

[54] DISPOSABLE ASPIRATOR

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[56]

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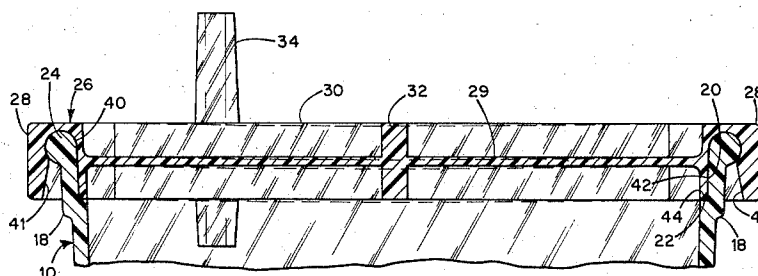
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[57]

ABSTRACT

A vacuum operated fluid collection container incorporates a molded plastic receptacle and a unitary molded plastic lid. The receptacle and lid have mating sealing surfaces which are drawn into sealing engagement when the lid is applied to the receptacle and sub-atmospheric pressure is established in the resulting container. The lid includes stiffening ribs and a diaphragm which cooperate to press the sealing surfaces of the lid into effective sealing engagement when sub-atmospheric pressure is applied. A pair of tubular passages extend through the ribs of the lid, one passage forming a connection to a vacuum source and the other passage providing a fluid inlet leading to the fluid source. The fluid inlet passage includes a spout interior of the container, located near the container wall for directing incoming fluid down the wall of the container to reduce any tendency of the fluid to splash or foam.

9 Claims, 8 Drawing Figures

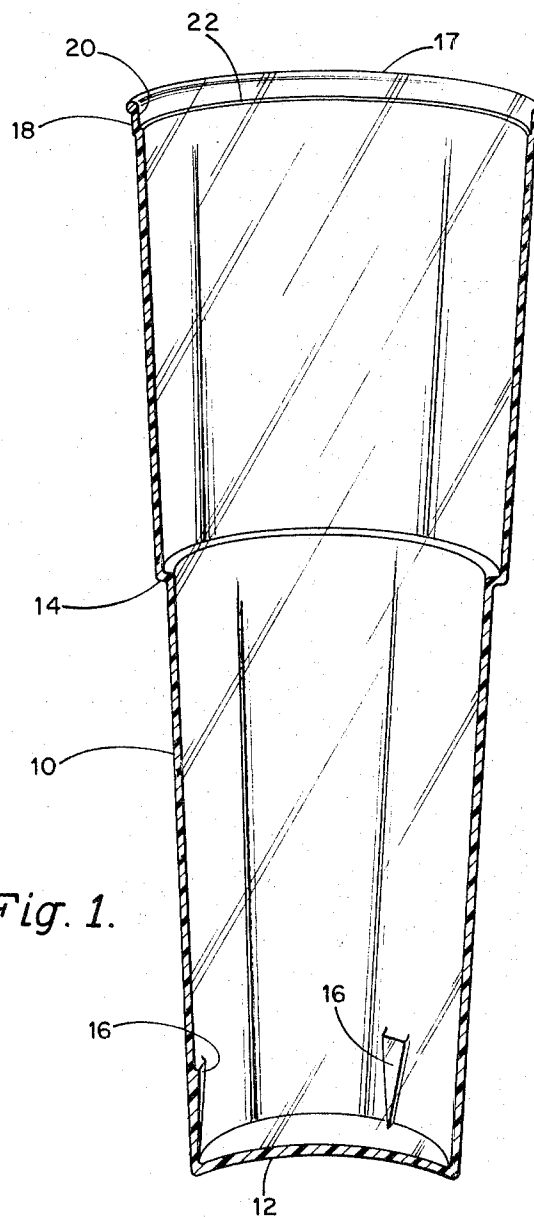


Fig. 1.

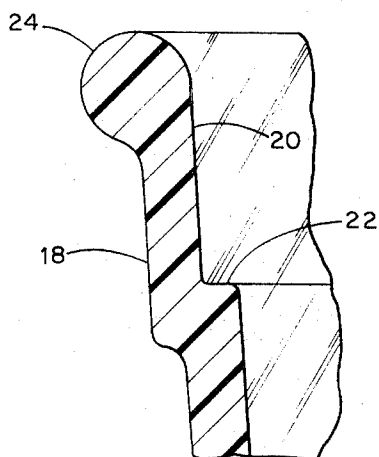


Fig. 2.

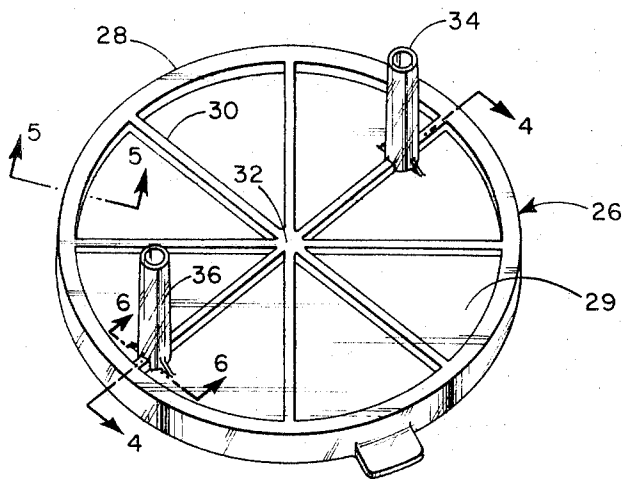


Fig. 3.

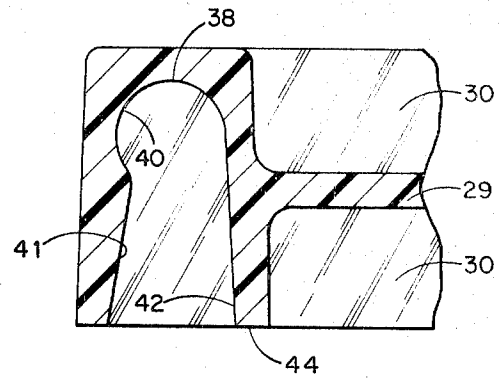


Fig. 5.

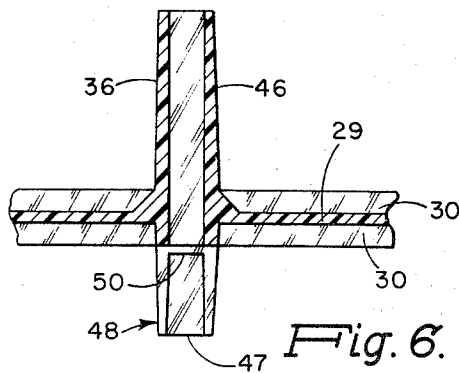


Fig. 6.

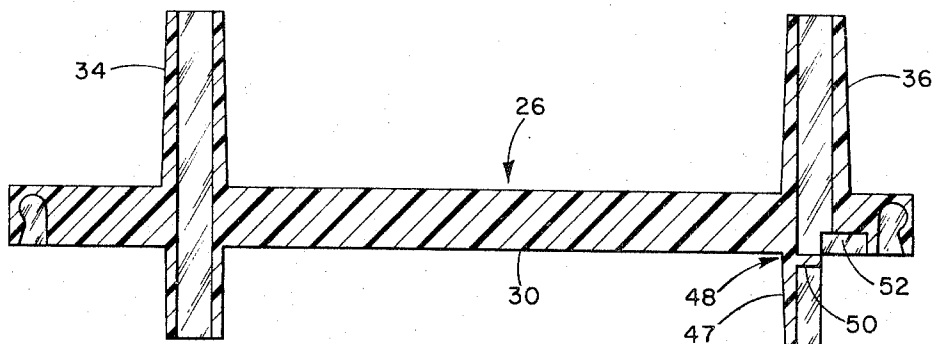


Fig. 4.

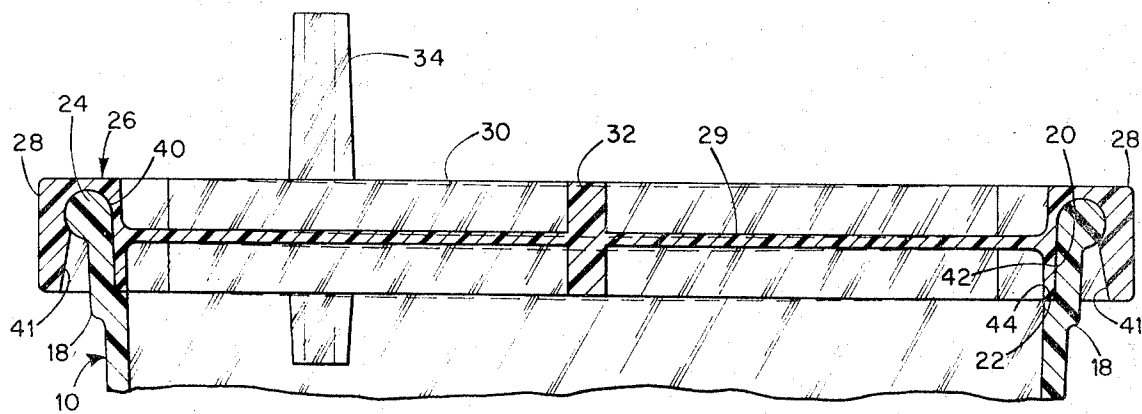


Fig. 7.

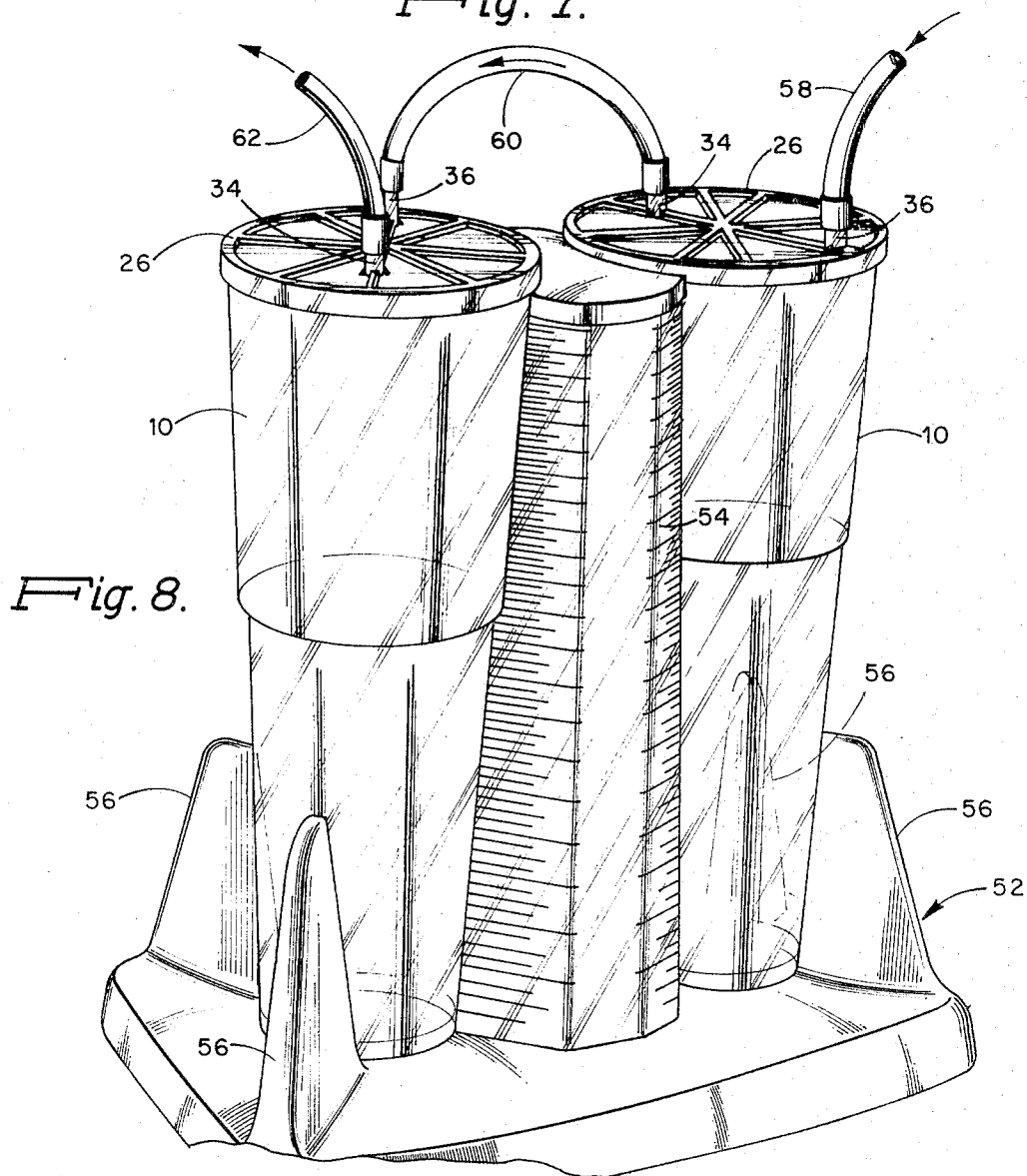


Fig. 8.

DISPOSABLE ASPIRATOR

BACKGROUND OF THE INVENTION

Vacuum filled fluid collection devices have conventionally been reusable. This requires that the apparatus be cleaned after each use and stored. Cleaning and storing is particularly time-consuming, expensive and inconvenient in medical applications where a high degree of cleanliness must be maintained. Accordingly, the need for disposable fluid collection devices has been recognized and recently attention has been directed to their development.

It is a primary object of the present invention to provide a disposable vacuum operated fluid collection device utilizing a minimum of materials and having a highly effective fluid seal between a receptacle and a lid.

It is another object of this invention to provide a vacuum filled fluid collection device wherein the seal between the lid and the receptacle is rendered more secure as the pressure within the fluid collection device is reduced.

It is a further object of this invention to provide a vacuum filled fluid collection device incorporating a minimum of material and having high resistance to implosion.

It is still another object of this invention to provide a vacuum filled fluid collection container having an integrally molded device reducing the tendency of fluids to splash and foam.

SUMMARY OF THE INVENTION

This invention relates to vacuum filled containers wherein a receptacle and a lid have mating sealing surfaces. The receptacle sealing surface lies around the inside surface of the upper portion of the receptacle. The lid has a mating surface which fits down into this upper portion of the receptacle. An abutment extending inwardly from the sealing surface of the receptacle is engageable by a cooperating abutment along the lower portion of the lid to limit movement of the lid into the receptacle. Both the abutment and the upper sealing surfaces are drawn into secure fluid-tight sealing engagement when sub-atmospheric pressure is applied to the container. A plurality of stiffening ribs extend across the container and a flexible diaphragm passes through the ribs so that the diaphragm and the ribs cooperate to force the sealing surfaces into tighter sealing engagement as the degree of vacuum within the container increases. Tubular fluid passages extend through the ribs to provide a connection between the interior of the container and a vacuum source and between the container interior and a fluid source. The fluid inlet tube is preferably located near the receptacle wall and includes a spout extending near the inner surface of the receptacle wall so that fluid entering the container will flow down this inner surface to reduce the tendency of fluid to splash or foam.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of the receptacle;
FIG. 2 is a detailed view of a portion of FIG. 1;
FIG. 3 shows a lid for the receptacle of FIG. 1;
FIG. 4 is a sectional view of FIG. 3 taken along lines 4—4;

FIG. 5 is a sectional view of FIG. 3 taken along lines 5—5;

FIG. 6 is a sectional view of FIG. 3 taken along lines 6—6;

FIG. 7 is a sectional view showing an assembled receptacle and lid; and

FIG. 8 is a perspective view showing a pair of containers connected in series.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to FIG. 1, a preferred embodiment of the receptacle 10 of this invention generally approximates the shape of a truncated cone with circular base. For increasing the strength of the structure, a concave bottom 12 is provided together with an off-set 14 approximately midway between the bottom and the top of the receptacle. Near the bottom of the receptacle, a plurality of inwardly projecting stops 16 limit the extent to which one receptacle can be nested into another for storage. Without the stops 16, nesting of receptacles 10 might result in one receptacle being tightly wedged into another so that separation would be difficult. Adjacent the open end 17, or outer periphery, of the container is a second offset 18 which serves to provide rigidity to the open end and also provides a sealing surface 20 and an abutment 22. The sealing surface 20 and the abutment 22 are shown more clearly in the enlarged view of FIG. 3. Also shown in FIG. 2 is an outwardly turned bead 24 and a slight outward flare of the sealing surface 20. The outward flare of the sealing surface 20 enables a lid 26 to be applied to the container 10 in a more convenient and facile manner than would be possible if the flare were not present.

The lid 26, shown in FIG. 3, includes a sealing ring 28 from which a plurality of stiffening ribs 30 extend and meet in the center 32 of the lid. Extending through one of the ribs 30 is a tubular passage 34 which provides a connection between the interior of the container and a vacuum source. Extending through a second rib 30 of the lid is a tubular passage 36 which connects the interior of the container to a fluid source. FIG. 4 is a cross-sectional view through the lid 26 taken along one of the ribs 30 and illustrates the integrally molded feature of the lid construction.

FIG. 5 is a view through the sealing ring 28 which shows clearly the configuration 38 in the sealing ring 28 for mating with the receptacle 10. The configuration forms a curve 40 along the upper portion thereof which is complimentary to the outwardly turned bead 24. A sealing surface 42 is adapted to lie along the sealing surface 20 in surface-to-surface contact and an abutment 44 formed at the terminal, or innermost, edge of the sealing surface 42 is adapted to mate with the abutment 22 on the receptacle. Depending from the curve 40 is an outwardly flared cam surface 41 for facilitating advancement of the lid over the bead 24. The precise manner in which the lid 26 and the receptacle 10 mate in sealing engagement will be subsequently described.

FIG. 6 illustrates the fluid inlet tube 36 in detail. The tube is located near the edge of the lid to be near the sidewall of the receptacle when the lid is placed thereon. It incorporates an upper portion 46 to which a flexible plastic tube leading to the fluid source may be attached. The lower portion includes a spout 48 with its open face being directed toward the sidewall of the receptacle 10. Across the upper portion of the open

face of the spout 48 is a projection 50 and a cavity 52 which cooperate with the spout to direct incoming fluid against the sidewall of the receptacle.

When the lid 26 is applied to the receptacle 10, the sealing ring 28 is placed over the peripheral edge of the receptacle so that the outwardly flared cam surface 41 engages the outwardly turned bead 24; and lower portion of the sealing surface 42 (i.e., that portion adjacent the abutment 44) engages the portion of sealing surface 20 nearest the peripheral edge of the receptacle 10. Downward pressure is applied to the lid 26. As this occurs, the cam surface 41 deflects outwardly relative to the bead 24 and passes over the bead until the bead is securely mated with the curve 40. Simultaneously, the sealing surface 42 slides tangentially over the sealing surface 20 until the abutment 44 strikes the abutment 22. The sealing surfaces 20 and 42 are then in face-to-face engagement and the abutments 44 and 22 are similarly in engagement. When the lid 26 is first applied to the receptacle, the diaphragm 29 is in a planar configuration and the stiffening ribs 30 are undeflected as shown in solid line in FIG. 7. However, when sub-atmospheric pressure is applied to the container, the diaphragm 29 and the stiffening ribs 30 deflect downwardly as shown in dotted lines in FIG. 7, and the lid is subject to a pressure differential which tends to pull it over the bead 24 and draw it down into the receptacle 10. However, abutments 44 and 22 prevent this and the pressure differential seats the abutment 44 in firm fluid-tight manner against the abutment 22. Deflection of the diaphragm 29 and the ribs 30 press the sealing surface 42 outwardly into firm fluid-tight engagement with the sealing surface 20.

The operation of the container formed by the receptacle 10 and the lid 26 will now be described.

When the lid is installed on the receptacle as described above, the fluid inlet passage 36 is connected to a suitable flexible tube communicating with a liquid source; the passage 34 is connected to a suitable flexible tube connected to a vacuum pump or the like. As the vacuum pump draws a negative pressure in the container, fluid is drawn through the inlet passage 36 from the source and travels past the spout means 48 where it is directed against the inner surface of the receptacle, thence to run down the receptacle's sidewall. Direction of the fluid against the sidewall inhibits any tendency of the fluid to splash or foam. The device is particularly adaptable for use as an aspirator during surgery to remove blood and other body fluids from an open incision. A preferred system for this use is described below in connection with FIG. 8.

In FIG. 8 there is shown a stand 52 for supporting a pair of containers connected in series. Between the containers, a center supporting projection 54 bears indicia to indicate the volume of fluid in either of the containers. The stand further comprises four corner supports 56 which cooperate with the support 54 to securely hold the pair of containers in place.

The series connection of the containers is achieved by connecting a flexible plastic tube 58 from the inlet passage 36 of a first container to a cannula, not shown, for insertion into the open incision; another length of the plastic tube 60 is connected between the passage 34 of the first container and the inlet passage 36 of a second container. The passage 34 of the second container is connected by a third length of plastic tube 62 to a vacuum pump or the like, not shown.

With this configuration, a reserve container is always available for quick change when a container being used is filled. During surgery, the surgeon cannot tolerate a long shut-down of the aspirator. Consequently, when the system is first operating, the container connected to the cannula is first filled. The vacuum is drawn on the container being filled through the second container by the connection 60 between them. When the first container is filled, excess fluid may pour over into the second container; otherwise, the tube 60 is moved from the passage 36 of the second container; then the tube 58 is removed from the passage 36 of the first container and applied to the passage 36 of the second container; in this manner, the second container immediately begins to fill while the filled first container is removed and disposed of. A fresh container is then placed in the stand to replace it and stands ready for subsequent use when needed. When the first container is being thrown away, the end of the tube 60 removed from passage 36 of the second container may be applied to passage 36 of the first container so that the tube 60 forms a closure for the passage through the lid 26 and thereby avoids spillage of the fluid before it is properly disposed of.

The lid 26 and receptacle 10 may be of any suitable material. However, it is preferred that each be a unitary molded plastic unit. One suitable material for the receptacle 10 is crystal polystyrene. Others are polyethylene, polypropylene, and polycarbonate. A suitable material for the lid 26 is linear polyethylene and others are polyvinyl chloride, ionomers, and polyurethane. In a preferred embodiment, the container is disposable. This requires a maximum savings of material, so the thickness of the wall members is reduced to a minimum. It is in this preferred embodiment that the stiffening offset 14 and the offset 18 as well as the concave bottom 12 of the receptacle 10 are particularly advantageous. Similarly, the lid 26 is constructed to minimize the material required in its construction. The diaphragm 20 forms the main cover area of the lid and, for example, may be 0.035 inches thick and extend through the center of stiffening ribs 0.311 inches high and 0.060 inches thick. The sealing ring 28 may be of a height equivalent to the height of the stiffening ribs.

The present invention has been described with respect to preferred embodiments. Those skilled in the art will recognize that changes may be made without departing from the scope of the invention.

We claim:

1. A vacuum operated fluid collection container comprising in combination a receptacle and a unitary mating lid; said receptacle comprising adjacent its open end an abutment extending substantially normal to the receptacle sidewall from the inner surface thereof, wall means extending approximately orthogonally from said abutment; said mating lid comprising peripheral sealing ring means defining a wall complimentary to said receptacle wall means for surface-to-surface contact therewith when said lid is operatively mounted upon said receptacle, a lid abutment at the inner end of said lid wall for engaging said receptacle abutment when said lid is operatively installed upon said receptacle and vacuum applied thereto to prevent said lid from being drawn down into said receptacle, a plurality of stiffening ribs extending inwardly from said sealing ring means, a diaphragm passing through said ribs and intersecting said sealing ring means along a plane substan-

tially parallel to the plane of said lid abutment whereby, when said lid is operatively mounted upon said receptacle and vacuum is applied to said container, said abutments are drawn into firm engagement and said diaphragm deflects downwardly to press said lid wall into sealing engagement with said receptacle wall means.

2. A fluid collection container according to claim 1 wherein said receptacle wall means forms an outwardly turned bead along its outer periphery and said lid comprises an annular recess for mating with said bead, a skirt depending from said annular recess defining an outwardly flared cam surface for facilitating the mating of said annular recess with said bead when said lid is mounted on said receptacle.

3. A fluid collection container according to claim 1 wherein said stiffening ribs extend radially inward from said sealing ring means and intersect at the center of said lid.

4. A fluid collection container according to claim 1 wherein said stiffening ribs are characterized by a height normal to the nominal plane of said lid substantially in excess of their width parallel to the nominal plane of said lid and wherein said diaphragm passes through said ribs along a zone approximately midway their height.

5. A fluid collection container according to claim 4 further comprising at least two tubular passages, each formed integrally with and extending through one said stiffening ribs.

6. A fluid collection container according to claim 1 further comprising at least two tubular passages, each formed integrally with and extending through a stiffening rib.

7. A fluid collection container according to claim 6 wherein one of said passages comprises means for connecting the container interior to a vacuum source and another passage comprises a fluid inlet having an inwardly extending spout closely adjacent the inner surface of said receptacle sidewall for directing incoming fluid against said inner surface to reduce any tendency of the fluid to splash or foam.

8. A fluid collection container according to claim 1 wherein said wall means flares slightly outward from said receptacle abutment and lid wall is similarly flared to mate in surface-to-surface contact with said wall means when said lid is operatively mounted upon said

receptacle.

9. A vacuum operated fluid collection container comprising in combination a receptacle and a unitary mating lid; said receptacle comprising an abutment extending substantially normal to the receptacle sidewall from the inner surface thereof, sealing wall means in a slightly outwardly tapered configuration extending from said abutment and forming an outwardly turned bead along its periphery; said mating lid comprising peripheral sealing ring means defining a lid wall complementary to said sealing wall means for engaging the inner surface of said sealing wall means in surface-to-surface contact when said lid is operatively mounted upon said receptacle, a lid abutment at the inner end of said lid wall for engaging said receptacle abutment when said lid is operatively installed upon said receptacle and vacuum is applied thereto to prevent said lid from being drawn down into said receptacle, an annular recess for mating with said bead, a skirt depending from said annular recess defining an outwardly flared cam surface for facilitating the mating of said annular recess with said bead, a plurality of radial stiffening ribs extending inwardly from said sealing ring means and intersecting a common point in the center of said lid, said stiffening ribs being characterized by a height normal to the nominal plane of said lid substantially in excess of the width parallel to the nominal plane of the lid, a diaphragm passing through said ribs along a plane substantially parallel to and above the plane of said lid abutment, and at least two tubular passages each formed integrally with and extending through one of said stiffening ribs, one of said passages comprising means for connecting the container interior to a vacuum source and another passage comprising a fluid inlet having an inwardly extending spout closely adjacent the inner surface of said receptacle sidewall for directing incoming fluid against said inner receptacle surface to reduce any tendency of the fluid to splash or foam, whereby when said lid is operatively mounted upon said receptacle and vacuum is applied to said container, said abutments are drawn into sealing engagement and said diaphragm deflects downwardly to press said lid wall into sealing engagement with said receptacle wall means.

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