METHOD AND DEVICE FOR MANUFACTURING CLOSURE CAPS AND CLOSURE CAP PRODUCED THEREBY

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The present invention relates to the manufacture of closure caps, and more particularly to a method and device for manufacturing closure caps and to the improved closure cap produced thereby, having gaskets or coatings formed therein from a piece of moldable material.

This application is in part a continuation of application Serial No. 17,857, filed in the United States Patent Office on January 10, 1950.

With the present method and device, a cup-shaped shell for a closure cap, usually of sheet metal, may first have placed therein a piece or slug of material such as unsecured rubber compound; the piece of material is thereafter subjected to the action of a pressure member which deforms the material and forces it into contact with shell walls to form it into desired shape. In some instances, the plastic or moldable compound may be forced into the shape of an annular gasket which extends around the skirt portion of a closure cap, and in other instances the compound may be squeezed to form such a gasket and also completely cover the underside of a top panel of the closure cap.

In addition to the other features of the invention, I have discovered that in practicing the method under normal conditions blisters form on the rubber material in the closure and that the blisters are caused by small bubbles of air being compressed to a high degree by the pressure used in molding the rubber. When this high pressure is removed, the air expands to cause blisters or recesses in the rubber compound. In order to overcome this difficulty, I have utilized an attachment for exhausting the air from the chamber formed during the liner molding operation. By thus exhausting the air from in and around the rubber slug at the time of the molding operation, trapped air is minimized and blisters cease to be a problem. The metal of the closure, or a coating thereon, is completely covered with rubber and the exposed surface of the rubber is smooth and adapted to form an excellent seal.

In addition to forming an excellent seal, the closure formed by the present method eliminates so-called "pinholes" in fast foods which packaged in closed containers attack the metal of the closure cap sealing the container. This slow action tends to form pinholes which perforate the metal. Of course, any perforation permits air to enter the container, and the product is spoiled. Enormous quantities of packaged foods have been spoiled due to this tendency of the product to attack the metal. It is not possible to coat the metal with lacquers which will eliminate the difficulty.

The present invention aims to overcome the above and other difficulties by providing a new and improved method and device for manufacturing closure caps by shaping under high pressure a moldable compound within a cap shell so as to conform to appropriate portions of the shell and to so effectively unite the shaped compound with shell surfaces that the compound cannot be separated without considerable effort; thereafter an edge of the shell is preferably interlocked to lock the molded material into position. The invention further contemplates a new and improved means and method of preventing the formation of cavities or blisters in the material which is shaped to form a gasket or interior coating in the closure cap. In addition, the invention aims to provide an improved closure cap and package.

An object of the present invention is to provide a new and improved method of manufacturing closure caps.

Another object of the invention is to provide a new and improved device for manufacturing closure caps.

Another object of the invention is to provide an improved closure cap and package.

Another object is to provide a new and improved means and method of minimizing or preventing the formation of defects such as cavities in the gaskets or interior linings of closure caps.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein:

Fig. 1 is a diagrammatic view illustrating the manufacture of a closure cap according to the present invention;

Fig. 2 is a sectional view illustrating one means for practicing the present invention;

Fig. 3 is an enlarged fragmentary sectional view illustrating the parts of Fig. 2 in another position;

Fig. 4 is an enlarged fragmentary sectional view of a device for shaping the moldable material, embodying a plunger with a different shaped lower end than that of Figs. 2 and 3;

Fig. 4a is a sectional view showing a molding press generally similar to that of Figs. 2 and 3 but embodying certain refinements therefrom;

Fig. 5 is an enlarged fragmentary sectional view showing a portion of a closure cap manufactured by the present method and device;

Fig. 6 is an enlarged fragmentary sectional view also illustrating a portion of a closure cap, similar to that of Fig. 5 manufactured by the present method and device;

Fig. 7 is a plan view, partly broken away, showing a square slug of moldable material with corner portions retaining it in position within the shell;

Fig. 8 is a plan view, partially broken away, showing a triangular slug of moldable material with corner portions thereof retaining the slug in position within the cap shell;

Fig. 9 is an enlarged fragmentary sectional view showing a portion of modified closure cap manufactured by the present method and device; and

Fig. 10 is a fragmentary sectional view showing a container having sealed thereto a closure cap of the present invention.

Referring again to the drawings, and more particularly to Fig. 1, there is shown in diagrammatic form various steps preferably utilized to produce the present closure cap, a completed cap being shown at the right side of the figure. For purposes of convenience, the invention will be described chiefly with reference to its use in manufacturing a closure cap having both annular gasket portion and a thickness of material lying against the underside of the cap cover portion. Certain features of the invention may be used to produce a closure cap embodying a ring gasket, with or without the layer of material underlying the entire cover portion.

The closure cap shell is stamped and formed from a strip of suitably coated sheet metal (not shown) so that it has an inset center portion 2, annular offset cover groove 4 and depending skirt portion 5, as illustrated at
The shells are formed so that a coated surface of the sheet is disposed inwardly, the preferable coating being a vinyl base coating. The juncture of skirt 5 and cap 2 may be as shown in the enlarged view of Fig. 5 or may be more rounded as shown in Fig. 9. The lower edge of the skirt 5 is turned or rolled inwardly on a usual rolling machine, for example, to form a flange 6. In this condition, the shell is ready to receive a piece 18 of molding material that is to be formed so as to occupy the interior of the closure and form both an annular gasket portion 9 and protective layer 10 (see d at right side of Fig. 1).

For purposes of convenience, the deformable material which is used to form the gasket and covering layer at the interior of the shell will be described as comprising some suitable rubber compound or material, it being intended that this terminology include the various examples referred to herein as well as other materials or compounds having appropriate qualities. It will be observed that various synthetic or natural rubber compounds may be utilized, as well as materials other than rubber compounds, without departing from the spirit and scope of the invention. The present invention is not intended to be limited to any particular molding compound or material, as the method and device are equally useful with various ones. Synthetic materials could be used which would be ready for use immediately without being shaped into desired formation within the closure cap. The rubber compound is preferably in uncured or unvulcanized condition when placed into the shell and may, if desired, be subsequently vulcanized to the desired state of hardness, elasticity, strength, etc. The molding materials may be of any desired color for giving a pleasing appearance with the particular material to be packaged; for example, when the caps are used for dark colored jams or jellies, the molding material may have a matching dark color, and when used for packaging cheeses it may be of lighter matching color.

The rubber compound may be formed into one or more strips 12 of appropriate width and thickness by any suitable machine, for example by that shown in expired Patent No. 1,871,560. Such a machine is indicated generally in Fig. 1 by reference character 13. A strip 12 is then severed by shear 14 into slugs 18 of desired length or suitable slugs may be punched from the strip.

The shape and thickness of the slugs should be suitable to so particular closure cap as to be formed. With a shell diameter of about 2¾” and a skirt length of about ¾”, the slug may be about one inch square and ½” thick; these are merely examples. A circular or other shape of slug could also be used. The slugs may have marginal portions that project beyond the skirt flange 6 and engage the skirt 5, such as the corners of the square and triangular slugs shown in Figs. 7 and 8 respectively, to thereby retain the slugs within the cap shells. However, some areas of the top panel within the confines of the skirt 5 are preferably left uncovered by the slug which is placed in the shell.

The slugs are formed by inserting and fastened by hand within closure cap shells adjacent central parts thereof, as indicated at b in Fig. 1, or may be guided thereto by a chute 15. In this relationship, the shell is supported and the slug squeezed under high pressure so as to displace portions of it to cover the center panel, fill the groove 4 in the top of the cap, and extend upwardly along the skirt 5, as shown at a. Subsequently, the skirt flange 6 is turned toward the top panel 2, as indicated at 7. An enlarged fragmentary section of a completed cap is shown in Fig. 5. The means and method for forming the closure cap illustrated at d in Fig. 1 and in Fig. 5, from the condition of the parts as shown at b in Fig. 1, is illustrated more particularly in Figs. 2 and 3 and will now be described.

As shown in Fig. 2, the cap shell with slug 18 therein is placed in a recess in a support member 20 positioned beneath a reciprocable plunger 21, shown carrying a relatively movable stripper and sealing member 22. The support member may be part of the unit not shown herein. This presents caps beneath the plunger 21 and subsequently moves them away from the plunger. The plunger 21 may be hydraulically operated to give the high pressures desired or may be mounted for reciprocation on any suitable press or mechanism, the details of such a press being well understood in the art and not shown herein. The relatively movable member 22 may be supported on the plunger by bolts 23 that extend through openings in extensions 25 of the plunger, and may be normally urged downwardly by springs 26 positioned intermediate the plunger projections 25 and the relatively movable member 22.

As the plunger 21 and member 22 move downwardly, sealing means 28 at the underside of the movable member contacts the surface 29 of the cap supporting member 20 and co-operates therewith and with the plunger 21 to form a chamber around the shell and its lug of moulable material within the closure cap. A suitable exhausting device to withdraw air from the cap enclosing chamber. This may be achieved in any suitable manner; for example a projection 35 of a valve 37 may strike an adjustable screw 36, to thereby open the valve 37, which connects the conduit 34 with a vacuum tank or other means for withdrawing air from the interior of the cap chamber through the conduit 34 and a passage-way 39 of the movable member 22. Withdrawal of air from the chamber thus commences prior to the lowermost surface 40 of the plunger 21 coming into contact with the rubber slug 18, upon continued downward movement of the plunger. The sealing ring 28 may be of round, square, or any other appropriate cross section, being retained in a correspondingly shaped groove.

When the movable member 22 contacts the cap support member 20, its movement is arrested but the plunger 21 continues to move downwardly in opposition to the spring or springs 26 and its lower surface comes into contact with the rubber slug 18. The pressure exerted by the plunger 21 causes the material to flow first radially outwardly and thence down along the cap skirt into the shape illustrated at e of Fig. 1.

The amount of pressure required to deform the slug 18, 18b, or 18c is influenced by the particular composition of the plastic material. With some materials, the total load per cap may be in the neighborhood of eight tons. This, of course, will also vary with the size of the slug which must be reformed, as well as with the particular material of the slug. With a load of eight tons the pressure is in the neighborhood of 4,000 pounds per square inch; it is preferably not less than about 3,500 pounds per square inch regardless of cap size and material being molded, and may be more. I have found that by using pressures from about 3,500 pounds per square inch to about 10,000 pounds per square inch, I get a very superior bond of the cap and its vinyl base coating with liner or gasket, as well as liners or gaskets of optimum and uniform density and toughness throughout out the layers. This is of great importance as it assures uniform sealing pressures against the rim and annular sealing zone of containers. These pressures are so high that they are obtained by a hydraulic press. The uniform density and toughness and superior bond thus obtained makes it difficult to scrape away with a suitable instrument the lining or gasket so as to expose the underlying metal and prevents removal in normal conditions of usage. Applying this
pressure for a period of about two to four seconds will give good results.

This method of reforming the molding slug under high pressure on the portions of the top half of the mold to shift outwardly from central locations over underlying portions of the top half of the mold and to squeeze the air film molecules off the vinyl base coating or a metal surface to give a bond or uniting between the compound and underlying coating or metal that is very difficult to break. The strength of this bond is undoubtedly due in large measure to the high pressure utilized to reform the slug and force it against the interior of the cap, and it is believed that absorbed surface films of air are so broken or weakened that there is obtained a molecular interlocking between the compound material and the underlying vinyl base coating or metal.

The bond obtained is so strong that the plunger 21 may be pulled out of the resulting cup-shaped liner or gasket without the necessity of first heating the cap in order to get sufficient adherence between the material and the cap so that the plunger will not pull the molded material loose as it moves away from the cap. As a matter of fact, the bond obtained is so strong that the plunger may actually be hotter than the cap and yet not pull the liner loose as it moves out. The advantage of thus being able to heat both plunger and cap is that it permits supplying just sufficient heat during pressing to render the pressure highly effective in the distribution of the material and reduces the time required for application; this heat makes the material flow easier.

The above high pressure action supplements the simultaneous withdrawal of air that creates a partial vacuum and is particularly useful and desirable in manufacturing the present closure caps at high speeds.

The high pressures utilized give flow and adherence of the lining at temperatures which will avoid objectionable hardening of the material of the lining so that the precise nature of the lining as to hardness and other sealing qualities may be predetermined and retained during reformation of the slug. If desired, the caps with the molded material therein may be subsequently subjected to heat for curing and in this way render the closures suitable for sealing products requiring a cured or vulcanized gasket.

The uniform density and toughness obtained by the high pressures utilized is in all probability due to squeezing minute amounts of adhered or adsorbed air out of the slugs and in achieving a closer contact between the particles which comprise the slug material.

While the closures may be subsequently heated to vulcanize the rubber and secure greater toughness and hardness, such subsequent heating is neither necessary nor desirable for sealing many types of products.

While lower pressures may be used to reshape a slug so that it conforms to a cap shell with apparatus of relatively light construction, the lighter pressure does not give the uniformly dense and tough gaskets obtained by those formed under the preferred pressures of about 5,000 lb per square inch.

Even though the interior of the container may be subjected to an unusually high vacuum, the "pulling down" force on the closure cap is not sufficient to cause the container rim to dig its way entirely through any portion of a liner or gasket formed under the above pressures, even where the rubber is unvulcanized.

Where a plunger 21 with a flat end is used, the inset center portion 2 provides a desired depth to the groove 4 around the periphery of this center portion. The horizontal portion of a gasket formed in the groove 4 provides a top seal for a container and the vertical wall portion of a gasket provides a side seal for a container. If desired, the end of the plunger may have an annular portion 48 (Fig. 4) which projects beyond the remainder thereof; this offset part 48 serves to press the moldable material firmly into the annular cap recess and may even inset it slightly.

The cap supporting member 20 and the reciprocable plunger 21 may be heated by suitable electric heaters or plates 45 and 46. These may partially vulcanize a rubber compound during its formation within the cap, and the cap may be subsequently subjected to additional heat for completing the vulcanization, for example by exposing them to a battery of infra-red lamps as the caps move through a suitable tunnel or pass through a vulcanizing oven. The heaters 45 and 46 of the cap support member and plunger may be heated to any appropriate temperatures. Good results will be achieved with some compounds by maintaining the plunger heater at a temperature of about 160° F. and the cap support heater at about 140° F., giving a general average temperature of about 150° F. Preferable temperatures of cap and molding material at the end of the molding operation are in the order of 130° F. to 160° F.

If desired, one or more ducts 43 may be provided in the plunger 21 (Fig. 2) to receive, during displacement of the slug 18, any excess rubber compound comprising the slug. It is preferred not to have such ducts, however, as they generally allow objectionable protuberances to form. Air is not drawn into the cap chamber through the ducts, as they are generally blocked by excess slug material.

Adjacent the end of the molding stroke of the plunger 21, the flange 6 of the shell is turned inwardly toward the center panel of the closure to fit around and grip the shaped molding compound. This may be accomplished by an inclined shoulder 59 on the plunger 21, which strikes against the inwardly extending flange 6 and bends it toward the cover portion of the cap. The means for evacuating the cap chamber preferably remains connected during intumescence of the cap lower edge so that no air is trapped between the gasket and the edge of the skirt during its inward turning, where it might tend to blow the gasket edge laterally upon release of pressure caused by inward movement of the plunger 21.

The molding press illustrated in Fig. 4a is similar to that of Figs. 2 and 4 but embodies certain refinements. For example, the closure is shown in the support member 20a for lifting closures when the ejector is elevated by the underlying reciprocable cam, a chute is provided at the left side for guiding closures away from the machine, and upright rods are shown for guiding the plunger-carrying means during reciprocation by the piston rod and its hydraulic cylinder indicated at the top of the figure. A bell crank at the right side of the figure may be actuated with the plunger to operate the ejector-elevating cam.

Final preferred shapes of the cap edge are illustrated in the enlarged view of Figs. 5 and 9 where the inwardly disposed surface of the intumesced skirt is shown forming substantially a continuation of the surface of the skirt gasket portion. The completed closure may thus be readily fitted downwardly over the mouth of a container. The skirt and cover portions may merge together as shown in Fig. 5 or may be more rounded at their juncture as indicated in Fig. 9. The more rounded form is more desirable as it facilitates flow and even distribution of vulcanizing material during pressing of the slug and further minimizes the possibility of trapping air in or beneath the molding material. With a cap of about 2/4" diameter, the rounded connecting portion may have a radius of about 1/2" of an inch.

In addition to securely gripping the gasket material, the intumesced edge of the skirt also conceals any uneven edge or gap 51 which may form on the material due to placing too small a slug in a shell, as indicated generally in Fig. 6. Thus each closure cap produced by the present method has a uniform and neat appearance, even though the moldable compound may not be sufficient to contact the underside of the inwardly extending flange 6 prior to inward turning thereof.
The distance that the cover portion 2 of the shell (Figs. 5 and 9) is inset with respect to the groove wall 4 determines the thickness of the gasket formed in the groove. The thickness of the gasket may be varied by insetting the cover portion an appropriate distance. Where the plunger has an offset annular ridge 48 (Fig. 4), this also serves to shape the rubber slug adjacent the groove wall 46 of the cap. The final closure shown and described herein preferably has a rubber thickness at its center portion of about 9/100 of an inch.

The gasket material shown in Figs. 5 and 9 is thinner adjacent lower portions of the cap than adjacent upper portions, which provides a larger diameter so that the cap may readily fit over a container side wall. The lower inner surface of the material may be inclined as shown in Fig. 5 or may be substantially cylindrical as shown in Fig. 9.

As either of the closures shown moves down over a container, due to external pressure or vacuum from the interior of the container, material from the thickened upper gasket portion is reformed or displaced as it moves toward the lower thinner cross section and presses radially inward against an annular side wall portion of the container below its rim. The relationship between a container and closure cap such as that of Fig. 9 sealed thereto is illustrated in Fig. 10, and it will be noted that the gasket material often protrudes inward at 8 so as to contact adjacent portions of the container side wall 3. If desired, the container may have a thickened upper edge or bead so that the reformed or displaced rubber compound of the gasket may interlock beneath such bead or edge. A similar relationship exists when the closure cap of Fig. 5 is applied to the container.

Upon completion of molding, the plunger 21 moves out of the cap and the movable stripper and sealing member 22 remains temporarily in lower position, due to the springs 26 which hold it downwardly. As the plunger continues to move out, portions of the plunger projections 25 come into contact with the enlarged heads of the bolts 23 and lift the stripper away from the cap supporting member 20. The member 22 retains the closure within its seat in the member 20 until the plunger 21 has moved completely away from it. Completed closures may be removed from their seats in the seating member 20 in any suitable manner, for example by a cam-operated ejector member, and sent to means for completing vulcanization of the shaped material.

While the evacuating passages 39 and conduit 34 are shown in the stripper member 22, they could instead be provided in the plunger member 21. The construction shown and described is preferred, however, as it facilitates operation of the method and provides a relatively simple device for withdrawing air prior to the instant at which the plunger comes into contact with a slug of material.

It will be seen that the present invention provides a new and improved method and device for manufacturing closure caps, as well as an improved closure cap and sealed package. With the present method and device, objectionable cavities in the moldable material are either minimized or eliminated, the resulting gasket being substantially uniform in density and toughness is adapted to form secure seals and to prevent contact of container contents with the metal of the cap. The tenacity of the bond between the liner or gasket and the shell of the cap is so strong that there is very little likelihood of their separation.

Air is withdrawn from a closed chamber which contains the slug and the moldable slug is simultaneously subjected to extraordinarily high pressure. As the slug reforms under this high pressure, portions of it scrub so closely along interior surfaces of the cap that adsorbed surface films of air are broken or weakened and a very strong interlock, probably molecular, is obtained between slug material and cap surfaces. Turning the edge or skirt of the closure toward a cover portion of the cap is achieved simultaneously with evacuation of air from the cap and the containing chamber, so that there is little likelihood of trapping air at the rear or some other portion of the moldable material. The turned edge of the cap skirt conceals the edge of the rubber and permits considerable leeway in the rubber forced up about the periphery of the closure cap.

The cover portion of a closure cap is preferably inset with respect to an annular marginal portion to provide a groove which is adapted to hold moldable material at that portion adapted to contact and form a seal with the rim of a container. In addition to forming a seal at the upper part of the rim, a closure manufactured in accordance with the present method and device is also adapted to form a seal about an adjacent side wall of the container.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. A sheet metal closure cap of the class described comprising a top portion and a depending cylindrical skirt, a rubber compound forming an imperforate covering over the entire inner walls of said top portion and depending skirt, said covering having its greatest thickness along the upper portion of the skirt for telescoping over and engaging the side wall of a container, the inner surface of the covering along the lower portion of the skirt flaring downwardly, and the lower edge portion of the skirt being turned inwardly and upwardly about the lower edge portion of the covering, the forming and encasing said lower edge portion of the covering.

2. A sheet metal closure cap of the class described comprising a top portion and a depending cylindrical skirt, said top portion and skirt having their inner surface covered by a lacquer coating, a rubber compound forming an imperforate covering over the entire inner surface and being bonded thereto by said lacquer coating, said covering having its greatest thickness along the upper portion of the skirt for telescoping over and engaging the side wall of a container, the inner surface of the covering along the lower portion of the skirt flaring downwardly, and a lower edge portion of said skirt extending inwardly and upwardly about the lower edge portion of the covering, the forming and enclosing and concealing said lower edge portion of the covering.

3. The method of manufacturing a closure cap which comprises providing a cup-shaped shell having a top panel, and skirt portion, and an inwardly projecting annular flange, placing against the interior of said top panel a piece of unvulcanized rubber sealing material, supporting the top and adjacent portion of the skirt to prevent deformation thereof, heating said shell and said material to at least partially vulcanize said material, withdrawing air from the interior of said shell, subjecting said piece of material to pressure to force it to flow along the bond to said panel and skirt and during the application of said pressure, bending said inwardly projecting annular flange toward the top panel to cover and clamp in position adjacent portions of said reformed piece of material.

4. The method as claimed in claim 3, wherein said pressure is applied for a period of about two to four seconds.

5. The method as claimed in claim 3, wherein said unvulcanized rubber compound is heated to a temperature of about 130° F. to 160° F. during subjecting to said pressure.

6. The method of forming a sealing gasket in a cup-shaped shell having top and skirt portions to provide a closure cap adapted to form a hermetic seal on a glass container which comprises placing within said cup-shaped shell a slug of unvulcanized rubber compound adapted to flow upon subjecting to pressure, supporting the top and
adjacent portion of the skirt to prevent deformation thereof, withdrawing air from the interior of said shell to form a partial vacuum about said slug and subjecting said slug to plunger pressure in the range of 3,500 to 10,000 pounds per square inch to cause it to flow under high pressure over the inside surface of the shell into the shape of a sealing gasket and in so doing to scrub the air film off the surface of the shell and to provide a molecular bond with the inside of the cup-shaped shell.

7. The method as claimed in claim 6 wherein the inside of the shell is coated with a bonding material.

8. A device for forming sealing gaskets in cup-shaped shells having top and skirt portions in the manufacture of closure caps comprising the combination of means for supporting the top and adjacent portion of the skirt to prevent deformation thereof, a plunger insertable into said shell for displacing portions of a plastic sealing material such as uncured rubber to conform to an interior surface of said shell and to provide a sealing gasket therefor, means carried by and movable with respect to said plunger for sealing said shell within a substantially air tight chamber, means for withdrawing air from the interior of said shell, and means on said plunger for turning a skirt portion of said shell over a depending portion of said material at the time of displacing portions of the sealing material.

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