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CLOSURES FOR CONTAINERS

5 This invention relates to closures for containers wherein the closure has a plastisol liner for forming a seal with the container neck finish; to an intermediate article in the manufacture of such closures, and to methods of making such closures.

10 It is conventional to provide closure caps with a shell having an internal plastisol liner for forming a seal with the end finish of a container. Such liners normally have primarily only an annular sealing surface, although the liners may extend slightly down the skirt of the shell. The plastisol liners are applied in their uncured state and are then cured, at which time a certain degree of
15 expansion takes place. This improves the sealing properties of the liner. However, in order that the liner may be applied at a high production rate, it is contoured by means of a moulding punch; to this end, the internal surface of the liner skirt must have a
20 straight line configuration in cross-section. Otherwise, there would be a wiping action as the moulding punch is removed.

25 According to the invention, in a first aspect, in a closure comprising a shell having a cured plastisol liner the plastisol is in a puffed state, the liner having a lower, radially inwardly-directed, locking bead, formed solely due to the puffed state of the plastisol for locking engagement beneath a container neck finish bead.

30 Preferably, the shell has a cylindrical upper portion and an outwardly-flared lower portion against which there lies the locking bead, the thickness of the liner being greater in the locking bead than in axially-adjacent portions of the liner,
35 due to its puffed state.

According to the invention, in a second aspect, an intermediate article in the manufacture of a closure according to said first aspect of the invention comprises a shell having an internal liner of uncured plastisol, including a liner skirt having an internal surface free of radially inwardly-directed projections, wherein the shell, adjacent a lower portion of the liner skirt, is radially-outwardly enlarged, the thickness of the said lower portion of the liner skirt being greater than that of an adjacent portion of the liner, and the plastisol being of a kind which puffs when cured, whereby thickened zones increase in thickness to a greater linear extent than thinner zones.

According to the invention, in a third aspect, a method of making a closure, including a shell having a plastisol liner for sealing engagement with a container comprises the steps of applying an uncured plastisol liner to a shell, having a skirt with an outwardly-flared lower portion, so as to form a skirt of the liner extending axially into overlapped relationship with the flared portion of the shell skirt whereby a lower portion of the liner skirt is thicker than an axially-adjacent portion thereof but the skirt is free of radially inwardly-directed projections; and then curing the liner so as to puff the plastisol, whereby the resultant greater radial expansion of the said lower portion of the liner skirt forms the lower portion into a radially inwardly-directed locking bead, resulting solely from the puffing of the plastisol, for locking engagement with a bead on a container neck finish.

By this method, an integral bead can be formed in the liner skirt during curing whilst the uncured liner will have an interior surface whose

cross-section is a straight line.

A further feature of the invention is the use of a plastisol for forming the liner wherein the percentage of puffing increases, within limits, as the thickness of the plastisol increases.

An embodiment of the invention will now be described, by way of example only, with reference to the drawings of this Application, in which:-

Figure 1 is a top perspective view of a container closed by a closure formed in accordance with this invention;

Figure 2 is a transverse vertical sectional view taken generally along the line 2-2 of Figure 1, and shows the specific cross-section of the shell of the closure and the liner and the interlocking relationship between the liner and the container neck finish bead;

Figure 3 is an enlarged sectional view taken, through the closure, showing in solid line the contour of the plastisol liner as applied, and in broken line the puffed plastisol liner after curing;

Figure 4 is similar to Figure 3, but has superimposed thereon a number of lines along which test dimensions were taken of both the uncured and

cured plastisol; and

Figure 5 is a graph showing puff percentage plotted against initial liner thickness.

Referring to Figure 1, a conventional
5 container 10 includes a body 12 terminating at its upper end in a neck finish 14. The latter carries a closure 16, made in accordance with this invention.

Referring now to Figure 2, the container 10
10 is of glass (although it may be of other materials). The neck finish 14 includes a free end sealing surface 18, and has an external integral locking bead 20 axially spaced below the sealing surface 18.

The closure 16 has a contoured shell 22
15 having a plastisol liner 24. The shell 22 includes an end panel 26 surrounded by an axially inwardly-opening channel portion 28, and also includes a generally-cylindrical skirt 30 which terminates in an integral, inwardly-directed curl 32. The skirt 30
20 has a cylindrical upper portion 34 and a radially outwardly- and downwardly-flared lower portion 36. The liner 24 includes an annular seal forming portion 38 and an integral liner skirt 40.

Referring now to Figure 3, it will be seen
25 that the liner 24 is contoured by means of a moulding punch 42 to the preselected contour, the plastisol which forms the liner being in its uncured state. Because the moulding punch 42 must be withdrawable, it cannot have any liner-forming projections or recesses in the peripheral surface thereof.

30 Therefore, the as-applied or uncured plastisol liner 24 must have, in its skirt, an internal surface 44 which, in cross-section, is either a straight line or curved in such a manner as to permit withdrawal of the punch. The surface 44 preferably has a slight
35 slope so as to facilitate withdrawal of the moulding

punch 42. It will be readily apparent that this slope must be radially outward and axially downward.

If it is assumed that, upon being heated and cured, the plastisol material of the liner 24 will expand or puff at a uniform rate irrespective of thickness, it will be seen that the internal contour of the liner 24 will be modified from the uncured contour in accordance with variation in thickness of the liner. Thus, by radially outwardly enlarging the shell skirt 30 and thereby providing for an increased thickness in the lower part 46 of the liner skirt portion 40, then, when the liner material puffs upon being cured, the increased thickness of the liner skirt portion 46 will result in a radially inwardly-directed expansion of the portion 46, which is greater than the corresponding expansion of an axially adjacent part of the liner skirt. Thus, by properly contouring the skirt of the shell 22, the lower part 46 of the cured plastisol liner skirt 40 defines a radially inwardly-directed bead 48.

Certain plastisols, particularly plasticized polyvinyl chloride, sometimes contain additives such as pigments, lubricants, stabilizers, and puffing agents, the percentages of which additives vary depending upon the closure type and package treatment. These plastisols, upon curing, do not uniformly puff, but their puff rate (i.e. percentage increase in thickness) is dependent on the initial thickness. The behaviour of a typical plastisol of this kind is illustrated in Figure 5, from which it will be seen that if the initial thickness increases from 0.254 mm (0.010 inch) to 0.787 mm (0.031 inch), there is a marked increase in puff rate, and that the puff rate decreases as the initial thickness decreases from 0.787 mm to a value

of approximately 1.27 mm (0.050 inch).

5 With particular reference to Figure 4 and
to the following table, in an actual study of a
closure having a plastisol which includes a puffing
agent, the actual thickness of the lower part of the
liner skirt, in both its uncured and cured
conditions, is given in the table as measured along a
series of lines perpendicular to the exposed inner
surface of the liner and located at positions denoted
10 in Figure 4 by the reference letters A to Q.

<u>POSITION</u>		<u>INITIAL THICKNESS</u>		<u>FINAL THICKNESS</u> <u>(ACTUAL)</u>	
		mm	(inch)	mm	(inch)
15	A	0.33	(.013)	0.66	(.026)
	B	0.30	(.012)	0.60	(.024)
	C	0.33	(.013)	0.63	(.025)
	D	0.41	(.016)	0.76	(.030)
	E	0.51	(.020)	1.02	(.040)
20	F	0.63	(.025)	1.17	(.046)
	G	0.79	(.031)	1.32	(.052)
	H	0.91	(.036)	1.50	(.059)
	I	1.04	(.041)	1.63	(.064)
	J	1.04	(.041)	1.52	(.060)
25	K	1.02	(.040)	1.47	(.058)
	L	1.07	(.042)	1.50	(.059)
	M	0.91	(.036)	1.52	(.060)
	N	0.74	(.029)	1.47	(.058)
	O	0.53	(.021)	1.37	(.054)
30	P	0.33	(.013)	1.14	(.045)
	Q	0.18	(.007)	0.81	(.032)

It can be deduced from the above table that
the degree of swelling of the plastisol is found to
vary within a comparatively small range of values of
puff rate, except in certain zones of the liner, in
35 which the puff rate is found to be greatly enhanced

(for example, along the line P, the ratio of final to initial thickness is 3.46). This enables the puffing in the applied area 46 of the liner to be predetermined so as specifically to define the bead with a contour which will interlock beneath the bead 20 of the container neck finish. It is to be understood, therefore, that by suitable design of the radial outward enlargement of the shell skirt 30, the contour of the bead 48 may be specifically predetermined.

The closure, 16, as thus formed, is applied to the container 10 by pressing the closure on to the container; the bead 48 engages over and beneath the bead 20 with a snap action, whilst the bead 48 becomes wedged underneath the bead 20.

The closure, when applied as set forth above, may be readily pried off or thumbed off, depending upon the contour of the bead 48. After removal of the closure, resealing is simply accomplished by applying the closure on top the neck finish and pressing down until an audible snap occurs. When this occurs, the container has been resealed.



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CLAIMS

1. A closure comprising a shell having a cured plastisol liner wherein the plastisol is in a puffed state, the liner having a lower, radially inwardly-directed, locking bead, formed solely due to the puffed state of the plastisol, for locking engagement beneath a container neck finish bead.
2. A closure according to Claim 1, wherein the shell has a cylindrical upper portion and an outwardly-flared lower portion against which there lies the locking bead, the thickness of the liner being greater in the locking bead than in axially-adjacent portions of the liner, due to its puffed state.
3. A closure according to Claim 1 or Claim 2, wherein the liner has a terminal, tapered ramp below the locking bead, the ramp terminating against the flared skirt portion between the ends of the flared portion.
4. A closure according to any one of the preceding claims, wherein the plastisol is one having a puff rate which increases with thickness.
5. An intermediate article in the manufacture of a closure according to any one of the preceding claims, the intermediate article comprising a shell having an internal liner of uncured plastisol including a liner skirt having an internal surface free of radially inwardly-directed projections, wherein the shell, adjacent a lower portion of the liner skirt, is radially-outwardly enlarged, the thickness of the said lower portion of the liner skirt being greater than that of an adjacent portion of the liner, and the plastisol being of a kind which puffs when cured, whereby thickened zones increase in thickness to a greater linear extent than thinner zones.



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6. An article according to Claim 5, wherein the plastisol has a puff rate which increases with thickness.

5 7. A method of making a closure including a shell having a plastisol liner for sealing engagement with a container, the method comprising the steps of applying an uncured plastisol liner to a shell, having a skirt with an outwardly-flared lower
10 portion, so as to form a skirt of the liner extending axially into overlapped relationship with the flared portion of the shell skirt whereby a lower portion of the liner skirt is thicker than an axially-adjacent portion thereof but the skirt is free of radially
15 inwardly-directed projections; and then curing the liner so as to puff the plastisol, whereby the resultant greater radial expansion of the said lower portion of the liner skirt forms the lower portion into a radially inwardly-directed locking bead,
20 resulting solely from the puffing of the plastisol, for locking engagement with a bead on a container neck finish.

8. A method according to Claim 7, wherein the skirt of the uncured liner has an interior surface
25 which is a straight line in cross-section.

9. A method according to Claim 7 or Claim 8, wherein the uncured liner is contoured by means of a moulding punch.

10. A method according to any one of Claims 7
30 to 9, wherein the plastisol has a puff rate which increases with thickness.

11. A closure constructed and adapted to operate substantially as hereinbefore described with reference to, and as illustrated in, Figures 1 and 2
35 of the drawings hereof.



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12. An intermediate article in the manufacture of a closure according to Claim 11, the intermediate article being substantially as hereinbefore described, and as illustrated in, Figures 3 and 4 of the drawings hereof.
13. A method of making a closure, performed substantially as hereinbefore described with reference to, and as illustrated in, Figures 2 to 4 of the drawings hereof.
14. In combination, a closure according to any one of Claims 1 to 4 or Claim 11, or made by a method according to any one of Claims 7 to 10 or Claim 13, with a beaded neck finish of a container.
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