July 14, 1970 C. E. MALONE 3,520,452

LEAKPROOF CONTAINER SEAL

Filed Nov. 29, 1968

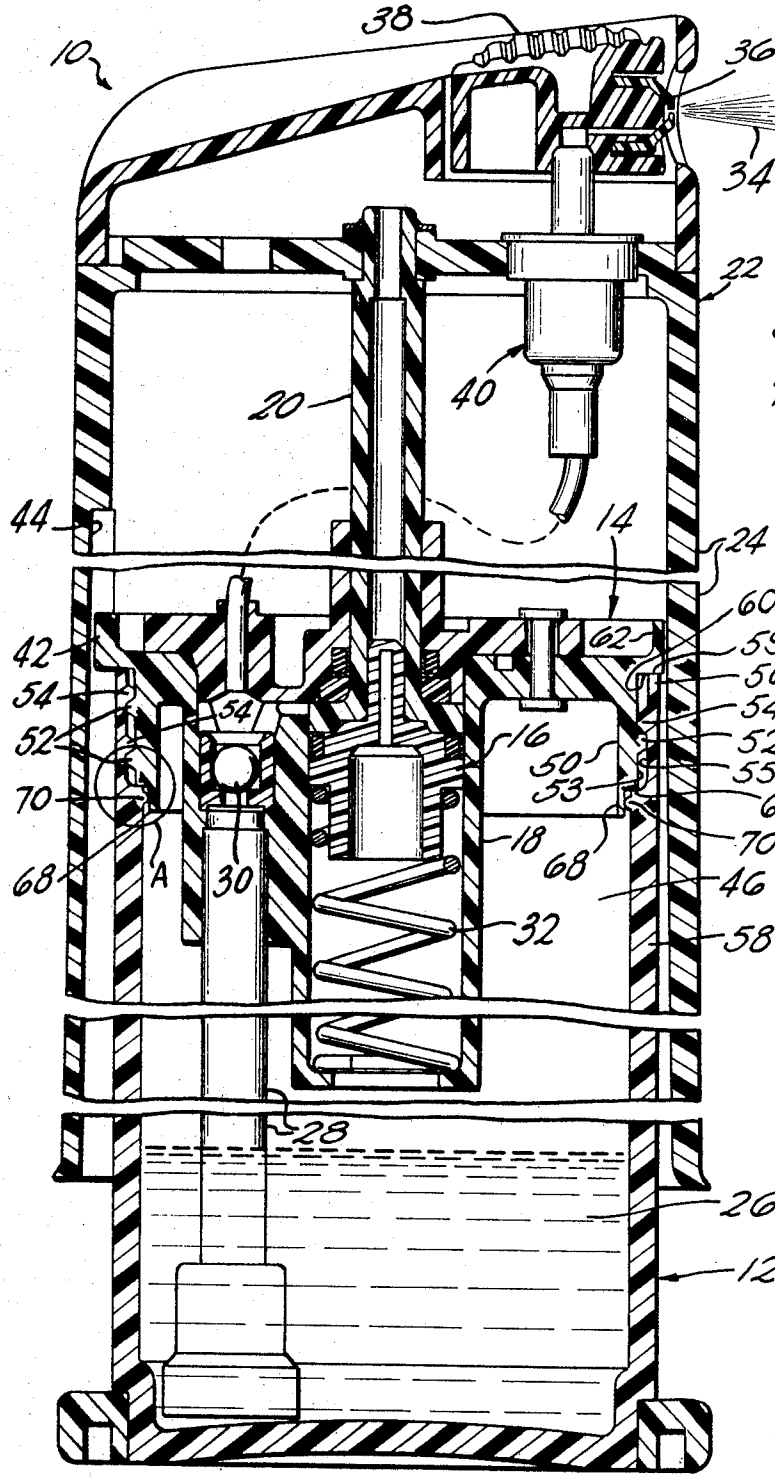


FIG. 1

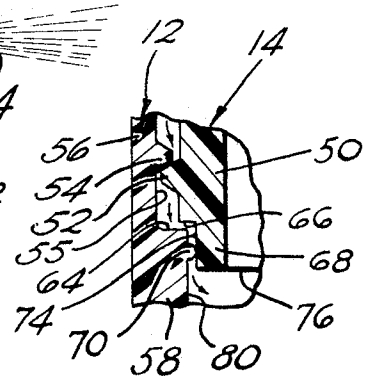


FIG. 2

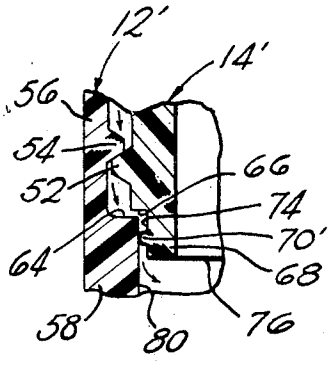


FIG. 3

INVENTOR
CARL E. MALONE

BY Barnes, Kisselle, Raisch & Choate

ATTORNEYS

United States Patent Office 3,520,452 Patented July 14, 1970

3,520,452

LEAKPROOF CONTAINER SEAL

Carl E. Malone, Fort Lauderdale, Fla., assignor to The AFA Corporation of Florida, Miami, Fla., a corporation of Florida

Filed Nov. 29, 1968, Ser. No. 779,755
Int. Cl. G01f 11/30
U.S. Cl. 222—321 8 Claims

ABSTRACT OF THE DISCLOSURE

A liquid tight air permeable seal structure interposed between the wall of a liquid container and a closure for the container which prevents leakage of liquid from the container but is effective to admit air to the container to equalize head space pressure with outside pressure.

This invention relates to seals for container enclosure assemblies and more particularly to a venting-type closure container assembly.

It is an object of this invention to provide a seal for a liquid container which cooperates with a screw-type closure for the container to proivde a simple, inexpensive seal construction which is durable, has a long life and has the unique ability of permitting air to seep into the container when a sub-atmospheric pressure is developed in the head space of the container but which prevents leakage of the liquid contents from the container.

Other objects, features and advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a vertical center sectional view of a hand pressurized liquid spraying device incorporating a leakproof container seal construction in accordance with the present invention.

FIG. 2 is a fragmentary enlarged view of the portion of the seal construction shown in circle A in FIG. 1.

FIG. 3 is a fragmentary vertical sectional view on the same scale as FIG. 2 but showing a modified form of the seal of the invention.

Referring in more detail to the drawings, FIG. 1 illustrates a leakproof container seal of my invention applied to a liquid spraying device 10 as disclosed and claimed in my co-pending application Ser. No. 712,306, filed Mar. 11, 1968 entitled "Liquid Spraying Device," which is a continuation of my prior co-pending application Ser. No. 488,454, filed Sept. 20, 1965, now abandoned, to which reference may be had for a more detailed disclosure of the structure and operation of liquid spraying device 10.

Briefly, device 10 comprises a manually operated, handheld liquid spraying device which includes a non-pressurized, refillable container 12, the open upper end of which is closed by a screw-on cover structure 14. The device includes a manually actuated, spring pressurizing pump comprising a piston 16 working in a cylinder 18. In the embodiment illustrated herein, cylinder 18 is an integral part of cover 14, whereas piston 16 is connected by a rigid stem 20 to a spray head 22 which is slidably guided on the container by a dependent skirt 24 which also forms a handhold for the device. Spray device 10 is cocked for spraying by pushing spray head 22 down so that it telescopes onto container 12, preferably while the container is supported as by resting it on a firm surface such as a tabletop. This movement drives piston 16 down on its suction stroke against the force of a yieldable spring 32, causing liquid 26 to be drawn from container 12, up dip tube 28, past inlet check valve 30 into the pump chamber defined between piston 16 and the upper end of cylinder 18, while simultaneously cocking spring

32. The liquid trapped under high pressure in the pump chamber is then releasable at will in the form of a spray 34 from the spray nozzle 36 by the operator depressing a spray button 38 which controls a discharge valve 40 of the device.

When it is desired to refill container 12 with liquid, spray head 22 is rotated relative to container 12 to thereby unscrew closure 14 from the container, closure 14 being keyed to head 22 by a key 42 which projects into a keyway 44 in skirt 24.

In order to permit shipment and safe storage of the liquid spraying device 10 in "full" condition, that is, with container 12 filled with liquid, it is essential that closure 14, including the pump unit constructed as a part thereof, provide a liquid-tight barrier to escape of the liquid 26 from the container even when the device is laying on its side or shipped upside down. On the other hand, because the liquid is to be intermittently withdrawn from container 12 during operation of the spray device, it is desirable that the head space 46 of container 12 have some form of gas venting communication with outside atmosphere so that as liquid is withdrawn from the container and the head space volume thereby enlarged, the resultant sub-atmospheric pressure created therein will be relieved by air seeping into the container. This pressure equalization is helpful in reducing evaporation of the liquid contents in the container. In my aforementioned co-pending application, various forms of vent passages are disclosed including different types of one-way check valves which will meet the aforementioned requirements of liquid-tight sealing while permitting air venting. My present invention provides an improved construction of such venting structure particularly useful in my device 10, but which is also applicable to closure and container assemblies generally where such liquid sealing and air venting features are advantageous.

Referring to FIGS. 1 and 2, closure 14 is provided with a dependent cylindrical skirt 50 having external helical threads 52 threadably engageable with complementary internal threads 54 on a cylindrical extension 56 of the upper end of the cylindrical wall 58 of container 12. Extension 56 has a smaller radial thickness than wall 58 and has an upper edge 59 which engages the radially extending under surface of a shoulder 60 of the larger diameter cylindrical rim 62 of closure 14 when closure 14 has been screwed down all the way into the upper end of container 12 as shown in FIG. 1. In this fully closed condition, there remains a vertical or axial clearance between a shoulder 64, formed at the junction of extension 56 with wall 58 (FIG. 2), and a shoulder 66 formed at the junction of skirt 50 and with a lip 68, which constitutes a reduced thickness cylindrical extension of the bottom end of skirt 50.

Normally the engagement between the upper edge 59 of extension 56 and shoulder 60 of closure 14 is not a sealing engagement for either gases or liquids, either because the user fails to securely screw closure 14 down tight on the container, or even when this is done due to manufacturing tolerances and imperfections which preclude a uniform sealing pressure all way around these annular surfaces. In accordance with my present invention, I take advantage of this unavoidable leak to permit entrance of air into the space between the outer periphery 53 of skirt 50 and the inner periphery 55 of extension 56, as indicated by the uppermost arrow in FIG. 2. Further, and also in accordance with my present invention, the engaging surfaces 60 and 58 may be made with a knurled finish or with a circumferentially extending series of axial corrugations or teeth of very fine pitch in order to increase the frictional engagement between these surfaces when closure 14 is screwed down tight on the container. This in effect gives a locking action while at

the same time providing a more air permeable joint between these surfaces.

The engagement between threads **52** and **54** also does not provide a liquid or gas tight seal, and hence air can travel past these threads to the lower end of the space between skirt **50** and wall **58**, as indicated by the middle arrow in FIG. 2. If desired, the rate of air leakage through this path can be increased by using interrupted threads and/or increasing the pitch of the threads, both of which are also advantageous in decreasing the number of turns required to screw the closure **14** on and off of container **12** without reducing the holding power of the closure.

Although the closure structure described thus far will prevent rapid escape of the liquid contents of the container and hence serve as a seal against gross liquid leakage, it will not prevent liquid from seeping through the aforementioned air path should the container be tipped on its side or inverted. Accordingly, a principal feature of my present invention comprises a liquid tight seal structure including the lowermost extremity of closure **14** and the adjacent portion of the container wall **58** when closure **14** is screwed all the way down on container **12**. In one exemplary but preferred form, my seal comprises two basic components; (1) the continuous annular sealing rib **70** protruding radially inwardly from wall **58** and (2) the thin cylindrical axial extension **68** of closure **14**. The outer surface **74** of extension **68** is cylindrical and extends vertically or axially approximately equidistant above and below rib **70** in the full-on condition of closure **14**. Rib **70** preferably has a uniform radius of curvature so as to have a semi-circular cross section. The outside diameter of surface **74** is slightly larger than the minimum inside diameter of rib **70** (at its apex) so that extension **68** has an interference fit with rib **70**.

By way of example, the interference or squeeze fit between rib **70** and extension or lip **68** may be as little as .002 inch or as large as .015 inch when the closure and container are scaled from the drawings and the inside diameter of rib **70** is approximately 1.687 inches, the radial thickness of wall **58** is approximately .094 inch, the radial thickness of wall **50** is approximately .063 inch, the radial thickness of extension **68** is approximately .023 inch, the axial length of extension **68** is approximately .063 inch and the radius of curvature of rib **70** is approximately .004 inch.

In the foregoing example, both container **12** and closure **14** are preferably injection molded of a plastic material such as that sold under the trademark "Delrin," but may be made of other plastic material, such as polyvinyl chloride, polyethylene or other high density polyolefins. Such materials have a certain amount of resilience and a rather slippery surface characteristic which enhances the ability of extension **68** to slide past rib **70** even though they have an interference fit and the lower edge **76** of extension **68** is formed square (its end surface is radial).

When extension **68** and rib **70** are constructed to the above scale and with the aforementioned materials they are backed up by the relatively heavy walls **58** and **50** of the container and closure respectively. Thus seal parts **68** and **70** are essentially "rigid" as compared to the flexing or resilient one-way seals well known in the art for venting gases. That is, the interference fit engagement between rib **70** and extension **68** is essentially a rigid engagement, which in turn causes the seal supporting structure, i.e., wall **50** and wall **58**, to "give" or deflect the very slight amount needed to permit extension **68** to slide past rib **70**. Hence, the deflection required to accommodate the interference fit is transferred back into the container structure rather than occurring primarily in the interengaging seal parts **68** and **70**.

It has been found that the "spring" force generated by the interference fit of rib **70** against wall **74** of extension **68** biases these surfaces into sufficiently close mating

contact to provide a liquid tight joint, but a joint which remains air permeable due to the smaller size of the air molecules relative to the liquid molecules. This joint thus operates as a "static seal" in that lip **68** and rib **70** do not move to pass or vent air or to block liquid leakage, and the seal is a "two-way" seal, i.e., gas flow can occur in either direction past the engaged seal parts but liquid flow cannot occur in either direction. It is also to be understood that the aforementioned leakproof container seal does not normally have to prevent or stop leakage of liquid under pressure since liquid **26** is normally and desirably a non-pressurized body of liquid. Moreover when device **10** is operated to withdraw liquid from the container through the pump structure, the headspace-to-outside atmosphere pressure differential created at this time promotes seepage of air past the joint or seal into the headspace.

Referring to FIG. 3, a reversed arrangement of my improved leakproof container is shown, like parts being given the same reference numerals applied above and corresponding parts given a corresponding reference numeral with a prime suffix. In this arrangement, sealing rib **70'** is an external continuous circular rib projecting radially outwardly from the surface **74** of extension **68** of closure **14'**. The inner cylindrical surface **80** of wall **58** of container **12'** is made smooth and cylindrical up to the junction with shoulder **64** of wall **58**. Rib **70'** and wall **80** are dimensioned to have an interference fit as described previously when closure **14'** is screwed down fully onto container **12**. Seal **70'** operates in the same manner as seal **70**.

It is also to be understood that the foregoing principle of a relatively "rigid" liquid tight, air permeable static seal may be embodied in a seal formed by molding or other suitable processes as a separate piece, similar to a washer, and having a molded radial extension to provide the sealing rib **70** or **70'**, such washer being molded of rubber or its synthetic equivalents, i.e., Buna N, neoprene, etc. However, the provision of rib **70** as an integral portion of the container wall or closure wall is advantageous in that it eliminates handling of additional parts during assembly, thereby reducing manufacturing costs, and also is less likely to become lost, damaged or misassembled during service.

From the foregoing description, it will now be apparent that the leakproof container seal of the present invention provides a simple, inexpensive and easily manufactured air venting structure particularly well adapted to cooperate with the structure of my manually operated aerosol spraying device **10** as well as for use in other container enclosure assembly applications where head space pressure is to be maintained equalized with atmospheric pressure without danger of the liquid contents escaping from the closed container.

I claim:

1. A container enclosure assembly comprising a container member having a tubular side wall open at one end thereof and closed at the opposite end thereof, a closure member for said open end of said container member, cooperating interlocking means on said container and closure members for holding said closure member assembled in closing relation to said open end of said container member, and first and second sealing means, one on said container member and the other on said closure member, said sealing means being disposed between said interlocking means and said opposite end of said container, said first sealing means having a peripheral surface on one of said members, said surface being generally parallel to the direction of bodily movement of said closure member when the same is being assembled and disassembled from said container member, said second sealing means comprising a peripheral rib secured to said other member and projecting toward said surface from a portion of said other member juxtaposed to said peripheral surface when said members are in said as-

sembled closed relation, said rib and surface being constructed and dimensioned to have a sliding interference fit engagement with one another so as to permit relative movement of said rib and surface in said direction into the assembled closed relation of said members and such that the engagement pressure between said rib and surface is sufficient to prevent leakage of liquid therepast but not enough to prevent seepage of gas therepast, said rib and said surface being immovable in response to pressure differential normally occurring across said sealing engagement in the assembled closed relation of said members to thereby operate as a two-way static seal for liquids and a two-way vent for gases.

2. The combination set forth in claim 1 wherein said rib is relatively rigid and at least one of said members resiliently deflect to accommodate said sliding interference fit engagement of said rib and said surface.

3. The combination set forth in claim 1 wherein said one member comprises said closure and has a transverse wall with an annular skirt dependent therefrom, said skirt carrying said interlocking means of said closure member, said closure having a circular lip extending axially from the free end of said skirt remote from said transverse wall, said lip having a radial thickness less than that of the radial thickness of said skirt and said surface comprising the outer peripheral surface of said lip, said sealing rib comprising an integral protuberance on the inner surface of said side wall of said container member extending radially inwardly therefrom.

4. The combination set forth in claim 1 wherein said rib comprises an external rib projecting radially outwardly from a cylindrical surface on the outer periphery of said closure member adjacent the inner end thereof and said first sealing means comprises a cylindrical surface defining a portion of the inner surface of said side wall of said container member juxtaposed to said rib.

5. The combination set forth in claim 4 wherein said closure member has a lip at the inner end thereof of reduced radial thickness relative to the main wall portion of said closure member and wherein said rib comprises an integral protuberance extending from said lip, said side wall of container member having a radial thickness greater than that of said lip.

6. The combination set forth in claim 1 wherein said cooperating interlocking means comprise external threads on said cover and internal threads on said container member, said threads having an air permeable engagement in the closed assembled condition of said cover and container members.

7. The combination set forth in claim 1 wherein said members are made of a plastic material having a relatively slippery surface characteristic and said rib and surface are disposed for axial sliding engagement during

assembly of said closure member to its closed position on said container member, said members having sufficient resiliency so that said cover means deflect upon said interference sliding engagement of said rib with said surface and deflection of said rib and surface upon such engagement is held to a minimum.

8. In a liquid spraying device having a receptacle adapted to hold a quantity of liquid and having an opening for filling the same with the liquid and a cover adapted to removably close said liquid fill opening and to define with said receptacle a headspace above the body of liquid in the receptacle, a spray pressurizing head movably mounted on said cover including first and second pump members movably relative to one another and defining a liquid pressurizing chamber and operably connected to said cover and head such that movement of said head relative to said cover changes the volume of said chamber, an inlet conduit adapted to conduct the liquid in the receptacle to said chamber, a spray nozzle mounted on said head, an outlet conduit adapted to conduct pressurized liquid from said chamber to said spray nozzle, a discharge valve in said outlet conduit, and biasing means operably connected to said pump members to bias said pump members in a direction tending to decrease the volume of said chamber whereby said biasing means is stressed when said device is manually actuated to move said head relative to said receptacle and thereby draw liquid from said receptacle into said chamber, the improvement comprising cooperating inter-engaging first and second seal means disposed one on said cover and the other on said receptacle, said first seal means comprising a rigid annular rib and said second seal means comprising a cylindrical surface concentric with said rib, said rib and surface having a sliding interference fit engagement in the closed condition of said cover on said receptacle, said fit being sufficiently tight to prevent leakage of the liquid from said receptacle via said rib and surface engagement but being sufficiently loose to permit seepage of air into said headspace of said receptacle via said rib-surface engagement when liquid is withdrawn from said receptacle by operation of said pump members.

References Cited

UNITED STATES PATENTS

1,517,932	12/1924	Aftergut	222—321
3,228,571	1/1966	O'Donnell et al.	222—321
3,302,822	2/1967	Edwards	220—44

SAMUEL F. COLEMAN, Primary Examiner

N. L. STACK, JR., Assistant Examiner

U.S. Cl. X.R.

220—44; 222—340