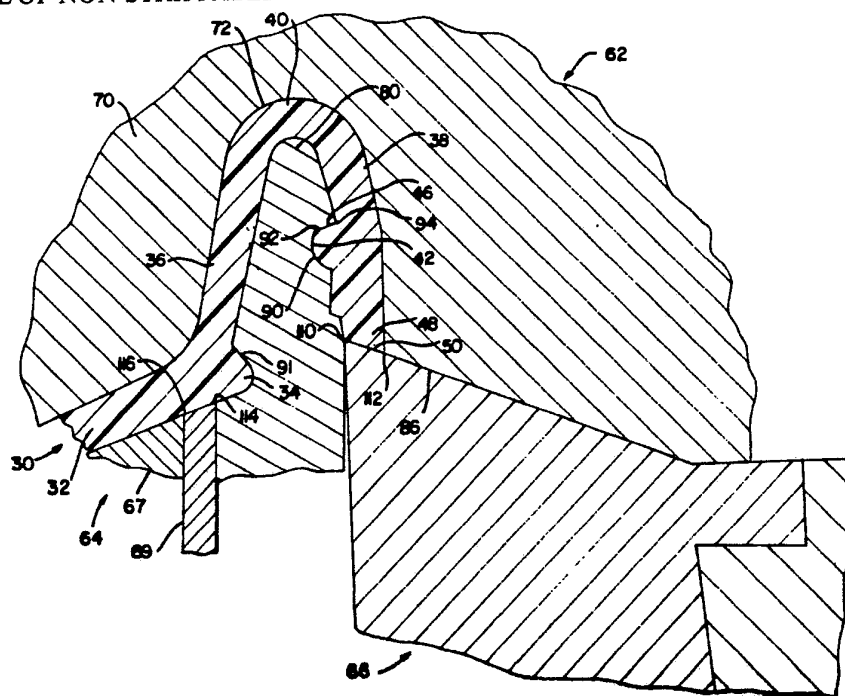




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(54) Title: REMOVAL OF NON-STRIPPABLE ARTICLES FROM A MOLD



(57) Abstract

Removal of a generally rigid plastic non-strippable molded article (30) such as a plastic carbonated beverage container closure from an undercut interior core portion (64) of a mold (60) is afforded by forming the stripper ring portion (66) of the mold with an upper angled wedging surface (86). The molded article is formed having a correspondingly angled face (50) so that during travel of the stripper ring with respect to the interior core portion, the angled wedging surface of the stripper ring will cause the article segment (42) initially seated in the undercut portion (90) of the interior core to be cammed or wedged out of the undercut thereby allowing the generally rigid, non-strippable article to be removed from the mold.

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REMOVAL OF NON-STRIPPABLE ARTICLES
FROM A MOLD

Field of the Invention

The present invention is directed generally to
5 the removal of a non-strippable article from an
undercut core portion of a mold. More particularly,
the present invention is directed to a method and
apparatus for removal of a non-strippable article
from an undercut core portion of a closed cavity
10 mold, and to the article itself. Most specifically,
the present invention is directed to a method and
apparatus for removal of a non-strippable PET
container closure from an undercut core portion of a
mold and to the container closure. The closure is
15 primarily intended for use with a so-called plastic
beverage can and has at least one undercut shoulder
that has heretofore prevented removal of the
closure, which is made of a generally rigid or
non-strippable plastic material from an undercut
20 core portion of a mold. This removal is
accomplished in accordance with the present
invention through the use of a cooperatively shaped
lower closure rim face portion and a stripper ring
upper wedging surface.

25 Description of the Prior Art

Metal containers for carbonated beverages such
as beer and soft drinks are generally well known and
have been available in the market for a number of
years. There has recently been introduced a
30 so-called plastic can in which the can body and
closure or lid are made of a generally rigid plastic
material such as is commonly referred to as PET.
Plastic beverage containers of this type have
several advantages over the prior metal cans in

areas such as lower cost, reduced weight, ease of chilling, better recyclability, ease of printing and the like. A plastic beverage container particularly suitable for use with pressurized liquids such as carbonated beverages is set forth in co-pending patent application Serial No. 824,893, filed January 23, 1986 by the inventor of the present invention and assigned to a common assignee. The disclosure of this application is hereby incorporated herein by reference.

As is set forth in greater detail in the above-referenced application, the closure or lid for the plastic beverage container is made of a generally rigid, plastic material such as PET. It will be understood that PET, which is a well recognized abbreviation in the art, refers to polyethylene terephthalate and will be used as such throughout the application. The rigidity of this plastic material allows it to be used with a plastic container body also made from PET or a similar generally rigid plastic material in a manner that results in the formation of a plastic beverage container able to withstand at least 100 psi internal pressure as well as being able to form a leakproof closure with or alternatively without the need for additional sealing materials. It is anticipated that these plastic carbonated beverage containers will continue to find increasing popularity and that they will be produced in substantial numbers.

Generally rigid plastic container closures of a type disclosed in co-pending application Serial No. 824,983 are, as previously discussed, molded from PET or similar materials. These generally rigid plastic compositions such as PET, ABS, polycarbonate, polystyrene and nylon are referred to in the industry as non-strippable. This differentiates them from non-rigid or strippable

compounds such as polyethylene, polypropylene, various thermoplastic rubber materials, and the like. The delineation between strippable and non-strippable moldable or formable materials resides in the material's ability to be stripped or removed from an undercut core portion of a mold by flexure or bending of the molded product.

A typical strippable plastic closure cap, a tool for making it, and a method for removing this closure cap from its mold are disclosed in U.S. Patent No. 4,552,328, co-invented by the inventor of the present invention and also assigned to a common assignee. The disclosure of this patent is also hereby incorporated herein by reference.

Strippable materials are quite readily removed from undercut core portions of molds through the use of a stripper ring that exerts a force against a portion of the article to be stripped and removes it from the mold core by temporarily deforming it. Since so-called strippable materials are somewhat resilient, such temporary deformation is easily and readily accomplished. Thus a strippable material article may be removed from an undercut core portion of a mold in a generally known manner.

In contrast to strippable materials, it has been quite difficult to remove generally rigid or non-strippable plastic articles from an undercut core portion of a mold. Since the non-strippable plastic material is generally rigid and non-resilient, it is not easy to deform the article to a great extent so that the molded article can be removed from the mold. This has been particularly the case when the article, such as the closure for a plastic beverage container, has included at least one inwardly directed flange, ring, or shoulder that must be unseated from a groove in an undercut core portion of a mold. Prior art stripper rings have

proven unsatisfactory and have resulted in an excessive number of damaged closures.

The usual prior art solution has been to utilize an interior core portion which is collapsible so that after molding and curing, the interior core can be reduced in size to free the molded closure lid from the core. Unfortunately, collapsible mold cores are relatively complex and hence expensive structures. A companion problem with collapsible interior cores is one of dimensional variations in the molded parts produced by the mold. Since the size of the interior core portion of the mold is cyclically varied as it is collapsed and then reexpanded, it is difficult to standardize the size of the container closure or lid being molded. Closures lid size variations lead to poorly fitting closures which either do not fit and are thus unuseable, or which fit poorly and leak.

The plastic carbonated beverage can and lid assembly appears to be one which will enjoy a high degree of success, and thus will require the manufacture of a large number of container lids made of generally rigid, non-strippable materials. Removal of these closures and of other generally similar non-strippable articles from a mold having an undercut core portion is substantially facilitated in accordance with the apparatus of the present invention, its method of useage, and the physical configuration of the closure cover, all in accordance with the present invention.

Summary of the Invention

It is an object of the present invention to provide a method for removal of a non-strippable article from an undercut core portion of a mold.

Another object of the present invention is to provide an apparatus for removal of a non-strippable article from an undercut core portion of a mold.

A further object of the present invention is to provide a removable, generally rigid molded article made of a non-strippable plastic material.

Yet another object of the present invention is to provide a method and apparatus for removal of a non-strippable container closure from an undercut interior core portion of a mold.

Still a further object of the present invention is to provide a removable plastic container closure of a non-strippable material.

Even yet another object of the present invention is to provide a stripper ring having an angled wedging article engaging surface.

Yet still a further object of the present invention is to provide a removable, non-strippable plastic container closure having a wedging stripper ring receiving surface.

As will be discussed in greater detail in the description of the preferred embodiment, the present invention is directed to a method and apparatus for the removal of a generally rigid, non-strippable plastic article from an undercut core portion of a mold, and to the article itself. This is accomplished, in accordance with the present invention, by providing the outer, undercut shoulder rim portion of the plastic carbonated beverage container closure or lid, as described in detail in application Serial No. 824,983, with a lower, angled rim face. This angled lower rim face cooperates with an angled upper wedging surface of a vertically reciprocable stripper ring portion of a generally well known closed chamber molding assembly such as is generally shown in U.S. Patent No. 4,552,328. The upper wedging surface of the stripper ring engages the lower angled rim face of the closure's outer rim during article removal and cams or wedges the outer rim or flange portion of the container

closures radially outwardly from the interior core portion of the mold assembly. Even though the closure lid is molded from PET or another similar generally rigid, and hence traditionally

5 non-strippable material, the cooperation between the inclined lower surface of the closure lid's outer rim with the inclined upper wedging surface of the stripper ring provides sufficient flexure of the non-strippable material to allow it to be removed

10 from the undercut interior core portion of the mold. This is true even when the closure lid includes an inwardly directed shoulder that is molded in a undercut groove in the sidewall of the interior undercut core portion of the mold.

15 The undercut core portion of the mold may also include an annular bead ring forming portion in the shape of an undercut rim. In this situation the undercut core portion of the mold, which includes a stationary center core and an ejector sleeve which

20 is movable in coordination with the stripper ring includes an angled wedging surface on the ejector sleeve to aid in removing the annular bead portion of the closure lid from the undercut core portion of the mold.

25 The removal process and apparatus in accordance with the present invention facilitates the manufacture of a large number of container closures of PET or another similar, generally rigid non-strippable material in a manner that does not

30 result in broken container closures or in a slow tedious removal process, as has previously been the situation. The size of the interior core piece of the mold will not have to continually be changed to facilitate molded article removal. This means that

35 the size of the container closure lid will not vary from one molding cycle to another, thus resulting in a uniform molded product.

The method and apparatus for removal of non-strippable article from a mold, and the article itself, all in accordance with the present invention, greatly facilitates the production of the all plastic carbonated beverage container disclosed in application Serial No. 824,983. More broadly stated, the principles of operation and structure of the present invention render generally rigid and hence previously non-strippable material articles removable from an undercut core portion of a mold after molding of the article.

Brief Description of the Drawings

While the novel feature of the method and apparatus for removal of non-strippable articles from a mold, and the articles themselves are set forth with particularity in the appended claims, a full and complete understanding of the invention may be had by referring to the description of the preferred embodiment as set forth hereinafter, and as is illustrated in the accompanying drawings in which:

Fig. 1 is a cross sectional view of a portion of a plastic carbonated beverage container and closure which is formed in accordance with the present invention;

Fig. 2 is a cross sectional view of a portion of a mold assembly and non-strippable container closure of the present invention;

Fig. 3 is a cross sectional view of an upper cavity portion of a mold and a portion of the upper cavity retainer plate;

Fig. 4 is a cross sectional view of a stripper ring and the stripper ring retainer plate in accordance with the present invention;

Fig. 5 is a cross sectional view of an interior undercut core portion of the mold;

Fig. 6 is an enlarged cross sectional view of the encircled portion of the mold assembly of Fig. 2;

Fig. 7 is a view similar to Fig. 6 and showing the upper cavity portion of the mold separated from the molded container lid;

Fig. 8 is a view similar to Fig. 7 and showing partial removal of the molded container closure in accordance with the present invention; and

Fig. 9 is a view similar to Figs. 7 and 8 and showing complete removal of the non-strippable container lid of the present invention.

Description of the Preferred Embodiment

Referring initially to Fig. 1, there may be seen generally at 10 a partial cross-sectional view of a wide mouth plastic carbonated beverage can and closure assembly wherein the closure is molded and is removed from a mold in accordance with the present invention. As was indicated previously, the structure of this container and closure is set forth in detail in co-pending application Serial No. 824,983, filed January 23, 1986 and assigned to a common assignee. The description of the container and closure set forth hereinafter is not to be construed as a complete description of the invention disclosed in the above recited application, whose disclosure is incorporated herein by reference, but instead is presented here as a summary of the structure and as an aid to a better understanding of the present invention.

Container and closure assembly, generally at 10 is comprised of a wide mouthed, plastic, molded or otherwise formed can 12 having a neck 14 which terminates in an inner taper 16 that serves as a transition to an outwardly flared neck segment 18. Neck segment 18 recurves at a top edge 20 of can 12 and joins an outwardly and downwardly extending

locking flange 22 having a free lower locking flange end 24. It will be understood that can 12 is suitably molded or otherwise formed from a generally rigid plastic material such as PET or the like.

5 A plastic lid or closure, generally at 30 snap fits onto the upper portion of can 12 to form a positive, secure closure which will not fail under internal pressures of 100 psi or more, thus forming a suitable container and closure assembly for
10 carbonated beverages and the like. Closure or lid 30 is formed having a generally spherical top wall 32 that has an annular bead 34 which seats beneath inner taper 16 when cover 30 is in place. An inner rim wall 36 intends upwardly and outwardly from
15 annular bead 34 and then turns downwardly and outwardly as an outer rim wall 38. These two walls are joined by an upper bridging wall 40 that forms the upper rim of the closure or lid 30. An annular undercut shoulder 42 is formed during molding on an
20 inner surface 44 of outer rim wall 38 and has an upper ledge 46 which is contacted by the free lower locking flange end 24 of can 12, as is further discussed in Serial No. 824,983. Outer rim wall 38 terminates at its lower free end 48 in an angled
25 lower rim face 50 which will be discussed in greater detail subsequently.

Plastic closure lid 30 is typically injection molded in a generally known mold assembly such as is depicted somewhat schematically at 60 in Fig. 2.
30 Molds of this type are generally well known in the art and include an upper cavity portion 62 carried by an upper cavity retainer plate 63 and which defines the outer surface of the closure 30 being formed; a lower interior undercut core portion 64,
35 carried by a core retainer plate 65, including a stationary center core portion 67 and a movable ejector sleeve 69, and forming the support core for

the closure lid 30 being molded; and a stripper ring 66 which is carried by a stripper retainer plate 68 and which is movable with respect to the interior core portion 64 of mold 60 , and in cooperation with
5 ejector sleeve 69 to remove the closure 30 from the interior core portion 64 once molding has been completed. A somewhat similar mold assembly is set forth in greater detail in previously referenced
10 U.S. Patent No. 4,552,328, issued November 12, 1985 to the present applicant and a co-inventor, and assigned to a common assignee. A significant difference between the present invention and that set forth in Patent No. 4,552,328 is the fact that the material used to mold closure lid 30 in
15 accordance with the present invention is a so-called non-strippable material. As discussed previously, generally rigid or non-strippable materials such as PET, ABS, polycarbonate, polypropylene and the like have, before the present invention, not been
20 adaptable for mold forming in an undercut mold such as the type utilized in the present invention and particularly have not been moldable in a configuration having inwardly extending portions such as the present closure's undercut shoulder 42
25 and annular bead 34. However, due to the present invention there is now provided a method and apparatus for removal of non-strippable articles from an undercut core portion of a mold as well as the article itself.

30 Turning now to Figs. 3, 4, and 5, which together form an exploded view of mold assembly 60, each of the three components of the mold assembly 60 is shown in somewhat greater detail. Upper cavity portion 62 of mold assembly 60 is substantially
35 shaped as a plate having a planar top wall 70. A convex central lower surface 71 of upper cavity portion 62 is surrounded by an annular rim groove

72. An annular sloped side wall 74 is formed radially outwardly of rim groove 72 and ends at a planar bottom wall 76. Through proper sizing and positioning of the three mold components, there
5 remains a space for receipt of the material such as PET which will be molded to form closure or lid 30 when the mold components are assembled. The form of closure 30, which was discussed and shown in Fig. 1, is defined, in part by upper cavity 62 whose convex
10 lower surface 71 forms closure top wall 32, and whose annular rim groove 72 forms the outer surface of rim portion 40 of closure 30.

Lower interior core portion 64 of mold 60 is shaped to cooperate with upper cavity portion 62 and
15 is generally shaped as an upwardly facing cup. The center stationary core segment 67 of interior core portion 64 and the concentric movable ejector sleeve 69 have upper surfaces which define the upwardly facing cup. A cup rim portion 80 of lower interior
20 core portion 64 fits within annular rim groove 72 of upper cavity portion 62. In their assembled position, these two mold components; i.e., upper cavity portion 62 and lower interior core portion, are spaced from each other an amount which
25 determines the thickness of the container closure or lid 30 being molded. The third mold component, stripper ring 66 is generally in the form of a truncated cone which is positioned adjacent the outer wall surface 82 of sidewall 84 of interior
30 mold core 64. Stripper ring has an upper, angled wedging surface 86 which forms a substantial portion of the present invention.

Turning now to Fig. 6 there may be seen an enlarged view of a portion of the upper cavity
35 portion 62, lower interior core portion 64, stripper ring 66, and closure lid assembly 30 in accordance with the present invention. The upper rim portion

80 of interior core portion 64 is aligned with, and positioned within the annular rim groove 72 of upper cavity portion 62 and is spaced therefrom by the desired thickness of the closure lid 30 being
5 molded. An annular circumferential undercut groove 90 is formed in the outer side wall surface 82 of the cup shaped rim portion 80 of interior core portion 64. This undercut groove 90 forms the annular undercut shoulder 42 of the closure cover or
10 lid 30 during the molding of lid 30. Since annular shoulder 42 must be provided with a generally planar upper ledge 46, which cooperates with the flange free end 24 of locking flange 22, as was discussed previously, it is necessary that undercut groove 90
15 be formed with a corresponding planar upper groove face 92. An annular circumferential undercut rim 91 is formed on the inner side wall surface of rim 80. This undercut rim 91 forms the annular bead 34. As presently disclosed this bead 34 has a generally
20 smooth rounded surface but could have a planar face.

The requirement of a planar upper undercut groove face 92 and its termination in a sharp groove edge 94 has rendered the non-strippable closure or lid 30 extremely difficult to remove from interior
25 undercut core portion 64 of mold assembly 60 prior to the discovery of the present invention. In order to render the non-strippable, generally rigid closure or lid 30 removable from the interior core 64, the lower free end 48 of outer rim wall 38 of
30 closure 30 is formed having an angled surface 50, as previously described. The upper portion of stripper ring 66 is formed having a cooperating angled wedging or camming surface 86, as was also indicated above. It is the cooperation of angle wedging
35 surface 86 on stripper ring 66 with the inclined free end face 50 of closure flange free end 48 which

5 allows this previously non-strippable material to be removed from the interior undercut core mold 64.

An operational sequence may be seen in Figs. 7, 8, and 9 and shows the steps of removal of a non-strippable article 30 from an interior core portion 64, particularly when the article such as container lid 30 is formed having an annular shoulder 42 and an annular bead 34 which would have previously rendered this rigid, non-strippable material not readily removable from an interior core portion having an undercut groove. The upper cavity portion 62 is separated from the lid 30 after molding, as seen in Fig. 7, to separate the upper surface of the closure lid 30 from the lower surface 71 of upper cavity portion 62. Since the annular rim groove 72 of upper cavity portion 62 opens or widens in the downward direction, there is no difficulty separating the upper cavity portion 62 from the now molded and cured PET closure or lid 30. After the upper cavity portion 62 has been separated, the stripper ring 66 and ejector sleeve 69 are caused to move upwardly as shown by arrows A and B in Fig. 8. They may move together or at cooperating but separate times depending on the structure of the molded closure being removed. The upper angled wedging or camming face 86 of stripper ring 66 engages the lower rim face 50 of lower free end 48 of outer rim wall 38 of lid 30 and, as the stripper ring is moved upwardly, the outer rim wall 38 is moved radially outwardly. The upper ledge 46 of annular shoulder 42 of lid 30 slides and pivots about the sharp groove edge 94 which, to some extent, functions as a fulcrum about which upper ledge 46 pivots. This occurs since the upper angled wedging surface 86 causes the lower rim face 50 of outer rim wall 38 to slide radially outwardly as the stripper ring moves upwardly. This compound motion

of outer rim sliding and spreading, which is accomplished by the angle cooperation of the stripper ring 66 and the closure lid 30 continues until the annular shoulder 42 of closure lid 30 has been removed from the undercut groove 90 on the outer sidewall 82 of inner core portion 64 of mold 60. An upper wedging surface 87 of ejector sleeve 69 causes the annular bead 34 to be unseated from undercut rim 91 in a similar manner. At this point, the closure or lid 30 has been effectively removed from the undercut core portion 64 and can be taken away for further handling by conventional means.

The angle 100 of the angled wedging surface 86 and the corresponding angle of lower rim face 50 of outer rim wall 38 will vary with the type of non-strippable or generally rigid plastic material being molded. For example, in a closure lid 30 having a configuration such as is disclosed herein and in greater detail in application Serial No. 824,983 wherein the plastic material is PET, a slope of 15-25 below horizontal has been formed to be appropriate for angled wedging surface 86. As may be seen in Fig. 9, this angle 100 of wedging surface 86 is the same as the angle of lower rim face 50 since, when the three part mold is in its closed molding position, the upper wedging surface 86 of stripper ring 66 generally forms the portion of the mold that is responsible for the shape of lower rim face 50 of closure lid 30.

Although the drawings of the present invention appear to depict the outer wall surface 82 of the undercut core portion 64 and the inner surface of truncated cone-shaped stripper ring 66 as being in contact with each other, this is merely for ease of illustration and is not an exact depiction of the structure. This is also true of the stationary center core segment 67 and the ejector sleeve 69.

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In order to insure that the stripper ring 66 moves freely with respect to the inner core portion 64 , and that the ejector sleeve 69 moves freely with respect to the center core segment 67 during removal of the molded product, these elements are spaced slightly from each other. Accordingly, the stripper ring will not bind on the undercut inner core during product removal. When mold assembly 60 is in the closed, molding position, as seen in Fig. 6, there are no actual points of contact between stripper ring 66 and undercut core portion 64 and upper cavity portion 62, and between ejector sleeve 69 and center core segment 67. Two generally well known shut-off bands 110 and 112, are provided to prevent leakage of the material being molded. Shut-off band 110 is at the area of adjacency of stripper ring upper angled wedging surface 86 with outer wall 82 of inner core portion 64, and shut-off band 112 is at the point of adjacency of upper angled wedging surface 86 with the radially innermost portion of the annular sloped sidewall 74 of upper cavity portion 62 of mold assembly 60. These two shut-off bands 110 and 112 prevent flow of the material being molded into areas between stripper ring 66 and interior core portion 64 and between stripper ring 66 and bottom wall 76 of upper cavity portion 62. Similar shut off bands 114 and 116 are provided between ejector sleeve 69 and rim 80 and between sleeve 69 and center segment 67, respectively.

The specific angle of wedging surface 86 is a function of the rigidity of the non-strippable material being used, of the shape of the undercut groove 90 which forms the closure annular shoulder 42, and of a lead angle 102. When the closure lid 30 of the subject configuration is made of PET, the angle should be in the range of 15-25. Also, if the annular shoulder 42 has a configuration other

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than the one discussed herein and in the co-pending application, the angle 100 would have to be changed. The planar upper face 92 of undercut groove 90 has the undercut or lead angle indicated generally at 102 also in Fig. 9. The wedging angle 100 must be equal to or greater than the lead angle 102. If this were not the case; i.e., if the wedging angle 100 were less than the lead angle 102, the camming action discussed above would not be able to move the closure lid's shoulder 42 out of undercut groove 90. In such a situation, the annular shoulder 42 would be sheared off the closure 30 by movement of the stripper ring 66.

The present invention provides a process and apparatus for removing a non-strippable molded plastic article such as a container closure or lid from an undercut interior core portion of a mold. Although the specific camming or wedging angle provided on the upper surface of the vertically reciprocable stripper ring may vary with the type of material being used and with the specific undercut configuration, the cooperation of a stripper ring having an upper angled wedging surface with an article such as a container lid having a sloped or angled lower rim face will result in the removal of a non-strippable article from an undercut mold core in an expeditious manner.

While a preferred embodiment of a process and apparatus for the removal of a generally rigid non-strippable article from an undercut core portion of a mold assembly in accordance with the present invention has been fully and completely set forth hereinabove, it will be obvious to one of skill in the art that a number of changes in, for example the specific material being molded, the overall shape and end use of the molded article, the materials used for the mold and their overall shape and the

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like could be made without departing from the true spirit and scope of the present invention which is to be limited only by the following claims.

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What is Claimed:

1. A method for removing a non-strippable, generally rigid, molded plastic article having an undercut shoulder from an undercut core portion of a mold assembly which includes said undercut core, a cavity portion, and a stripper ring, said method including the steps of:

providing an angled wedging surface on said stripper ring;
forming an angled face portion on said article during molding;
opening said mold assembly after molding of said article by separating said cavity portion and said undercut core portion ;
engaging said angled face portion of said molded article with said angled wedging surface of said stripper ring; and
moving said stripper ring relative to said undercut core portion to remove said molded article from said undercut core.

2. The method of claim 1 including the step of unseating said undercut shoulder from said undercut core portion.

3. The method of claim 2 further including the steps of forming said undercut shoulder on a radial rim portion of said article and further forming said angled face portion on a free face of said radial rim.

4. The method of claim 3 wherein the step of unseating said undercut shoulder from said undercut core portion includes radially spreading said radial rim of said molded article relative to said undercut core portion.

5. The method of claim 4 wherein the step of unseating said undercut shoulder from said undercut core portion includes wedging said radial rim outwardly.

6. A method for removing a non-strippable, generally rigid molded plastic container lid having a generally round top and a surrounding radial rim including an annular undercut shoulder on an inner surface of an outer rim wall from an undercut core portion of a mold assembly which further includes a cavity portion and a movable stripper ring, said method including the steps of;

forming an angled face portion on a rim face of said radial rim;

providing an angled wedging surface on said stripper ring, said angled wedging surface forming said angled face portion on said rim face during molding of said container lid;

separating said cavity portion from said undercut core portion after molding of said container lid;

moving said stripper ring relative to said core mold;

wedging said radial rim of said container lid radially outwardly by sliding said angled face portion of said radial rim face of said container lid radially outwardly along said wedging surface of said stripper ring during movement of said stripper ring relative to said undercut core portion; and

unseating said annular undercut shoulder from said undercut groove concurrently with said radially outwardly sliding of said radial rim thereby removing said container lid from said mold.

7. A generally rigid, non-strippable, molded plastic lid for a wide-mouthed container wherein the container includes a side wall having at its upper peripheral edge a radially outwardly and downwardly flared locking flange terminating in a free flange edge, said lid comprising:

a top wall having a peripheral rim extending generally upwardly, outwardly, and then downwardly

from said top wall to define a V-shaped peripheral groove having inner, upper, and outer walls receiving the locking flange of a container;

an annular shoulder integrally formed within
5 said peripheral groove on the outer wall thereof for engaging the free edge of the locking flange of a container;

an angled face portion on a lower rim face of said outer wall, said angled face being angled at
10 generally between 15-25 downwardly and radially outwardly with respect to said outer wall of said plastic lid; and

an annular bead extending outwardly from the inner wall of said peripheral rim for engaging the
15 interior surface of the side wall of a container below the locking flange thereof, said lid being shaped to extend into the mouth of a container with said groove engaging the locking flange in a snap-on fit to produce a surface-to-surface sealing
20 engagement between the container and said lid.

8. A mold assembly for forming a generally rigid non-strippable plastic container lid having a top wall and a radial rim including an annular undercut shoulder on an inner surface of an outer
25 rim wall and for removing the formed lid from the mold, said mold assembly comprising:

an upper cavity portion;

a lower interior undercut core portion
cooperable with said upper cavity portion, said
30 undercut core portion including an upwardly directed cup rim portion, said cup rim portion including an undercut groove on an outer sidewall thereof; and

a stripper ring movable with respect to said cup rim portion of said interior undercut core portion,
35 said stripper ring having an upper angled wedging surface.

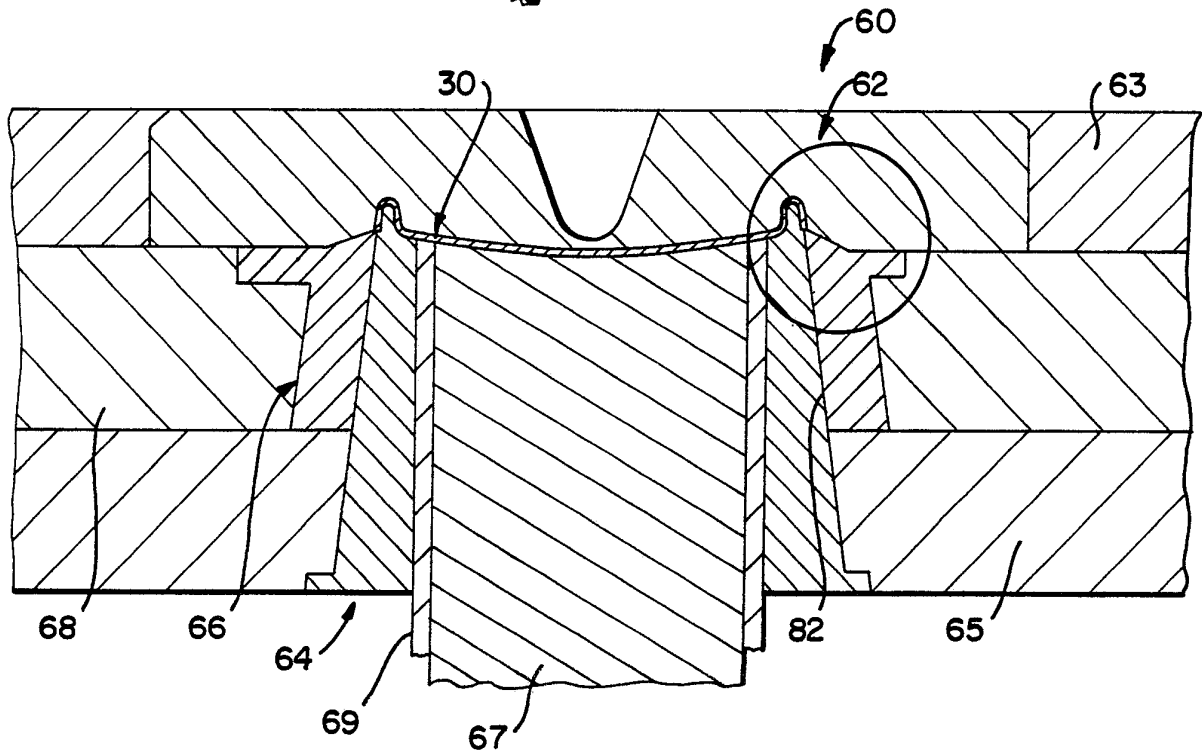
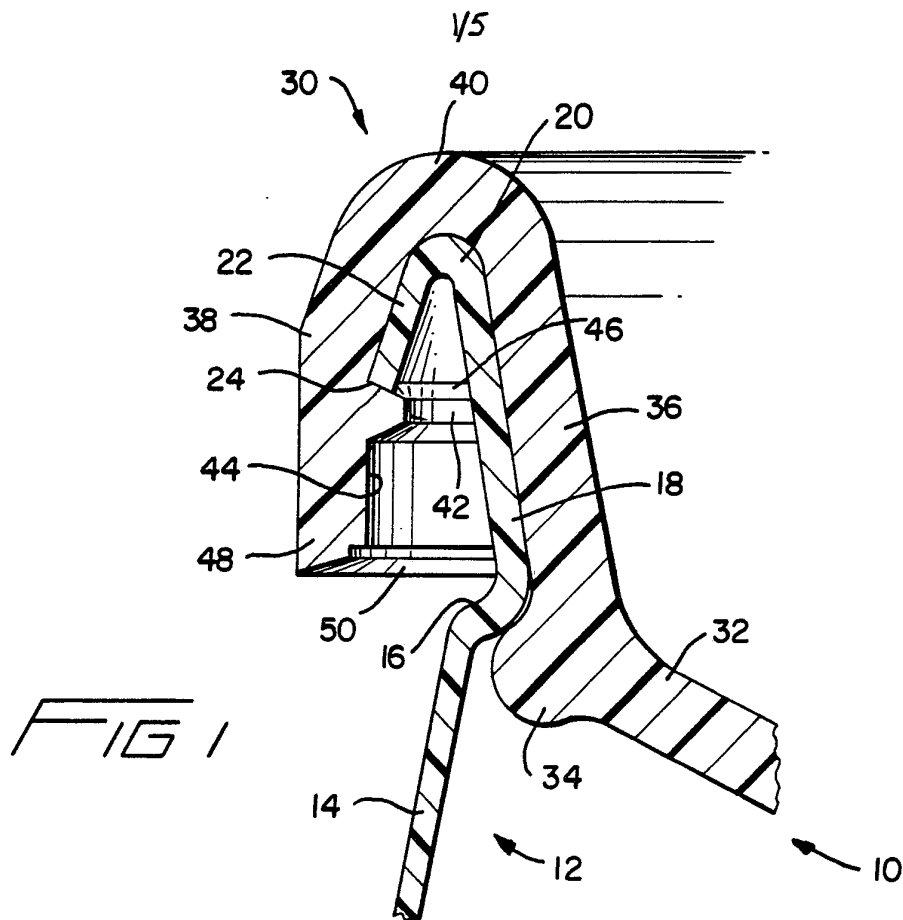
9. The mold assembly of claim 8 wherein said upper cavity portion, lower interior undercut core portion, and stripper ring cooperate to form a closed mold.

5 10. The mold assembly of claim 9 wherein said stripper ring is a generally truncated cone.

11. The mold assembly of claim 10 wherein said upper angled wedging surface of said stripper ring is angled generally downwardly and radially
10 outwardly at a wedging angle of generally between about 15-25 with respect to a sidewall of said truncated cone.

12. The mold assembly of claim 11 wherein said undercut groove includes a generally planar upper
15 surface inclined at a lead angle generally downwardly and radially inwardly with respect to said cup rim portion.

13. The mold assembly of claim 12 wherein said wedging angle is equal to, or greater than said lead
20 angle.



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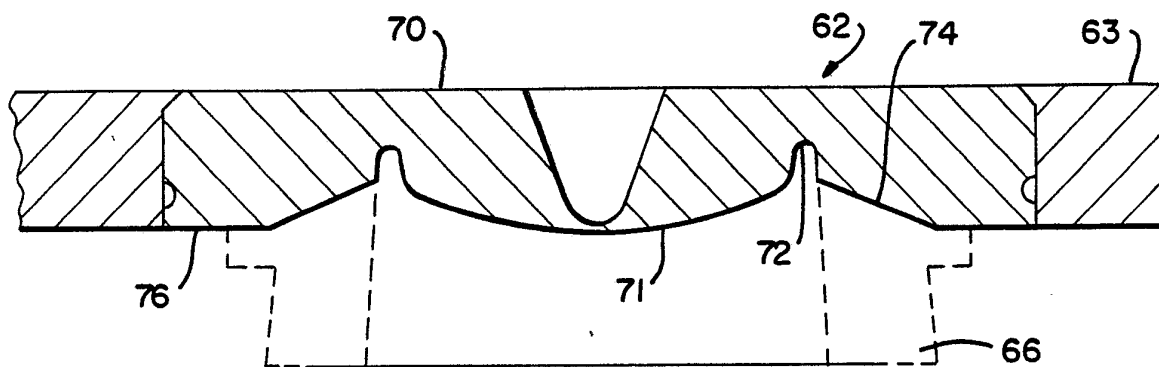


FIG 3

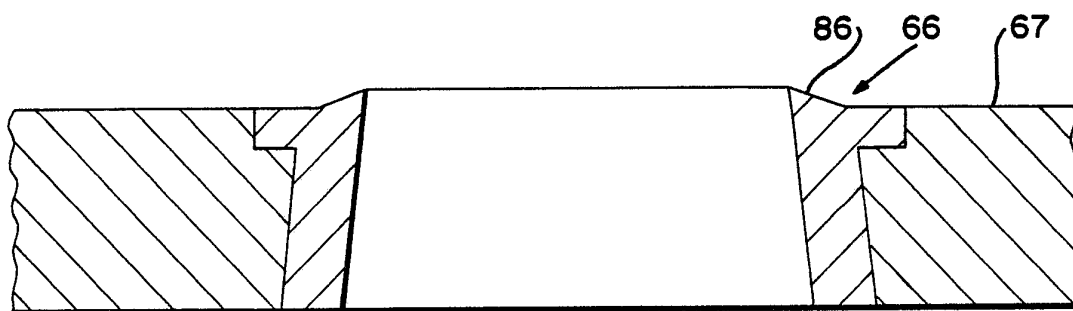


FIG 4

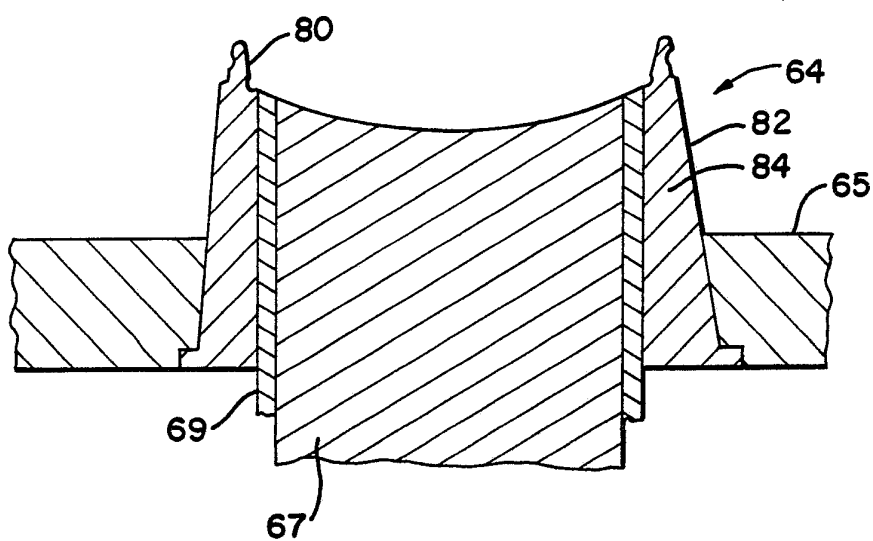


FIG 5

3/5

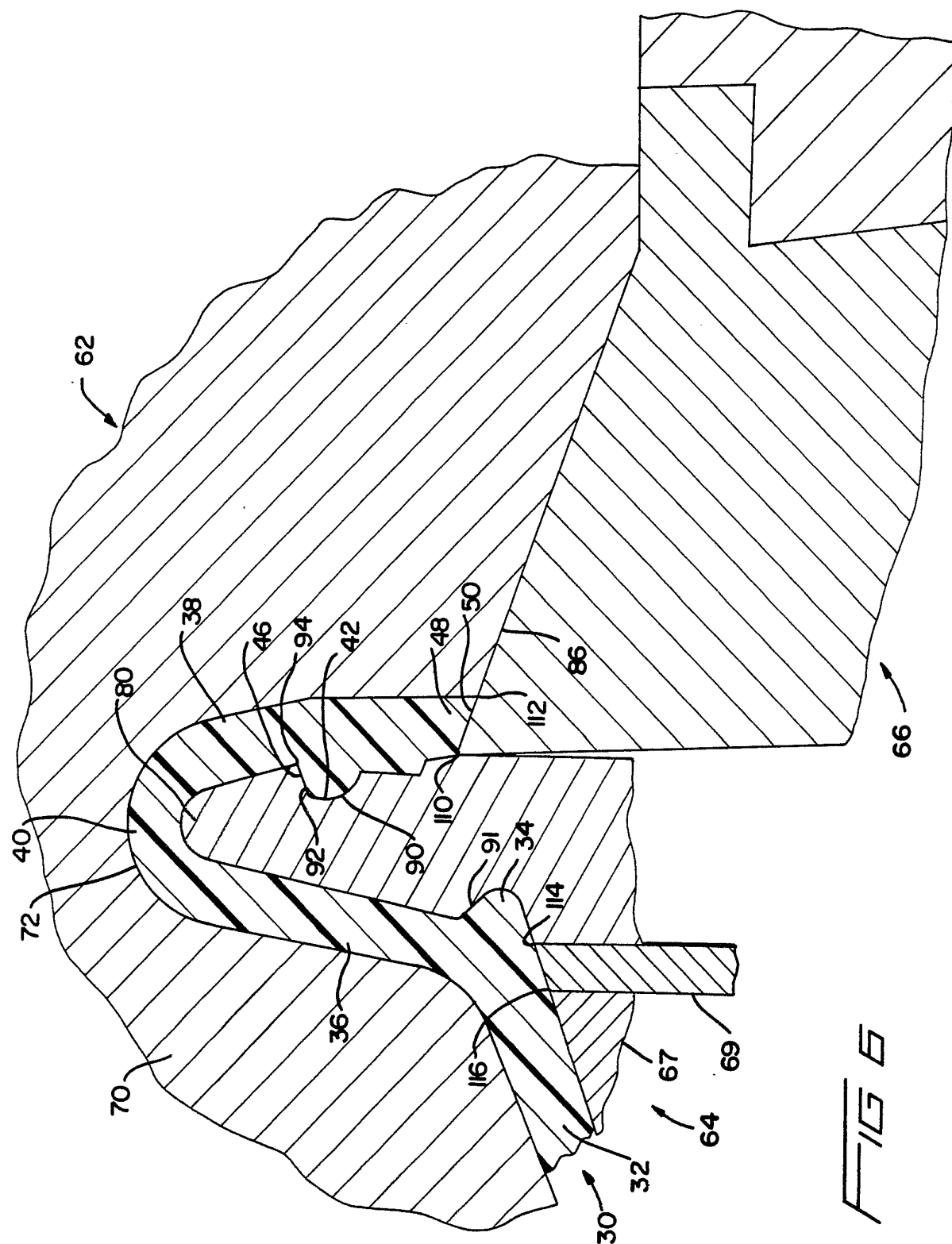
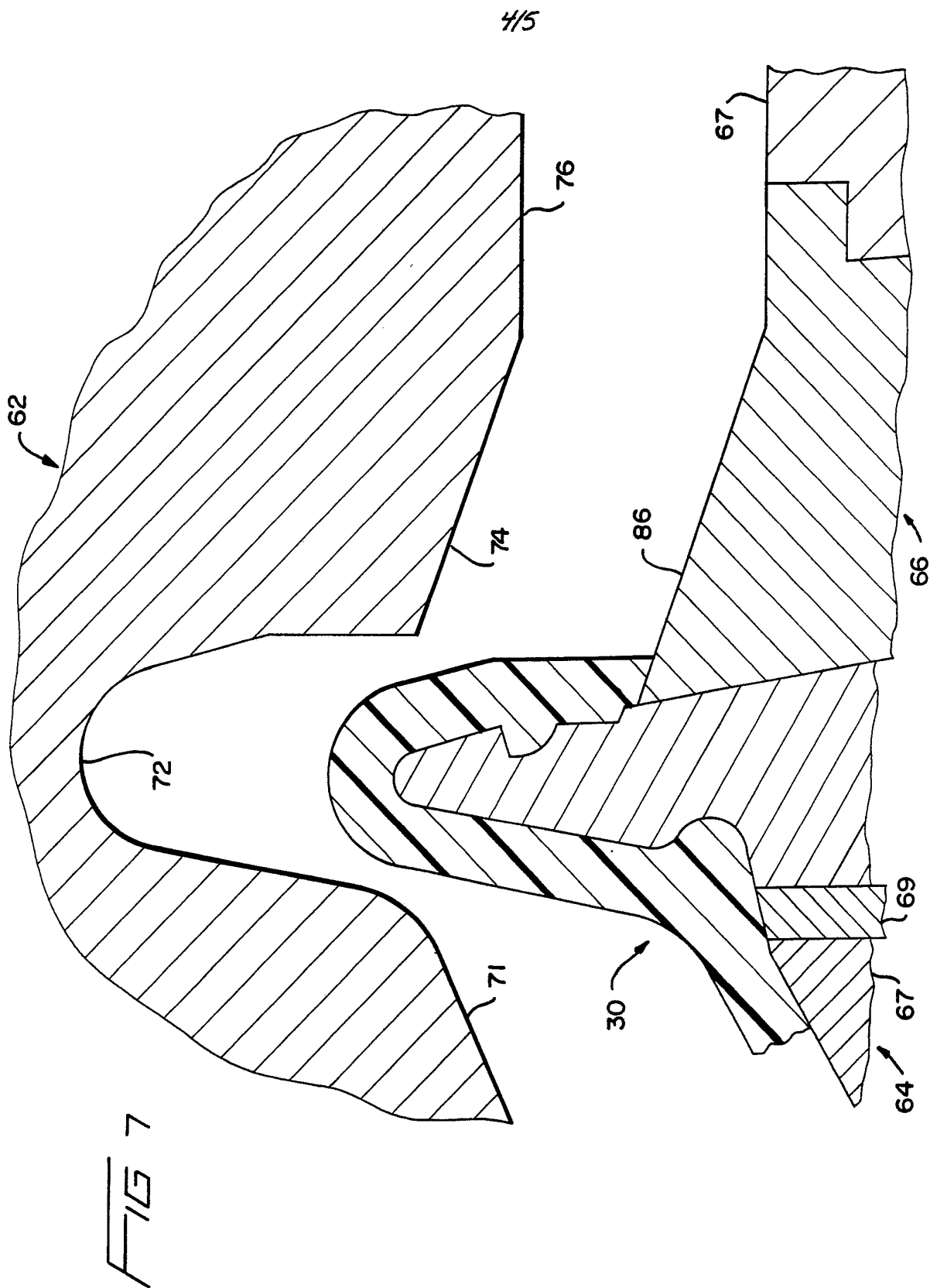
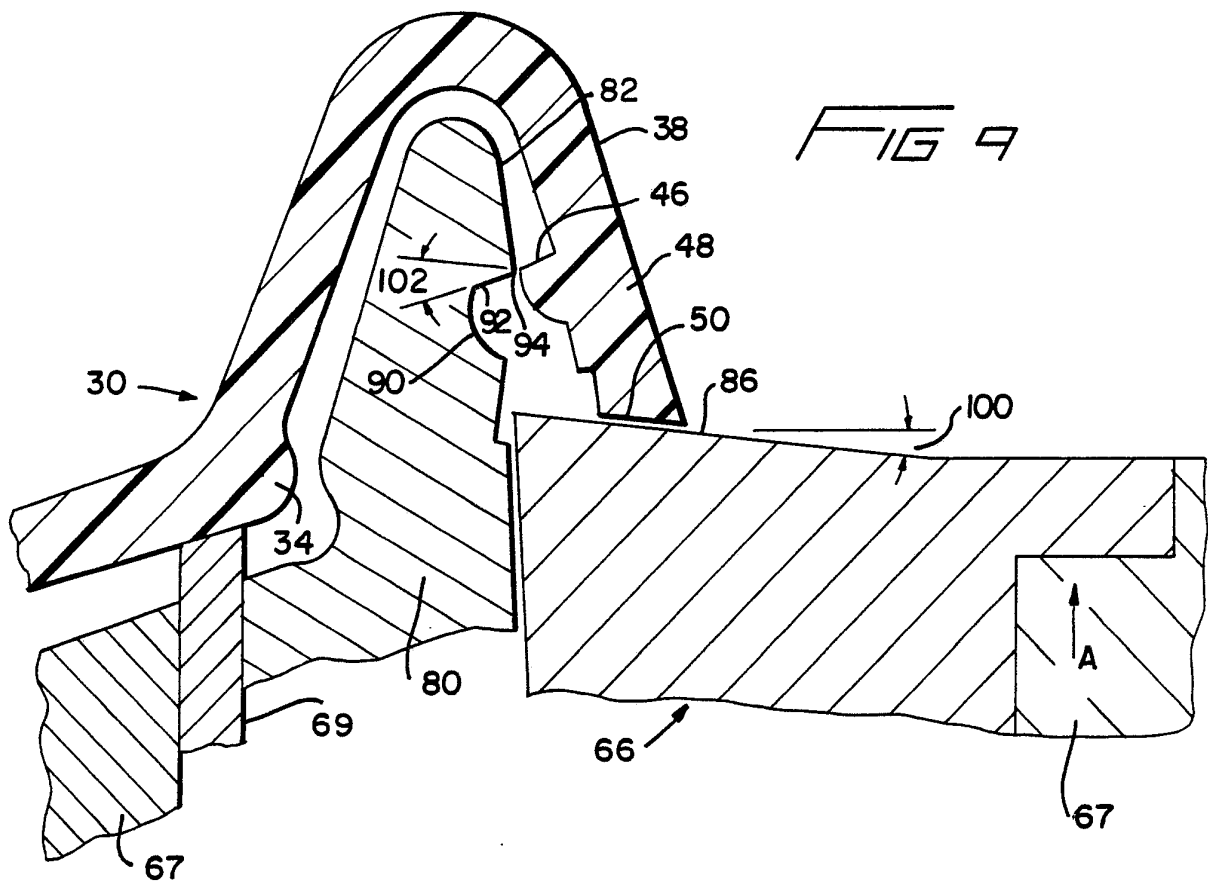
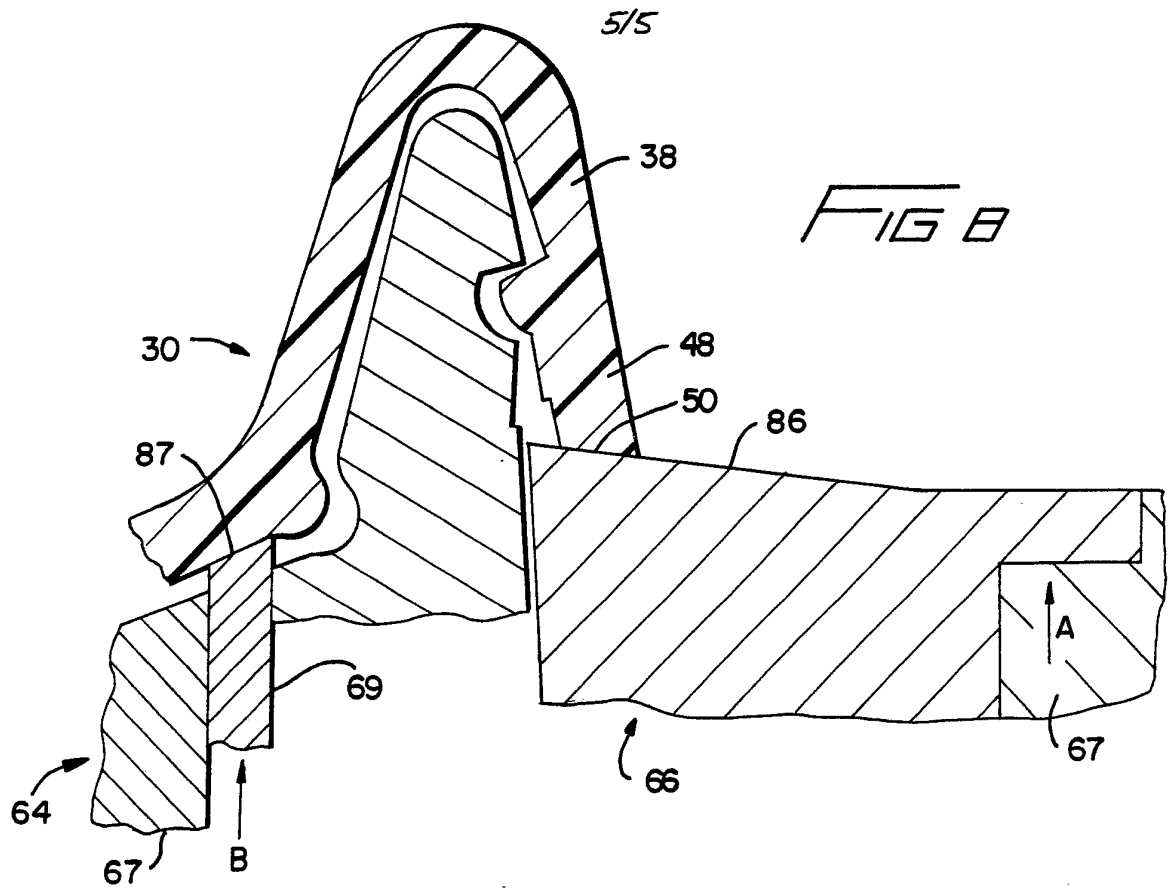


FIG. 6





INTERNATIONAL SEARCH REPORT

International Application No **PCT/US87/01639**

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³ According to International Patent Classification (IPC) or to both, National Classification and IPC IPC(4): B65D 41/18//B29C 33/44//B29C 45/44 US. C1. 220/306; 249/63; 264/318; 264/334; 425/438																										
II. FIELDS SEARCHED <div style="text-align: right; font-size: small;">Minimum Documentation Searched ⁴</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%; text-align: left; border-bottom: 1px solid black;">Classification System</th> <th style="text-align: left; border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="border-bottom: 1px solid black;">U.S. C1.</td> <td style="border-bottom: 1px solid black;">220/306, 307 249/59, 63, 64, 67, 68, 142, 144 264/318, 328.1, 334, 336 425/236, 351, 438, 443, 444, 556, 577, DIG. 58</td> </tr> </table> <div style="text-align: right; font-size: small;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵</div>			Classification System	Classification Symbols	U.S. C1.	220/306, 307 249/59, 63, 64, 67, 68, 142, 144 264/318, 328.1, 334, 336 425/236, 351, 438, 443, 444, 556, 577, DIG. 58																				
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III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; text-align: left; font-size: small;">Category *</th> <th style="width: 70%; text-align: left; font-size: small;">Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷</th> <th style="width: 20%; text-align: left; font-size: small;">Relevant to Claim No. ¹⁸</th> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>US, A, 3,555,606 HEDGEWICK 19 JANUARY 1971 (19.01.71) (NOTE ENTIRE DOCUMENT).</td> <td>1-6, 8-13</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X, P</td> <td>US, A, 4,640,435 DUTT 03 FEBRUARY 1987 (03.02.87) (NOTE FIGURE 4, COLUMN 6, LINE 34 TO COLUMN 7, LINE 24).</td> <td>7</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>SE, B, 317,896 AKERLUND & RAUSING 24 NOVEMBER 1969 (24.11.69) (NOTE FIGURES 2 AND 4).</td> <td>7</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>US, A, 3,627,170 PULLIAM ET AL 14 DECEMBER 1971 (14.12.71) (NOTE FIGURE 3, AND COLUMN 2, LINES 35-66).</td> <td>7</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>US, A, 4,210,258 VON HOLDT 01 JULY 1980 (01.07.80) (SEE FIGURE 8).</td> <td>7</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>US, A, 4,453,646 HARRILD 12 JUNE 1984 (12.06.84) (SEE FIGURE 2, AND COLUMN 3, LINES 31-45).</td> <td>7</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>US, A, 4,046,282 RUCH 06 SEPTEMBER 1977 (06.09.77) (SEE ABSTRACT).</td> <td>1-13</td> </tr> </table> <div style="font-size: x-small; margin-top: 10px;"> <p>* Special categories of cited documents: ¹⁵</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"&" document member of the same patent family</p> </div>			Category *	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸	X	US, A, 3,555,606 HEDGEWICK 19 JANUARY 1971 (19.01.71) (NOTE ENTIRE DOCUMENT).	1-6, 8-13	X, P	US, A, 4,640,435 DUTT 03 FEBRUARY 1987 (03.02.87) (NOTE FIGURE 4, COLUMN 6, LINE 34 TO COLUMN 7, LINE 24).	7	Y	SE, B, 317,896 AKERLUND & RAUSING 24 NOVEMBER 1969 (24.11.69) (NOTE FIGURES 2 AND 4).	7	Y	US, A, 3,627,170 PULLIAM ET AL 14 DECEMBER 1971 (14.12.71) (NOTE FIGURE 3, AND COLUMN 2, LINES 35-66).	7	Y	US, A, 4,210,258 VON HOLDT 01 JULY 1980 (01.07.80) (SEE FIGURE 8).	7	Y	US, A, 4,453,646 HARRILD 12 JUNE 1984 (12.06.84) (SEE FIGURE 2, AND COLUMN 3, LINES 31-45).	7	A	US, A, 4,046,282 RUCH 06 SEPTEMBER 1977 (06.09.77) (SEE ABSTRACT).	1-13
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