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(54) Method and apparatus for assembling a closure

(57) There is described a method of assembling a closure comprising the steps of providing a web (74) of a sealing medium, the web defining one or more circular apertures (86); urging an insert (14) into a circular aperture within the web; and cutting a circle (90) in the web. The circle (90) is concentric with and of a larger diameter than the aperture (86) so as to form from the web an annulus of the sealing medium in an assembled configuration with the insert.

There is also described a closure assembly apparatus and an annulus of a sealing medium.

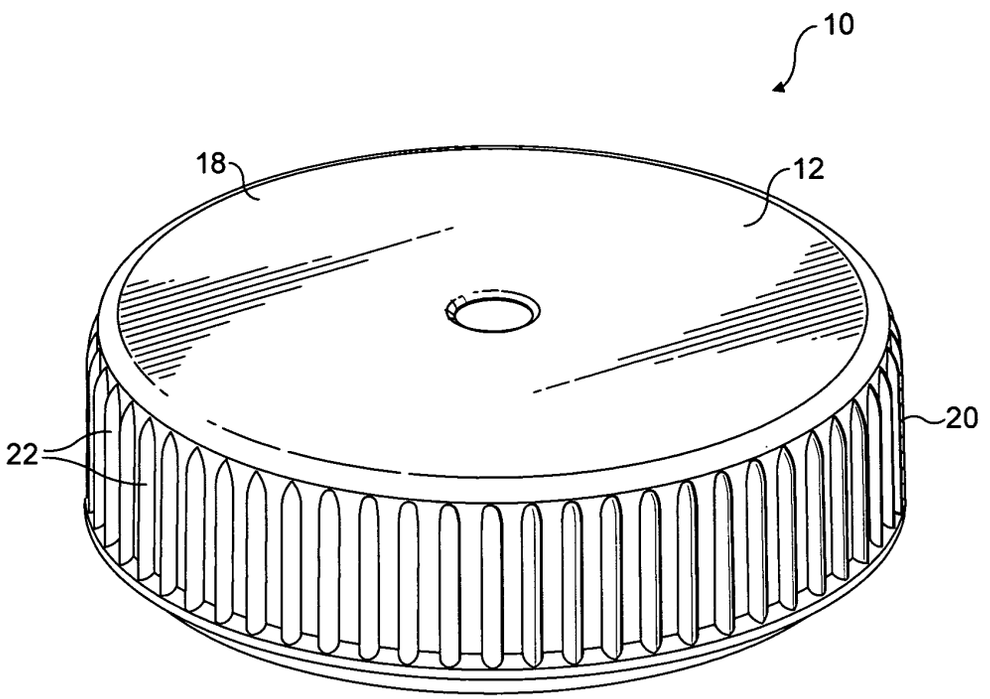

FIG. 1

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Description

[0001] The present invention relates to a method and apparatus for assembling a closure and to an annulus of a sealing medium.

[0002] It is well known to package potable fluids such as water, milk and fruit juices in plastics containers. However, the problems associated with the leakage of fluids from such containers is equally well known. One of the main causes of these leaks, apart from damage to the container or its closure (for example, during transportation), is the failure to achieve an adequate seal between the container and the closure. This difficulty is compounded by the fact that the container and the closure are manufactured by fundamentally different processes and often by different producers. For example, milk has conventionally been packaged in blow-moulded plastics containers, whereas the associated resealable closures are typically formed by injection moulding. As is well known, there is a disparity in the manufacturing tolerances of blow-moulded plastics products and injection-moulded plastics products. For example, the tolerance of the diameter of the neck of the container may be of the order of $\pm$ 0.3 mm, whereas the tolerance of the diameter of the closure may be $\pm$ 0.1 mm. This inevitably leads to a substantial number of closures and bottle necks not fitting together tightly and forming an adequate seal. This problem is only exacerbated by the fact that the closures and the containers are often manufactured by different producers and at different sites. Accordingly, it is not until the closures are applied to the containers in a bottling plant and after the containers have been filled that it is known whether or not an adequate seal between a particular container and a particular closure has been made.

[0003] A number of attempts to address the problem of providing an adequate seal between a container and its respective closure have been made. One approach has been to form an annular plug on an underside of the closure which, in use, engages the bore defined by the container neck to form a primary seal. However, the effectiveness of this seal still depends on the dimensional compatibility of the closure and the container.

[0004] Another more recent approach has been to provide a two-part closure, comprising a neck portion and a complementary cap, both formed of injection-moulded plastics. The neck portion is permanently bonded to a still blow-moulded plastics container, with the result that the active seal can be provided between two components made to the same tolerance specifications. However, to date such an arrangement has resulted in the shape of the container and/or cap being different from the conventional silhouette. In particular, in order to accommodate the injection molded neck portion the finished container/closure combination has had to be of increased height or else the blow-molded plastics container has had to be of reduced dimensions. As a result, it is not possible to use existing industry standard bottling equipment, which is a clear disincentive for producers to move to this design of closure.

[0005] In order to address the problems of the prior art the applicant has devised a closure, which will be described in more detail below, and which comprises a cap and an insert. The cap preferably has a conventional silhouette; that is, its external dimensions (such as its height and diameter) are the same as those of existing caps, thereby enabling the cap to be handled using existing capping equipment. At the same time, the insert is designed to fit inside a bore of the container so that neither the height of the container prior to filling nor the height of the container/closure combination is compromised by the presence of the insert. The insert is shaped so as to engage, in use, both the cap and the container neck. A downwardly extending cylindrical wall of the insert is received within the neck of the container. Merging with the downwardly extending cylindrical wall is a radially outwardly extending annular flange, which overlies a rim of the container neck. The insert is bonded or otherwise secured to the container neck by means of a sealing medium interposed between the annular flange and the rim while, at an opposite end, the downwardly extending cylindrical wall is closed by a removable membrane. An annular plug disposed on an underside of the cap is arranged to engage an interior surface of the downwardly extending cylindrical wall to provide a primary seal between the insert and the cap.

[0006] There exist a number of techniques for bonding the insert, and in particular the annular flange, to the container neck. For example, the sealing medium may be extruded, sprayed, painted or otherwise applied. One particularly preferred technique is to employ a sealing medium with sufficient structural integrity to be capable of forming an annular ring which may be received within an annular recess disposed in an under surface of the annular flange. For example, the sealing medium may comprise an electrically conductive annular substrate coated on one or both sides with a layer of heat-activated adhesive. With suitable stimulation, eddy currents may be generated within the annular substrate, the resulting heat being sufficient to cause the adhesive flow and bond the insert to the rim of the container.

[0007] One material suitable for this purpose is a metallic foil, such as an aluminium foil. However, conventional techniques for cutting metallic foils to shape have a number of problems associated with them. Metallic foils for use in sealing media are very thin and typically of the order of 0.10mm to 0.35mm thick depending on whether a support layer, such as a foam is present. Where no support layer is provided the thickness of the foil may be reduced to less than 0.25mm but as a result, the foil tends to wrinkle during cutting, or on placement within the annular recess. This may lead to uneven sealing between the insert and container as a result of the foil not resting uniformly upon the rim of the container neck. This same wrinkling may also lead to misalignment of the metallic foil with either of the annular flange

or the rim. With known foil-cutting techniques, therefore, there is a clear risk of the occurrence of leaks.

[0008] Accordingly, it would be desirable to provide a foil cutting apparatus and method which does not cause or permit the resulting annular rings to wrinkle.

[0009] The present invention aims to address the above objectives by providing an improved method and apparatus for assembling a closure and an improved annulus of a sealing medium.

[0010] According to a first aspect of the present invention, there is provided a method of assembling a closure, comprising the steps of: providing a web of a sealing medium, the web defining one or more circular apertures; urging an insert into a circular aperture within the web; and cutting a circle in the web, the circle being concentric with and of a larger diameter than the aperture, so as to form from the web an annulus of the sealing medium in an assembled configuration with the insert.

[0011] Advantageously the method may comprise the prior step of cutting the web to form said one or more circular apertures. Preferably the method may further comprise the step of providing relative movement between the web and a stripper plate to remove any unwanted remnants of the web from the or each aperture after the web has been cut to form said one or more circular apertures.

[0012] Advantageously the insert and the aperture may be sized so as to provide a frictional or interference fit therebetween.

[0013] Advantageously the insert may comprise a generally cylindrical portion and a flange disposed at a first end of the cylindrical portion, the step of urging an insert into a circular aperture within the web may then comprise urging the cylindrical portion into the aperture until the flange abuts the web. Preferably a second end of the generally cylindrical portion opposite the first may be rounded radially inwardly to facilitate initial reception of the insert within the aperture defined by the web. Preferably the generally cylindrical portion may taper radially inwardly in a direction away from the flange to facilitate initial reception of the insert within the aperture defined by the web.

[0014] Advantageously the circle may be cut with a diameter not greater than an outer diameter of the flange. Preferably the flange may comprise an annular recess and the circle may be cut with a diameter substantially equal to, or less than, an outer diameter of the annular recess, such that the annulus of the sealing medium is formed and retained within the recess. Preferably the step of cutting the circle may be performed by a punch, the operation of the punch forcing the resulting annulus into the annular recess.

[0015] Advantageously the method may further comprise the step of urging the assembled insert and annulus away from the web with a follow-through punch, following the step of cutting the circle in the web. Preferably the step of urging the assembled insert and annulus away from the web may comprise urging the assembled insert and annulus into a cap to form a closure assembly. Preferably the method may comprise the step of delivering an inverted cap to a resilient receiving means with an interior of the cap facing the assembled insert and annulus, the receiving means accommodating movement of the cap during assembly of the closure.

[0016] Advantageously the sealing medium may comprise a metallic foil coated with an adhesive.

[0017] According to a second aspect of the present invention there is provided a closure assembly apparatus, comprising: web drawing means arranged to draw a web of a sealing medium through the apparatus, the web defining one or more circular apertures; an insert pusher, adapted to urge an insert into a circular aperture within the web; and a first punch located downstream of the insert pusher and adapted to cut a circle in the web, the circle being concentric with and of a larger diameter than the aperture, such that an annulus of the sealing medium is formed from the web in an assembled configuration with the insert.

[0018] Advantageously the closure assembly may further comprise a second punch located upstream of the insert pusher, the second punch being adapted to cut the web to form said one or more circular apertures. Preferably a stripper plate may be located between the second punch and the insert pusher, the stripper plate being adapted to remove any unwanted remnants of the web from the or each aperture.

[0019] Advantageously the insert may comprise a generally cylindrical portion and a flange disposed at a first end of the cylindrical portion, the insert pusher being adapted to urge the cylindrical portion into the aperture until the flange abuts the web. Preferably the first punch may be adapted to cut the circle with a diameter not greater than an outer diameter of the flange. Preferably the flange may comprise an annular recess and the first punch may be adapted to cut the circle with a diameter substantially equal to, or less than, an outer diameter of the annular recess. Preferably in addition to cutting the circle, the first punch may be adapted to force the resulting annulus into the annular recess.

[0020] Advantageously the first punch may further comprise a follow-through punch adapted to urge an assembled insert and annulus away from the web following cutting of the circle by the first punch. Preferably the closure assembly apparatus may further comprise receiving means aligned with the follow-through punch and adapted to hold an inverted cap with an interior of the cap facing the assembled insert and annulus, the follow-through punch being further adapted to urge the assembled insert and annulus into the cap to form a closure assembly. Preferably the receiving means may be resilient and adapted to accommodate any movement of the cap during assembly of the closure.

[0021] According to a third aspect of the present invention there is provided an annulus of a sealing medium formed according to any of the previously described methods and/or having a thickness of between 0.05mm

and 0.35mm and a radial distance between an outer circumference and an inner circumference of less than 4mm.

[0022] Advantageously the annulus may have a thickness of between 0.10mm and 0.25mm and a radial distance between an outer circumference and an inner circumference of between 1mm and 3mm.

[0023] Advantageously the sealing medium may comprise a metallic foil coated with an adhesive. Preferably the adhesive may be disposed on opposing sides of the metallic foil. Preferably the adhesive may comprise a heat-activated adhesive.

[0024] A preferred embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a closure;
Figure 2 is a cross-sectional view of the closure of Figure 1, showing the closure inverted and comprising a cap, an insert and an annular foil sealing medium;
Figure 3 is a perspective view of the closure of Figure 1 bonded to a container neck;
Figure 4 is a schematic cross-sectional view of a foil cutter and closure assembly;
Figure 5 is a schematic plan view of a foil web;
Figure 6 is a schematic cross-sectional view of an insert pusher subassembly of the assembly of Figure 4;
Figure 7 is an enlarged schematic cross-sectional view of a master punch and follow-through punch subassembly of the assembly of Figure 4;
Figure 8 is a cross-sectional view of the insert and annular foil in combination, prior to insertion into the cap; and
Figure 9 is a perspective view of the combination of Figure 8, prior to insertion into the cap.

[0025] Referring to Figures 1 and 2, there is shown a closure 10 comprising a cap 12, an insert 14 received within the cap, and an annular foil 16. The cap 12 which forms part of the closure 10 preferably has a conventional silhouette. In other words, its external dimensions, for example, its height and diameter are the same as those of existing caps and the cap 12 may therefore be handled using existing capping equipment.

[0026] As shown in Figures 1 and 2, the cap 12 comprises a circular top 18, which merges at a radially outer edge with a depending annular side wall 20. On an exterior surface of the depending annular side wall 20, there are provided a plurality of circumferentially spaced, vertically extending ribs 22, which serve as knurls to facilitate the gripping of the cap 12 by a user. On an interior surface of the depending annular side wall 20, there is provided engagement means 24 for repeated and releaseable engagement with complementary engagement means (not shown) provided on a neck of a container with which the closure 10 is to be used. In this embodiment, the engagement means 24 comprises a male helical thread configuration; but other engagement means 24 may be used.

[0027] In addition to the engagement means 24, the interior of the cap 12 is also provided with an annular plug 26, which depends from an under surface 28 of the circular top 18. The annular plug 26, is spaced radially inwardly of the depending annular side wall 20 and extends generally perpendicularly from the under surface 28. A distal, radially outer edge 27 of the annular plug 26 is bevelled for reasons that will be explained below. As will be understood, the annular plug 26 has a degree of resilience and is capable of flexing in a radial direction.

[0028] The insert 14, which is sized and shaped so as to be received within the neck of a container, is defined, in part, by a cylindrical wall 30. At a first end, the cylindrical wall 30 merges with a radially outwardly extending annular flange 32 while at an opposite end, the cylindrical wall 30 merges with a generally downwardly and radially inwardly directed annular wall 36. The annular wall 36 would define a circular aperture but for the provision of a membrane 34 which spans the aperture and is joined to the annular wall 36 by a narrow annular web 38. The annular web 38 defines a line of weakness in the insert 14 and is frangible upon user initiation.

[0029] A pull-ring 40, defined by an annular band, merges with the membrane 34 via a connection 41. The connection 41 merges with the circular membrane 34 at a location radially inward of, and adjacent to, the annular web 38. In this way, a user may pull against the annular ring of the pull-ring 40 and cause the circular membrane 34 to tear around the annular web 38, thereby providing access to the contents of the container to which the closure 10 is affixed.

[0030] In an assembled closure 10, the insert 14 is held in place by means of engagement between the annular plug 26 of the cap 12 and an inner surface of the cylindrical wall 30. In this configuration, the annular flange 32 confronts a portion of the under surface 28 of the circular top 18 while the pull-ring 40 is housed within a volume defined by an inner wall of the annular plug 26, the remainder of the cylindrical wall 30, the membrane 34 and the circular top 18.

[0031] The annular flange 32 of the insert 14 is defined by an upper surface 42, which slopes upwardly and radially outwardly before terminating in an annular pour lip 44. A lower surface of the annular flange 32 is provided with an annular recess 46, which extends from a radially outer surface of the cylindrical wall 30 and is bound, at an end of the annular flange 32 remote from the cylindrical wall, by an outer annular lip 48. In this embodiment, the annular foil 16 is housed within the annular recess 46 of the insert 14.

[0032] The annular foil 16 serves as a sealing medium, to bond the lower surface of the annular flange 32 to a rim of the neck of the container with which the closure 10 is to be used. The sealing medium comprises

an electrically conductive substrate, coated on opposed surfaces with respective first and second layers of an adhesive. The electrically conductive substrate may be formed of any of the materials conventionally used for providing a heat seal in existing plastics containers and may, for example, comprise a metallic foil such as an aluminium foil. Likewise, the one or two layers of adhesive may be of any commercially available type, which is capable of bonding with the surrounding plastics material once activated by, for example, the application of heat. The foil, including the or each layer of adhesive, may have a thickness of between 0.05mm and 0.35mm depending on whether or not a support layer, for example, a foam is also present and preferably has a thickness of between 0.10mm and 0.25mm. In a currently preferred embodiment in which no support layer is present the sealing medium represented by the metallic foil and the or each layer of adhesive has a thickness of between 0.10mm and 0.15mm. Figure 3 shows a closure 10 fitted in sealing engagement with a neck (not shown) of a container 50.

[0033] The closure 10 is assembled by first assembling the insert 14 and the sealing medium, or annular foil 16. This will be described in greater detail below, but generally involves inserting the cylindrical wall 30 through a central aperture of the annular foil 16. In any case the assembly is facilitated by the rounded nature of the radially inwardly directed annular wall 36 of the insert 14.

Although in the described embodiment, the annular foil 16 is received within the annular recess 46, nevertheless it is preferably retained in place by means of a friction fit with the radially outer surface of the cylindrical wall 30. Thus the provision of the outer annular lip 48 is preferably for cosmetic purposes only and serves to conceal the presence of the annular foil 16, rather than to retain it in position. Indeed, in some embodiments, the outer annular lip 48 may be omitted.

[0034] Having assembled the insert 14 and annular foil 16, the two are then assembled with the cap 12. In so doing, the annular plug 26 of the cap 12 is received within the bore defined by the inner surface of the cylindrical wall 30.

The receipt of the annular plug 26 in this way is facilitated by the bevelled nature of the plug. Nevertheless, the annular plug 26 is so arranged as to be required to flex radially inwardly in order to be received within the bore. In this way, once the annular plug 26 has been fully received, the resilience of the material forming the plug causes an outer wall of the plug to be urged into sealing engagement with the inner surface of the cylindrical wall 30.

[0035] It will be noted that the limit to which the annular plug 26 can be received within the bore defined by the cylindrical wall 30 is determined by the engagement of the upper surface 42 of the annular flange 32 with the under surface 28 of the circular top 18 of the cap 12. However, even in the fully received position, the pull-ring is arranged such that it remains spaced from and does not abut the cap 12.

[0036] The closure 10, comprising the cap 12, the insert 14 and the annular foil 16 is now fully assembled. However, all of the components are received within the cap 12 with the result that the external dimensions of the closure 10 are the same as those of the cap 12 which, as stated previously, may be entirely conventional. As a result, the assembled closure 10 may be manipulated and applied using conventional processing and capping equipment.

[0037] Referring now to Figure 4, there is shown a closure assembling apparatus according to an embodiment of the present invention. The apparatus comprises a workbench 60, which accommodates a disc punch 62, a stripper plate 64, an insert pusher 66, a master punch 68, a follow-through punch 70, and a resilient receiving stand 72. Web drawing means (now shown) is also provided to draw a foil web 74 across the workbench 60 during operation. Looking at Figure 4, an upstream location of the apparatus is towards the left-hand side of the Figure and a downstream location of the apparatus is towards the right-hand side of the Figure; that is, the foil web 74 is drawn from left to right.

[0038] The disc punch arrangement comprises a disc punch die 76, incorporated into the workbench 60, and a disc punch bed 78 for receiving the disc punch 62. Upon operation of disc punch 62, the disc punch is urged downwards into the disc punch bed 78, thereby cutting a foil disc from the foil web 74. The disc punch 62 is then drawn out of the disc punch bed 78, to its original position leaving the foil disc cut from the web 74 to fall downwards away from the web.

[0039] The stripper plate 64 is fixed to the workbench 60 at a location downstream of the disc punch 62 and is arranged so that the foil web 74 rests upon and is drawn over the stripper plate. In this way, any loose, redundant fragments of foil web 74 are removed by the stripper plate 64.

[0040] The insert pusher 66, located downstream of the stripper plate 64, is cam operated and arranged to move up and down periodically. An insert pusher opening 80 formed in the workbench 60 is sized so as to receive the insert pusher 66, such that the insert pusher may rise to a point at which its upper surface is substantially flush with an upper surface of the workbench. The operation of the insert pusher 66 is synchronised with the drawing of the foil web 74, such that the insert pusher extends to its maximum reach when an aperture formed by the cutting out of the foil disc is located above the insert pusher opening 80.

[0041] The master and follow-through punch arrangement comprises a master punch die 82, incorporated into the workbench 60, and a follow-through punch opening 84, for receiving the follow-through punch 70. The follow-through punch (also known as a follow-through pusher) is concentrically housed within the master punch 68. Actuation of the master punch 68 results in

the master punch being urged downwards towards the workbench 60. In this case, however, the master punch 68 is not received within an opening in the workbench 60, but remains substantially at or above the workbench. Once the master punch 68 has completed its downward movement, the follow-through punch 70 is actuated and is urged downwards into the follow-through punch opening 84. The follow-through punch 70 is arranged to extend as far as an upper surface of the resilient receiving stand 72. If required, the follow-through punch 70 may be arranged to extend further still, in which case the resilient receiving stand 72 is arranged to accommodate this further extension by deforming resiliently. Once full downward movement of the master and follow-through punch arrangement has been completed, the follow-through punch 70 is withdrawn from the follow-through punch opening 84 and both the master punch 68 and follow-through punch are drawn back towards their starting positions. The master punch 68 and follow-through punch 70 are each synchronised in a similar manner to the insert pusher 66, such that their downward movement coincides with the arrival of an aperture formed within the foil web 74.

[0042] Operation of the apparatus and a method for assembling a closure of the type previously described will now be described with reference to Figures 4 to 9. The foil web 74 is arranged to be drawn intermittently across the workbench 60 by the drawing means (not shown) by predetermined increments. While the foil web 74 is stationary, the disc punch 62 is arranged to stamp out a foil disc from the foil web. This is achieved by urging the disc punch 62 downwards into the disc punch bed 78, so that the disc punch encounters and cuts a circular aperture in the foil web 74. The resulting foil disc (not shown) may be removed via the disc punch bed 78 by suction or gravity and discarded, recycled, or otherwise used. Once the disc punch 62 has extended to its full reach, the disc punch is withdrawn from the disc punch bed 78, back towards its starting position. The foil web 74 is then advanced so that a non apertured portion of the web once again overlies the disc punch bed 78 and the process is repeated.

[0043] Figure 5 shows a foil web 74 where a plurality of disc punches 62 have been used to form an array of circular apertures 86 in the foil web. Each circular aperture 86 is defined by what is left of the foil web 74 and represents an inner circumference 88 of what will become an annular foil 16. The dashed circular lines surrounding each circular aperture 86, represent an outer diameter 90 of the annular foil 16. However, the dashed lines are purely for illustrative purposes and are not a result of the operation of the disc punch 62 on the foil web 74. The outer diameter 90 is concentric with and of a larger diameter than the inner diameter 88, such that, when a circle represented by the outer diameter is cut in the foil web 74 a foil annulus (i.e. the annular foil 16) is formed. Any suitable array of circular apertures 86 may be formed in the foil web 74 and may include a single-line or multi-line array, packed according to the efficiency afforded by the structural integrity of the foil web 74.

[0044] Once the one or more circular apertures 86 have been cut from the foil web 74, the foil web is drawn over the stripper plate 64, which strips off any unwanted remnants of the foil disc from around the edge of the circular aperture. In this way, a well-defined edge to the circular aperture 86 may be assured. The stripper plate 64 may be disposed along the workbench 60 substantially at any point between the disc punch bed 78 and the insert pusher opening 80.

[0045] As the foil web 74 is drawn along the workbench 60, the newly cut circular aperture 86 is advanced from a location above the disc punch bed 78 to a position above the insert pusher opening 80. While the Figures illustrate the described apparatus in cross section and although the openings 78, 80, and 84 may take any suitable form, it will be understood that the openings in this embodiment define cylindrical volumes and at least those parts of the disc punch 62, insert pusher 66, and follow-through punch 70 which are received within the respective opening are also generally cylindrical. Accordingly, the insert pusher opening 80 is aligned in the direction of travel of the web 74 with the disc punch bed 78, so that the circular aperture 86 is substantially concentric with the insert pusher opening when the circular aperture passes above this opening. Likewise, the follow-through punch opening 84 is similarly aligned so that when suitably advanced the circular aperture 86 is substantially concentric therewith.

[0046] As shown in Figures 4 and 6, the diameter of the circular aperture 86 is less than that of the insert pusher opening 80. The diameter of the insert pusher opening 80 is, in fact, such that the opening may readily accommodate an inverted insert 14, when mounted on the upper surface of the insert pusher 66 as shown in Figure 6. Figure 6 shows schematically the insert 14 being held, annular flange-side down, on the insert pusher 66. The insert 14 may be conveyed in this orientation to the insert pusher 66 by any known means. Once the circular aperture 86 has been indexed to a position above the insert pusher opening 80, the insert pusher 66 is urged upwards into the insert pusher opening until the insert pusher is substantially flush with the upper surface of the workbench 60. During this operation, the cylindrical wall 30 of the insert 14 is also urged upwards and into the circular aperture 86. The initial receipt of the cylindrical wall 30 within the circular aperture 86 is facilitated by the fact that the cylindrical wall is connected to the circular membrane 34 by a radially inwardly directed annular wall 36. This receipt may be further facilitated by forming the insert 14 so that the cylindrical wall 30 extends radially inwardly from the flange 32 by a small number of degrees.

[0047] The diameter of the circular aperture 86 is arranged to be substantially equal to or slightly less than that of the exterior of the cylindrical wall 30. In this way,

once the cylindrical wall 30 of the insert 14 has been urged into the circular aperture 86, it is held in place by means of a friction fit.

[0048] The cylindrical wall 30 of the insert 14 is urged into the circular aperture 86 by the insert pusher 66 until a confronting surface of the flange 32 makes contact with the foil web 74 surrounding the circular aperture. At this point, the insert pusher 66 has extended to its maximum reach and is withdrawn downwards, back towards its starting position and ready for receipt of a further insert 14.

[0049] The foil web 74 is then advanced further along the workbench 60, towards the master and follow-through punch arrangement. In order to prevent the upper surface 42, or the annular pour lip 44, of the flange 32 from catching on an edge of the insert pusher opening 80, the insert pusher 66 may be retained at its maximum reach while the foil web 74 and received insert 14 are drawn away from the opening. Nevertheless, the circular aperture 86 and received insert 14 are drawn along the workbench 60 until they are centrally disposed above the follow-through punch opening 84.

[0050] At this point, the master punch 68 is urged downwards, towards the workbench 60, such that a further circle is cut in the foil web 74. This further circle has a circumference corresponding to the outer circumference 90 shown in Figure 5. The outer circumference 90 is concentric with and of a larger diameter than the circular aperture 86, such that an annular foil 16 is cut from the foil web 74 by the action of the master punch 68. It is preferable that the diameter of the outer circumference 90 is not greater than an outer diameter of the annular flange 32, so that when the insert is affixed to a neck of a container, no part of the annular foil 16 protrudes from the flange although this need not necessarily be the case. In one embodiment, the annular flange comprises an annular recess 46, which is intended to house the annular foil 16, once formed. In this case, the diameter of the outer circumference 90 is substantially equal to or less than an outer diameter of the annular recess 46. Thus, upon operation of the master punch 68, the annular foil 16 may actually be formed in place and retained within the annular recess 46. As a result, the insert 14 and annular foil 16 may be assembled in full engagement, the annular foil being held in place as a consequence of the dimensions of the inner and outer diameters of the annular foil and the annular recess 46 respectively. The assembled insert 14 and annular foil 16, of this embodiment, is shown in Figure 8.

[0051] Referring to Figure 7, once the assembled insert 14 and annular foil 16 has been formed, the follow-through punch 70 is actuated. The operation of the follow-through punch 70 urges the assembled insert 14 and annular foil 16 away from the foil web 74, towards the interior of an inverted cap 12 mounted on the receiving stand 72. The follow-through punch 70 forces the assembled insert 14 and annular foil 16 through the follow-through punch opening 84 and into the interior of the cap 12. In this embodiment, the receiving stand 72 is a resilient receiving stand, so that any minor misalignment between the assembled insert 14 and annular foil 16 on the one hand and the cap 12 on the other may be accommodated by correspondingly minor deformations of the stand. In this way, the cap 12 is prevented from being forced away from the assembled insert 14 and annular foil 16 merely because of a misalignment. Figure 9 shows a perspective view of the assembled insert 14 and annular foil 16 as it is urged into engagement with the interior of the cap 12. When the follow-through punch 70 has extended to and withdrawn from its maximum reach, the assembled insert 14 and annular foil 16 are engaged within the cap 12 to form the assembled closure 10 of Figures 1 and 2. The assembled closure 10 may then be conveyed away from the receiving stand 72 by any known means for transportation to a bottling plant for affixing to the necks of containers with which they are to be used. Similarly, further caps 12 may be conveyed to the receiving stand 72, by any known means to receive a respective insert 14 and annular foil 16 assembly.

[0052] The dimensions of each annular foil 16 formed according to the method of the present invention may be such that the annular foil 16 is suitable for use with a wide range of closures. Accordingly, the outer diameter of the annular foil 16 may be between 2cm and 12cm and so may find use with 26mm closures, 28mm closures, 38mm closures, 43mm closures, 65mm closures, 80mm closures and 110mm closures. The radial distance between the outer circumference 90 and the inner circumference 88 of the annular foil 16 may be 4mm or less and preferably may be between approximately 1mm and 3mm. In embodiments of the present invention, for use with milk containers which typically are provided with 38mm closures, the outer diameter of the annular foil 16 is preferably between 34mm and 37mm and most preferably between 35mm and 36mm, while the radial distance between the outer circumference and the inner circumference is preferably approximately 2mm.

[0053] Although one specific form of closure 10 has been described and illustrated in the accompanying Figures, it will be understood that the method and apparatus of the present invention may find use with a number of different designs of closure.

[0054] Any suitable form of punch, follow-through punch, or pusher is envisaged and intended to form part of the present invention. For example, whereas the Figures illustrate a cutting edge formed on each of the disc punch 62 and master punch 68, in another embodiment a circular cutting edge may be disposed below the foil web 74. In this way, a circular aperture 86 may be cut from the foil web 74 by the downward compressive action of the disc punch directly onto the cutting edge, with the foil web disposed therebetween.

[0055] While it is preferable for the circular aperture 86 to be cut from the foil web 74 by the apparatus of the present invention, the foil web may alternatively already

contain the circular aperture. That is, the foil web 74 may be supplied and dispensed with one or more circular apertures 86 already cut therein. As such, the first stage in the assembly of the closure 10 would be the positioning of the insert 14 within the circular aperture 86, by the insert pusher 66.

[0056] The insert pusher 66 may be provided with any suitable means for retaining the insert 14 in position or alignment on the upper surface of the insert pusher 66, such as a circular or annular recess or rim, within which the insert may be mounted. Similarly, although in preferred embodiments, the receiving stand 72 is resilient and capable of maintaining a substantially level attitude of the cap 12 during insertion of the assembled insert 14 and annular foil 16 assembly, the receiving stand may alternatively or additionally comprise a circular or annular recess of rim, to improve alignment of components.

[0057] While the embodiments described above relate to an apparatus comprising only one of each component, any number of such components may be used. Figure 5 illustrates a foil web 74 comprising an array of circular apertures 86 and any array of suitable form and any apparatus configuration for use with such arrays are envisaged and intended to form part of the present invention.

Claims

1. A method of assembling a closure, comprising the steps of:

   providing a web of a sealing medium, the web defining one or more circular apertures;
   urging an insert into a circular aperture within the web; and
   cutting a circle in the web, the circle being concentric with and of a larger diameter than the aperture, so as to form from the web an annulus of the sealing medium in an assembled configuration with the insert.

2. The method of claim 1, further comprising the prior step of cutting the web to form said one or more circular apertures.

3. The method of claim 2, further comprising the step of providing relative movement between the web and a stripper plate to remove any unwanted remnants of the web from the or each aperture after the web has been cut to form said one or more circular apertures.

4. The method of any preceding claim wherein, the insert and the aperture are sized so as to provide a frictional or interference fit therebetween.

5. The method of any preceding claim, wherein the insert comprises a generally cylindrical portion and a flange disposed at a first end of the cylindrical portion, the step of urging an insert into a circular aperture within the web comprising urging the cylindrical portion into the aperture until the flange abuts the web.

6. The method of claim 5, wherein a second end of the generally cylindrical portion opposite the first is rounded radially inwardly to facilitate initial reception of the insert within the aperture defined by the web.

7. The method of any of claims 5 to 6, wherein the generally cylindrical portion tapers radially inwardly in a direction away from the flange to facilitate initial reception of the insert within the aperture defined by the web.

8. The method of any of claims 5 to 7, wherein the circle is cut with a diameter not greater than an outer diameter of the flange.

9. The method of any of claims 5 to 8, wherein the flange comprises an annular recess and the circle is cut with a diameter substantially equal to, or less than, an outer diameter of the annular recess, such that the annulus of the sealing medium is formed and retained within the recess.

10. The method of claim 9, wherein the step of cutting the circle is performed by a punch, the operation of the punch forcing the resulting annulus into the annular recess.

11. The method of any preceding claim, further comprising the step of urging the assembled insert and annulus away from the web with a follow-through punch, following the step of cutting the circle in the web.

12. The method of claim 11, wherein the step of urging the assembled insert and annulus away from the web comprises urging the assembled insert and annulus into a cap to form a closure assembly.

13. The method of claim 12, further comprising the step of delivering an inverted cap to a resilient receiving means with an interior of the cap facing the assembled insert and annulus, the receiving means accommodating movement of the cap during assembly of the closure.

14. The method of any preceding claim, wherein the sealing medium comprises a metallic foil coated with an adhesive.

15. A closure assembly apparatus, comprising:

web drawing means arranged to draw a web of a sealing medium through the apparatus, the web defining one or more circular apertures;
an insert pusher, adapted to urge an insert into a circular aperture within the web; and
a first punch located downstream of the insert pusher and adapted to cut a circle in the web, the circle being concentric with and of a larger diameter than the aperture, such that an annulus of the sealing medium is formed from the web in an assembled configuration with the insert.

16. The closure assembly apparatus of claim 15, further comprising a second punch located upstream of the insert pusher, the second punch being adapted to cut the web to form said one or more circular apertures.

17. The closure assembly apparatus of claim 16, further comprising a stripper plate located between the second punch and the insert pusher, the stripper plate being adapted to remove any unwanted remnants of the web from the or each aperture.

18. The closure assembly apparatus of any of claims 15 to 17, wherein the insert comprises a generally cylindrical portion and a flange disposed at a first end of the cylindrical portion, the insert pusher being adapted to urge the cylindrical portion into the aperture until the flange abuts the web.

19. The closure assembly apparatus of claim 18, wherein the first punch is adapted to cut the circle with a diameter not greater than an outer diameter of the flange.

20. The closure assembly apparatus of claim 18 or claim 19, wherein the flange comprises an annular recess and the first punch is adapted to cut the circle with a diameter substantially equal to, or less than, an outer diameter of the annular recess.

21. The closure assembly apparatus of claim 20, wherein, in addition to cutting the circle, the first punch is adapted to force the resulting annulus into the annular recess.

22. The closure assembly apparatus of any of claims 15 to 21, wherein the first punch further comprises a follow-through punch adapted to urge an assembled insert and annulus away from the web following cutting of the circle by the first punch.

23. The closure assembly apparatus of claim 22, further comprising receiving means aligned with the follow-through punch and adapted to hold an inverted cap with an interior of the cap facing the assembled insert and annulus, the follow-through punch being further adapted to urge the assembled insert and annulus into the cap to form a closure assembly.

24. The closure assembly apparatus of claim 23, wherein the receiving means is resilient and adapted to accommodate movement of the cap during assembly of the closure.

25. An annulus of a sealing medium formed according to the method of any of claims 1 to 14.

26. An annulus of a sealing medium having a thickness of between 0.05mm and 0.35mm and a radial distance between an outer circumference and an inner circumference of less than 4mm.

27. The annulus of claim 25 or claim 26, wherein the annulus has a thickness of between 0.10mm and 0.25mm and a radial distance between an outer circumference and an inner circumference of between 1mm and 3mm.

28. The annulus of any of claims 25 to 27, wherein the sealing medium comprises a metallic foil coated with an adhesive.

29. The annulus of claims 28, wherein the adhesive is disposed on opposing surfaces of the metallic foil.

30. The annulus of claim 28 or claim 29, wherein the adhesive comprises a heat-activated adhesive.

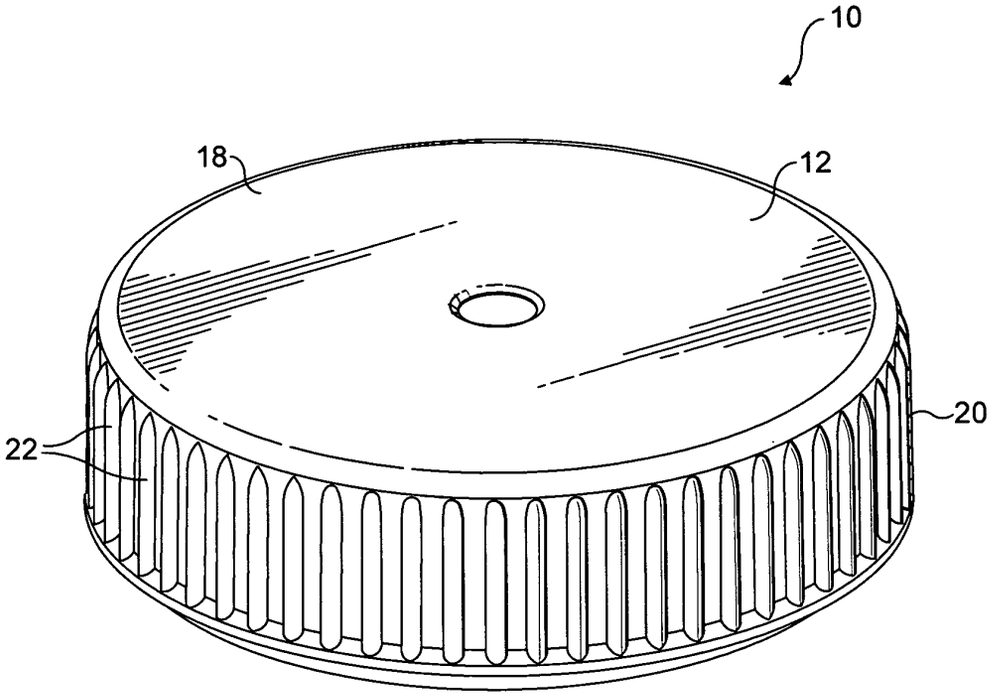
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FIG. 1

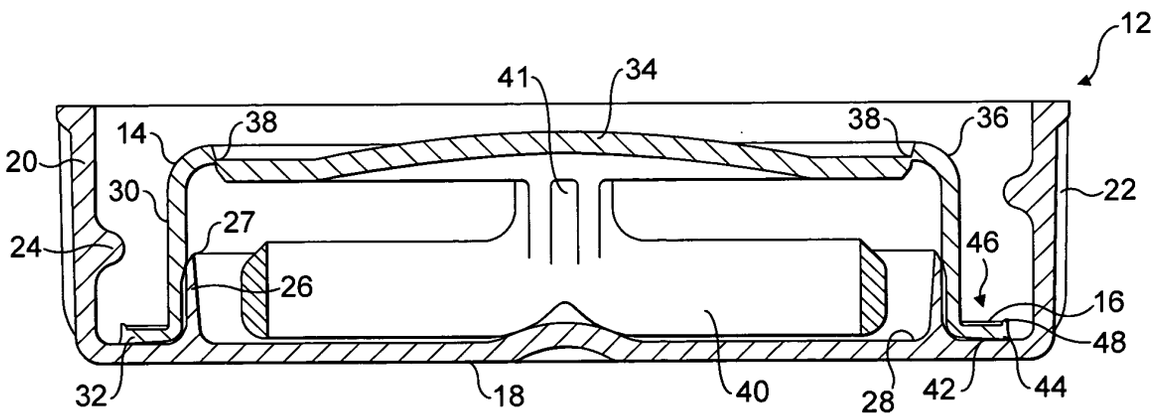
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FIG. 2

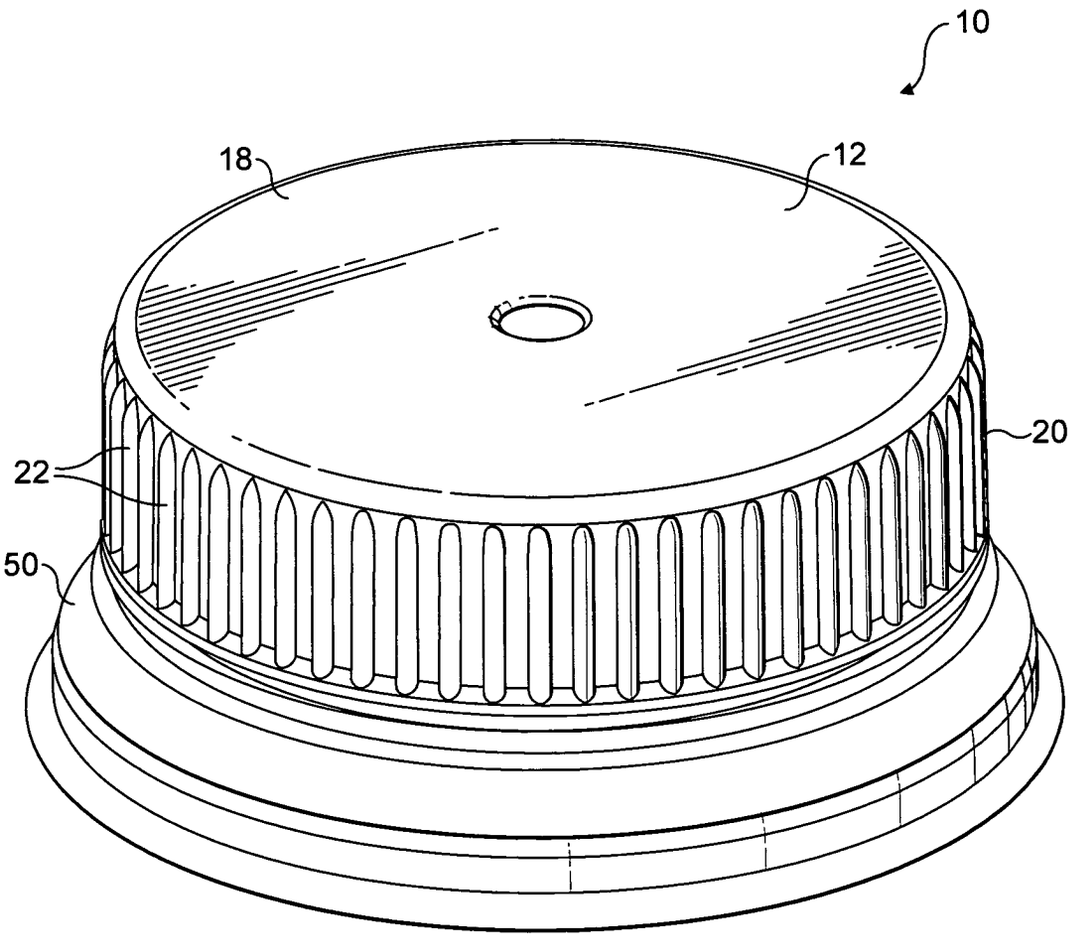

FIG. 3

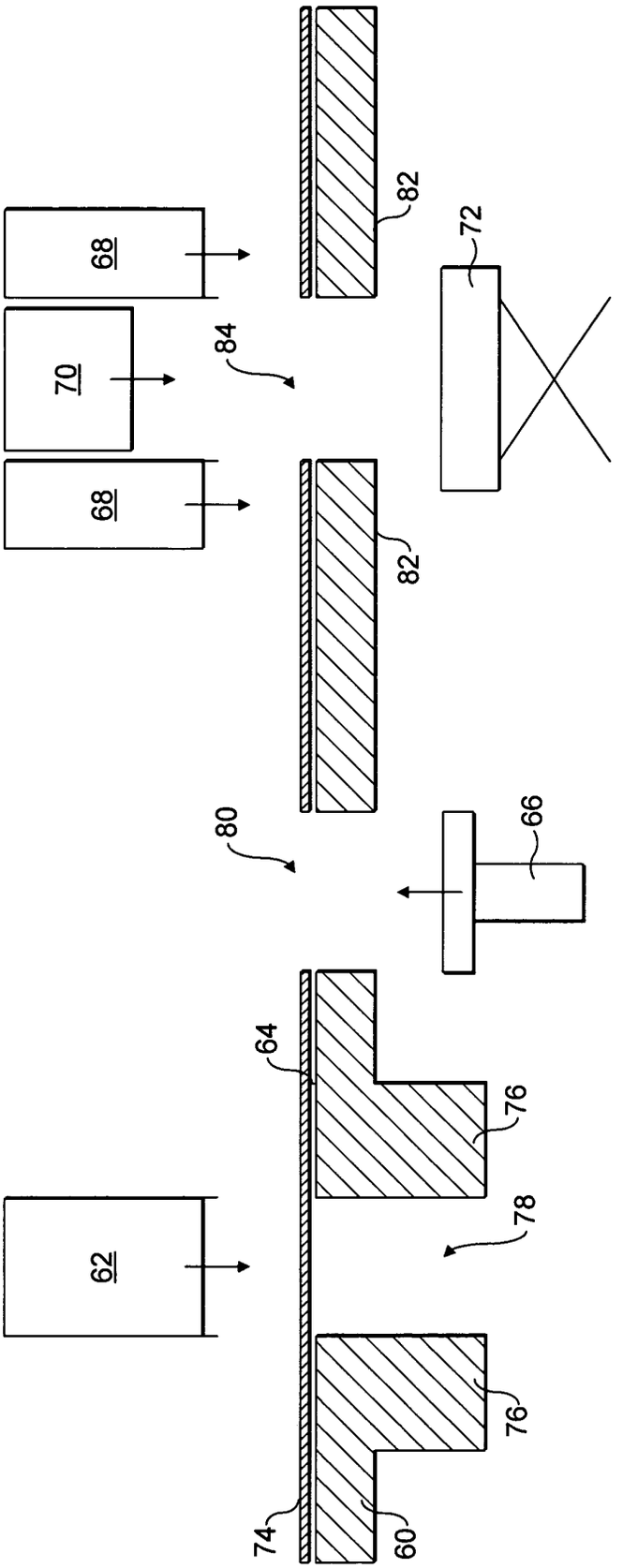

FIG. 4

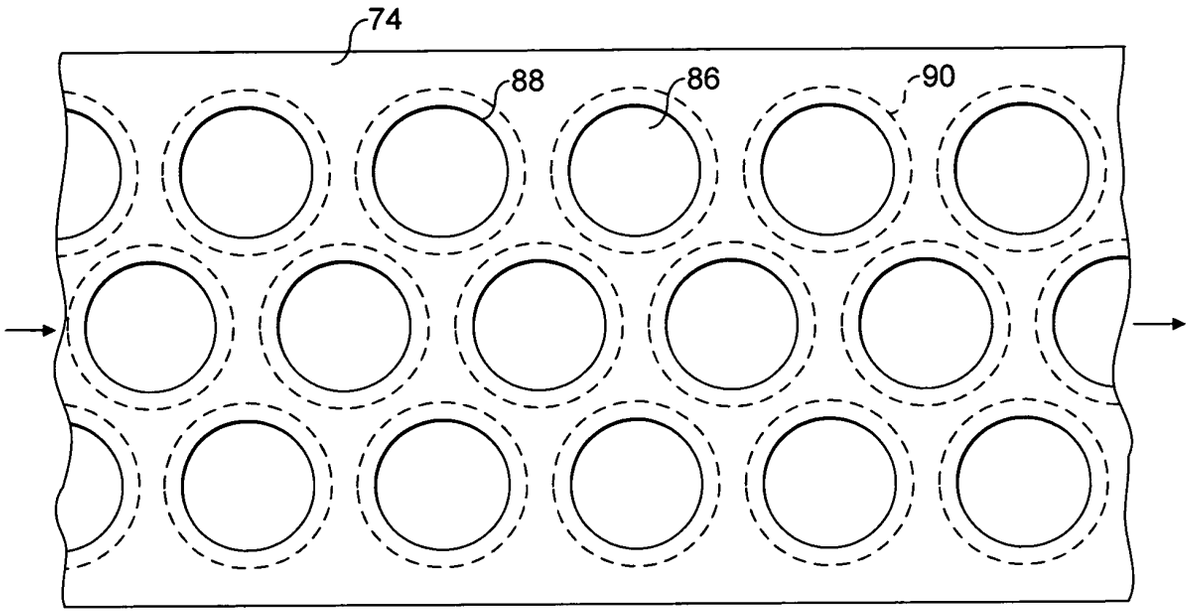

FIG. 5

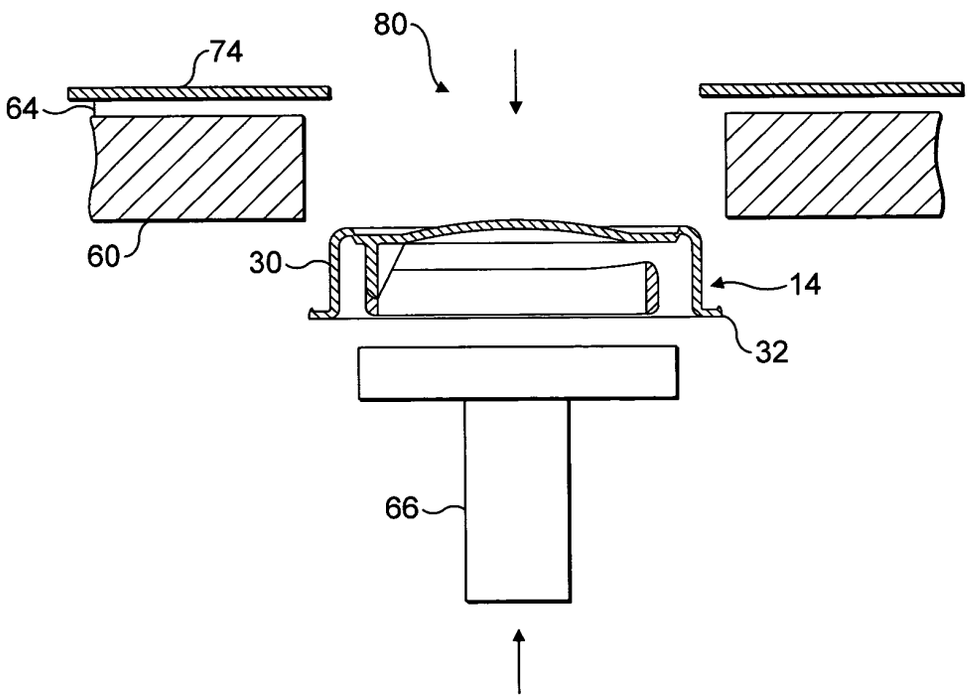

FIG. 6

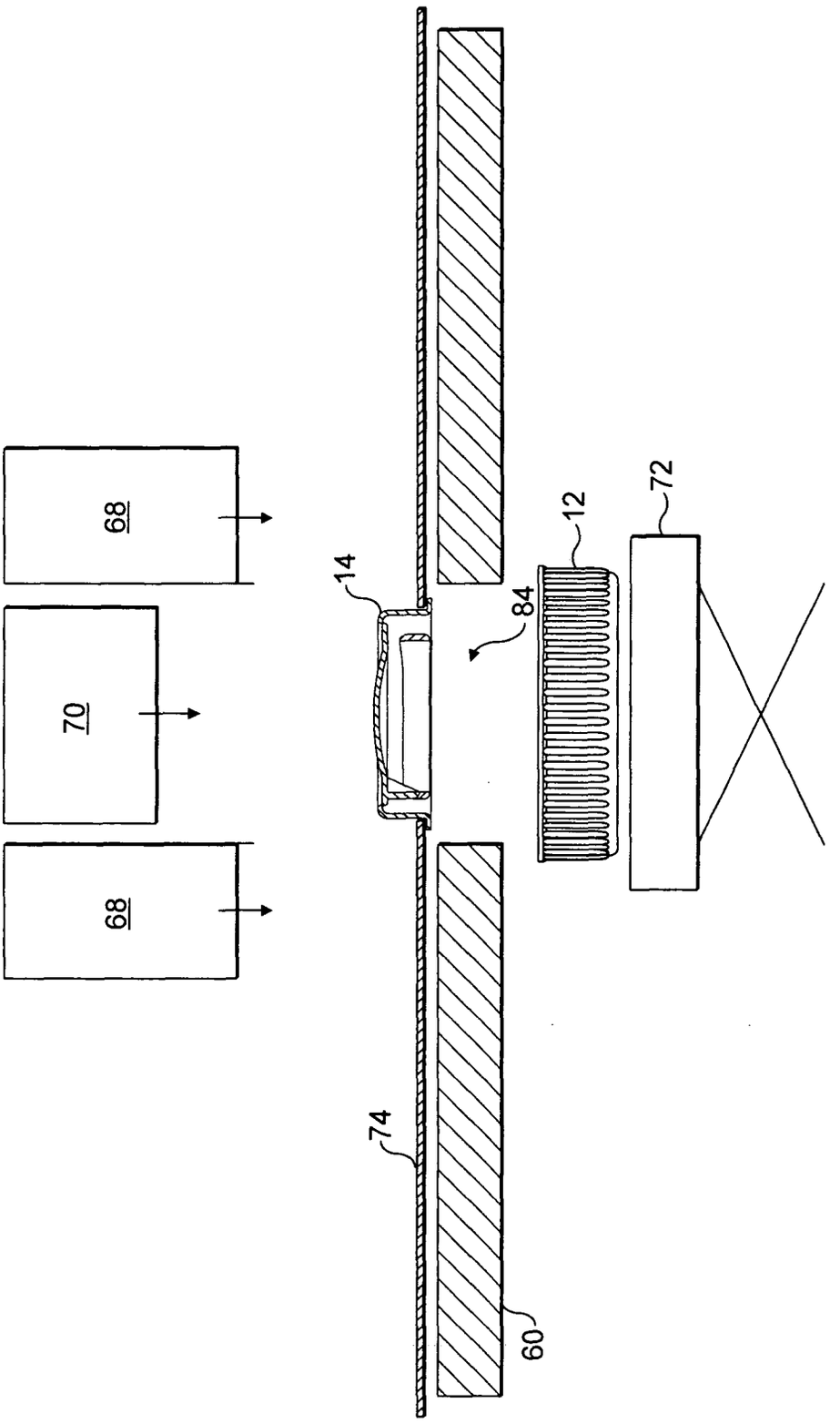

FIG. 7

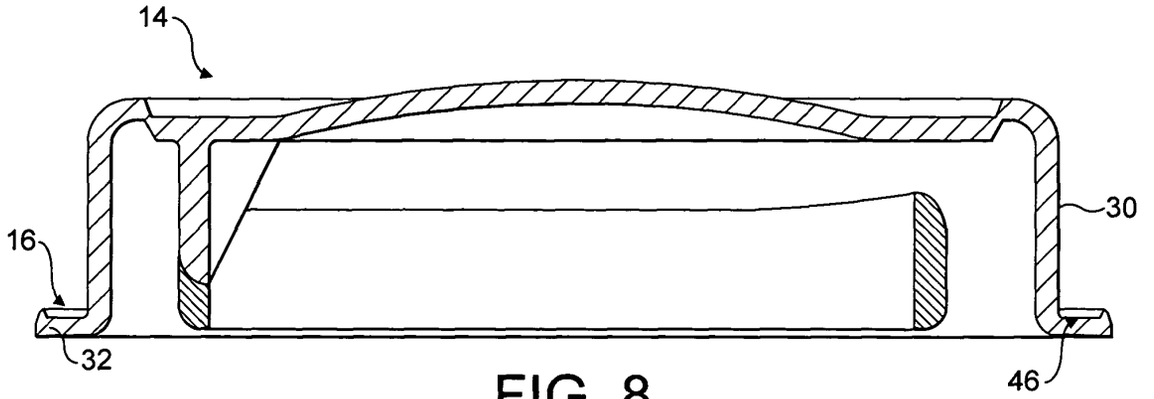

FIG. 8

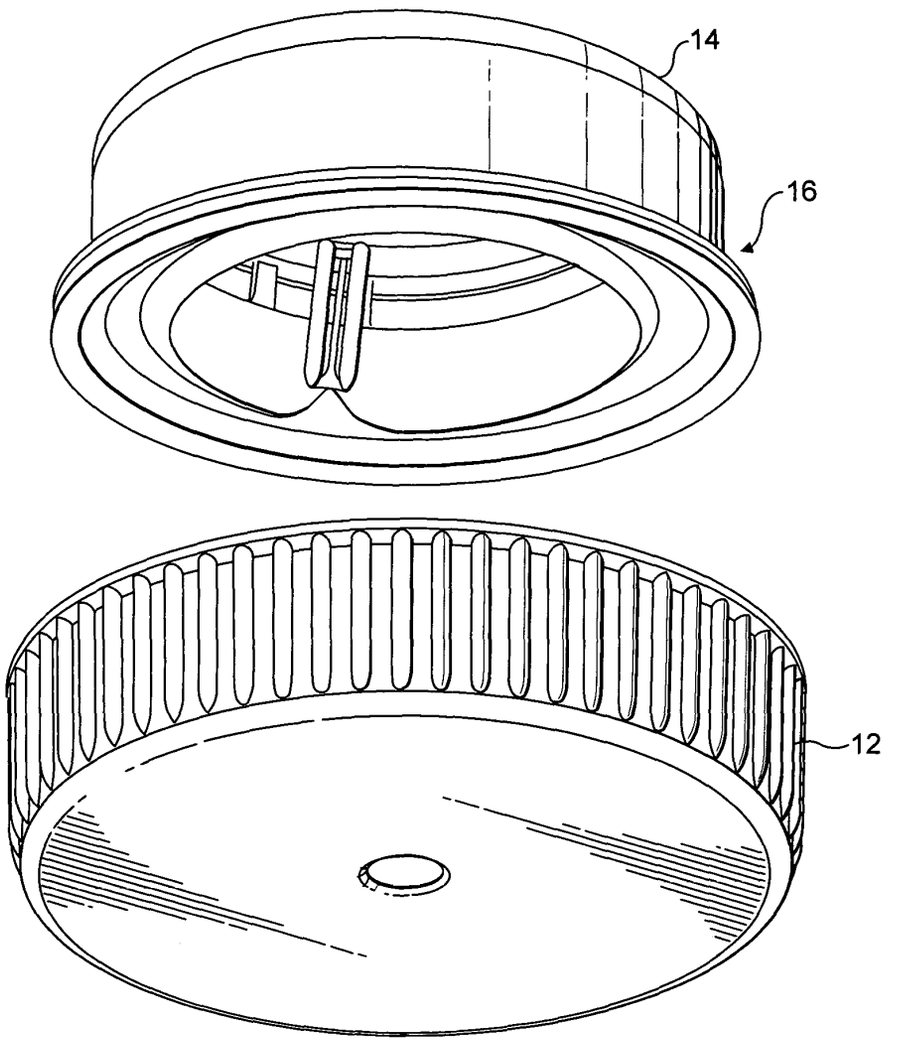

FIG. 9