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[54] **RETAINER VALVE ASSEMBLY FOR SYRINGE**
5 Claims, 11 Drawing Figs.

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128/232

[51] Int. Cl. **B65d 37/00**

[50] Field of Search **222/207,**
209, 490; 137/493; 128/230-232

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ABSTRACT: A retainer valve assembly for a syringe including a body portion with means thereon for mounting the valve assembly in the barrel of a syringe. The assembly also includes a valve portion movably mounted on the body portion and normally being seated in a central opening in the body portion to form a seal and isolate one end portion of the syringe from the other end portion. The valve member is responsive to a predetermined amount of pressure from either end portion of the syringe so that it will unseat from the body portion when the pressure is applied to permit fluid to flow from one end portion of the syringe to the other end portion. When the pressure is relieved, the valve member will return to its normal seated position to thereby re-form the seal between the end portions of the syringe and alleviate the danger of leakage from the syringe when the predetermined amount of pressure is not being applied.

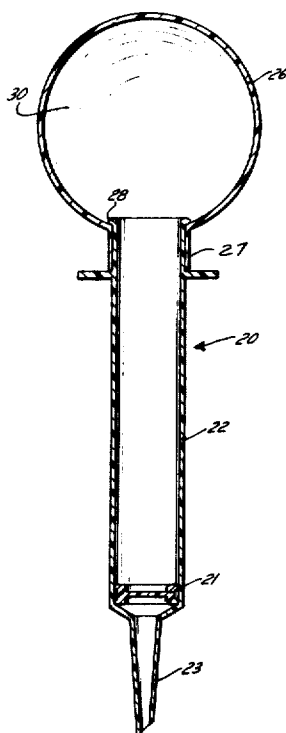


FIG. 1

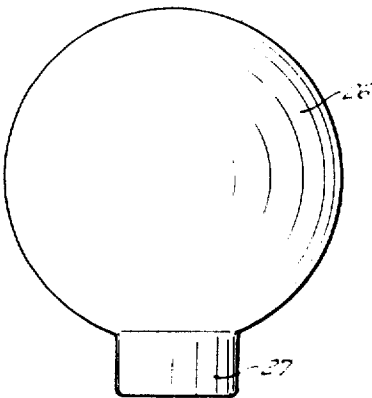
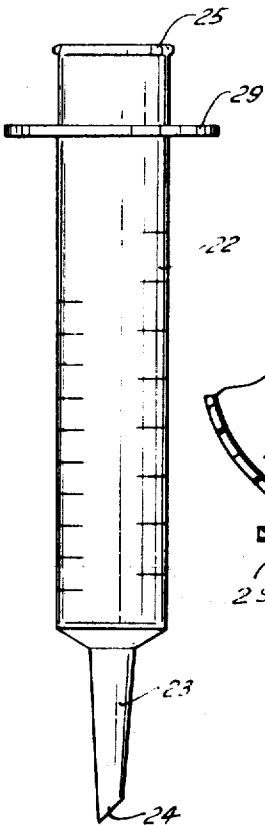


FIG. 2

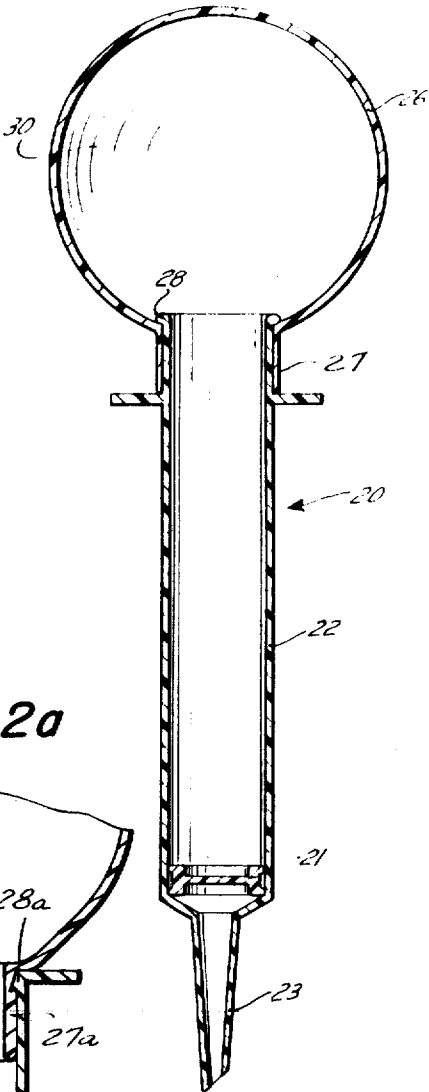
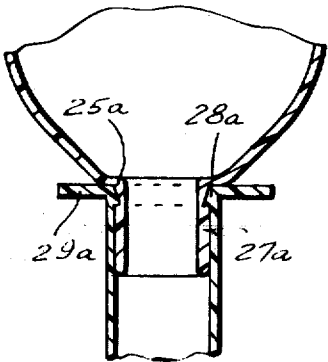


FIG. 2a



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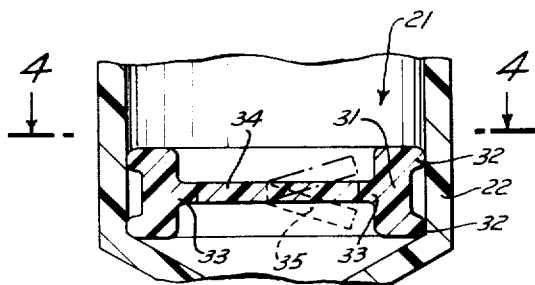


FIG. 3

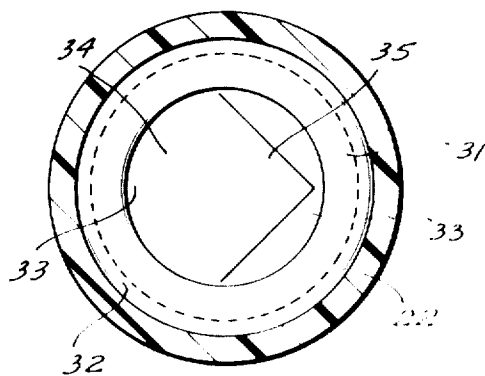


FIG. 4

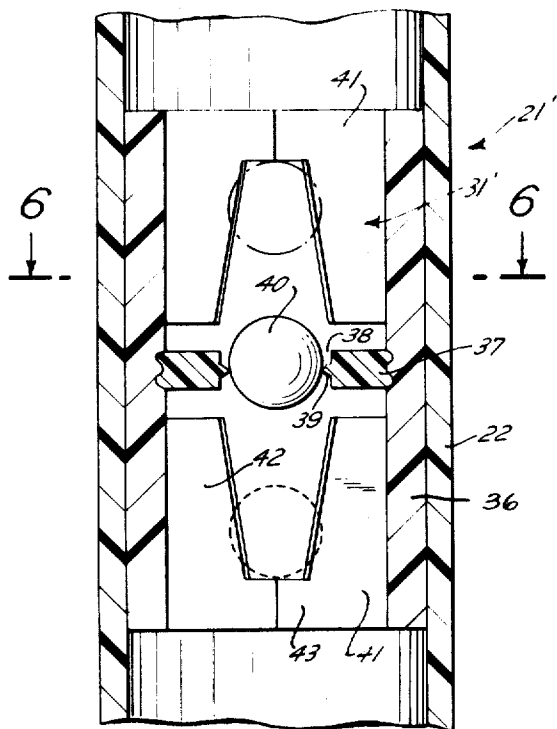


FIG. 5

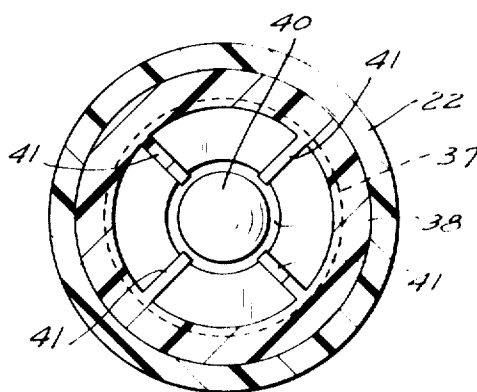


FIG. 6

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FIG. 7

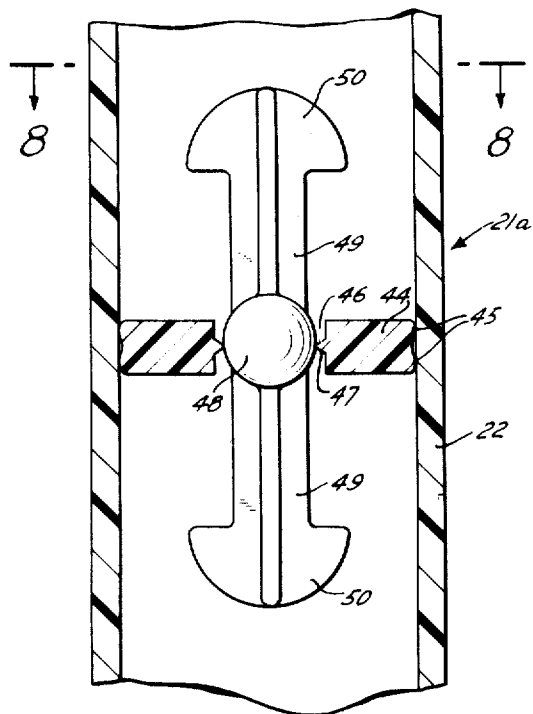


FIG. 8

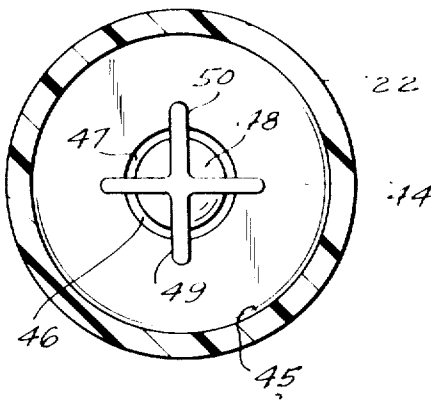
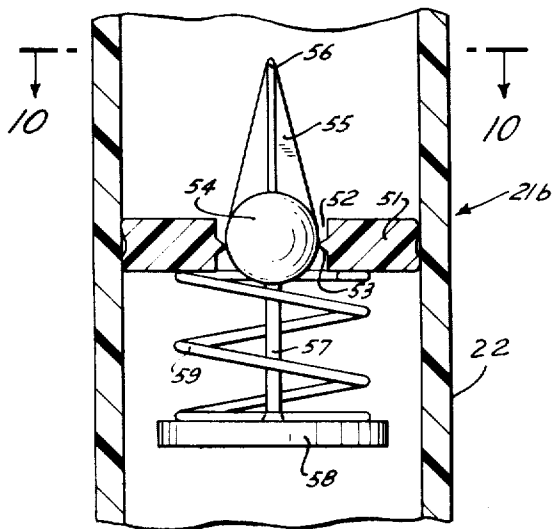


FIG. 9

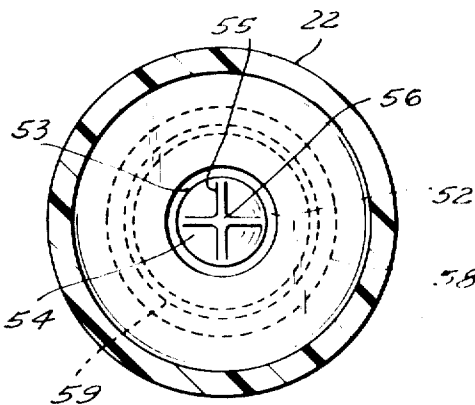


FIG. 10

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RETAINER VALVE ASSEMBLY FOR SYRINGE

BACKGROUND OF THE INVENTION

In the handling of fluids, it is often desirable to transport a fluid through a flow line for a variety of reasons. For example, it may be desirable to collect a fluid in a receptacle and transport it to a new location and then release the fluid into a different receptacle. In order to transport the fluid from one location to another it generally passes through a flow line. Often this flow line is used to pass the fluid in both directions, that is, from a source into a receptacle and then at a later point in time out of the receptacle through the same flow line into a different fluid container. In devices of this kind, it is occasionally difficult to prevent the flow or drip from the transporting receptacle through the flow line while the fluid is being transported. This may come from natural leakage during normal handling procedures of the receptacle and flow line or it may come from other types of agitation of the receptacle and flow line as it is being transferred. Naturally this is undesirable since it may cause loss of a valuable percentage of the fluid, creation of unsightly or undesirable contact with other surface areas or even contamination of areas or persons in the vicinity such as handlers of the apparatus.

It would be a considerable improvement in the art for a two-way retainer valve structure to be positioned in the flow line in order to alleviate the danger of leakage during storage of the fluid in the transporting container and yet still permit the fluid to pass in both directions through the flow line when a predetermined amount of pressure is applied in either direction.

For descriptive purposes, perhaps it would be advantageous to describe an apparatus and environment wherein this type of valve structure would be most helpful in accomplishing the purposes described above. In medical applications, a bulb type of syringe is often employed for a variety of uses. This apparatus is basically composed of a syringe barrel having a reduced forward end open at the tip and having a flexible bulb attached to the rear end of the barrel and open to the interior of the barrel. It is a well-known procedure to collect fluid within such a syringe and transport it to another location and then expel the fluid into another receptacle for test purposes or other reasons.

To briefly describe this procedure, when the fluid is collected, the bulb is compressed thereby expelling air from the syringe assembly and then the open forward tip of the syringe is inserted into a fluid source. When the bulb is released and allowed to return to its normal expanded shape, the increase of volume in contrast to the amount of air in the syringe provides a reduction of pressure at the bulb end of the syringe assembly. Atmospheric pressure or other outside means will, at that time, be great enough to force fluid through the open forward tip of the syringe assembly and on through the barrel into the rear portion thereof where it is collected. The syringe assembly is then removed from the fluid source and transported to a new location where pressure upon the bulb once again reduces the volume within the syringe assembly and fluid is expelled through the forward tip of the syringe into a new receptacle. Difficulty often arises during transportation of the syringe assembly from the fluid source to the fluid collection assembly. If the syringe assembly is jostled in any way or tipped downwardly, fluid will sometimes leak or drip from the tip of the assembly and cause the problem discussed above. Therefore, a two-way retainer valve assembly of the type previously described would be extremely advantageous when inserted in the barrel of the syringe assembly of this type. It would permit fluid to flow in both directions from the tip end into the rear end of the barrel when the fluid is collected and then from the rear end of the barrel out through the tip end when the fluid is expelled. Furthermore, it would reduce or prevent flow or drip from the syringe assembly which is filled or partially filled with a liquid or gas while the assembly is being handled and transported to a new position or location.

Naturally, it would be particularly advantageous to have a valve device which can be located in any location in the flow line for liquid or gas. In the syringe assembly, this would most normally be intermediate the ends of the barrel portion of the syringe. The seat tension of the valve assembly would have to be able to be set to withstand the largest standing head of gas or liquid to be applied on either side of the valve assembly. The assembly would then have to be preset to open when pressures exceed the setting either by mechanical pressure or increased volumes of standing heads of liquid or gas. A two-way valve retainer assembly of this type would be extremely valuable when located in a bulb type syringe assembly as that described above for normal laboratory, hospital or doctor's use.

SUMMARY OF THE INVENTION

With the above state of the art in mind, it is a primary objective of this invention to provide a retainer valve assembly which will facilitate the reduction or prevention of flow or drip from a container filled or partially filled with a liquid or gas while still allowing flow of the liquid or gas, both in or out of the container assembly when a predetermined amount of pressure is applied. The valve device may be located in any part of a flow line for liquid or gas. The seat tension may be set to withstand the largest standing head of gas or liquid to be applied on either side of the valve assembly and the valve may be preset to open when pressures exceed the setting either by mechanical pressure or increased volumes of standing heads of liquid or gas. Furthermore, the valve assembly is adapted for use with a syringe in the medical field such as in a bulb-type syringe whereby the valve assembly is designed to be located within the barrel of the syringe assembly and is designed to minimize or prevent dripping of liquid from the filled or partially filled syringe when it is handled or transported by a user from a fluid source to a fluid collection receptacle.

In summary, a retainer valve assembly for a syringe or other common type of flow line is provided which includes a body portion having means thereon for mounting the valve assembly in the barrel of the syringe intermediate the ends of the syringe. A valve portion is movably mounted on the body portion and is normally seated in a central opening in the body portion to form a seal and isolate one end portion of the syringe from the other end portion. The valve member is responsive to a predetermined amount of pressure from either end portion of the syringe so as to unseat from the body portion to permit fluid to flow from one end portion of the syringe to the other end portion thereof. Furthermore, when the pressure is relieved, the valve member will return to its normal seated position thereby reforming the seal between the ends of the syringe and alleviating the danger of leakage from the syringe when the predetermined amount of pressure is not being applied.

With the above objectives in mind as well as the above brief summary of the invention, reference is had to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is an exploded elevation view of a retainer valve assembly of this invention located in a bulb-type syringe;

FIG. 2 is an assembled sectional elevation view thereof;

FIG. 2a is a fragmentary assembled sectional elevation view of a retainer valve of this invention located in a bulb-type syringe having an alternative configuration;

FIG. 3 is an enlarged fragmentary sectional elevation view of the syringe of FIG. 1 with the valve portion of the assembly shown in phantom in either of its two open positions;

FIG. 4 is a top sectional view thereof taken along the plane of line 4-4 of FIG. 3;

FIG. 5 is an enlarged fragmentary sectional elevation view of another embodiment of the invention with the valve portion of the assembly shown in phantom in two different open positions;

FIG. 6 is a top sectional view thereof taken along the plane of line 6—6 of FIG. 5;

FIG. 7 is an enlarged fragmentary sectional elevation view of a further embodiment of the invention;

FIG. 8 is a top sectional view thereof taken along the plane of line 8—8 of FIG. 7;

FIG. 9 is an enlarged fragmentary sectional elevational view of a still further embodiment of the invention; and

FIG. 10 is a top sectional view thereof taken along the plane of line 10—10 of FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The retainer valve assembly of this invention is adaptable for use in many different types of applications in which a flow line is employed through which fluid may flow in both directions. By positioning the retainer valve assembly in the flow line, in its normal closed position it produces a seal which prevents flow or passage of any fluid from the flow line on one side of the assembly to the flow line on the other side of the assembly. However, the assembly is such that a sufficient amount of pressure applied to either side of the retainer valve assembly will cause the valve to open and permit fluid to flow in the direction of the applied pressure. When the pressure is relieved, the valve returns to its normal closed or seated position and the seal between the two portions of the flow line is once again intact. There are naturally many different locations where a valve of this type would be extremely valuable, however, for descriptive purposes in explaining the operation and use of the valve assembly, it will be located in a medical syringe environment. In particular, the assembly will be mounted in the barrel of a common type of bulb syringe used in the transportation of fluids from one receptacle to another.

FIGS. 1 and 2 generally show the assembled condition of the valve assembly when utilized with a bulb syringe of this type. The overall syringe and valve assembly includes the two-way retainer valve assembly 21 mounted in the barrel 22 of a bulb-type syringe. This type of syringe has a reduced forward end 23 terminating in an opened tip 24 at its forward end. Both the barrel 22 and the forward reduced end are opened along their entire length so as to be in communication and provide a continuous passage between forward tip 24 and the rear rim 25 of barrel 22. A flexible resilient bulb 26 is mounted on the rear end portion of barrel 22. This is accomplished by the presence of a reduced forward neck 27 on bulb 26 which snugly engages the rear portion of barrel 22 in circumferential sealing engaging relationship to form the assembly. As will be noted in FIG. 2, the rear rim 25 of barrel 22 has an annular lip 28 which aids in insuring a sealing engagement with the inner surface of bulb 26 and the outer surface of the rear portion of barrel 22. The extension of neck 27 onto the rear portion of barrel 22 is restricted by the presence of a flange 29 which serves to assure that the bulb is properly seated in assembly with the syringe barrel. When assembled, the opened rear end of barrel 22 communicates with the interior of bulb 26 thereby providing a continuous passage from the tip 24 to the interior 30 of bulb 26. The resilient snug engagement between neck 27 and barrel 22 and the presence of lip 28 on rear rim 25 of barrel 22 assure that a sealed engagement exists between the bulb and the barrel portion of the syringe assembly.

Alternatively, as shown in FIG. 2a of the drawings, neck 27a of the bulb may have a diameter which facilitates its deformation and insertion interiorly of rear rim 25a. The engagement would be such that a tight frictional engagement would exist between the outer surface of neck 27a and the inner surface of the syringe barrel when the resilient deformed neck positioned within the barrel tends to assume its normal expanded configuration. An annular shoulder 28a may be positioned adjacent lip 25a on the interior surface of the syringe barrel to assure that a sealed engagement exists between the bulb and the barrel portion of the syringe. If desired, as shown, in this embodiment flanges 29a may be positioned adjacent rim 25a of the syringe barrel.

With the particular type of syringe, as shown in FIGS. 1-2a, the retainer valve assembly 21 is located intermediate the ends of the barrel 22 and preferably adjacent the reduced forward portion 23 of barrel 22. When these elements are thus assembled, and the retainer valve assembly is in its normally closed position, the continuous passageway between tip 24 and the interior 30 of bulb 26 is interrupted by the presence of valve assembly 21 so that no fluid may flow from one side of assembly 21 to the other side of assembly 21.

Valve assembly 21 is responsive to an increase in pressure from either side thereof and this is controlled by the flexible resilient nature of bulb 26. By compressing bulb 26 the volume of the assembly to the rear of valve assembly 21 is reduced thereby increasing the pressure of whatever fluid is contained in that volume until a predetermined point is reached at which time valve 21 will open allowing fluid to flow forward of valve assembly 21 and out through reduced portion 23 and tip 24.

In turn, when the bulb 26 is released, its natural resiliency will permit it to return to its original normal shape thereby once again increasing the volume rearward of valve assembly 21 resulting in a reduction in pressure to the rearward side of valve assembly 21 sufficient at least to permit valve 21 to return to its normal closed position. Furthermore, if sufficient pressure exists at the portion of the syringe assembly forward of valve assembly 21 the valve will once again respond and open in the rearward direction to permit fluid to flow therethrough and into the rear portion of barrel 22 and into cavity 30 in bulb 26. When the pressure is sufficiently equalized, the valve assembly will then return to its normal sealed position. The seat tension of the valve portion of valve assembly 21 may be adjusted so that the seat tension is set to withstand the larger standing head of gas or liquid which would then be located in the rear portion of barrel 22 and within bulb 26. The setting of the valve assembly would be such that an increase in pressure would have to be applied to bulb 26 in order to open valve 21 in the forward direction which would then naturally allow fluid to flow out through tip 24.

In this manner, fluid may be collected in the syringe assembly and the assembly carried or moved to a new location with little danger of leakage during handling or transporting of the syringe assembly and then the fluid contained within the assembly expelled into a new fluid receptacle or container.

Turning to consideration of the retainer valve assembly 21 in detail, there are a variety of embodiments which this valve assembly may assume, several of which are depicted in the drawings.

For example, an initial embodiment is that depicted in FIGS. 1-4. Particular details of the assembly are to be noted in FIGS. 3 and 4. This valve assembly 21 includes a ring-shaped body portion 31 which is frictionally mounted on the inner surface of syringe barrel 22. Body portion 21 may be constructed of a common resilient material and may be formed by any common method of manufacture such as a molding process. As shown, the outer surface of ring 31 contains two rims 32 which give body portion or ring 31 a greater outer diameter at the location of rims 32 than the inner diameter of syringe barrel 22. Therefore, rims 32 are compressed due to their resiliency and maintain a tight sealing engagement with the syringe barrel inner wall.

Extending inwardly from ring 31 is an annular shoulder 33 approximately centrally located with respect to the forward and rear edges of body portion 31 and extending inwardly therefrom.

The valve portion of valve assembly 21 includes a flexible diaphragm or disc 34 of any common flexible type of non-porous material and it is mounted to body portion 31 by means of an epoxy resin or other common type of bonding means, or it may be integral therewith. The bond or connection will occur between the outer circumferential rim of disc 34 and the inner circumferential surface of shoulder 33. When this relationship is accomplished, diaphragm or disc 34 is per-

manently mounted to body portion 31 and cannot be removed with respect thereto. A flap is provided in diaphragm 34 by means of a cut either V-shaped as shown, or any of a number of other common configurations, through the entire width of the diaphragm. Due to the natural resiliency of the material chosen for diaphragm 34, flap 35 will normally remain in the closed or sealed position as shown in FIGS. 3 and 4 with the V-shaped outer configuration of the flap surface engaged with the corresponding mating configuration of the remaining portion of the diaphragm. In this manner, no fluid may pass between the forward end of the syringe barrel and the rear end of the syringe barrel. As previously stated, diaphragm 34 is of a material having a certain strength and resiliency which will permit it to withstand a certain amount of pressure before it will be deformed. When this threshold of pressure is reached, flap 35 will be displaced to either of the two phantom positions shown in FIG. 3 thereby providing an opening for fluid to pass through valve assembly 21. The resistance of flap 35 to displacement can be controlled, as previously stated, by the type of material chosen for diaphragm 34 as well as the size and shape of the V-shaped cut to form a flap 35 along with the other relative dimensions of diaphragm 34 such as width and depth. These parameters can be easily determined as is well known in the art by considering the fluids to be handled.

In operation, when it is desired to draw fluid into the syringe, bulb 26 is compressed thereby reducing the volume on the rear side of retainer assembly 21 with a consequent increase in pressure which is sufficient to force flap 35 forward creating an opening through which to expel air within the syringe barrel which then exits through tip 24. The syringe may then be extended into a fluid source by placing the tip and forward portion 23 therein and bulb 26 thereafter released. The resiliency of bulb 26 will force it to return to its normal shape thereby greatly increasing the volume to the rear of retainer assembly 21 and permitting flap 35 to return to the closed position and to open rearwardly under the influence of the increased pressure created by atmosphere in forcing fluid through tip 24 and rearwardly through the opening created by flap 35 into barrel 22 and bulb 26. When sufficient fluid has been drawn into barrel 22 and bulb 26, the pressure will be neutralized and the head or weight of the fluid within the syringe will cause flap 35 to return to its closed or normal position. The strength of diaphragm 34 and flap 35 is set by predetermined parameters so that flap 35 will not open in the forward direction under the influence of the fluid contained within barrel 22 and bulb 26 alone. An additional amount of pressure will be required to open flap 35. The syringe may now be handled and moved to any location desired without danger of leakage of any of the fluid contained within the syringe assembly. Flap 35 will be in the closed position and valve assembly 21 will maintain the sealed condition and will alleviate the danger of leakage from the syringe assembly.

When the syringe is at the desired location for displacement of the fluid, the bulb 26 is once again compressed decreasing the volume in the rear part of the syringe assembly and consequently increasing the pressure within the assembly to a sufficient degree to force flap 35 to open forward and allow the fluid to flow out of barrel 22 through tip 24 into the desired receptacle. When the desired amount is in the receptacle, bulb 26 may be released and it will return to its original shape and flap 35 will consequently return to the closed position once again sealing the syringe assembly and alleviating the danger of leakage of fluid from the assembly should any remain therein. The steps as outlined above may be subsequently repeated as many times as desired in order to transfer desired amounts of fluid from receptacle to receptacle with minimal danger of leakage.

An alternative embodiment of the two-way retainer valve 21' is shown in FIGS. 5 and 6 of the drawings in detail. Assembly 21' may be inserted in a syringe barrel 22 in place of assembly 21 of the previous embodiment and will operate in a similar manner during the same identical operational steps as discussed above. However, there are certain structural dif-

ferences in the assembly which should be pointed out. The body portion 31' of the valve assembly includes an elongated hollow cylindrical member 36 of a solid or rigid material which is tightly engaged with the inner wall of syringe barrel 32 by frictional engagement or by means of an epoxy or other similar bonding agent so that a seal is formed between the two engaging surfaces. Extending inwardly from the inner surface of cylinder 36 and approximately centrally located is a resilient flexible disc 37 which is permanently mounted at its outer circumferential surface to the inner wall of cylinder 36. This once again forms a sealing surface. Disc 37 has a central opening 38 which provides the opening for fluid to flow between the forward portion of barrel 22 and the rear portion of barrel 22 as previously described with respect to the initially discussed embodiment. Extending inwardly from the surface forming opening 38 on diaphragm 37 is an annular rib or rim 39 which serves to form an interference fit with the valve member 40 which is a ball shaped rigid member. Ball 40 may be formed of any common type of rigid material. The flexible nature of rim 39 which has an inner diameter which is less than the outer diameter of ball 40 forms the interference fit so that ball 40 will normally be seated so that its outer surface is in sealing engagement with rim 39 thereby preventing flow of fluid between the forward portion of the syringe assembly and the rear portion of the syringe assembly. When the pressure is varied to a predetermined degree ball 40 will be displaced either forward or rearward of rim 39 thereby providing an opening for the passage of fluid.

In order to prevent ball 40 from being displaced completely from assembly 21', a cage 41 is provided at both the forward and rear parts of cylinder 36. Cage 41 is comprised of a group of parallel-spaced ribs extending inwardly from the inner surface of cylinder 36 and extending toward ball 40 from an annular base 43 but terminating before contacting disc 37. The inner edges of each of these ribs 42 taper outwardly as it approaches the normal location of ball 40 so as to receive ball 40 in surrounding relationship after it has been displaced and restrict its movement in either direction. The base portion 43 of each cage 41 contains sufficient openings to allow fluid to flow therethrough regardless of the position of ball 40 with respect to the cage, that is whether it is being held by cage 41, is located in some intermediate position or is in its normal closed position in engagement with rib 39. As previously discussed, the normal steps employed with the previous embodiment in use of the syringe will also serve to operate this assembly 21' in a similar manner with ball 40 acting as the valve member as flap 35 acted as a valve member with assembly 21.

A further embodiment is disclosed in FIGS. 7 and 8 which will operate in a similar environment and location as the embodiments previously discussed. In addition, the same operational steps will also accomplish the same results. The valve assembly 21a is a disc-shaped flexible resilient member 44 having two annular projections 45 from its outer surface which engage with the inner surface of a syringe barrel 22 to form a sealing engagement. This sealing engagement in this embodiment as well as in the other discussed embodiments serves to maintain the particular valve assembly utilized in fixed position so that the fluid flow will not displace the entire assembly. A central opening 46 is located in disc 44 which serves to provide the opening for passage of fluid when the valve member is unseated. A rib 47 extends inwardly approximately centrally located with respect to the depth of disc 44 from the surface forming hole 46. This annular rib 47 forms a shoulder which provides an interference fit with the valve member when it is in a normal position to provide a seal thereby preventing flow of fluid between the forward portion of the syringe assembly to the rear portion of the syringe assembly. In this instance, the valve member itself when it is in normally closed position has its central portion in sealing engagement with rim 47 by means of an interference fit. This central portion 48 is ball shaped in configuration and engages rim 47 in a similar manner as ball 40 engaged rim 39 in the

previously discussed embodiment. Extending rearwardly and forwardly from central ball-shaped portion 48 are ribbed identically shaped projecting members 49. These rib members 49 terminate in a flanged head 50. The maximum outer diameter of rib portions 49 is less than the diameter of the inner surface of rim 47 so that when central ball 48 is displaced, fluid may flow between the end portions of the syringe assembly by pressing between the outer edges of ribs 49 and rim 47 and also between each pair of spaced ribs 49. Each flanged head 50 serves to form a stop to prevent the valve member from being completely disengaged from body portion 44 when ball 48 is displaced from engagement therewith and valve assembly 21a is open. This is due to the fact that the lateral flanges on flange head 50 have a greater diameter than opening 46 in body portion 44 so that central ball portion 48 may only be displaced in either direction a distance equivalent to the length of projecting stem 49. In this manner, assembly 21a is kept intact during the various opening and closing steps of the valve assembly in operation. Valve assembly 21a may be substituted for valve assemblies 21 and 21' without detracting from the operation of a syringe assembly into which it is placed and the operational steps will be carried out in a similar manner.

A still further embodiment of the invention is disclosed in FIGS. 9 and 10 where the corresponding valve assembly is designated as assembly 21b. Once again, assembly 21b may be substituted for valve assemblies 21, 21' and 21a in the syringe of the type previously discussed or in any other environment without a change in the operational steps required in operating the syringe assembly or in the functional operation of the valve itself. However, there are certain structural features which are somewhat different in this assembly 21b from the previously discussed assemblies. In this instance, body portion 51 of the valve assembly 21b is substantially identical to body portion 44 of previously discussed embodiment 21a. It is a resilient flexible member in engagement with the wall of syringe barrel 22 in a similar manner and contains a central opening 52 and an annular inwardly extending rib 53 which serves to form an interference fit with the valve member when the valve member is seated within opening 52 to create the closed position of the valve and to prevent flow between the end portions of the syringe assembly. However, in this embodiment the valve portion is of a different construction than previously disclosed in prior embodiments. However, as in the previous embodiment the valve member as an intermediate ball-shaped portion 54 which forms the seal with shoulder 53 when ball 54 is located in its normally closed position within opening 52 in valve assembly 21b. As previously described, the interference fit between ball-shaped portion 54 and resilient shoulder 53 forms the seal.

Extending rearward from ball-shaped portion 54 is a ribbed member 55 which tapers as it extends away from ball portion 54 from a diameter not greater than the diameter of ball portion 54 to a rear apex or point 56.

Extending forward from ball portion 54 is a stem 57 having a cross-sectional diameter considerably less than the diameter of ball portion 54. The forward end of stem 57 terminates and is connected to a disc-shaped head 58 which has a diameter considerably greater than the diameter opening 52 in body portion 51. A helical spring 59 is mounted at its forward end to disc 58 in a convenient manner and at its rear end to body portion 51 also in any convenient manner.

The opening and closing of the valve portion of valve assembly 21b will occur during the same sequence of steps as outlined for the previous embodiments 21, 21' and 21a. When sufficient pressure is exerted from the rear end of the syringe assembly, ball-shaped portion 54 will be displaced from engagement with shoulder 53 and spring 59 will be compressed as ball-shaped portion 54 moves to the forward side of body portion 51. Since rearwardly extending portion 55 is of a smaller diameter than ball portion 54 and is constructed of a plurality of spaced ribs, fluid may pass between the ribs of portion 55 through the opening 52 and into the forward portion of

syringe barrel 22. When pressure is relieved, ball portion 54 will reseat itself in engagement with shoulder 53 assisted by the influence of helical spring 59 returning to its normal position.

When a predetermined amount of pressure is exerted from the forward portion of the syringe assembly, it will exert a force of disc 58 which will move rearwardly thereby compressing helical spring 59 which will exert sufficient force on ball 54 to displace it rearwardly with respect to body portion 51. This will provide an opening between the valve member and the body portion to permit fluid to flow to the rear portion of the syringe assembly. When the pressure is relieved, the ball portion 54 will return to its seated position into sealing engagement with shoulder 53 and will be assisted in this movement by the return of helical spring 59 to its normal expanded position. The amount of pressure necessary to open the valve can be controlled in a variety of different ways such as those previously discussed as well as by controlling the tension in helical spring 59 which may be adjusted so that a certain amount of pressure will be required to compress the spring.

It should also be noted that ball 54 is restricted in its movement in the open direction by the fact that helical spring 59 is permanently mounted to body portion 51 and disc 58. Furthermore, when ball portion 54 is open in the forward direction, pointed stem 55 will have some portion of its length still remaining within opening 52 to assist in guiding ball portion 54 in its return to the seated position. Rearward-extending portion 55 is long enough so that there will never be sufficient compression of spring 59 to displace it entirely from opening 52. In this manner, the valve portion of the valve assembly 21b will always remain in proper position with respect to body portion 51 whether the valve is in the open or closed position. As previously discussed, the various steps in operating a syringe assembly of the bulb type contains two-way valve retainer assembly 21b are identical to the steps employed with respect to the previously discussed embodiments designated as 21, 21' and 21a. All four valve assembly embodiments are interchangeable in the particular environment chosen for their use.

Thus the above-mentioned objectives, among others, are achieved.

We claim:

1. A retainer valve assembly for a syringe comprising:

a body portion having means thereon for mounting said valve assembly in the barrel of said syringe intermediate the ends thereof;

a reciprocally operating valve member movably mounted on said body portion and normally being seated in a central opening in said body portion to form a seal and isolate one end portion of the syringe from the other end portion and adapted to be unseated by sufficient pressure from either side thereof;

said valve member being responsive to a threshold pressure from either end portion of the syringe so as to unseat from said body portion and provide a large enough opening to permit fluid and some solids to flow from one end portion of said syringe to the other end portion thereof, the threshold pressure needed to unseat the valve member being greater than the operating pressure needed to keep the valve open until a desired amount of fluid and solids are transferred and when the operating pressure is relieved the valve member will return to its normal seated position thereby reforming the seal between the end portions of said syringe and alleviating the danger of leakage from the syringe when the threshold pressure is not being applied;

wherein said body portion is a resilient hollow cylindrical member adapted to be placed in sealing engagement with the inner wall of said syringe barrel around the entire circumference of said member, the valve portion being of resilient material and circular in configuration and being circumferentially mounted on the inner surface of said hollow member, a reciprocally movable flap on said valve

portion normally in the closed position thereby permitting said valve assembly to seal one end portion of the syringe from the other end portion, the flap being responsive to a predetermined amount of pressure from either end portion of the syringe to be thereby opened and provide a passageway from one end of the syringe to the other end and the resiliency of the flap permitting the flap to return to the normally closed position when the pressure is relieved.

2. The invention in accordance with claim 1 wherein said flap is formed by a V-shaped cut in the central part of the valve portion.

3. A retainer valve assembly for a syringe comprising:

a body portion having means thereon for mounting said valve assembly in the barrel of said syringe intermediate the ends thereof;

a valve portion movably mounted on said body portion and normally being seated in a central opening in said body portion to form a seal and isolate one end portion of the syringe from the other end portion;

said valve member being responsive to a predetermined amount of pressure from either end portion of the syringe so as to unseat from said body portion to permit fluid to flow from one end portion of said syringe to the other end portion thereof and when said pressure is relieved the valve member will return to its normal seated position thereby reforming the seal between the end portions of said syringe and alleviating the danger of leakage from the syringe when the predetermined amount of pressure is not being applied;

said body portion including an elongated hollow cylindrical tube adapted to be mounted in said syringe with the outer surface thereof engaging the inner surface of said syringe; a resilient circular diaphragm mounted in said tube in sealing engagement therewith and having an opening therein; an annular shoulder on the circumferential surface of said opening;

a pair of cages mounted on the inner surface of said tube with one cage located on one side of said diaphragm and the other cage on the other side of said diaphragm;

each cage including an opening in the top surface thereof and a web of members extending toward the diaphragm and arranged in circumferential engagement with the inner surface of said tube;

the central portion of said web being opened so as to communicate with the opening in the top surface of said cage;

the inner surface of each of said web members tapering outwardly as it approaches the diaphragm thereby providing an open central area in said cage with a larger diameter nearer the diaphragm and a smaller diameter adjacent the top surface of said cage;

the openings in said cages and said diaphragm communicating to provide a passageway between one end portion of the syringe and the other end portion thereof;

the valve portion of said assembly including a ball of a slightly larger diameter than the inner diameter of the annular shoulder and normally positioned in engagement with said shoulder in an interference fit to thereby prevent communication between the end portions of said syringe;

said ball being responsive to a predetermined amount of pressure from the direction of either end portion of said syringe so as to be displaced from engagement with said shoulder in either direction to permit opening of the passageway between the end portions of the syringe; and said cage is being positioned to receive and confine said ball when it is displaced without closing said passageway until the pressure is relieved and said ball will return to its normal closed position in interfering engagement with said annular shoulder.

4. A retainer valve assembly for a syringe comprising:

a body portion having means thereon for mounting said valve assembly in the barrel of said syringe intermediate the ends thereof;

a valve portion movably mounted on said body portion and normally being seated in a central opening in said body portion to form a seal and isolate one end portion of the syringe from the other end portion;

said valve member being responsive to a predetermined amount of pressure from either end portion of the syringe so as to unseat from said body portion to permit fluid to flow from one end portion of said syringe to the other end portion thereof and when said pressure is relieved the valve member will return to its normal seated position thereby reforming the seal between the end portions of said syringe and alleviating the danger of leakage from the syringe when the predetermined amount of pressure is not being applied;

said body portion including a resilient circular diaphragm adapted to be mounted in said syringe barrel in sealing engagement therewith and having an opening therein;

an annular shoulder on the circumferential surface of said opening;

said valve portion including an elongated member having a plurality of spaced ribs extending along the length thereof and a ball-shaped portion mounted intermediate the ends thereof;

said valve portion having flanged head portions on both ends;

the ball-shaped portion having a slightly larger outer diameter than the inner diameter of said annular shoulder and normally positioned in engagement with said shoulder and in an interference fit to thereby prevent communication between the end portions of said syringe;

said ball-shaped portion being responsive to a predetermined amount of pressure from the direction of either end portion of the syringe so as to be displaced from engagement with said shoulder in either direction to permit the opening to be exposed and provide communication between the end portions of the syringe;

the flanged head portion having a larger diameter than the opening in said diaphragm so that the displacement of said valve portion is restricted to a desired distance by contact of a flanged head portion with the diaphragm;

the flange on said head being spaced so that communication between the end portions of the syringe is not precluded when the head is in contact with the diaphragm; and

said flanged head remaining in contact with said diaphragm until the pressure is relieved and then said ball-shaped portion will return to its normal closed position in interfering engagement with said annular shoulder.

5. A retainer valve assembly for a syringe comprising:

a body portion having means thereon for mounting said valve assembly in the barrel of said syringe intermediate the ends thereof;

a valve portion movably mounted on said body portion and normally being seated in a central opening in said body portion to form a seal and isolate one end portion of the syringe from the other end portion;

said valve member being responsive to a predetermined amount of pressure from either end portion of the syringe so as to unseat from said body portion to permit fluid to flow from one end portion of said syringe to the other end portion thereof and when said pressure is relieved the valve member will return to its normal seated position thereby reforming the seal between the end portions of said syringe and alleviating the danger of leakage from the syringe when the predetermined amount of pressure is not being applied;

said body portion including a resilient circular diaphragm adapted to be mounted in said syringe barrel in sealing engagement therewith and having an opening therein;

an annular shoulder on the circumferential surface of said opening;

said valve portion having a pointed forward end tapering outwardly from said point by means of a series of spaced longitudinal ribs which terminate in a ball-shaped intermediate portion normally positioned in contact with said annular shoulder;

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said ball-shaped intermediate portion having a larger outer diameter than the inner diameter of said resilient annular shoulder thereby providing an interference fit therebetween and preventing communication between the end portions of said syringe;

a stem is connected to said intermediate portion and extends rearwardly therefrom;

the rear end of said stem is connected to a disc-shaped head; a helical spring surrounds said stem and is held in position by means of connection at one end with said diaphragm and at the other end with the forward surface of said disc-shaped head;

said intermediate portion being responsive to a predetermined amount of pressure from the direction of either end portion of the syringe so as to be displaced from en-

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gagement with said shoulder in either direction to permit the opening to be exposed and provide communication between the end portions of the syringe;

the spring being compressed when the intermediate portion is moved in one direction to thereby compensate by spring force for the pressure and restrict the displacement distance of said intermediate portion and being extended when the intermediate portion is moved in the other direction to thereby compensate by spring force for the pressure and restrict the displacement distance of said intermediate portion in the other direction; and

said intermediate portion adapted to return to its normal closed position when the pressure is relieved into interfering engagement with said annular shoulder.

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