Dec. 4, 1951 J. A. BENNER 2,576,917

LINERLESS VENTING CLOSURE

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Fig. 1

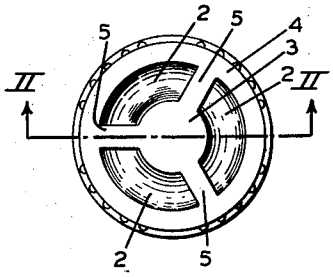


Fig. 2

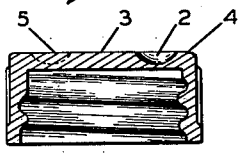


Fig. 3

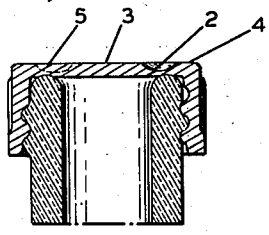
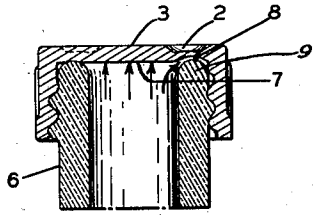


Fig. 4



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LINERLESS VENTING CLOSURE

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6 Claims. (Cl. 215—56)

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This invention relates to venting closures. More particularly, the invention relates to linerless venting closures of resilient and flexible plastic material.

In the packaging of certain products, particularly bleaching solutions such as sodium hypochlorite, hydrogen peroxide, and the like, and bleaching powders such as calcium hypochlorite, there is a problem presented by the development of pressure within containers holding such materials, which pressure may be due to the presence in the material of impurities, such as small amounts of iron, copper, or organic material, which impurities cause decomposition of the products resulting in the evolution of gas which develops pressure in the container. The development of pressure may also be caused by storage of such containers in places in which they are subjected to elevated temperatures as the application of fairly high temperatures to such materials also results in decomposition of at least a portion of the material resulting in the evolution of gases therefrom.

Pressure development within such containers is a definite hazard as excessive pressures have resulted in sudden disintegration of the container with an explosive force which may have very harmful effects. In addition, in many instances wherein pressure has developed and has not been relieved, sudden opening of the package results in a rapid discharge of its contents due to comparatively high pressures within the package.

Various closures known to the art as venting closures have been proposed and used to overcome the problem of pressure development within this type of package. These venting closures are, generally speaking, quite complicated and difficult to manufacture and, for that reason, only a few of them have been employed commercially in an attempt to overcome the problem of pressure development. While closures have been developed which vent upon the development of comparatively high pressures within the container, such closures, generally speaking, are inclined to allow leakage of the container contents, particularly in the case of liquids. This is generally due to the fact that venting closures of necessity must have some sort of valve arrangement to enable venting of the closure to release the gases present in the package, and leakage through such valve arrangement often occurs. Generally speaking, it is desirable to provide a venting closure which vents so as to release excess pressure at a pressure of 10 to 15 pounds

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per square inch. In some instances, depending upon the particular product, the design of the container or package, and the like, venting at pressures of 5 to 10 pounds per square inch is desirable. An acceptable venting closure should vent or release pressure at pressures at least as high as those indicated above and should also have a valve action so that, upon release of the pressure, there will be a sealing off of the remaining contents of the container to which the closure is applied.

In addition to the above-discussed problems of venting, while at the same time providing a seal after release of pressure, there is the requirement that such a closure be capable of convenient manufacture at comparatively low cost. There have been many venting closures which depend for their venting action upon cooperation between the liner and the closure shell. These closures require the presence of a liner material. Not only does this mean additional material in the closure, but also means an additional step in its manufacture, that is the step of inserting the liner.

It is, accordingly, an object of this invention to provide a linerless closure which is capable of relieving pressure developed in containers or packages for pressure-developing compositions.

A further object of this invention is the provision of a linerless venting closure which may be conveniently manufactured on conventional equipment.

These and other objects of this invention will become apparent to those skilled in the art upon becoming familiar with the following description when taken in conjunction with the accompanying drawing in which like parts are designated by like numerals, and in which:

Figure 1 is a top plan view of the closure of by invention;

Figure 2 is a vertical sectional view taken along the line II—II of Figure 1;

Figure 3 is a partial sectional view of the closure of my invention applied to a container; and

Figure 4 is a view similar to Figure 3 illustrating the manner in which venting occurs when pressure developing gases are formed in a container to which my closure is applied.

In accordance with my invention, I provide a closure manufactured from resilient and flexible plastic material having, as illustrated in Figures 1 and 2, on the upper surface of the top thereof a plurality of arcuate segments of reduced thickness designated by numeral 2. The arcuate segments 2 are advantageously formed so that they

gradually reduce in thickness from that substantially equal to the maximum thickness of the top to a minimum thickness. A particularly advantageous means for obtaining this gradual reduction in thickness is that shown in Figure 2 wherein there is illustrated a closure molded in such a manner that the cross section of the segment is substantially semicircular. The central portion 3 of the top of my closure is substantially equal in thickness to the thickness of the annular reinforcing ring 4. Extending radially from the central reinforcing portion 3 and of a thickness substantially equal thereto are a plurality of reinforcing ridges 5.

While the number of thin segments 2 and the number of reinforcing ridges 5 in the top of my closure may vary somewhat depending, among other things, upon the particular composition from which the closure is molded, the particular product to be packaged, the dimensions of the closure, and the like, generally speaking, I have found it particularly advantageous to provide three arcuate segments of substantially equal area divided by three radially extending reinforcing ridges, the center lines of which are separated from each other by an angle of approximately 120°. With such an arrangement, I have obtained the desired venting action. In certain instances, when more than three ridges are employed, the flexibility of the thin segments is overcome by the reinforcing action of the ridges.

The action of the closure of my invention upon the development of pressure within a container to which it is applied is illustrated in Figure 4. When gas forms within the container 6 and exerts pressure on the flat undersurface 7 of the closure, because of the flexibility provided in the area of the thin segments 2, the sealing portion at the top of the closure is forced upwardly to provide at least one channel 8 around the lip 9 of the container. This enables the gases to pass through the channel and follow the thread of the container to the atmosphere. Upon the release of pressure, the thin segments 2 resume their original position as shown in Figure 3 to reseal the container and its contents. It is to be understood venting can occur when anyone of the segments 2 is forced out of sealing engagement with the container lip. However, I do not intend to be limited by any theory of operation expressed herein.

The closure of my invention may be molded in any of the conventional molding equipment used in the manufacture of plastic closures. I have obtained particularly advantageous results by manufacturing a plastic closure in accordance with my invention from a material known to the art as "Polythene" which is polymerized ethylene. However, materials having equivalent properties of flexibility and resiliency may be used such as suitably plasticized synthetic resins and natural and synthetic elastomers.

In some instances, it may be desired to apply a thin protective film of resistant material to the undersurface of the closure of my invention, particularly when the closure itself is manufactured from a material which may not possess such resistance. However, it is to be understood that these protective films are not in the nature of venting liners as the closure of my invention will function without the necessity of applying any liners to cooperate with the closure to perform the venting function.

While the particular dimensions of the arcuate segments of the closure of my invention may vary considerably, depending, among other things, upon the particular composition from which the closure is molded, the diameter of the closure, and the like, generally speaking, I have obtained advantageous results when the minimum thickness of the arcuate segments is less than one half the maximum thickness of the closure top. If desired, the minimum thickness of the segments may be about one third the maximum thickness of the top.

Although I have particularly described my closure with reference to its venting characteristics, it is to be understood that my closure may be employed in a sealing container where venting is no problem as an excellent seal is provided without need of a liner.

The closure of my invention may be readily manufactured in conventional molding equipment. In fact, because of the presence of the reinforcing ridges, comparatively low injection pressures may be used to fill out the mold.

While my invention has been described with reference to certain particular embodiments, it is to be understood that the invention is not limited thereby. Therefore, changes, omissions, substitutions and/or additions may be made without departing from the spirit of the invention as defined in the appended claims which are intended to be limited only as required by the prior art.

I claim:

1. A linerless closure comprising a skirt having means for affixing the closure to a container and a top portion including a rigid central portion of substantial thickness having extending radially therefrom a plurality of reinforcing ridges terminating in an annular section of substantially equal thickness and a plurality of resilient and flexible segments which have a minimum thickness of less than one half the maximum thickness of said central portion, whereby upon the application of pressure to the undersurface of said closure at least one of said segments is forced upwardly to return to its original position upon release of said pressure.

2. A linerless closure comprising a skirt carrying means for affixing the closure to a container and a top portion having a flat undersurface and an upper surface including three depressions which are substantially semi-circular in cross section and form a section the minimum thickness of which is less than one half the maximum thickness of said top portion separated one from the other by three radially extending reinforcing ridges terminating in an annular rigid ring, whereby upon the application of pressure to the undersurface of said closure at least one of said segments is forced upwardly to return to its original position upon release of said pressure.

3. A linerless venting closure molded from resilient and flexible plastic material including a skirt having means for affixing said closure to a container and a top portion including a rigid central area of uniform substantial thickness having extending radially therefrom a plurality of reinforcing ridges of substantially identical thickness to said central area and terminating in an annular section of thickness equal to said central area and a plurality of resilient and flexible segments which are substantially semicircular in cross section of a minimum thickness less than one half of the thickness of said reinforcing ridges, whereby upon the application of pressure to the undersurface of said closure at least one of said segments is forced upwardly to

return to its original position upon release of said pressure.

4. A linerless venting closure molded from polymerized ethylene and comprising a skirt having means for affixing the closure to a container and a top portion including a rigid central portion of uniform substantial thickness having extending radially therefrom three reinforcing ridges terminating in an annular rigid ring and providing three equally spaced sections which are resilient and flexible and substantially semicircular in cross section and of a minimum thickness less than one half of the thickness of said reinforcing ridges, whereby upon the application of pressure to the undersurface of said closure at least one of said segments is forced upwardly to return to its original position upon release of said pressure.

5. A plastic linerless venting closure comprising a skirt-carrying means for affixing said closure to a container and a top including a rigid central section of uniform substantial thickness having extending radially therefrom a plurality of members of identical thickness terminating in an annular rigid ring and a plurality of arcuate flexible segments of curved cross section, the minimum thickness of which is less than half the thickness of said rigid central section, whereby upon the application of pressure to the undersurface of said closure at least one of said segments is forced upwardly to return to its original position upon release of said pressure.

6. In combination with a container, a linerless venting closure having means for affixing said closure to said container and a top portion

including a central rigid section of uniform thickness having extending radially therefrom a plurality of reinforcing ridges terminating in an annular ring of substantially equal thickness and rigidity and also including a plurality of equally spaced areas forming sections the minimum thickness of which is less than one half the thickness of said central rigid section, whereby, upon development of pressure within a container, at least one of said areas of minimum thickness is forced out of sealing engagement with the lip of said container to release said pressure, said area being adapted to return to sealing engagement with said lip upon release of said pressure.

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