United States Patent

Leitz

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[45] **July 4, 1972**

[54] METHOD OF APPLYING PILFER-PROOF CLOSURES

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[73] Assignee: **CIBA-Geigy AG.**

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[21] Appl. No.: **112,735**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 810,113, March 25, 1969, abandoned.

[30] **Foreign Application Priority Data**

March 30, 1968 Germany ..... L 47079
July 23, 1968 Germany ..... P 17 79 252.8

[52] **U.S. Cl.** **53/42**, 53/329, 215/42
[51] **Int. Cl.** **B65b 7/28**
[58] **Field of Search** 53/42, 329; 215/42

[56] **References Cited**

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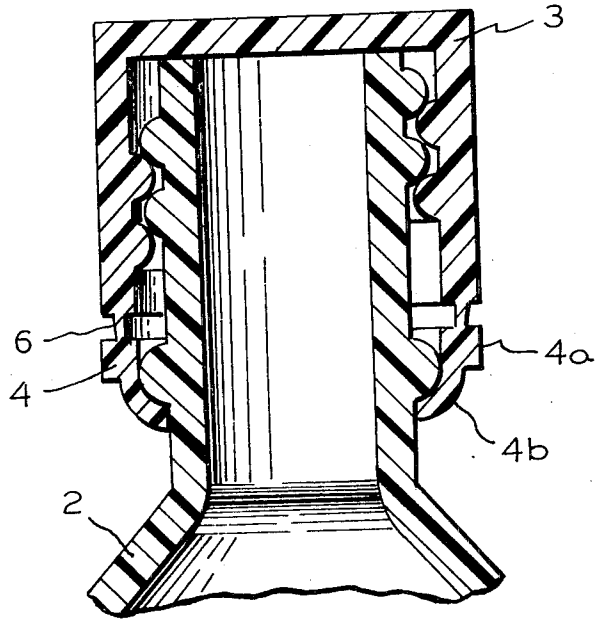
Primary Examiner—Travis S. McGehee
Attorney—E. F. Wenderoth et al.

[57] **ABSTRACT**

Method of applying a pilferproof closure which has a capping portion and has joined thereto along a failure line of reduced strength a security ring which has adjacent said failure line an annular portion from which extends a skirt portion having a thickness less than that of the annular portion. The closure member is formed from thermoplastic material and the skirt portion is warm rolled onto an undercut section of the neck of a container without heating the material at the failure line so as to distort it.

4 Claims, 11 Drawing Figures



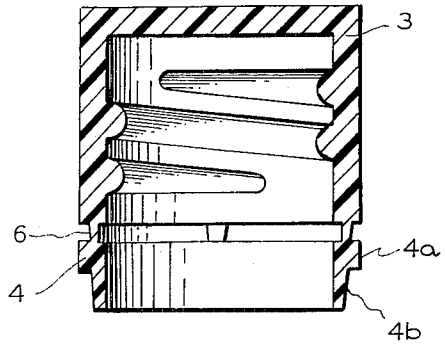


FIG. 1

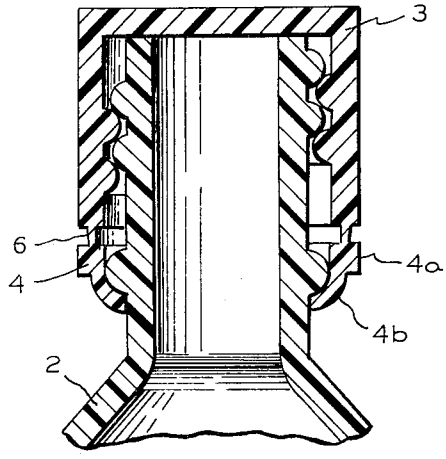


FIG. 5

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FIG. 2

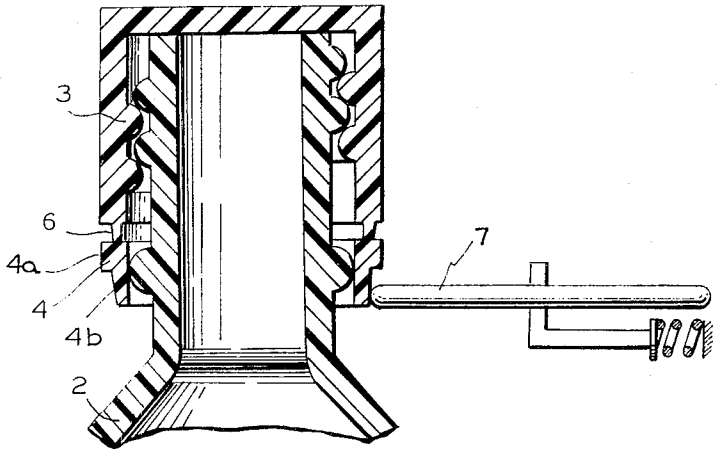

FIG. 3

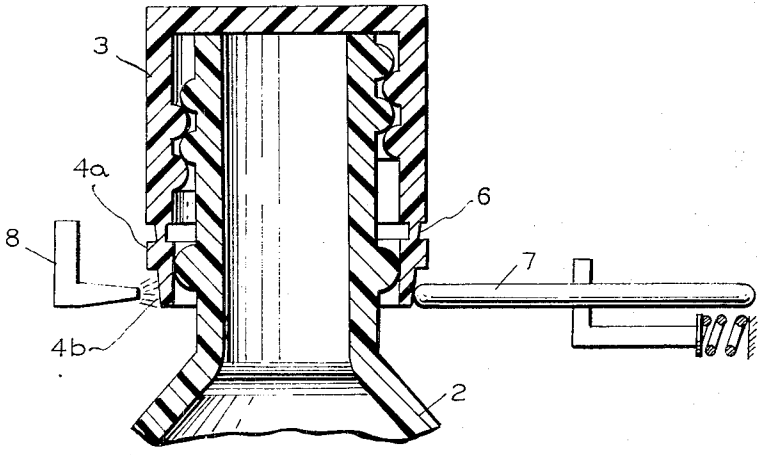

FIG. 4

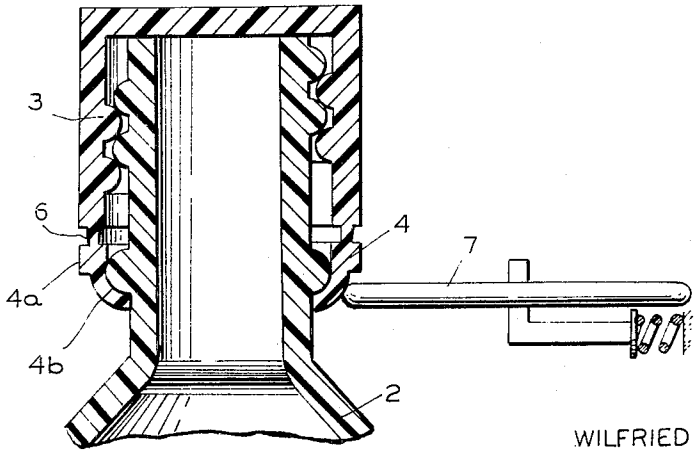

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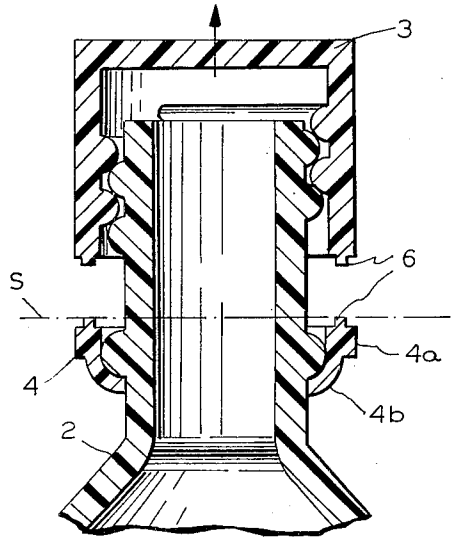
FIG.6



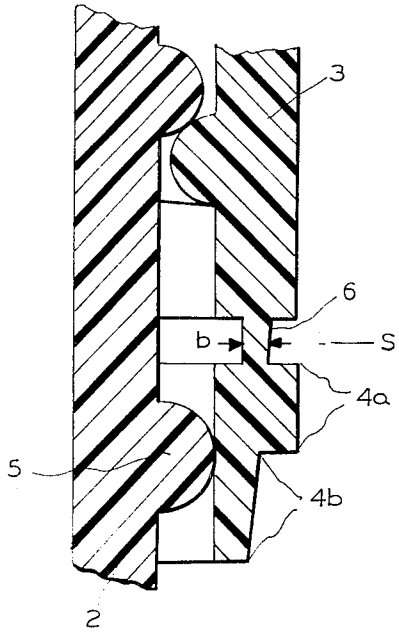


FIG.7

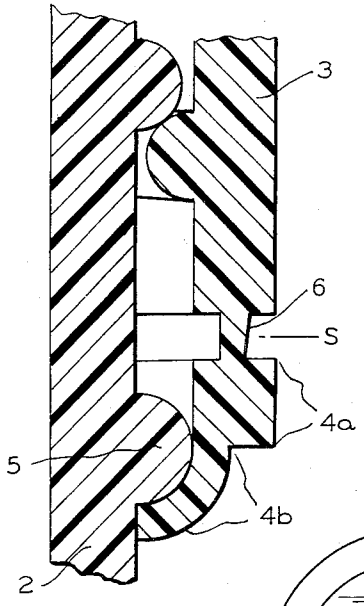


FIG.8

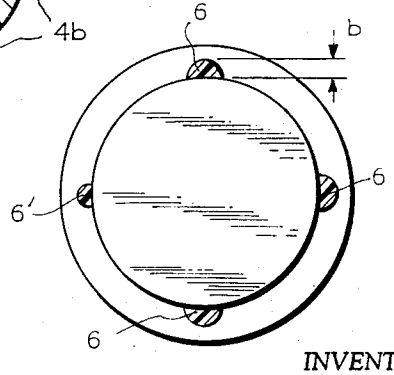


FIG.9

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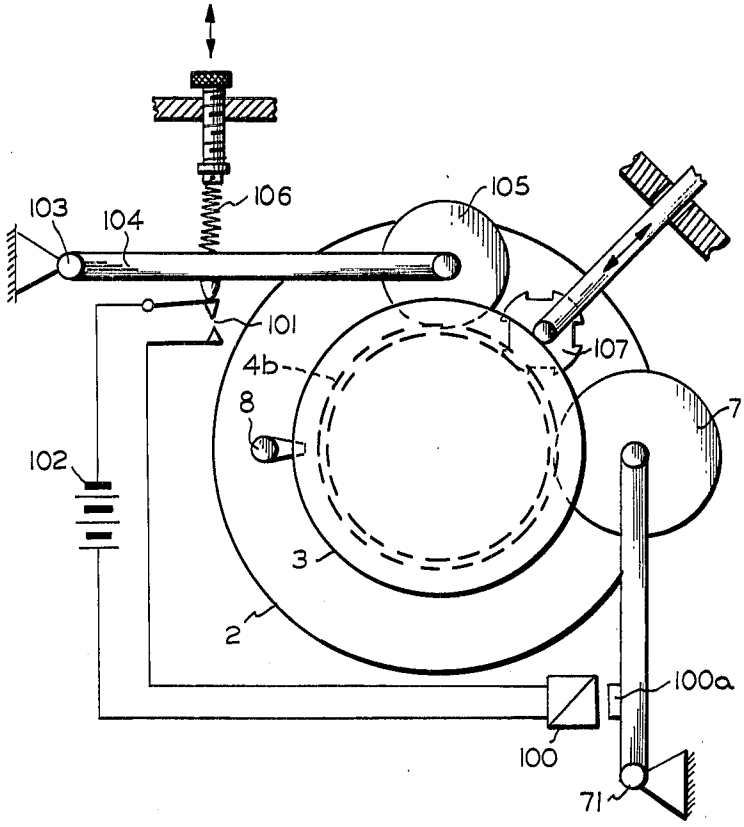

FIG.10

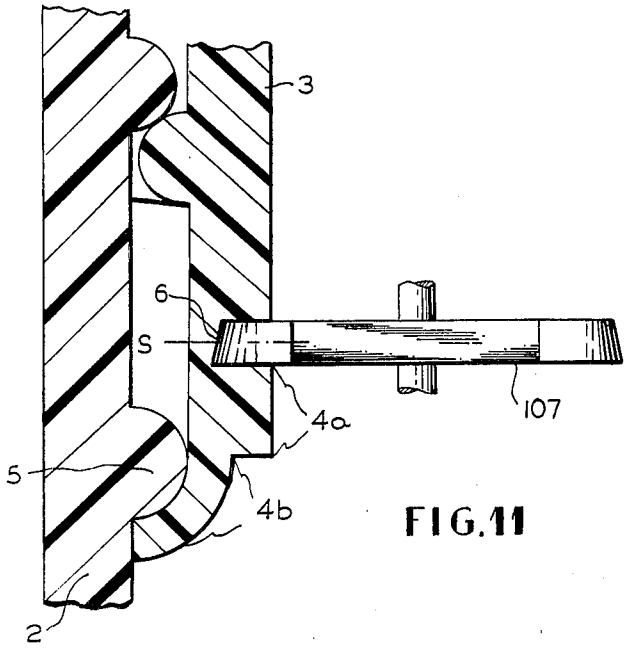

FIG.11

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METHOD OF APPLYING PILFER-PROOF CLOSURES

This application is a continuation-in-part of application Ser. No. 810,113, filed Mar. 25, 1969 and now abandoned.

This invention relates to a process for capping a container with a container cap incorporating a pilferproof seal in the form of a security ring joined to an upper portion of the cap across a failure line so that part of the ring can be rolled onto an undercut section of the container neck; the ring breaking away from the cap portion along the failure line on initial opening.

Rolled-on pilferproof caps are usually made of sheet metal such as aluminum which can be formed cold. The security ring is then cold rolled onto the undercut section of the container neck. Metal caps have several disadvantages, however, and there is a requirement for a similar type of cap made of plastic material.

It is difficult to cap rapidly containers using plastic caps similar to the above metal design due to the fact that thermoplastic materials cannot be shaped in the cold condition. The security ring of the cap must therefore be preheated to a given temperature before it can be rolled onto the neck of the container. Unfortunately, stresses are produced when the ring is in the thermoplastic state which usually cause considerable distortion of the ring.

A surprisingly simple solution to the problem has been discovered by adopting a special shape of blank for the cap and carrying out the capping steps in a certain way.

We therefore provide, in accordance with the present invention, a pilferproof closure member comprising a capping portion and joined thereto along a failure line of reduced strength a security ring which has adjacent said closure line an annular portion from which extends a skirt portion having a thickness less than that of the annular portion, the closure member being formed from plastic material and the thickness of the annular and skirt portions of the security ring being so chosen that application of heat and pressure to the skirt portion to roll it onto an undercut portion of the neck of a container to be closed by said closure member can be accomplished without the annular portion and the material along the failure line becoming plasticized and distorted.

The process for capping the neck of a container having an undercut portion to provide a pilferproof seal therefor, comprises applying heat and pressure to plasticize the skirt portion and roll it onto the undercut portion, the supply of heat being controlled so as to prevent the annular portion becoming plasticized.

The process according to the invention thus utilizes a closure member incorporating a security ring divided into a thicker and a thinner zone with the required difference in mass. It has been found quite feasible to deform the thinner zone, that is the skirt portion, thermoplastically without softening the thicker one, that is the annular portion, so that the latter retains both its shape and strength. Local control of heat is not critical, although at least the same amount of heat should be supplied to the thinner zone per unit of volume as to the thicker one, preferably more.

The invention will now be described in greater detail with the aid of the accompanying drawings, which represent the following in cross-section:

FIG. 1: a closure-cap blank shaped according to the invention,

FIGS. 2 to 4: the main stages in the process of capping a container according to the invention.

FIG. 5: a completed pilferproof closure,

FIG. 6: the pilferproof closure during initial opening of the container,

FIGS. 7 and 8: is an enlarged view of the skirt of a screw-cap blank in position on the container neck before shaping of the security ring (FIG. 7) and afterwards (FIG. 8),

FIG. 9: depicts a section perpendicular to the cap axis through the failure line,

FIG. 10: is a schematic view of a means for monitoring the softness of the plastic material of the skirt and subsequently applying pressure, and

FIG. 11: is an enlarged sectional view similar to FIG. 4 showing the use of a notched cutting roller.

These types of closure caps comprise two main parts, i.e. the actual cap 3 and a security ring 4 attached to it through webs 6 illustrated in plan view in FIG. 9, the section of the connecting portion between the portions of the cap being referred to as a failure line S. The neck of a container marked 2 is provided with an annular beading 5 for locating the security ring. The security ring 4 is made up of a thicker zone 4*a* and a thinner one 4*b*. In one embodiment of the method the cap blank is molded by conventional molding means with the failure line S present in the cap blank before the pilferproof seal is created as shown in FIG. 1.

A pilferproof seal for a container can be produced as illustrated in FIGS. 2 to 4, for instance. The stages involve (a) screwing the cap blank 1 made of thermoplastic material as shown in FIG. 1 onto the container neck 2, (b) then applying pressure to the thinner zone of the security ring 4*b* by at least one roller 7 (FIG. 2), the pressure being adjusted so that it is sufficient to deform the zone of the ring 4*b* after it has been plasticized, (c) rotating either the container 2 complete with the screw cap 1 and/or the support of the roller 7 about the center line of the container or the cap, (d) blowing hot air onto the security ring zone 4*b* through at least one jet nozzle 8 until the zone has been plasticized (FIG. 3) and using the roller 7 to force the zone 4*b* under the beading on the container neck 5 (FIG. 4) and (*e*) withdrawing the roller 7 and stopping the rotation as soon as the zone 4*b* has hardened again. The sequence of the stages (b) and (c) could be reversed. The entire process can be automated to achieve a high capping rate of one seal every 1 to 2 seconds. The individual stages of the process partly overlap.

It will be understood that the pressure urging the roller toward the skirt acts to monitor the plasticity of the skirt, since the roller will act to roll the skirt under automatically when the proper plasticity is reached.

Alternatively a sensor can be used which continuously monitors the thermoplastic condition of the thinner zone 4*b* of the security ring as heat is being applied so that the deforming pressure can be exerted by a separate pressure applying means when an adequate degree of plasticity is detected.

An example of a separate sensor and a separate pressure applying means is shown schematically in FIG. 10. A sensing roller 105 is mounted on an arm 104 pivoted at 103, and spring pressure is exerted on the arm 104 by a spring 106 to urge the arm 104 around the pivot 103 so as to urge the roller 105 toward the skirt portion 4*b* of the security ring on the cap 3. Contacts 101 are disposed on the side of the arm 104 toward which it is urged by the spring 106, and the contacts are in a circuit with a power supply 102 and an electromagnet 100 which is positioned opposite an armature 100*a* on an arm 70 pivoted at 71 and carrying a pressure roller 7 at the free end thereof.

In operation, heat is directed against the skirt portion 4*b* by the nozzle 8 and when the skirt portion is sufficiently plasticized to give way slightly under the force of the spring 106, the arm 104 will pivot, thus closing contacts 101 and energizing magnet 100. This abruptly swings arm 70 and roller 7 toward the skirt portion 4*b*, thus applying pressure thereto for rolling it under the undercut portion.

The supply of heat is interrupted at the latest simultaneously with the application of the deforming pressure or is at least reduced to such a degree that the temperature of the thinner zone 4*b* no longer rises. An alternative solution involves subjecting the thinner zone 4*b* to the full deforming pressure from the moment heat is first applied so that as soon as the required degree of plasticity is detected pressure can take effect immediately and shaping then occurs suddenly.

The roller(s) 7 can be adapted to sense the thermoplastic condition of the thinner zone 4*b* so that they not only detect the softness of the thinner zone 4*b* but can also apply the deforming pressure to roll the thinner zone 4*b* over the beaded portion 5 of the container 2.

The neck of the container with the completed pilferproof closure is shown in FIG. 5. When the container is opened for the first time the upper part of the screw cap 3—which provides the actual closure—is of necessity sheared off from the security ring 4 along the failure line S, the ring remaining on the neck of the container as shown in FIG. 6.

As already explained, the use of two zones in the security ring of the cap blank is an essential feature of the invention. The enlarged cross-section shown in FIG. 7 once again depicts part of the container neck 2 and the cap blank. The zone 4*a* of the security ring 4 is twice the thickness of the zone 4*b;* in practice thickness ratios can vary from about 2:1 to 3:1. FIG. 8 also illustrates an enlarged section of the pilferproof closure after rolling the zone 4*b* of the security ring over the neck beading 5.

The portion connecting the cap 3 and the security ring 4 at which the failure line S is located is normally made up of slits and webs, the most successful design incorporating one web 6' which is weaker than the others. It has been demonstrated that such a design not only ensures a satisfactory connection between the security ring and the upper part of the cap but that it also considerably reduces the force needed to shear off the security ring during initial opening. The web designated with 6' in FIG. 9 is weaker than the three others (6). The thickness *b* of the webs 6 and 6' is preferably only a fraction of the wall thickness of the screw cap, the webs being set in from the outer surface of the cap.

As described in connection with the embodiment of FIGS. 1–9, the webs 6 and 6' can be formed in the cap blank when the cap blank is formed by conventional molding processes prior to its being placed on the container. However, it is also possible to form it as the cap is being acted on to secure it to the container. As seen in FIGS. 10 and 11, there is provided a notched cutting roller 107 which is urged against the periphery of the cap blank between the cap 3 and the security ring 4 in order to form the failure line S. As seen in FIG. 11, the notched cutting roller removes material from the cap leaving only the webs 6, which can be all the same size, or some of which can be slightly smaller than the others depending on the sizes of the notches in the roller 107. The notched cutting roller 107 is applied to the cap after the cap blank is placed on the container, and at the latest when the pressure roller 7 is applied.

The advantages of the security-ring zone 4*a* with a greater thickness have already been outlined. This reinforcement increases the strength of the cap and provides a more positive location of the security ring over the beading on the container neck.

Most thermoplastic materials can be used for the closure cap, for example polystyrol. The majority of these plastics only retain their shape up to about 80° to 90° C.

The temperature of the hot air provided by the jet(s) 8 is best set to between 200° and 250° C. or between about 1.3 to 3.5 (preferably between about 2.2 to 3.1) times the temperature needed for plasticizing the thinner zone 4*b*. The jet nozzle is positioned as close as possible to the zone being plasticized to reduce to a minimum the heat loss from the hot air. Since the temperature of this air is well above that required for plasticizing, the softening process is very short. Experience has revealed that applying the shaping pressure to the thinner zone 4*b* virtually as soon as plasticizing takes place and interrupting or reducing the supply of heat or hot air as soon as the material becomes soft, the shaping of the thermoplastic material of the thinner zone 4*b* is already complete before the thicker zone 4*a* can distort.

Preferably, the period of time during which heat is applied is adjusted, so that the supply of heat is stopped just before the plastic state is reached or at least reduced to such an extent that the temperature in the zone being shaped no longer rises. The process timing can readily be adopted in mass production.

Switching the supply of hot air on and off or varying its intensity is best achieved by altering the distance between the jet nozzle and the zone being plasticized. Optimum temperatures can be obtained by suitably adjusting the control sequence. Solidification of the softened zone is achieved merely by interrupting or cutting down the supply of hot air coupled with the cooling effect of the pressure rollers 7.

It is also possible to use the rollers themselves for producing the plasticizing temperature, for instance by raising their rolling speed and slip to the point where the heat generated by friction becomes adequte for the purpose. The speed of rotation of the screw cap (blank) or of the rollers, i.e. the relative speed, must then be increased to between 5,000 and 9,000 revolutions per minute.

The closures illustrated in the drawings (FIGS. 1, 2, 3 and 6) are all equipped with an internal screw thread but a cap without threads could obviously also be used. These screwless closures could be used in conjunction with an existing top, e.g. a stopper or an ordinary screw cap. To form the pilferproof seal, their security ring is rolled over the container-neck beading as described above. It is also possible to roll threads in smooth cap blanks using the container-neck thread as a former so that after the security ring has been broken away, the cap can be unscrewed.

What is claimed is:

1. A process for capping the neck of a container having an undercut portion to provide a pilferproof seal therefor, comprising forming from plastic material a cap blank having a capping portion and having a security ring connected thereto along a failure line of reduced thickness, the security ring having adjacent said failure line an annular portion and extending therefrom a skirt portion having a uniform thickness around the entire periphery of at the most one-half that of the annular portion, placing said cap blank on the container, applying heat to plasticize the skirt portion by directing a jet of hot air at the skirt portion, monitoring continuously the plasticity of the skirt portion as said heat is being applied, applying a pressure to the outer surface of said thinner skirt portion by engaging the surface of a roller with the periphery of the skirt portion and moving the roller around the security ring in order to roll it under said undercut portion when a predetermined degree of plasticity is detected, and controlling the application of heat so that there is no substantial further increase in temperature of the skirt portion, whereby only the skirt portion is plasticized and the temperature of the annular portion and the material at the failure line of the cap blank is prevented from rising to the plasticizing temperature and the material at the failure line is kept undistorted.

2. A process as claimed in claim 1 in which said monitoring step is carried out by placing a monitoring means against said skirt which is responsive to the plasticity of the skirt, and operating said pressure applying roller only after said monitoring means senses that the material of the skirt portion has been plasticized.

3. A process as claimed in claim 1 in which said monitoring step is carried out by engaging the roller with the periphery of the skirt portion and continuously urging said roller toward said skirt portion, whereby when the perdetermined degree of plasticity has been attained, the pressure on the roller will roll the skirt portion under the undercut portion.

4. A process for capping the neck of a container having an undercut portion to provide a pilferproof seal therefor, comprising forming from plastic material a cap blank having a capping portion and having a security ring thereon of substantially the same thickness as that of said capping portion, the security ring being comprised of an annular portion and extending therefrom a skirt portion having a uniform thickness around the entire periphery of at the most one-half that of the annular portion, placing said cap blank on the container, applying heat to plasticize the skirt portion by directing a jet of hot air at the skirt portion, monitoring continuously the plasticity of the skirt portion as said heat is being applied, applying a pressure to the outer surface of said thinner skirt portion by engaging the surface of a roller with the periphery of the skirt portion and moving the roller around the security ring in order to roll it under said undercut portion when a

predetermined degree of plasticity is detected, controlling the application of heat so that there is no substantial further increase in temperature of the skirt portion, and at a time no later than the application of rolling pressure, forming a failure line of reduced thickness around said cap blank by rolling a notched cutting roller around the cap blank to cut slits in said blank to leave a plurality of webs joining the capping portion to the security ring, whereby only the skirt portion is plasticized and the temperature of the annular portion and the material at the failure line of the cap blank is prevented from rising to the plasticizing temperature and the material at the failure line is kept undistorted.

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