Title: INDUCTION HEAT SEALED CONTAINER CLOSURES

Abstract: Container closures for bottles, cans, tubs, etc. having an internal, sloping or complementary flange on the container which matches with a sloping flange or recess on the closure. A line carried by the closure, in the form of a foil or the like, includes an induction heat activated adhesive or at least the portion thereof facing the sloping or complementary flange or; the container for greatly increasing the burst strength of the container because the adhesion is in shear. Provision is also made for facilitating peeling of the liner to assist the consumer in accessing the container contents. The liner, say, in addition, also be adhered, to a horizontal surface of the container for further securing the liner thereto.
Title: Induction Heat Sealed Container Closures

Background of the Invention

It has previously been disclosed to provide flexible closures for containers wherein the burst strength, internal vacuum resistance, and drop impact strength are increased by placing seals in shear without increasing the peel forces needed for consumers to open the closures and thereby gain access to the contents in the container.

Summary of the Invention

The present invention expands the concept of placing seals in shear into the field of induction sealed closures wherein induction heating is used during the process of closing and heat sealing the containers that have been filled with the product to be protected.

Plastic container closures, or lids, which may be twisted on with threads, or snapped in place, with an interference fit, onto the flange of a bottle, can, or cup, are to be modified in accord with the present invention by providing a cap and multi-layered liner into position for the liner to seal to the flange. Either the liner must have a metal foil in the structure, or the container be formed of or containing metal in the form of a metal rim or ring, or the like, or both the liner and the container be formed of metal so as to allow induction heat to be created during the closing process. The bottom layer of the liner or the peripheral flange of the
container must have an adhesive sealant layer which is activated by induction heat.

A primary feature of the new concept is to form a seal between the closure and the container on an angled flange, or finish, of the closure and the container rather than merely sealing on a top edge or surface of the container as is presently done. The result is a much stronger seal which is in shear rather than peel. The improved burst performance of angled seals is documented in the results of lab tests described here:

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Burst Tests: Heat Seal in Shear (Angled) vs. Peel (Flat)
307 Diameter Plastic Bowls with Sealing Film, Heat Sealed to the Flange
Standard Plant Air

<table>
<thead>
<tr>
<th>Test Results:*</th>
<th>PSI</th>
</tr>
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<tbody>
<tr>
<td>Variable</td>
<td>Average Burst</td>
</tr>
<tr>
<td>Flat (Control)</td>
<td>26</td>
</tr>
<tr>
<td>30 Degree Angle</td>
<td>45</td>
</tr>
<tr>
<td>45 Degree Angle</td>
<td>56</td>
</tr>
</tbody>
</table>

** Note: In the same tests, aluminum BZO ends buckle or fail in the 40-45 psi range.

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To achieve the time, temperature and pressure needed in the process, an angled section under, and at the outer, internal edge of the closure is added. The shape of this section can vary depending upon the geometry of the container flange but is intended, in all cases, to exert pressure on the
angled liner and container flange as the closure is twisted or snapped into place.

While the angle section is generally around the entire inner corner or circumference, 360 degrees of the closure, some designs change the shape, or reduce the angle, over a small section to prevent a full section heat seal on the periphery to facilitate a pull tab, or peel opening feature. This technique of providing a pull tab helps to initiate the peel opening, and also reduces tearing of the liner or of the lid when opened from the outside by a consumer. The force needed to peel the pull tab is, ideally, in the range of 2 to 6 pounds. The necessary force could be higher, on the order of 10 to 12 pounds, but that risks tearing of the liner or inducing the consumer to use a sharp instrument to tear the liner for opening the container.

All current liners are flat and are pushed into the closure as a component, or are cut from a web of liner material and pressed into the closure. The liner contemplated by the present invention may also be flat and may be inserted into the closure the same as with existing liners. Or, the liner may be preformed before insertion into the closure. Preforming has two advantages. First, since the outside diameter of an angled liner could well be greater than flat liners, preforming would allow clearance past the closure threads or snap ring as the liner is being inserted. Second, because of a requirement to angle the full periphery of the
liner, preforming would avoid wrinkles which could impede effective seals.

Those skilled in the container and packaging art will recognize that the invention is suitable for use with the three different types of closure caps, namely, (1) push on - push off, (2) twist on - twist off, and (3) push on - twist off. Thus, the container closures and/or the containers can be provided with helical threads, or with circumferential snap rings.
Brief Description of the Drawings

FIG. 1 is a perspective view of a prior art closure cap for closing a container.

FIG. 2 is a vertical section of the prior art closure cap of FIG. 1 and shows a liner contained therein.

FIG. 3 is a fragmentary section of a container provided with an inwardly turned top flange portion having a slanted engagement surface.

FIG. 4 illustrates the fragmentary section of FIG. 3 positioned within a closure cap that is provided with a matching slanted engagement surface for capturing a peripheral portion of a liner along the slanted flange portion of the container.

FIG. 5 illustrates a modification of the top portion of a container wherein a downwardly and outwardly slanted surface is provided.

FIG. 6 illustrates the fragmentary section of FIG. 5 positioned within a closure cap that is provided with a matching slanted engagement surface for capturing a peripheral portion of a liner along the slanted flange portion of the container, with an outermost portion of a liner for providing a pull tab aiding a consumer in removing the liner from the container after removal of the closure cap.

FIG. 7 illustrates a modified form of the invention wherein the container flange is provided with a horizontal,
flat sealing surface and a downwardly and outwardly slanted
sealing surface cooperating with matching surfaces on the
container cap for securing an outer periphery of a liner there
between.

FIG. 8 illustrates another modified form of the
invention wherein the container flange is provided with a
horizontal, flat sealing surface and a downwardly and
outwardly slanted sealing surface cooperating with surfaces on
the container cap for securing an outer periphery of a liner
there between wherein the slanted surface on the closure cap
is foreshortened to avoid sealing a pull tab portion of the
liner against the container flange.

FIG. 9 illustrates a modified snap-on closure cap and a
modified container flange with an externally turned and
downwardly angled surface matched or slightly greater angle
than a corresponding angle on the underside of the cap and
liner.

FIG. 10 shows the closure cap and container of FIG. 9 in
a closed position wherein the peripheral portion of a liner is
captured between the closure cap and an outwardly and
downwardly sloping surface of the container.

FIG. 11 illustrates a modified flange on a container,
which may be formed of metal, the edge portion being curled
for avoiding a hazardous sharp edge.

FIG. 12 shows apparatus for providing a sealing line for
closing a plurality of containers with an opposing conveyor
belt to snap the closure onto the container and hold it while an induction heating device and a cooling device create the sealing process.

FIG. 13 is a fragmentary, sectional view of a closure cap which includes a small circumferential ring member for engaging the peripheral edge of a liner for centering and hold the liner in place prior to closing of the container with the closure cap. The closure in FIG. 13 is snapped in place instead of relying on threads.

FIG. 14 depicts an "Existing", or "Prior Art" example of a traditional "twist-on, twist-off" threaded cap and conventional flat liner.

FIG. 15 illustrates a "Push-On, Push-Off" closure cap with a liner that is induction heat-sealed to the slanted finish of a container.

The lines A and B shown on FIGS. 14 and 15 represent the identical fill level for both designs of finish and closures.

FIG. 16 is a fragmentary showing of a production line for inserting liners into a closure cap of the type shown in FIG. 17.

FIG. 17 shows a modified container closure having a slanted surface for cooperating with a slanted surface of a liner and the container finish, and being provided with screw threads for attaching the closure cap to a container.

FIG. 18 illustrates a prior art closure cap wherein the top of the cap and the side wall of the cap are joined at a
right angle corner and a flat, annular, plastisol gasket is located at the corner.

FIG. 19 is a further example of a prior art closure cap joined at a right angle corner, and a gasket of moldable resilient material is applied within the corner.

FIG. 20 is a fragmentary section of a novel form of closure cap wherein the top and side wall of the cap are joined at an angle, similar to FIG. 17, and a moldable resilient material forms a gasket that conforms under pressure to an angled surface of the container.

FIG. 21 is a fragmentary section of a blow molded container and a closure cap wherein the container terminates at its open end with a horizontal, inwardly directed flange.
Description of the Preferred Embodiments

FIG. 1 is a perspective view of a closure member also referred to as a cap or lid known in the prior art, generally indicated by the numeral 10, and includes a central end closure panel 12 and a depending skirt portion 14 for closing a conventional container, such as a metal, glass or plastic can or bottle.

FIG. 2 is a vertical section of the closure member 10 of FIG. 1 and illustrates a series of internal threaded portions 16 which can be used for pushing on, and twisting off the closure member 10, and includes a flat liner 18 -- which may be made of paper, foil or plastic or be multilayer -- underlying the central end closure panel 12.

FIG. 3 shows a fragmentary, vertical, upper container section 20 of a container 22 which is provided with an external, helical threaded portion 24. It is to be understood that a snap ring can be used in lieu of helical threads. A tongue member 26 extends upwardly and inwardly at the uppermost portion of top section 20 and includes a slanted, non-horizontal, upper surface 28 which extends circumferentially about the container 22.

FIG. 4 shows a novel container closure, lid or cap member 30 including a non-horizontal, circumferential, slanted surface 32 which cooperates with the slanted, upper surface 28 on the tongue member 28 of container 22. Closure 30 has a skirt portion 34 which may include internal thread or threads.
36 for adapting closure 30 to be threaded onto, or pushed on
and twisted off, the top portion 20 of container 22. A liner
38 includes a thin layer of heat-sensitive adhesive 39 on the
underside thereof that comes into contact with the slanted
surface 28 of the tongue 26 on the top section 20 of the
container 22. Liner 38 is preferably of metal foil and the
underlying, thin layer of adhesive 39 is heat sensitive such
that during closure of the container, induction heating causes
the adhesive 39 to seal the liner 38 to the slanted surface 28
on the container 22. As is shown in FIG. 4, a peripheral
portion 40 of liner 38 is disposed between the slanted surface
28 of tongue 26 and the slanted surface 32 on the underside of
closure member 30. While the parts are shown partly separated
for clarity, it is to be understood that when tightly
assembled by threads 24 and 36, liner 38 has its peripheral
portion 40 tightly pressed against slanted surface 28. While
the slanted surfaces 28 and 32 are shown as having flat, or
planar, surfaces, it is to be understood that one surface may
be slightly domed and the other surface slightly concave
thereby having a smooth even grip on the peripheral portion 40
of liner 38. After filling and sealing, when the closure
member 30 is removed during opening of the container 22, the
liner 38 is adhered in shear rather than peel, and the
consumer's opening motion is in peel.

FIGS. 5 and 6 show an upper container section 42 of a
container 44 having exterior threads 46. Container 44 may be
formed of plastic, glass or metal, and at its uppermost portion, or finish, is topped with a non-horizontal, slanted surface 48. As is shown in FIG. 6, a peripheral portion 40 of liner 38 is disposed between slanted surface 32 of closure 30 with the heat-sensitive adhesive side 39 disposed for contact with slanted surface 48 of container 44. During closure of container 44, closure 30 presses the peripheral portion 40, of liner 38, against slanted surface 48, and induction heat is applied for causing adhesive 39 to secure liner 28 to slanted surface 48. When the closure member 30 is removed during opening of the container 44, the liner 38 is adhered in shear rather than peel. It is shown in FIG. 6 that the peripheral portion 40, of liner 38, includes an over-hanging portion forming a pull tab 50 for assisting a consumer in opening the container 44 by peeling liner 38 from container 44.

FIG. 7 illustrates a different embodiment of a closure, cap or lid 52 and container 54 wherein an inwardly sloping tongue 56 includes a slanted surface 58 and flat upper surface 60 for increasing the area of contact with the peripheral portion of liner 38. A portion 62 of liner 38 overhangs the tongue 56 to provide a pull tab for assisting a consumer to peel the liner 38 from container 54 after the closure 52 is removed.

FIG. 8 is similar to FIG. 7 but includes a closure 64 having a shortened slanted surface 66 and a horizontal flat portion 68 such that a peripheral portion 70 of the liner 38
is free of the tongue 56 to provide a pull tab. It is to be understood that the flat portion 68 may only extend about 10 degrees about the circumference of container 54.

FIG. 9 shows a modified closure 94 and a liner 38 having matching outwardly and downwardly slanted surfaces. As previously described, liner 38 has a thin layer of adhesive on the side thereof that comes into contact with the related container. A container 95, which may be formed of metal, paper or plastic, has an outwardly and downwardly extending flange 96 which comes into contact with liner 38 when pressed together as indicated by the arrow in FIG. 9, and as shown in FIG. 10. Closure 94 has an inwardly extending cam surface 97 which deflects container flange 96 inwardly during assembly and the flange 96 then snaps into contact with liner 38 as is shown in FIG. 10. The parts are shown slightly spaced for clarity but it is to be understood that the flange 96 and liner 38 are in firm contact with each other during the step of induction heating for sealing the container 95 with the adhesive layer 39 of liner 38.

FIG. 11 is a fragmentary portion of a modified metal container 98 having an outwardly and downwardly slanted flange 99 which is intended to cooperate with the closure 94, as in FIGS. 9 and 10. Flange 99 terminates in a curl to protect against a sharp peripheral edge.

FIG. 12 shows a closing line, generally indicated by the numeral 100, wherein a plurality of containers 102 are shown.

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moving under a conveyor belt 104 for pressing caps 106 onto the containers 102 and holding them together while an induction heater 108 causes adhesive on the liner contained within the cap 106 to seal the container 102. The adhesive can then be cooled by a cooling unit 110.

FIG. 13 shows a further modification wherein a closure, cap or lid 90 includes a ring or series of nibs 92 extending circumferentially about the underside of closure 90 for being contacted by the peripheral edge of liner 38 to center the liner 38 and maintain it in proper position while the closure is placed upon a container during the closing operation.

FIG. 14 illustrates an existing, prior art, traditional threaded container 72, threaded closure 73 and liner 74. In accord with the present invention, it is seen that a bottom part of the circumferential skirt 75 is to be eliminated, as is an upper part of the container finish 76. The result is shown in FIG. 15 wherein liner 38 has its adhesive side 39 heat sealed to a container tongue 78 and closure 80 is a "Push-On, Push-Off" closure. The weight reduction of the container finish 76 is approximately 5 grams for a container of 63mm finish and the closure skirt portion 75 is also a meaningful change resulting in significant cost savings.

The lines A and B shown on FIGS. 14 and 15 represent the identical fill level for both designs of finish and closures. The savings in material through utilizing the closure cap and container of FIG. 15, rather than the prior art structures of
FIG. 14, is economically meaningful.

FIG. 16 is a fragmentary showing of a production line for preforming liners 38 from a web of liner material 82 that on its upperside is coated with a thin layer of adhesive 83. Web 82 moves in the direction of arrow 84 and passes beneath a forming tool 86 which shapes the outline of a desired liner 38. The web 82 continues and is acted upon by a punch 88 that inserts liner 38 into an underlying closure 52 first shown in FIG. 7 and shown in cross section in FIG. 17. It is to be understood that the same procedure is used for inserting a liner 38 into closures 30, 64 and 80, described above.

FIGS. 18 and 19 are both examples of prior art closures wherein the end panels wherein the central end panel closures 12 are joined to depending skirt portions 14 at right angles 15. In the embodiment of FIG. 18 there is provided a preformed gasket 17, generally rectangular in section, that extends circumferentially about the skirt 14. In the embodiment of FIG. 19, a gasket 19 of moldable resilient material is applied within the right angle corner where the end panel closure 12 meets the skirt portion 14.

FIG. 20 is an improvement over the embodiments of FIGS. 18 and 19. A gasket 25 of moldable resilient material is provided where the end panel 21 meets with the depending skirt portion 23. In view of the tapered tongue 56 on the container 54, similar to the showing in FIG. 8, the gasket 25 is caused to conform to the tapered tongue 56 and capture a peripheral
portion of liner 38 and place it in shear. A pull tab 70 assists the consumer in initially pealing the liner from the container 54.

FIG. 21 illustrates a closure cap 120 for a blow molded container 122 having a horizontally, inwardly, extending flange 124. Closure cap 120 holds liner 38 against flange 124 during induction heating for causing adhesive 39 to secure the liner 38 to flange 124. This embodiment of the invention is useful for vacuum packed products wherein liner 38 tends to be drawn into the container 122 but is securely held, in shear, to the top surface of flange 124.

FIG. 21 also illustrates a feature of the invention with respect to the width of the container flanges and the sealing area between the respective liners 38 and adhesive layer 39 of the various disclosed embodiments. The dimension D in FIG. 21 may be in the range of 0.050 to 0.250 inches, or wider for larger containers. These dimensions are suitable for hot packed, retorted product, or for vacuum packed products, and maintains the liners adhered to the container flanges in shear condition.

Modifications and variations as would be apparent to those skilled in the art are deemed to be within the scope of the present invention as defined by the appended claimed subject matter.
CLAIMS

1. The combination of a container for a product and a closure cap used for closing said container;
said container including a top flange portion defining a container opening and having an engagement surface;
said closure cap having a complementary engagement surface;
a liner disposed between said top flange portion of container and said closure cap;
said liner having a peripheral portion captured between said engagement surface of said top flange portion of container and said complementary engagement surface of said closure cap.

2. The combination as defined in claim 1 wherein said engagement surface of said top flange portion of said container and said complementary engagement surface of said closure cap are slanted outwardly and downwardly of a central portion of said container.

3. The combination as defined in claim 1 including a layer of adhesive material located between said liner and said top flange portion of said container.

4. The combination as defined in claim 3 wherein at least said peripheral portion of said liner is composed of metal foil.

5. The combination as defined in claim 3 wherein at least said top flange portion of said container includes a
metal surface.

6. The combination as defined in claim 1 wherein said top flange portion of said container is comprised of a tongue member extending upwardly and inwardly at an uppermost portion of said container and extends circumferentially about said container.

7. The combination as defined in claim 6 wherein said closure cap includes a non-horizontal, circumferential, slanted surface complementing and cooperating with said tongue member of said container for capturing said peripheral portion of said liner therebetween.

8. A closure cap for a container, said closure cap including a top portion and a skirt portion joined to and circumscribing said top portion and depending therefrom, and a slanted surface on an underside of said top portion adjacent to where said skirt portion is joined to said top portion, and said slanted surface extending about an interior periphery of said container cap.

9. A closure cap as defined in claim 8 wherein said slanted surface is composed of a moldable resilient material.

10. A process for sealing a container, said process including the steps of:
   a. providing a container for containing a product, said container having a flat, peripheral surface defining an open end of said container;
   b. providing a foil liner comprised of a layer of foil
coated with a layer of heat activated adhesive;

c. filling said container with a product;

d. placing said foil liner across said open end of said container with a portion of said layer of heat activated adhesive in contact with said flat, peripheral surface of said container;

e. applying pressure to said foil liner for holding it against said container; and

f. applying heat to said foil liner for activating said adhesive and sealing said foil liner to said flat, peripheral surface of said container.

11. A process as defined in claim 10 including the step of inserting said foil liner into a push on-push off plastic closure into engagement with a circumferential ring member for engaging a peripheral edge of said liner for centering and holding said liner in place, pushing said plastic closure onto said open end of said container for accurately positioning said foil liner in engagement with said flat, peripheral surface and applying said pressure to said foil liner.

12. A process as defined in claim 11 including the step of exposing said foil liner to induction heating for activating said adhesive.

13. A container for containing a product, said container having a flat, peripheral surface defining an open end of said container; said peripheral surface comprising a smooth flange portion for providing an area for adhering to a complementary
14. A container as defined in claim 13 wherein said flange portion has a radial length in the range of at least 0.025 to 0.250 inch.

15. A container as defined in claim 13 wherein said flange portion is disposed horizontally, and extends radially inwardly of said container.
### A. CLASSIFICATION OF SUBJECT MATTER

**IP(C8) - B65D 23/00 (2014.01)**  
**USPC - 215/232**

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

| IPC(8): B65D 23/00 (2014.01) | USPC: 215/232 |

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

| IPC(8): B65D 23/00 (2014.01) | USPC: 215/43-45,224,232,233,274,277,316,318,326,327,341,343; 220/359.2,359.4 (keyword limited; terms below) |

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PubWEST (PGPB, USPT, USOC, EPAB, JPAB); PatBase; Google (Patents, Scholar, Web) Search terms used: container closure seal liner cap top slant angle outward away inward radial open foil metal adhesive pressure heat activated flange lip molded resilient inclined capture secure upper taper lid induction flat planar under

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 4,209,128 A (ELIAS) 24 June 1980 (24.06.1980), entire document, especially Fig 3, 9; col 1, In 16-17; col 2, In 45-49; col 3, In 9-29, In 59-62</td>
<td>1-5</td>
</tr>
<tr>
<td>X</td>
<td>US 5,992,658 A (BERGER) 30 November 1999 (30.11.1999), entire document, especially Fig 1; col 2, In 60 to col 3, In 2; col 3, In 10-19, In 38-45</td>
<td>1, 3, 6, 7</td>
</tr>
<tr>
<td>X</td>
<td>US 2,388,738 A (GUDHEIM) 13 November 1945 (13.11.1945), entire document, especially Fig 1-2; pg 1, col 1, In 5-13; pg 1, col 2, In 28-54; pg 2; col 1, In 45-51</td>
<td>1, 3</td>
</tr>
<tr>
<td>X</td>
<td>US 3,255,909 A (MILLER et al.) 14 June 1966 (14.06.1966), entire document, especially Fig 1-3; col 1, In 9-11; col 2, In 18-20, In 23-28, In 36-40, In 44-46</td>
<td>8, 9</td>
</tr>
<tr>
<td>X</td>
<td>US 4,531,649 A (SHULL) 30 July 1985 (30.07.1985), entire document, especially Fig 1, 2, 5, 7; 8; col 2, In 21, In 47-49, In 59</td>
<td>13, 15</td>
</tr>
<tr>
<td>Y</td>
<td>US 2008/0190880 A1 (NEEDHAM et al.) 14 August 2008 (14.08.2008), entire document, especially Fig 5; para [0001], [0027], [0029], [0030], [0035], [0040]-[0042], [0045], [0046], [0048], [0053], [0055]</td>
<td>10-12</td>
</tr>
<tr>
<td>A</td>
<td>US 5,325,976 A (VALYI et al.) 05 July 1994 (05.07.1994), entire document, especially Fig 2; col 3, In 18-43</td>
<td>8, 9</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C.

- Special categories of cited documents:
  - "A" document defining the general state of the art which is not considered to be of particular relevance
  - "E" earlier application or patent but published on or after the international filing date
  - "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  - "O" document referring to an oral disclosure, use, exhibition or other means
  - "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "$A$" document member of the same patent family

**Date of the actual completion of the international search**

15 April 2014 (15.04.2014)

**Date of mailing of the international search report**

19 MAY 2014

**Name and mailing address of the ISA/US**

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents  
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