Oct. 5, 1971 E. E. ROSE ET AL 3,610,115

METHOD AND APPARATUS FOR SCORING AND FLATTENING TUBES

Filed July 18, 1969 3 Sheets-Sheet 1

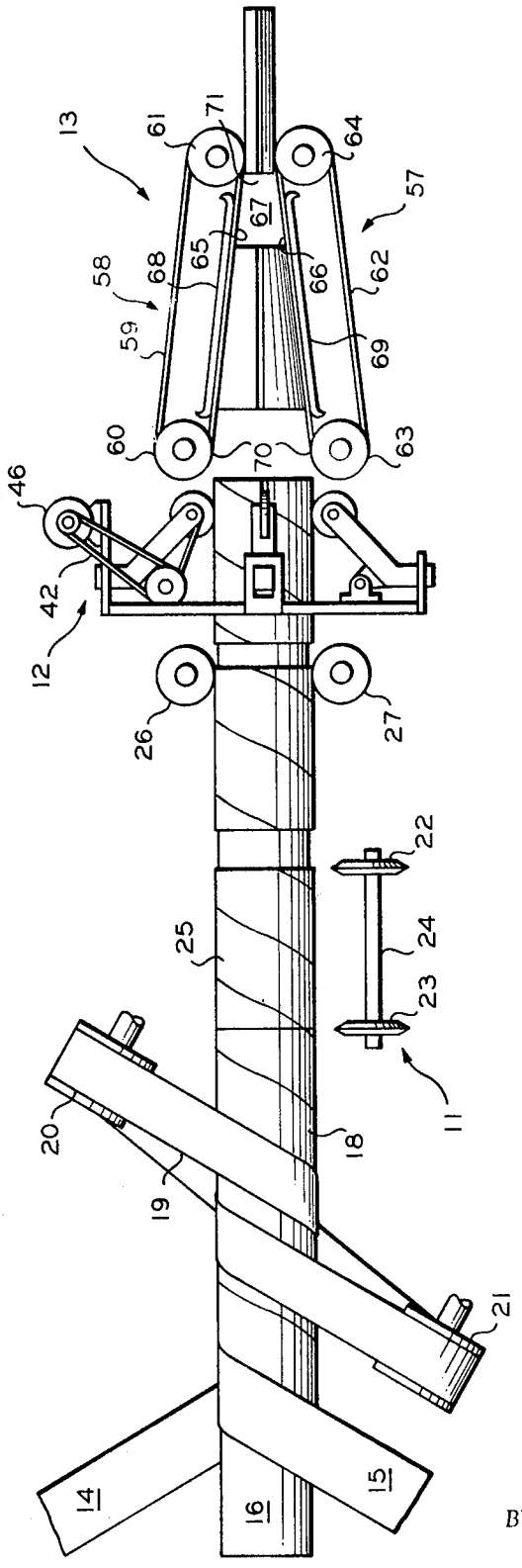


FIG. 1

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METHOD AND APPARATUS FOR SCORING AND FLATTENING TUBES

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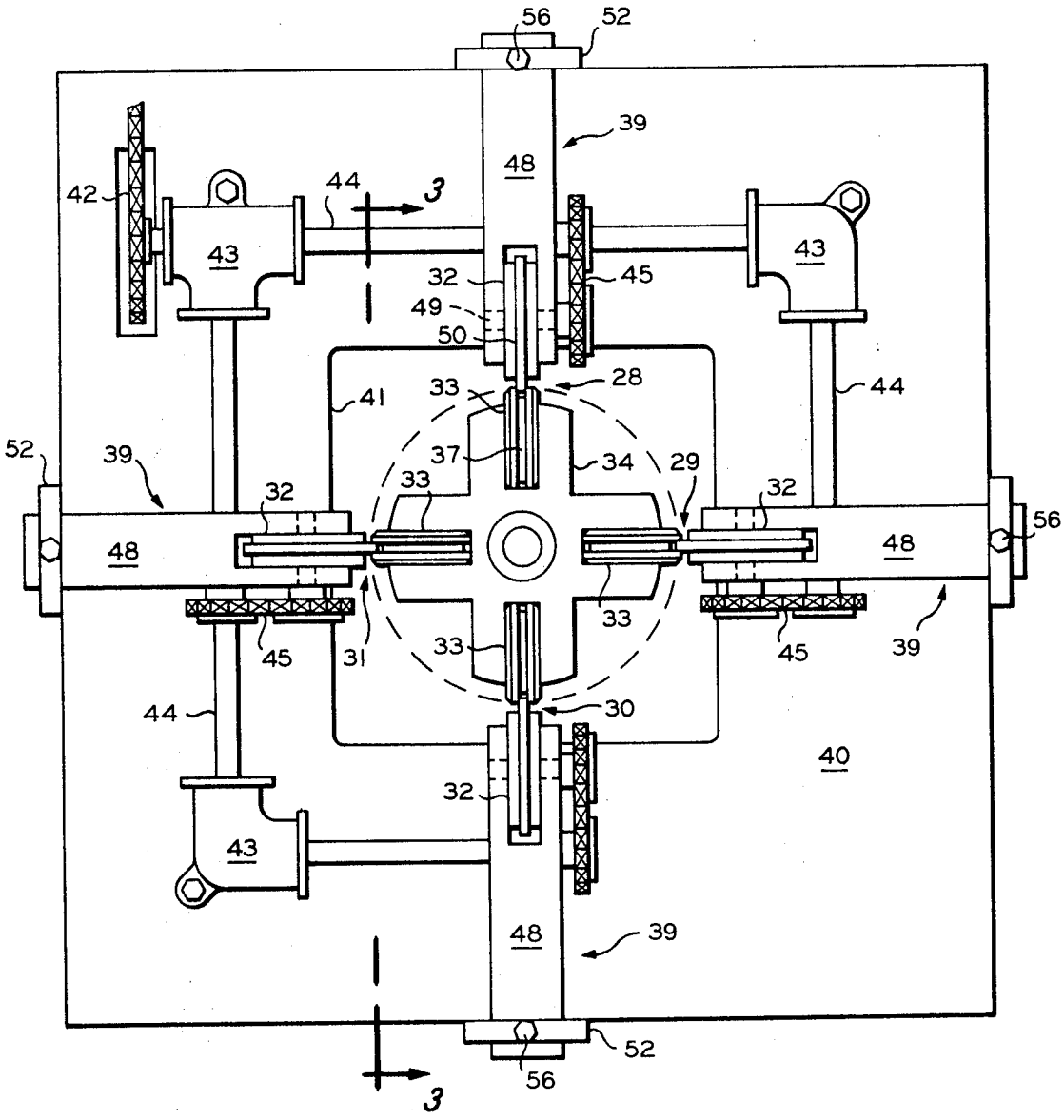


FIG. 2

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Filed July 18, 1969 3 Sheets-Sheet 3

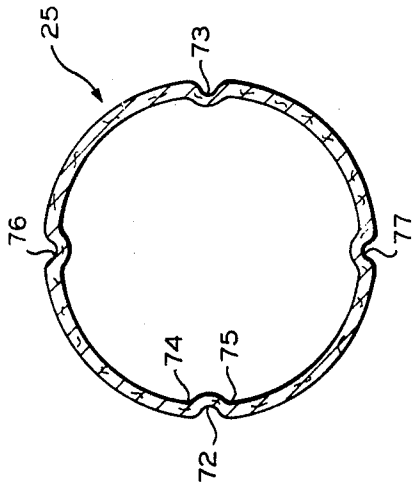


FIG. 4

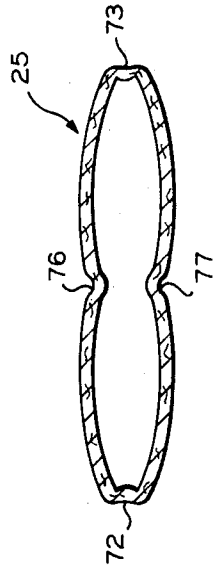


FIG. 5

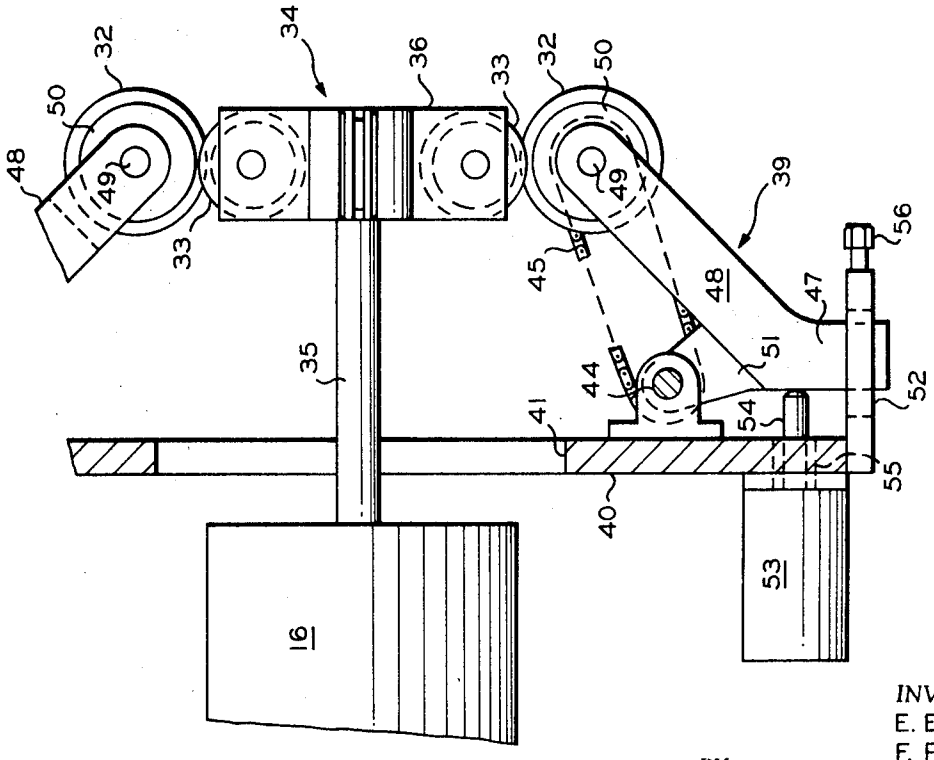


FIG. 3

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3,610,115

METHOD AND APPARATUS FOR SCORING AND FLATTENING TUBES

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Int. Cl. B31c 3/04; B31b 1/88, 43/00
U.S. Cl. 93—80 2 Claims

ABSTRACT OF THE DISCLOSURE

Tubes composed of fiber material are passed sequentially through a scoring apparatus wherein longitudinally extending score lines are formed in the tube, and a compression zone wherein the scored tubes are flattened.

This invention relates to fiber containers. In one aspect it relates to a novel method and apparatus for collapsing fiber containers and placing them in a condition for transit and/or storage.

Fiber containers are made in a variety of constructions, principal of which is the convolute wound, lap seam, and spiral wound. All constructions include a tubular body composed of plies of fiber material and separate end closures. The fiber container is rapidly supplanting metal containers in many packaging areas such as food, coffee, motor oil, and the like. One advantage offered by the fiber container, particularly for containers having a volume capacity of two or more gallons, is its ability to be collapsed to a flattened condition for transit and/or storage. At the situs of use, the container can be assembled by expanding the body and inserting the end closures. In order to collapse the tubular body of the container, longitudinally extending scores are formed in the container body so that when the body is collapsed to the flattened condition the wall will break along the weakened lines provided by the scores thereby preventing wall cracking. The packaging line can conventionally be mechanized so that the tubular container bodies are automatically formed and flattened in a continuous process. This conventional process involves first continuously forming the bodies on the winding mandrel, cutting them to length and then feeding them one at a time sideways in a more or less random fashion through a scoring zone and then a compression zone wherein the container is flattened. Since the attitude of the container is not controlled when it enters the compression zone, there are no means for placing the score lines in proper alignment with the compression forces. Consequently, many score lines are circumferentially spaced about the container so that at least two diametrically positioned score lines will be in proper alignment with the compression forces as it passes through the compression zone. Thus, it will be appreciated that the majority of these score lines serve no practical function and, furthermore, the equipment required to provide the surplus score lines unduly complicates the system. More importantly, however, the surplus score lines adversely affect the column strength of the container. For containers used to package liquids, the column strength is of paramount importance. For example, when two gallon containers containing ice cream melt are stacked in a refrigerator, it has been found that the bottom containers fail in compression. The failure is due to the weakened condition of the container resulting from the large number of longitudinally extending score lines.

The purpose of the present invention is to provide a collapsible fiber container having superior column strength thereby enabling the container to withstand the compressive forces when stacked one on another.

The present invention contemplates maintaining the tubular container body under control throughout the scoring and flattening phases of the operation. More specifically, the attitude of the tubular body emerging from the scoring assembly is maintained in a fixed attitude as it passes through the compression zone. By maintaining its attitude, the tubular body requires only two diametrically positioned score lines, which determine the point at which the tubular body breaks when flattened. For thin-walled containers, two score lines are sufficient, but for thick-walled containers additional score lines located intermediate the diametric score lines may be necessary to prevent wall cracking of the semicircular wall surfaces being flattened. For convenience of illustration, the diametric score lines will be referred to as the primary score lines and the additional score lines as the secondary score lines. The number, location and configuration of the secondary score lines will depend to a large extent upon the composition and dimensions of the tubular bodies. It should be observed that the sole function of the secondary score lines is to determine the point at which the semicircular halves break in moving to the flattened condition.

The present invention contemplates the continuous process of forming an elongate tube by wrapping webs of fiber material around a winding mandrel; cutting the tube at longitudinally spaced intervals thereby forming container bodies, and while maintaining a fixed attitude on the body passing it sequentially through a scoring apparatus wherein at least two diametrically located longitudinally extending scores are formed therein and then flattening the body by pressing the semicircular portions on either side of the score lines inwardly.

The apparatus for constructing the container body is conventional and can be according to the techniques known as convolution winding, lap seam, or spiral winding.

The novel scoring and flattening apparatus comprises at least two opposed scoring rollers engageable with opposite sides of the container wall at diametric points, and opposed compression means positioned within one container length from the scoring apparatus. Thus, it will be appreciated that the container body is maintained in a fixed attitude as it passes sequentially through the scoring apparatus and the flattening apparatus.

In summary, then, an object of this invention is to provide a method and apparatus for scoring and flattening fiber containers. Another object is to provide an in-line process wherein the fiber container is first scored and then collapsed in a predetermined attitude. A further object is to provide a method and apparatus wherein the container is flattened as it passes endwise through a compression zone. These and other objects will become apparent to those skilled in the art from the following disclosure taken in conjunction with the attached drawings in which:

FIG. 1 is a diagrammatic view illustrating the in-line system comprising a spiral winding apparatus, a cutting apparatus, a scoring apparatus, and a flattening apparatus;

FIG. 2 is an enlarged fragmentary front elevational view showing details of the scoring apparatus;

FIG. 3 is a sectional view of FIG. 2 taken generally along the cutting plane indicated by line 3—3 thereof; and

FIGS. 4 and 5 are transverse sectional views of the scored tubular body in the expanded and the flattened conditions, respectively.

As shown in FIG. 1 the in-line equipment for forming collapsed container bodies includes an apparatus for forming a round elongate tube, comprising a cutting apparatus 11 for cutting the tube at longitudinal intervals forming

cylindrical open-ended container bodies, a scoring apparatus **12** for forming longitudinally extending scores in the container bodies, and a flattening apparatus **13** for collapsing the cylindrical body to a flattened condition for transit and/or storage.

The present invention is described in connection with a machine for manufacturing a container constructed by the spiral wound technique, but it should be understood that the principles exemplified therein are applicable to other container constructions, the only requirement being that the container be wound on a mandrel and that the system be adapted to an in-line process contemplated by the present invention.

The spiral wound body is manufactured by pulling multiple webs, two shown in FIG. 1 as **14** and **15**, of material over a winding mandrel **16**. The webs **14** and **15** can be composed of paperboard or plies of foil, plastic films or specially treated paper liners such as the type commonly used in composite cans. An adhesive is applied to the webs to bond them together as they are wrapped in overlying relation on the mandrel **16** forming an elongate tube shown generally as **18**. An endless belt **19** looped around tube **18** and trained about spaced-apart, driven pulleys **20** and **21** provides the means for turning the tube **18** and advancing it along the mandrel **16**. Thus, as the tube is continuously rotatably advanced along the mandrel **16**, the webs **14** and **15** are spirally wound thereon and bonded together thereby continuously forming the container walls.

As the tube **18** is advanced along the mandrel **16**, a leading portion thereof passes adjacent the cutting apparatus **11** comprising a pair of spaced cutting rollers **22** and **23** keyed to shaft **24**. The assembly **11** can be movably mounted in relation to the mandrel **16** and movable in timed relation with the advancing tube **18** so that when the cutters are placed in the cutting position the tube **18** is circumferentially cut at longitudinal intervals. The spacing of the cutting rollers **22** and **23** is equal to the container body length. Thus, the cutting assembly **11** operates to sever individual container bodies shown as **25** from the elongate tube **18**. The severed body **25** is pushed forwardly along the mandrel **16** by the advancing tube **18** until the leading edge of body **25** contacts the periphery of friction rollers **26** and **27**. The peripheral speed of the rollers **26** and **27** is greater than the rate of advancement of the tube **18** so that body **25** is pulled away from the tube **18** and forced into the scoring apparatus **12**.

As shown in FIGS. 2 and 3, the scoring apparatus **12** includes four sets of rollers **28**, **29**, **30** and **31**, each set comprising a driven roller **32** and a backup roller **33**. In this embodiment the driven and backup rollers of one set, e.g., **28**, are identical to those of the other sets, e.g., **29–31**. Therefore, the same character references (**32** and **33**) identify respectively the driven rollers and backup rollers for each set **28–31**. The backup rollers **33** of sets **28–31** are free-wheelingly mounted on a structure shown generally as **34** which includes a shaft **35** mounted on the forward end of mandrel **16** (see FIG. 3) and a cross member **36** secured to the forward end of shaft **35**. The cross member **36** journally supports the backup rollers **33**. The backup rollers **33** each have a circumferentially extending groove **37** the width of which determines the width of the score formed in the body **25**. The backup rollers **33** are arranged so that their outer peripheries engage the interior surface of the body **25** passing through the scoring apparatus **12**.

The driven rollers **32** are each mounted on a lever **39** which in turn is pivotally mounted on a frame **40**. Since the driven rollers **32** of each of the sets **28–31** and its associated lever **39** are identical in structure, only one set will be described in detail, with like reference characters being assigned to corresponding parts of the other sets. The frame **40** is in the form of a plate transversely disposed across the path of the oncoming container bodies **25**. The frame **40** has formed therein a square opening

41 which is aligned with the mandrel **16**. Drive means comprising a main sprocket and chain assembly shown generally as **42** (FIG. 1), bevel gear boxes **43** (FIG. 2), shafts **44** (FIG. 2), and chain drive **45** (FIG. 3) transmits power from a motor **46** (FIG. 1) to the separate driven rollers **32**. Each lever **39** is in the form of a dog leg having an upright portion **47** and an angularly disposed portion **48** (FIG. 3). The outer end of portion **48** is bifurcated, the roller **32** being received between the forks and keyed to a shaft **49** journally mounted to the lever **39**.

Each driven roller **32** is arranged in confronting relation with a corresponding backup roller **33** and is provided with a circumferential rib **50**. The width of the rib **50** is slightly less than the width of groove **37** so that a peripheral portion of the former is received in a peripheral portion of the latter. The shoulders on either side of the groove **37** and rib **50** of rollers **33** and **32**, respectively, can be knurled in order to increase the gripping ability at the nip between the two. The scoring roller sets **28–31** are disposed 90 degrees apart so that the container body **25** is engaged at four circumferentially and equally spaced points. Thus, as the container body **25** enters the scoring apparatus, the driven rollers **32** in combination with the backup rollers **33** grip the container body advancing it therethrough. As the container body is advanced therethrough, the action of the ribs **50** presses wall portions of body **25** into the grooves **37** forming longitudinal score lines. The amount of pressure at the nip of each of the scoring roller sets will depend upon the thickness of the body wall and the composition of the body.

In order that the scoring apparatus **12** can accommodate a variety of container bodies, both as to wall thickness and as to body composition, means are provided for controlling the pressure at a nip of the scoring roller sets **28–31**.

As best seen in FIG. 3, the lever **39** has formed therein a tab **51** journaled to shaft **44**. The tab provides a pivot axis for the lever **39** and roller **32** carried thereby. The end of portion **47** extends through a slotted bar **52** secured to frame **40**. Bolted to the forward side of frame **40** is an air cylinder **53**. Cylinder **53** has a piston rod **54** projecting through aperture **55** and engageable with the edge of upright portion **47** of lever **39**. Extension of piston rod **54** pivots lever **39** about the axis provided by tab **51** and moves roller **32** toward roller **33** thereby increasing the pressure on the tube wall disposed therebetween. The pivotal movement of lever **39** is limited to the length of the slot in bars **52**. Set screw **56** provides means for adjusting the slot length.

The flattening apparatus **13** includes a pair of belt conveyors **57** and **58**. The conveyor **58** has an endless belt **59** trained about spaced pulleys **60** and **61**. Similarly, conveyors **57** and **58**. The conveyor **58** has an endless belt pulleys **63** and **64**. Pulleys **61** and **64** are counterrotatively driven providing counterorbital movement for their associated belts. The endless belts **59** and **62** have runs **65** and **66** arranged in confronting relation and in combination define a compression zone **67**. Backup frames **68** and **69** for runs **65** and **66**, respectively, maintain the proper spacing for the belts **59** and **62** through the compression zone **67**. The compression zone **67** has an inlet **70** the height of which is slightly greater than the diameter of the container body **25**. The runs **65** and **66** converge from the compression zone from the inlet **70** continuously to its outlet **71**. The location of the compression zone inlet **70** is less than one body length from the nip of the scoring roller sets **28–31** so that the tubular body emerging from the scoring apparatus **12** comes under the force of the flattening apparatus **13** while still under the control of the scoring apparatus **12**. Thus, the body **25** is maintained in a fixed attitude throughout the flattening steps of the process, and in passing through compression zone **67** the body **25** is crushed gradually from the fully cylindrical

condition as shown in FIG. 4 to the fully flattened condition as shown in FIG. 5.

As indicated earlier, the scoring apparatus **12** forms primary and secondary longitudinally extending scores in the container body **25**. In this embodiment, the scoring roller sets **29** and **31** form the primary scores and sets **28** and **30** form the secondary sets. It should be noted that for thin-walled flexible containers only the primary scoring sets **29** and **31** are required. The terms primary and secondary are used merely to indicate the different functions of the scores. For example, as shown in FIG. 4, the primary scoring sets **29** and **31** form longitudinally extending scores or depressions **72** and **73**, respectively. Each score provides flexure joints **74** and **75** about which the semicircular surfaces on either side of the scores **72** and **73** can bend. The scores or depressions **76** and **77** formed by the scoring sets **28** and **30** also permit flexing of the wall but flexing is in the opposite direction as is evident in FIG. 5. The depressions provided by the secondary scores permit bending of the wall without cracking. Primary scores **72** and **73** lie in a plane which is normal to the compression force of the compression zone **67**. When the container body **25** emerges from the scoring apparatus **12** and enters the compression zone **67** the opposed belt runs **65** and **66** engage the leading edge of the body **25** at diametric points approximately located at the secondary scores **76** and **77**. Drive pulleys **61** and **64** can propel the belts **59** and **62** at a greater rate or about the same rate as the peripheral velocity of the driven rollers **32**. As the container body passes through the continuously diminishing compression zone **67**, the compressive forces applied at the diametric points press the container to the flattened condition shown in FIG. 5.

In summary, then, the process according to this invention comprises the steps of forming a fiber container body, passing the body in a fixed attitude through a scoring apparatus where at least two diametrically positioned longitudinally extending score lines are formed coextensive with the length of the body, and while in said fixed attitude passing said scored body through a compression zone wherein compressive forces are applied in a direction transverse to the plane defined by said score lines thereby causing said body to be substantially flattened.

As indicated earlier the function of the primary score lines **72**, **73** and secondary score lines **76**, **77** are different. Consequently, the configuration of the primary and secondary lines can be different to effectively perform their respective functions. For example, it may be desirable to deform the secondary score lines **76**, **77** less than the primary score lines **72**, **73** since the sole function of the secondary score lines is to localize bending thereby preventing cracking of the container wall. The means for controlling the pressure at the nip of the scoring roller sets **28–31** can be selectively operated in order to provide the difference in the primary and secondary score lines. It should also be observed that the configuration of the score rollers **32**, **33** can be modified to provide a wide variety of score line configurations. For example, under certain conditions it may be desirable to intermittently score the container wall or it may be desirable to intermittently offer means for controlling the operation of the scoring means to suit the conditions of a particular container composition and wall thickness.

While this preferred embodiment has been described in particular detail, it should be emphasized that variations and modifications may be made therein without departing from the scope and spirit of the invention as set forth in the appended claims.

We claim:

1. In an in-line container forming machine including means for spirally winding multiple webs of fiber material on a winding mandrel to form an elongate tube thereon, means for cutting said tube at longitudinal intervals forming cylindrical container bodies, and scoring means for forming longitudinally extending score lines in said bodies, the improvement wherein said scoring means comprises: an outer frame having an opening formed therein, said opening being in axial alignment with said mandrel; a plurality of scoring rollers mounted on said frame and extending inwardly of said opening placing peripheral portions of said rollers in position to engage the outer surface of said bodies passing axially through said openings, at least two of said rollers being arranged to engage said body at diametric points; a plurality of backup rollers supported by said mandrel and arranged in confronting and companion relation with said scoring rollers, each of said backup rollers adapted to engage the internal surface of said bodies passing through said opening, each of said scoring rollers and said companion backup rollers having their peripheries disposed in confronting relation to respectively engage the outer and inner surfaces of said body wall passing therebetween and being complementary-shaped for longitudinally deforming the wall of said body passing therebetween; a plurality of levers, each having a scoring roller journally supported at one end thereof with each of said levers being pivotally mounted on said frame for moving each of said scoring rollers relative to said companion backup means for varying the spacing and the press force on the body wall disposed therebetween; means for forcefully driving each of said bodies axially through said score means; and means for rotationally driving said scoring rollers whereby a plurality of longitudinally extending scores are formed on said body.

2. In an in-line container forming machine including means for spirally winding multiple webs of fiber material on a winding mandrel to form an elongate tube thereon, means for cutting said tube at longitudinal intervals forming cylindrical container bodies, and scoring means for forming longitudinally extending score lines in said bodies, the improvement wherein said scoring means comprises: an outer frame having an opening formed therein, said opening being in axial alignment with said mandrel; a plurality of scoring rollers mounted on said frame and extending inwardly of said opening placing peripheral portions of said rollers in position to engage the outer surface of said bodies passing axially through said openings, at least two of said rollers being arranged to engage said body at diametric points; backup means supported by said mandrel and arranged in confronting and companion relation with said scoring rollers, said backup means adapted to engage the internal surface of said bodies passing through said opening, each of said scoring rollers and said companion backup means having complementary-shaped portions for longitudinally deforming the wall of said body passing therebetween; means for moving each of said scoring rollers relative to said companion backup means for varying the spacing therebetween; means for forcefully driving each of said bodies axially through said score means whereby a plurality of longitudinally extending scores are formed therein; a body flattening apparatus disposed in-line with said scoring means, said flattening apparatus including force means for applying a press force on the outer surface of said body in a direction transverse to the plane defined by said diametric longitudinally extending score lines, and means for passing said body from said scoring means to said flattening apparatus with said body flattening apparatus being mounted less than one body length from said scoring means for passing said body in a fixed attitude so that the relationship of the direction of said force in said plane is maintained and said force of said flattening apparatus becomes operative upon a leading portion of said body while the force of said scoring means is operative upon a trailing portion of said body; and other pairs of scoring rollers in addition to said diametrically arranged scoring rollers, said other pairs of scoring rollers being of a number in the range of 1–2 pairs with each roller of a pair being circumferentially spaced between said diametric scoring rollers, diametrically positioned relative one to the other, and operative to form longitudinally extending scores in said body for locating

the line at which the body wall breaks between said diametrically arranged score lines in moving from the circular to the flattened configuration.

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U.S. Cl. X.R.

93—1 G, 8 W, 58.1, 58.2, 58 ST