form of this type of valve.

An important object of this invention is to provide a double check valve suitable for liquefied gases which, although relatively small in size, has a high flow capacity in either direction and a large cross sectional area on each of the valve members subject to closing pressure, resulting in quicker closing and tighter seating of the valve elements.

Another object is to provide a double check valve arrangement in which the downstream check valve element, during filling, is quicker to close than the upstream check, whereby damage to the seat and sealing element of the upper check due to high velocity closing is much less likely to occur.

Another object is to provide a valve having an improved downstream check arrangement, whereby that member effects a sealing relationship by line contact rather than surface contact for better sealing, should foreign particles be present in the fluid, and in which the downstream check is free to orient itself for optimum sealing without affecting the action of the upstream check valve.

Another important object is to provide a dual check valve in which the valve elements are so assembled and arranged in relation to each other that depression of the upper valve element effects an opening of the lower valve element by virtue of engagement of the two valves during the opening movement of the upper valve element.

A further object is to provide a valve structure which may be easily fabricated and in which there is no possibility of parts becoming loose and dropping into the container on which the valve is mounted.

A further object is to provide a filler valve which may be thoroughly serviced without removal of the body from the filling conduit or tank, the sealing elements being readily replaceable and the valve being characterized by relatively large diameter closing springs and valve ports for longer wear.

A further object is to provide a double check valve which effects a minimum pressure drop on flowing fluid passing therethrough whether the tank is being filled or evacuated.

Other objects and advantages of this invention will present themselves to those familiar with the art on reading the following specification in conjunction with the drawing and the appended claims.

In the drawing,

Fig. 1 is a vertical section of a storage tank equipped with a multiple purpose fitting having the filler valve of this invention incorporated therein;

Fig. 2 is a vertical section of another embodiment of the filler valve of this invention;

Fig. 3 is a vertical section of the filler valve of Fig. 2 with a filling hose connected thereto, the valve elements being shown in the positions they occupy during filling; and

Fig. 4 is a vertical section of the filler valve and an unloading adaptor connected thereto, the valve elements being shown in the positions they occupy during the emptying of the tank.

One manner in which the filler valve 10 of this invention is used in connection with a storage tank 11 is shown in Fig. 1 of the drawing. The filler valve 10 is a part of

a unitary head 14 which also contains a vapor return valve 12 and an eduction valve 13. The unitary head 14 may also contain a liquid level gauge, a safety valve, a pressure gauge, etc., if desired. From the head 14 a dip tube 15 extends downwardly to a point near the bottom of the tank 11. The upper end of this tube is in direct communication with the filler valve 10 and may be connected to the eduction valve 13 if liquid is to be withdrawn from the tank through the service line 16 which extends to the appliances using the fuel. In the case of liquid eduction it is usually desirable to employ a vaporizer in the service line 16.

If desired, the valve 10 of this invention may be used without the dip tube 15 which extends to the bottom of the tank 11, the valve merely opening into the top of the tank. In such installations, however, the valve 10 may not be used to withdraw liquid from the tank. In some above ground tank installations the filler valve may be installed in the tank wall at the bottom, permitting draining of the tank without the use of a dip tube.

The internal construction of the valve is shown in Figs. 2 to 4, the valve 10 being shown in these figures as a unitary fitting which must be separately installed in the tank wall or at the top of the dip tube. The internal construction of the valve, however, is substantially the same whether it is a part of a multiple fitting as shown in Fig. 1 or is a separate fitting.

The valve 10 comprises an upper body 17 and a lower body 18 which are threaded together by threads 20. The bottom of the lower body is provided with an external pipe thread 21 which may be threaded into a flange mounted in the tank wall or in the top of the dip tube 15 extending to the bottom of the tank 11. The upper portion of the body 18 is preferably hexagonal in cross section for wrenching, as is the middle portion of the upper body 17. The top of the body 17 is provided with a coarse thread 23 to which the filling hose coupling nut 24 is threaded during filling, as shown in Fig. 3.

At the juncture between the two bodies, a sealing washer 25 is provided in a recess to prevent any leakage through the thread 20. Each of the bodies is axially bored as shown to provide a passageway therethrough for the fluid. The upper portion of the bore in the upper body 17 is substantially smaller in diameter so as to form a valve port 26 and is internally threaded as indicated at 27 so that the protective cap 28 may be installed when the filler valve is not connected to a hose.

The portion of the bore below the valve port 26 is cylindrical and receives the upper valve member 30 which cooperates with the port 26. The bore in the lower body 18 is larger in diameter at its upper end to accommodate the lower check valve member 31, and the bottom of this bore is internally machined to provide a shoulder 32 which supports the end of the valve spring 33. The upper end of this spring bears against the bottom of the lower valve member 31. As will be seen in the drawing, the spring 32 is quite large in diameter so as to support the valve member 31 against tilting in the bore even when the member 31 is forced downwardly by flowing fluid or by mechanical pressure exerted through the upper valve member 30 when evacuating, as shown in Fig. 4. Also, the spring and valve assembly are operative in effecting better alignment of the two check valves and, furthermore, to accommodate any slight misalignment of the upper check valve in the event it does occur, which ordinarily would prevent its sealing, and at the same time accomplishing an effective sealing of the lower check valve under such conditions.

As a further precaution the sides of both valve members 30 and 31 are fluted, as indicated at 34 in Fig. 2, preferably by machining these members from fluted bar stock. The flutes act to guide the members during travel by engaging the sides of the bores should the members be displaced from the axial position. Actually the flutes are rarely necessary once the filler valve is in-

stalled because of the centering effect of the conical contour of the lower valve member 31 and the large diameter of the spring 33, but they serve to prevent misalignment due to cocking of the valve members during shipment and installation when mechanical shocks are likely to be encountered.

To provide a port or seat for the lower valve member 31 a threaded ring 35 and elastomer washer 36 are supported in the bore, the periphery of the washer being clamped tightly against a shoulder 37 by the ring 35. To provide for tightening the ring 35, a pair of wrench sockets 38 is provided in the conical upper face of the ring 35.

The conical upper face of the valve member 31 makes a narrow contact with the edge of the washer 31, thereby insuring that a tight seal will be effected even if foreign particles are present in the fluid. It also operates as an aligning means for the valve 31 in its support of the upper check valve 30. In the event of wear on the washer element the valve member 31 is free to move a corresponding amount to compensate for the wear and still effect a seal. Furthermore, as wear occurs, the member 31 is free to move upwardly a greater distance to make a tight seal regardless of the extent of the wear.

The bottom of the lower valve member is hollow as indicated at 40, and a plurality of radial holes 41 extend outwardly from this hollow between the flutes 34 to provide additional passages for the fluid. The arrangement is such that fluid flowing down the upper face of the valve will be reflected off the side wall of the bore and through the holes 41 with a minimum resistance to its flow. Were the holes 41 not provided, the resistance would be substantially increased because of the relative narrowness of the spaces between the flutes 34 and the side wall.

The upper valve member 30 is supported solely by the lower member 31. An integral axial stem 42 is provided on the upper member and is loosely received in an axial bore 43 in the lower member 31. A light coil spring 44 surrounds the stem and urges the two members apart, tending to move the upper member toward its valve port 26. This spring is purposely made much lighter than the spring 33 so that the upper check valve will open a substantial distance before the lower check is opened and so that the lower check will close first on cessation of fluid flow. This tends to increase the life of the resilient sealing disc 45 in the upper valve for part of the closing pressure is absorbed by the lower check valve with the result that the upper valve cannot be moved toward the port at too high a velocity. Since the upper valve is the primary sealing element, it is particularly important that this valve continue to form an absolutely tight seal for as long a life as possible. An important function of the lower valve, therefore, is to protect the upper valve against sudden closing and thereby prolong its life. The fact that the diameter of the lower valve port is greater than that of the upper port aids in this respect, for not only is the closing force greater on the lower valve but also the upper valve opens a greater distance under flow conditions and must travel a greater distance in closing.

An equally important function of the lighter spring in the upper check valve is to permit it to be opened part way before effecting any opening of the lower check valve. This function is important for several reasons, among which are, to permit assembly of an unloading adaptor without interfering with the seal of the lower check valve, and to make it possible to maintain a seal of the lower check valve should the upper valve be held open because of foreign material. In this way there is accomplished a dual seal, each valve acting independently of the other, and any interference with the sealing of the upper check valve does not affect or hinder the sealing of the lower check valve.

Another important function of the lower valve is, of

course, to form a secondary seal which will stop enough of the fluid flow so that the sealing disc 45 of the upper valve may be replaced without emptying the storage tank 11. This is accomplished by unthreading the upper body 17 from the lower body 18, removing the screw 46 and washer 47 which hold the disc 45 in place, replacing the disc 45, and reassembling the elements. Since the procedure is so simple, it may be accomplished in a very short time, with the result that little gas is lost. In some cases it has proved desirable to employ an upper valve member having the sealing disc molded therein, the screw 46 being eliminated and a central metal boss being provided instead against which the unloading adaptor may operate. In such valves the whole upper member is replaced when the sealing disc becomes worn.

The only reason that gas is lost when the disc 45 is replaced is that a small diameter opening 48 is provided through the lower valve member 31 into the bottom of the stem receiving bore 43. No liquid will escape during replacement of the disc 45, because the diameter of the opening 48 is such that the rate of vapor flow there-through is less than the rate of vaporization of fuel in the dip tube 15. Thus heat is transferred to the liquid in the tube at a rate high enough to vaporize liquid at the same rate as it flows through the opening 48. The primary purpose of the opening 48 is to insure the gradual application of tank pressure on the upper valve member 30 so that it will be urged solidly against the valve port 26 and cannot stick in an open position once the lower valve has closed. This pressure of the storage tank is transmitted initially through the opening 48 to the base of the stem 42 which acts as a piston in a cylinder to exert an upward force on the valve member 30. The size of the opening 48 is such that the gas flows therethrough comparatively slowly so that once the lower valve member is closed there is no application of pressure exerted upon the upper valve member 30 which will cause it to slam closed and become damaged thereby. In one form of valve of this invention the opening 48 has a diameter of .040 inch. However, some variation in size is found to be permissible without loss of the functions mentioned.

The operation of the filler valve 10 should be readily apparent from the drawing and the foregoing description of the construction. In Fig. 2 the valve is shown in the closed position with the protective cover 28 in place. In Fig. 3 the valve is shown with the filling hose 50 connected thereto with the valve elements in the open position they occupy when fluid under pressure is flowing into the storage tank 11 from the hose.

Both of the valve members 30 and 31 move downwardly a slight distance under fluid pressure to permit the fluid to pass through the ports and out the bottom of the valve into the tank. The extent of downward movement depends on the velocity of fluid flow through the valve. The greater the pressure differential and velocity, the farther the members will move downwardly. When fluid flow ceases, the lower member 31, due to its heavier spring 33 and larger port area, moves upwardly first. Then the upper valve member 30 moves upwardly to close the port 26 under the influence of the light spring 44 and fluid pressure beneath the stem 42. The hose 24 may then be disconnected and the cover 28 reinstalled. Should the operator forget to detach the hose and drive off in the tank truck, the undercut 51 at the end of the hose thread 23 insures that the valve body will fracture at this point and that the tank 11 will remain tightly sealed.

To empty the storage tank 11, an unloading adaptor 52 is employed such as is shown in Fig. 4. The details of construction of a preferred form of unloading adaptor are fully disclosed in the patent application of Norman S. Blaydes for Unloading Adaptor, Serial No. 755,997, filed June 20, 1947, now Patent No. 2,620,817 granted Dec. 9, 1952, and need not be repeated here. The adaptor 51 is connected to the end of a hose (not shown) leading to the container into which the fluid is to be transferred

from the tank 11, and when the connections have been completed the axial actuator rod 53 is moved downwardly to the position shown in Fig. 4, causing the upper valve member 30 to move away from its seat. After this member has moved a short distance, a shoulder 54 on its lower surface engages the top of the lower valve member 31 to move it downwardly and open the lower valve. Then fluid may be pumped from the tank 11 through the dip tube either by a pump in the hose line leading to the fluid receiving container or by applying pressure above the liquid level in the storage tank 11. Upon retraction of the rod 53 the valve members move upwardly under spring pressure to the positions shown in Fig. 1.

From the foregoing description it will be apparent that an improved filler valve has been provided forming a better seal and having a longer service life than the valves used heretofore and which fulfills the objects of this invention.

Various changes or modifications in addition to those set forth herein may be made without departing from the spirit of this invention whose scope is commensurate with the following claims:

What is claimed is:

1. A valve of the class described comprising a lower body having an opening therethrough with a shoulder on the wall thereof, the lower portion of said opening being of a lesser diameter to define an internal integral shoulder, an upper body received in the top of said opening, said upper body also having an opening therethrough, a ring element supported in the first mentioned opening intermediate the first shoulder and the upper body to divide the openings into compartments, a resilient element compressed at its peripheral edge between the first shoulder and ring element for sealing said compartments from each other, said resilient element defining a valve port, a valve member in the first mentioned opening of a diameter greater than said lower portion of said opening having a lesser diameter than the outside of said ring element so as to be removable through the opening only when the upper body and ring element are removed, a helical spring resting upon said shoulder for urging said valve member upwardly to close said port, said spring being the sole support for said valve, a second valve member resiliently supported by the first mentioned valve member, the second opening having a lesser diameter portion at the upper end of the body defining a valve port adapted to be closed by the second valve member.

2. A valve of the class described comprising a lower body having an opening therethrough, the lower portion of said opening being of a lesser diameter to define an integral shoulder, an upper body threadably received in the top of said opening, said upper body also having an opening therethrough, an externally threaded ring element supported in the first mentioned opening intermediate the shoulder and the upper body, said element defining a valve port, a valve member in the first mentioned opening of a diameter greater than said integral shoulder and having fluted sides contacting the wall of the first opening in guided relationship of a lesser diameter than said ring element but a greater diameter than said shoulder, a helical spring resting upon said shoulder and engaging the valve member at approximately the level of said fluted sides for urging said valve member upwardly to close said port, said spring being the sole support for said valve, a second valve member resiliently supported by the first mentioned valve member, the second opening having a lesser diameter portion at the upper end of the body defining a valve port adapted to be closed by the second valve member.

3. In a double check valve, the combination including a body having a pair of axially spaced valve ports, one of said ports having a resilient element defining a circular sealing edge, a conical valve element for closing against said circular edge, a helical spring for urging said element toward the port, said spring being the sole support

means for said element whereby said valve element is free to shift laterally and angularly to effect the best possible closure, a second valve element having a flat sealing disc for closing the other port, said second valve element being solely supported by the first mentioned element, said valve elements closing against their respective ports in the same direction and being larger in diameter than either of said ports, a stem on said second element loosely received in a bore in the end of the first element, said bore having a minor diameter orifice portion extending through the valve element whereby fluid pressure is transmitted to said stem when the valve is closed, and a second helical spring substantially smaller than the first mentioned spring for urging the second element away from the first toward the second port.

4. A filler valve comprising an upper body and a lower body threadably connected together in sealed relationship, said bodies having passage means therein for the flow of fluid including: a large diameter cavity opening into the lower body from the top, a second large diameter cavity opening into the upper body from the bottom and smaller diameter openings from the ends of said cavities through the bodies, a downwardly facing valve port surrounding the opening at the top of the upper cavity, an elastomer ring forming a second downwardly facing valve port supported in the lower body dividing said cavities in peripherally sealed relationship, a valve member disposed in the lower cavity cooperating with said second port and closing same when moved upwardly, said valve member having a conical sealing surface for engaging said ring, a helical spring disposed in the lower cavity below said valve member and bearing against said member and the bottom of said cavity to urge said member upwardly against said ring, a second valve member mounted upon the first mentioned valve member and carried solely thereby for sealing the upper port, a second helical spring for urging said second member upwardly away from the first member, said second spring being much more readily compressible than the first spring, said valve elements and elastomer ring being greater in diameter than either of said smaller diameter openings and means including a projecting stem on one valve member received in an opening in the other for maintaining the two in axial alignment.

5. A filler valve comprising an upper body and a lower body threadably connected together in sealed relationship, said bodies having passage means therein for the flow of fluid including: a cavity opening into the lower body from the top, a second cavity opening into the upper body from the bottom and smaller diameter openings from the ends of said cavities through integral portions of the bodies, a valve port surrounding the opening at the top of the upper cavity, an elastomer ring forming a second valve port supported in the lower cavity, a valve member disposed in the lower cavity cooperating with said second port and closing same when moved upwardly, said valve member having a conical sealing surface for engaging said ring, a helical spring disposed in the lower cavity below said valve member and bearing against said member and the bottom of said cavity to urge said member upwardly against said ring as the sole support thereof, a second valve member mounted upon the first mentioned valve member for sealing the upper port, a second helical spring for urging said second member away from the first member, said second spring being much more readily compressible than the first spring, and means including a projecting stem on the upper valve member received in an opening in the other member for maintaining the two in axial alignment, the lower end of said last mentioned opening extending through the lower valve member and being of a relatively small diameter to provide a restricted passage for fluid past the lower valve to insure tight sealing of the upper valve.

6. A double check valve comprising a body having a passage for fluid therethrough, an integral valve seat near

one end of said passage, a moveable valve member having a flat resilient surface cooperating with said seat to close the passage, a shoulder in the wall of the passage spaced from said valve seat, a retainer means above said shoulder, a removable ring shaped element mounted in said passage between said shoulder and retainer means to establish a seal therebetween and forming a valve port having a contacting edge defining a circle smaller than said valve member, a valve element having a conical surface thereon for closing said port, resilient means for urging said valve element toward said port, one of said elements being formed of a resilient material and the other of a hard material whereby a tight line contact seal is effected when the two are in contact, said resilient means being the sole support of the valve element to permit a lateral shifting thereof, a second resilient means disposed between said moveable valve member and said valve element, said moveable valve member being supported solely by said resilient means so as to be moveable independently of the valve element.

7. A double check valve comprising a body having an upper member and a lower member joined together to form a passage for fluid therethrough, an integral valve seat near the top of said passage, a moveable valve cooperating with said seat to close the passage, a ring shaped resilient element mounted in said passage below said seat and moveable valve dividing the passage into two compartments sealed thereby from each other at the wall of the passage, said element forming a valve port having a contacting edge defining a circle, a valve element having a conical surface thereon for closing said port, said element having a hollow therein opening from the bottom and a plurality of radial openings through externally fluted side walls of said hollow for the passage of fluid flowing off said conical surface, and a coil spring for urging said valve element toward said port, said spring being substantially the same diameter as said hollow to define a cylindrical passage within it for the flow of fluid out of said hollow when said spring is completely compressed and constituting the sole support of said valve element and valve.

8. A double check valve comprising a body having an upper member and a lower member joined together and defining a passage therethrough, an integral valve seat in the upper member defining a port near one end of the passage, a radial flange integral on the lower member defining a reduced opening at the other end of the passage, a ring shaped means mounted in said passage intermediate said valve seat and flange including a resilient element forming a second valve port dividing the passage into two compartments, said resilient element sealing the compartments from each other at the walls of said passage and being held against removal by the joining of the two members, a moveable valve member cooperating with said valve seat to close that end of the passage, a valve element having a conical surface thereon cooperating with said ring shaped element to close the second valve port, fluted sides closely adjacent to said conical surface for contacting the side of the passage in guided relationship, means for supporting the valve member on the valve element including telescoping elements and a compression spring, a second compression spring disposed between said flange and valve element, the upper end of the second spring engaging the valve element at approximately the level of said fluted sides and constituting the sole support for said valve element.

9. A valve of the class described comprising a lower body having an opening therethrough, the lower portion of said opening being of a lesser diameter to define an internal shoulder, means on said lower body for externally supporting the lower body in sealed relationship with respect to said opening, an upper body threadably received in the top of said opening, said upper body also having an opening therethrough, a ring element supported

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in the opening of the lower body in spaced relationship to the internal shoulder, said element defining a valve port held against removal by the joining of the upper and lower bodies, a valve member in the first mentioned opening cooperating with said port, a helical spring resting upon said internal shoulder for urging said valve member upward to close said port, said spring being the sole support for the valve and said valve when closed against said port dividing the openings of the two bodies into two compartments, and a second valve member of a diameter greater than said valve port resiliently supported by the first-mentioned valve member, the opening of the upper body having a reduced diameter portion at the upper end thereof defining a valve port adapted to be closed by the second valve member.

10. A valve of the class described comprising a lower body having an opening therethrough, the lower portion of said opening being offset to define an internal shoulder, means on said lower body for externally supporting said lower body in sealed relationship with respect to said opening, an upper body threadably received in the top of said opening, said upper body also having an opening therethrough, said opening being of reduced diameter at the upper end of the body to define a valve port, a ring element supported in the opening of the lower body in spaced relationship to the internal shoulder, said element defining a valve port held against removal by the joining of the upper and lower bodies, a valve member in the first-mentioned opening cooperating with said port, a helical spring resting upon said shoulder for urging said valve member upwardly to close said port, said spring being the sole support for the valve, said valve when

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closed against said port dividing the openings of the two bodies into two compartments, a second valve member, of a diameter greater than said valve port, for closing the port in the upper valve body, means for supporting said second valve member in guided relationship upon the first-mentioned valve member including a stem on one of the members and a bore on the other member receiving said stem in guided relationship to maintain the two members in axial alignment, said valve members closing against their respective ports in the same direction, and a second helical spring for urging the second valve member away from the first valve member.

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