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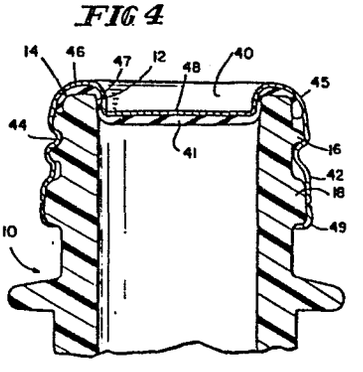
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(54) Pasteurizable container closure.

(57) A closure for bottles (10) is disclosed which includes an internal radius support disc (48) or cylinder (58) for positioning within the mouth (12) of the bottle to enable the bottle to resist radial inward deformation when subjected to pasteurisation or other post-bottling heat treatment. The closure (40) can be formed by coining a conventional aluminium roll-on cap blank using a pressure block (60) having a central land (64) projectable into the mouth of the bottle to form the support disc or cylinder from the top of the cap blank. Also the cap (50) can be moulded thereby providing a moulded cylinder (58).

FIG 4



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PASTEURIZABLE CONTAINER CLOSURE

This invention relates generally to closures for containers formed of thermoplastic resins, and particularly to closures which are specifically designed for sealing such containers of pressurized liquids, such as carbonated beverages in situations where, after filling, the bottle and its contents will be subjected to an elevated heat treatment of one sort or another, such as pasteurization.

The use of thermoplastic resins to form bottles for containing various liquid commodities has expanded rapidly in recent years. Much of the growth has occurred in the development of non-returnable containers for carbonated beverages, the containers being typically molded of thermoplastic polyethylene terephthalate (PET). Bottles of this construction are disclosed in United States Patent 3,733,309. The toiletry, cosmetic, detergent, and pharmaceutical markets are examples of other industries in which significant growth has occurred in the use of such plastic containers and bottles. Despite this expansion, the development of satisfactory closures for such bottles for certain products has remained illusive.

Certain products require post-bottling heat treatment, such as pasteurization, to assure stable product quality and long shelf life. An example of such a product is beer. Pasteurized bottled beer is produced by filling cold beer into previously rinsed containers which

are then capped. The bottled beer is then passed through a pasteurizer where the bottle is subjected to an external spray of water for 20 minutes or more with the temperature of the water being approximately 150 degrees F. The pasteurizer is programmed such that the beer temperature rises to about 140 degrees F and is held at that temperature for about 6 minutes. The product is then cooled as it exits the pasteurizer.

Numerous closures have been employed in an attempt to seal the containers in such a manner that when subjected to the elevated temperature of pasteurization and inherent internal pressures, the integrity of the seal remains intact. One type of closure employed was the conventional aluminum roll-on closure of the type used on soft drink bottles wherein the skirt of the closure has threads or impressions formed in it by the deformation of the skirt against the finish of the container. An example of an apparatus for applying such beverage closures with a locking band (pilfer proof ring) is described in United States Patent 3,760,561. Closures of molded plastic similar to those disclosed in United States Patents 4,322,009 or 4,352,436 have also been tested. It has been observed that when PET containers are sealed with conventional aluminum roll-on caps or with plastic caps featuring a top edge seal, and the sealed containers then subjected to the pasteurization process, closure leak failures occur in more than 5% of the containers.

It has been observed that the cause for the failure is generally a reforming or a movement of the sealing surface, primarily of the bottle finish, under the temperatures and pressures involved during the pasteurization process. To overcome this problem, it has been suggested that the polyester forming the container itself be modified by a heat treatment. See, for example, United States Patents 4,039,641 and 4,375,442. However, even when the bottles are heat-set and conventional closures as previously discussed are employed, the elevated temperatures and pressures of the pasteurization treatment cause the thermoplastic in the region of the finish to creep sufficiently to cause seal failure resulting in loss of carbonation and possible product contamination.

It has been suggested to provide a separate hermetic seal over the mouth of the bottle, for example, by a mylar film sonically welded to the mouth of the bottle. The presence of the welded seal is not only permitted but also desirable in certain industries, such as pharmaceuticals in that it can be used to indicate to the purchaser the absence of any tampering with the contents of the container. In other industries, however, the presence of such a seal is thought to be commercially unacceptable to the public. It is generally accepted that the presence of such a sonically welded seal on the mouth of a bottle containing beer, ale, or other malt liquor

would be commercially unsatisfactory.

In accordance with the present invention, a closure is provided which includes an internal radius support means in the form of a cylinder or disk which is positioned within the container mouth to enable the container to resist radial deformation of the mouth. The cylinder or disk depends into the mouth of the container a sufficient distance to provide support with sufficient compressive strength to resist any inward radial collapse of the top edge of the opening of the container so as to maintain the integrity of contact between the sealing portion of the closure and the outer edge of the top sealing surface of the container. The support disk does not generally form a sealing contact with the inner edge of the mouth of the container. The support disk can be preformed in the cap or can be created by a forming of the cap blank at the time the cap is applied to the bottle.

The reformation of conventional aluminum roll-on caps or other caps can be achieved at the time of application by the use of a modified pressure block to form a closure in accordance with this invention. The pressure block includes a central land of a diameter slightly less than the inner diameter of the mouth of the container to which the closure is to be applied. The central land has an axial dimension sufficient to displace a central portion in the form of a disk or cylinder of the material forming the cap into the mouth of the container

so as to enable the container to resist radial deformation. The skirt of the aluminum cap can be elongated slightly so as to still properly interact with the conventionally positioned pilfer-proof enlargement band on the bottle. Alternatively, a conventionally sized aluminium roll-on cap can be used with a bottle having a slightly narrower pilfer proof band.

Early experimental results suggest that the present invention is adaptable to all conventional finish sizes including both 28mm and 38mm. Surprisingly, it has been determined that it is no longer necessary to use bottles with heat-set finishes and instead conventional amorphus untreated bottle finishes of PET or other thermoplastic resin can be employed with the present cap with no seal failure occurring during or subsequent to the conventional beer pasteurization process.

The various features and advantages derived from the present invention can be more readily understood by a consideration of the following discussion and the accompanying drawings illustrating the prior art and the invention, and showing a preferred embodiment of the invention exemplifying the best mode of carrying out the invention as presently perceived. In such drawings:

Fig. 1 is an elevation view of a typical PET bottle on which a cap of the present invention can be employed.

Fig. 2 is a sectional detail view of a

conventional PET bottle having a heat-set finish with a conventional roll-on aluminum cap properly positioned thereon.

Fig. 3 is a sectional view of the bottle and cap shown in Fig. 2 subsequent to the beer pasteurization treatment.

Fig. 4 is a sectional view of an aluminum roll-on cap in accordance with the present invention.

Fig. 5 is a sectional view of a molded plastic cap in accordance with the present invention.

Fig. 6 is a partial sectional view of a pressure block in accordance with the present invention in touching contact with a cap blank on the top of a bottle.

Fig. 7 is a sectional view of the pressure block shown in Fig. 6 in full pressure contact forming the cap blank on the top of the bottle.

Fig. 8 is a sectional view of the pressure block shown in Fig. 6 with the thread forming members engaging the skirt of the cap to roll or swage the closure threads.

A bottle 10 is shown in Fig. 1 which has been formed by conventional blow molding techniques of a suitable plastic material, such as polyethylene terephthalate, polypropylene, polyethylene, or polyvinylchloride. The bottle 10 has an opening 12 at the top which includes a top sealing surface 14 and a screw-threaded finish 16 terminating in its lower end with a pilfer-proof band 18. Spaced below the pilfer proof

band 18 is a neck support ledge 20. Below the neck support ledge 20 is a tubular sidewall or body portion 22. The bottle 10 typically terminates at its lower end in a generally convex or dome-shaped pressure bottom 24 which is enclosed in a base cup 26 either cemented or snap fit to the lower end of the bottle 10. The bottle 10 is generally symmetrical about longitudinal axis 28 although various designs have been adopted particularly for the tubular sidewall portion 22 as a secondary indication of the bottle contents.

Bottles 10 having the general configuration illustrated in Fig. 1 have been subjected to a crystallization of the finish 16 in general accordance with the teachings of United States Patent 4, 375,442. A sectional detail of such a bottle 10 is shown in both Figs. 2 and 3. In Fig. 2, the crystallized section 11 shows some small variation of the linearity of the internal surface 13 of the bottle 10 due principally to heat shrinkage which occurs during the crystallization process. The uncrystallized portion 15 of bottle 10 remains substantially undeformed even through a typical capping procedure.

In a typical capping procedure, an aluminum cap 30 is applied which includes a deformable plastic liner typically made of a moldable thermoplastic such as polyvinylchloride or ethylenevinylacetate. The cap 30 includes a flat top wall 32 and a skirt portion 34 which

has been swaged by rollers against the finish 16 of the bottle 10 in order to form cooperative threads 36. The process for forming such threads is well known and disclosed, for example, in United States Patent 3,760,561. The cap 30 also includes a pilfer-proof ring portion 38 which has been swaged under the pilfer-proof band 18 at the time the threads 36 are formed.

When a cap 30 is properly applied as shown in Fig. 2 under the usual soft drink bottling process which includes no pasteurization or other elevated temperature scheme, the cap seals satisfactorily and a negligible failure rate is observed. When such a cap is employed in bottling beer or other commodities which are then subjected to a post bottling pasteurization process as previously outlined, it has been observed that the neck portion of the bottle 10 has deformed to the shape shown in Fig. 3. Despite the fact that portion 11 of the bottle has been crystallized or heat set, considerable deformation particularly of the sealing surface 14 is observed. Tests have shown that a failure rate of more than 5% can be expected even in bottles having crystallized finishes containing beer after having completed the beer pasteurization cycle described above. The deformation observed is characterized by an essentially radial inward collapse of the mouth portion 12 which in turn causes the sealing surface 14 to draw away from the rim portion 33 of the cap 30. While in many

instances the deformation of the bottle is so small as to not cause a problem, in more than 5% of the bottles, the deformation is sufficient to cause a leak to develop.

This inward deformation of the bottle mouth 12 can be prevented by use of a cap constructed in accordance with the present invention. One such cap 40 is shown in Fig. 4 to include an annular skirt portion 42 having threads 44 engaging the external screw threaded finish 16 of the container 10. A rim portion 46 integral with the top 45 of the skirt portion 42 extends radially inward from the skirt and sealingly engages the sealing surface 14 of the bottle. An internal support portion 48 is integral with the inner edge 47 of the rim portion and depends therefrom into the mouth 12 of the container. The support portion 48 has the form of a cylinder and has sufficient compressive strength to resist any radial collapse of the top edge of the opening 12 of the bottle so as to maintain the integrity of contact between the rim portion 46 of the cap 40 and the sealing surface 14 of the container 10. The cap will preferrably include a pilfer-proof ring 49 which engages the pilfer-proof band 18 of the container in the usual fashion. The cap 40 will include a conventional liner 41 similar to the liner 32 of cap 30.

An alternative embodiment of the invention is illustrated as cap 50 in Fig. 5. Cap 50 is shown to be constructed of a suitable molded plastic resin such as

polypropylene, polyethylene, copolymers or mechanical blends of these, or other suitable polymers. The cap 50 can include one or more sealing rings or ridges such as are variously disclosed in United States Patents 4,276,989, 4,299,328, and 4,398,645. Alternatively, the cap can include a flowed-in sealing liner 52 such as that disclosed in United States Patent No. 4,331,249 the material of which may be selected from a vinylchloride type resin and can include any of those disclosed by United States Patent No. 4,392,581. The cap 50 includes a skirt portion 54 having threads 55 engaging the external screw-threaded finish 16 of the container 10. The rim portion 56 including either the liner 52 as illustrated or sealing rings as disclosed in prior art, engages the sealing surface 14 of the bottle 10. An internal support portion 58 depends from the rim portion 56 into the mouth 12 of the container 10. The material selected for forming the support portion should have sufficient compressive strength to resist any radial inward collapse of the top edge 12 of the bottle 10 so as to maintain the integrity of contact between the rim portion 56 of the cap 50 and the sealing surface 14 of the container 10. The cap 50 can include a pilfer-proof ring 59 which engages the pilfer-proof band 18 of the bottle 10. The cap 50 can be applied with the aid of apparatus such as that disclosed in United States Patent 4,308,707.

The cap shown in Fig. 4 was installed in a manner

discussed below on PET bottles containing beer. The bottles did not have a heat treated or crystallized finish but instead were made of conventional amorphous untreated PET. The bottles with the cap 40 installed in place were subjected to the convention beer pasteurization treatment discussed above and no failures whatsoever were observed. It is believed that the central support portion 48 of cap 40 provided a sufficient resistance to counter any tendency for the radial collapse of the top portion of the bottle during the pasteurization procedure thereby maintaining the integrity of contact between the top sealing surface 14 of the bottle and the rim portion 46 of the cap.

The closure 40 can be formed from conventional cap blanks during the roll forming capping process by including a modified pressure block 60 such as is shown in Figs. 6 - 8. The pressure block 60 is used in a conventional capping machine 61 the details of which are not shown but can comprise an apparatus such as that shown in United States Patent 3,760,561 or other conventional machines. The pressure block 60 includes an annular ring portion 62 for ensuring the sealing engagement of the cap and the top surface of the container. The pressure block 60 also includes a central land portion 64 having a diameter less than the inner diameter of the mouth 12 of the bottle. The land 64 extends in the direction of axis 65 axially a distance sufficient to displace a central

disk or cylinder of the metal forming the cap blank 43 into the mouth 12 of the bottle 10. As illustrated, the central land portion 64 comprises one end of a cylinder 67 having three distinct radius portions including the land portion 64 and outer rim portion 66 and a body portion 68. The outer rim portion 66 and body portion 68 are snugly received within the sleeve 63 of the pressure block 60 while the central land portion 64 extends axially downward so as to project into the container mouth 12.

The method for simultaneously forming and applying a closure in accordance with the present invention is illustrated in Figs. 6 - 8. As shown in Fig. 6, a conventional aluminum roll-on cap blank 43 is positioned over the finish 14 of the bottle 10 and the capping machine with the modified pressure block 60 descends to contact the top of the cap blank 43. As in the conventional process, the bottle 10 is retained and supported by the neck support 20 so that a compressive force may be applied to the cap blank 43.

As the pressure block 60 descends in direction D against the support S of the bottle 10, the central land portion 64 of the pressure block 60 contacts and depresses a central portion in the form of cylinder or disk 48 into the mouth 12 of the bottle as shown in Fig. 7. This causes the contiguous annular portion 47 into conforming relation with the cylindrical inner surface 12 of the rim of the bottle 10. The annular ring portion 62 on the

lower end of sleeve 63 of the pressure block 60 then contacts the outer rim 45 to pinch the liner 41 in tight sealing relation with the sealing surface 14 of the bottle 10.

With the modified pressure block thus in place, the thread rollers 72 and the pilfer-proof band roller 74 radially contact the outer surface of the skirt 42 as shown in Fig. 8 to form the threads 44 and swage the pilfer-proof ring 49 around the bottle finish 16 in the conventional manner. The rollers 72 and 74 are then retracted and the capped bottle released from the capping machine in the usual process, leaving a cap 40 as shown in Fig. 4 firmly in place on the bottle 10.

Inasmuch as the displacement of the central disk 48 downward into the mouth of the bottle requires a slightly greater amount of aluminum than would be necessary with a flat topped cap such as is shown in Fig. 2, it is preferred that either the length of the skirt portion 42 of the cap blank be increased or the vertical dimension of the pilfer-proof band 18 on the bottle finish be shortened so as to ensure continued proper operation of the pilfer-proof ring feature in the conventional manner. An increase in skirt length of about .040 inches is believed to be sufficient to achieve the desired results. Alternatively, the lower margin of the pilfer-proof band may be raised by this same approximate distance to achieve substantially the same results.

While the present invention has been described with reference to a description of preferred embodiments, demonstrative, and comparative examples, it is intended that the invention not be unduly limited by this description, and instead that the invention be defined by the means and their obvious equivalents set forth in the following claims.

CLAIMS

1. A closure for sealing an opening of a container, the closure comprising an annular skirt portion for gripping the outside of the container and an integral radial portion for covering the opening of the container, characterised in that the radial portion (46) includes a support portion (48) positionable in the opening (12) of the container (10), the support portion (48) having sufficient compressive strength to resist radial collapse of that portion of the container defining the opening (12) during exposure to elevated temperature.

2. A closure as claimed in claim 1, and further characterised by a liner (41) positioned within the annular skirt portion (42) conformable to the opening (12) of the container in sealing relation thereto.

3. A closure as claimed in claim 1 or 2, charaterised in that the skirt portion (42) includes threads (44) for cooperatively engaging the outside of the opening of the container (10).

4. A closure as claimed in claim 1,2 or 3, characterised in that the support portion (48) is formed prior to the application of the closure (40) to the container.

5. A closure as claimed in claim 1,2,3 or 4, characterised in that the support portion (48) is formed at the time the closure (40) is applied to the container.

6. A screw-threaded closure for capping the open mouth of a container, the closure including a skirt portion for enveloping the outside of the container mouth and a sealing portion for sealingly contacting the sealing surface of the mouth of the container, characterised in that the closure member (50) includes a internal radius support portion (58) for positioning within the container mouth (12) to enable the container (10) to resist radial deformation of the container mouth (12).

7. A screw-threaded closure as claimed in claim 6, and further characterised by a pilfer proof ring portion (59) joined to the lower edge of the skirt portion (54).

8. A screw-threaded closure as claimed in claim 6 or 7, and characterised by the skirt portion (54) and the internal radius support portion (58) comprising essentially of a metal cylinder shaped to conform to the dimensions of the container mouth (12).

9. A screw-threaded closure as claimed in claim 6 or 7, and characterised in that the skirt portion (54) and the internal radius support portion (58) consists essentially of a unitary moulded thermoplastic resin.

10. A closure for use on a plastics container having an opening including a top sealing surface and an externally screw-threaded finish for containing liquid at elevated pressure, characterised in that the closure is especially adapted to assist the opening of the container (10) to resist deformation due to exposure to an elevated temperature, the closure being characterised by;

an annular skirt portion (42;54) having threads (44;55) for cooperatively engaging the external screw-threads (16) on the finish of the container (10), a rim portion (45;56) integral with a top of the skirt portion (42;54) and extending radially inward from the skirt portion (42;54) for sealingly engaging the sealing surface (14) of the container (10); and an internal support portion (48;58) integral with an inner edge of the rim portion (45;56) and depending therefrom into the mouth (12) of the container (10), the support portion (45;56) having sufficient compressive strength to resist radial collapse of the top edge of the opening of the container to maintain the integrity of contact between the rim portion of the closure and the top sealing surface of the container.

11. A pressure block for use in a capping machine for applying roll-on closures to the threaded finish of a container characterised in that the pressure block (60) comprises an annular ring portion (62) for ensuring the sealing engagement of the cap blank (43) with the sealing surface of the container (10) and a central land portion (64) having a diameter slightly less than the inner diameter of the mouth (12) of the container (10) to which the closure is to be applied, the central land (64) having an axial dimension sufficient to displace a central disc (48) of the material forming the cap into the mouth (12) of the container to enable the container finish to resist radial inward deformation from exposure to an elevated temperature.

12. A pressure block for use in bottle capping equipment , characterised by a sleeve portion (63) having an annular ring (62) positioned on the lower surface thereof for contacting the outer rim of a cap blank, and a central insert including a central land portion (64) having a diameter slightly less than the interior diameter of the mouth (12) of the container (10), the land portion extending axially a distance sufficient to displace a central disc of the cap blank (43) into the mouth of the bottle.

13. A pressure block as claimed in claim 12, characterised in that the central insert further comprises a body portion (68) and an outer rim portion (66) for supporting the central insert (64) within the sleeve portion (62) to assure proper axial and radial placement of the central land portion.

14. A process for applying roll on closures to the threaded neck of a container, characterised by the steps of placing a cap blank (43) over the threaded neck of a container (10); contacting a central disc portion of the cap blank (43) with sufficient pressure to press the disc portion into the mouth (12) of the container (10); and swaging the skirt portion (42) of the cap blank to conform to the outer dimension of the neck of the container.

15. A process as claimed in claim 14, and further characterised by the step of swaging a pilfer proof ring (49) below the lower periphery of a pilfer proof band (18) existing on the outer surface of the neck of the container.

16. The method of capping a plastic bottle having a mouth defined by an annular rim which forms an annular end surface and a substantially contiguous generally cylindrical, inner surface, characterised by the steps of; placing over the mouth of the bottle (10) a cap having a circumferential skirt (42) and an end wall extending across the mouth (12) of the bottle and containing a sealing liner or the like (41); forcing a central portion (48) of said end wall axially into the mouth (12) of the bottle and a contiguous annular portion of such wall into conforming relation with the cylindrical inner surface of the rim of the bottle; and forcing a surrounding annular portion (42) of the cap towards the end surface of the rim to compress the liner into sealing engagement therebetween.

17. A method as claimed in claim 16,and characterised in that the bottle has a threaded neck (16) adjacent the rim of the bottle, which method is characterised by the further step of compressing the skirt (42) into conforming relation with the threads of the bottle

18. A method as claimed in claim 16, and further characterised by the step of forcing the circumferential skirt portion (42) of the cap into conforming relation with the outer surface of the bottle rim.

19. A metal-capped plastics bottle adapted to maintain its cap seal when subjected to heat treatment such as heat sterilization or pasturization, characterised by; a bottle (10) of plastics material having a finish portion adjacent a mouth defined by an annular rim having an annular end surface and an adjacent generally cylindrical inner surface; a metal cap (40) having a skirt (42) surrounding and interengaged with the finish portion of the bottle to hold the cap in place on the bottle, such cap having an annular web (46) overlying the end surface (14) of the rim of the bottle, and having an inner side wall extending axially inward of the bottle mouth along the inner surface of the bottle rim, a disc portion (48) joined to the inner edge of said of said inner sidewall and extending in supporting relation therewith across the mouth (12) of the bottle inward of the end seal face thereof; and a sealing liner or the like (41) in sealing relation between the bottle rim and the overlying portion of the cap.

20. A metal-capped plastics bottle as claimed in claim 19, and characterised in that the cap (40) includes an outer side portion extending in thread gripping relation along the outer circumferential surface of the bottle rim.

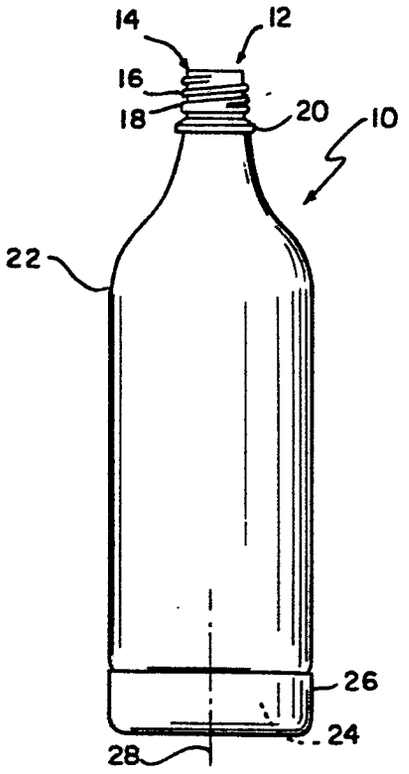
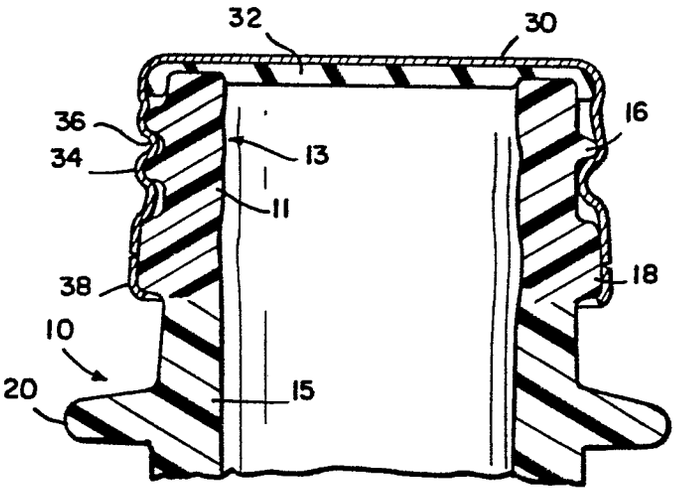


FIG. 1

FIG. 2



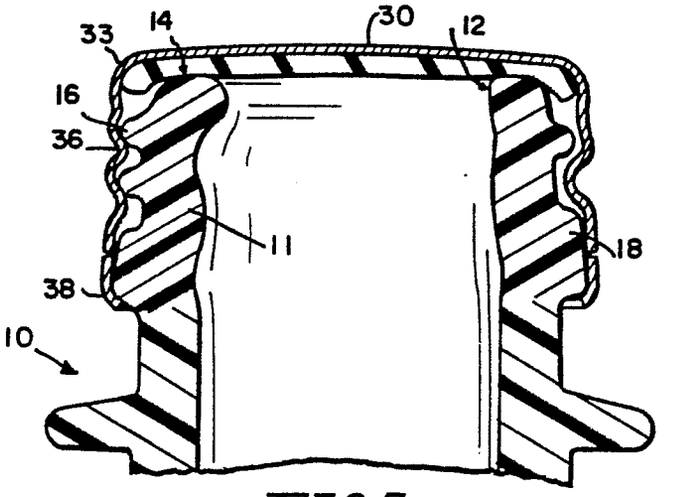
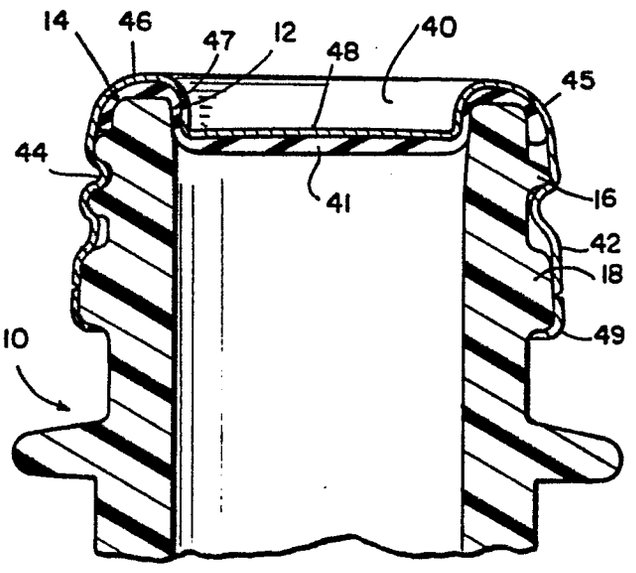


FIG. 3

FIG 4



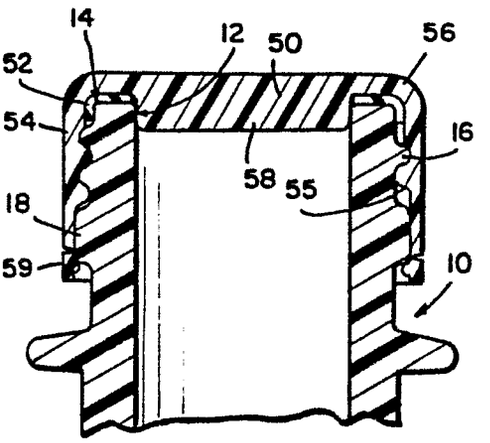


FIG 5

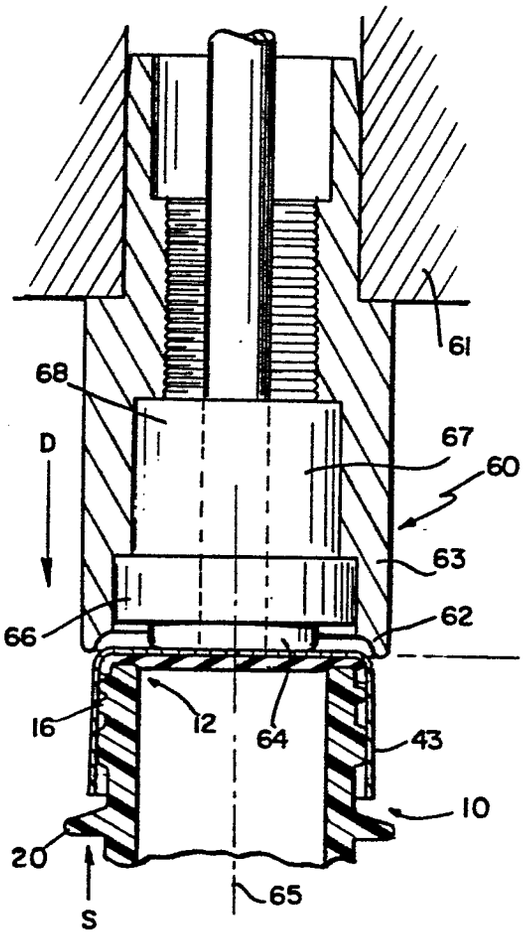


FIG. 6

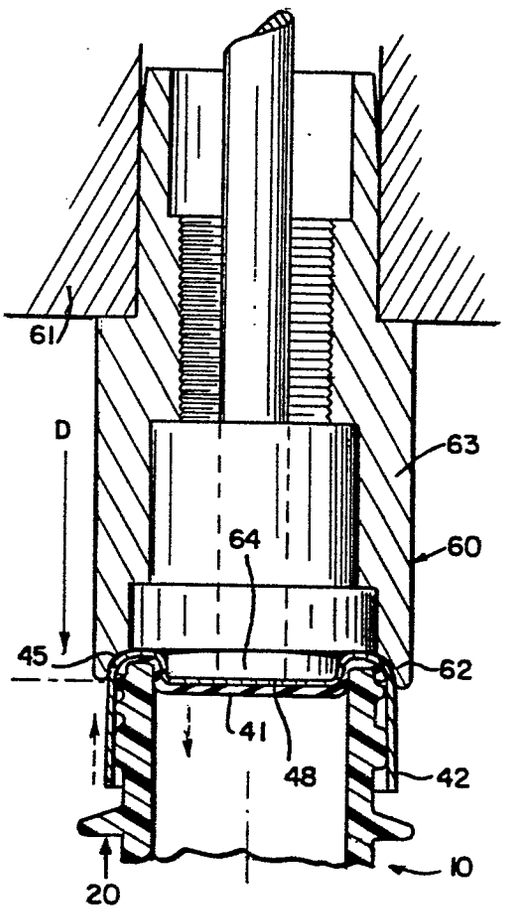


FIG. 7

FIG. 8

