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COMPLETE SPECIFICATION

Improvements in or relating to Closures for Containers
and Methods of applying the same

We, METAL CLOSURES LIMITED, a British Company, of Bromford Lane, West Bromwich, Staffordshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method of applying closure seals capable of holding against an internal pressure of the order of 120 p.s.i., to containers of the type having an externally threaded neck, such as bottles, jars and cans. The invention also relates to closure blanks for application by the method of the present invention, and to externally screw-threaded containers when sealed by such closure blanks.

The sealing of the mouth of any container by means of a closure seal involves compressing gasket material against a sealing surface on the container. The general practice in the case of externally screw-threaded containers is to form a seal by pressing a gasket against a surface on the top end of the container immediately adjacent to and surrounding the mouth of the container.

In the case of glassware containers, such as bottles and jars, the sealing surface on the top end of the container merges through a radiused corner with a plain, substantially cylindrical surface on the exterior of the container neck above the top end of the thread. In the method of sealing containers provided by the present invention the primary seal is between the sealing gasket and such plain, cylindrical surface and also the radiused corner. Some sealing effect is or may be also provided against the top sealing surface of the container, but this is only secondary to the seal against the side sealing surface.

It is well-known to apply a closure seal to an externally screw-threaded container by placing a closure blank, made of aluminium or like metal and having a cylindrical skirt of

greater diameter than the thread, over the top end of the container and then rolling thread into the said skirt to engage with the projecting external thread formations on the container, by inwardly deforming the skirt between adjacent thread ribs on the container by means of thread rollers positioned symmetrically about the container.

In the conventional method of rolling on closure blanks to externally threaded containers outlined above, prior to the thread rolling operation, pressure is applied to the top of the closure blank so as to form a seal between the gasket in the closure blank and a sealing surface on the top end of the container.

It has not previously been possible to utilise rolled-on aluminium closures to retain pressures of the order which arise with carbonated soft drinks and with bottled beers during the pasteurisation process, and it has not heretofore been practicable to utilise light gauge metal caps on externally screw-threaded bottles for this purpose. Indeed, it has been the general practice to utilise for this purpose either crown corks, which cannot be used as reclosures after the bottles have been opened, or screw-threaded stoppers, which fit into internally screw-thread bottles, with all their known disadvantages.

However, the method of the present invention may be employed to sealing closures on bottles, the contents of which develop pressures of the order of 120 pounds per square inch, as occurs, for instance, during the pasteurisation of bottled beers.

It is an object of the present invention to provide a method of forming a more secure seal between the closure and the container where internal pressures of the order of 120 p.s.i., obtain, than can be achieved by the conventional method, which has the disadvantage that the closure has a tendency to resile slightly when the pressure on the top of the

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closure is released. In the method of the present invention any resiling movement of the closure has less effect on the seal between the closure gasket and the container because it results in relative axial movement between two concentric substantially cylindrical surfaces, between which the gasket material is compressed, as compared with relative separating movement between two flat surfaces when closures are applied by the conventional method.

The present invention provides a method of sealing a container having an externally screw-threaded neck and a sealing surface on the side of the neck of the container between the thread and the container mouth, to hold against an internal pressure of the order of 120 p.s.i., said method comprising placing a closure blank formed of aluminium having a thickness within the range of 0.008 to 0.012 inch, over the mouth of the container, the closure blank having a top and a skirt, the inside surface of the top being covered by a very thin layer of flowed-in gasket material which increases to a thicker annulus of the same material lying in the angle between the top and the skirt, the mean internal diameter of said annulus being less than the external diameter of the neck of the container, pressing the closure blank down against the top of the container, and, whilst so held, reducing the diameter of the skirt at a position radially outward of said thicker annulus of gasket material and above the neck thread and in register with the side sealing surface to compress the gasket material between the side sealing surface and the reduced diameter portion of the skirt and forming thread in the skirt by inwardly deforming it.

Preferably the reduction of diameter is effected for a short distance downwardly from the top edge of the skirt and this has the effect of compressing the gasket material both against the cylindrical surface on the outside of the neck and against the radiused corner surface.

The invention also provides a closure blank for application to externally screw-threaded containers by the method as above defined, said blank comprising a shell having a top and a substantially cylindrical skirt, and a gasket formed from a flowed-in viscous composition, said gasket consisting of a very thin layer on the under-surface of the top of the closure blank and of an annulus of said composition of greater thickness located in the angle between said top and said skirt of said shell, the thickness of said annulus, perpendicular to the top, increasing progressively toward the skirt.

A preferred form of closure blank has a flowed-in gasket formed of polyvinyl chloride compound, which is securely bonded to the metal of the closure blank, through an inter-

mediate lacquer, if necessary. The polyvinyl chloride compound is soft and is readily moulded to the contour of the sealing surface by the application pressures. Preferably the gasket material forms a layer of about 0.010 inch on the undersurface of the top of the closure gasket, whilst in the angle between the top and skirt of the closure blank it is laid in the form of an annulus, the surface of which is inclined or the tangent thereof lies at an angle of 40—60° to the surface of the top of the closure. The amount of gasket material laid in the angle of the closure blank depends largely on the purpose for which the closure blank is to be employed; for heavier duty sealing effects the amount of gasket material in said angle is increased, so that not only is it thicker at its thickest point, but it also extends further down the inside of the closure skirt, thus increasing the width of the sealing area between the gasket and the cylindrical surface on the outside of the container neck.

The gasket material is preferably applied as a flowable viscous composition on the middle of the top of the closure blank when inverted. When a predetermined quantity of gasket material is applied in this manner and then the closure blank is spun at a predetermined speed, some of the gasket material spreads out over the undersurface of the top of the closure blank to form a layer whose thickness is governed by the viscosity of the gasket material and the remainder forms an annulus of the desired shape in the angle between the skirt and the top. The gasket material is then cured. Thus, the amount of gasket material supplied will determine the amount in the annulus, whereas the layer on the undersurface of the top will remain substantially constant if the rotational speed to which the closure blank is subjected and the viscosity of the gasket material are maintained substantially constant.

In order that the invention may be more readily understood the application of the invention will be described with reference to the accompanying drawings, wherein:

Fig. 1 is a side elevation of the neck of a bottle to which a closure may be applied.

Fig. 2 is a cross section through a suitable form of closure blank.

Fig. 3 is an enlarged view of the corner of the closure blank showing the initial disposition of gasket material as spun into position.

Fig. 4 is a sectional elevation of a presser block assembly suitable for applying a closure blank of the form shown in Fig. 2.

Fig. 5 is an enlarged detail view of the forming surfaces of the presser-block assembly.

Fig. 6 is a cross section showing the closure blank according to Fig. 2 applied to a bottle neck of the form shown in Fig. 1, by a presser block assembly of the form shown in Fig. 4, and

Fig. 7 is an enlarged, fragmentary sectional view showing the approximate disposition of the gasket material in the sealed closure.

In Fig. 1, the corner radius 1 at the junction between the top sealing surface 2 and the side sealing surface 3 of the bottle neck 4, instead of being the conventional radius of about .063 inch, is from 0.030—0.047 inch, which provides for maximum side sealing effect with a given amount of gasket material and secures the maximum possible holding pressure; this range of corner radii is readily obtainable in standard commercial glassware. Pressure sealing on glassware with a greater radius may be obtained, but this involves the use of more gasket material to give the necessary concentration at the bottle neck corner to provide the required side sealing effect.

The closure shell 5 (Fig. 2) is a pressing made of aluminium sheet, with a thickness of 0.009—0.010 inch for a 31 mm. neck finish size container, that is, the shell 5 has an external diameter at the side sealing surface of 1.205—1.185 inches; sheet aluminium of slightly less or slightly greater thickness may be employed in some circumstances. The shell 5 is conveniently provided with a reinforcement in the shape of an area or band of knurling 6, which is sunk or recessed into the skirt 7 of the closure shell; the width of the knurled band 6 may be, for example, about 0.1—0.15, say 0.130 inch, the top of the band being about the same distance, that is, about 0.15 inch down the skirt 7 from the crown or top 8 of the shell 5.

The angle between the skirt 7 and the top 8 of the closure shell 5 is radiused to about 0.05 inch, and the knurled area, of course, terminates above that part of the skirt in which a thread 15 (Figs. 6 and 7) is formed in applying it to a container. The depth of the skirt 7 is determined by the extent of the thread 16 on the neck 4 of the bottle and the bottom edge of the skirt 7 terminates in an outwardly curled bead 17.

The knurled area or band 6 also acts as a shoulder to prevent excess spreading of the gasket material when the closure blank is spun to spread said gasket material before curing. Its reinforcing action reduces the distortion of the upper end of the skirt 7 under the action of the thread rollers and thus opposes any tendency to disturb the side seal, which is produced by the reduction of the diameter of the top end of the skirt 7.

The amount of gasket material used in a 31 mm. closure for a seal capable of holding against an internal pressure of the order of 120 p.s.i., is 0.65 ± 0.05 grams of polyvinyl chloride, and in a closure for a 28 mm. neck finish size bottle the amount of gasket material is 0.52 ± 0.05 grams.

The gasket material is allowed to flow into position and because of the difference of amount it settles to provide, between the layer

9 which lies on the underside of the crown or top 8 and the annular layer 10 extending along the interior surface of skirt 7, a somewhat triangular radiused fillet 11 having a thickness of 0.040—0.045 inch, measured in a direction normal to a tangent of said radiused fillet.

The annulus of gasket material may not always flow into the inside corner of shell 5 to provide a fillet 11 with a well-defined radius 12, but may assume a form in which the general line of its surface is at about 45° to the top 8 and skirt 7 of the closure shell 5.

It will be appreciated that the exact shape and disposition of the triangular section annulus of gasket material in the angle between the top 8 and the skirt 7 is not of great importance, since the soft polyvinyl chloride gasket material will flow as the result of reforming operation during application of the closure. It is important, however, that there should be sufficient amount of gasket material in the angle.

It will be seen from Fig. 3 that the annular layer 10 of the gasket material extends along the skirt 7 so as to overlies part of the knurled band 6. When a closure blank of the form exemplified in Figs. 2 and 3 is applied to standard glassware and is pressed down to form a seal, the resulting closure will satisfactorily withstand an internal pressure of the order of 120 p.s.i. after the thread 15 is formed in the skirt 7 and the head pressure is released, if the reduction in outside diameter 13 at the top end of the skirt 7 is such that the gasket material is squeezed down to a thickness 14 (Figs. 6 and 7) of about 0.02 inch.

When the closure blank is applied, the gasket material not only flows lengthwise of the bottle neck 4 under the axial and radial pressures to which the metal shell 5 is subjected, but also in the circumferential direction so as to make up for any slight ovality and imperfections such as are frequently found in the necks of glass containers.

The operation of reducing the closure diameter 13 is preferably effected before the thread rolling operation and is carried out by means of a two-part presser block (Fig. 4), comprising a holder 18 for mounting in a press and supporting a plunger 19 loaded by a spring 20, adapted to apply a predetermined load to the top 8 of a closure shell 5. The holder 18 has a skirted outer part 21, which reforms the upper end of the skirt 7 of the closure shell 5 in the desired manner. The skirted outer part 21 of the presser block holder 18 has a flaring lead-in surface 22 to exert a centring action on the closure shell and a forming surface 23 which is essentially cylindrical, but flares slightly. The diameter of the forming surface 23 is less than the outer diameter of the closure shell 5, which is to be formed thereby, and is preferably about 0.05 inch in excess of the diameter of the cylindrical surface 24

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on the bottle neck 4, against which the seal is to be formed, but this depends upon the gauge of the metal of the closure shell 5 and the quantity of gasket material used.

- 5 The plunger 19 of the presser block preferably has at its periphery a slightly dished surface 25 to engage against the peripheral portion of the top 8 of shell 5 and form it to a corresponding shape, partly bending the edge of the top portion downwardly around the radiused corner 1 of the container neck 4.

10 The flared lead-in surface 22 of the presser block holder 18 has an included angle 26 of about 50° (Fig. 5).

- 15 In general head pressures are in the range of 400/450 pounds; these loadings apply for 31 mm. and 28 mm. closures. If head loads less than this are utilised the result is a partial reforming of the aluminium and the compound.

20 An example of the re-forming of the upper part of a closure shell and the flowing of the gasket material under pressure is illustrated in Fig. 7. It will be understood that the re-forming of the upper end of the skirt 7 stiffens it and increases the strength of the support of the gasket material which forms the sealing band against the side of the container neck 4. In particular the step at the bottom end of the reduced diameter portion serves an important stiffening function and substantially defines the bottom end of the sealing zone. The distance from the top therefore to which the upper part of the skirt 7 is reformed should be substantially equal to the depth of the side seal, so that the reinforcement provided by the step is substantially coincident with the bottom end of the side sealing zone.

25 The depth of the side sealing zone required for screw-top containers having external diameters in the range of 25—32 mms. (1—1.25 inches) is found to approximate to 0.09 inch and therefore the reforming of the side wall is effected to a slightly greater distance on the skirt 7, so as to allow for the corner radius 1 on the container 4 and the thickness of the closure top 8. The reduction of the diameter of the upper end of the skirt 7 is such as to squeeze out the soft gasket material of the roughly triangular section annular layer and flow it into a sealing band of the required depth, (Fig. 7).

30 With light gauge aluminium caps, flexure of the top 8 of the closure occurs when the contents of the container are under pressure and with sealing against the top sealing surface this flexure tends to break the seal. On the other hand, with side sealing, as employed in the present method, flexure of the closure top 8 under internal pressure only serves to draw in the top of the skirt 7 more tightly against the neck 4 of the container.

35 With larger sizes of bottles it is necessary to be able to replace the closure and hold the pressure of the residual carbon dioxide. The

extensive side sealing provided is a great advantage when the closure is used for re-sealing after initial opening. There is found to be considerable latitude in the amount of screwing up required to form a sufficient re-seal.

WHAT WE CLAIM IS:—

1. A method of sealing a container having an externally screw-threaded neck and a sealing surface on the side of the neck of the container between the thread and the container mouth, to hold against an internal pressure of the order of 120 p.s.i., said method comprising placing a metal closure blank formed of aluminium having a thickness within the range of 0.008 to 0.012 inch, over the mouth of the container, the closure blank having a top and a skirt, the inside surface of said top being covered by a very thin layer of flowed-in gasket material which increases to a thicker annulus of the same material lying in the angle between said top and said skirt and the mean internal diameter of said annulus being less than the external diameter of said sealing surface on the neck of the container, pressing the closure blank down against said top of the container, and, whilst so held, reducing the diameter of said skirt at a position radially outward of said thicker annulus of gasket material and above the neck thread and in register with said side sealing surface to compress said gasket material between said side sealing surface and the reduced diameter portion of said skirt and forming thread in said skirt by inwardly deforming it.

2. The method as claimed in claim 1, wherein reduction of diameter in the region of side sealing is effected for a short distance downwardly from the top edge of said skirt, so as to compress said gasket material both against the cylindrical surface on the outside of the neck and against the radiused corner surface thereof.

3. The method as claimed in claim 1, in which reduction of diameter in the region of side sealing is effected before the thread rolling operation on said skirt.

4. A closure blank for application to externally screw-threaded containers by a method as claimed in any one of the preceding claims, said blank being made of aluminium sheet of a thickness between 0.008 to 0.012 inch, and comprising a shell having a top and a substantially cylindrical skirt, and a gasket formed from a flowed-in viscous composition, said gasket consisting of a very thin layer on the undersurface of the top of the closure shell and of an annulus of said composition of greater thickness located in the angle between said top and said skirt of said shell, the thickness of said annulus, perpendicular to the top, increasing progressively toward said skirt.

5. A closure blank as claimed in claim 4,



on the bottle neck 4, against which the seal is to be formed, but this depends upon the gauge of the metal of the closure shell 5 and the quantity of gasket material used.

- 5 The plunger 19 of the presser block preferably has at its periphery a slightly dished surface 25 to engage against the peripheral portion of the top 8 of shell 5 and form it to a corresponding shape, partly bending the edge of the top portion downwardly around the radiused corner 1 of the container neck 4.

10 The flared lead-in surface 22 of the presser block holder 18 has an included angle 26 of about 50° (Fig. 5).

- 15 In general head pressures are in the range of 400/450 pounds; these loadings apply for 31 mm. and 28 mm. closures. If head loads less than this are utilised the result is a partial reforming of the aluminium and the compound.

- 20 An example of the re-forming of the upper part of a closure shell and the flowing of the gasket material under pressure is illustrated in Fig. 7. It will be understood that the re-forming of the upper end of the skirt 7 stiffens it and increases the strength of the support of the gasket material which forms the sealing band against the side of the container neck 4. In particular the step at the bottom end of the reduced diameter portion serves an important stiffening function and substantially defines the bottom end of the sealing zone. The distance from the top therefore to which the upper part of the skirt 7 is reformed should be substantially equal to the depth of the side seal, so that the reinforcement provided by the step is substantially coincident with the bottom end of the side sealing zone.

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- 65 With larger sizes of bottles it is necessary to be able to replace the closure and hold the pressure of the residual carbon dioxide. The

extensive side sealing provided is a great advantage when the closure is used for re-sealing after initial opening. There is found to be considerable latitude in the amount of screwing up required to form a sufficient re-seal.

WHAT WE CLAIM IS:—

1. A method of sealing a container having an externally screw-threaded neck and a sealing surface on the side of the neck of the container between the thread and the container mouth, to hold against an internal pressure of the order of 120 p.s.i., said method comprising placing a metal closure blank formed of aluminium having a thickness within the range of 0.008 to 0.012 inch, over the mouth of the container, the closure blank having a top and a skirt, the inside surface of said top being covered by a very thin layer of flowed-in gasket material which increases to a thicker annulus of the same material lying in the angle between said top and said skirt and the mean internal diameter of said annulus being less than the external diameter of said sealing surface on the neck of the container, pressing the closure blank down against said top of the container, and, whilst so held, reducing the diameter of said skirt at a position radially outward of said thicker annulus of gasket material and above the neck thread and in register with said side sealing surface to compress said gasket material between said side sealing surface and the reduced diameter portion of said skirt and forming thread in said skirt by inwardly deforming it.

2. The method as claimed in claim 1, wherein reduction of diameter in the region of side sealing is effected for a short distance downwardly from the top edge of said skirt, so as to compress said gasket material both against the cylindrical surface on the outside of the neck and against the radiused corner surface thereof.

3. The method as claimed in claim 1, in which reduction of diameter in the region of side sealing is effected before the thread rolling operation on said skirt.

4. A closure blank for application to externally screw-threaded containers by a method as claimed in any one of the preceding claims, said blank being made of aluminium sheet of a thickness between 0.008 to 0.012 inch, and comprising a shell having a top and a substantially cylindrical skirt, and a gasket formed from a flowed-in viscous composition, said gasket consisting of a very thin layer on the undersurface of the top of the closure shell and of an annulus of said composition of greater thickness located in the angle between said top and said skirt of said shell, the thickness of said annulus, perpendicular to the top, increasing progressively toward said skirt.

5. A closure blank as claimed in claim 4,

having a shell made from aluminium sheet of 0.009—0.010 inch thickness.

5 6. A closure blank as claimed in claim 4 or claim 5, in which the skirt of the closure is provided with a reinforcement in the shape of
10 a sunk knurled area commencing about 0.15 inch from the top of the closure and having a width of about 0.1—0.15 inch, said knurled area being situated so as to terminate above
15 the top of the part of the skirt in which a thread is formed in applying it to a container.

7. A closure blank as claimed in claim 6, wherein said knurled area acts as a shoulder to prevent excess spreading of the gasket material when the closure is spun to spread the gasket material.

8. A closure blank as claimed in any one of claims 4 to 7, for use on a 31 mm. neck finish size container under conditions where
20 pressures of 110—120 p.s.i. may develop, wherein the general line of the surface of said annulus or the tangent thereof, lies at about 45° to the top and skirt of the closure shell, and the weight of the gasket is 0.65 ± 0.05
25 grams, providing a maximum thickness of gasket material in a direction normal to said surface or tangent of about 0.045 inch.

9. A closure blank as claimed in any one of claims 4 to 7, for use on a 28 mm. neck finish size container under conditions where pressures of 110—120 p.s.i. may develop, wherein the general line of the surface of said annulus or the tangent thereof, lies at about 45° to

the top and skirt of the closure blank shell, and the weight of the gasket material is 0.52 ± 0.05 grams, providing a maximum thickness of gasket material in a direction normal to said surface or tangent of about 0.045 inch. 35

10. A closure made from a blank as claimed in claim 8 or claim 9, in which the diameter at the top end of the closure skirt is so reduced that the gasket material has a thickness of about 0.02 inch, and the total depth of side seal when the closure is applied to a container with an outer corner radius of from 0.030 to 0.047 inch is about 0.09 inch. 40 45

11. Methods as claimed in claim 1 for sealing closures onto screw-top containers, substantially as herein described. 50

12. A closure blank as claimed in claim 4 for applying to a screw-top container, said blanks being formed substantially as hereinbefore described and as illustrated in Figs. 2 and 3 of the accompanying drawings. 55

13. A container having a closure applied to withstand internal pressures of 110—120 p.s.i., the closure when thus applied having a form substantially as hereinbefore described and as illustrated in Figs. 6 and 7. 60

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