United States Patent

[11] 3,581,456

[72] Inventor **Robert Andrew Gere**
Belle Mead, N.J.

[21] Appl. No. **776,335**
[22] Filed **Nov. 18, 1968**
[45] Patented **June 1, 1971**

[73] Assignee **American Can Company**
New York, N.Y.

[54] **APPLYING A THREADED CLOSURE BY MAGNETIC IMPULSE**
1 Claim, 4 Drawing Figs.

[52] **U.S. Cl.** **53/42,** 72/56
[51] **Int. Cl.** **B65b 7/28**
[50] **Field of Search** 53/42

[56] **References Cited**

UNITED STATES PATENTS

3,214,832	11/1965	Schwinghamer	53/42X
3,426,564	2/1969	Jansen et al.	53/42X
3,475,243	10/1969	Scalora	53/42X

Primary Examiner—Travis S. McGehee
Attorneys—Kenneth H. Murray, Robert P. Auber and Leonard R. Kohan

ABSTRACT: A method for forming a closure on the neck finish of a filled container which utilizes the force generated by a transient magnetic field. The skirt of a cap, positioned on the neck of the container, is urged by the field against the neck finish so as to cause the skirt to conform to the contours of the neck finish and to thereby hold the cap in engagement with the neck finish upon the neck of the container.

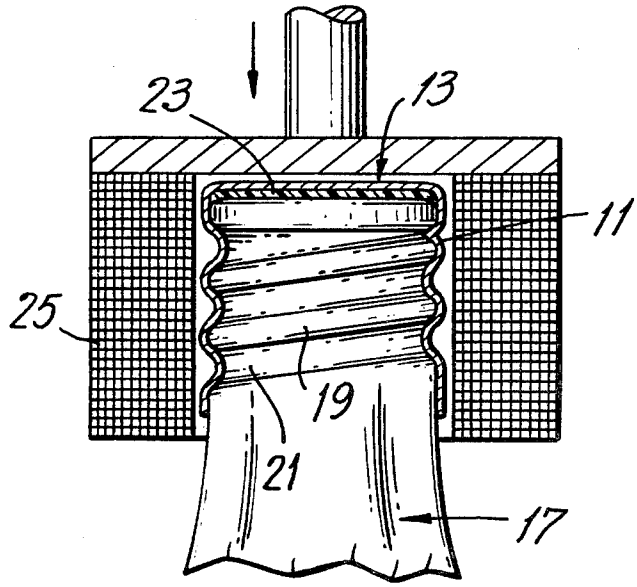


FIG. 1

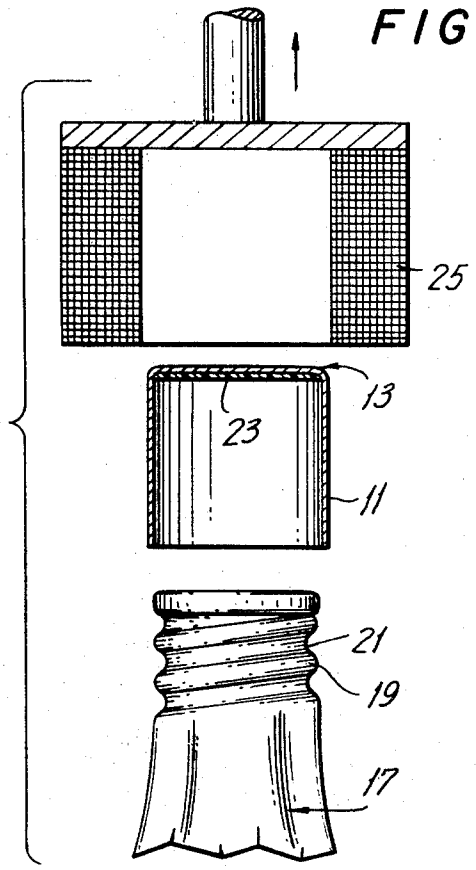


FIG. 3

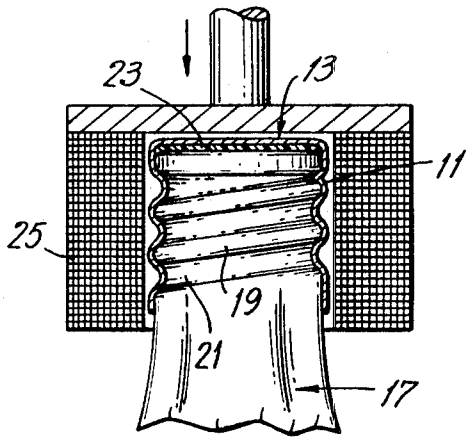


FIG. 2

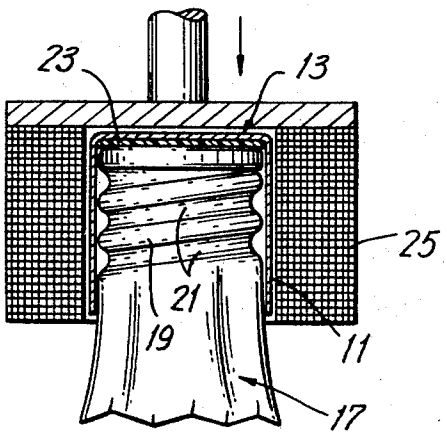
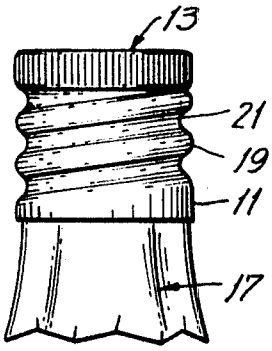


FIG. 4



INVENTOR.
ROBERT ANDREW GERE

BY

ATTORNEY

APPLYING A THREADED CLOSURE BY MAGNETIC IMPULSE

BACKGROUND OF THE INVENTION

Heretofore, such a closure on the neck finish of a container had been achieved only by mechanical methods. These methods included the following: forcing a crown cap onto a neck having retaining lugs thereon; mechanically twisting a suitably threaded cap onto a threaded neck; and urging a spinning head against a suitable blank placed on a threaded neck. In this last method, the skirt of the blank, acting as a workpiece, was deformed by the spinning head along the threaded contours of the neck, acting as a mandrel, and by impressing a mating thread in the skirt of the blank, a closure in threaded engagement with the neck finish was formed upon the neck. Typically, these closures could be easily opened and later reclosed by the consumer of the contents of the container, and for this reason both the pry-off and the twist-off closures were very popular in the bottling industry.

However, a serious drawback to mechanical methods of forming such closures was the fact that the mechanical device, used to force the cap into engagement with the neck finish, necessarily contacted a part of the cap. This contact inevitably produced a marred or scratched closure that tended to be unsuited to an aseptic packaging system. Other drawbacks to the mechanical methods of forming a closure, especially to the use of a spinning head to form a twist-off closure, were: the need for intricate and costly forming machinery; the limited production speed of such machinery; and the low deformation velocities that were unsuitable for forming a closure of certain materials which tend to break under slow loading conditions.

SUMMARY OF THE INVENTION

In order to overcome the drawbacks of existing mechanical methods as set forth in the background of the invention, this invention provides a method for forming a closure on the neck finish of a filled container by placing over the neck finish of the container a cap having an electrically conductive skirt adapted to conform to the neck finish when pressed against the finish. Then a transient magnetic field is applied to the skirt to press the skirt against the neck finish with sufficient force to conform it to the neck finish.

DESCRIPTION OF THE DRAWING

FIG. 1 is an enlarged, exploded, cross-sectional view of the cap and the source of a transient magnetic field with the threaded neck of the container in elevation;

FIG. 2 is an enlarged, partial-sectional view of the cap and source and of the threaded neck positioned for forming the closure on the neck;

FIG. 3 is an enlarged partial-sectional view of the cap and source and of the threaded neck during the forming of the twist-off closure on the threaded neck of the container:

FIG. 4 is an enlarged view of the formed closure on the threaded neck of the container.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As a preferred or exemplary embodiment of the instant invention FIG. 1 shows a source 25 of a strong, transient magnetic field, a neck 17 of a filled container having formed therein threads 19 with roots 21, and a cap 13 having a skirt 11 and a means for sealing the open mouth in the neck of the container, such as a plastisol or cork gasket 23. The skirt 11 of the cap 13 is made of an electrically conductive and deformable material, such as copper or aluminum, and is adapted to fit slidably over the container neck 17. The container neck 17 is made of a nonconductive and substantially rigid material, such as glass or plastic. Preferred are caps composed of aluminum and containers composed of glass, as has been essentially standard in the familiar twist-off closure. Of course, as will become apparent from the description of the preferred method, caps and necks having different qualities of deformability and conductivity would be suitable for magnetically forming a closure on the neck of a container

As shown in FIG. 2, after assembly of the cap 13 and the container neck 17, the source 25 is positioned in surrounding, near proximity to this bottle-cap assembly. The source 25 is sufficiently close to the skirt 11 of the cap 13 and is able to produce a magnetic field of sufficient strength to deform the skirt 11 to the contours of the neck finish.

Upon discharge of an electrical current into the source 25, in a manner described more fully hereinafter, a force presses the skirt 11 of the cap 13 against the container neck 17. As is shown in FIG. 3, without mechanical contact, the skirt 11 is deformed to the contours of the threads 19 and roots 21 of the neck finish, thereby impressing a thread in the skirt 11 mated to the neck finish of the container.

As shown in FIG. 4, the pressure of the source 25, squeezing the skirt 11 of the cap 13 against the neck finish, causes the cap to be held tightly to the container neck 17 to form a closure that can be easily uncapped by twisting the cap 13 relative to the container neck 17.

It is known that to properly deform the skirt 11 of the cap 13 positioned on the container neck 27, the source 25 must generate a high-intensity, transient magnetic field, of sufficient strength to cause a strong pressure to be exerted on the skirt of the cap. By using a fast-acting switching device to rapidly discharge current, stored in a capacitor bank, into a coil of wire, it is known that a rapidly varying current will be produced in the coil, and as a result thereof, an intense moving magnetic field will be generated by the coil. This field, applied to the skirt of the cap, induces the formation of eddy currents in the skirt, which currents in turn generate a secondary magnetic field. The secondary field then reacts against the primary field of the coil to produce a "magnetic pressure" between the skirt of the cap and the coil. The effect of the resulting "magnetic pressure" is to urge the conductive, deformable skirt 11 of the cap 13 to deform into threaded engagement with the nondeformable and nonconductive threaded neck 17 of the container.

Of course, were the container neck 17 deformable, it would be crimped inwardly by the skirt 11 pressed thereagainst, and were the container neck 17 conductive, a resultant "magnetic pressure" between it and the coil would occur that would tend to diminish the deforming pressure on the skirt 11. But when the qualities of conductivity and deformability differ in the cap and the container neck, the "magnetic pressure" of the claimed invention accomplishes substantially the same result as has been previously accomplished only by the physical contact required in mechanical methods of capping.

By way of example, a cap of tubular aluminum having a skirt thickness of 0.035 inches was placed on the threaded neck of a glass bottle. A helical coil, having 33 turns of 0.025-inch-diameter copper wire and having, with a voltage breakdown rating of at least 9,000 volts DC a resistance of 0.300 ohms, and inductance of 45 microhenrys, and an efficiency of 3.5 percent at the surface of the skirt at 8,400 c.p.s., was held about the skirt of the cap. Then, a rapidly varying current was discharged into the coil of wire by an ignitron, a fast action switching device, that was attached to capacitors rated at 8 microfarads and supplying 9,000 volts DC to the ignitron. Without physical contact, the transient magnetic field developed by the coil caused the cap to be held to the neck of the glass bottle to form a twist-off closure that was substantially similar to the closure achieved by mechanical methods.

Theoretically, a workpiece is most efficiently deformed when the transient magnetic field does not pass through the workpiece. "Skin depth" is a measure of the penetration of the field in the workpiece, and has been found to be inversely proportioned to the frequency of the applied field. Accordingly, 8,400 c.p.s. was used to obtain a "skin depth" in the tubular aluminum cap of 0.035 inch.

It has been found that decreasing the distance between the coil and the workpiece exponentially increases the efficiency of the deforming process. Accordingly, the coils were con-

structed as follows: The unformed aluminum cap was measured to determine the coil dimensions; these dimensions were then machined into a form made of Wood's alloy; the wire was then wound over this form using epoxy resin as a binder; and after curing the structure at room temperature, the form made of Wood's alloy was melted out at 75° C., leaving an interior contour of the coil with a close fit over the skirt of the cap.

The minimum height of the coil is determined by the area to be formed and was made no higher than the skirt of the cap. Since the coil is subjected to a force equal to that on the skirt of the cap, though opposite in direction, the wire and epoxy binder were selected with sufficient mechanical strength to withstand such force. The wire was also selected to minimize electrical resistance and with a view to the number of turns of wire which might be closely wound in the area determined for the coil. The number of turns of wire was also selected to maximize the magnetic field and to minimize coil inductance, which are both directly related to the number of turns of wire. Accordingly, the helical coil was constructed with 33 turns of 0.025-inch copper wire.

The workpiece should be highly conductive and suitably ductile. The first quality relates to minimizing the energy loss due to heating of the skirt of the cap by the eddy currents, and the latter relates to minimizing the force necessary to deform the skirt of the cap. Copper, aluminum and steel, whether alone or combined with a highly conductive plating material such as copper or aluminum, have been found to be satisfactory for use in the skirt of the cap. Aluminum is the preferred material due to its high conductivity, excellent ductility and also good resistance to corrosion.

It will be apparent that alternate arrangements may be conceived for magnetic-forming a closure on a container. By way of example, and not in limitation of the present invention, a transient magnetic field could be applied to a ductile and conductive neck of a container, having a nonconductive plug placed at an orifice in the neck, so as to squeeze the neck about the plug and seal the container, or a neck finish could comprise retaining lugs instead of threads.

It will be apparent that the present invention, as represented by the illustrated embodiment, fulfills and meets the objectives and advantages set forth in the Summary of Invention of this specification.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the steps of the methods described and their order of accomplishment without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

I claim:

1. A method for forming a twist-off closure for the threaded neck of a container, comprising the steps of:

placing, over the neck finish of the container, a cap having a ductile and electrically conductive skirt, which skirt is adapted to conform to the contours of the neck finish of the container when pressed against the neck; and

applying a transient magnetic field to the skirt to press the skirt against the contours of the neck finish with sufficient force to conform the skirt to the neck finish, a contour of roots and threads being impressed in the inner surface of the skirt which includes threads conforming closely to the roots of the neck finish.