

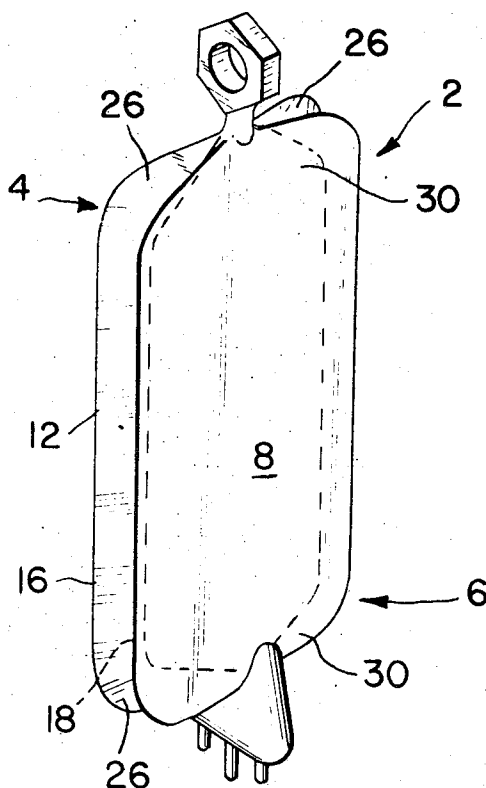


FIG. 1

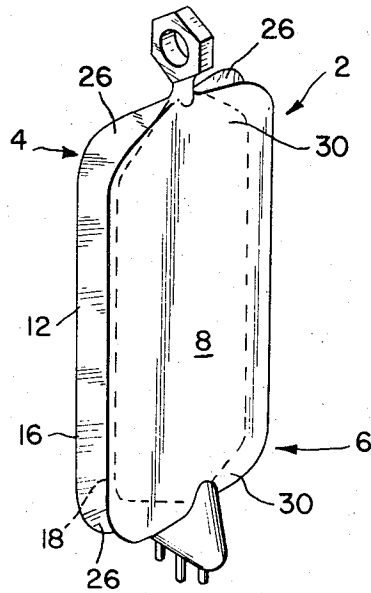


FIG. 2

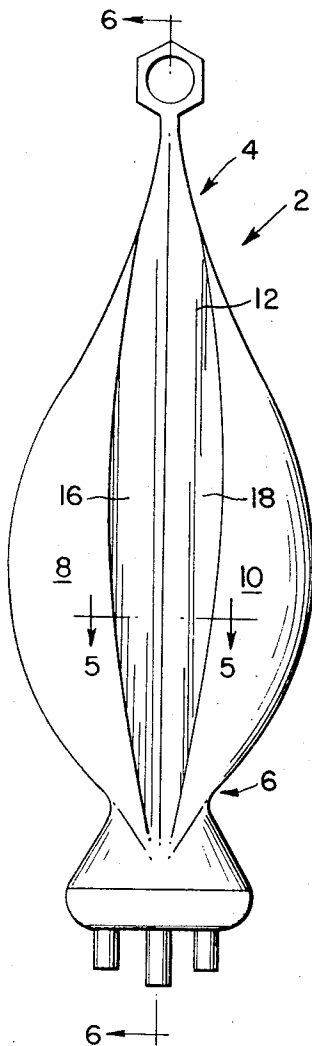


FIG. 3

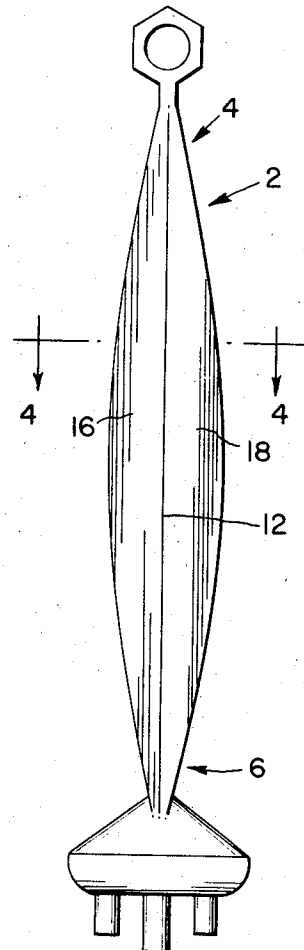


FIG. 4

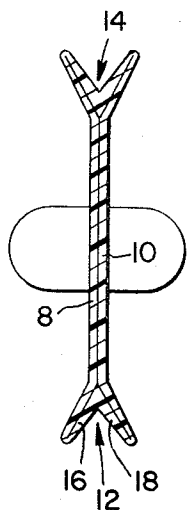


FIG. 5

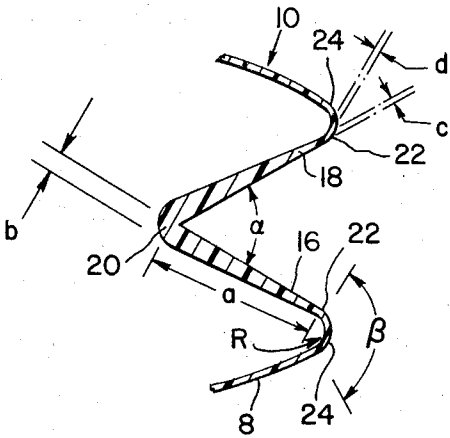


FIG. 6

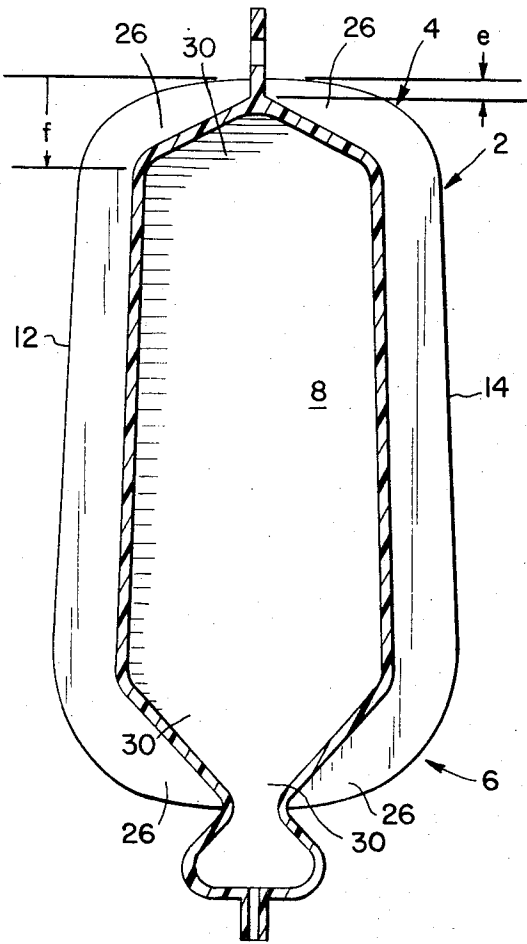


FIG. 7

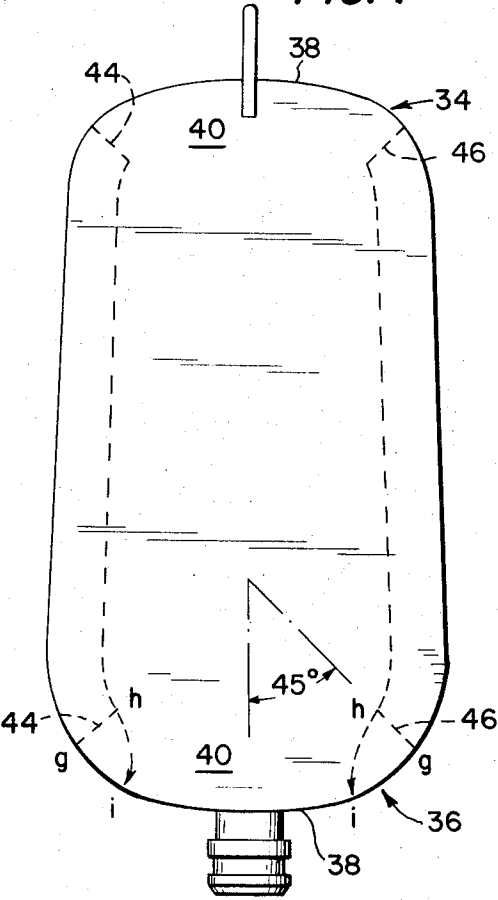


FIG. 8

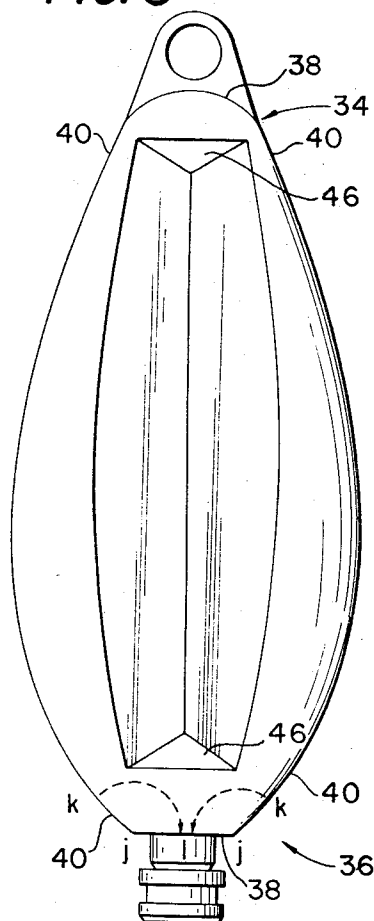


FIG. 9

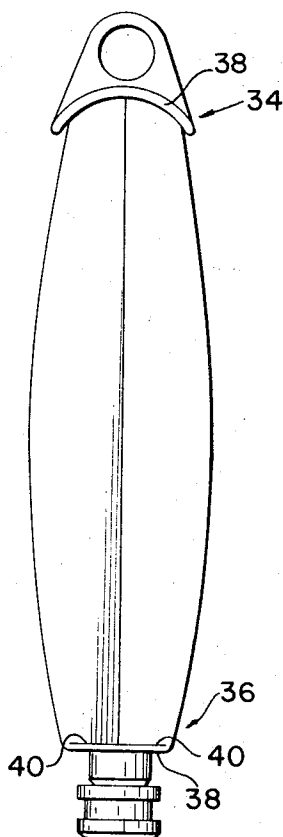


FIG. 15

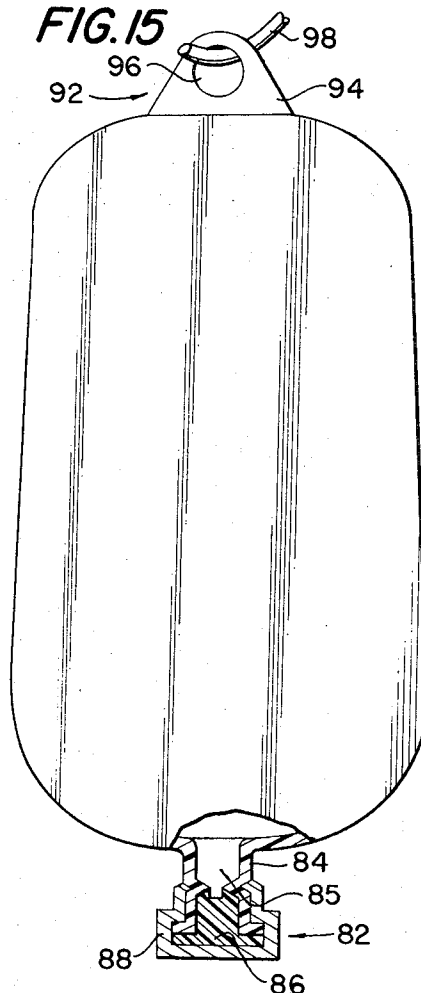


FIG. 10

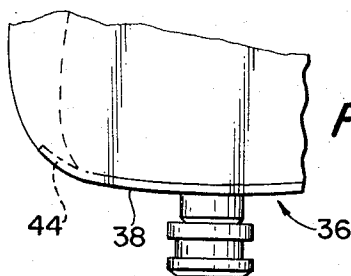


FIG. 16

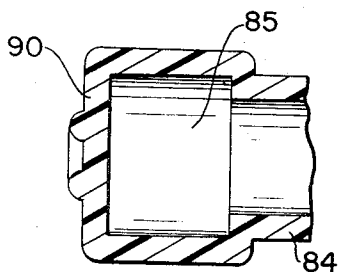
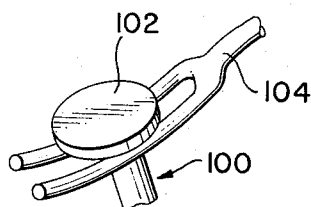


FIG. 17



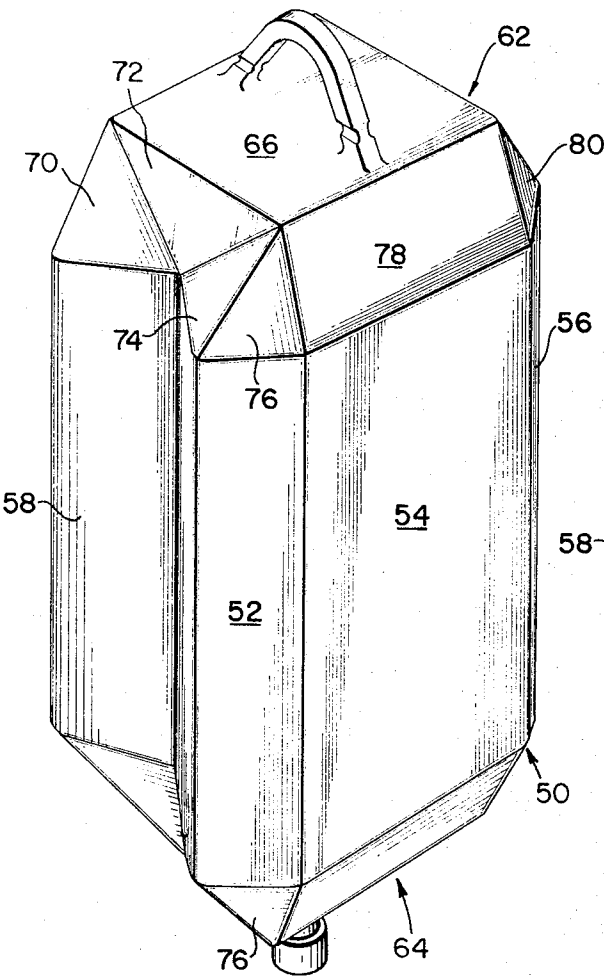


FIG. 11

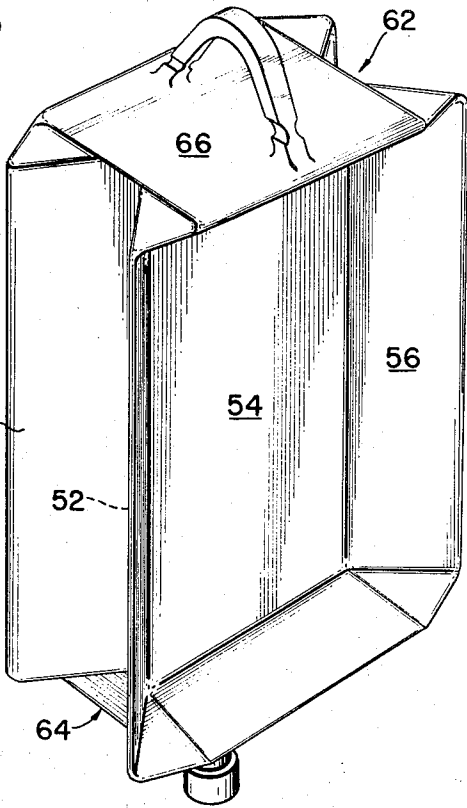


FIG. 12

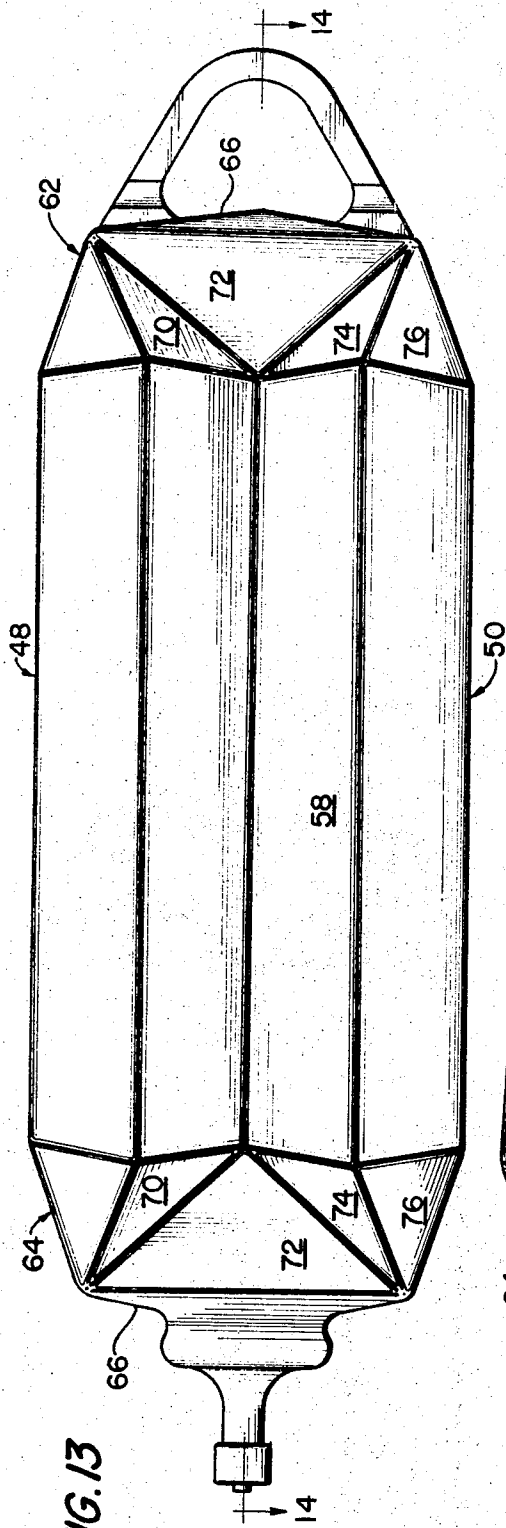


FIG. 13

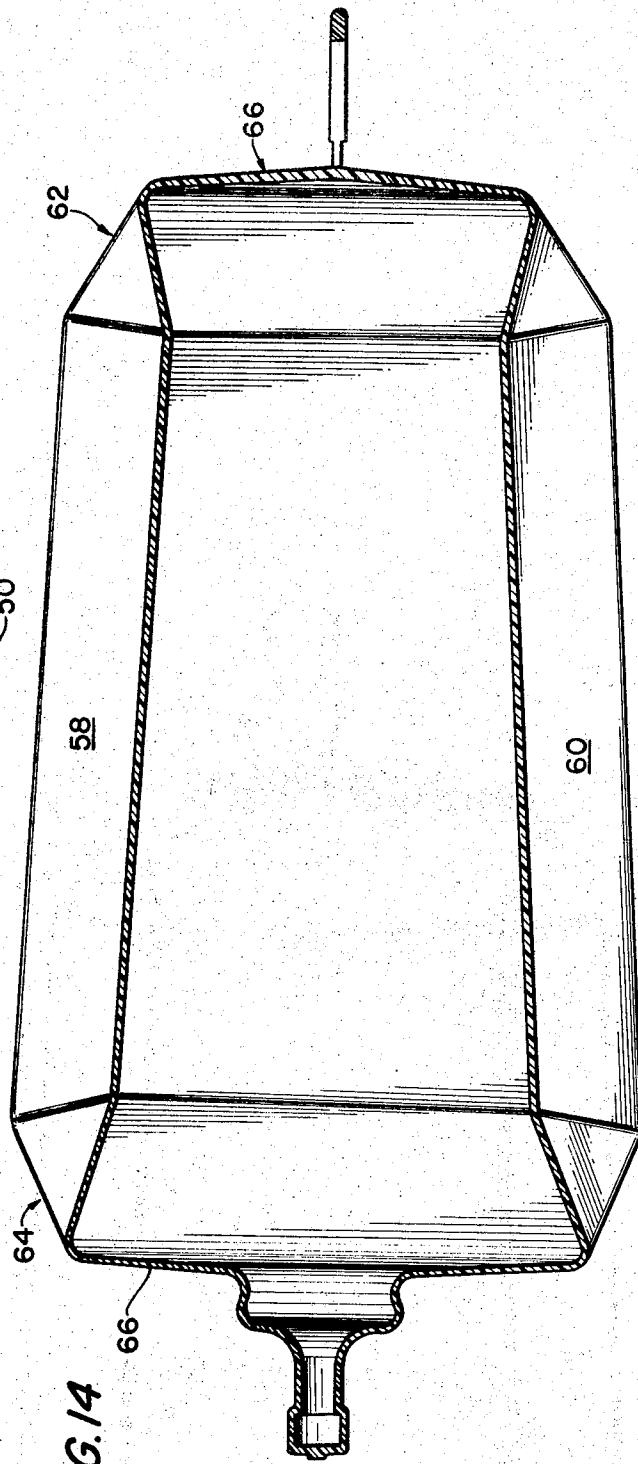


FIG. 14

VARIABLE VOLUME CONTAINER FOR FLUIDS

BACKGROUND OF THE INVENTION

1. Field Of The Invention

This invention relates to a variable volume container particularly adapted for storing and dispensing fluids such as parenteral solutions.

2. Description Of The Prior Art

Parenteral solutions are generally dispensed from rigid containers, e.g., glass bottles, which necessitate the introduction of air into the container to replace the solutions being withdrawn. Even though bacteriological filters are employed in the air inlets of such containers, the danger of contamination of the solution by air borne bacteria and resulting infection of the patient still persists. Furthermore, some solutions particularly solutions on the base side of neutrality, are adversely affected by contact with glass.

One solution which has been proposed to solve the problems attendant with the use of glass containers for fluids is to employ a flexible plastic fluid container which collapses as the solution is withdrawn. A common example of this is the use of plastic containers for storing and dispensing blood. These containers or bags are generally formed by sealing two plastic sheets at their periphery with one or more tubular entry or exit ports sealed into the bottom edge. As the blood flows from an exit port of the suspended bag, the walls of the bag gradually come together until essentially the entire contents of the bag have been delivered. Accordingly, air never comes into contact with the contents of the bag.

However, collapsible containers having sealed edges are not entirely satisfactory. Slight variations in wall thickness can cause the walls to come together diagonally during the administration so that a pocket of fluid is formed in an upper corner which flops over and prevents delivery of the fluid. The walls as they come together invariably wrinkle and the entire bag can twist near the end of the administration. Sometimes this twisting or curling is sufficient to cause the bottom exit port to be moved towards the horizontal, thereby preventing proper functioning of an attached dripmeter conventionally used therewith. Furthermore, containers of this type are very difficult to handle because they have no fixed or definite shape when filled with liquid and are also subject to leakage along the seam, thereby becoming utterly useless for the intended purpose.

In an attempt to overcome the above noted problems and to reduce the time and cost of manufacturing sealed seam plastic containers, parenteral solutions manufacturers have been investigating the possibility of forming flexible plastic containers by blow-molding processes. By such processes, plastic containers may be formed without seams and in a variety of shapes such as disclosed in the following U.S. patents: U.S. Pat. No. 3,171,412 issued Mar. 2, 1965, disclosing a cylindrical shape; U.S. Pat. No. 3,319,684 issued May 16, 1967, disclosing a rectangular shape; and U.S. Pat. No. 3,589,422 issued June 29, 1971, disclosing an ovoid shape. Some molded containers are even formed to permit controlled vertical collapse of the container as fluid is withdrawn such as disclosed in U.S. Pat. No. 3,319,684 noted above. However, when containers of this type are hung from the top in the conventional manner, hydrostatic forces are created which tend to

resist the vertical collapse of the container and thus interfere with the proper flow of fluid therefrom.

Collapsible containers of the type described above are generally practical only when formed of polyvinylchloride, since this material comes together with fewer wrinkles than most other plastics such as polyethylene or polypropylene. However, PVC has its drawbacks; namely, it is detrimental to fluids which are on the alkaline side, it contains plasticizers which are leachable and may be harmful, and it tends to be easily deformed when subjected to high temperatures. Polypropylene, on the other hand, is probably most desirable from the standpoint of compatibility with solutions of all kinds and with temperature variations. Unfortunately, polypropylene does not have the degree of flexibility that PVC has, and consequently, collapse of a container formed thereof leads to numerous wrinkles and the possibility of trapping pockets of solution. For example, a cylindrical blow-molded container of PVC will usually collapse with very few wrinkles. However, when a container of the same configuration is blow-molded from polypropylene, numerous wrinkles and irregular pockets are formed upon collapse of the container.

While flexible plastic containers adapted for controlled collapse are known generally, such as disclosed in U.S. Pat. No. 3,595,441, no variable volume container for fluids known heretofore has been disclosed which allows controlled and uniform collapse of biologically compatible plastic materials in a configuration which is convenient and easy to handle.

SUMMARY OF THE INVENTION

A primary object of this invention is to provide a variable volume container for fluids which overcomes the above noted deficiencies associated with prior art variable volume containers.

Another object of this invention is to provide a variable volume container for fluids which is adapted to permit controlled and uniform collapse without wrinkles or pockets being formed therein.

Yet another object of this invention is to provide a variable volume container for fluids which is adapted to permit controlled and uniform collapse without substantial variation in the vertical dimension thereof, whereby the flow of fluid into and out of the container is unaffected by hydrostatic forces.

Yet another object of this invention is to provide a variable volume container for fluids including a pair of opposed flexible side walls and a pair of opposed rigid side walls extending between and integrally connected with top and bottom portions, whereby the rigid side walls maintain the top and bottom portions in fixed vertically spaced relationship and permit uniform and controlled collapse of the flexible side walls as fluid is withdrawn from the container.

Still another object of this invention is to provide a variable volume container wherein each rigid side wall includes a pair of integrally connected planar walls forming a V-shaped pleat extending into the container along the entire vertical distance between the top and bottom portions. By this arrangement, the lateral edges of the flexible side walls are maintained in a generally fixed vertical orientation as the flexible side walls are flexed inwardly and outwardly to vary the container volume as fluids are introduced and withdrawn therefrom.

Yet another object of this invention is to provide a variable volume container formed of an integrally molded, one-piece unitary body of polypropylene.

It is a further object of this invention to provide a variable volume container wherein each planar wall has a maximum thickness adjacent the intersection with the other planar wall forming one of the rigid side walls of the container and a minimum thickness adjacent the outer edge of the planar wall, whereby the angle between the planar walls forming each rigid side wall remains constant while the outer edges are permitted variable movement.

Still another object of this invention is to provide a variable volume container wherein the opposed flexible side walls move toward a first position in which the flexible side walls are concaved inwardly in direct contact with the entire inner surfaces of the planar walls as fluid is withdrawn from the container and toward a second position in which the flexible side walls are convexed outwardly as fluid is introduced into the container.

Yet another object of this invention is to provide a variable volume container wherein the top portion includes a supporting means for supporting said container in a vertically depending manner and the bottom portion includes closure means for allowing fluids to be introduced or removed from the container.

Still another object of this invention is to provide a variable volume container wherein, in one embodiment, each of the top and bottom portions includes a rigid rectangular end member and flexible connective means for connecting the periphery of the end member with the flexible side walls and the planar walls. In this embodiment, the connective means includes a plurality of interconnected, substantially planar panels adapted to fold inwardly as said top and bottom portions move toward a first position adjacent the upper and lower edges of the side walls, respectively, as fluid is removed from the container and toward a second position spaced from the upper and lower edges of the side walls, respectively, as fluid is introduced into the container.

Yet another object of this invention is to provide a variable volume container wherein the top and bottom portions are formed by vertical extensions of the planar panels integrally connected with vertical extensions of the flexible side walls. In this embodiment, the planar panel extensions are integrally connected to form V-shaped pleats across the top and bottom of the container, the V-shaped pleats extending into the container at a minimum depth adjacent the central axis of the container and at a maximum depth adjacent the outer edges thereof.

It is yet another object of this invention to provide a variable volume container wherein the top and bottom portions each include an end panel and extensions of the flexible side walls integrally connected with the periphery of each end panel such that the end panels are movable toward a first extended position in which the flexible side wall extensions form a smooth continuous concave surface as fluid is inserted into the container and toward a second position in which the extensions of the side walls are folded against the end panel as fluid is withdrawn from the container.

Another object of this invention is to provide a variable volume container including a pair of opposed rigid side walls adapted to permit the container to be readily

grasped and manipulated and to lend integrity and uniformity to the flexible side walls, thereby to allow labels adhered thereto to be easily read.

Additional objects of this invention will become apparent from the following description of the preferred embodiments.

BRIEF SUMMARY OF THE DRAWINGS

FIG. 1 is a perspective view of a variable volume container in accordance with one embodiment of this invention;

FIG. 2 is a side elevational view of the variable volume container of FIG. 1 illustrating the configuration of the flexible side walls when the container is substantially full;

FIG. 3 is a side elevational view of the variable volume container of FIG. 1 illustrating the position of the flexible side walls when the container is substantially empty;

FIG. 4 is a cross sectional view of the variable volume container of FIG. 1 taken along line 4—4 of FIG. 3;

FIG. 5 is a partial cross sectional view of the variable volume container of FIG. 1 taken along line 5—5 of FIG. 2;

FIG. 6 is a cross sectional view of the variable volume container of FIG. 1 taken along line 6—6 of FIG. 2;

FIG. 7 is a side elevational view of a variable volume container in accordance with a second embodiment of this invention;

FIG. 8 is a side elevational view of the variable volume container of FIG. 7 illustrating the configuration of the flexible side walls when the container is substantially full;

FIG. 9 is a side elevational view of the variable volume container of FIG. 7 illustrating the configuration of the flexible side walls when the container is substantially empty;

FIG. 10 is an elevational view of a second side of the container illustrated in FIG. 9;

FIG. 11 is a perspective view of a variable volume container in accordance with a third embodiment of the subject invention;

FIG. 12 is a side elevational view of the variable volume container of FIG. 11 illustrating the configuration thereof when in a substantially empty condition;

FIG. 13 is a side elevational view of the variable volume container of FIG. 11;

FIG. 14 is a cross sectional view of the variable volume container of FIG. 11 taken along line 14—14 of FIG. 13;

FIG. 15 is a partial cross sectional view of a closure means and support means adapted for connection with the bottom and top portions, respectively, of a variable volume container arranged in accordance with this invention;

FIG. 16 is a cross-sectional view of a second type of closure means adapted for use with the variable volume container of this invention; and

FIG. 17 is a side elevational view of support means adapted for connection with the top portion of a variable volume container in accordance with the subject invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIGS. 1-6, and particularly FIG. 1, a variable volume container 2 for storing and dispens-

ing fluids such as parenteral fluids is disclosed. The variable volume container 2 includes a top portion 4 and a bottom portion 6, as well as flexible means including a pair of opposed flexible side walls 8, 10 extending between and integrally connected with top and bottom portions 4, 6. To support the opposed pair of flexible side walls and to maintain the top and bottom portions in fixed vertically spaced relationship, rigidifying means are provided including a pair of opposed relatively rigid side walls 12, 14 connected with the top and bottom portions and with the lateral edges of the flexible side walls 8 and 10 to completely enclose and define the container volume.

Each of the rigid side walls includes a pair of integrally connected planar walls 16, 18 forming a V-shaped pleat extending into the container along the entire vertical distance between the top and bottom portions. As best shown in FIGS. 2 and 3, this arrangement permits the lateral edges of the flexible side walls to be maintained in a generally constant vertical orientation as the flexible side walls are moved inwardly and outwardly to vary the container volume in response to insertion and withdrawal of fluid therefrom. In FIG. 2, flexible side walls 8, 10 are illustrated in an extended position in which the flexible side walls are convexed outwardly as each would appear when the container is full. In FIG. 3, flexible side walls 8, 10 are concaved inwardly in direct contact with the entire inner surfaces of the planar walls as would occur when the container is completely empty.

As best illustrated in FIG. 4, which is a cross sectional view of the container in FIG. 3, the flexible side walls are in direct contact over the portions thereof extending between the opposed pair of rigid side walls 12, 14 when the container is substantially empty.

In FIG. 5 a broken cross sectional view of rigid side wall 12 taken along line 5—5 of FIG. 2 is illustrated wherein planar walls 16, 18 form an intersection 20 at a predetermined fixed angle. This fixed angle may range between 5° to 175° and is preferably in the range of 10° to 90° . Optimum results, however, are usually obtained when the predetermined angle is greater than 20° but less than 60° . The perpendicular distance, a , between intersection 20 and the outer edge 22 of each of the planar walls is desirably greater than one-tenth but less than one-half the overall lateral width of the container. Also, as illustrated in FIG. 5, each planar wall varies in thickness from a maximum, b , adjacent intersection 20 to a minimum, c , adjacent the outer edge 22 thereof. By this arrangement the orientation of planar walls 16, 18 is maintained at the constant angle α adjacent intersection 20, whereas the outer edge portion of each planar wall is permitted to flex slightly as the opposed pair of flexible side walls 8 and 10 move between retracted and extended positions.

While the lateral length of each flexible side wall when in the contracted position illustrated in FIG. 4 is equal to the lateral length when in the extended position illustrated in FIG. 2, it has been found desirable to provide a flexible membrane 24 having a radius of curvature R and arc length β which is substantially greater than the thickness, d , of the membrane. The membrane 24 acts as a hinge between the edges of planar walls 16, 18 and the corresponding flexible side walls 8, 10 to thereby facilitate movement of the flexible side walls from the retracted to the extended position and to permit the flexible side walls to adjust exactly to the avail-

able surface area between opposed edges of rigid side walls 12 and 14.

The variable volume container of the subject invention is particularly well adapted for formation in a blow-molding process wherein the top and bottom portions and the side walls are integrally molded into a one-piece unitary body. Conventional materials such as polyvinylchloride, polyethylene, and copolymers of polyethylene are suitable for such blow-molding operations. Furthermore, polypropylene and copolymers of polypropylene are also suitable for this process. A typical copolymer of this type is E1 Rexene PP 23S2 made by Dart Industries. When the variable volume container is formed in accordance with the design disclosed herein, the disadvantages heretofore accompanying the use of polypropylene are eliminated. When formed of polypropylene, the thickness of the flexible side walls should range between 0.005 to 0.008 inches and the thickness, c , of the planar walls should be approximately 0.005 inches at the outer edge 22 and progressively increasing to thickness, b , of about 0.012 to 0.06 inches at intersection 20.

As best illustrated in FIGS. 1 and 6, the top and bottom portions 4, 6, respectively, are formed by extensions 26 of the planar panels 16, 18 and by vertical extensions 30 of the flexible side walls 8 and 10. The planar panel extensions are integrally connected to form a V-shaped pleat across the top and bottom of the container. Each V-shape pleat extends into the container at a minimum depth, e , adjacent the central axis of the container and progresses toward a maximum depth, f , adjacent the lateral sides thereof. The outer edges of the V-shaped pleats are integrally connected with the vertical extensions of the flexible side walls. This arrangement permits the vertical extensions of the flexible side walls to contract and expand along with the flexible side walls, thereby permitting the volume of the container to be reduced substantially to zero when the flexible side walls are in the retracted position.

Referring to FIGS. 7-10, a second embodiment of the variable volume container of the subject invention is disclosed wherein the top portion 34 and the bottom portion 36 each include an end panel 38 and flexible side wall extensions 40 integrally connected with the periphery of each of the end panels, respectively. Also included with each top and bottom portion is a pair of V-shaped panels 44, 46 integrally connected with the rigid side walls at the terminal end thereof. Each V-shaped panel is arranged in a plane perpendicular to the planar walls of the respective rigid side wall. When the variable volume container is full, the flexible side wall extensions form a smooth, continuous concave surface with the flexible side walls as shown in FIG. 8 and the V-shaped panels are arranged in a plane forming a 45° angle with the central axis of the container as best shown in FIG. 7. As fluid is drained from the variable volume container, V-shaped panels 44, 46 are moved from position gh to position gi wherein the V-shaped panels are folded against the end panel 38 of the top and bottom portions, respectively. At the same time, flexible side wall extensions 40 are moved from position jk into position jl as shown in FIG. 8, wherein the flexible side wall extensions are folded against end panel 38 of both the top and bottom portions. FIGS. 9 and 10 illustrate the position of the V-shaped panels 44, 46 and flexible side wall extensions 40 when the variable volume container is completely empty.

Reference is now made to FIGS. 11-14 in which a third embodiment of the variable volume container of the subject invention is illustrated. In this embodiment the flexible side walls 48, 50 are formed from three generally planar flexible panels 52, 54, 56. Rigid side walls 58, 60 are identical with the embodiments illustrated in FIGS. 1-10, whereas both the top and bottom portions 62, 64 of this third embodiment include a rigid rectangular end member 66 and connective means including a plurality of interconnected planar panel sections 70, 72, 74, 76, 78, and 80. As best illustrated in FIGS. 11 and 13, one edge of rigid rectangular end member 66 is joined to the planar walls of rigid side wall 58 by means of planar panel sections 70, 72, and 74. More particularly, panel section 72, triangular in outer configuration, is hingedly connected along two edge portions with triangular panel sections 70, 74 which are in turn connected with the planar walls of rigid side wall 58, respectively. In a similar manner, flexible panels 52, 54, 56 of the flexible side wall 50 are interconnected with an edge portion of rigid rectangular end member 66 by means of planar panel sections 76, 78, 80, respectively. The remaining edge portions of rectangular end member 66 are interconnected with flexible side wall 48 and rigid side wall 60 by means of corresponding planar panel sections thereby completely enclosing the top portion of the variable volume container. As fluid is inserted into the container, end members 66 move toward an extended position illustrated in FIGS. 11, 13 and 14, thereby to maximize the volume of the container. As fluid is withdrawn from the container, end members 66 by virtue of the flexible interconnection of the panel sections 70, 72, 74, 76, 78, and 80 are moved toward a second position immediately adjacent the upper and lower edges of the side walls as best illustrated in FIG. 12. Simultaneously with the movement of end panels 66, flexible side walls 48, 50 are caused to move from the extended position illustrated in FIG. 11 to the retracted position illustrated in FIG. 12 in a manner similar to that illustrated in FIGS. 2, 3, 8 and 9.

To permit fluid to be introduced and withdrawn from any one of the variable volume containers illustrated in FIGS. 1-14, closure means may be provided integrally connected with the bottom portion of the container. One form of such closure means is illustrated in FIG. 15, wherein the closure means 82 includes a depending port 84 having one opening 85 communicating with the internal volume of the container. Additional openings may be provided if desired. Each opening is closed by a resilient stopper 86 inserted into the opening and held in place by an overcap 88 which is either crimped or screw threaded to the port 84. If desired, port 84 may include a pierceable member 80 covering the opening 85 illustrated in FIG. 16, thereby eliminating the need for resilient stopper and overcap 86, 88.

To permit the variable volume container to be supported in a vertically hanging manner as is conventional with parenteral solution containers, supporting means 92 may be provided integrally connected with the top portion of the variable volume container. As illustrated in FIG. 15, the supporting means may include a tab 94 containing an opening 96 through which a support member such as hook 98 may be received. Alternatively, as illustrated in FIG. 17, the support means may include a knob 100 having an enlarged portion

102 adapted to engage a forked support 104 to maintain the container in a suspended position.

According to the foregoing description, a variable volume container has been described including rigid side walls which are particularly designed to allow for controlled and uniform collapse as a consequence of withdrawal of fluid from the container. As a further consequence of the rigid side wall structure, the fluid container is more readily grasped since the fingers can fit into the recesses created by the V-shaped pleats along the lateral edges of the container. Without these pleats, a filled flexible plastic container is very floppy and not readily held or manipulated. The rigid side walls forming the pleats also lend uniformity and integrity to the flexible side wall surfaces so that labels attached to these surfaces may be more easily read even during collapse because the walls tend to resist significant wrinkling.

We claim:

1. A variable volume plastic container for fluids capable of collapsing in a controlled and uniform manner, comprising

top and bottom portions;

flexible means responsive to pressure changes to vary the container volume, said flexible means including a pair of opposed flexible side walls extending between and integrally connected with said top and bottom portions; and

rigidifying means for supporting said flexible means and for maintaining said top and bottom portions in vertically spaced relationship, said rigidifying means including a pair of opposed relatively rigid side walls connected with said top and bottom portions and said flexible means to completely enclose the container volume, each said rigid side wall including a pair of integrally connected planar walls forming a V-shaped pleat extending into the container along the entire vertical distance between said top and bottom portions, said planar walls forming an intersection at a predetermined fixed angle, whereby the lateral edges of said flexible side walls are maintained in a generally constant vertical orientation as said flexible side walls are flexed inwardly and outwardly to vary the container volume in response to fluids being inserted and withdrawn therefrom.

2. A variable volume container as claimed in claim 1, wherein said predetermined angle is greater than 5° but less than 175°.

3. A variable volume container as claimed in claim 1, wherein said fixed predetermined angle is greater than 10° but less than 90°.

4. A variable volume container as claimed in claim 1, wherein said fixed predetermined angle is greater than 20° but less than 60°.

5. A variable volume container as claimed in claim 1, wherein the perpendicular distance between said intersections and the outer edge of each said planar wall is greater than one-tenth but less than one-half the overall lateral width of the container.

6. A variable volume container as claimed in claim 1, wherein each said planar wall varies in thickness from a maximum adjacent said intersection to a minimum adjacent the outer edge thereof.

7. A variable volume container as claimed in claim 6, wherein said top and bottom portions and said side

walls form an integrally molded, one-piece unitary body.

8. A variable volume container as claimed in claim 7, wherein said unitary body is formed from a material selected from the group consisting of polypropylene, copolymers of polypropylene, polyethylene, copolymers of polyethylene, and polyvinyl chloride.

9. A variable volume container as claimed in claim 7, wherein said unitary body is formed of polypropylene.

10. A variable volume container as claimed in claim 9, wherein the maximum thickness of said planar walls is greater than 0.012 inches but less than 0.06 inches and the minimum thickness of said planar walls is approximately 0.005 inches.

11. A variable volume container as claimed in claim 1, wherein said opposed flexible side walls move toward a first position in which said side walls are concave inwardly in direct contact with the entire inner surfaces of said planar walls as fluid is withdrawn from the container and toward a second position in which said side walls are convex outwardly as fluid is introduced into the container.

12. A variable volume container as claimed in claim 11, wherein the lateral length of each said flexible side wall in said first position is equal to the lateral length of said flexible side wall in said second position.

13. A variable volume container as claimed in claim 11, wherein said flexible side walls and said planar walls are integrally connected by means of a flexible membrane having radius of curvature substantially greater than the thickness of said flexible membrane.

14. A variable volume container as claimed in claim 11, wherein said flexible side walls while in said first position are in direct contact over the portion thereof extending between said intersections of said planar walls.

15. A variable volume container as claimed in claim 1, wherein said top portion includes supporting means for supporting said container in a vertically depending manner.

16. A variable volume container as claimed in claim 15 wherein said supporting means includes a tab containing an opening adapted to receive a support member.

17. A variable volume container as claimed in claim 15 wherein said supporting means includes a knob having an enlarged upper portion.

18. A variable volume container as claimed in claim 1, wherein said bottom portion includes closure means for allowing fluids to be introduced or removed from the container.

19. A variable volume container as claimed in claim 18, wherein said closure means includes at least one open port and cap means for removably closing said port.

20. A variable volume container as claimed in claim 19, wherein said cap means includes a resilient stopper and an overcap for securing the resilient stopper to said open port.

21. A variable volume container as claimed in claim 1, wherein each of said top and bottom portions includes a rigid rectangular end member and flexible connective means for connecting the periphery of said end member with said flexible side walls and said planar walls, said connective means including a plurality of interconnected substantially planar panel sections

adapted to fold inwardly to move said top and bottom portions toward a first position adjacent the upper and lower edges of said side walls, respectively, as fluid is removed from the container and toward a second position spaced from the upper and lower edges of said side walls, respectively, as fluid is introduced into the container.

22. A variable volume container as claimed in claim 1, wherein said top and bottom portions are formed by vertical extensions of said planar panels and said flexible side walls, said planar panel extensions being integrally connected to form V-shaped pleats across the top and bottom of the container, said V-shaped pleats extending into the container to a minimum depth adjacent the central axis of the container and to a maximum depth adjacent the lateral sides thereof.

23. A variable volume container as claimed in claim 1 wherein said top and bottom portions each include,

an end panel,

extensions of said flexible side walls being integrally connected with the periphery of said end panels, and

a pair of V-shaped panels integrally connected with said pair of rigid side walls at the terminal ends thereof, respectively, said V-shaped panels being arranged in a plane perpendicular to said planar walls, each said end panel being movable toward a first extended position in which said flexible side walls and said flexible side wall extensions form smooth continuous concave surfaces and in which said V-shaped panels are arranged in a plane forming a 45° angle with the central axis of the container as fluid is inserted into said container and toward a second position in which said extensions of said side walls and said V-shaped panels are folded against said end panel as fluid is withdrawn from the container.

24. A unitary, integrally molded variable volume container for fluids capable of collapsing in a controlled and uniform manner, comprising top and bottom portions,

flexible means responsive to pressure changes to vary the container volume, said flexible means including a pair of opposed flexible side walls extending between and integrally connected with said top and bottom portions,

rigidifying means for supporting said flexible means and for maintaining said top and bottom portions in vertically spaced relationship, said rigidifying means including a pair of opposed, relatively rigid side walls connected with said top and bottom portions and with said pair of flexible side walls, each said rigid side wall including a pair of integrally connected planar walls forming a V-shaped pleat, the intersection of said planar walls forming an angle greater than 20° but less than 60°, said V-shaped pleat extending into the container along the entire vertical distance between said top and bottom portions, each said planar wall being connected along the outer edge thereof with one of said flexible side walls, each said planar wall further varying in thickness from a maximum adjacent said corresponding intersection to a minimum adjacent the outer edge thereof,

said opposed flexible side walls being movable toward a first position in which said side walls are

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concaved inwardly in direct contact with the entire inner surfaces of said planar walls and in direct contact with each other over the portions of said flexible side walls extending between said intersections of said planar walls as fluid is withdrawn from the container and toward a second position in which said side walls are convexed outwardly as fluid is introduced into the container.

25. A container as claimed in claim 24, wherein the perpendicular distance between said intersection and the outer edge of each said planar wall is greater than one-tenth but less than one-half the overall lateral width of said container.

26. A container as claimed in claim 24, wherein the lateral length of each said flexible side wall in said first position is equal to the lateral length of said flexible

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side wall in said second position.

27. A container as claimed in claim 26, wherein said flexible side walls and said planar walls are integrally connected by means of a flexible membrane having a radius of curvature substantially greater than the thickness of said flexible membrane.

28. A container as claimed in claim 27, wherein the container is formed of polypropylene.

29. A container as claimed in claim 28, wherein the maximum thickness of said planar walls is greater than 0.012 inches but less than 0.06 inches and the minimum thickness of said planar walls is approximately 0.005 inches.

30. A container as claimed in claim 27, wherein the container is formed of polyvinyl chloride.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,810,503 Dated May 14, 1974
Inventor(s) Dan Lewis, Jr., et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 41, "adminsitration" should read
-- administration --. Column 4, line 41, "embodument" should
read -- embodiment --. Column 5, line 19, "latral" should read
-- lateral --. Column 6, line 34, "vertcal" should read
-- vertical --. Column 7, line 55, "member 80" should read
-- membrane 90 --. Column 8, line 32, "rigidfying" should read
-- rigidifying --. Column 9, lines 18 and 19, "concave"
should read -- concaved --; line 31, after "having" insert
-- a --.

Signed and sealed this 3rd day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents