May 24, 1949. L. R. N. CARVALHO 2,471,307

METHOD AND APPARATUS FOR FORMING THREADED CAPS

Filed May 4, 1943 4 Sheets-Sheet 1

Fig. 1.

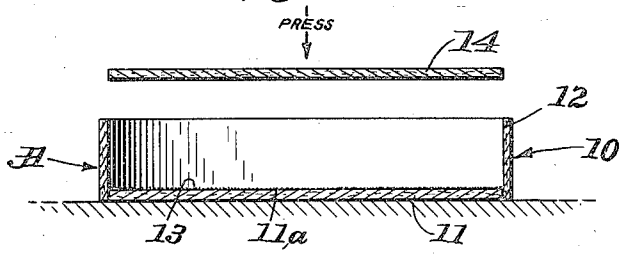


Fig. 2.

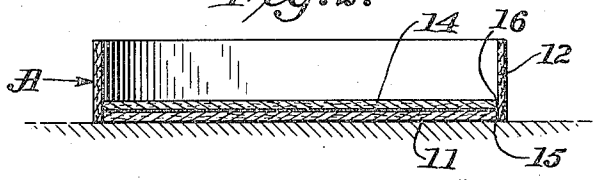


Fig. 3.

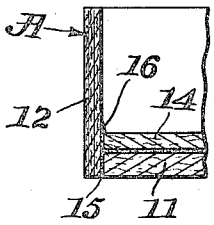


Fig. 4.

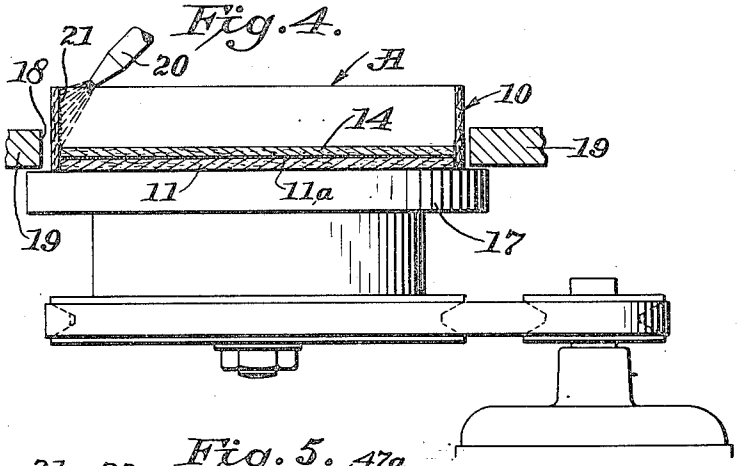


Fig. 5.

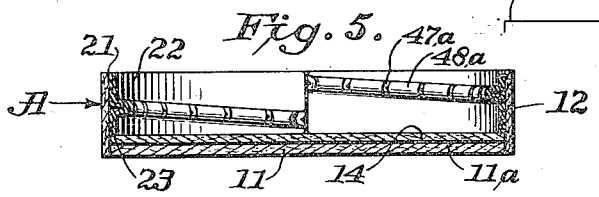


Fig. 6.

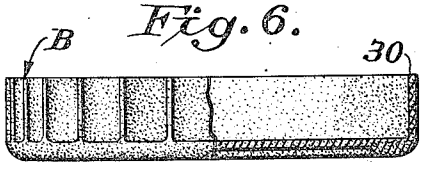
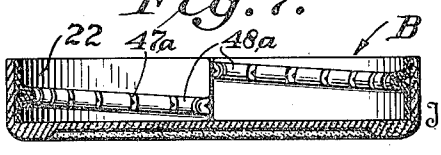


Fig. 7.



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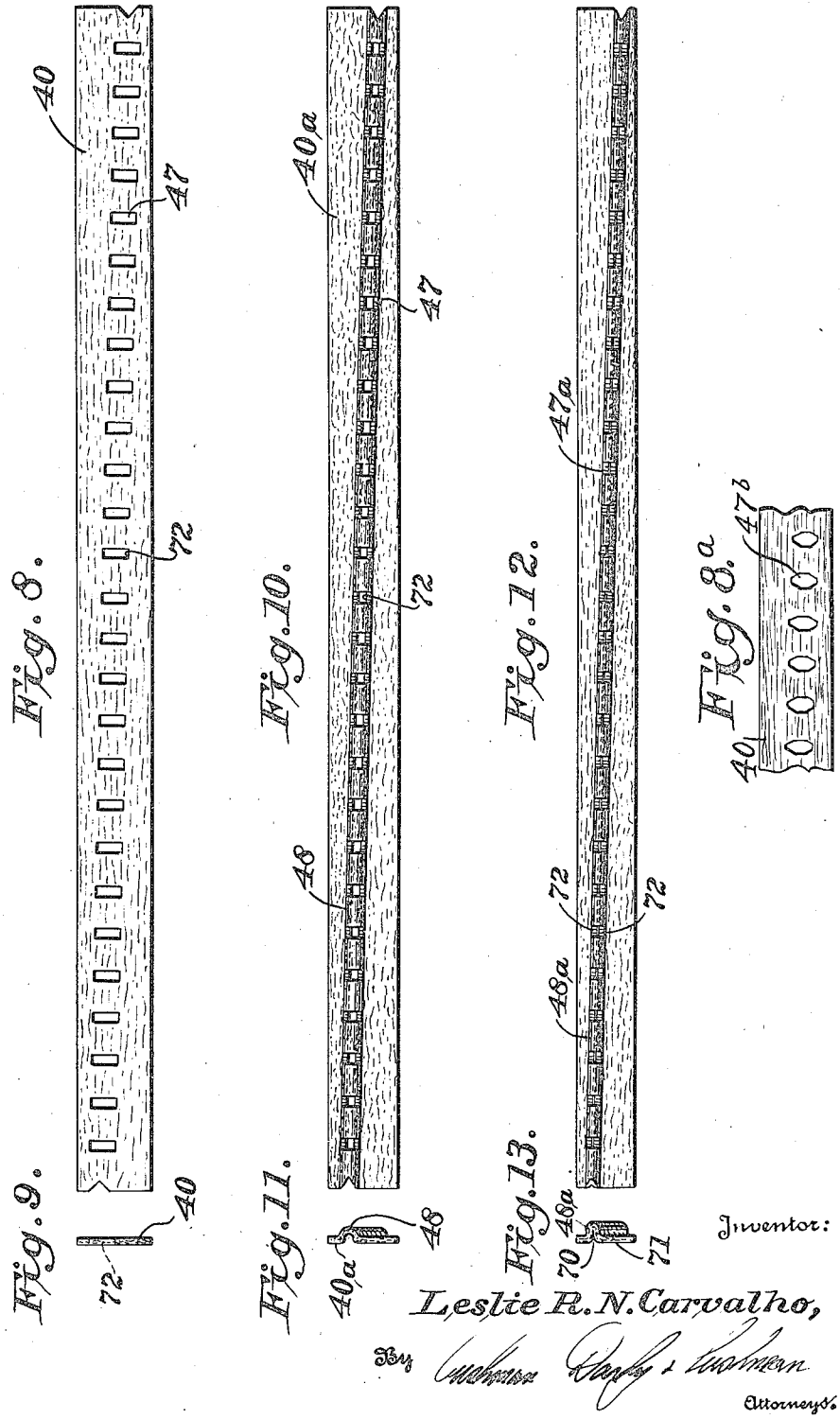
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METHOD AND APPARATUS FOR FORMING THREADED CAPS

Filed May 4, 1943 4 Sheets-Sheet 2



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METHOD AND APPARATUS FOR FORMING THREADED CAPS

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Fig. 14.

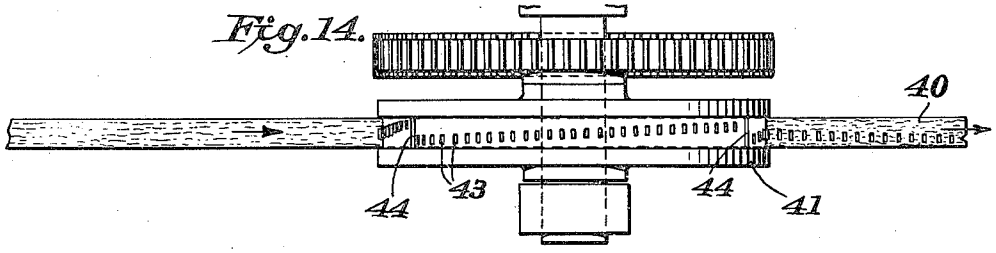


Fig. 15.

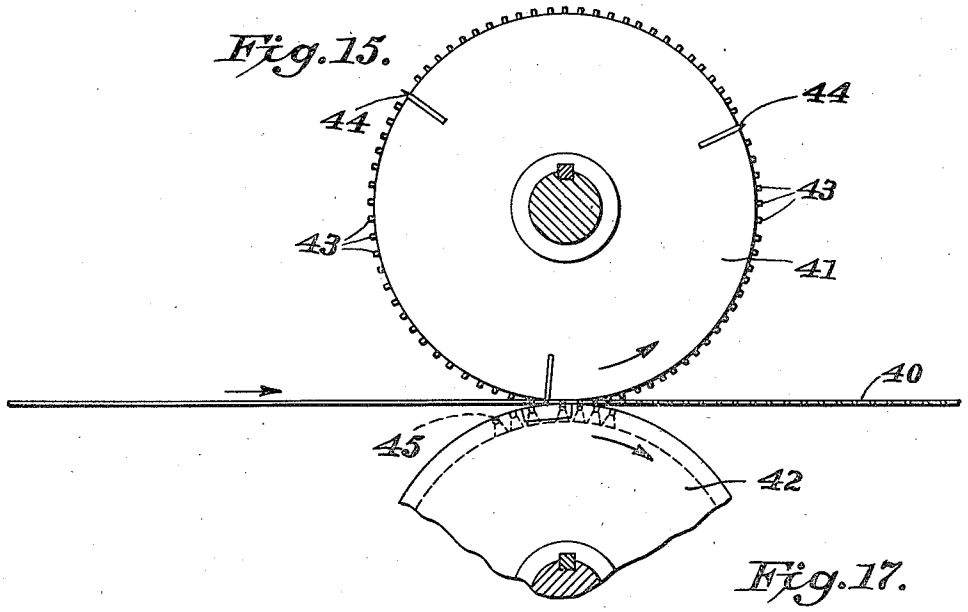


Fig. 16.

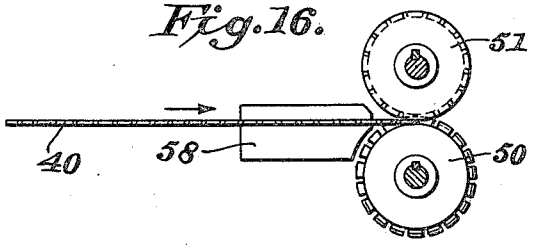


Fig. 17.

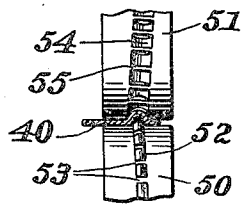


Fig. 18.

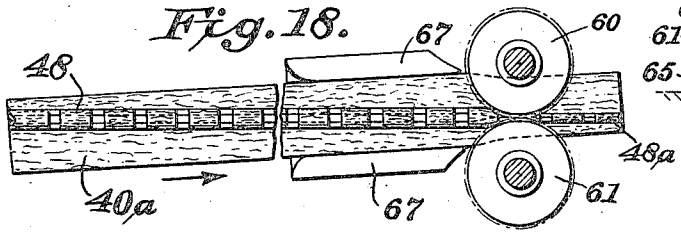
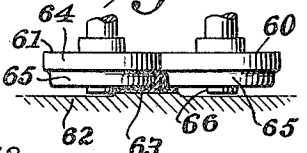


Fig. 19.



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METHOD AND APPARATUS FOR FORMING THREADED CAPS

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Fig. 20.

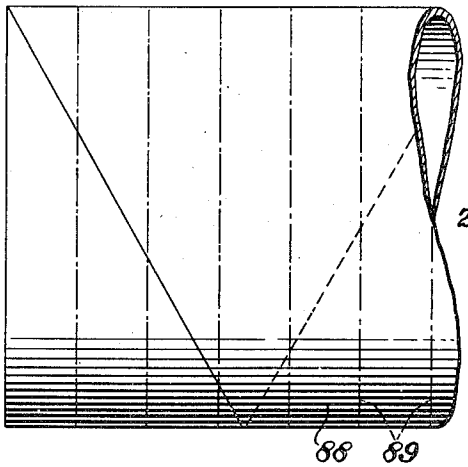


Fig. 21.

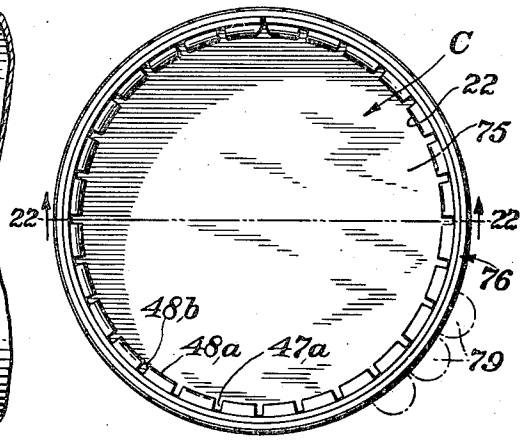


Fig. 22.

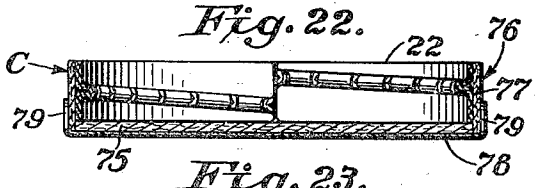


Fig. 24.

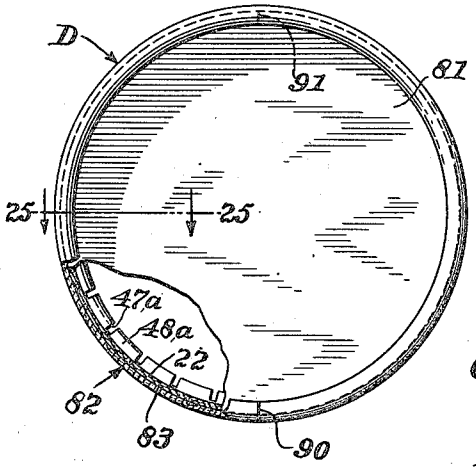


Fig. 23.

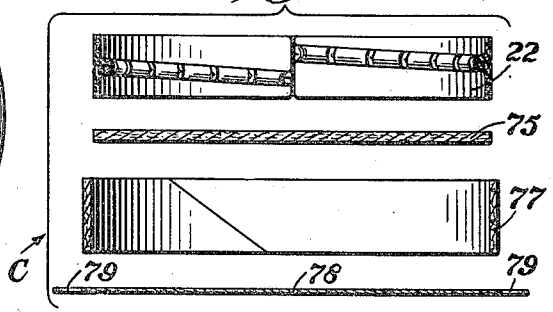


Fig. 25.

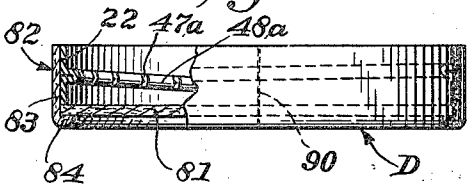
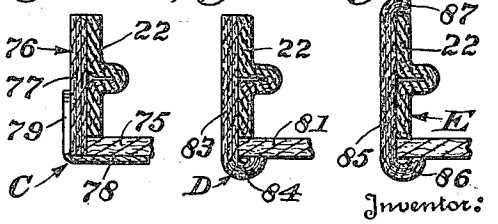


Fig. 26. Fig. 27. Fig. 28.



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Attorneys.

Patented May 24, 1949

2,471,307

UNITED STATES PATENT OFFICE

2,471,307

METHOD AND APPARATUS FOR FORMING THREADED CAPS

Leslie R. N. Carvalho, Decatur, Ill., assignor, by mesne assignments, to Crown Cork Specialty Corporation, Decatur, Ill., a corporation of Illinois

Application May 4, 1943, Serial No. 485,640

2 Claims. (Cl. 93—36)

1

The present invention relates to threaded caps and to methods and apparatus for forming the same.

It has heretofore been regarded as essential that at least the threaded carrying portion of a threaded cap should be formed of metal. This view has been based primarily on the fact that the threads provided on caps had to be formed by a drawing operation performed by dies. Since ductile metals readily withstand drawing action, the use of such material for at least the threaded element was thought necessary.

An object of the present invention is to provide a cap of such construction that the threaded element may be formed of either metal or of non-metallic materials.

Another object of the invention is to provide a thread which can be formed without the use of a drawing operation.

Another object of the invention is to provide a threaded band for use in caps of various types and materials, which band can be formed from flat strip material.

By the present invention, a ridge is formed in a flat strip of material and the strip is then bent to the form of a circular band or annulus and fitted within a cap shell, the ridge thereby forming a thread.

It has heretofore been proposed to provide a cap with a separate thread-carrying element and to form such element from a flat strip. However, these prior arrangements did not form the thread in the strip while retaining the latter in flat condition. Instead, the flat strip was bent into connected arcuate sections, each section having a length of the thread formed therein simultaneously with the bending. The arcuate sections were joined by very short unthreaded portions. This procedure required the bending of the flat strip to arcuate shape by the use of special dies and also required the drawing of the thread in the strip by such dies. The provision of the unthreaded portions permitted the arcuate sections to be bent with respect to each other to form a circular band and without the necessity of further bending of an arcuate and threaded portion upon itself.

A further important characteristic of the prior art threaded bands was that the non-threaded portions were so designed that they would bear upon the interior of the cap shell, thereby spacing the threaded arcuate sections inwardly from the shell. In other words, the band only contacted with the shell at widely spaced points at which non-threaded portions were provided. One purpose of this arrangement was to space the threaded sections of the band from the shell to thereby enable them to expand or otherwise conform to the threads on a container. Provision for such self-adjustment was necessary because, in practice, the bending of the arcuate sections with respect to each other to form a circular band might not occur at exactly the proper points. This would result in a slightly distorted thread.

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The fact that a prior art threaded ring or circular band had surface contact with the cap shell at only several points made it impractical to rely upon the use of adhesive at these points to hold the band in the cap shell. Therefore, it was necessary to provide a bead on the shell to secure the band in place. The space between the threads and shell also increased the overall diameter of the shell.

Summarizing the above discussion of prior art caps provided with separate threaded rings or circular bands, it will be observed that (1) the strip had to be bent by special dies to provide arcuate sections, (2) the bending of the arcuate sections with respect to each other to form a ring could distort the thread, necessitating space between the ring and shell to enable the ring to conform to the container threads, and (3) the necessity for the space between the ring and shell prevented the peripheral surface of the ring from contacting throughout its entire area with the shell, so that a beading operation had to be performed on the shell to secure the ring in place.

An object of the present invention is to provide a thread-carrying element or band of such design that a thread may be formed therein while the band is in a flat condition and so that a single bending of the band to circular form will enable it to be placed within a cap shell.

A further object of the invention is to provide a method and apparatus for forming in flat material, a threaded ridge of such design that the material may be bent to circular form without distorting the ridge.

Another object of the invention is to provide a threaded element for insertion in cap shells and which is of such design that it will have contact throughout its entire outer surface with the inner surface of the shell skirt, thereby enabling the threaded element to be readily secured in the shell and permitting the latter to be of minimum diameter.

Most caps heretofore produced have been formed of metal, the usual procedure being to form a cup-shaped blank and then form a thread in the flange or skirt of the blank. As has been

hereinbefore stated, the objects of the present invention include the provision of a cap formed of non-metallic materials. In forming a cap of materials which cannot be molded to cup-like shape, it becomes necessary to form the cap of separate top and skirt elements. It is highly desirable that these elements be of such design and the procedure for assembling them be so arranged that readily obtainable materials and easily available forms of those materials can be quickly secured together.

A further object of the invention is to provide a cap of such design that it can be formed of readily obtainable forms of available non-metallic materials.

Another object is to provide a convenient and economical method of assembling and securing together the parts of a cap.

In forming parts of a cap of non-metallic material, it is desirable to have those parts of such design that they will require only simple cutting or bending operations to fit them for use. This is necessary because most non-metallic materials are not sufficiently ductile to withstand the drawing operations usual in the making of metallic cap parts.

A cap of the present invention may be formed entirely of pieces of material cut either from flat stock or from stock tubing. In addition, a method of assembling contemplated by the invention enables the parts to be adhesively secured together by simple operations such as can be quickly performed by semi-skilled operators.

Another object of the present invention is to provide a method of forming a thread by stamping and bending operations such as can be performed with numerous types of materials other than metal, as well as with metal itself.

By the method of the present invention, a strip of any suitable material, whether metal, resin condensation product, vulcanized fiber, or heavy paper stock has a ridge formed thereon to extend longitudinally of the strip, the strip being provided with open slots or cut-outs spaced along the ridge so that the ridge will not be deformed when the strip is curved to annular shape and will thereby form a helical thread. As is hereinafter explained, the slots spaced along the ridge may be formed either before or after the formation of the ridge.

Other objects and advantages of the invention will become apparent from the following specification and accompanying drawings, wherein:

Figure 1 is a diametrical sectional view showing the manner of applying a liner to the outer shell of a cap.

Figure 2 is a diametrical section showing the liner applied.

Figure 3 is a fragmentary radial section of the Figure 2 structure.

Figure 4 illustrates a method of applying adhesive to the interior of the shell.

Figure 5 shows, in diametrical section, a completed cap formed by the method illustrated in Figures 1 to 4.

Figure 6 is a side elevation partly in diametrical section of a molded outer shell.

Figure 7 shows a completed cap of the present invention provided with the shell of Figure 6.

Figure 8 is a plan view of the strip used to form the threaded annulus or circular band of the present invention.

Figure 8*a* is a plan view of a strip provided with a form of slot different from that shown in Figure 8.

Figure 9 is an end view of the strip of Figure 8.

Figure 10 is a view of the strip of Figure 8 after the latter has been preliminarily ridged.

Figure 11 is an end view of Figure 10.

Figure 12 is a plan view, showing the strip of Figures 8 and 10 after the ridge has been shaped to final form.

Figure 13 is an end view of Figure 12.

Figure 14 is a plan view of an apparatus for slotting a strip.

Figure 15 is a side elevation of the apparatus of Figure 14.

Figure 16 is a side elevation showing an apparatus for ridging a strip.

Figure 17 is an end view of the structure of Figure 16.

Figure 18 is a plan view showing an apparatus for ridging or bending a strip to final form.

Figure 19 is an end view of the apparatus of Figure 18.

Figure 20 is an elevation of a tube of suitable material for use as the skirt of a cap of the present invention.

Figure 21 is a plan view of a modified form of cap with the skirt uppermost.

Figure 22 is a diametrical sectional view on the line 22—22 of Figure 21.

Figure 23 is a disassembled view of the cap of Figures 21 and 22.

Figure 24 is a view of the type of Figure 21 but showing another form of cap.

Figure 25 is a side elevation of the cap of Figure 24 with portions in section along the line 25—25 of Figure 24.

Figure 26 is an enlarged view, showing the edge of the cap of Figures 21 to 23 in radial section.

Figure 27 is a view of the type of Figure 26 but showing the cap of Figures 24 and 25, and

Figure 28 is a view of the type of Figure 26, but showing a further modification.

Referring to Figures 1 to 5, the cap A illustrated in inverted position and in various stages of assembly in these figures includes an outer shell 10 formed of a top disc 11 and a skirt 12. The elements 11 and 12 may be formed of any material or materials which can be secured together with an adhesive, including heavy paper stock, phenol condensation products, or vulcanized fiber. Disc 11 can be cut from flat or sheet stock and skirt 12 can be cut from tube stock as indicated in Figure 20. Disc 11 is of such diameter that it will closely fit within skirt 12.

The top disc 11 and skirt 12 of cap A must be secured together by the following procedure: A coating 13 of adhesive may be applied to the inner face 11*a* of disc 11 and a liner disc 14 then placed upon the coating 13 in the manner illustrated in Figure 2. The disc 14 has the same diameter as the disc 11 and when suitable pressure is exerted upon the liner 14, with the disc 11 and skirt 13 supported on a flat surface, the adhesive will be forced into the joint 15 between disc 11 and the inner surface of skirt 12 as well as into the joint 16 between the periphery of disc 14 and the skirt as illustrated in Figure 3. It will be noted that adhesive readily can be applied to the surface 11*a* of disc 11 either by hand or by suitable apparatus and that the parts can thereby be assembled without any operation requiring direct application of adhesive to the edge of a disc.

Figure 4 illustrates the outer shell 10, now fitted with the liner disc 14, mounted upon a

rotatable support 17 within an aperture 18 of a fixed table structure 19. Support 17 and the partially assembled cap may be rotated in any manner while an adhesive is applied to the inner wall of skirt 12 from a spray nozzle 20 so that a coating 21 of the adhesive quickly can be applied to the entire inner surface of the skirt. A threaded element 22 formed as hereinafter described and bent to annular form from a flat strip is then inserted in the skirt 12 and will be retained in position by the coating 21 of adhesive. It will be observed that the inner edge 23 of the element or band 22 will contact with the liner 14. In addition, because of the tendency of the band to straighten out, its entire peripheral surface, throughout its circumference and depth, will firmly contact with the coating 21 and skirt 12 so that element 22 is, for all practical purposes, a part of the cap skirt.

Referring to Figures 6 and 7, showing another form of cap, the shell 30 is molded of fibrous material, such as paper stock or it may be a hard plastic. The inner surface of the skirt of shell 30 can have adhesive applied thereto by the procedure illustrated in Figure 4 and a threaded element 22 may then be secured in the shell to provide a cap B in the same manner as described above in connection with Figure 5.

Figures 8 to 13 illustrate a manner of forming a threaded band 22 such as is provided in the caps A and B. Referring to Figure 8, the strip 40 illustrated may be of either metal or non-metal. If it is of metal, it must be sufficiently pliant that it may be bent through 180° without breaking or being markedly weakened. In addition, it must also have sufficient rigidity to remain in the shape to which it is formed in Figures 8 to 13, i. e., retain a ridge therein. If a non-metallic material is used it must have the same characteristics stated above. If the material is laminated, it must be bendable to the extent stated without cracking or de-laminating. It will be perceived that numerous metals and non-metallic materials meet the above specifications, among the non-metals being heavy paper-stock, phenol condensation products and vulcanized fiber, i. e., cotton fibres treated with zinc chloride or other suitable acid in well-known manner. I find that vulcanized fibre has these characteristics to an entirely satisfactory degree and, for use in cap substantially two inches in diameter, would use a strip of such fibre having a thickness of about $\frac{1}{32}$".

The material used for strip 40 may be supplied from a suitable reel, not shown, and moved through a rotary punch mechanism comprising a male die element 41 (Figures 14 and 15) and a female die element 42. The die element 41 is provided with a plurality of series of circumferentially spaced die teeth 43, and, as shown in Figure 14, the teeth in each series are arranged on a helical line. Element 41 is also fitted with cutters 44 between series of teeth and which serve to separate the material into strips, the cutting blades 44 being spaced circumferentially of element 41 by a distance corresponding to the length of the strips 40 to be produced.

The cooperating die 42 has sockets 45 provided therein and into which the teeth 43 may project, the sockets 45 preferably being of a self-clearing type. Element 42 also includes recesses to cooperate with the cutting blades 44.

Figures 8 and 9 illustrate a punched strip 40 produced by the apparatus of Figures 14 and 15,

and it will be observed from this that a line of open slots 47 extends obliquely and longitudinally of the strip.

It is ordinarily found desirable to form the thread from the punched strip 40 by means of two ridging or bending operations. Figures 16 and 17 illustrate an apparatus for preliminarily ridging or bending a strip and which comprises a pair of cooperating die rolls 50 and 51. Die 50 is provided with a helically extending shoulder 52 having notches 53 circumferentially spaced along the same while die 51 is provided with a helically extending groove 54 having teeth 55 spaced along it to mesh with the notches 53. The dies 50 and 51 are so mounted and their surfaces are so dimensioned that when a strip blank 40 is positioned between the same as illustrated in Figure 16, the teeth 55 will extend through the slots 47 of the blank and into the slots 53 of groove 52 on roll 50. In this way, the two die rolls intermesh with the blank punched strip 40 and with each other to pull the strip between the rolls. The shoulder 52 and groove 54 of the respective die rolls serve to bend the strip 40 to the form indicated at 40*a* in Figures 11 and 17 wherein it is provided on one surface with an open groove and on its other surface with a rounded ridge 48. It will be noted that the dies of Figures 16 and 17 simply bend the strip 40 upon itself to form the ridge 48. That is, the ridge can be formed without any drawing operation.

As shown in Figure 16, a guide 58 may be provided at the infeed side of the die rolls 50 and 51 for the purpose of guiding the punched strip 40 between the die rolls. Suitable means, not shown, can be provided to insure that each strip moves between the rolls with its oblique line of slots so synchronized with the die elements that the bending will occur along the line of slots 47.

Figures 18 and 19 show the apparatus for forming the preliminary ridged blanks 40*a* of Figures 10 and 11, provided with the rounded ridge 48, to final form. This apparatus comprises die rolls 60 and 61 mounted upon a base 62 including a flat surface 63. Each die roll includes a portion 64 of relatively large diameter and this portion of the respective rolls may contact as indicated in Figure 19. Beneath portion 64 each roll includes a portion of slightly reduced diameter as indicated at 65. Immediately adjacent surface 63 of the base, the rolls are of greatly reduced diameter as indicated at 66.

The axial height of the surface 65 corresponds to the height of the finished ridge 48*a* above the surface of the strip and the surfaces 65 accommodate a double thickness of the strip between them, as shown in Figure 19. The surfaces 65 act to press the rounded ridge 48 to the closed shape indicated in Figure 13.

Guides 67 are positioned at the infeed side of the rolls 60 and 61 to move the partially completed strips 40*a* between the rolls at such an angle that the ridge 48 will extend tangentially with respect to the surfaces 65 of both rolls and normal to a line passing through the axes of both rolls as shown in Figure 18.

It will be observed from Figure 13 that upon the completion of the action of the die rolls 60 and 61, a ridge or shoulder 48*a* will be formed on one side of the strip by reason of the fact that the rounded ridge 48 of Figure 10 has been closely pressed together to bring the open U-shaped form of the latter ridge to a closed U-shaped form. That is, as shown in Figure 13, the portions 70

defining the bases of the completed ridge 48a are in contact in the completed form. This causes the completed strip 22 to have a substantially uninterrupted surface 71 on the side opposite the ridge or shoulder 48a. As is indicated in Figure 12, the lateral edges 72 of the slots 47 are now in contact. This further insures that the surface 71 will be an entirely uninterrupted surface.

It will be clear that the mechanisms disclosed in Figures 14 to 19 can be combined in a single apparatus so that they will act successively upon material to produce strips 22.

The completed threaded strip 22 illustrated in Figures 12 and 13 can be bent by hand or by any suitable apparatus to enable it to be positioned within a cap. The material used will be sufficiently flexible that it will have a strong tendency to return to flat form and will thereby exert outward pressure throughout its entire circumference upon the cap shell. Because of this, it will firmly adhere to the latter or to the adhesive applied to the shell. The fact that the strip 22 has an uninterrupted outer surface will cause its entire area to contact with the shell.

Since the strip 22 will thus have an exactly accurate circular or annular form, it will properly fit any accurately formed thread on a container mouth. If a container mouth thread is inaccurate, the fact that thread 48a is separated by the kerfs 47a will enable the thread to bend upwardly or downwardly to at least a very slight extent to conform to the container mouth thread. Nevertheless, the material of which the strip is formed must have sufficient strength and bodily rigidity that the thread will not bend freely or easily.

The strip 22 will be of such length that its two opposite ends will be in abutment. Therefore, by proper control of the points at which the ridge 48a intersects the ends, the ridge can be made to properly conform to the thread on a container mouth. It will be noted from Figure 13 that the ridge or thread 48a has flat upper and lower surfaces. A thread having this flat characteristic is extremely efficient in use because it affords an adequate seal and area of contact with the opposed threads of the container mouth.

It will be clear that the open slots or cut-outs 47 formed in the strip 40 must be of sufficient width longitudinally of the strip that the adjacent individual ridges comprising the thread 48a will not exert pressure against each other when the strip is bent to the form of a circular band; otherwise, the bending of the strip to circular form will distort the thread or ridge 48a. The interruptions or kerfs 47a between the individual sections of the ridge 48a can be controlled by varying the width longitudinally of the strip of the open slots 47. As indicated in Figure 21, the kerfs 47a are ordinarily of such width that a space will be left between even the innermost edges 48b of the adjacent thread sections. In some cases, the open slots 47 may be so narrow that the innermost edges 48b may contact with each other, but without the exertion of any pressure one upon the other. In the event that it is desired to form a thread 48a which is not even broken at its base, the open slots may be cut to a hexagonal form of proper proportions as indicated at 47b in Figure 8a.

If desired, the completed ridge 48a can be formed in a strip which has not been provided with the slots 47. If this procedure is followed, kerfs 47a can be cut across the ridge 48a to

enable the strip to be bent to circular form without distorting the ridge.

Referring to the form of cap C shown in various stages of production in Figures 21 to 23 and 26, this cap comprises a top wall 75 formed of a disc of suitable material. The numeral 76 generally designates the skirt of the cap which preferably comprises an outer skirt element 77 which is of ring form and an inner skirt portion formed by a threaded element 22. It will be observed that the elements 75 and 77 comprise a cap shell.

A covering 78 may be provided on the top wall 75 for finishing purposes and also to assist in holding the top 75 and the skirt assembled as hereinafter described. For example, the covering 78 may be formed of lithographed paper which is scalloped at its edge, the scallop 79 extending along the skirt of the cap.

The form of cap shown in Figures 24, 25, and 27 and designated by the letter D comprises a top 81 and a skirt 82 formed of an outer element 83 and an inner and threaded element 22. In this form of cap, the end of the outer skirt element 83 which is adjacent the top 81 is beaded as indicated at 84, the beading engaging the outer wall of top 81.

Figure 28 illustrates a cap E wherein the outer element 85 of the cap skirt is beaded at both edges to provide a bead 86 to bear upon the top of a cap and a bead 87 to engage the free or lower edge of the threaded element 22.

The caps C, D, and E discussed above can be formed of any of the materials referred to in connection with Figures 1 to 3, particularly since all of these materials can be beaded.

The outer skirt elements 77, 82, and 85 of the caps C. D, and E described above could be cut from a wound tube 88 of material such as shown in Figure 20 and by cutting the tube on the lines 89. Alternatively, the outer skirt elements could be formed from flat strip material bent to the form of an annulus. The cap D is of the latter construction and Figure 24 best illustrates how the ends 90 of the strip used to form the outer skirt element 83 are in close abutment and are spaced substantially diametrically opposite to the ends 91 of threaded element 22.

The cap C illustrated in Figures 21 to 23 and 26 is assembled by positioning the disc which is to form the top 75 within the outer element of the skirt. The elements 75 and 77 are secured together with suitable adhesive. The threaded element 22 is then positioned within the outer skirt element, being joined to the latter by adhesive. If a paper cover is to be provided upon the top 11, it also would be joined to the latter by adhesive. The provision of a scalloped edge 79 upon the top 75 enables the scalloped portion to extend along the skirt element 77 to assist in holding the top to the latter.

In the cap D shown in Figure 24, the top 81 and the outer skirt element 83 are joined by adhesive as described above in connection with cap C and the bead 84 is then spun upon the skirt. It will be obvious that such a bead can be readily formed in any cardboard or fibrous material which is of such consistency that it can be bent without breaking and has sufficient rigidity that, after bending, it will remain in its bent form.

The cap E illustrated in Figure 28 would be assembled in the same manner as the caps C and D except that an additional bead 87 would be formed at the free end of the skirt.

In caps D and E it is not always necessary to

use adhesive to secure the top to the skirt. That is, if element 22 is secured to the outer skirt element and its edge bears on the top element, the top will be held in place between strip 22 and the beading.

It will be obvious that if metal is used for the outer skirt element or for the entire shell, adhesives could be used to hold element 22 in place.

The terminology used in the specification is for the purpose of description and not of limitation, the scope of the invention being indicated in the claims.

I claim:

1. A method of securing together a top element formed of a top wall disk, liner disk and a surrounding tubular skirt, comprising applying adhesive to a face of one of said disks, positioning said face of the last-mentioned disk in contact with a face of the other disk, positioning the two disks in one end of the skirt, and pressing the two disks together so that a portion of the adhesive will flow from between them and upon the peripheral edges of the disks and the opposed inner wall of the skirt, and adhesively securing to the internal surface of the free part of the skirt a cylindrical threaded element having a width substantially corresponding to the axial length of such free portion of the skirt.

2. Apparatus for forming a threaded strip comprising a pair of rolls rotatable about parallel axes, the respective rolls being provided with cooperating punch elements arranged along helical lines about the roll, means to guide a strip between the rolls along a line normal to the axes and tangential of the rolls so that a series of open slots will be punched in the strip along a line extending obliquely of the strip, a second pair of rolls mounted on parallel axes, and means associated with said second pair of rolls to guide a strip between the rolls along a line which is oblique with respect to a line passing through and normal to both roll axes and with the planar faces of the strip normal to both axes, so that said last-mentioned rolls will exert lateral pressure upon the edges of the strip and mold a ridge therein along the line of the slots in the strip.

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