

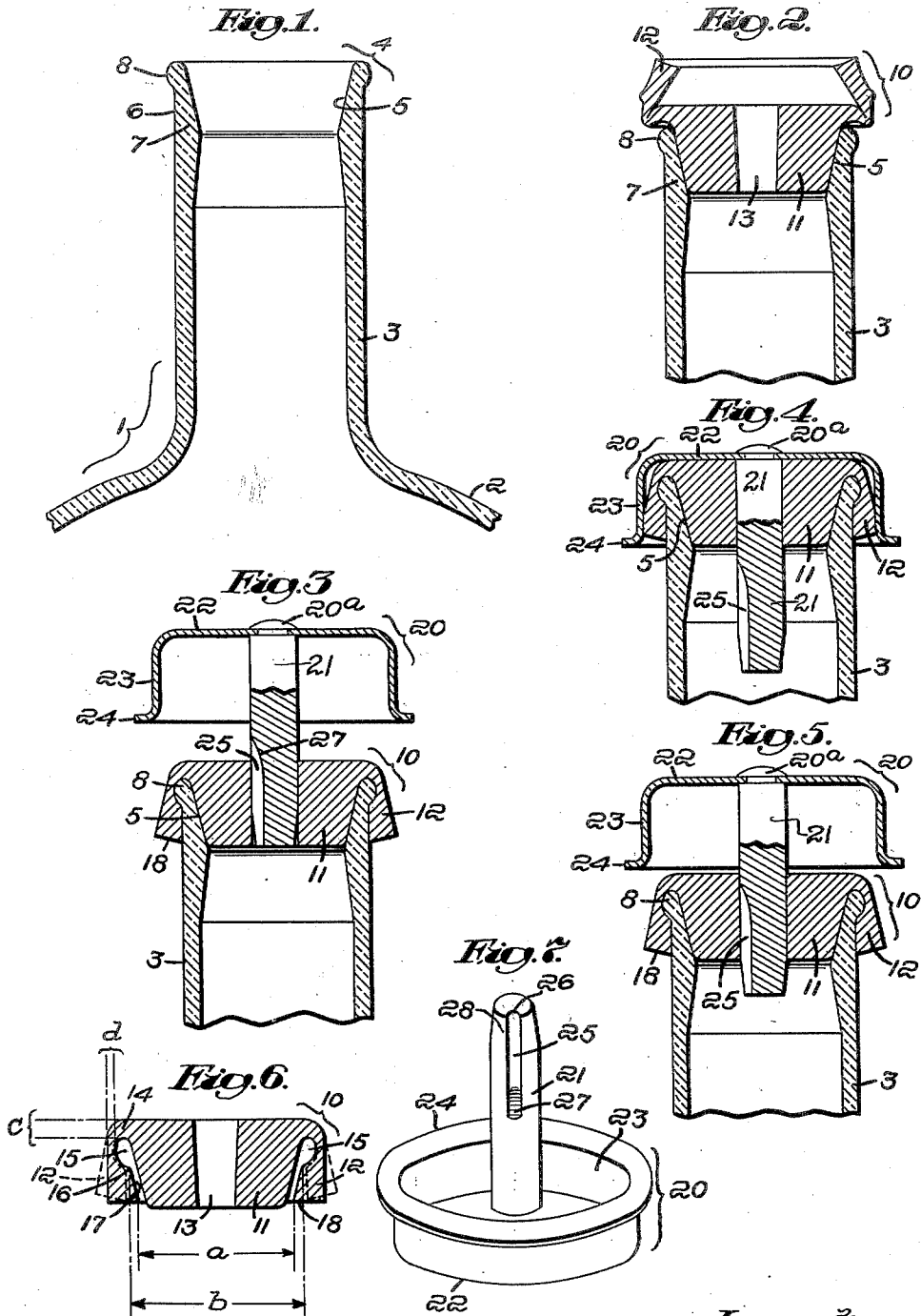
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FLASK AND CLOSURE MEANS THEREFOR

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FLASK AND CLOSURE MEANS THEREFOR

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My present invention relates to flasks, generally of glass, and like containers for liquids, and to their closure or stoppering means. More particularly the invention aims to provide a simplified and otherwise improved construction for devices of this class, and especially those for use in the preparation, storage and dispensing or administration of fluids which are required to be in a sterile condition, such for example as parenteral and other fluids for medical and surgical purposes. As to all common subject matter this application is a continuation in part of my co-pending application Serial No. 67,087, filed March 4, 1936, now Patent No. 2,116,132, dated May 3, 1938.

In the drawing, illustrating by way of example one embodiment of the invention:

Fig. 1 shows in vertical section so much of a flask or container as is necessary to an understanding of the invention;

Figs. 2 to 5 inclusive are vertical sectional views of the flask neck and mouth portions and associated closure elements, Fig. 2 showing a bushing element in partly applied position, Fig. 3 representing the bushing as fully applied and a stopper element partly inserted therein, Fig. 4 illustrating the flask in completely closed and sealed condition and Fig. 5 showing the stopper partly elevated, as in preparing for dispensing the fluid contents;

Fig. 6 is a cross section of the bushing element alone, showing its skirt in down-turned position; and

Fig. 7 is a perspective of the stoppering element.

Referring more particularly to the drawing, and first to Fig. 1, the flask of the invention is there indicated as a whole by the numeral 1, a portion of the flask body, which may be globular or otherwise shaped, being seen at 2. The neck 3 of the flask desirably is relatively short, as compared with usual articles of this type, and the flask as a whole, including preferably both the body and the neck portions, is thickened or reinforced to withstand an internal negative pressure or partial vacuum such as is likely to be developed during the cooling of the sealed flask subsequent to the sterilizing of its contents in the manner to be referred to. To avoid collapsing of the flask under such conditions and to provide an adequate margin of safety it has been found in actual practice that a 1500 cc. flask, for example, made of the heat-resistant glass known under the trade-mark "Pyrex," should weigh at least 390 grams.

The mouth or open end portion of the flask, indicated by the numeral 4 in Fig. 1, is in accordance with the invention specially constructed and arranged with reference to the negative pressure condition mentioned, and for cooperation with the closure means to be described. As illustrated, the flask mouth 4 is formed with an inwardly tapered or reduced portion 5 providing a seat for the correspondingly shaped bushing or reducing element indicated as a whole by the numeral 10. This inwardly tapering seat portion 5 desirably is accurately tooled or otherwise finished to standard dimensions corresponding with those of the bushing 10, insuring complete interchangeability among any number of the flasks and bushings of the given size.

The outer wall of the flask mouth opposite the tapered seat portion 5 is downwardly divergent relative to the inner wall, in the direction toward the body of the flask, being in the illustrated example substantially vertical, as indicated at 6. Thus the distance between the inner and outer surfaces or walls of the mouth portion increases in the direction toward the flask body, the base 7 of the mouth portion accordingly being of increased thickness, as clearly shown in Figs. 1 to 5. At the outer or open end of the mouth a prominent bead or rib 8 is formed externally on the flask neck.

The bushing 10, comprising an element of the closure means, is shown separately in Fig. 6 in its normal or inactive position. It comprises a reducing or plug portion 11 and a skirt 12 adapted to be turned up or away from the plug portion, as in Fig. 2, or to be down-turned as in the other figures. This bushing is formed of rubber, rubber composition or other non-toxic and heat-resistant resilient material adapted to retain its resiliency under repeated subjections to heat and to have hermetic sealing engagement with the flask. The bushing as herein illustrated has a single central through aperture 13 for the reception of the stopper member 20, to be described, and alternatively for receiving a correspondingly dimensioned tube for dispensing the liquid contents. The reducing or plug portion 11 of the bushing is tapered to conform accurately, with a tight fit, to the seat 5 at the mouth of the flask.

At the upper part of said plug portion 11 the bushing has a laterally offset peripheral portion or circumferential shoulder 14 of a substantial height or thickness in the vertical direction, as indicated by the dotted lines and the reference character c, Fig. 6. The skirt 12 is integrally connected with the outer portion of said thick-

ened shoulder 14, extending downwardly therefrom in the position of the parts as shown in Figs. 3 to 6. Between the upper portion of the skirt, in its position of Fig. 6, and the outer wall of the plug portion 11 is an annular channel 15 conforming in cross section substantially to that of the bead 8 of the flask. The lower portion of this channel or space 15 is defined by an inward projection 16 on the skirt, adapted for engagement below the lower portion of the bead 8. Below this projection 16, referring to the position of the parts as shown in Figs. 3 to 6, the inner wall 17 of the skirt is formed to have a downward taper substantially as illustrated and in general parallelism with the adjacent outer wall of the plug portion 11. Hence the lower or edge portion 18 of the skirt has a distinctly less diameter, in its natural condition as shown in Fig. 6 and as is indicated by the dotted lines and reference character *a*, than has the upper portion of the skirt adjacent the channel 15, as indicated in said Fig. 6 by the dotted lines and reference character *b*.

In the illustrated example the outer wall of the skirt 12, in its Fig. 6 position, is substantially vertical, so that the skirt is of increasing thickness in the downward direction in said figure, but said outer wall may be otherwise disposed, so long as the inner wall of the skirt has a portion which is of less diameter, as at *a*, than at a higher level, and which portion, as at 17, 18, in its normal full line position of Fig. 6 is also of less diameter than the corresponding portion of the outer wall 6 of the flask neck.

Accordingly it will be seen that when the bushing is inserted in the seat 5 of the flask and the skirt is turned down as in Figs. 3, 4 and 5, said lower and smaller-diametered portion of the skirt is tensioned and distended to a position such as represented by the dotted lines in Fig. 6. Thus the skirt portion of the bushing is caused to hug snugly upon and against the outer wall of the flask below and adjacent the bead 8, with a sealing action. In the construction shown, the wall of the skirt at the level of the bead channel 15 is of relatively less thickness, as indicated by the dotted lines and reference character *d*, Fig. 6, and as compared for example with the thickness *c* of the lateral shoulder portion 14 of the bushing. This allows for ready flexing of the skirt and facilitates the described gripping action, while at the same time leaves said shoulder portion of sufficient thickness and rigidity to assist in resisting tendency of the bushing to move inwardly under the action of a negative pressure within the flask. Such inward movement of the bushing is further resisted by the interengagement of the skirt projection 16 with the bead 8 of the flask, since pressure tending to move the plug portion inwardly acts to draw said projection the more firmly up against the under portion of the bead, the latter acting as a stop or abutment.

The stopper 20 in accordance with the invention is composed of a material which not only is non-corrosive and chemically resistant but also is capable of effective sealing but non-sticking engagement with the bushing. Accordingly, as a result of extensive experiment, I employ in the preferred embodiment a so-called stainless steel or a steel of fairly high chromium content, such for example as that known commercially and in the steel industry as "Carpenter Group 8" stainless steel, which corresponds to the Iron and Steel Institute No. 303, having a chromium

content of about 18 per cent and a nickel content of about 9 per cent, which actual practice has proven to be highly satisfactory for the purpose. Within the contemplation of the invention, however, other metallic or non-metallic materials may be used provided they possess the desired properties of non-corrosiveness, lack of harmful reaction with the rubber or composition of the bushing, non-adhesiveness therewith to any objectionable extent, even at sterilizing temperatures, and have a surface texture or consistency cooperative with the rubber or rubber composition of the bushing to effect a gas-tight seal.

The stopper 20 comprises a central stem 21 conforming to and having a snug fit in the apertures 13 of the bushing, and a cap member 22 integral or rigidly connected to and sealed with respect to the stem, as by firmly riveting, welding or otherwise, as seen at 20^a. The cap member includes a substantially flat base or cover portion of an area corresponding to that of the bushing 10 when positioned with its skirt downturned as in Figs. 3 to 6 and a peripheral flange 23 with out-turned lip 24 substantially as illustrated, the flange being receivable over the downturned skirt of the bushing and extending substantially downwardly over it. The neck of the flask, the bushing and the stopper are proportioned and arranged to fit snugly with respect to each other, as illustrated in Fig. 4, and in such manner as to form an hermetic seal under the conditions to be described, which sealing action is increased in the presence of negative pressure within the flask.

The stem 21 of the stopper is provided with a longitudinal vent or channel 25 for the constricted escape of air, steam or other gas when the stopper is in partly inserted position, as in Fig. 3. This vent may be variously formed, but for the purposes of simplicity and cleanliness is fashioned as an open channel or groove of relatively small cross-sectional area, as compared with that of the stem as a whole. Preferably it has a rounded bottom as indicated at 26, see Fig. 7, and slopes outwardly at its end nearer the cap, as at 27, to avoid corners or angles in which dirt might collect, and to make it easier to clean. This channel 25 is formed in the lower portion of the stopper stem and is of a length desirably at least equal to the vertical central thickness of the plug portion 11 of the bushing 10 so that the channel may provide a passage completely through the central aperture 13 of the bushing when so desired, as during sterilization of the fluid. The stem has a total length, including the solid unchanneled portion between the channel 25 and the cap, of sufficient extent so that when the stopper is completely inserted, as in Fig. 4, the channel comes largely or wholly beyond the inner end of the bushing and the aperture in the latter is effectively closed by the solid part of the stem. Accordingly, as will be noted from a comparison of Figs. 3 and 4, the over-all length of the stem desirably is at least approximately twice the vertical length or thickness of the central part of the plug portion of the bushing. Obviously it is not essential that the channel 25 be carried to the extreme end of the stem if the latter is given a length in excess of that necessary to the functions described, so long as the stem and channel are so proportioned and arranged with respect to the bushing as to provide for their venting and their sealing positions with respect to each other.

The stopper stem and its channel desirably

also are formed and proportioned for the purpose of affording an audible signal attendant on the passage of air, steam or other gases through the channel, in either direction, useful in a manner more fully referred to later. This audible sound or signal is in the nature of a whistling action, dependent in part on the small cross-sectional size of the channel, having reference to the gas pressure likely to be available, and in some part on the conformation of the channel whereby the controlled passage of the air or other gas effects the desired whistling or signaling action. The free end of the stopper stem may be rounded off or tapered, as indicated at 2' to facilitate its insertion in the bushing.

In the use of the flask and closure, as for example in preparing sterile fluids such as for parenteral application, the fluid or solution is measured into the flask. A clean bushing 10 is then fitted into the mouth of the flask, the skirt 12 of the bushing is turned down, and the stem 21 of the stopper 20 is partially inserted, as shown in Fig. 3.

Each such flask with its partly inserted stopper is then subjected to heat treatment in any convenient manner, preferably in an autoclave or sterilizer, the recommended temperature and time, for the sterilization of parenteral fluids, being 250° for 20 minutes. During the sterilizing operation, the air, steam or other gases from within the flask pass off through the channel 25 in the stopper stem. Following such period the steam supply to the autoclave is shut off and the latter is permitted to cool to 180° F. before being opened. This avoids undesired concentration of the solution resulting from the ebullition of steam which would follow a sudden release of pressure. But if for any reason the sterilizer is prematurely opened and a resultant concentrating effect upon the solution occurs, the steam or gas passing out through the stoppering means, then still elevated, produces the audible signal or whistle previously referred to, and hence automatically informs and warns that the solution has been spoiled for the intended use, in such cases where excess concentration is dangerous or undesirable.

Where cooling within the sterilizer has been properly effected, absence of an audible signaling effect at the stoppers of the flasks gives assurance that the concentration of the fluid has not been unduly increased, and the flasks are ready for removal. Attendant on removal of each flask from the autoclave or sterilizer, its stopper 20 is immediately pushed or driven home into the completely hermetic sealing position as illustrated in Fig. 4. The nurse or operator may conveniently do this with the palm of the hand applied only to the top of the stopper cap 22, so that no portion of the apparatus which is to be contacted by the fluid will be exposed or touched. The hermetic seal is effected by the close, pressure fit between the stopper and the down-turned skirt of the bushing and between the latter and the neck of the flask. This sealing action is augmented and insured by the further cooling of the contents of the flask, resulting in an internal negative pressure which effects an absolute sealing engagement between the parts referred to, in the manner already described.

This formation of a partial vacuum within the flask in the manner described is utilized for the additional important function, at the time when the contents of the flask are to be used, of informing that such contents have remained in the desired sterile condition. This is because sub-

sequent withdrawal of the stopper, when the flask and its contents are to be utilized, produces a similar audible signal as already referred to in connection with insufficient cooling, in this instance caused by the inrush of air to replace the partial vacuum. If the nurse or operator fails to receive the sound signal when the stopper is released, it is then apparent that the fluid contents have not been properly sterilized or have been tampered with.

The vacuum or partial vacuum formed in the sealed flask as it cools also serves the additional function of enabling a nurse or other person who has occasion to examine the flask to determine immediately and without breaking the stoppering seal that the hermetic seal has been maintained and that accordingly the fluid contents retain their sterile condition. The vacuum within the sealed flask normally is such as to afford a water-hammer effect, so that by merely tilting or jarring the flask sufficiently to move the fluid contents a distinct ringing, knocking or hammering sound is produced, due to the contact of the fluid contents with the flask wall in the presence of the negative pressure within the flask. Failure to note this sound effect when the fluid contents are disturbed may be considered as an indication that the sealing of the flask has been tampered with or has failed for some reason and that the contents accordingly are unsafe.

Following the heat-treating or sterilizing period and subsequent initial cooling, the stopper 20 is fully inserted into the sealing position of Fig. 4, as already noted. Then follows a further period of cooling of the contents of the flask, resulting in the building up of a substantial internal negative pressure. So long as the stopper 20 remains in the sealed position of Fig. 4, the bushing and the stopper together resist the outside atmospheric pressure which tends to draw or force the parts into the flask, and an efficient seal is produced by the interaction of the parts as previously described, including the accurate seating of the bushing within the tapered portion 5 of the flask mouth, and the elastic gripping action of the bushing skirt, further augmented by the engagement of the flange 23 of the stopper outside the skirt.

A succeeding stage in the use of the flask and closure is illustrated in Fig. 5, in which the contents of the flask are about to be utilized, and the stopper 20 is being withdrawn to permit the insertion of a dispensing tube or other dispensing instrument. It is to be assumed that the negative pressure has been maintained within the flask. Hence, as the stopper is lifted, and until its vent 25 is open to the atmosphere, the suction, or external pressure, by reason of the vacuum or partial vacuum within the flask, must be resisted solely by the bushing 10 itself. The tendency is for the bushing to be driven more or less violently partly or completely into or through the neck of the flask, thus either hindering the further use of the flask, or objectionably exposing the contents. But with the flask and bushing construction as illustrated the relatively heavy and hence relatively rigid shoulder 14 resists the downward force upon the bushing, as also does the tapered or reduced formation of the seat portion 5 of the flask. This down or in pressure on the bushing is still further resisted by the snug gripping action of the lower portion 17, 18 of the skirt 12 upon the outer wall of the flask and by the engagement of the shouldered portion or projection 16 of the skirt below the bead 8. Since

the inner diameter of the skirt, in its natural condition, is distinctly less than that of the outer wall of the flask, as previously explained, the gripping of the skirt against the flask resists the force which tends to drive the plug 11 down into the flask and hence to move the skirt up along the outer wall of the flask. In addition, the bead 8 and projection 16 oppose each other vertically and further resist upward movement of the skirt and downward or inward movement of the plug. As a result the bushing retains its proper position with respect to the flask during and following withdrawal of the stopper 20 in the manner illustrated in Fig. 5, despite the negative pressure internally of the flask.

Flasks containing solutions prepared and sterilized as described can be stored indefinitely without impairing the contents of the flasks as safe parenteral fluids. The stoppering means described affords an efficient and sterile seal, preserving the sterile condition of the fluid indefinitely and in the original container, so that it is instantly available for use whenever desired.

When the fluid is to be used it is but necessary to withdraw the stopper 20, checking the condition of the contents by means of the occurrence or non-occurrence of the audible signal. Sounding of the signal at this time, it will be understood, is indicative of correct conditions, whereas its occurrence at the earlier stage of the process as previously described signifies non-correct conditions. That is, at the cooling step it is a stop-warning, while at the fluid-administering stage it is a confirmatory signal.

From the foregoing it will be apparent that the flask and closure means of my invention is especially suited for use by hospitals, clinics and the like, enabling them to prepare parenteral and other fluids and solutions, to store the same conveniently and in adequate quantity, and to administer the same from the original container, with all reasonable assurance of safety.

It will be understood that my invention is not limited to the exemplary embodiment herein illustrated and described, its scope being set forth in my following claims.

I claim:

1. Stoppering means for flasks and like fluid containers, comprising in combination: a resilient bushing including a reducing portion receivable in the container mouth, a skirt for turning down about the mouth, and a single aperture through said reducing portion; and a stopper including a central stem receivable in said bushing aperture and a cap fixed at the outer end of the stem and having a depending peripheral flange arranged for sealing reception about the down-turned skirt of the bushing, said stem having a length substantially in excess of the length of the bushing aperture and being provided with a gas-escape channel in a portion thereof spaced from the cap, said channel providing a constricted gas outlet for the container when the stopper is but partially inserted with reference to the bushing but being completely closed when the stopper is fully seated in sealing position.

2. Stoppering means for flasks and the like, comprising a resilient bushing including a plug portion having a central substantially uniform through aperture and a skirt for turning down about a flask mouth, and a stopper of non-corrosive material having an elongated stem fitting the bushing aperture and channeled longitudinally to afford a restricted passage for communi-

cating through the bushing only in an elevated position of the stopper relative to the bushing, said stopper also having a flanged cap tightly engageable over the down-turned bushing skirt.

3. Stoppering means for flasks and the like, comprising a resilient bushing including an apertured plug portion and a skirt for turning down about a flask mouth, and a stainless steel stopper having an elongated stem to fit the bushing aperture and a flanged cap tightly engageable over the down-turned bushing skirt, said stopper stem being formed with a channel of relatively small cross-sectional area extending along a portion of the stem sufficiently spaced from the cap to provide for safe closure of the channel by the bushing when the stopper is fully seated, the channel being of a length to afford a restricted passage through the bushing when the stopper is positioned with its cap spaced from the bushing.

4. A flask stopper composed entirely of non-corrosive material having a surface texture adapted to have sealing but non-adherent engagement with rubber and rubber composition, said stopper comprising a substantially flat cap having a down-turned peripheral flange and an elongated depending central stem of relatively small diameter as compared with the cap, said stem having in a portion thereof spaced from the cap a longitudinal gas-escape channel of restricted cross-sectional area, the spacing of the channel from the cap being sufficient to provide for blocking the channel when the stopper is inserted with its cap substantially flush with the stem-receiving element with which it is adapted to be used.

5. A stopper for fluid-handling apparatus, comprising a substantially flat cap having a down-turned peripheral flange and an elongated depending central stem of relatively small diameter as compared with the cap, said stem having in a portion thereof spaced from the cap a longitudinal gas-escape channel communicating between the free end of the stem and a point substantially spaced from said end and also spaced from the cap sufficiently to provide for blocking of the channel by an element to receive the stopper stem, said channel having a length, conformation and restricted cross-sectional area whereby in the use of the stopper the passage of gas under pressure through the channel in either direction is designed to produce an audible signal.

6. A flask stopper composed entirely of non-corrosive material having a surface texture adapted to have sealing but non-adherent engagement with rubber and rubber composition, said stopper comprising a substantially flat cap having a down-turned peripheral flange and an elongated depending central stem of relatively small diameter as compared with the cap, said stem having in a portion thereof spaced from the cap a longitudinal gas-escape channel of restricted cross-sectional area, the spacing of the channel from the cap being sufficient to provide for blocking the channel when the stopper cap is inserted flush with the stem-receiving element with which it is adapted to be used, said channel being formed externally along the stem and having rounded bottom and end walls, for sanitary purposes.

7. In combination, a glass flask for the preparation, including sterilizing heat-treatment, and for the storage and dispensing of fluids, particularly for medical and surgical purposes, said flask having a mouth the inner and outer walls of

which have a downwardly divergent relation, a bushing element including a plug portion for reception in the flask mouth and an elastic skirt peripherally attached about the upper part of the plug portion and adapted to be received tightly around said flask mouth, a lower portion of the skirt, in a down-turned position thereof, being of less internal diameter than the portion above it, whereby in the seated position of the closure element the skirt is expanded and caused to grip the outer wall of the flask mouth, said bushing having a single central through aperture, and a stopper cooperable with said bushing and flask mouth, said stopper including a central stem receivable in the aperture of the bushing and a substantially flat cap having a down-turned peripheral flange engageable about the down-turned skirt of the bushing.

8. A flask for the preparation, including sterilizing heat-treatment, and for the sterile storage and dispensing of fluids, said flask comprising a generally globular body portion and a narrowed tubular neck portion, said flask composed of insoluble heat-resistant glass of such weight and strength above the usual for chemical flasks as to withstand substantial negative pressure in the flask, said neck portion having a mouth formed with a pronounced inwardly and downwardly tapering inner wall providing a seat for a like-formed closure element, said neck portion having also an integral outwardly projecting annular rib on its outer wall at the top of the mouth and circumferentially thereof, said rib presenting a prominent downwardly facing abutment affording a stop against upward movement of an elastic skirt portion of a closure element to surround the flask neck below the rib, the outer wall of the neck portion below said rib and opposite said tapered seat being downwardly divergent with respect to the tapered wall of said seat.

9. A flask for the preparation, including sterilizing heat-treatment, and for the sterile storage and dispensing of fluids, said flask comprising a generally globular body portion and a narrowed tubular neck portion, said flask composed of insoluble heat-resistant glass of such weight and strength above the usual for chemical flasks as to withstand substantial negative pressure in the flask, said neck portion having a mouth formed with a pronounced inwardly and downwardly tapering inner wall providing a seat for a like-formed closure element, said neck portion having also an integral outwardly projecting annular rib on its outer wall at the top of the mouth and circumferentially thereof, said rib presenting a prominent downwardly facing abutment affording a stop against upward movement of an elastic skirt portion of a closure element to surround the flask neck below the rib, the outer wall of the neck portion below said rib and opposite said tapered seat being downwardly divergent with respect to the tapered wall of the latter, in com-

bination with a closure element of resilient material having a substantially down tapering plug portion shaped and proportioned for reception on said tapered seat in the flask mouth and having an elastic skirt peripherally attached about the upper part of the plug portion, a lower portion of the skirt, in a down-turned position thereof, being of such internal diameter and so located as to be expanded by and to grip firmly the outer wall of the flask mouth below said rib thereon, and said skirt portion having internally thereof means presenting an upwardly facing formation for abutting engagement with the downwardly facing abutment of said rib, thereby to resist forces tending to move the closure element bodily either into or out from the flask.

10. A flask for the preparation, including sterilizing heat-treatment, sterile storage or dispensing of parenteral or other fluids, said flask comprising a generally globular body and a narrowed tubular neck of a length and diameter adapting it for encircling grasping by the user's entire hand, said flask composed of insoluble heat-resistant glass of a weight and strength above that usual for chemical flasks sufficient to withstand substantial negative pressures within it, said neck having at its outer end a mouth formed with a pronounced inwardly and downwardly tapering seat-forming inner wall, said neck also having an integral external outwardly projecting annular rib on its outer wall circumferentially about the edge of its mouth, said rib presenting a prominent downwardly facing abutment completely encircling the flask neck, the outer wall of the neck below said rib and opposite said internal tapered wall being downwardly divergent with respect to the latter at least to an extent to present said outer wall in parallelism with the longitudinal axis of the neck, said heat-resistant glass flask so constructed and arranged being thereby particularly adapted for cooperation with a closure element of resilient material having a down-tapering plug portion receivable on said tapered seat-forming wall of the flask mouth and having an elastic skirt peripherally attached about the upper part of such plug portion, the outer wall of the flask mouth being of such diameter that a lower portion of the skirt of such closure element when down-turned will be expanded by and caused to grip firmly against said outer wall of the flask mouth below the external rib thereon, the downwardly facing abutment of said external rib being adapted then to have upward abutting engagement with an inwardly projecting formation at the inner face of such down-turned skirt portion of the closure element thereby effectively to oppose forces tending to move such closure element relative to the flask mouth either in the direction into or out from the flask.

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