United States Patent

Reinhold et al.

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[54] BRIM CURLING METHOD

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[21] Appl. No.: **62,742**

Related U.S. Application Data

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[52] **U.S. Cl.** **264/296**, 264/322

[51] **Int. Cl.** **B29c 17/02**

[58] **Field of Search** 264/322, 296; 18/19

[56] **References Cited**

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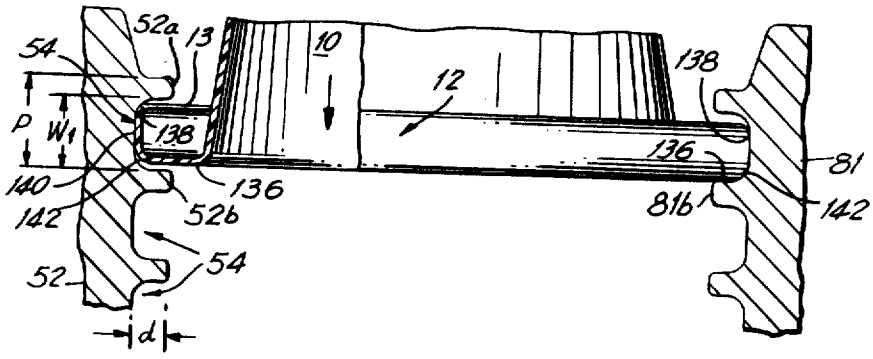
[57] **ABSTRACT**

In forming a curled turned-in lip about the open mouth of a flexible walled, thermoplastic container, a plurality of threaded rollers engage the brim of the containers so that the faces of the thread progressively turn-in the brim as the container is advanced longitudinally of the rollers. The threaded rollers are arranged to bias the brim between the faces of the threads to facilitate formation of the turned-in lip as the rollers are rotated.

6 Claims, 5 Drawing Figures



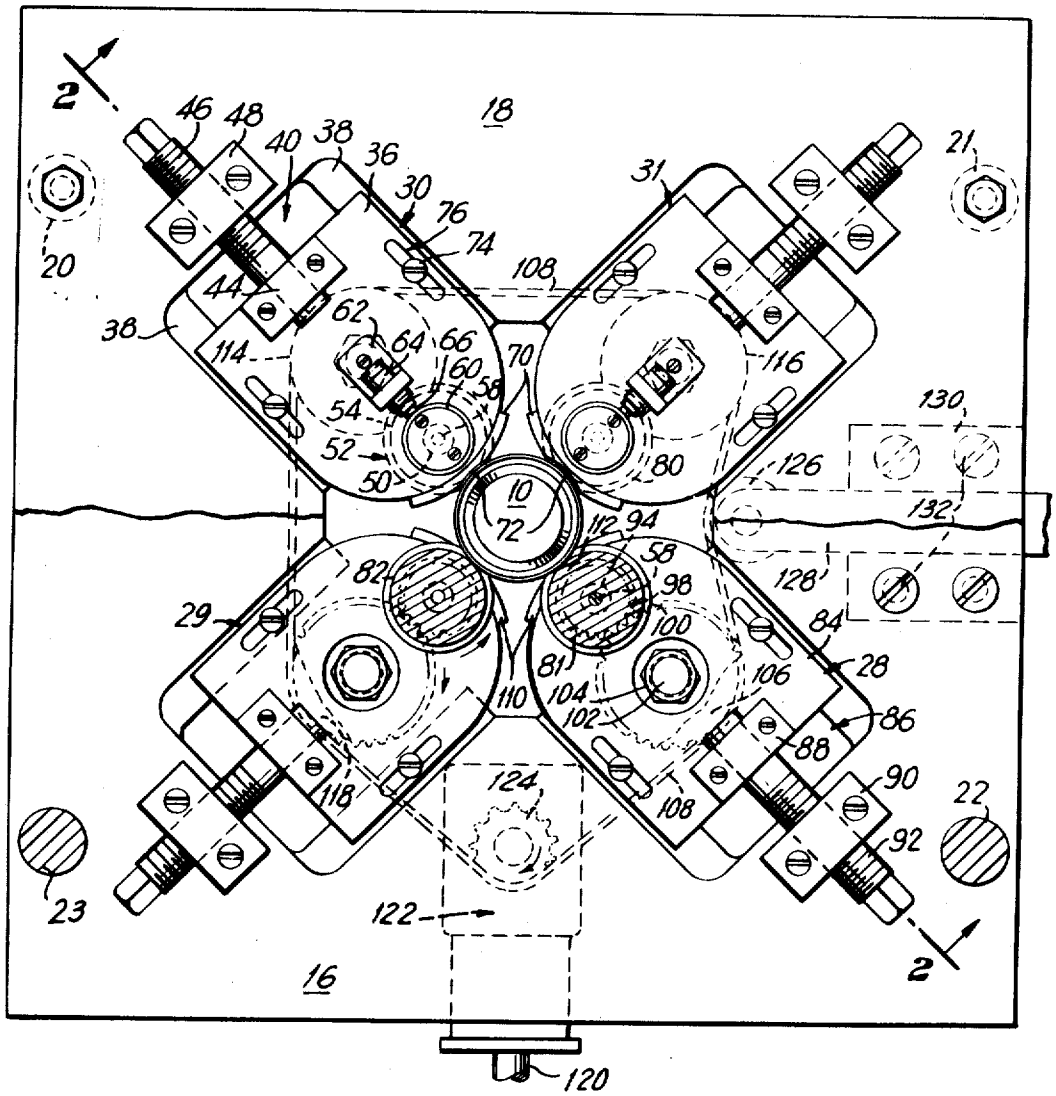


FIG. 1

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FIG. 2

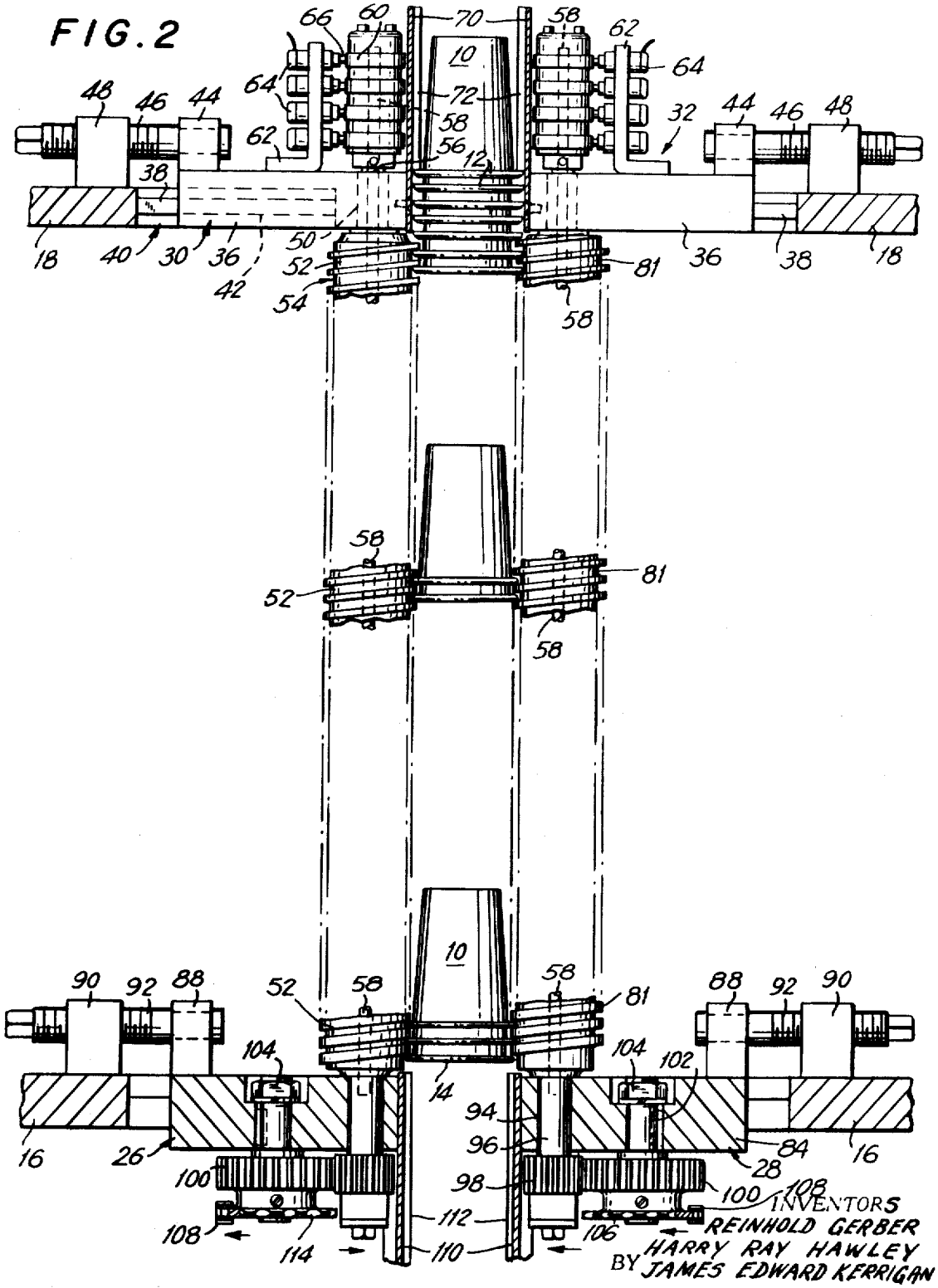

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FIG. 3

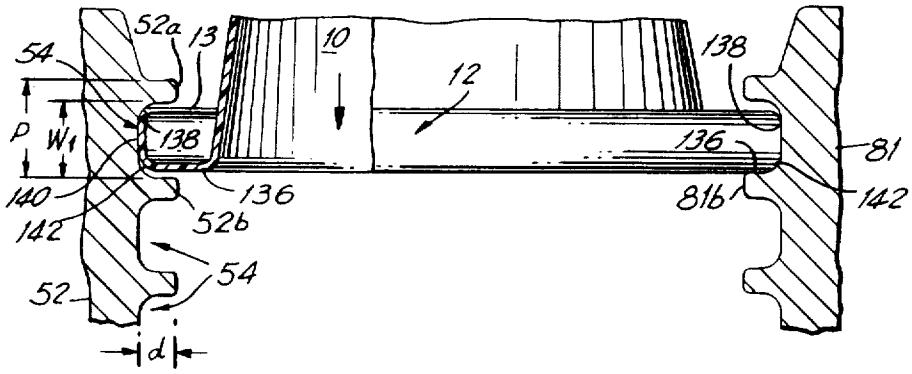


FIG. 4

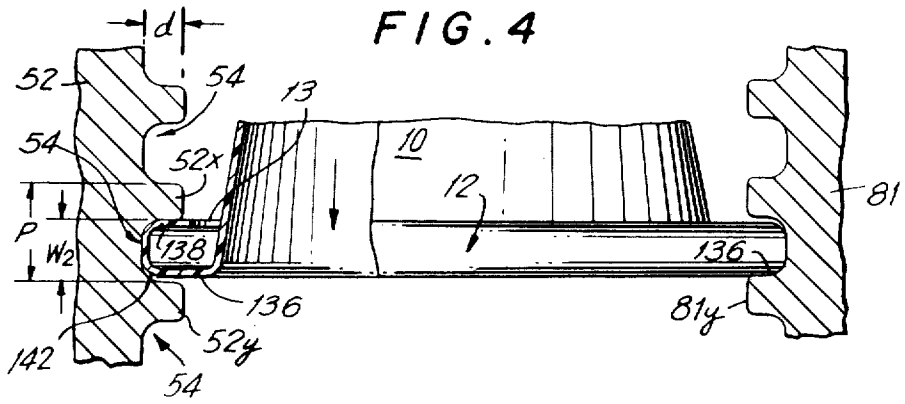
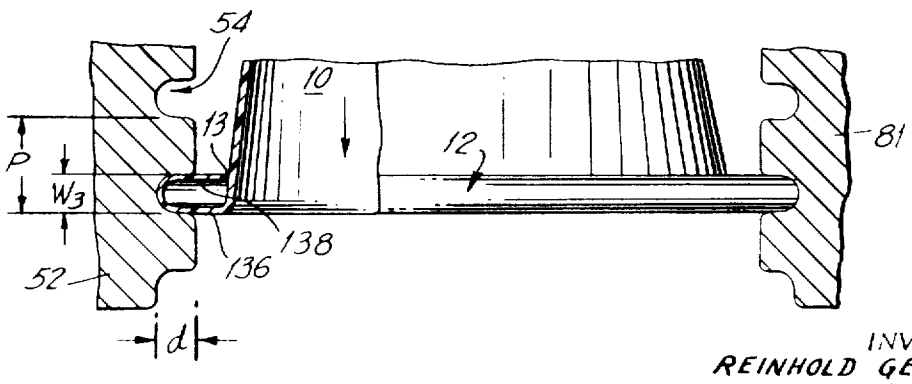


FIG. 5



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BRIM CURLING METHOD

This application is a division of my copending application Ser. No. 767,752, filed Oct. 15, 1968 now U.S. Pat. No. 3,479,737.

BACKGROUND OF THE INVENTION

This invention relates to a method for forming a curled lip abut the open mouth of plastic cups or the like containers.

Thin walled plastic cups and containers have many advantages over paper cups in that they are moistureproof and light in weight while of adequate strength. When the cups are made from a plastic sheet, a certain amount of flash is left by the forming apparatus along the cut edge and this presents a sharp edge which may be injurious to the fingers and mouth of the user. To guard against this and to further strengthen the cup or other container, the edge of the cup is folded over to provide a rolled lip with the previously mentioned cut edge positioned within the rolled lip wherein it will no longer be exposed to cause injury. Even in the absence of sharp edges it is undesireable to have edges of sheet material exposed because even a sheet of paper can cut a finger. Also exposed edges are always susceptible to physical damage.

An object of the present invention is to provide a method for rolling a lip on the edge of a plastic cup or other container to dispose the edge of the container in an inaccessible position. Another object is to provide a method for automatically rolling over the edges on plastic containers in a fast, repetitive, trouble-free manner.

The novel features that are considered characteristic of this invention are set forth with particularity in the annexed claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will be best understood by the description of the illustrated embodiment when read in connection with the accompanying drawings.

SUMMARY OF THE INVENTION

In forming a curled, turned-in lip about the open mouth of a flexible walled, thermoplastic container of the type having a brim which extends outwardly and then downwardly about said open mouth, the container is fed with its open mouth in the direction of feed. The free end of the downwardly extending portion of the brim is engaged at a plurality of radially spaced positions while the outwardly extending portion of the brim is unengaged at said plurality of radially spaced stations. The outwardly extending portion of the brim is engaged on at least one other position without engaging said free end at said one other position such that the engaged positions of said free end are biased against a forming means. Heat is applied to said free end at a temperature sufficient to soften and permit mechanical deformation of said free end and the adjacent portion of said brim without substantially heating the outwardly extending portion of said brim to the forming temperature. The free end is forced toward the container sidewall to form a turned-in lip about the open mouth of the container.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of an apparatus constructed in accordance with the invention, the upper half of the drawing being a plan view of the upper roller supports and the lower half of the drawing being a plan view of the lower roller supports, other parts of the apparatus being partially broken away for purposes of illustration.

FIG. 2 is a sectional view looking substantially along the line 2—2 of FIG. 1.

FIGS. 3 to 5 are successive, partial, sectional views on an enlarged scale showing the progression of the cup along the rollers and the progressive forming of a lip thereon.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, there will be seen a stack of cups 10 made of a thermoplastic material, for example polystyrene.

As can be seen in FIG. 3 in which the cup 10 is shown in an inverted position, the side wall of the cup terminates in a folded over, depending brim 12 and appears as it comes from a cup forming machine (not shown). The edge 13 of the brim 12 is in an exposed position where it could be engaged by the fingers of a user, and at times, the terminating edge 13 of the brim 12 may be sharp. Any possibility of discomfort or danger from such sharp edge is eliminated by curling or rolling over the brim to provide a lip 14, as shown in FIG. 5. It will be also apparent that the lip 14 is more rigid than the brim 12, for a given amount of material.

Apparatus for curling over the brim 12 to form the lip 14 includes a base plate 16 and an elevated support plate 18, said two plates 16, 18 being spaced from one another and secured in said spaced relationship by elongated rods or uprights 20, 21, 22, 23 (FIG. 1). The base plate 16 slidably mounts four lower bearing support means 26, 27, 28, 29, two of which are shown in the lower half of FIG. 1. Similarly, the support plate 18 slidably mounts four upper bearing support means 30, 31, 32, 33, two of which are shown in the upper half of FIG. 1. It will be appreciated that although only two each of the two sets of bearing support means 26–29 and 30–33 on the baseplate 16 and on the support plate 18 respectively, are shown in FIG. 1, that each such plate 16 and 18 mounts four of said bearing support means spaced ninety degrees apart.

The upper bearing support means 30 comprises a slide member 36 slidably mounted on the support plate 18 by suitable slide means which, as shown in FIG. 2, comprises a tongue 38 (only one shown) on each side of a channel 40 in the support plate 18 which engages a groove 42 formed in the slide member 36. The slide member 36 has an upwardly projecting lug 44 in which the end of a horizontally disposed adjusting screw 46 is received. The support plate 18 is also provided with an upwardly projecting lug 48 which threadly receives the adjusting screw 46. The adjusting screw 46 is rotatable in an opening in the lug 44 but is not axially shiftable relative to the lug 44. Accordingly, it will be apparent that when the adjusting screw 46 is rotated, the lug 44 and the slide member 36 to which the lug 44 is secured will be shifted back or forth in the channel 40, depending on which way the screw 46 is rotated.

The slide member 36 carries a bearing 50 for rotatably supporting the upper end of a vertically disposed, elongated roller 52 which is provided with an external groove or depressed screw thread 54 running from top to bottom thereof. The character of the thread 54 will be described shortly. The roller 52 has a reduced diameter end portion 56 projecting above the slide member 36 as best shown in FIG. 2. The roller 52 is provided with a heating element 58 of a suitable electric type positioned within a central bore in the roller 52. The heating element 58 is suitably connected to a plurality of slip rings 60 on the reduced diameter end portion 56 of roller 52. The slide member 36 has suitably secured thereto a bracket 62 on which vertically spaced brush holders 64 are mounted. The brush holders 64 carry brushes 66 engageable with the slip rings 60 to supply electric power to the heating element 58.

Also secured to the slide member 36 of bearing support means 30 is an elongated guide 70 having an arcuate surface 72 which, in cooperation with three other similar guides, engage the brims 12 of a nested stack of cups 10 as said stack is fed vertically downwardly, open end first.

From the above description it will be apparent that the slide member 36 including the bearing 50 for the roller 52, the slip ring and brush assembly 60, 62, 64, 66 and the elongated guide 70 may be slid back and forth as a unit in the channel 40 of support plate 18 as the adjusting screw 46 is rotated. Once the slide 36 has been located in a desired position, it may be locked in said position by tightening the screws 74 (FIG. 1) which are threaded in the support plate 18 and which are carried in elongated slots 76 in the slide member 36.

Although only the upper bearing support means 30 has been described in detail, it will be understood that the other three bearing support means 31, 32, and 33 mounted on the support

plate 18 are of a similar construction and arrangement and that the bearing support means 31, 32, and 33 rotatably support the upper ends of vertically disposed, elongated rollers 80, 81, and 82 respectively, said rollers 80, 81, and 82 being constructed similar to the roller 52, previously mentioned, and as will be more fully described.

As previously mentioned, the base plate 16 slidably mounts four lower bearing support means 26, 27, 28, 29. The lower bearing support means 28 comprises a slide member 84 slidably mounted in a channel 86 in the baseplate 16 by a suitable slide means such as a cooperating tongue and groove previously described. As in the case of the upper bearing support means 30, and lower bearing support means 28 includes a lug 88 on the slide member 84 and a lug 90 on the base plate 16 with an adjusting screw 92 threadedly engaged with the lug 90 and rotatable in lug 88 to move the slide member 84 back and forth in the channel 86.

The slide member 84 carries a bearing 94 for rotatably supporting the lower end of the previously mentioned roller 81. The roller 81 has a reduced diameter end portion 96 projecting below the slide member 84. The reduced diameter end portion 96 has secured thereto a spur gear 98 which meshes with another spur gear 100, the latter gear being rotatably mounted on a shaft 102 which in turn is secured to the slide member 84 as by the threaded nut 104. The shaft 102 also has fixed thereto a sprocket 106 which is engaged by a chain 108.

Also secured to the slide member 84 of bearing support means 28 is an elongated guide 110 having an arcuate surface 112 which, in cooperation with three other similar elongated guides engage the rolled lip 14 of the cups 10 to guide the cups to discharge after they are released by the threads on the rollers 52, 80, 81, 82.

Although only the lower bearing support means 28 has been described in detail, it will be understood that the other three lower bearing support means 26, 27, and 29 mounted on the base plate 16 are of a similar construction and arrangement and that the lower bearing support means 26, 27, and 29 rotatably support the lower ends of vertically disposed rollers 52, 80 and 82 respectively.

From the above description, it will be seen that the roller 52 may be slid laterally to and from the longitudinal centerline of the nested stack of the cups by the bearing support means 30, 26; the roller 80 by the bearing support means 31, 27; the roller 81 by the bearing support means 32, 28; and the roller 82 by the bearing support means 33, 29.

In addition to the sprocket 106 on lower bearing support means 28, there are similar sprockets 114, 116, and 118 on lower bearing support means 26, 27 and 29 respectively. The previously mentioned chain 108 is endless, as can be seen in FIG. 1, and engages each of the sprockets 114, 116, 118, and 106 to drive all of said sprockets. In turn, the chain 108 is driven by a drive motor (not shown) through a shaft 120 (FIG. 1), gear reduction unit 122, and gear reduction unit output sprocket 124 over which the chain 108 passes.

From the above description, it will be apparent that the sprockets 114, 116, 106, 118 drive rollers 52, 80, 81, 82 respectively, through separate drive means each of which drive means comprises meshing spur gears arranged like the meshing spur gears 98, 100 shown in FIG. 2 for driving the roller 81. Adjustable means in the form of a slideably mounted sprocket 126 (FIG. 1) is provided to take up any slack in the endless chain 108. The sprocket 126 may be slid to the left or right as viewed in FIG. 1 by means of a slideable sprocket support member 128, the latter being adapted to be adjusted in a bracket 130 which is detachably secured to a fixed frame member by threaded fasteners 132.

Each of the rollers 52, 80, 81, 82 may be moved laterally towards and away from the centerline of the stack of nested cups 10, said movement being effected by sliding the upper and lower bearing support means in their respective channels in the support and base plates 18 and 16 as previously described. Accordingly, different size cups may be worked on by the rollers 52, 80, 81, 82 as determined by the lateral spacing between said rollers 52, 80, 81, 82. The slideable sprocket support member 128 carrying the sprocket 126 may be adjusted to take up or allow for slack in the chain 108 as required. The guides 70 on the upper bearing support means 30, 31, 32, 33, and 110 on the lower bearing support means 26, 27, 28, 29 are also varied in their spacing to provide variable sized entrance ways and exit passages for the different size cups as the latter are fed to and discharged by the rollers.

The nature of the screw thread or groove 54 on roller 52 is shown in the sequential views of FIGS. 3 to 5. More specifically, the thread comprises a groove 54 which progressively narrows, from its start at the top of the roller (FIG. 3) to its end at the bottom of the roller (FIG. 5). Thus, it will be seen by comparing FIG. 3, which is a view at the entrance or longitudinal top end of the roller 52; FIG. 4 which is a view at the longitudinal middle of the roller 52; and FIG. 5, which is a view at the exit or longitudinal bottom end of the roller 52, that the width of groove 54 progressively decreases from W1 through W2 and finally W3. However, as the width of the groove 54 decreases, the width of the thread which defines the groove 54 progressively increases proportionally so that the pitch P of the thread remains constant for the full length of the roller 52. Also the depth *d* of the groove 54 remains substantially constant along the entire groove 54.

It will be observed that the thread groove 54 is substantially square, in cross-section, with rounded corners, for almost the full longitudinal length of the roller 52. However, at the longitudinal bottom of the roller 52, the square groove 54 gradually and progressively changes to a circular cross-section as shown in FIG. 5 so that said circular cross section can be used to size and shape the lip to the final desired configuration.

The threads on the four rollers 52, 80, 81, 82 are identical. However, at least one of the rollers, e.g., roller 81 in the illustrated embodiment, is slightly out of phase with the remaining rollers, in this case rollers 52, 80, and 82. Thus, rollers 52, 80, and 82 being in phase with one another engage the brim 12 of the cup 10 as shown in the left hand half of FIGS. 3 to 5. Roller 81, being slightly out of phase in that its thread is slightly ahead or more advanced than the thread on rollers 52, 80, 82, engages the brim 12 out of the cup 10 as shown in the right hand half of FIGS. 3 to 5. In FIG. 3, the leading annular face 136 of the brim 12 is engaged by the trailing face of the thread portion 81*b* of roller 81. On the other hand, because rollers 81 and 52 are slightly out of phase as previously described, the trailing edge 13 of brim 12 tends to be engaged by the leading face of thread portion 52*a*. Thus it will be apparent that the brim 12 tends to be biased between the trailing face of thread portion 81*b* and the leading face of thread portion 52*a*. As the cup 10 advances downwardly along the threads and the width of the thread groove 54 progressively decreases from W1 (FIG. 3) through W2 (FIG. 4) to W3 (FIG. 5), the aforesaid biasing force will tend to curl the trailing edge portion 138 of the brim 12 back towards the cup, as shown in FIG. 4 and 5. Expressed otherwise, the trailing edge portion 138 of the brim 12 is folded over by the leading face of the thread (e.g., the leading face of thread portion 52*a* shown in FIG. 3) on rollers 52, 80, and 82, as the cups are advanced through the threads from top to bottom.

The thread on all the rollers is right handed and the rollers rotate in a counterclockwise direction as viewed from above. Hence, the cups are lowered or advanced by the rollers from the FIG. 3 position to the FIG. 5 position. As heretofore noted, the cups are made of a thermoplastic material, and the heating of the rollers by the electric heating elements 58 causes the deformation of the brims 12 to be permanent and without damage to the brims. More specifically, it will be observed in FIG. 3 that the trailing edge 13 of the brim 12 is engaged by the leading face of thread portion 52*a*, and the outer cylindrical portion 140 of the brim 12 is engaged by the root or bottom of the thread groove 54. Due to this engagement, heat from the heated roller 52 is applied to the edge 13 of the brim 12 and to the outer cylindrical portion 140 of the brim 12

where such heat is more desirous to facilitate the folding of the brims as these are the areas where the brim is actually bent or folded. On the other hand, the annular leading face **136** and arcuate leading portion **142** of the brim **12** are slightly spaced from the trailing face of thread portion **52***b* of the roller **52**, as clearly shown in FIG. **3**, so that there is less heat applied to the brim portions **136**, **142**. This, of course, is desireable because the maximum heat is applied to those areas which are to be bent, in preference to those areas which are not to bend, thereby ensuring that the bending will occur in the desired areas. Since the roller **81** engages the annular leading face **136** and arcuate leading portion **142** of the brim **12**, the roller **81** may not be heated. However, the roller **81** is shown with a heating element to provide for interchangeability of the rollers, but such heating element may be shut off or used to apply a reduced amount of heat, for example, to facilitate distribution of heat around the periphery of the brim **12**.

In FIG. **4**, it will be seen that the brim **12** has been partially curled over in that the trailing edge portion **138** has been directed back to the cup **10**. It will also be noted that the leading annular face **136** of the brim and leading arcuate portion **142** of the brim **12** are still spaced from the trailing edge of thread portion **52***y* and that the bending of the brim is effected on the leading face of thread portion **52***x*. At the same time, the leading annular face **136** of the brim **12** is engaged by the trailing face of thread portion **81***y*. Accordingly the relationships between the brim **12** and the thread on the rollers **52**, **81** is the same in FIGS. **3** and **4** in the sense that the brim **12** continues to be biased between the trailing face of the screw thread on roller **81** and the leading face of the screw thread on roller **52** as the brim is being curled by the latter. The aforesaid biasing of the brim **12** between the screw threads continues as the cup traverses substantially the longitudinal length of the rollers. At the bottom, exit end of the rollers, however, the groove in the thread of the rollers may be sized, as shown in FIG. **5**, to accommodate the curled lip **14** in the size and shape desired for the final curled lip on the cup. Expressed otherwise, the last one or more turns of the thread on one or more of the rollers may be used as a sizing groove to finish off the curled lip **14** in the size and shape desired.

In the illustrated embodiment, the rollers **80** and **82** are in synchronism with roller **52** so that the detailed description on the operation of roller **52** is equally applicable to rollers **80** and **82**. As an alternate arrangement, the two rollers, e.g., **52** and **81**, may be in synchronism with one another and the two rollers, e.g., **80** and **82**, in synchronism with one another but slightly out of phase with the rollers **52**, **81**. In this alternate arrangement the two synchronized rollers **52**, **81** would function as shown in the left hand half of FIGS. **3** to **5** and the other two rollers **80**, **82** would function as shown in the right hand half of FIGS. **3** to **5**. As a further alternate arrangement, a total of six rollers may be employed with each group of three synchronized rollers being slightly out of sychronism with the other three synchronized rollers.

Although the invention has been described specifically with regard to turned down brims on plastic cups, it will be understood that the invention is generally applicable to sheet material containers having exposed circular edges.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of parts of the apparatus mentioned herein and in the steps and their order of accomplishment of the process (method) described herein, without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the apparatus and process hereinbefore described being merely a preferred embodiment thereof.

We claim:

1. A method for curling a turned-in lip about the open mouth of a flexible walled, thermoplastic container having a brim which extends outwardly and then downwardly about said mouth without changing the wall thickness of said brim, comprising:

engaging the free end of the downwardly extending portion of said brim with a plurality of first helical means at a plurality of circumferentially spaced positions while the outwardly extending portion of said brim is unengaged at said plurality of circumferentially spaced positions;

engaging the outwardly extending portion of said brim with second helical means at least one other position such that the brim is biased between the first and second helical means, said first and second helical means each comprising a roller each having a substantially identical helical groove whereby said first and second helical means are interchangeable, each of said helical grooves having a longitudinal width which progressively decreases along the longitudinal length thereof, the major extent of said helical grooves being generally rectangular in cross section considered in a cutting plane containing the longitudinal axis of said rollers;

rotating said first and second helical means to advance said container along its longitudinal axis as said first helical means forces the free end toward the container sidewall to form a turned-in lip about the open mouth of said container, the first helical means being rotated in synchronism with one another, and the second helical means being rotated out of phase with said first helical means.

2. The method of claim **1** additionally including a sizing and shaping step which comprises advancing the container through said helical grooves whose longitudinal end portions are generally circular in longitudinal cross section.

3. The method of claim **2** wherein the longitudinal width of the thread portion which defines said helical grooves progressively increases along the longitudinal length of said rollers.

4. The method of claim **2** wherein the pitch of said helical grooves is substantially constant.

5. The method of claim **2** wherein the depth of said helical grooves is substantially the same throughout the helical length.

6. The method of claim **2** further comprising heating said first helical means.

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