Jan. 15, 1957 O. MUNK 2,777,490

CLOSURE DEVICE FOR FLEXIBLE-WALLED HOLLOW ARTICLES

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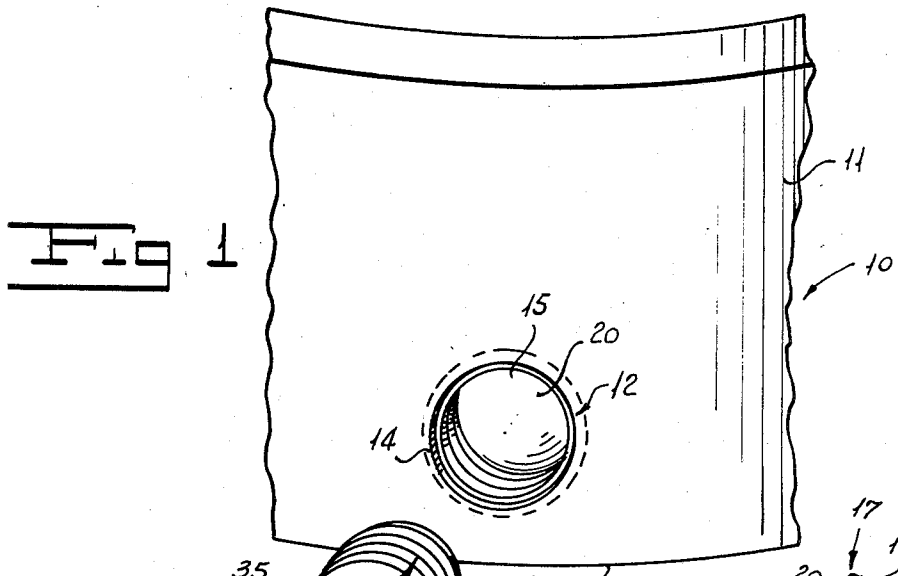
Fig 1



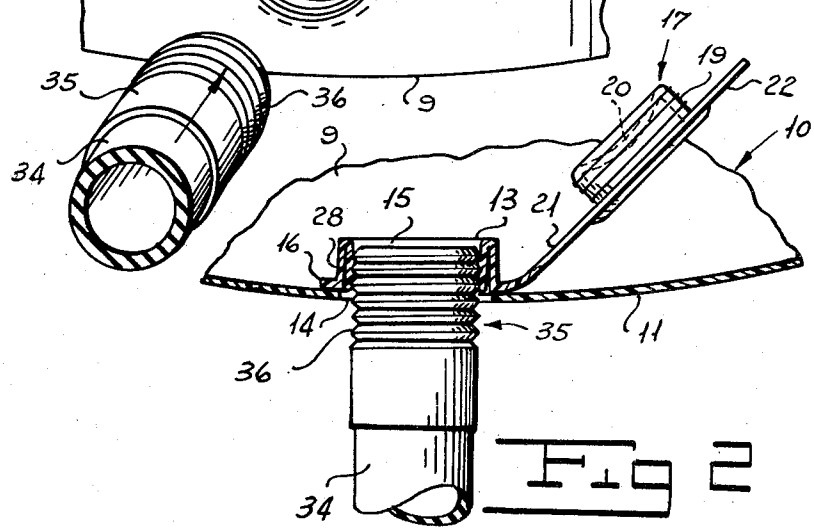


Fig 2

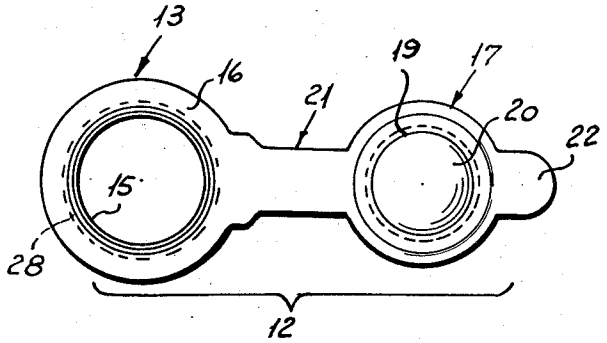


Fig 3

INVENTOR
OTTO MUNK
BY Alfred W. Vibber
ATTORNEY

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Fig 4

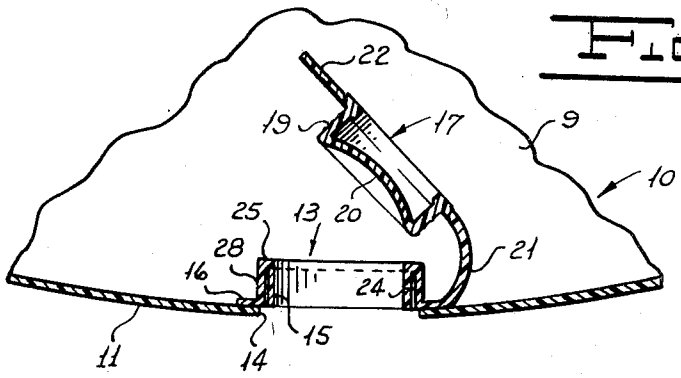


Fig 5

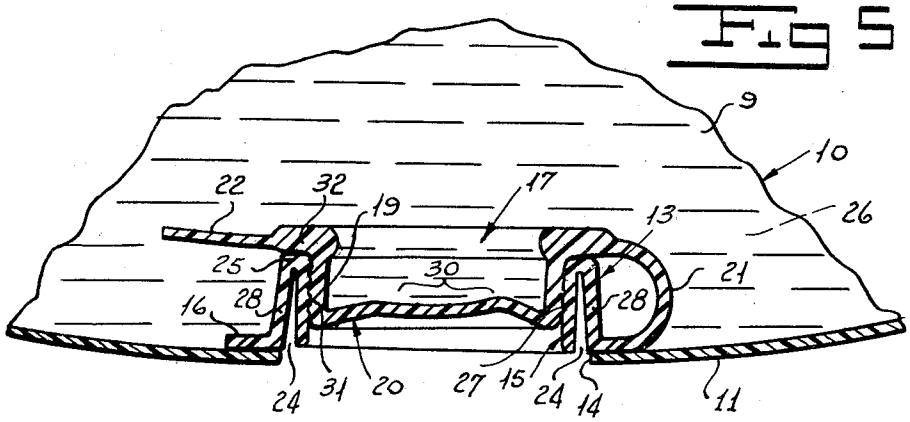
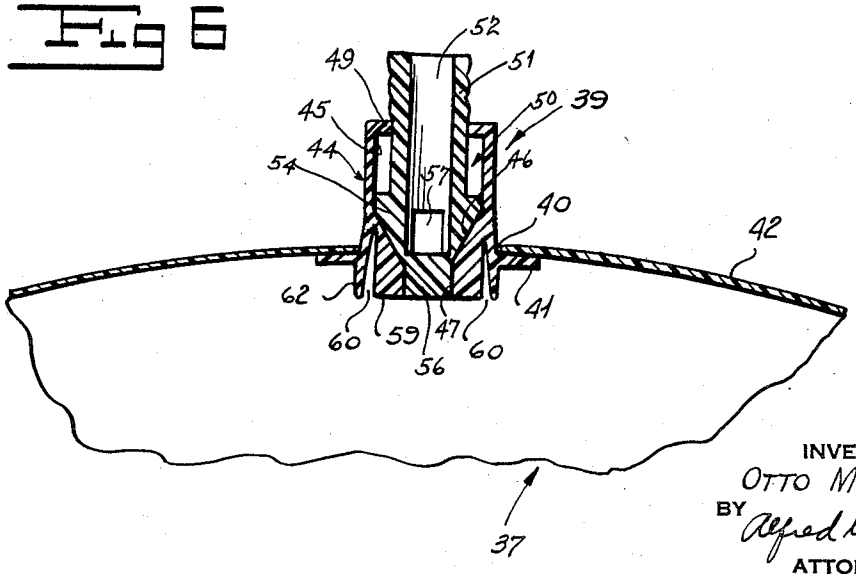


Fig 6



INVENTOR
OTTO MUNK
BY Alfred W. Dibber
ATTORNEY

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2,777,490

CLOSURE DEVICE FOR FLEXIBLE-WALLED HOLLOW ARTICLES

Otto Munk, Packanack Lake, N. J., assignor to Halkey-Roberts Corporation, Paramus, N. J., a corporation of New Jersey

Application October 26, 1955, Serial No. 542,870

5 Claims. (Cl. 150—8)

This invention relates to a closure device for incorporation in the wall of a flexible-walled article, and more particularly relates to a closure device having a body made of flexible plastic material sealed to the thin flexible wall of a hollow article containing fluid under pressure.

The advantages of closure devices wherein both the outer and inner parts thereof are made of flexible plastic material, particularly for sealing openings in flexible thin-walled hollow articles, have been pointed out in Mackal patent application Ser. No. 462,562, filed October 15, 1954. Closures such as the valve of the type there shown and described are particularly of advantage because of their simplicity of manufacture and manipulation, because they do not tend to rust, and because they are yielding and thus do not tend to puncture the wall of a hollow article nor to scratch or injure furniture or other articles with which they may come into contact.

It has been found, however, that in uses wherein the fluid pressure in the hollow article is appreciable, the body of the article of the closure device must be made of a section thicker than otherwise required merely to serve as a support for the movable closure member and to withstand the internal pressure within the hollow article, because of the subjection of the body of the closure device to distorting tensions exerted thereon by the flexible side wall of the hollow article. Such tensions tend to enlarge the body of the closure device at the opening therethrough, usually unevenly, and thus tend to cause the closure device to leak

The closure device of the present invention, which is of the type having an outer closure device body with a passage therethrough, and a movable closure element insertable into the passage to close it, incorporates means interposed between the main portion of the side wall of the hollow article and the body of the closure device which decreases or minimizes the distortion of the body which would otherwise be caused by the tensions exerted thereon by the side wall of the hollow article when the latter is under pressure. Further, such construction tends to even out the enlarging effect upon the opening or passage through the closure body by such tensions exerted thereon, so that the movable closure member can make an effective seal with the body of the closure device.

In the preferred embodiment of the closure device shown there is provided, in effect, a deep pleated annular diaphragm zone surrounding the closure device body and interposed between it and the side wall of the hollow article which is adapted to contain fluid under pressure. The construction is such that the walls of the pleat may separate somewhat under radially outwardly directed tensions exerted thereon by the side wall of the article. The thus formed annular diaphragm zone tends to even out distortion of the body of the closure device, so that the movable closure element may seal the passage effectively. Preferably the location of the attachment of the diaphragm zone to the body of the closure device is markedly spaced from the zone of primary sealing between the body of the closure device and the movable closure element, whereby distortion of the body of the closure device at the primary sealing zone thereof is minimized. Preferably, also, the diaphragm zone is formed integral with the body of the closure device, as by molding or cutting a deep, narrow annular slot into the body of the closure device, to separate the radially projecting flange thereon, by which the body of the closure device is attached to the side wall of the hollow article, from attachment to the body adjacent the zone of primary sealing. The annular slot in the body of the sealing device lies generally coaxial of and is of appreciably greater diameter than the passage in the body, the slot extending from the inner end of the body to a depth well inward of the primary sealing zone. In a preferred embodiment of the device, the outer sleeve or skirt portion thus formed by the annular slot in the body surrounds the inner (as regards the hollow article) portion of the body at the primary sealing zone thereof, the side wall of the hollow article being attached to such outer sleeve or skirt at a location markedly spaced from the inner, free end of the slot. Preferably, connection between the wall of the hollow article and the skirt is effected by a generally radially directed flange which extends outwardly from the skirt at least relatively adjacent its inner free end.

In a first preferred embodiment of the closure device of the invention disclosed herein, the closure device is provided with a captive movable closure element which is normally completely removed from engagement with the body of the closure device when the closure device is open, as for filling the article or for discharging the contents from the hollow article. In the second illustrated preferred embodiment of the device the closure device is a valve wherein the movable valve element is normally not removed from the valve body, but is moved from an inner, closed position to an outer, open, position.

The invention has among its objects the provision of a closure device having a flexible plastic body for incorporation in the side wall of a flexible-walled article, wherein the body of the closure device is substantially relieved of leak-causing distortion produced by tensional forces exerted thereon by the side wall of the hollow article, and to the combination of such closure device and a hollow article in which it is incorporated.

A further object of the invention resides in the provision, with such closure device, of a pleated diaphragm zone which is interposed between the body of the closure device and the side wall of the hollow article in which it is incorporated.

Yet another object of the invention, in a preferred embodiment thereof, resides in the provision of a diaphragm zone close to the body of the closure device, the body of the device forming a part of the diaphragm zone, the peak of the pleat being attached to the body at a location substantially removed from the flange by which the body of the device is attached to the wall of the article and also substantially spaced from the zone of primary sealing between the body of the closure device and the movable closure element thereof.

A still further object of the invention lies in the provision of a novel closure device for a flexible-walled article, such closure device being an integral closure device having a movable closure element removable from the body of the closure device.

The above and further objects of the invention relating to economies of use and manufacture will more particularly appear in the following description of preferred embodiments thereof as shown in the accompanying drawings, in which:

Fig. 1 is a fragmentary view in perspective of a portion of the side wall of a wading pool in the vicinity of a pool-filling and pool-emptying closure device in the wall thereof, the closure device being shown in closed position with an end of a drain hose about to be attached thereto.

Fig. 2 is a fragmentary view in horizontal section through the closure device in the wading pool, the closure device being shown in open position, the body of the device having an end of a draining hose inserted thereinto, the hose being shown in plan.

Fig. 3 is a view in plan of the closure device including the closure body and the movable closure element or plug integrally attached thereto, the device being shown in the as-molded condition.

Fig. 4 is a fragmentary horizontal section through the wall of the wading pool, the body of the closure device, and the closure element, the closure element being shown in open position.

Fig. 5 is a fragmentary horizontal section through the wall of the wading pool filled with water, the closure element of the closure device being shown in closed position.

Fig. 6 is a fragmentary view in section through the wall of an inflated article and through the axis of an inflation valve associated therewith, the valve body having a strain-minimizing flexible diaphragm in accordance with the present invention associated therewith.

As evident from the above, there are shown and described herein two embodiments of container closures. The first such container closure, shown in Figs. 1–5, inclusive, is a device useful, for example, in the filling and draining of hollow articles such as wading pools. In Fig. 6 there is shown a valve useful for inflating and deflating a hollow article such as an air or gas filled ball or toy. Both the closure devices of Figs. 1–5, inclusive, and that of Fig. 6 include a tensional-strain minimizing device interposed between the closure device body and the wall of the hollow article whereby distortion of the body of the closure device is minimized. In both embodiments of the invention shown the bodies of the closure devices are made of flexible plastic material which would otherwise tend to be appreciably distorted by tensional forces exerted thereon by the wall of the hollow article.

The closure device of Figs. 1–5, inclusive, is shown incorporated in a shallow wading pool, generally designated **10**, having a side wall **11** and a bottom **9**. The closure device, which is generally designated **12**, has an annular body **13** which has a central circular opening **15** therethrough. Body **13** has a flange **16** projecting radially outwardly therefrom, the flange fitting within the side wall **11** at the opening **14** therethrough and being connected to the side wall as by being heat sealed thereto. The central opening in the closure body **13** may be selectively closed by the closure element generally designated **17**, which is of a cup-like shape having a generally cylindrical thin flexible side wall **19** and a disc-like transverse end wall **20**. The closure member **12** is preferably molded as an integral element, in the form shown in Fig. 3, wherein the closure body **13** and the closure element **17** are integrally connected by a thin, flexible strap-like member **21**. Member **21** is of sufficient length to allow the closure element **17** freely to be folded around from the position shown in Fig. 4 wherein the closure device is open, into that shown in Fig. 5 wherein the closure element **17** is fully telescoped within the central opening in the body **13** of the closure device. A manipulating tab **22**, projecting from the element **17** opposite the strap like member **21**, facilitates manipulation of the closure element **17** from inside the wall of the wading pool. An annular flange **32**, extending around the inner end of element **17**, limits the depth of insertion of element **17** into the central opening in body **13** of the closure device.

Although it is to be understood that the invention is not restricted thereto, the bodies **13** and **17** and the strap-like member **21** in a preferred embodiment of the closure device are molded from polyvinyl chloride, which is relatively soft and plastic but is sufficiently stiff to be self-sustaining. Other suitable elastic plastic materials may, of course, be used for making the parts of the closure device. The use of polyvinyl chloride is of advantage when the wall **11** of the wading pool is also made of polyvinyl chloride, since the flange **16** of the body of the closure device may then be readily heat sealed to such wall by the use of conventional high frequency electronic sealing apparatus.

When the closure device is in the position of Fig. 5, and the wading pool **10** is filled with water **26**, the wall **11** of the wading pool tends to flex outwardly somewhat and thereby to exert substantial forces in tension radially outwardly on the body **13** of the closure device. Such tensional forces are not uniform around the periphery of the body **13**, tending to be greater in horizontal direction than they are in the vertical direction. Consequently, if the side wall of the wading pool were attached directly to a solid portion or zone of the body **13** in the immediate vicinity of the primary zone of sealing relied upon between the surfaces of the members **13** and **17**, there would be a marked tendency for leakage to occur between such members, even with the parts of the wading pool at rest, because of the difficulties of forming the closure member **17** so as to be complementary to the distorted inner surface of the sealing zone in the body member **13**. Such tendency of the closure member to leak would, of course, be much greater if the wading pool were in use, since the motion of the water and the shifting of weight on the bottom **9** thereof, as children moved about in the pool, would intensify the distortions of the pool wall **11** and of the body **13** of the closure device.

In accordance with the invention there is incorporated in the organization, between the opening in the wall of the hollow body such as the wall **11** of the wading pool and the body **13** of the closure device a flexible diaphragm which tends to isolate the zone of primary sealing of the body of the closure device from the wall of the hollow article, so that the closure element may make an effective seal with the body of the closure device and can maintain such seal regardless of additional unpredictable variable distortions of the wall of the hollow article immediately adjacent the body of the closure device. In addition, there is provided in the closure device of Figs. 1–5, inclusive, a closure element of such structure that it yields to an appreciable extent so that it conforms to the shape of the zone of primary sealing in the body of the closure device and, further, such that the pressure of fluid within the hollow article upon the closure element tends to force it more firmly into sealing engagement with the body of the closure device.

As shown most clearly in Figs. 4 and 5, the side wall of the closure body **13** has an annular slot **24** therein which extends from the outer end of the side wall deeply thereinto, so as to leave a zone of connection **25**, at the inner edges of the inner and outer sleeve portions of such side wall, which is of substantially the same thickness as each of the sleeves. The inner and outer walls **27** and **28**, respectively, of body **13**, formed by the annular slot **24**, and the radial flange **16** attached to the side wall **11** of the hollow article **10**, form in effect, a deep, readily distortable, pleat in a diaphragm-like structure interposed between the side wall of the body **11** and the inner sleeve member **27** of the side wall of body **13**. When tensions are exerted on the flange **16** by the side wall **11** of body **10**, instead of directly distorting the inner sleeve **27** of body **13**, such tensions merely result in pulling the walls **27** and **28** more or less widely apart, thereby spreading the slot **24** from the inner blind end thereof at what is, in effect, the peak of the pleat in the diaphragm, without appreciably distorting the inner, sealing zone providing, sleeve **27** at the body **13**.

The closure element **17** is of such outer diameter that it snugly fits within the central annular opening in the body **13** when both the body and the closure element are

in their relaxed state. The transverse member **20** of closure element **17** is of inwardly convex shape, as shown in Fig. 4, when it is in a relaxed state. The member **20** retains substantially such shape when element **17** is placed in closed position when the body **10** is unfilled with water. When, however, the element is in the position shown in Fig. 5 and body **10** is filled with water to a depth of the closure member, member **20** is subjected to a substantial outward force which tends to straighten out the central portion **30** of member **20**, as shown in Fig. 5. This straightening of member **20** results in a toggle-like action, which tends to thrust the outer rim portion **31** of element **17** more strongly into contact with the confronting annular zone of the wall **27** of body **13**. Such zone **31** of member **20**, herein termed the zone of primary sealing, is positioned well outwardly of the zone **25**, the peak of the pleat, at which the inner edges of the inner and outer sleeves of the side wall portion of the body **13** are joined. Accordingly, as above explained, distortion of the outer sleeve **28** is almost entirely effectively isolated from the sealing zone **31**.

The closure device **12** of Figs. 1–5, inclusive, has the further virtue that it allows the ready connection thereto of a hose to empty the pool **10**. In the embodiment shown, the central opening through the body **13** of the closure device is made of such diameter as snugly and sealingly to receive the threaded end **36** on the ferrule **35** attached to the end of a discharge hose **34**. To empty the wading pool, therefore, it is merely necessary to thrust the end of the hose in the direction shown in Fig. 1 so that the threaded end of the ferrule extends into the central opening in the body **13**. This insertion of the hose thrusts the closure member **17** out of and away from the opening in body **13**, and makes a substantial seal between the hose and the body of the closure device. When it is desired again to fill the pool, this can be done either by placing the filling hose into the opening in the body **13**, and when the pool is filled withdrawing the hose and then applying the closure element manually to the body **13**. Preferably, however, the closure element **13** will be applied to the body **13** to close the latter when the pool is empty, and the pool will be filled from above as by a hose.

As illustrated by Fig. 6, the tension isolating, diaphragm-like annular attaching means interposed between a closure or valve body and the side wall of a fluid containing article is useful in a variety of applications. In this figure there is shown a fragment of an inflated article, such as a ball or toy, having an inflation valve generally designated **39** inserted in an opening **40** in the side wall **42** of such inflated article. The valve is attached to the wall of the article by a radially directed flange **41** which is positioned inwardly of and sealed to the side wall of the article. In such construction, also, as with the closure and drain device above described, the side wall of the inflated article exerts appeciable tension upon the body of the valve, and such tension is not usually uniform even when the parts of the inflated article and of the valve are at rest. The inequality of tensions and the consequent inequality of distortion of the valve body are aggravated when the inflated article is bounced or punched around. In former constructions, wherein the valve body was made of a flexible plastic material and was directly attached to the side wall of the inflated article there was a pronounced tendency of the valve to leak even when it was in fully closed position, particularly if the inflated article were roughly used.

The valve **39** shown in Fig. 6 may be generally of the type shown and described in the above-referred to application of Mackal, Ser. No. 462,562, filed October 15, 1954. Such valve has a body generally designated **44**, which may conveniently be made of a flexible self-sustaining plastic material, such as polyvinyl chloride. Body **44** has a main cylindrical passage **45** extending therethrough, an inner portion of the passage being inwardly tapering and frusto-conical in configuration as indicated at **46**, and the inner end of such passage being of circular cylindrical shape at **47**. Valve body **44** has an inwardly directed shallow flange **49** at the outer end thereof, such flange retaining the movable valve element **50** within the valve body **44**. The element **50** has a hollow stem **51**, through the central elongated opening **52** of which air to inflate the article and discharge it from the article passes. The valve element **50** has a frusto-conical portion **54** thereon which accurately interfits with the frusto-conical seat **46** in the valve body when the valve element is fully inserted therein. At the inner end of the valve element **50** there is provided a central plug-like closure member **56** which preferably is at least somewhat larger than the diameter of the opening **47** in the valve body. The zone of engagement between the plug-like portion **56** on the movable valve element and the small passage **47** in the valve body is that primarily relied upon for the effective closure of the valve. Intermediate the ends of the frusto-conical portion **54** on the movable valve element there is provided a transverse passage **57** thereto which allows communication between the central axial opening **52** in the movable valve element and the interior of the inflated article when the valve element is in its raised, open position as shown in Fig. 6. When the valve element is depressed, so that the plug-like element **56** fits snugly in the opening **47** of the valve body, communication between the interior of the inflated article and the passage **52** in the valve element is shut off.

Although the inner end of the body **44** of the valve is of heavy section, the appreciable tensile forces, especially when the inflated toy is bounced or punched, would distort the valve body sufficiently to tend to cause leakage between the plug-like member **56** and the passage **47** in the valve body, if the side walls of the inflated article were attached directly to the valve body in the vicinity of the passage **47** through the valve body. In accordance with the present invention, such distortion of the valve body by the side wall of the inflated article is obviated, even though the zone of attachment between the valve body and the wall of the inflated article lies physically adjacent the passage **47** in the valve body. In accordance with the invention, the heavy inner portion **59** of the valve body is provided with an annular generally cylindrical slot **60** which extends from the inner end of the valve body to an appreciable depth, the inner end of the slot lying substantially outwardly of the outer end of the passage **47** in the valve body. The slot **60** thus, in effect, divides the lower heavy section **59** of the valve body into two concentric sleeve portions, the outer sleeve or skirt portion **62** serving as the support for the radially outwardly directed flange **41** to which the side wall **42** of the inflated article is attached.

In this construction, as with that of Figs. 1–5, inclusive, forces in tension directed on the valve body by the side wall **42** of the inflated article are substantially effectively isolated from the zone of primary sealing of the valve between the plug-like member **56** and the inner wall of the passage **47**. The flange **41**, the outer sleeve or skirt portion **62**, and the inner sleeve-like portion of the valve body bearing the surface **47** form, in effect, a deeply pleated diaphragm which is interposed between the side wall of the inflated article and the zone of primary sealing of the valve. The peak of the pleat, at the blind end of annular slot **60**, lies remote from the passage **47**. When, therefore, the article **37** is inflated under appreciable pressure, any tensional forces exerted on the valve body by the side wall **42** of the article tend to distort such body. Such distortion, however, is concentrated in the outer skirt portion **62**, the inner end of the annular slot **60** in the valve body tending to grow wider. Such distortion of the skirt, however, can not be directly transmitted to the primary sealing surfaces

of the valve, and when the article is subjected to momentarily increased pressures, as by being punched or bounced, the increased distortion of the valve body is concentrated primarily in the outer skirt portion **62**, leaving the portions **56** and **47** substantially undistorted so that they maintain a tight seal at all times.

Although for purposes of illustration I have shown preferred embodiments of the closure device for flexible-walled hollow articles of the invention, it will be understood that such embodiments are illustrative only, since the invention is capable of considerable variation as to details. The invention is, therefore, to be defined by the scope of the claims appended hereto.

I claim as new the following:

1. A closure device adapted for incorporation in the wall of a flexible-walled hollow article adapted to retain fluid under pressure, comprising an annular body, the body having a passage therethrough, a movable closure member adapted to fit within such opening to close it by being applied to the opening, the closure member comprising a cup-like body of plastic material having a relatively thin flexible side wall and a thin flexible disc-like end member distortable by normal pressures within the article, the end member when lying within the opening and not subjected to appreciable outwardly directed pressure being dished so as to present its convex side to the interior of the hollow article.

2. A closure device adapted for incorporation in the wall of a flexible-walled hollow article adapted to retain fluid under pressure, comprising an annular body, the body having a passage therethrough, a movable closure member adapted to fit within such opening to close it by being applied to the opening from within the article, the closure member comprising a cup-like body of plastic material having a relatively thin flexible side wall and a thin flexible disc-like end member distortable by normal pressures within the article, the end member when lying within the opening and not subjected to appreciable outwardly directed pressure being dished so as to present its convex side to the interior of the hollow article.

3. A closure device adapted for incorporation in the wall of a flexible-walled hollow article adapted to retain fluid under pressure, comprising an annular body molded of flexible plastic material, the body having a passage therethrough, a movable closure member molded of flexible plastic material and adapted to fit within such opening to close it by being applied to the opening from within the article, the annular body and the closure member of the closure device being integrally connected by a flexible molded strap member, the closure member comprising a cup-like body having a relatively thin flexible side wall and a thin flexible disc-like end member distortable by normal fluid pressures within the article, the end member when lying within the opening and otherwise relaxed being dished to as to present its convex side to the interior of the hollow article.

4. A closure device adapted for incorporation in the wall of a flexible-walled hollow article adapted to retain fluid under pressure, comprising a double-walled annular body of flexible plastic material and having an inner sleeve with a central circular opening therethrough and an outer sleeve connected to the inner sleeve at the edges of the sleeves adapted to lie inwardly of the article, the outer edges of the sleeves being unconnected to each other, a movable closure member adapted to fit within the opening in the inner sleeve to close it by being applied to the opening from within the article, the closure member comprising a cup-like body of plastic material having a relatively thin flexible side wall and a thin flexible disc-like end member distortable by normal fluid pressures within the article, the end member when lying within the opening being spaced appreciably outwardly of the joined inner edge of the sleeves, the end member when lying within the opening and otherwise relaxed being dished so as to present its convex side to the interior of the hollow article, and means adapted sealingly to connect the free end of the outer sleeve of the body to the wall of a hollow article.

5. The combination comprising a flexible-walled hollow article, a closure device incorporated in the wall of said article, said closure device comprising a double-walled annular body of flexible plastic material and having an inner sleeve with a central circular opening therethrough and an outer sleeve connected to the inner sleeve at the edges of the sleeves lying inwardly of the article, the outer edges of the sleeves being unconnected to each other, a movable closure member adapted to fit within the opening in the inner sleeve to close it by being applied to the opening from within the article, the closure member comprising a cup-like body of plastic material having a relatively thin flexible side wall and a thin flexible disc-like end member distortable by normal fluid pressures within the article, the end member when lying within the opening being spaced appreciably outwardly of the joined inner edge of the sleeves, the end member when lying within the opening and otherwise relaxed being dished so as to present its convex side to the interior of the hollow article, and a generally radially directed annular flange connected to the outer end of the outer sleeve and sealed to the wall of the hollow body at a closure device-receiving opening in the latter.

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