Aug. 29, 1967 C. R. MEYERS, JR 3,338,447

QUICK CLOSING STOPPER

Filed Sept. 22, 1965

FIG. 1.

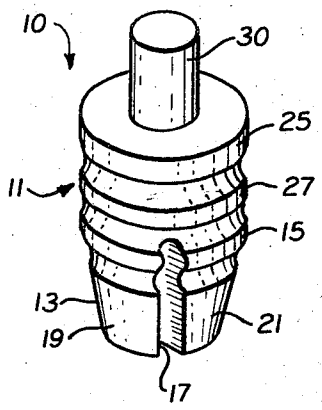


FIG. 2.

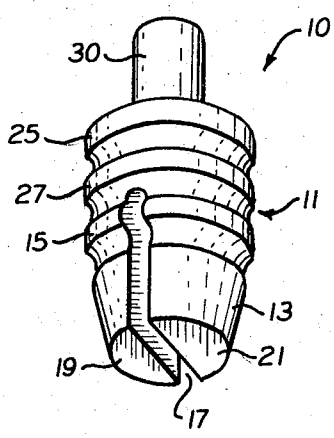


FIG. 3.

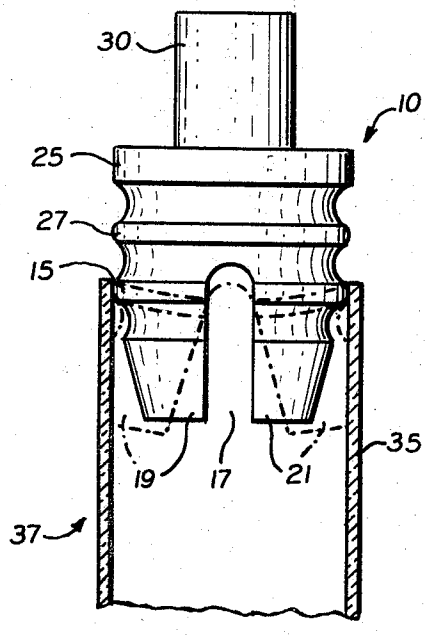
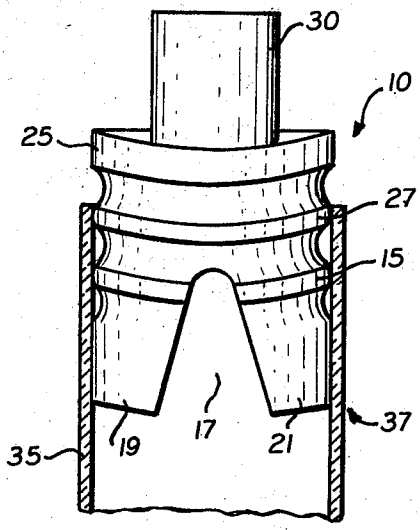


FIG. 4.



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QUICK CLOSING STOPPER

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8 Claims. (Cl. 215—52)

This invention relates to the art of container stoppers, more particularly to an improved stopper permitting positioning of the stopper in dust closing relationship with respect to the contents of a container, and thereafter permitting rapid fluid-tight sealing of the container so as to maintain desired gas and pressure conditions in the container.

A variety of situations exist in which it is desired to partially stopper a container while it is being filled, or while the contents of the container are being treated. The partial stoppering is employed to minimize losses from the container due to evaporation, and to provide a dust cover for the contents of the container during some treating stage which requires access to the interior of the container. After filling or treatment is completed, it is then desirable to seal the container by positioning the stopper in a container-sealing orientation, as rapidly as possible so as to minimize losses and costs.

Thus by way of example, it is noted that with heat labile substances, drying of the substance within the container is accomplished by lyophilization. During the lyophilization of the contents of a container, the container is filled with the substance to be treated, and partially closed to minimize evaporative losses of the contents of the container and contamination of the contents of the container. Thereafter a vacuum is produced within the container requiring that there be access past the stopper to the interior of the container, and the container contents are frozen under this vacuum producing sublimation of the ice portion of the contents, thereby producing a drying of the contents of the container. In order to effectively obtain desired drying action, it is desirable that upon completion of the drying step, the stopper be subject to rapid insertion into sealing relationship with respect to the container.

It is with the above problems and desiderata in mind, that the present stopper has been evolved, a stopper serving to provide partial closure for a container so as to prevent undesired losses and contamination of the contents of the container, and thereafter permitting rapid positioning of the stopper to effect a relatively fluid-tight seal of the container.

It is accordingly among the primary objects of this invention to provide an improved stopper serving the twofold function of (1) providing partial closure of a container to protect the contents of the container from contamination and loss during treatment of the contents of the container, and (2) thereafter permitting rapid positioning of the stopper to effect fluid-tight sealing of the container.

A further object of the invention is to provide an improved stopper construction particularly adapted for use in lyophilizing the contents of a container.

A further object of the invention is to provide a stopper in which the degree of engagement of the stopper with respect to the container, and the resultant sealing effectiveness of the stopper is increased as the stopper is inserted into the container.

These and other objects of the invention which will become hereafter apparent are achieved by forming a lyophilizing stopper of a resilient material such as butyl rubber or the like. The stopper is formed with a body dimensioned to permit its insertion into a container. The lower end of the body is formed with a conically contoured entry tip, and a slot is extended from the free end of the entry tip up into the body. The slot is formed with a rounded contour at its closed end to implement the bending of the portions of the stopper separated by the slot. A first lower ridge is formed on the body adjacent the slot. This first ridge is below the end of the slot so that upon insertion of the stopper into a container up to this first ridge, the container will be substantially closed, except for the passage provided by the slot between the interior and exterior of the container. A second ridge is formed on the body of the stopper at a point spaced from the end of the slot, so that upon insertion of the stopper into the container up to said second ridge the container will be substantially sealed.

A feature of the invention resides in the fact that the apex of the first ridge lies in a diametral transverse plane through the stopper spaced from the closed end of the slot, so that upon insertion of the stopper into the container, contact of the side walls of the container with the apex of the first ridge will produce a turning moment about the closed end of the slot causing the spaced portions of the stopper on either side of the slot to move outwardly against the side walls of the container thereby insuring a desired gas-tight seal between the stopper and the interior side walls of the container.

A further feature of the invention resides in the provision of a handle element on the stopper which element is dimensioned so that the normal pressure applied to this handle as the plug is inserted into the container produces a turning moment acting to force the ridges of the stopper against the walls of the container.

The specific details of a preferred embodiment of the invention, and their mode of functioning will be made most manifest and particularly pointed out in clear, concise and exact terms in conjunction with the accompanying drawings, wherein:

FIG. 1 is an enlarged perspective view of a stopper made in accordance with the teachings of this invention, angled to look at the top of the stopper;

FIG. 2 is an enlarged perspective view similar to FIG. 1 angled to provide a view of the bottom of the stopper;

FIG. 3 is an enlarged elevational view showing the stopper as it is being inserted into closure position with respect to an ampoule, indicating in dot-dash line the orientation of the lower end of the stopper into a sealing position with respect to the ampoule; and

FIG. 4 is an enlarged elevational view like FIG. 3 showing the position of the ridges as the stopper is being moved into the container.

Referring now more particularly to the drawings, like numerals in the various figures will be employed to designate like parts.

As seen in the drawings, the stopper **10** is formed with a body portion **11** dimensioned to fit within a container such as an ampoule or the like, in conjunction with which the stopper is to be employed. At the lower end of the body **11**, a conically shaped entry tip **13** is provided formed integrally with the body portion **11** and dimensioned so as to fit freely into the container in conjunction with which the stopper is employed. A first lower ridge **15** extends circumferentially about the body **11** a distance such as to frictionally engage the interior side walls of the container with which the stopper is used. As can clearly be seen from the drawings, the dimensioning of this first ridge **15** is such as to extend slightly beyond the maximum extension of entry tip **13**. Thus, whereas entry tip **13** moves freely into the container, as best seen in FIG. 3, first ridge **15** normally contacts the interior side walls of the container. A slot **17** extends from a portion of body **11** to the free end of the entry tip **13** from a point in body **11** spaced from first ridge **15**. The slot **17** preferably ex-

tends diametrically across the conventionally employed circular in cross section stopper and acts to form two spaced stopper segments **19** and **21**.

A top ridge **25** is formed as a flange at the upper end of body **11** extending outwardly a distance substantially equal to that of lower first ridge **15**, and like ridge **15** is dimensioned to frictionally contact the said walls of the container in connection with which the stopper is employed. In the illustrated embodiment, a middle ridge **27** is provided between lower ridge **15** and upper ridge **25**. Ridge **27** is dimensioned like ridges **15** and **25** to extend circumferentially about the body **11** of the stopper and of a size to frictionally contact the side walls of the container. This ridge **27** is above the closed end of slot **17**.

A handle element **30** having a cross sectional dimension less than the cross sectional dimension extending transversely through body **11** is provided at the upper end of the stopper, and formed integrally therewith.

The stopper **10** is preferably molded of a relatively elastic resilient material such as butyl or the like, it being preferred to employ a temperature stable, chemically inert material.

Operation

In use, the aforedescribed stopper **10** finds particular applicability in connection with the lyophilization of materials to be packaged in containers such as ampoules or the like.

As best seen in FIG. 3, the stopper **10** is inserted into the upper open cylindrical end **35** of ampoule **37** with the conical lower entry tip **13** of the stopper **10** acting to guide the stopper into the ampoule **37**. The stopper **10** is inserted until the lower entry ridge **15** engages the interior of the side walls of the open cylindrical end **35** of the ampoule, at which time the stopper is frictionally engaged with the ampoule and acts to substantially close the ampoule to provide a dust cover and minimize flow to and from the ampoule, while permitting communication with the interior of the ampoule via slot **17**, the upper end of which is above the lower ridge **15**.

With the stopper in this orientation, the contents of the ampoule may be treated or subjected to various atmospheres, or lyophilized as desired. After treatment of the contents of the ampoule **37** has been completed, and it is desired to insure the maintenance of the contents of the ampoule under desired pressures, gaseous atmospheres, or other relatively gas tight enclosure, the stopper **10** is forced further into the cylindrical end **35** by exerting pressure on the handle **30** to force the stopper downwardly into the cylindrical end **35**, as viewed in FIG. 3.

Upon the initial application of pressure axially to handle **30** so as to force the stopper downwardly into the container, in the first instance, while the lower ridge **13** is frictionally engaged with the side wall of the container, the downward pressure produces a fulcruming of the stopper portions beneath lower ridge **15** about the ridge to separate the spaced portions **19** and **21** of the entry tip **13**, which assume the configuration illustrated in dash lines in FIG. 3 in which the separated portions **19** and **21** move against the side walls of the container and act to implement the sealing thereof.

After this initial movement of the stopper, subsequent engagement of the middle ridge **27**, and the upper ridge **25** with the interior of the side walls of the container produces a further tendency of the separable portions **19** and **21** to move towards the side walls of the container fulcruming about the areas of contact between the ridges and the container side walls. This fulcruming action results from the fact that the slot **17** between the portions **19** and **21** ends up at a point above the lower ridge **15** thereby permitting rocking of the segments **19** and **21** about the point of contact of this lower ridge. The subsequent turning movement of the segments **19** and **21** is produced as a result of the turning couple produced by the line of force transmitted via handle **30** which must of necessity be spaced from the area of normal contact between the ridges and the side walls.

It is thus seen that an improved stopper has been provided in which at the instant that relatively gas tight sealing of the contents of a container is desired to be effected, sealing is produced almost simultaneously with the application of pressure to the stopper without the delay normally required for the stopper first to be axially displaced in the container before sealing can be effected.

The above disclosure has been given by way of illustration and elucidation, and not by way of limitation, and it is desired to protect all embodiments of the herein disclosed inventive concept within the scope of the appended claims.

What is claimed is:

1. A container stopper comprising: a resilient body dimensioned to fit within the neck of a container to be closed; said body having a slot extending from a lower end thereof to a point in a medial part of said body; two spaced stopper segments on opposed sides of said slot; and a ridge on said body, the uppermost portion of which ridge is spaced downwardly from the upper end of the slot a distance such that upon frictional engagement of said ridge with a sidewall of a container and the exertion of pressure on the upper end of the stopper there will be a separation of the stopper segments against the interior of the container.

2. A container stopper as in claim **1** in which a conically shaped entry tip is formed on the lower end of said body member beneath said ridge.

3. A container stopper as in claim **2** in which a handle element having a cross sectional dimension less than that of said body is secured to the upper end of said body.

4. A container stopper as in claim **1** in which a second ridge is formed on said body above the upper end of said slot.

5. A lyophilizing stopper for use in closing off a container while the contents of the container are subjected to a lyophilizing treatment to drive off the moisture therefrom, and to subsequently seal the contents under a vacuum, said stopper comprising a body dimensioned to fit within the neck of the container; a conical tapered entry portion on said body, said body and said conical entry portion having a slot extending from said body to the end of said entry portion; a ridge extending about said body, said ridge having the upper end thereof spaced downwardly from the upper end of the slot in said body; and a second ridge spaced from said first ridge on said body above the closed end of the slot, whereby upon insertion of said stopper into the container up to said first ridge, the slot in said body will provide a path of communication between the interior and exterior of the container, and upon insertion of said stopper further into said container up to said second ridge, said conical entry portion will be spread to insure a gas-tight seal between said stopper and the interior side walls of the container.

6. A lyophilizing stopper as in claim **5** in which an intermediate ridge is formed on said body between said first mentioned ridges.

7. A lyophilizing stopper as in claim **5** in which a handle element having a cross sectional dimension less than that of said body is secured to the upper end of said body.

8. In combination with a container in which the contents are to be lyophilized, said container having a circular opening, and walls surrounding said opening which provide an entry passage of uniform cross-section; a lyophilizing stopper for closing off the container opening to provide a dust cover for the contents of the container while permitting access to the contents of the container during the initial lyophilization process, and permitting rapid effective sealing of the container when desired, said stopper comprising: a resilient body of circular cross-section dimensioned to fit within said container opening; a tapered entry portion on said body; said body

and said entry portion having a slot extending from an open end of said slot at the free end of said entry portion to a closed end of said slot in a medial portion of said body and separating said body and entry portion into two spaced stopper segments; a ridge extending about said body at a point between the closed and open end of said slot, said ridge dimensioned to provide a press fit against the walls surrounding said container opening upon insertion of said stopper in said opening, and providing a fulcrum about which the stopper segments are pivoted as pressure is applied to the top of the stopper to cause the stopper segments to engage the container passage wall.

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