Nov. 27, 1962 J. E. ARMSTRONG 3,065,678

CONTAINER FORMING APPARATUS

Filed Aug. 29, 1961 4 Sheets-Sheet 1

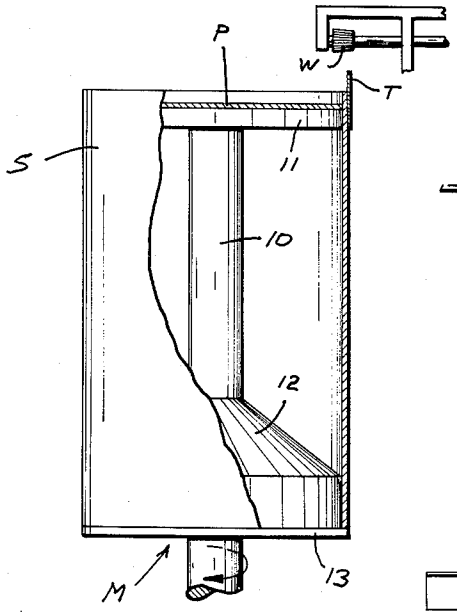
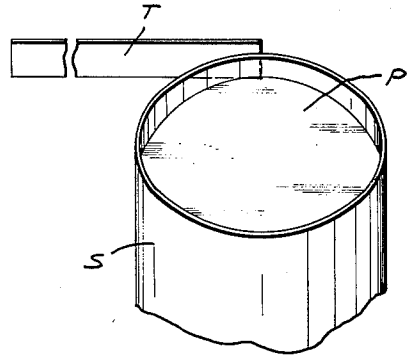


FIG 1

FIG 2



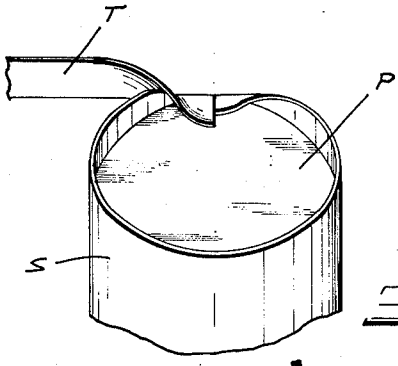


FIG 3

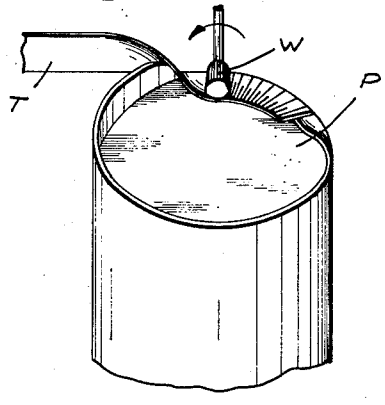


FIG 4

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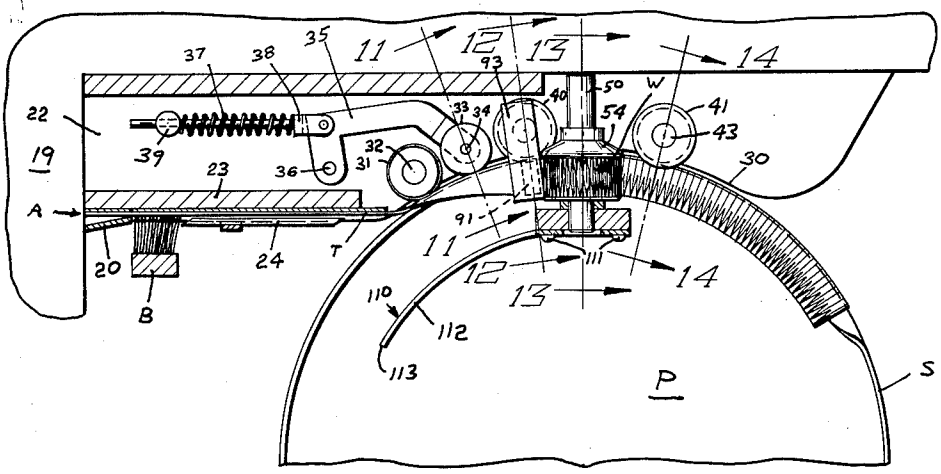
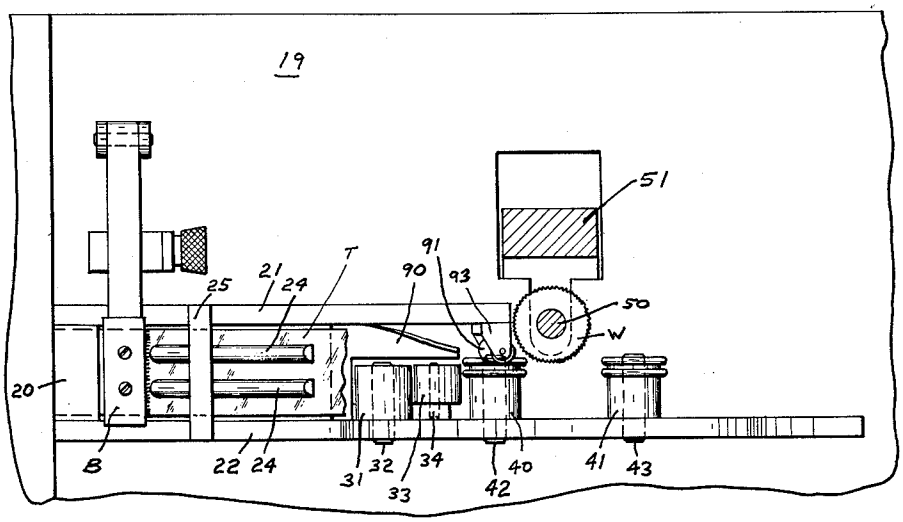


FIG. 6

FIG. 5



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FIG 7

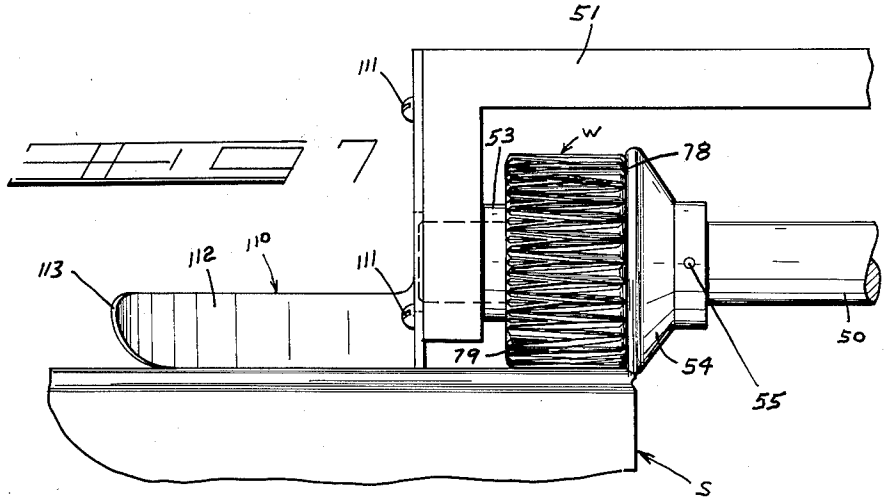


FIG 8

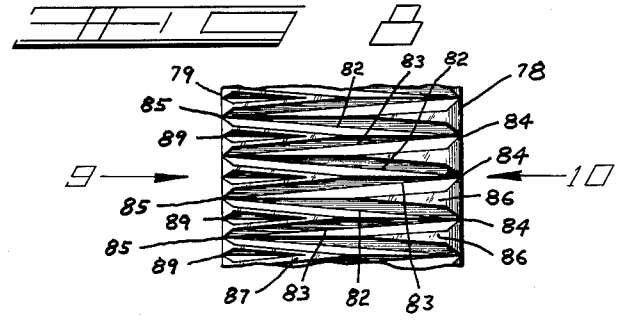


FIG 9

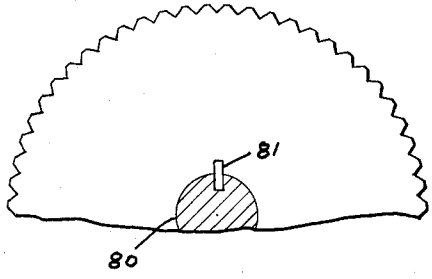
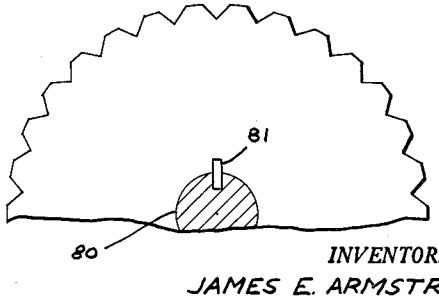


FIG 10



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FIG 11

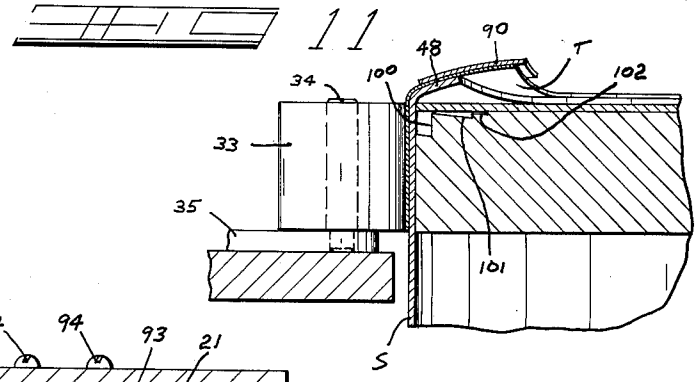


FIG 12

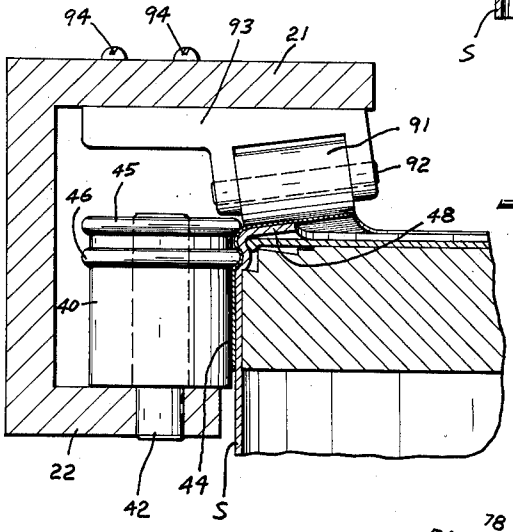


FIG 13

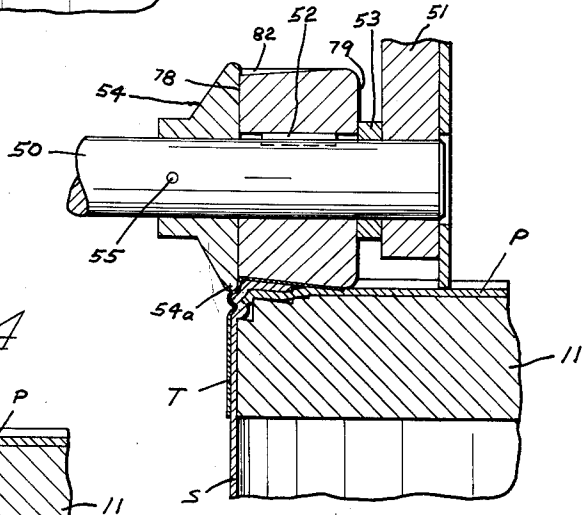
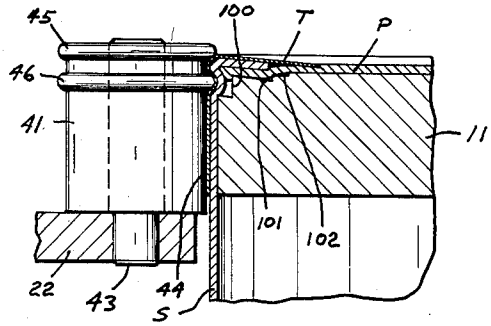


FIG 14



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3,065,678

CONTAINER FORMING APPARATUS

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Filed Aug. 29, 1961, Ser. No. 134,767
11 Claims. (Cl. 93—39.1)

This invention relates generally to container forming apparatus, and more particularly to improvements in container forming apparatus of the type described in copending application Serial No. 98,156, filed March 24, 1961, and assigned to the assignee of this application.

The invention disclosed in the above-identified application, entitled "Method and Apparatus for Forming Containers," of which I am a co-inventor, comprises apparatus for infolding a portion of a deformable sleeve, formed of paperboard, for example, and a length of encircling tape, and axially pressing the infolded portions of the sleeve and tape into continuous face-to-face contact with an end panel to form a container having a liquid-tight end structure. The axial pressure is applied by means of a serrated forming wheel, which is designed to compensate for the surplus material at the peripheral edges of the infolded portions.

Because of dimensional variations in the components of the container, such as in the thickness of the end panel and the length of the sleeve, a uniform, tight seal is not always formed. For example, variations in the thickness of the end panel will affect the degree to which the tape is pressed into the end panel, and occasionally, the tape, which is preferably formed of paper, will rupture. Variations in the length of the sleeve, and hence variations in the length of the infolded portion of the sleeve, affect the manner in which the material in infolded and the amount of material in the seal area. This invention is directed primarily to the provision of an improved serrated forming wheel of novel design and greater efficiency than heretofore possible, and to improved forming means for use in conjunction with a serrated forming wheel. The forming wheel is characterized by having a greater number of teeth in the area where the greatest amount of surplus material must be pressed into place, and the greatest tooth depth in the area where the thickness of the infolded material is the greatest.

Accordingly, it is an object of the present invention to provide an improved forming wheel for forming tubular containers, whereby dimensional variations in the components of the container are less critical.

Another object of the invention is to provide an improved forming wheel for uniformly pressing, along an arcuate path, lineal material into continuous face-to-face contact with a plane surface.

A further object of the invention is to provide an improved serrated forming wheel characterized by having twice as many teeth at one end as at the other.

A still further object of the invention is to provide improved forming means for inwardly folding a circular sleeve and tape and pressing them into continuous face-to-face contact with a circular end panel to form a container.

The specific nature of this invention, as well as other objects and advantages thereof, will become apparent to those skilled in the art from the following detailed description, taken in conjunction with the annexed sheets of drawings on which, by way of example only, the preferred embodiment of this invention is illustrated.

In the drawings:

FIG. 1 is a side elevational view, partly in section, showing the components of the container mounted on a rotatable mandrel;

FIGS. 2–4 schematically illustrate the steps in the formation of a container by the apparatus disclosed in copending application Serial No. 98,156, filed March 24, 1961;

FIG. 5 is a front elevational view of the forming means of my invention;

FIG. 6 is a plan view partly in section, of the forming means of my invention showing a container partly formed;

FIG. 7 is a side elevational view of the forming wheel of my invention in forming position on a container;

FIG. 8 is an enlarged, partial side view of the forming wheel of my invention;

FIG. 9 is a partial end view showing the end profile of the forming wheel of my invention taken along the line 9 of FIG. 8;

FIG. 10 is a partial end view showing the end profile of the forming wheel of my invention taken along the line 10 of FIG. 8;

FIG. 11 is a sectional view taken along the line 11—11 of FIG. 6;

FIG. 12 is a sectional view taken along the line 12—12 of FIG. 6;

FIG. 13 is a sectional view taken along the line 13—13 of FIG. 6; and,

FIG. 14 is a sectional view taken along the line 14—14 of FIG. 6.

With reference to the drawings, the invention is illustrated as being incorporated in container forming apparatus of the type described in detail in copending application Serial No. 98,156, filed March 24, 1961, and assigned to the assignee of this invention. In the preferred operation of the aforementioned apparatus, three elements are combined to form a container having a liquid tight end structure. The preferred elements comprise an open ended paperboard sleeve S having a circular cross-section, a circular end panel P adapted to span and fit snugly within one end of the sleeve, and a length of tape T having one surface thereof adhesively coated.

Referring to FIG. 1, paperboard sleeve S is mounted on a freely rotatable mandrel M. The mandrel M comprises a freely rotatable central shaft 10 having mounted thereon, at its upper end, a mandrel plate 11 and at its lower end a funnel shaped guide 12. The mandrel plate 11 and the funnel shaped guide 12 center the sleeve S relative to the axis of rotation of the shaft 10. The funnel shaped guide includes an annular ledge 13 which supports the sleeve S with a marginal portion of the sleeve S projecting above the mandrel plate 11. The mandrel plate supports the circular end panel P. In the operation of the apparatus of the aforementioned application, as illustrated schematically in FIGS. 2–3, a length of tape T is fed tangentially to and in line with the protruding marginal portion of the sleeve S. The mandrel M is moved laterally to press the sleeve S against the tape T and adhesively affix it thereto. When the sleeve is moved against the tape, the marginal portion of the sleeve and the tape that becomes affixed thereto are simultaneously inwardly deformed by a guide surface and a series of forming rollers (not shown). A rotary forming wheel W is lowered vertically onto the inwardly folded portions and allowed to axially compress them into contact with the end panel P. The forming wheel W is then rotated, thereby rotating the sleeve S and end panel P and drawing additional tape into place. As the forming wheel rotates, the tape and marginal portions which have been inwardly folded are compressed into face-to-face contact with the end panel by means of axial pressure asserted by the forming wheel.

As shown on FIGS. 5 and 6, the tape T in the present invention, exists from the cowling 19 of the apparatus at point A and is guided by a funnel like guide 20. The tape T moves on edge between upper and lower sta-

tionary plates 21 and 22, respectively. The tape T is wetted by a pivotally mounted, moistened brush B. The moistened tape is held by a pair of rigid guide fingers 24, against a backing plate 23 which is secured between the upper and lower plates 21 and 22. The guide fingers 24 are formed of a conventional material which is non-reactive with the wetted adhesive of the tape, and are held in place by means of a bracket 25 that is secured to the upper and lower plates 21 and 22.

The lower plate 22 has an arcuate peripheral surface 30 which is generally circular and conforms to the side wall of the sleeve S. Circumferentially spaced along the peripheral surface 30 are four rollers whose function it is to press wetted tape against the sleeve S and inwardly fold the tape T and the marginal portion of the sleeve S.

The first roller 31 is generally cylindrical and is rotatably mounted on a pin 32 that is secured to the lower plate 22. The first roller 31 is arranged to tangentially engage the sleeve S when it is moved into the proper forming position.

Referring to FIGS. 6 and 11, the second roller 33 is generally cylindrical and rotatably mounted on a pivot pin 34. The pin 34 is secured at its lower end to a spring loaded arm 35. The arm 35 is pivotally mounted on a pivot pin 36 and is spring loaded by means of a compression spring 37. Compression spring 37 is carried by a link 38 that is pivotally connected to the arm 35, and bears against a stationary stud 39 that is secured to the lower plate 22.

The third and fourth rollers 40 and 41 are identical to each other and are pivotally mounted on pivot pins 42 and 43, respectively. The rollers 40 and 41 are circumferentially arranged on either side of the forming wheel W which will be described hereinafter. The rollers 40 and 41 have a generally cylindrical surface 44 that is arranged to tangentially engage the side wall of the sleeve S. The rollers 40 and 41 also have a pair of axially spaced, annular shoulders 45 and 46 that protrude radially outwardly to engage, and inwardly crimp and fold the upper margin portion 48 of the sleeve. See FIG. 12.

Referring to FIGS. 7–10, the forming wheel W is fabricated by machining a preferably rigid material, such as steel, to a generally cylindrical form and providing it with a longitudinal bore 80 by means of which it is mounted on a rotary shaft 50, which will be described hereinafter. A keyway 81 is also provided to non-rotatably mount the wheel on the rotary shaft 50. An annular series of equally spaced apart, longitudinally extending pitch lines are then marked off on the peripheral surface of the forming wheel W. The forming wheel W is then serrated by means of an annular series of first and second V-shaped grooves 82 and 83 that are formed on the surface of the cylinder, such as by means of a 90° included angle milling cutter. For purposes of reference, one end of the wheel, that which is ultimately positioned the farthest away from the central axis of the mandrel M, will be called the outer end 78; and the opposite end, the inner end 79.

The first and second grooves 82 and 83 commence on a common pitch line, or at a common point 84, at the outer end, and divergingly extend across the cylinder to terminate at spaced apart points 85 at the inner end 79. The points 85 are circumferentially spaced apart a distance equal to the circumferential distance between the points 84. The first and second grooves thereby define a continuous annular series of opposed, generally triangular shaped teeth on the peripheral surface of the cylinder. The spacing of the points 84 and 85, and the depth of the groove are arranged to provide flats 86 on the teeth at the outer end 78 of the cylinder and flats 87 on the teeth at the inner end 79 of the cylinder. The first and second grooves 82 and 83 are preferably made twice as deep at the outer end 78 as at the inner end 79 to thereby slope radially outwardly as they extend from the outer end to the inner end. See FIG. 13. This sloping of the grooves causes the flats 87 at the inner end to be somewhat larger than the flats 86 at the outer end. The flats 87 at the inner end are bisected by third V-shaped grooves 89, which commence at the inner end 79 and slope radially outwardly to terminate at the plane of the flats 87. The forming wheel thus has twice as many teeth or apexes, as defined by the grooves or valleys, at the inner end 79 as at the outer end 78 thereof.

Referring to FIG. 7, the forming wheel W of my invention is keyed to a rotary shaft 50 that is rotated by means not shown. The shaft 50 is journaled at its outer end in a supporting bracket 51 that is vertically movable by means not shown. The forming wheel W which is keyed to the rotary shaft 50 by means of a key 52, FIG. 13, is spaced from the outer end of the supporting bracket 51 by means of a bushing 53. The forming wheel W is maintained against bushing 53 by a second forming wheel 54 that is pinned to the rotary shaft 50 by a pin 55. The forming wheel W is arranged to overlie the peripheral portion of the end panel P. The axis of rotation of the forming wheel W is in line with and perpendicular to the axis of rotation of the mandrel M.

The forming wheel W is backed up by forming roller 54 which has an annular shoulder 54*a* that extends radially beyond, a slight distance, the outer surface of the forming wheel W. The forming roller 54 serves to back up the forming wheel W and applies axial pressure on the periphery of the sleeve S.

Referring to FIGS. 6 and 7, an end panel guide 110 is attached by means of screws 111 to the outer end of the supporting bracket 51. The guide 110, which is preferably of a rigid material, such as sheet metal, comprises a semi-circular arm 112 having a radiused outer end 113. The guide 110 is vertically positioned, relative to the supporting bracket, to lightly engage the end panel P and serves to keep the end panel P in a horizontal plane as it rotates and approaches the forming wheel W.

The tape is initially folded inwardly by means of a guide surface 90 which is an extension of the backing plate 23. The guide surface 90 is a curved surface which is shaped to fold the tap T over as it approaches the forming area. See FIGS. 5 and 11. As an extension of this guide surface is a guide roller 91, rotatably mounted on a pin 92. The pin 92 is secured in a bracket 93 that is secured by screws 94 to the upper plate 21. The roller 91, which is arranged to have its axis of rotation in line with the central axis of the mandrel M and approximately 10° from the horizontal is positioned to closely overlie the deforming roller 40. See FIG. 12. The roller 91 engages the inwardly folded portions of the tape and sleeve at the time they are initially deformed by the forming roller 40 and serves to keep them in the desired plane at the time they have the greatest tendency to spring back to their former, upright position. The roller 91, since it has its axis of rotation normal to the path of travel of the infolded portions, materially decreases the frictional forces acting on the infolded portions.

The mandrel plate 11 has at its outer peripheral edge a notch 100 which is in line with the annular shoulders 46 of the deforming rollers 40 and 41. See FIG. 14. An annular relief or undercut 101 is formed on the upper plane surface of the mandrel plate 11 in the area that is beneath the in folded portion of the sleeve S. An auxiliary annular relief 102 may be formed in the inner peripheral edge of the relief 101.

In operation, the tape T is preferably fed out to extend past at least the forming roller 33. The mandrel M is then moved inwardly to press the sleeve S against the tape T and inwardly fold the marginal portion of the sleeve and the tape by means of the deforming rollers 40 and 41, and the guide roller 91. The forming wheel W is lowered to press the infolded portions into the panel

P. The annular reliefs **101** and **102** receive a peripheral portion of the panel and serve to relieve the pressure in this area and prevent the forming wheel from cutting through the tape. The forming wheel is then rotated by the means of the rotary shaft **50**. As the forming wheel rotates, the sleeve S and the panel P rotate and the remainder of the sleeve and tape are infolded and pressed into the end panel.

The deforming rollers **40** and **41** by means of their annular shoulders **45** and **46** break in the side wall of the sleeve to remove its tendency to spring upright. The annular shoulder **46** deforms the side wall of the sleeve into the peripheral notch **100**. The annular shoulder **45** overlies the infolded portion of the sleeve and tape to apply radially inward and axially downward pressure. The forming wheel W presses the tape and infolded portion of the sleeve into continuous contact with the end panel P.

When the marginal portion of the sleeve S and tape T are infolded, their inner peripheral edges would normally overlap themselves because of the smaller circumference of the path they take. The forming wheel, however, because of having twice as many teeth at its inner end as at its outer end and hence a greater lineal distance around the inner end, presses the surplus material into uniform continuous contact with the end panel. As shown in FIG. 13, it is to be noted that the greatest tooth depth is in the area where the infolded material is the thickest, thereby allowing for the increased thickness of material in this area. Another feature that is to be noted is that the teeth on the forming wheel are defined by continuous straight lines and that there are no abrupt changes in directions which would rupture the tape.

It will, of course, be understood that various details of construction may be modified through a wide range without departing from the principles of this invention, and it is not, therefore, the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim:

1. In forming apparatus for inwardly folding the marginal portion of a cylindrical paperboard sleeve and a length of tape into continuous face-to-face contact with a circular end panel disposed within the sleeve and adjacent to the marginal portion thereof, the improvement comprising, means for inwardly folding said marginal portion and tape, and a rotary forming wheel for axially pressing said inturned portions into said end panel, said wheel having a plurality of grooves extending generally longitudinally across its outer peripheral surface, said grooves arranged to define an annular series of teeth having twice as many apexes at one end thereof as at the other.

2. The improvement in forming apparatus as defined in claim 1, wherein said means includes a pair of rotatably mounted rollers, said rollers arranged to tangentially engage said sleeve, and said rollers having a pair of axially spaced apart annular shoulders adapted to radially inwardly deform said sleeve.

3. The improvement in forming apparatus as defined in claim 1, wherein said means includes a guide surface arranged to inwardly fold said infolded portions, said surface defined in part by a rotatably mounted roller positioned normal to the path of said infolded portions.

4. The improvement in forming apparatus as defined in claim 1, and a circular mandrel plate arranged to support said end panel, said plate having a top plane surface, and a peripheral marginal portion of said plane surface being undercut in the area corresponding to the infolded portion of said sleeve.

5. A forming wheel comprising a generally cylindrical body portion having oppositely disposed ends and a longitudinal axis of rotation, a plurality of first and second grooves formed on the periphery of said body portion and defining a continuous annular series of teeth, said first and second grooves commencing from common equally spaced apart points on the periphery of said first end, said first and second grooves extending continuously across said body portion and diverging to terminate at respective equally spaced apart points on the periphery of said second end, the depth of said grooves and the spacing of said points being arranged to provide flats on said teeth adjacent said second end, and a plurality of third grooves commencing at said second end and bisecting said flats to provide twice as many teeth at said second end as at said first end.

6. A forming wheel as defined in claim 5, wherein said grooves are generally V-shaped in cross-section.

7. A forming wheel as defined in claim 5, wherein the spacing of the points at said first end and the depth of said first and second grooves are arranged to provide flats on the teeth at said first end.

8. In container forming apparatus, a forming wheel comprising a generally cylindrical body portion having oppositely disposed first and second ends and a longitudinal axis of rotation, a plurality of first and second V-shaped grooves formed on the periphery of said body portion and defining a continuous annular series of teeth, said first and second grooves commencing from common equally spaced apart points on the periphery of said first end, said first and second grooves extending continuously across said body portion and diverging to terminate at respective spaced apart points at said second end thereby defining a continuous annular series of teeth, said first and second grooves sloping radially outwardly from said first end to said second end to provide flats on the teeth adjacent said second end, and a plurality of third V-shaped grooves commencing at said second end and bisecting said flats, said third grooves sloping radially outwardly from said second end to terminate at the surface of said flats, thereby providing twice as many teeth at said second end as at said first end.

9. A forming wheel as defined in claim 8, wherein the spacing between the points at the first end and at the second end is the same.

10. A forming wheel as defined in claim 9, wherein the circumferential spacing between the points at said first and second ends is the same.

11. A forming wheel comprising a cylindrical body portion having a longitudinal axis and a pair of oppositely disposed first and second ends, an annular series of teeth formed on the periphery of said body portion, said teeth extending longitudinally of said body portion and having flattened upper surfaces, and a plurality of grooves commencing at said one first end of said body portion and bisecting the flats adjacent thereto, said grooves terminating short of said second end to provide twice as many teeth at said first end as at said second end.

No references cited.