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(54) Title: BARREL WITH A LID AND CLAMPING RING CLOSURE

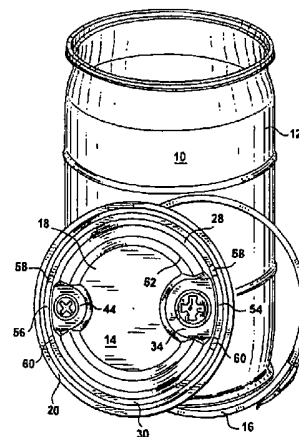
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(57) Abstract

The invention concerns a barrel (10) with a lid (14) and clamping ring closure (16). The lid (14) comprises between a flat lid plate (18) and the outer lid edge (20) a peripheral groove (30), and is equipped with at least one lateral plug hollow or plug-hole opening (34, 44). If the barrel falls, the regions around the plug hollow (34, 44) are most at risk of breakage and it is there that the lid (14) has the greatest tendency to come out of the clamping ring (16), resulting in leakages. The object of the invention is to improve leaktightness in cases of extreme stress of a lidded barrel (10) which is in particular also suitable or permissible for holding hazardous fluids so that the stress can be relieved in the region about the plug hollow (34, 44) in the lid (14) in the event of overstressing (if the barrel falls). To that end, appropriate means are provided between the lower-lying plug hollow (34, 44) and the upper edge (32) of the downwardly open, outer U-shaped edge (20) of the lid (14). These means are such that the radial expansion lengths - measured between the mid-point of the lid and the upper edge (32) of the U-shaped lid edge (20) - of this lid region or segment are extended in comparison with the adjacent lid regions or segments outside the plug hollow (34, 44).

(57) Zusammenfassung

Die Erfindung bezieht sich auf ein Deckelfaß (10) mit Faßdeckel (14) und Spannringverschluß (16). Der Faßdeckel (14) weist zwischen flacher Deckelscheibe (18) und äußerem Deckelrand (20) eine umlaufende Nut (30) auf und ist mit wenigstens einer seitlich angeordneten Spundmulde bzw. Spundlochöffnung (34, 44) ausgestattet. Bei einem Faßabsturz sind die Bereiche um die Spundmulde (34, 44) am meisten bruchgefährdet bzw. zieht sich dort der Faßdeckel (14) am ehesten aus dem Spannring (16) heraus mit der Folge von Undichtigkeiten. Um die Dichtigkeit eines insbesondere auch für gefährliche flüssige Füllgüter geeigneten bzw. zugelassenen Deckelfasses (10) in Extrembelastungsfällen zu verbessern, soll in dem Bereich um die Spundmulden (34, 44) des Faßdeckels (14) eine Spannungsentlastung bei Überbeanspruchung (Faßabsturz) erfolgen. Dazu sind zwischen der tieferliegenden Spundmulde (34, 44) und der oberen Stirnkante (32) des äußeren, nach unten offenen, U-förmigen Randes (20) des Faßdeckels (14) entsprechende Maßnahmen derart vorgesehen und ausgebildet, daß die radialen Dehnungslängen - gemessen vom Deckelmittelpunkt bis zur oberen Stirnkante (32) des U-förmigen Deckelrandes (20) - dieses Faßdeckelbereiches bzw. Faßdeckelsegmentes im Vergleich zu den benachbarten Faßdeckelbereichen bzw. Faßdeckelsegmenten außerhalb der Spundmulde (34, 44) verlängert ausgebildet sind.



Abstract (Fig. 5)

The object of this invention is a lidded barrel with a barrel lid and a clamping-ring closure. Between its flat lid plate and its outer rim, the barrel lid is provided with a circular, perimetric groove while also featuring in its periphery at least one bung well with or without bunghole. When a barrel is dropped, the areas around the bung well are most vulnerable to breakage, i.e. it is there that the barrel lid is most likely to slip out of the clamping ring, with leaks being the consequence.

In order to improve leak resistance of a lidded barrel, especially one suitable and approved for hazardous liquids, under extreme stress-load conditions, the area around the bung wells of the barrel lid is to be stress-relieved in the event of overstress (dropped barrel).

This is to be accomplished by making and incorporating between the recessed bung well (34, 44) and the upper edge (32) of the outer, inverted-U-shaped rim (20) of the barrel lid (14) suitable provisions whereby the radially linear extensions -- as measured from the center of the lid to the upper edge of the U-shaped rim (20) -- of this area or segment of the barrel lid are elongated in relation to the neighboring areas or segments of the barrel lid away from the bung well (34, 44).



Lidded Barrel with Barrel Lid and Clamping-Ring Closure

The object of this invention is a lidded barrel for the storage and transportation especially of hazardous bulk materials in particulate, paste or liquid form, consisting of a cylindrical or cone-shaped lidded barrel body with an upper, radially asymmetrical barrel lid and a U-shaped clamping-ring closure which in the area of the upper barrel opening hooks under a flanged rim provided on the outer barrel wall while gripping the outer U-shaped rim of the barrel lid and, when in the closed position, pressing it against the barrel opening for a closure impermeable to gas and liquids, the barrel lid featuring between its flat top and its outer rim a circular groove (e.g. a groove for the grippers of barrel hoists) and at least one peripherally located, recessed bung well (i.e. bung enclosure) including, as the case may be, a bunghole with gas-tight and impermeable stopcap.

The problem: This invention is based on the realization that with this type of radially asymmetric barrel lid peripherally provided with at least one bung well and, as the case may be, a bunghole incorporated therein (for instance a 2" filling/draining bunghole on one side and/or a 3/4" venting/bunghole in the opposite peripheral area), the adjoining areas around the bung well or the transitions between the normal barrel-lid top level and the bung well are most vulnerable to impact, i.e. breakage-prone in the event the barrel is dropped and are the most likely to develop material overstress with attendant cracks and leaks. The same is true for barrel lids which are provided with bung wells but not with bungholes and fittings or spouts.

In cases of extreme stress such as internal-pressure tests, diagonal or lateral (side-wall) drop tests involving a barrel lid attached to a corresponding lidded barrel by means of a clamping ring, local overstress in the areas most strongly dented and thus most exposed to tensile stress plus substantial superimposed bending stress will cause these areas to be the first where the rim of the lid slips out of the upper part of the clamping ring, rendering the lidded barrel leaky. Especially barrel lids made of a thermoplastic material (hard plastic) will often crack and break in these areas even though they remain attached to the rim of the barrel body. The areas of the barrel lid which include the peripheral, recessed bung wells (perhaps even with a raised spout) are usually more rigid and inelastic than regular peripheral areas of barrel lids not containing bung wells.



A very significant reason for the breakage and cracking in the immediate area of the recessed bung well addressed in this invention, is the pressure in such radially asymmetrical barrel lids of differentiated linear extensions or surface lengths. The linear extensions are measured from the centre point of the lid to the upper, horizontally level edge of the outer inverted U-shaped rim of the lid that opens towards the bottom. It is in these very recessed bung wells that the linear extensions are relatively shorter. This is true even so in the case of barrel lids with a second circular corrugation which is interrupted by the bung enclosure. When there is an increased internal-pressure test, shorter linear extensions in the area of the bung well will expose this area to greater stress (ovalisation) and may cause a leak. The barrel lids as well as the lidded barrel bodies may consist of a thermoplastic material and/or metal (sheet iron).

It is an advantage of this invention to overcome these shortcomings of the current state of the art, improving the integrity in the extreme stress situations especially of a lidded-barrel suitable, approved and used in hazardous liquid materials. This is also accomplished by relieving the stress in the area around the bung well of the barrel lid.

Summary of the invention

This invention is a lidded barrel for storing and transporting hazardous, liquid or solid bulk materials, comprising a cylindrical or conical barrel body, having an open top provided with a flanged rim, an asymmetrical barrel lid having an inverted U-shaped rim and a U-shaped clamping-ring closure to hook under the flanged rim of the barrel and over outer rim of the barrel lid and, in the closed position to press the lid against the barrel to create a closure impermeable to gas and liquids, wherein

the barrel lid includes a central flat area and, between the central flat area and the rim at least one recessed circular perimetric groove, and

at least one bung well for a gas- and liquid-sealable bunghole positioned in the periphery of the central flat lid area, and,

between the bung well and the rim formations are provided such that the length measured along the surface of the lid from the centre radially to the upper edge of the rim is longer in sectors that include a bung well relative to the length measured for other sectors.



As a result of these provisions on the barrel lid, areas surrounding a bung well will no longer display the traditionally extreme stress peaks and thus will no longer be the most likely location of leaks or cracks.

A circular perimetric groove may be provided on the barrel lid that
 5 varies in depth being deeper in front of or adjacent to the bung well than away from the bung well.

The length measured along the surface of the barrel lid from the center radially to the upper edge of the rim may be identical in areas that do not include the bung well.

10 Given these identical lengths, the lid areas around the bung wells will not be subjected to greater stress loads than the remaining lid areas, or at least significantly less so than without this compensating measure. Thus, the rim of the lid will no longer slip out of the clamping ring, or indeed break, more readily near areas that include the bung wells as has traditionally been the
 15 case in prior art.

Optionally, the barrel lid areas that include the transitions in depth of the circular perimetric groove, being deeper in areas in front of the bung well than away from the bung well, is formed by a flat sloped connecting element. The length of the sloped connecting element, measured in the circumferential
 20 direction, could be about 20 mm to 80 mm, and preferably about 60 mm.

The barrel lid areas that include the transitions in depth of the circular perimetric groove, being deeper in areas in front of the bung well to the regular, shallower depth away from the bung well, could be formed by a continuous transitional gentle slope that extends over a length 90° relative to
 25 the bung well. This permits further significant reduction of the stress peaks in the relatively stiff areas traditionally found in front and around bung wells. The clustering of stress peaks will now take place in the comparatively uncritically stressed lid areas away from the bung wells.

In a further enhancement of the invention, the length measured in the
 30 circumferential direction of the barrel lid area that contains the deeper depth of the circular perimetric groove is approximately equal to the width of the bung well.

The lidded barrel with a capacity of about 220 L (55 gal.) utilising the barrel lid with a lid diameter of about 560 mm, the difference in depth of the
 35 recessed groove between the deeper depth in front of the bung well and



regular depth away from the bung well may be between about 5 mm and 15 mm, and preferably about 7 mm.

The lidded barrel with a capacity of about 120 L (336 gal.) utilising the barrel lid with a diameter of about 460 mm, the difference in depth of the recessed groove between the deeper depth in front of the bung well and regular depth away from the bung well may be between about 2 mm and 12 mm, and preferably about 6 mm.

The lidded barrel may include a second continuous or partly continuous recessed groove in the periphery of the lid serves as an expansion channel. This second recessed groove improves the flexibility and resilience of the barrel lid in both the radial and axial direction especially in an internal pressure test.

The length measured in the radial direction along the surface of the barrel lid in areas not including the bung well could be predefined by means of specific angle of inclination of the conical or rounded circular elements that create the sidewalls of the perimetric circular groove or any recessed groove provided on the barrel lid.

The deeper depth of the recessed groove or the variation of the angle of inclination of the barrel lid's recessed groove sidewalls may be implemented in only the recessed groove which has the larger diameter or can be implemented in both the circular perimetric groove having the larger diameter and the second recessed groove having the smaller diameter.

Optionally, the length measured in a radial direction along the surface of the barrel lid may be greater in areas in front of and/or adjacent to the bung well, than in areas away from the bung well. Further, the barrel lid areas that include the transitions in depth of the groove, being deeper in areas in front of the bung well to the regular, shallower depth away from the bung well, may be continuously gradual without steps and may extend over a length 90° relative to the bung well.

The circular perimetric groove of the barrel lid has a width measured in a radial direction of between 8 mm and 25 mm, and preferably about 15 mm, and on the underside of the lid the deepest edge of the recessed groove closest to the rim may connect to the outer rim at a point on the side of the rims rising circular element which also extends axially downward into the mouth of the barrel when the lid is mounted on. Also on the underside of the barrel



lid, the deepest edge of the circular perimetric groove may connect to the central lid plate or expansion groove at a point on the side of a rising, rounded circular element, which may also extend axially downward into the mouth of the barrel when the lid is mounted.

- 5 The length of the axial extension, as measured on the underside of the barrel lid from the deepest point of the circular perimetric groove, may be between 8 mm and 30 mm, and preferably about 14 mm.

- 10 Optionally, the length of the axial extension closest to the rim of the barrel lid is greater than the length of the axial extension closest to the center of the lid. The length of the axial extension as measured on the underside of the barrel lid from the deepest point on the recessed groove, may be between 8 mm and 30 mm, and preferably about 18 mm for the extension closest to the rim of the lid, and, the axial extension closest to the center of the lid may be between 8 mm and 20 mm, and preferably about 12 mm.

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The following describes and explains this invention in more detail with the aid of design examples schematically illustrated in the attached diagrams in which:

- Figure 1 is a partial, sectional view of the upper right end of a lidded barrel according to this invention, with a perimetric i.e. circular groove in the rim of the barrel lid;
- Figure 2 is a top view of the lidded barrel per fig. 1;
- Figure 3 is a schematic lateral view of a conventional thermoplastic lidded barrel at the moment of a lateral impact (dropped sideways) on the ground;
- Figure 4 is a front view of the conventional thermoplastic barrel per fig. 3 at the moment of the said lateral impact on the ground;
- Figure 5 is a perspective view of another lidded barrel according to this invention, showing next to it the detached barrel lid and the clamping ring;
- Figure 6 is a top view of the barrel lid with clamping ring per fig. 5;
- Figure 7 shows a modified barrel lid with bung wells but without bung openings;
- Figure 8 is a top view of another barrel lid according to this invention;
- Figure 9 shows a cross section of the barrel lid per fig. 8 away from the bung wells;
- Figure 10 shows a cross section of the barrel lid per fig. 8 through both bung wells;
- Figure 11 is a top view of another barrel lid according to this invention;
- Figure 12 shows a cross section of another, modified barrel lid;
- Figure 13 shows a partial cross section of another, modified barrel lid; and
- Figure 14 shows a cross section of the barrel lid per fig. 11 through both bung wells.

In figure 1, the number 10 refers to a lidded barrel according to this invention, with a barrel body 12, a mounted barrel lid 14 and a clamping ring 16. The barrel lid 14 incorporates a central, flat lid plate 18 and a U-shaped lid rim 20 opening up toward the bottom, with an outer circular element 22 and an inner circular element 24. The U-shaped rim 20 holds a circular gasket 26 which, when the clamping ring 16 is tightened, seals the barrel lid 14 in gas- and liquid-impermeable fashion against the upper mouth edge of the barrel-body opening. The central lid plate 18 is connected, via a downward-tapered circular element 28, to the inner circular element 24 of the U-shaped rim 20 in such fashion that between the tapered or rounded circular element 28 and the inner circular element 24 of the U-shaped rim, partly extending into the opening of



the barrel body, a circular gripping groove 30 is created. In the regular areas of the lid (away from the bung wells and away from the residue-draining slope), the gripping groove 30, roughly wedge-shaped in this case, should have a depth of not less than 15 mm as measured from the groove base to the upper edge 32 of the U-shaped rim 20. To provide internal support pressure for stacking purposes, the central, flat lid plate 18 protrudes by about 6 to 12 mm beyond the upper edge 32 of the rim of the lid. The peripheral area of the flat lid plate 18 incorporates a recessed bung well 34 with a projecting bung spout 36 and a bunghole 38. The upper leg of the clamping ring 16 reaches around a radially projecting rim flange 46 of the lid, located at the bottom edge of the outer circular element 22 of the lid rim 20, while its lower leg reaches around a casing flange 48 positioned on the outside wall of the barrel body 12 at a certain distance of about 40 mm below the barrel opening, pressing the barrel lid 10 against the barrel opening in gas- and liquid-impermeable fashion. This method of attaching the barrel lid using a clamping ring in a lower position corresponds to the barrel lid developed by Mauser in 1975 for the globally known and employed "standard lidded barrel". In the case at hand, the lidded barrel 10 is provided with an inserted, thin-walled Inliner 50 (foil liner).

As is more clearly shown in figure 2, the flat lid plate 18 is provided beside the bung well 34 with a symmetric plane or slope 40 for easiest possible draining of residual material from the lidded barrel in slightly tilted upside-down position. In this case, a stopcock is screwed into the 2" bunghole spout and, covering both, a seal-off cap 42 is snapped on. On the opposite side of the barrel lid 14, likewise recessed into a bung well 44, is a second smaller 3/4" bunghole, itself covered by a seal-off cap 42'. According to this invention, the groove base of the gripping groove 30 is deeper in the area in front of the bung wells 34, 44 than in the neighboring areas away from the bung wells 34, 44 outside the slope 40. Several barrel-lid segments are marked to show this more clearly. The lid segments a, b and b' are symmetrical. The lid segments c and c' directly in front of the bung wells 34, 44 are of different circumferential lengths corresponding to the width of the bung well 34 and 44, respectively, and their groove base is deeper. The lid segments a, by contrast, define the area with a regular depth of the groove base while the segment areas b and b' define the transitional sections from the regular depth to the greater depths of the groove base in front of the bung wells. To explain the deformation process in the case of lateral impact (i.e. when dropped sideways), figure 3 illustrates in a schematic lateral view a lidded barrel, where the solid lines indicate the normal contour and the dashed lines indicate the maximum-deformation.



condition at the moment of impact on the ground. Figure 4 is a front view of the lidded barrel. The points critical for the liquid-impermeable integrity and unity of the barrel body, barrel lid and clamping ring are marked A (fig. 3), C and D (fig. 4). The largest axial deformation of the lid occurs in the area of point A. The flattening along C-A-D produces strong radial inward tensile stress in the exterior areas C and D. In these two areas, the barrel body, i.e. the rim of the barrel body to which the lid is attached by means of the clamping ring, also wants to expand strongly in a radial direction; this, too, creates strong outward tensile stress at the rim of the barrel body. Due to the maximum bending force on the lid superimposed at this point and the high tensile stress patterns working in the opposite principal directions it follows virtually as a matter of course that in the case of overstress it is first and foremost at a point like this that the barrel lid comes off, i.e. the outer rim of the lid slips out of the upper leg of the clamping ring.

In a diagonal drop, i.e. the oblique impact of the lid rim and clamping ring on the ground, the main stress on the lid is in the area 180° from the point of impact due to the overlaying of radial and axial tensile stress forces, in that the barrel body and lid are abruptly stopped in their movement while the contents of the barrel want to continue moving in the direction of the drop (surge pressure). At that point the lid will buckle strongly in the axial direction, reducing its diameter and causing its rim to be pulled out from under the upper part, or leg, of the clamping ring.

The elasticity of a barrel lid can be improved by providing an additional circular expansion groove in the perimeter area of the central lid plate, elongating the radial linear extensions; however, this enhancement of the linear extensions must exclude the bung areas so that these areas, having shorter linear extensions while being more rigid by virtue of the bung-spout material, are the trouble spots in the case of extreme bending stress.

The measures provided by this invention permit a precise selection of the linear extensions in the barrel lid. On the one hand, identical linear extensions may be selected throughout so as to truncate stress peaks and obtain a specific stress relief in the areas of the bung enclosures; on the other hand, intentionally nonuniform linear extensions can be selected so that for the lid segments c and c', incorporating the bung enclosures, longer linear extensions are present than



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for instance in the lid segments a, offset by 90°, in such fashion that the highest stress loads are shifted into these uncritical, highly elastic lid areas.

Figure 5 shows another lidded barrel 10 with the barrel lid 14 and clamping ring 16 detached. The barrel body 12 is equipped in its central cylindrical area with two protruding rolling hoops and at the transition between its side wall and the barrel bottom with a massive, perimetric bottom-rolling hoop. Directly behind its rim 20, the barrel lid 14 features the circular gripping groove 30, and near the perimeter of the flat central lid plate 18 another circular expansion groove 52 with a V-shaped cross section. This expansion groove 52 is interrupted only by the two mutually opposite, peripheral bung wells 34, 44. In the area of these two bung wells 34, 44 the outer gripping groove 30 is deeper than in the other rim areas away from the bung wells. The lower-lying sections 54, 56 (segments c, c') with the adjoining sloped sections 58, 60 (segments b, b') transitioning to the higher groove base level (segment a) are clearly discernible.

Figure 6 is a top view of the barrel lid design per fig. 5, with the clamping ring 16 mounted. Figure 7 shows a similar barrel lid 14' with circular gripping groove 30 and circular expansion groove 52 incorporating the bung wells 34, 44, albeit without the bung spouts and bungholes. Here as well, the concept of a deeper groove base in the gripping groove in front of the bung wells is implemented. For instance, if customers want a lid without bunghole, as shown in fig. 7, such a lid can be produced in the same injection mold as the lid per fig. 6. One simply mounts two corresponding blanks or dummy inserts in the mold. No second, expensive injection mold for lids without a bunghole is necessary.

For simplicity's sake, the following additional barrel-lid design examples will use the same reference numbers where the components are identical.

Figure 8 illustrates a liquid-impermeable barrel lid 10 which, in a special design version, is provided with a flat groove base, about 16 mm wide, in the outer circular gripping groove 30. Connecting to the inverted U-shaped rim 20, with a short outer leg (i.e. circular element 22) and an inner leg (circular element 24) which in this design version is stepped or configured as a shoulder, is the shallow groove base of the gripping groove 30. From the groove base, the inner



side wall of the gripping groove 30 rises as a tapered or rounded circular element 28 up to the level of the central flat lid plate 18. The angle of inclination of this sloped side wall is about 55° . For a precise selection of the linear extensions in the various lid segments the angle of inclination of the conical or obliquely rounded circular elements (i.e. side walls of the grooves) may be varied, i.e. preselected, in the range between 30° and 70° . Located in the peripheral area of the raised central lid plate 18 are the two diametrically opposite bung wells 34, 44. The recessed bung well 34 incorporates the protruding bung spout 36 with the 2" bunghole while the smaller bung well 44 incorporates the smaller bung spout with a $3/4$ " bunghole. Also located in the peripheral area of the central lid plate 18 is the second partially circular groove 52 serving as a V-shaped expansion groove the circular path of which is interrupted by the bung wells 34 and 44 while its groove base transitions flush into the bottom plane of these two bung wells. The outer, obliquely conical or rounded side wall of the expansion groove 52 bears the reference number 62, its inner side wall the number 64. The angle of inclination of both sidewalls 62 and 64 is about 45° , resulting in an opening angle of about 90° for the expansion groove 52. Of course, depending on the desired linear extension, these angles of inclination may be varied and adapted as necessary. For example, a sidewall may rise at a varying slope, with continuous, gradual transitions between the different slope angles. As can be seen in fig. 8, an essentially V-shaped circular element 66 (i.e. a ridge), open toward the lid underside, rises between the two grooves 30 and 52, its outer boundary constituted by the inner conical sidewall of the gripping groove 30 and its inner boundary by the outer conical sidewall of the expansion groove 52. It can also be seen that both sides of the lower-lying section 54 of the gripping groove in front of the bung well 34 bound on the sloped connecting sections 58, and both sides of the lower-lying section 56 in front of the bung well 44 bound on the sloped connecting sections 60 to transition to the regular, i.e. higher, level of the groove base of the gripping groove.

Figure 9 is a cross-sectional view of the barrel lid per fig. 8 in an area away from the bung wells such as a lid area offset by 90° relative to the bung wells. The outer area of the central lid plate 18 is provided with the V-shaped expansion groove 52 having an opening angle of about 90° . Between the expansion groove 52 and the gripping groove 30 there is once again the inverted V-shaped circular element 66 (ridge) opening towards the bottom. In this case, the regular-depth, shallow gripping groove, represented by a solid line, has a width or radial dimension of 15 mm.



For comparison, the dashed line indicates the deeper groove base in the offset area in front of the bung wells. The special feature of this design version, as can be seen, is that the inner circular element 24 of the U-shaped rim 20 is slightly angled at first (curved somewhat like an S) and is then axially elongated in such fashion that, when the lid is mounted on the mouth of the barrel, it extends into the said mouth of the barrel by between about 25 mm and 55 mm, and preferably about 35 mm, as measured from the bottom edge of the outer circular element 22 of the U-shaped rim 20. As seen from the underside of the barrel lid, this elongation is in the form of a cylindrical circular element 68 which in the external transitional area extends axially from the groove base to the tapered or rounded, rising circular element 24 (i.e. the inner leg of the inverted U-shaped rim of the lid). Likewise, a second (cylindrical) circular element 70 extends axially in the inner transitional area from the groove base to the internally conical or rounded, rising circular element (i.e. the circular element connecting to the central lid plate 18 and the expansion groove 52, respectively). The lid area between the U-shaped rim 20 and the circular element or ridge 66 or, respectively, the central lid plate 18 thus takes on the cross-sectional shape of an H. This structural shape is extremely deformation-resistant especially in terms of hydraulic internal pressure and in drop tests. Remaining dents, for instance after the barrel was dropped, are largely absorbed by the inner circular element 70 or occur in the latter, thus leaving no remaining deformations in the outer circular element 68, so that the lidded barrel will not spring a leak. The axial dimension of the circular elements 68, 70, as measured from the bottom of the groove base, is between 8 mm and 30 mm, and preferably about 14 mm.

Figure 10 is a cross-sectional view through the bung areas of a slightly modified lid 14. It shows, in solid lines, the deeper groove base of the gripping groove 30 in front of the bung wells 34 and 44; the regular, shallower groove base of the gripping groove away from the bung areas is indicated, for comparison, by a dashed line. The axial dimension of the outer circular element 68 is larger in this design variation than the axial dimension of the inner circular element 70. The axial dimension of the outer circular element 68 should be between 8 mm and 30 mm, and preferably about 18 mm, while the axial dimension of the inner circular element 70 should be between 8 mm and 20 mm, and preferably about 12 mm. In typical barrel lids with peripheral bung spouts, the bottom plane of the bung well is generally at the same level as (i.e. flush with) the groove base of the circular gripping groove. One of the major features of the barrel lid



according to this invention is that the groove base of the gripping groove in front of the bung well is in any event deeper still, by about 10 mm to 14 mm and preferably about 12 mm, than the bottom plane of the bung well (meaning a stepped transition from the bung well to the groove base).

Figure 11 is a top view of another design version of a barrel lid according to this invention. In this case, the bung well 44 with the smaller 3/4" bunghole is particularly wide. This will also produce particularly long transitional sections or sloped connecting sections 60 (segment areas b') on both sides of the lower-lying section 66 of the gripping groove 30 in front of the bung well 44. The sloped connecting sections 58 (segment areas b) on both sides of the lower-lying section 54 in front of the bung well 34 with the 2" bunghole 38 are still somewhat longer, but that is because the 2" bung is configured as a residual drain bung for which purpose an appropriate slope 40 is provided on both sides of the bung well in the peripheral area of the central lid plate 18. In order to assure nearly complete residual draining of the lidded barrel in a slightly inclined upside-down position, preventing residual liquid from being retained on the lid underside behind or between the circular, cylindrical elements 68, 70, a centered, radially extending drain gutter 74 is provided in front of the 2" drain bung within the gripping groove 30. On the top surface of the lid, this drain gutter appears as a ridge 72 rising obliquely toward the center of the lid, while on the outside it runs flush into the lower-lying section 54 and on the inside it rises to the level of the regular groove base (away from the bung area). In addition, at certain points within the course of the gutter, sloped passages 76 (holes) are provided in the two cylindrical circular elements 68, 70. This will allow the very last residue of the liquid that may have collected behind these circular elements to exit via the drain bung by themselves. The drain gutter 72/74 with the holes 76 can also be seen in the cross-sectional illustration of the barrel lid (per fig. 11) in figure 14. The same barrel lid is depicted in figure 13. The only difference here is that in lieu of the 3/4" bung a fine-pitch threaded 2" bung (US version) is used.

Figure 12 shows the same barrel lid minus the bung spouts and bungholes. For its production, the tools for the various bung spouts are simply replaced in the injection mold with appropriate dummy blanks.

It is a matter of course that the individual features described here and illustrated in the diagrams can be mutually interchanged and combined in any way.



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According to the invention here described, a deepening of the groove in the lid-segment areas c, c' in front of the bung wells and/or a flatter or steeper sloping of the groove sidewalls in the segment areas a away from the bung wells thus allows for the linear extensions or surface lengths of the barrel lid to be somewhat shorter in the areas away from the bung enclosure than in the areas in front of the bung wells. This is a simple way to specifically shift the stress peaks into uncritical, more elastic areas of the lid away from the stiff bung-well areas, whereby, when a barrel is dropped or the internal pressure is significantly increased, the lidded barrel according to this invention is substantially more leak-proof, making it superbly suitable for use with liquid products and admissible even for certain hazardous substances.

While conventional lidded barrels filled with liquid typically start leaking, and the lid even comes off in many cases, when the barrel is dropped from a height of as little as 1.2 m, the lidded barrel according to this invention remains absolutely leakproof even when dropped from a height of up to 1.4 m.



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List of Reference Numbers

10	Lidded barrel	70	Inner cyl. circular element
12	Barrel body	72	Drain gutter (outer ridge)
14	Barrel lid	74	Drain gutter (inner channel)
16	Clamping ring	76	Pass-through hole
18	Central flat lid plate	78	2" bung (US version)
20	U-shaped rim of lid		
22	Outer circular element (20)		
24	Inner circular element (20)		
26	Gasket (14)		
28	Sloped conical circular element		
30	Gripping groove (20/28)		
32	Upper facing edge (20)		
34	Bung well		
36	Bung spout		
38	Bunghole		
40	Residual-drain slope (18)		
42	Seal-off cap		
44	Bung well		
46	Flanged rim on lid		
48	Casing flange		
50	Inliner		
52	V-shaped expansion groove		
54	Lower-lying section (30, 34)		
56	Lower-lying section (30, 44)		
58	Sloped connecting section (30, 54)		
60	Sloped connecting section (30, 56)		
62	Outer side wall (52)		
64	Inner side wall (52)		
66	Circular element - ridge section (52/30)		
	Outer cylindrical circular element		



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A lidded barrel for storing and transporting hazardous, liquid or solid bulk materials, comprising a cylindrical or conical barrel body, having an open top provided with a flanged rim, an asymmetrical barrel lid having an inverted U-shaped rim and a U-shaped clamping-ring closure to hook under the flanged rim of the barrel and over outer rim of the barrel lid and, in the closed position to press the lid against the barrel to create a closure impermeable to gas and liquids, wherein
 - the barrel lid includes a central flat area and, between the central flat area and the rim at least one recessed circular perimetric groove, and
 - at least one bung well for a gas- and liquid-sealable bunghole positioned in the periphery of the central flat lid area, and,
 - between the bung well and the rim formations are provided such that the length measured along the surface of the lid from the centre radially to the upper edge of the rim is longer in sectors that include a bung well relative to the length measured for other sectors.
2. A lidded barrel as in claim 1, wherein the circular perimetric groove varies in depth and is deeper in front of or adjacent to the bung well than away from the bung well.
3. A lidded barrel as in claim 1 or 2, wherein the length measured along the surface of the lid from the center radially to the upper edge of the rim is identical in areas that do not include the bung well.
4. A lidded barrel according to any one of claims 1 to 3, wherein the lid areas that include the transitions in depth of the circular perimetric groove, being deeper in areas in front of the bung well than away from the bung well, is formed by a flat sloped connecting element.
5. A lidded barrel as in claim 4, wherein the length of the sloped connecting element, measured in the circumferential direction, is about 20 mm to 80 mm, and preferably about 60 mm.
6. A lidded barrel according to any one of claims 1 to 5, wherein the lid areas that include the transitions in depth of the circular perimetric groove,



being deeper in areas in front of the bung well to the regular, shallower depth away from the bung well, is formed by a continuous transitional gentle slope that extends over a length 90° relative to the bung well.

- 5 7. A lidded barrel according to any one of claims 1 to 6, wherein the length measured in the circumferential direction of the lid area that contains the deeper depth of the circular perimetric groove is approximately equal to the width of the bung well.
- 10 8. A lidded barrel according to any one of claims 1 to 7, wherein a lidded barrel with a capacity of about 220 L (55 gal.) and a lid diameter of about 560 mm, the difference in depth of the recessed groove between the deeper depth in front of the bung well and regular depth away from the bung well is between about 5 mm and 15 mm, and preferably about 7 mm.
- 15 9. A lidded barrel according to any one of claims 1 to 7, wherein a lidded barrel with a capacity of about 120 L (336 gal.) and a lid diameter of about 460 mm, the difference in depth of the recessed groove between the deeper depth in front of the bung well and regular depth away from the bung well is between about 2 mm and 12 mm, and preferably about 6 mm.
- 20 10. A lidded barrel according to any one of the preceding claims 1 to 9, wherein a second continuous or partly continuous recessed groove in the periphery of the lid serves as an expansion channel.
- 25 11. A lidded barrel according to any one of the preceding claims 1 to 9, wherein the length measured in the radial direction along the surface of the lid in areas not including the bung well can be predefined by means of specific angle of inclination of the conical or rounded circular elements that
- 30 create the sidewalls of the perimetric circular groove.
12. A lidded barrel according to claim 10, wherein the length measured in the radial direction along the surface of the lid in areas not including the bung well can be predefined by means of specific angle of inclination of the
- 35 conical or rounded circular elements that create the sidewalls of any recessed groove.



13. A lidded barrel according to any one of claims 1 to 12, wherein the deeper depth of the groove or variation of the angle of inclination of the groove sidewalls is limited to the recessed groove which has the larger diameter.
14. A lidded barrel according to any one of claims 1 to 13, wherein a deeper depth of the recessed groove or the variation of the angle of inclination of the recessed groove sidewalls is implemented in both the circular perimetric groove having the larger diameter and the second recessed groove having the smaller diameter.
15. A lidded barrel according to any one of the claims 1 to 14, wherein the length measured in a radial direction along the surface of the lid is greater in areas in front of and/or adjacent to the bung well, than in areas away from the bung well.
16. A lidded barrel according to any one of claims 1 to 15, wherein the lid areas that include the transitions in depth of the groove, being deeper in areas in front of the bung well to the regular, shallower depth away from the bung well, is continuously gradual without steps and extends over a length 90° relative to the bung well.
17. A lidded barrel according of any one of the preceding claims 1 to 16, wherein the circular perimetric groove has a width measured in a radial direction of between 8 mm and 25 mm, and preferably about 15 mm, and on the underside of the lid the deepest edge of the recessed groove closest to the rim connects to the outer rim at a point on the side of the rims rising circular element which also extends axially downward into the mouth of the barrel when the lid is mounted on.
18. A lidded barrel according of any one of the preceding claims 1 to 17, wherein on the underside of the lid, the deepest edge of the circular perimetric groove connects to the central lid plate or expansion groove at a point on the side of a rising, rounded circular element, which also extends axially downward into the mouth of the barrel when the lid is mounted.



19. A lidded barrel according to any one of the preceding claims 17 and 18,
wherein the length of the axial extension, as measured on the underside of
the lid from the deepest point of the circular perimetric groove, is between 8
5 mm and 30 mm, and preferably about 14 mm.

20. A lidded barrel according to any one of the preceding claims 17 to 19,
wherein the length of the axial extension closest to the rim of the lid is greater
than the length of the axial extension closest to the center of the lid.
10

21. A lidded barrel as in claim 20, wherein the length of the axial extension
as measured on the underside of the lid from the deepest point on the
recessed groove, is between 8 mm and 30 mm, and preferably about 18 mm
for the extension closest to the rim of the lid, and, the axial extension closest
15 to the center of the lid is between 8 mm and 20 mm, and preferably about 12
mm.

22. A lidded barrel as herein described with reference to the accompanying
drawings, figures 1 to 2 and 5 to 14.
20

Dated this twenty fifth day of May 2001

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F B RICE & CO



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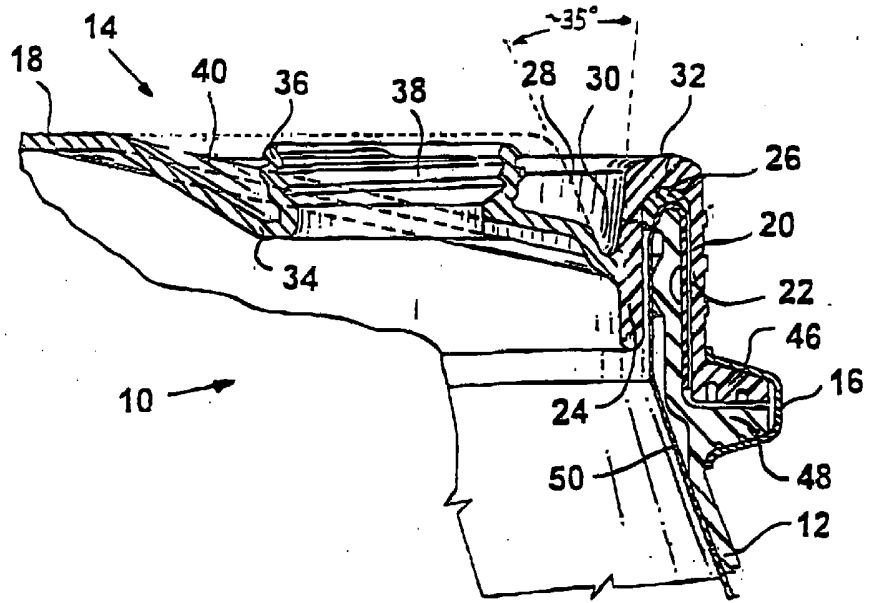


FIG. 1

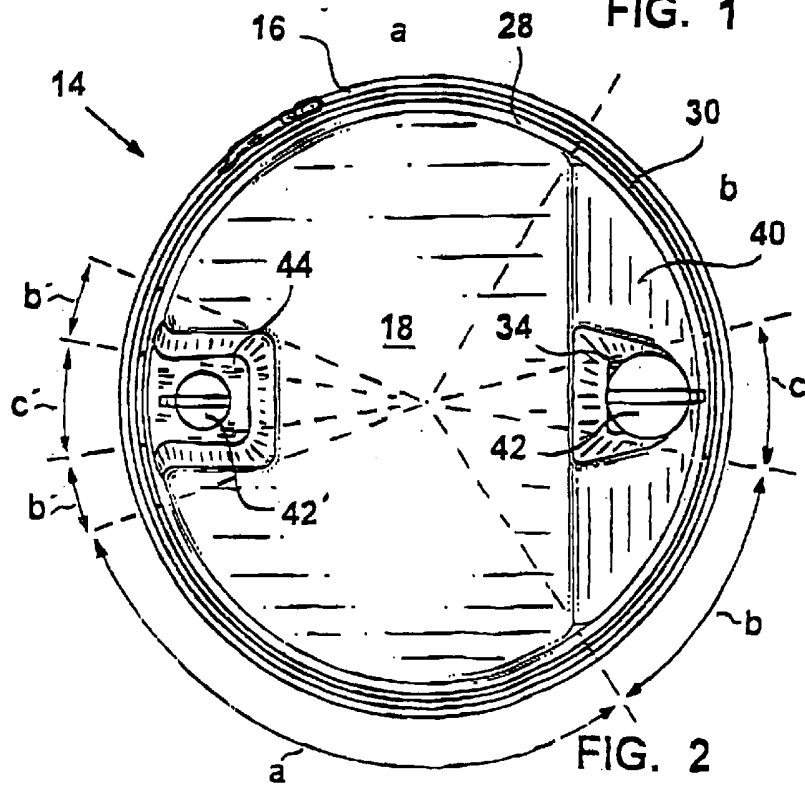


FIG. 2

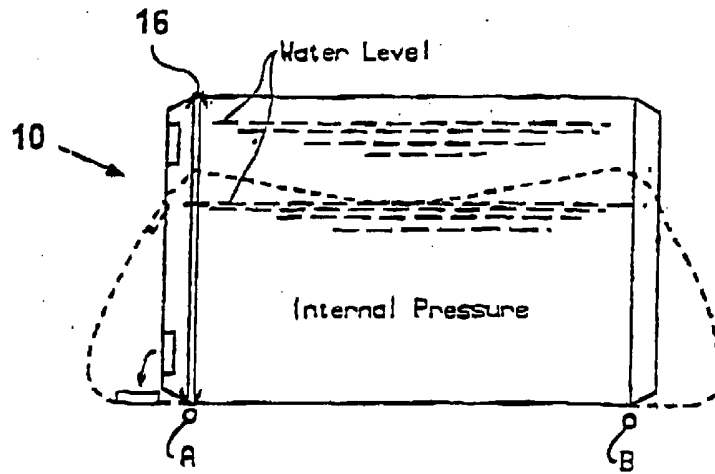


FIG. 3 (Prior Art)

— Normal Shape
 - - - Deformed Shape

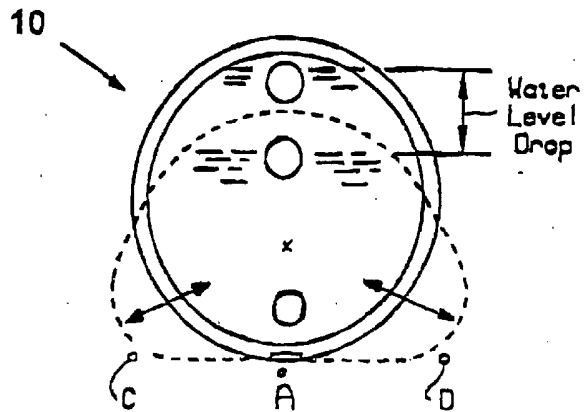
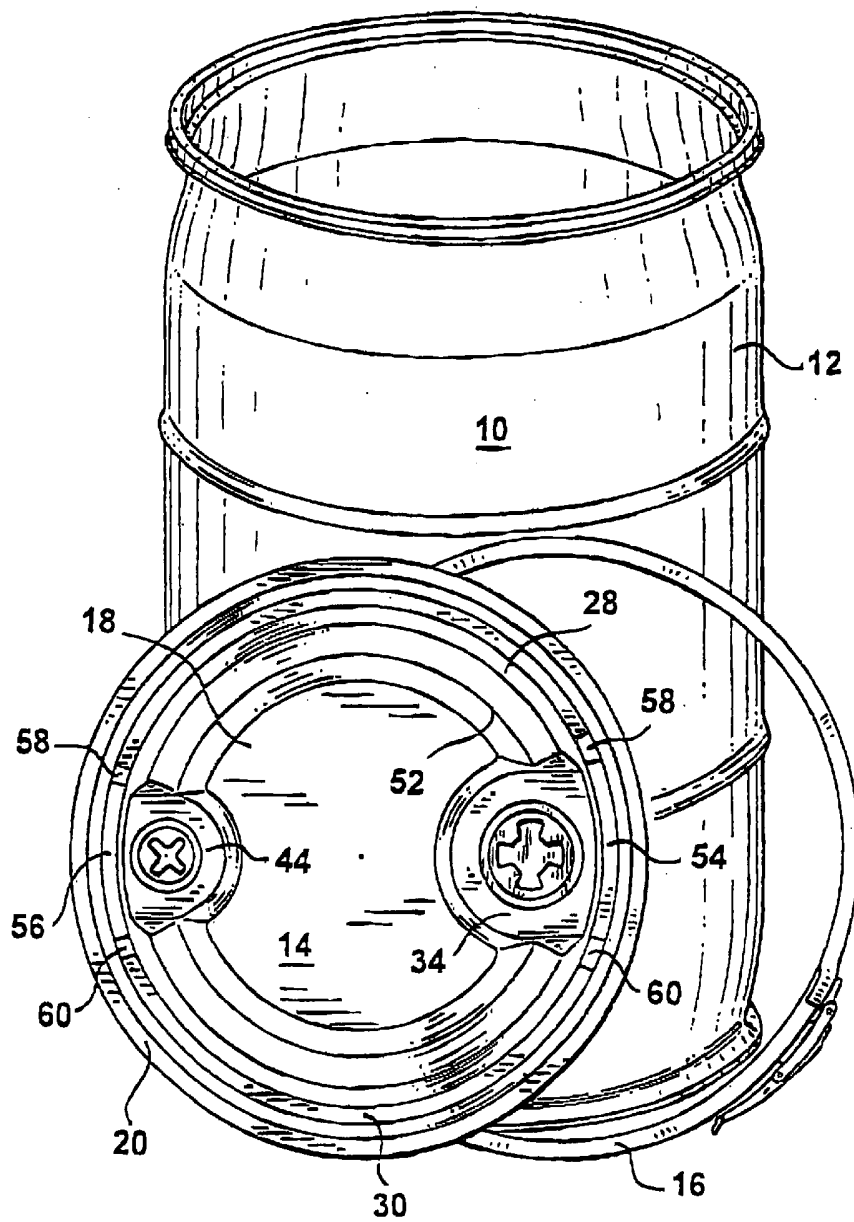


FIG. 4 (Prior Art)

— Normal Shape
 - - - Deformed Shape

FIG. 5



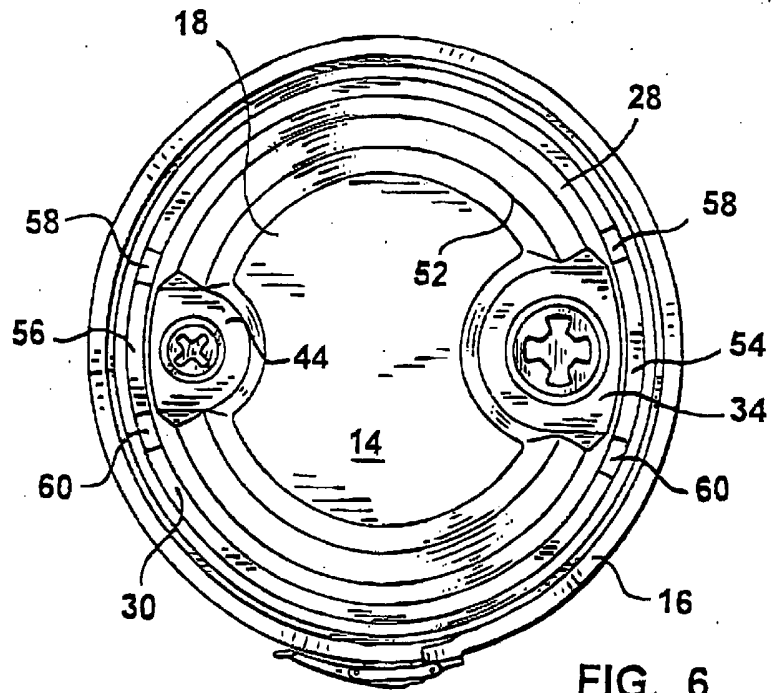


FIG. 6

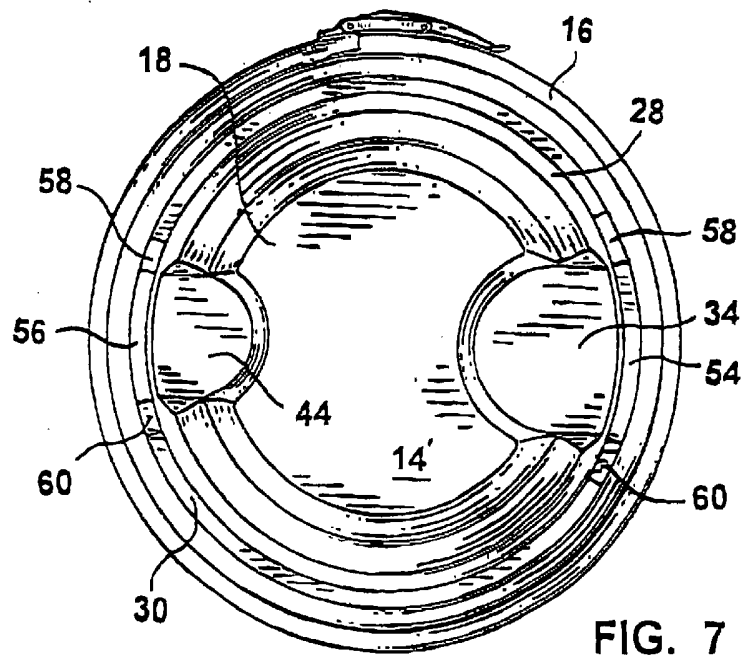


FIG. 7

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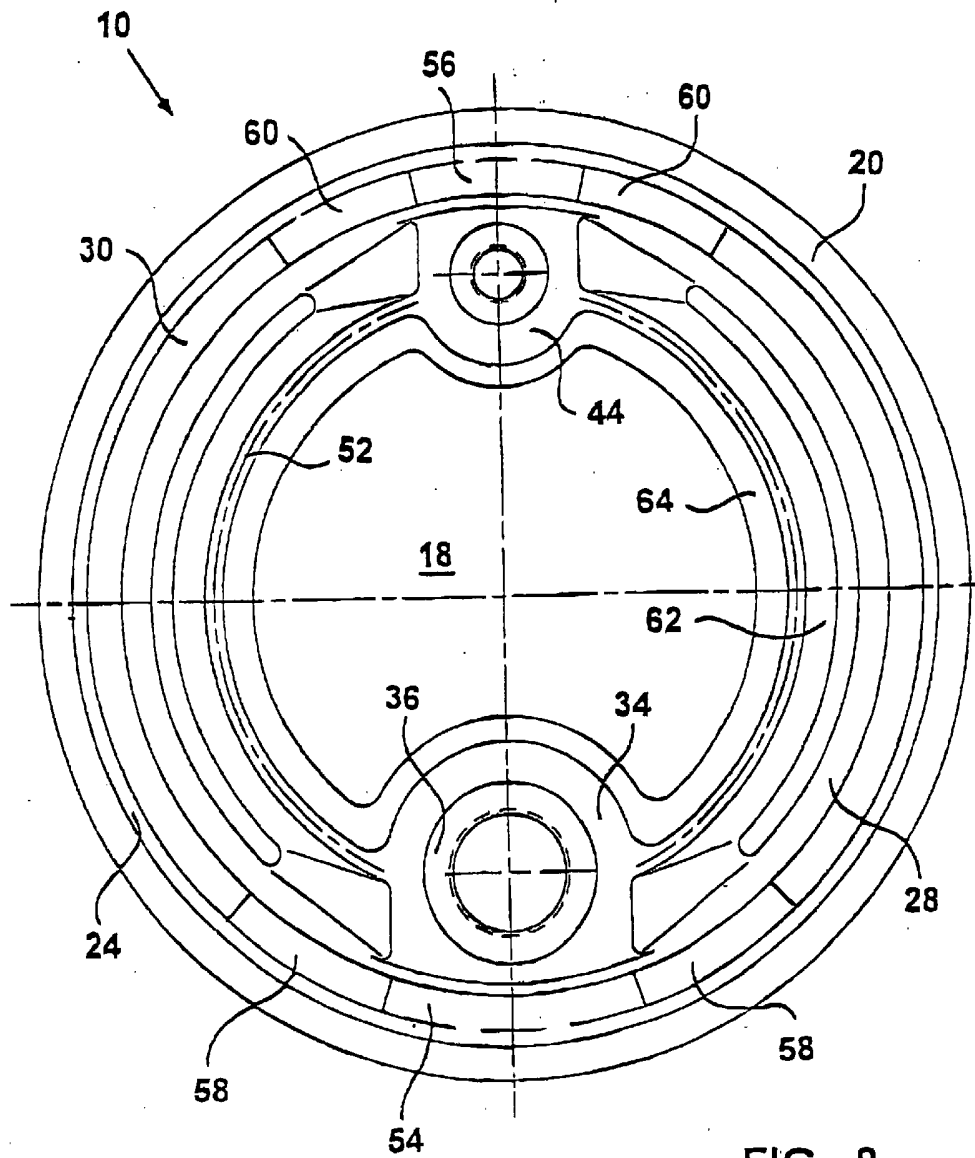


FIG. 8

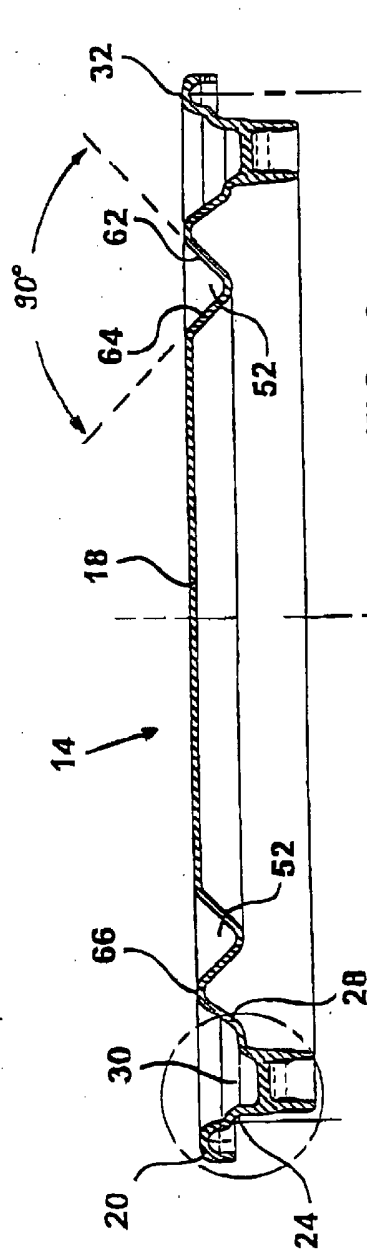


FIG. 9

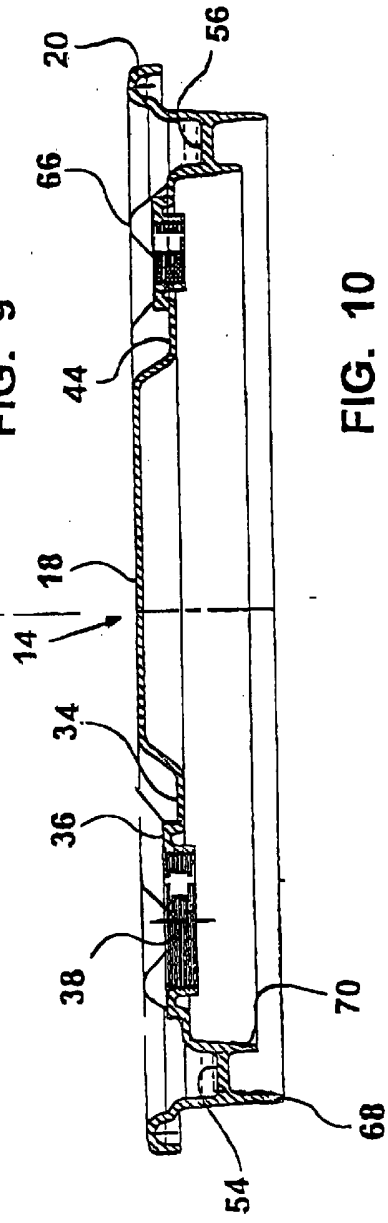


FIG. 10

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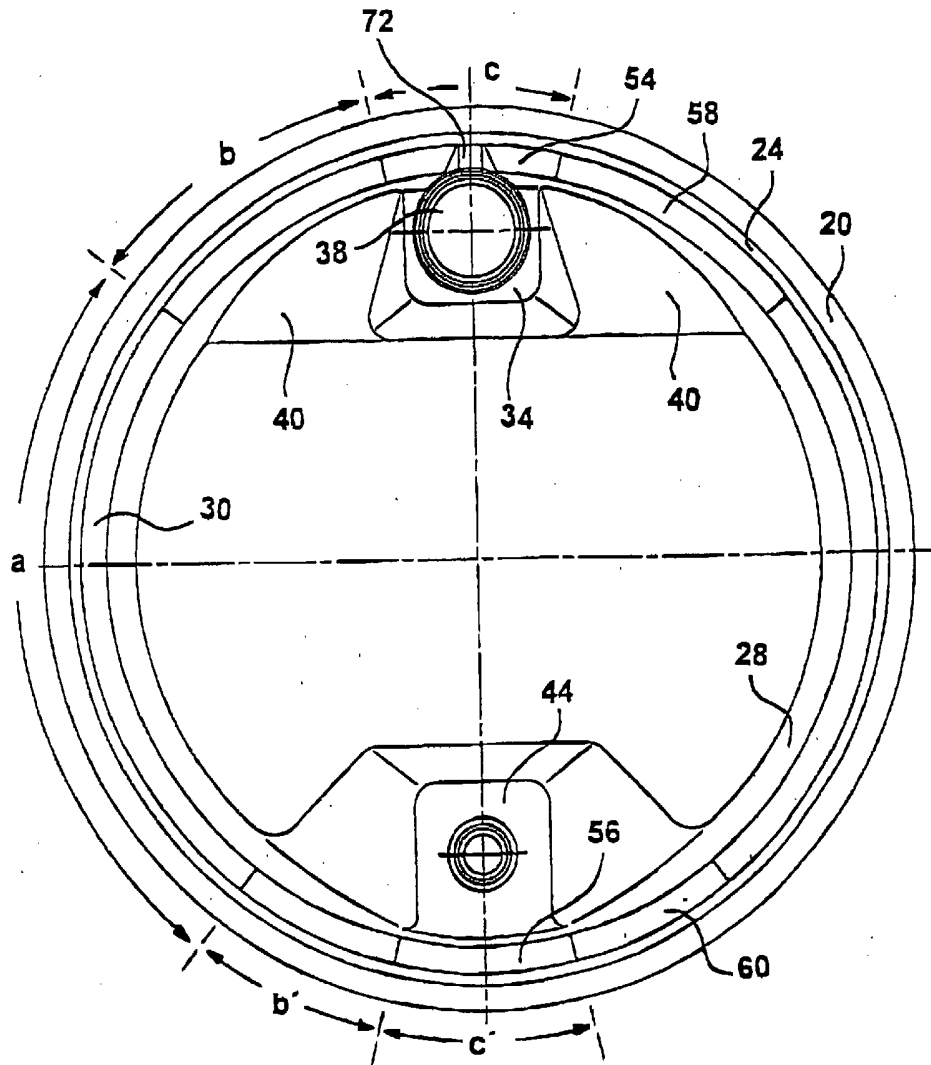


FIG. 11

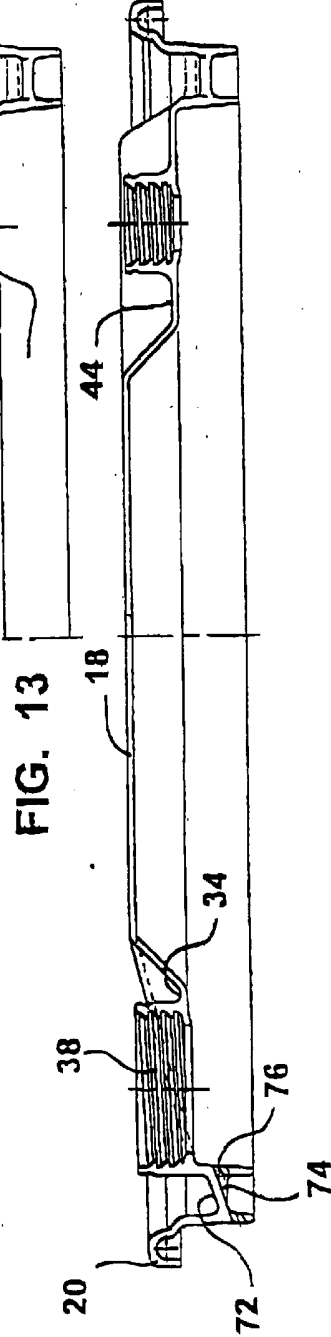
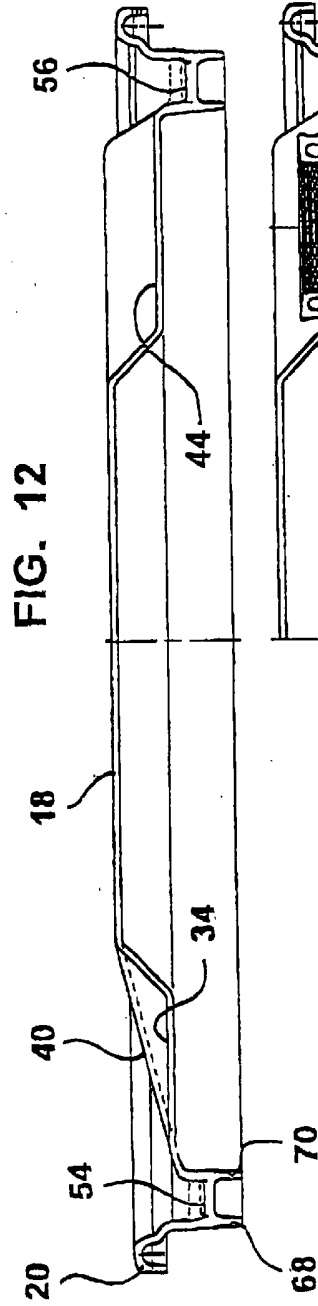


FIG. 14