March 17, 1970 R. W. ASMUS ET AL 3,501,045

SEALED CONTAINER ASSEMBLY

Filed April 8, 1968 2 Sheets-Sheet 1

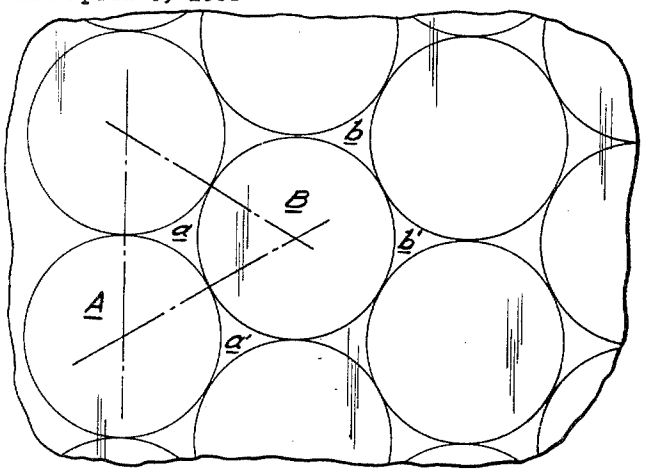


Fig. 1

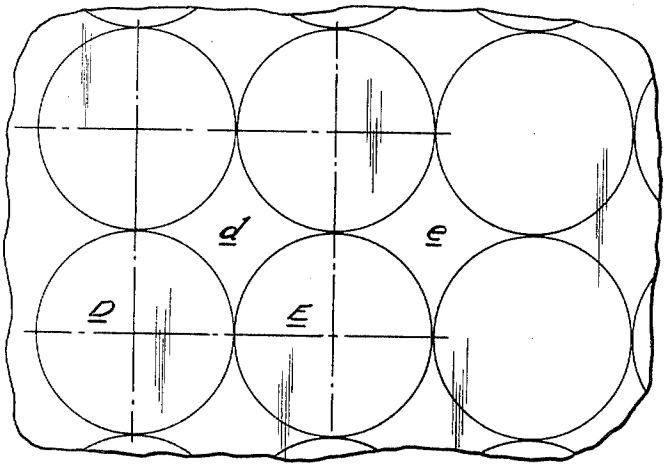


Fig. 2

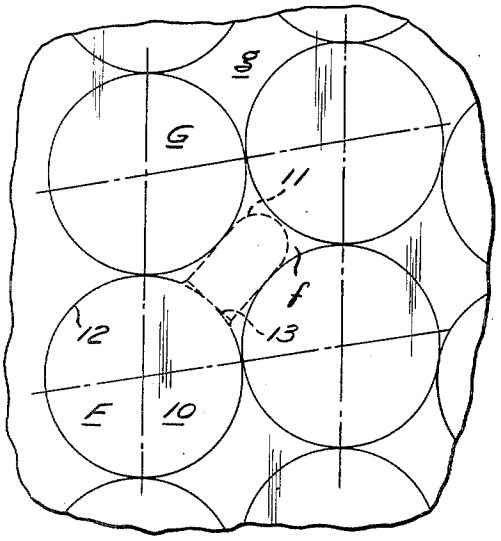


Fig. 3

INVENTORS
RICHARD W. ASMUS,
& ANDREW E. JECKER
BY
ELY & GOLRICK

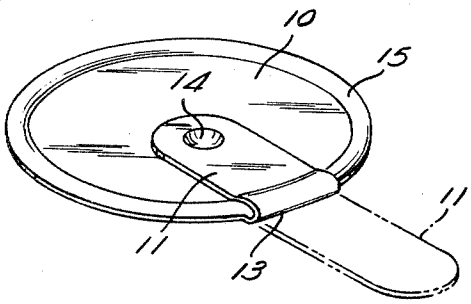
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March 17, 1970 R. W. ASMUS ET AL 3,501,045

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Filed April 8, 1968 2 Sheets-Sheet 2

Fig. 4



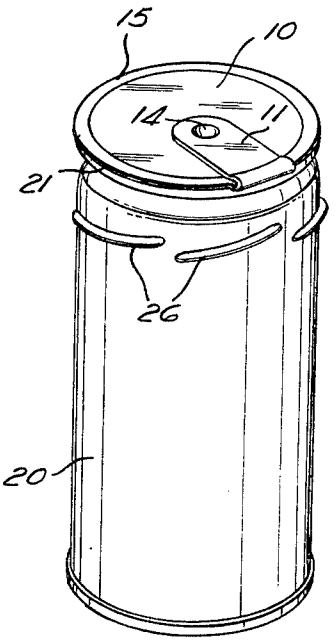


Fig. 5

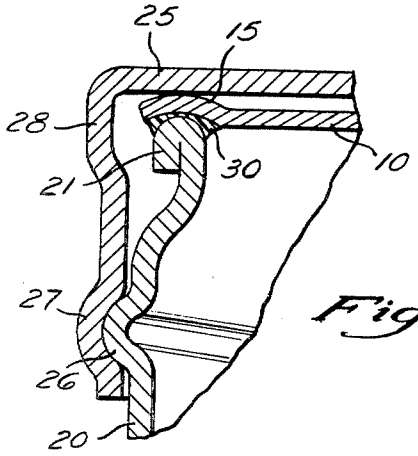


Fig. 6

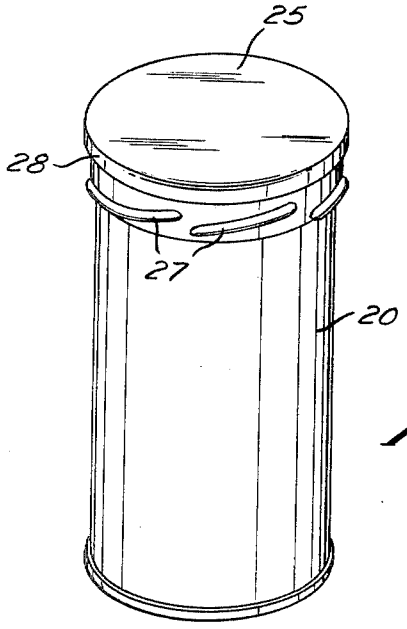


Fig. 7

INVENTORS
RICHARD W. ASMUS,
& ANDREW E. JECKER
BY
ELY & GOLRICK

ATTORNEYS

United States Patent Office

3,501,045

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SEALED CONTAINER ASSEMBLY

Richard W. Asmus, 3628 W. 28th St., and Andrew E. Jecker, 3610 W. 49th St., both of Cleveland, Ohio 44102

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U.S. Cl. 220—29 7 Claims

ABSTRACT OF THE DISCLOSURE

Easily opened sealed container comprising a rigid container body preferably having an opening provided with a beaded edge, a rigid outer cover for the opening, the outer cover being readily releasably mechanically interlocked over the opening, an inner peelable sealing diaphragm equipped with an integral pull-tab disposed between said outer cover and said edge, and a plasticized resinous sealant adhering said diaphragm to said edge The sealant, preferably of a solventless heat activated type, is characterized by relatively weak shear strength. The diaphragm is preferably cut from sheet material with areas to be cut from sheet "packed" to provide a quadrilateral "scrap" area from which an integral tab is formed.

This invention relates to container assemblies which may be securely sealed for shipment and storage and yet which are safely, easily, and quickly opened manually without the need for opening tools or equipment.

It is an object of this invention to provide a manually operated container which requires a minimal torque or like force to provide access to the contents, which may be liquids or solids packaged at pressures ranging from substantial vacuum through atmospheric pressure to substantial super-atmospheric pressure. It is an advantage of this invention that, while the container is closed by a thin diaphragm, usually of foils of stronger materials, such as steel, or a light-gauge sheet of aluminum or other metals having less tensile strength, the manual opening does not involve the puncturing or ripping of the diaphragm, thereby avoiding the danger of cutting the hands or lips, for example, of the user. Further, containers made according to this invention are re-closable, another advantage not achievable heretofore by containers employing manually operable sealing diaphragms.

Essentially, as indicated above, this invention involves the use of an inner sealing diaphragm and a relatively rigid and strong mechanically secured cap which protects the diaphragm during shipping and storage. Concededly this basic construction has been employed for years in packing liquids which were highly volatile or have highly volatile components, such as, for example, various petroleum spirits or other organic solvents packaged in metal cans. In such cases, the inner metallic seal functions both to prevent leakage and evaporation of the contents, but also to protect the resilient sealant in the usual screw cap from attack by the contents. In such container assemblies, the inner seal is usually forced mechanically into the container opening—requiring a sharp-edged or pointed tool to rupture and remove it—and the seal is effected by high pressure exerted by the outer screw cap; in order to exert such pressure, the cap is so tightly turned that the user usually needs pliers or a wrench to open it initially.

A variant of the above-described screw-top sealant cans has been used for anaerobic or hermetic packaging at atmospheric pressure of medicines, for example, in glass bottles having screw-cap closures. As a barrier to gases and vapors in the interim between packaging and opening for use, a thin foil disc, with or without a laminated reinforcing ply of paper and/or film is adhered over the mouth of the bottle beneath the screw cap. Functionally, the vunerable point of such a seal is the gas and vapor transmission potential of the adhesive between the foil and rim of the bottle mouth; consequently, powerful adhesives are used so that the diaphragm must be ruptured to open the bottle after the cap has been removed. And possibly because the pressure of the cap or the disc may compact the adhesive and reduce its vapor transmission or because a mechanical as well as adhesive seal of the foil barrier is desired, the screw top is usually tightened down so that a gripping tool, if not essential, is very helpful in first opening the screw cap and is faster than other expedients, such as tapping, heating the caps, etc.

Another prior art can closure upon which this present invention improves is the key-opened can, familiarly used for packing processed fish, most commonly sardines. Most such cans crimp the top to the body adjacent the tab initially wound, or the key, requiring an actual tearing of metal and leaving an undesirable sharp edge as well as a portion partly closing the can opening. Certain styles of key-opened cans avoided such torn edges by relying solely on the soldering of the can top to the body so that the winding of the top on the key ruptured the soldering and allowed all of the top to be wound on the key; this eleminated a dangerous torn edge, but required a special tool, i.e., the key, which notoriously frequently failed, and, of course, the container was not re-closable.

As indicated at the outset, containers, particularly cans, closed according to this invention, require no tools for opening and are re-closable to the extent of preventing spilling and protecting the contents remaining in the container after opening, though not necessarily reclosable to the extent of restoring the original seal.

Other objects and advantages of this invention wili be apparent from the drawings, in which:

FIGURE 1 is a fragmentary plan view showing one method of "packing" the top closure for cylindrical cans to be stamped out of sheet material.

FIG. 2 is a fragmentary plan similar to FIG. 1, showing another arrangement.

FIG. 3 is a fragmentary plan showing a frequently preferred variant of the arrangement shown in FIG. 2.

FIG. 4 is a perspective view showing a top with integral tab stamped and folded for affixation to a cylindrical can.

FIG. 5 is a perspective view of a cylindrical can sealed with a top as shown in FIG. 4.

FIG. 6 is a detailed cross-section of a top section of cylindrical can having an assembled closure made according to this invention.

FIG. 7 is a perspective view similar to FIG. 5, but showing the assembled closed container.

Referring to the drawings illustrating a preferred embodiment of this invention, namely, a cylindrical metal can closed with a steel foil diaphragm, FIG. 1 illustrates the usual arrangement of circular portions intended to be stamped out of sheet material employed for closures. This arrangement is based on the assumption that, provided the sheet is of sufficient width or length, "packing" so that the lines from the center of any one blank to those of two adjacent tangent blanks will define a 60° angle, will provide the minimum waste or "scrap" area between the blanks. The assumption is true for such a "honeycomb" arrangement if the blanks are to be precisely circular. It is not true if some of the so-called "scrap" is to be used for an integral opening tab, as in this invention, and the reason is evident from FIG. 1. In such a "honeycomb" arrangement, and ignoring marginal losses, there are two areas of scrap for each blank;

hus, in FIG. 1, there are two essentially triangular scrap areas *a* and *a'* for the blank A, two scrap areas *b* and *b'* for the blank B, etc.

A more economical arrangement to provide material for integral lifting tabs from such scrap areas is illustrated in FIG. 2, in which four rather than three blanks are tangent to each other about each non-marginal scrap area. As indicated in FIG. 2, the lines between centers may define squares, leaving essentially quadrilateral scrap areas, but with one scrap area per blank, thus allowing material for one larger tab. Rather than having the essentially square waste area *d* for the blank D, the area *e* for the blank E, etc., as shown in FIG. 2, it is usually preferable to arrange the blanks in tangent rows with each row tangent to but offset from an adjacent row so that the resultant quadrilateral waste area per blank is rectangular, rather than square, as illustrated in FIG. 3 by the waste area *f* for the blank F, *g* for the blank G, etc. This allows the tab **11** for the top, shown in dotted line in the waste area *f*, to have greater length for gripping and an adequate width for strength which avoid excessive interference with the circular edge **12** by the straight fold, shown by the dotted line **13**, when the tab **11** is folded back on the inner can top **10**.

As shown in plan in FIG. 4, the inner can top **10** is provided with the integral reverse folded tab **11**, stamped from a blank, such as the blank F shown in FIG. 3. As indicated, in stamping out the blank, the edges of the tab **11** may be provided with a slight bead around its edge to reduce the danger of cutting and with a dimple **14**, which will raise the edge of the tab from the blank and allow it to be readily lifted for opening. Also, the edge of the top **10** may be formed with a slight annular groove **15** to accommodate the bead of the can body. This groove is usually formed after or during the operation which folds back the tab **11** so that its straight fold **13** will not interfere with the seating of the top **10** on the can body.

As indicated in cross-section in FIG. 6, the top **10** is sealed to the beaded edge **21** of the cylindrical can by means of an adhesive organic sealant **30**, to be described in further detail below. The tensile strength of the sealant is adjustable and variable so that, together with the variability of the sealing area provided by the bead **21** and the groove **15**, the tensile strength of the seal **30** will, in the absence of external forces, withstand the internal pressures, sub-atmospheric or super-atmospheric, which the can body **20** is otherwise capable of withstanding.

To protect the internal top **10** and its seal **30** from external forces which can be expected to arise from normal handling during shipping and storage, the can **20** is provided with a seemingly conventional lid **25** mechanically interlocked on the can by mating portions **26** and **27** formed in body **20** and flange of the lid **25**, the portions **26** and **27** providing a wedging engagement by being in the form, for example, of interrupted threads to provide a bayonet type of lock. If need be, the usual circumferential bead **28** in the upper corner of the lid **25** is slightly enlarged to provide ample clearance for the folded edge **13** and thereby avoiding disturbing the top **10** by engagement between the slight projections left by the fold **13** and the interior of the lid **25** when it is twisted to interlock it upon the can body **20**.

In order to permit easy opening of the can, the lid **25** is tightened by engagement of the portions **26** and **27** only to the point of bringing the inner surface of the lid into contact with the outer surface of the sealing groove **15**. The lid **25** thus provides mechanical protection for the inner top **10** and also backs up the seal **30** if the packaged contents are suddenly shifted due to the external force of dropping. Since the seal **30** is sufficient to withstand the fixed loads imposed by contents, no substantial pressure need be applied by the lid upon the groove **15** beyond that which is sufficient to create sufficient friction with and between the members **26** and **27** to resist the minimal torque which could be caused by shifting the container during handling and shipping. Being assembled on the container lightly and with minimal torque, the relatively rigid lid **25** may, thus, be readily dis-assembled by manual application of minimal torque.

With the lid **25** removed, opening of the container for access to the contents is easily accomplished by lifting the tab **11** and pulling it back to rupture the seal provided by the sealant **30**. The sealant **30**, while characterized by ample tensile strength (and adhesion to the adjacent surfaces of the bead **21** and the groove **15**) is of a type characterized by relatively weak shear strength. Thus, while the sealant **30** is amply strong to resist the tensile loads imposed by internal pressure (or absence of pressure) under which the contents are packaged, it takes but a light transverse pull on the tab **11** to rupture the sealant in the vicinity of the fold **13**. The concentration of a shear load at one point by the initial pull on the tab **11** and the subsequent concentration of shear force at two points where the top **10** is being pulled away from the bead **21** enables the top **10** therefore to be simply and easily peeled off the opening of the can body **20**.

In this connection, it has been appreciated that generally the relative strengths of the sealant, per se, in tensile and shear, is also indicative of an even greater relative disparity in surface adhesion under tensile and shear load. Thus, sealants which are amply strong to withstand the tensile loads distributed over the entire sealed area can be formulated and selected to peel away from the surface of the bead or the groove in preference to rupturing the sealant itself under the shear load imposed by pulling on the tab **11**. When the sealant is selected so as to peel from a surface under shear rather than rupture, it takes but a minute difference in preferential adhesion to the groove **15** rather than to the bead **21** to cause the sealant **30** to peel away with the lip **10**, leaving the bead clean. Often the mere greater area in the groove contacted by the sealant is sufficient to cause usch preferential adhesion which makes the opened can body attractive for pouring or as a drinking vessel. If this difference in surface area is insufficient, the preferential adhesion may be provided by surface treatment and use of an adhesion primer.

For any particular container assembly made according to this invention, the most critical member is usually the adhesive sealant **30**. Many details, some seemingly minor, such as (a) the contents to be packaged and the packaging pressures required, (b) the materials of the top **10** and the bead **21** and their respective surface finishes, (c) the ability of the package contents, of the material of the can **20** and **10**, and of the surface ornamentation of the can body (labeling, lithography, printing, etc.) to withstand the temperatures for activating the sealant, (d) whether the seal **30** must be activated before filling (in which case the can is usually filled through the bottom and sealed in conventional filling and sealing equipment) or must be activated after filling, (e) the size of the container opening, (f) specific inertness or non-toxicity, etc., are all factors which may dictate selection of a particularly formulated adhesive for a specific packaging assembly.

Because of the vast variations dictated by specific packaging needs, it is impossible, in view of the current state of the art, to categorize all adhesive sealants which will meet the requirements of the sealant **30** so that it will be relatively weaker in strength and/or adhesiveness in direct shear than it is under tensile loads. By and large, the sealants having these physical characteristics are of the organic type which are activated by heat without significant evolution of volatile solvents or products of reaction. In somewhat more detail, this includes a wide variety of thermoset and reacted materials, such as plasticized epoxies, plastisols (or organisols which have sub-

stantially eliminated volatiles when processed to the gel stage), many of the vast number of so-called "hot melt" adhesives based on olefins, polyesters, and cellulosic resins modified by plasticizers and elastromers.

The following is the formulation of a specific embodiment of a sealant which was found operative for .004 in. plated steel foil tops **10** adhered to a 12 oz. beaded can body of 65 mm. diameter suitable for packaging soft drinks or the like:

	Parts (by wt.)
Polyvinyl chloride resin, dispersion grade (Geon 121)	50
Polyvinyl chloride extender resin (Marvinol VR10)	50
Non-toxic plasticizer ("DOP," such as Goodrich GP264 alone, or mixed with, or replaced by a relatively, tasteless plasticizer such as Citroflex A–4)	20–120
Stabilizer (M&T Thermolite 13)	1–5
Epoxy stabilizing plasticizer (Paraplex G–62)	5–10
Adhesion-promoting plasticizer (Kodaflex AD–2)	30–70

The plastisols according to the foregoing formulas were prepared with the proportion of resin plasticizer varied according to the shear strength desired, the greater the proportion of plasticizer, the lower the shear strength. When the lower shear strength plastisols are employed, thixotropic thickening agents, such as non-toxic colloidal silicas (e.g. Cab-O-Sil) in the order of 2 to 5 parts are usually employed.

The sealant **30** was deposited as a ring in the groove **15** of the inverted top **10** and heated to 200° F. to gel the plastisol in the groove. The top, with the gelled sealant down, was then placed on the can body which was open at both ends and then contacted by a hot plate which quickly raised the gelled plastisol to 350° F. to fuse the sealant on the bead of the can body. The lid **25** was then placed on the can over the sealed top **10**. Because the contents were to be packaged under pressure, the can body, with the lid **25** and top **10** forming the bottom closure, were then passed through a conventional filling and closing machine which closed with a conventional crimped seam. Depending upon the internal pressure, the cans withstood simulated handing and, upon manual removal of the lid, the top **10** was easily lifted from the can body. Because the relatively stiff top **10** was merely peeled away without permanent bending and distortion, it was easily replaced and the can re-closed by the lid **25**.

If the contents are to be packaged at atmospheric pressure or under vacuum, it can be as convenient to close the filled container with the assembly of the sealed top **10** and lid **25**. Other factors directing the choice of assembling the top **10** and lid **25** before or after filling may also be the type of labeling or ornamentation employed. The heat of fusion of the plastios might discolor the lithography and, thus, closure before lithographing and filling would usually be recommended.

Although the above specific and illustrated examples were directed to the closure of metal cans, it is to be understood that, with a properly selected sealant, the closure may be applied to thermoplastic or thermosetting plastics as well as to glass bottles and jars, the rounded edge of the rim of the mouth of many heavier-walled bottles and jars constituting the appropriate bead. Further, the lid **25** is disclosed as a lid for a circular mouth opening which is mechanically engaged or dis-engaged by twisting. Particularly for closure with rectangular openings, it is to be understood that a sliding interlock for the outer lid **25** will be employed. Also, the lid **25** in any event may be of glass of appropriate plastic.

Accordingly, this invention is not to be limited to the particular embodiment disclosed but may be varied and modified without departing from the scope of this invention.

What is claimed is:

1. A closure assembly for containers comprising a relatively rigid container body having an opening therefor comprised of a mouth with an upwardly facing edge providing a sealing area, means carried by the container body adjacent the opening as one portion of a mechanical interlocking means, a top overlying said opening and said edge, said top being of flexible material having sufficient strength to avoid bursting or substantial distortion under expected pressure loads of the contents of the container, said top being thin relative to the width of the sealing area provided by the edge of the opening, an organic sealant engaged between and adhered to both said sealing area and the adjacent area of said top, said sealant being weaker in shear strength than in tensile strength, a lid having a depending flange portion carrying means for cooperating with the interlocking means of said container body to provide a manually readily releasable interlock between said container body and said lid, said lid engaging said top when said interlock is activated, and an integral pull tab on said top folded to be enclosed between said top and lid when said interlock is actuated, whereby release of said interlock allows said lid to be removed to expose said tab and said tab may be pulled so as to subject said sealant to a shear load and allow manual opening of said container.

2. A container closure assembly as defined in claim **1** in which said sealant is of a type which is heat activated with the substantial absence of released solvent or products of reaction and is of sufficient strength and amount to withstand the fixed load imposed on the closure by the packaged contents.

3. A container closure assembly as defined in claim **2** in which said sealant is of the class consisting of plasticized epoxies, adhesive plastisols, and hot melt adhesives.

4. A container closure assembly as defined in claim **3** in which said sealant exhibits preferential adhesion to said top.

5. A container closure assembly as defined in claim **4** in which the sealing area of the container opening is provided with a circumferential bead at the periphery of the said edge and the top is formed with a mating groove.

6. A container closure assembly as defined in claim **5** in which said top is a steel foil.

7. A container closure assembly as defined in claim **5** in which said lid is peripherally enlarged in the locus of the fold connecting the top and its integral pull tab to provide a clearance for the fold between said top and tab.

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DONALD F. NORTON, Primary Examiner

J. R. GARRETT, Assistant Examiner

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