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N. E. SPIESS, JR., ET AL
CLOSURE FOR CONTAINERS

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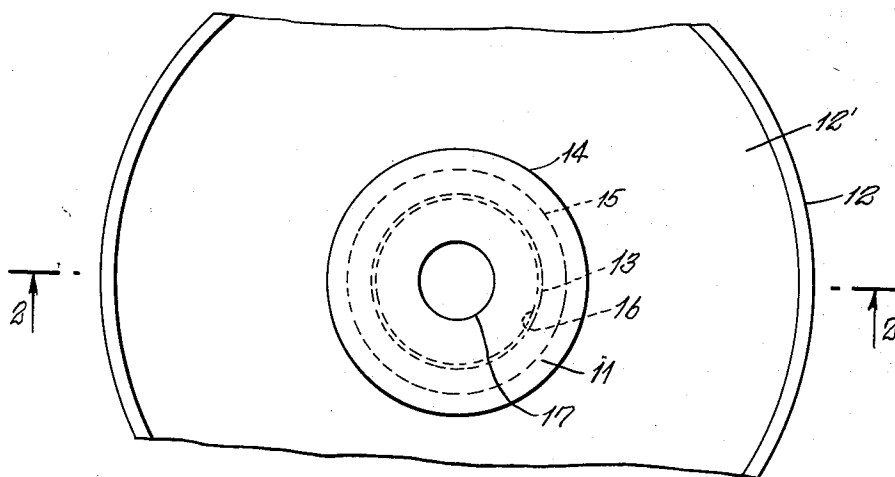


Fig. 1.

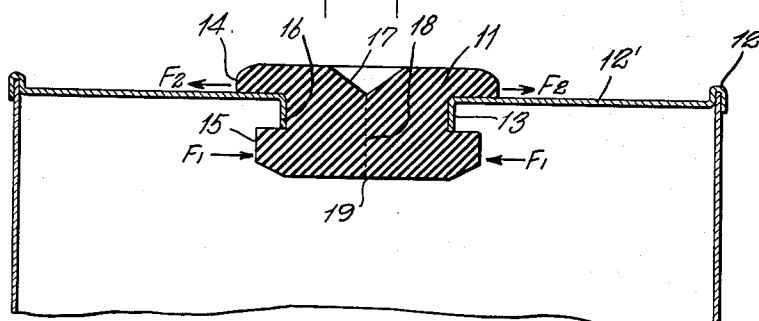


Fig. 2.

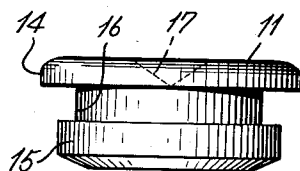


Fig. 3.

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CLOSURE FOR CONTAINERS

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2 Claims. (Cl. 220-24)

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The present invention relates generally to closures for containers of fluids under pressure. More particularly, the present invention embodies a self-sealing, leak-proof closure for containers adapted to hold a liquid such as cream, under the pressure of a gas, such as nitrous oxide.

Closures have been used, for example, in footballs and similar inflatable articles to permit inflation by the use of a tube resembling a hypodermic needle. In such instances the closure is formed of rubber or like material and designed so that the diameter of the closure is made much larger than the diameter of the aperture of the article in which the closure is placed. This construction places that portion of the closure confined by the aperture under sufficient radial compressive stresses to cause sealing of the puncture made by a perforating needle.

If such closures are used with containers from which the contents are charged or dispensed by means of a piercing tube (resembling a hypodermic needle, for example) which is inserted through the closure, we have found that the compressive stresses existing in the material of the closure renders difficult the piercing or insertion of the tube through the closure.

It is an object of this invention to provide a closure for containers designed to hold a fluid under pressure, which closure is easily pierced by an instrument for injecting fluid or gas into the center or by an instrument for dispensing the fluid under pressure of the gas from the container.

It is another object of this invention to provide a self-sealing closure for fluid containers which can easily be inserted into the aperture of the container designed to receive the closure.

Other advantages of the invention will appear as it is described in greater detail in connection with the accompanying drawings, wherein

Figure 1 is a plan view of a closure, constructed in accordance with this invention, shown seated in a metal container;

Figure 2 is a vertical cross-sectional view taken on the line 2-2 of Figure 1 and looking in the direction of the arrows; and

Figure 3 is a view in elevation of the closure member of Figures 1 and 2.

Referring to the above drawings, a closure typical of our invention is shown at 11 as being seated in a metal container 12 which is adapted to hold a fluid under pressure. The closure is formed of rubber or similar material. The wall 12' of the container 12 has an aperture formed

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therein with a depending circular flange 13 defining the boundary thereof. In order that this aperture may be sealed in accordance with this invention, the closure 11 is formed with an outer flange 14, an inner flange 15 and a neck 16 between the flanges 14 and 15.

We have found that sealing of the closure may be accomplished more effectively where the closure is punctured, as aforesaid, by forming the neck 16 of an axial length shorter than the length of the flange 13. As a result, when the closure is inserted in the container aperture, the inner and outer flanges 14 and 15 are under compressive stresses, as indicated by the arrows F-1 and F-2. This preloading (creating the foregoing stresses) will thus insure effective sealing of the holes formed in the closure as a result of punctures formed by dispensing devices and will prevent leakage between the material of the container aperture and the inner flange 15. Sealing of the puncture holes occurs at the surface 19 where radial compressive stresses are induced by the compressive stresses shown by arrows F-1. Furthermore, pressure within the container will exert force on the surface 19 tending to expel the closure from the container, thereby increasing the magnitude of forces F-1, which in turn increases the radial compressive stresses in the surface 19. In this way, sealing forces are developed which are proportional to the container pressure thereby assuring an effective seal at all pressures.

Thus we have found that it is not necessary to make the neck 16 larger than the aperture 13 in order to maintain radial compressive stresses in the closure. This makes insertion of a charging or dispensing instrument into and through the closure an easy operation by eliminating resistance caused by radial compressive stresses within the material of the neck of the closure.

An example of the effectiveness of this self-sealing principle is found in a closure having a neck diameter 16 of .266 inch, a flange 15 of an axial thickness of .125 inch and fitting an aperture having a diameter of .281 inch. This closure was found to be self-sealing even when punctured repeatedly by a needle having a diameter of .090 inch.

With a closure having the dimensions above stated, the total sealing compressive stress developed, when the closure is used in a container under pressure, will be only as much as is required to seal at the specific pressure within the container. As a result, the closure may be pierced more easily than where radial compressive

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sion in the neck 16 is produced by the circular flange 13. Moreover, that portion of the closure which is under compression (induced by tension in neck 16 and pressure within the container) is not confined by the seat of the container aperture so that very little increase in compression will result when a charging or dispensing instrument is inserted through the closure, thus enabling the piercing operation to be accomplished more easily.

The closure has a guide hole 17 (preferably centrally disposed) through which the dispensing needle or charging instrument is inserted. 18 represents the aperture made by the hollow charging needle and into which aperture the discharging instrument may be placed. In this fashion, the dispensing operation is greatly facilitated since each time the discharging instrument is positioned in the closure, it is not necessary to puncture a new hole, but rather, merely to use the hole formed by the charging device. The guide 17 facilitates locating the hole 18 formed by the charging device.

We have found that varying the ratio of the area of the inner flange 15 with respect to the area of the aperture of the container over a wide range has very little effect on the blow out pressure (i. e. the internal pressure at which the closure is blown out of the aperture). On the other hand, as would be expected, the greater this ratio, the greater the force required to insert the closure into the aperture. The following table shows the blow out pressure and inserting force at several different ratios of flange area to aperture area:

Ratio	Pressure	Force
1.26:1	105	8
1.57:1	102	12
2.24:1	100	45

The advantages of the relatively low ratio thus permit not only the design of a closure capable of insertion into the container by a substantially lower force, but also a closure requiring less material.

We have also discovered that when neck 16 is not larger than the aperture formed by flange 13, the most critical dimensional factor determining the blow out pressure of a closure is the thickness of the flange 15 beneath the neck 16 in an axial direction. For example, a given closure, in which dimensions for this thickness were varied, was found to have the following blow out pressures:

Thickness Beneath the Neck	Blow Out Pressure
.020"	50 lbs. per sq. inch.
.094"	225 lbs. per sq. inch.
.125"	275 lbs. per sq. inch.
.187"	310 lbs. per sq. inch.
.250"	360 lbs. per sq. inch.

While the invention has been described with specific reference to the accompanying drawings, it is not to be limited save as defined in the appended claims.

We claim:

1. In combination, a container for withstand-

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ing fluids under pressure, an external wall in the container having an opening formed therein communicating with the insides of the container, a resilient self-sealing closure member mounted in the opening and comprising outer and inner stressed flanges separated by a stressed resilient neck which passes through the opening, said closure member having a puncturing axis which passes axially through the neck so that communication may be established with the insides of the container by a member passing through the closure member, the outer and inner flanges having opposed bearing surfaces tightly engaging the outer and inner surfaces respectively of the wall of the container adjacent the opening to place the neck in tension, the bearing surface of the flange on the high pressure side of the wall engaging the wall all around the opening to seal the latter against the passage of fluid through the opening around the closure member, the bearing surfaces of the outer and inner flanges in their unstressed condition having a spacing, measured axially of the opening, which is less than the corresponding spacing of the outer and inner surfaces of the wall at the points of engagement of the flanges therewith, the flanges thereby being stressed in situ to place the neck in tension within the opening, said neck having an unstressed diameter no larger than the diameter of the opening and sufficiently small in relation to the diameter of the opening to avoid the setting up of radial compressive stresses in the neck in situ, whereby the neck may be readily inserted into the opening and whereby the tension imparted to the neck by means of the stressed flanges serves to close and seal, in the absence of radial compression on the neck, a puncture along the said puncturing axis of the closure member, thereby to prevent leakage of fluid through the closure member, and whereby the tension in the neck in addition cooperates with the fluid pressure to cause the flange on the high pressure side of the wall to be pressed thereagainst in sealing relationship to prevent the leakage of fluid around the closure member.

2. The combination as set forth in claim 1, including a reentrant tube carried by the external wall of the container and defining the said opening therein, said reentrant tube being engaged at its inner end by the said inner flange of the closure member, the said outer flange of the closure member overlying the external wall of the container adjacent the reentrant tube.

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