

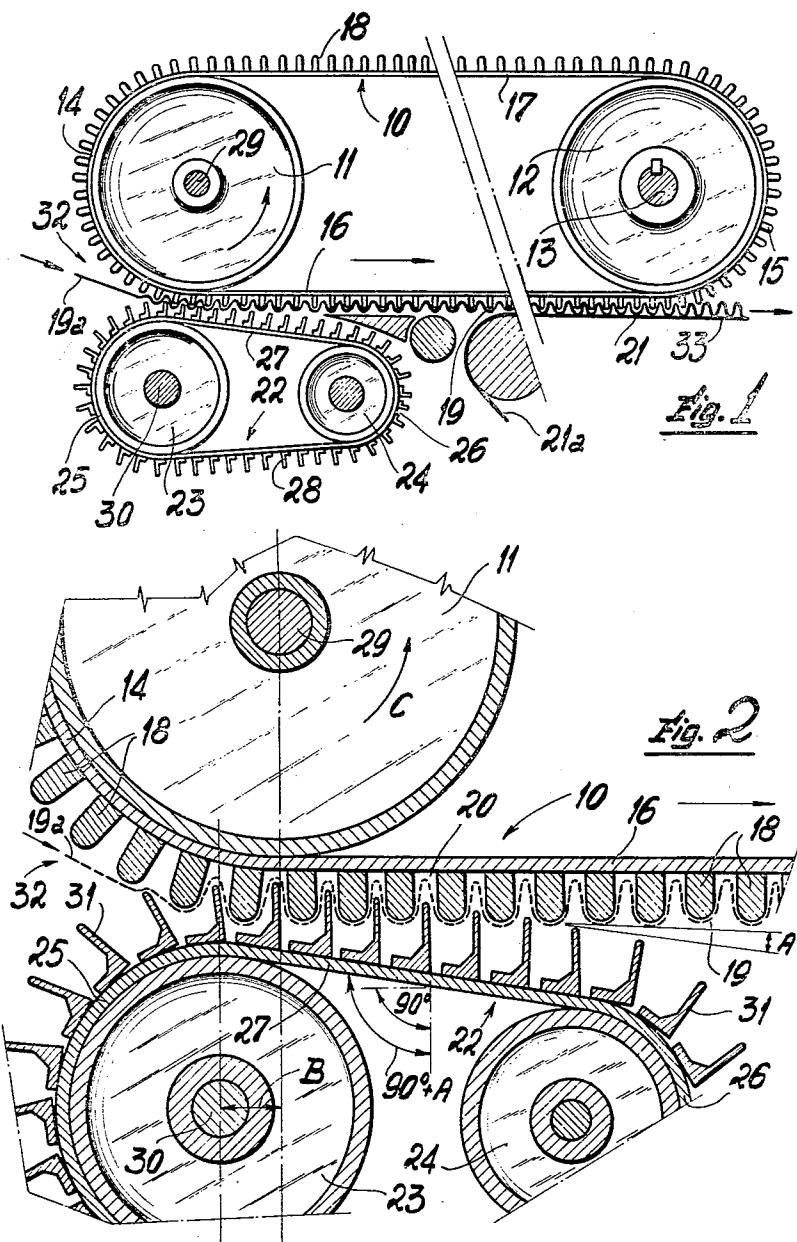
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APPARATUS FOR PRODUCING ASYMMETRICALLY CORRUGATED
STRIPS OF CARDBOARD, AND THE LIKE

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APPARATUS FOR PRODUCING ASYMMETRICALLY CORRUGATED STRIPS OF CARDBOARD, AND THE LIKE
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This invention relates to an apparatus designed for producing an asymmetrically undulated strip of cardboard or of other sheet material of like character and, more particularly it is directed to a new and improved apparatus or machine designed to impart to a continuous strip of cardboard an asymmetric corrugation including alternate relatively large and respectively relatively small radius bends or warps in its wave-form, prior to glueing or otherwise attaching said corrugated strip to a second or base second strip.

It is known to those skilled in the art to which this invention appertains that such asymmetrically corrugated strips of cardboards may be advantageously made use of for producing containers for elongated small articles of manufacture, say glass phials for medicinals, solvents and so on, and/or for storage, transportation and protection of other small and generally elongated goods, say ampoules, small electrical lamps, electronic tubes and the like.

In such containers the asymmetric corrugations of the strip, secured to a second base strip at the backs or outward faces of its larger bends, a plurality of articles' seat forming cavities are formed inside each one of said bends, the said cavities being separated by partition forming walls formed by the smaller bends and the cardboard portions adjacent thereto. The resiliency of the sheet material ensures the firm fit of each article into each cavity. For full enclosure and protection of the article the said partitions are necessarily made pretty high, for instance at least one-and-one-half times the diameter of the larger bends (which form the bottom of the cavities), and the same partition forming portions are desirably formed as thin as possible for having the seated articles positioned side-by-side in the container at intervals as small as possible, obviously for saving space.

In other words, such known containers substantially appear in side elevation as a rack including a plurality of relatively high and thin teeth confining relatively deep, large and round bottomed cavities. Owing to such asymmetrical wave form, in particular to the height and thinness of the partitions or teeth, said corrugations may not be produced "by direct generation," say by simply passing the cardboard strip between two toothed gears in meshing relationship, because gears provided with toothed portions of such profile or wave form cannot mesh, and particularly the elongated and thin teeth cannot penetrate into and get off from correspondingly shaped cavities in the mating gear.

To overcome said limitation, it had been heretofore proposed to produce said corrugated cardboard by making use of apparatuses provided with reciprocating members adapted to successively bend adjacent portions of the strip, which is intermittently fed into the machine. Such machines are subject to the known limitations and drawbacks typical of mechanisms having reciprocating elements, said machines are relatively slow and the production ability thereof is poor. It had been further proposed to produce such asymmetrical corrugation in a continuous machine wherein the final wave form is obtained in two steps, wherein a first substantially symmetrical wave form is produced by passing a strip between a forming gear and mating spaced rods of a

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Caterpillar-like element, and the final wave form is produced by approaching such rods toward each other, as soon as they leave the cavities of the forming gear. In effect such machines operate according to an intermittent cycle, wherein the said rods successively stop when freed from the forming gear until the subsequent rod is carried in abutting relationship with the antecedent one.

Having the above and other conditions in mind, this invention has for its general object to provide a continuous machine wherein the said asymmetrical corrugation may be produced in one step and by direct generation in the length of a strip of pliable sheet material, particularly but not exclusively of cardboard.

More particularly, it is an object of this invention to provide a new and improved apparatus including a first Caterpillar-like or belt-like rotary element provided with a plurality of first members connected at intervals to said first element and positioned and shaped according to the final wave form of the corrugation to be finally produced, and adapted to feed the corrugated strip in the part of the machine (known in the art) wherein the corrugated strip is glued to the base strip, and a second forming rotary element provided with spaced teeth forming second members shaped and positioned to mesh in the cavities defined between any two first members of the first element, the said two rotary elements being positioned for meshing relationship of said members.

A more specific object of this invention is to provide, in an apparatus as above, a second caterpillar-like or belt-like element having a curved portion biased with respect to an oppositely curved portion of first rotary element, so that the second members (which may be considered, when in said curved portion, as thin and elongated teeth of a gear) may penetrate in the mating thin and deep cavities defined between the first members in a curved portion of first element, and an adjacent linear portion forming an angle with a linear portion of said first element, and wherein the said second members (which in said linear portion may be considered as thin and elongated teeth of a rack) may slide off the said thin and deep cavities.

According to the said new structure of the apparatus of the invention, the final wave form of asymmetrical corrugation of the strip is directly and continuously obtained as the said first and second members mesh, when traveling along the curved portions of the respective elements, and then the said second members slide off from the thinner cavities of the corrugated strip as the two racks, formed by the said elements in their linear or straight portions, travel in diverging directions, due to the angle formed therebetween.

With the above mentioned objects in view and others which will appear as this description proceeds, the invention may be said to comprise the essential structure as illustrated in the accompanying drawing, forming an essential component of this disclosure and hereinafter described and particularly set forth in the appended claims, together with such variations and modifications thereof as will be apparent to those skilled in the art to which the invention appertains.

Now, reference should be had to the accompanying drawing, in which the mechanism of the invention is shown in a rather simplified representation, the various merely structural details and the various implements, devices and means as required for completing and operating the machine, and which may be constructed and adapted to a machine of the invention by applying the teachings of common knowledge in the art, being omitted, and wherein:

FIGURE 1 diagrammatically illustrates the various rotary elements of the apparatus and the members there-

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of, co-operating in the continuous formation of the desired asymmetrical corrugation, by a one-step direct generation process, according to the invention, and

FIGURE 2 is a more detailed showing of the part of the mechanism of FIG. 1, wherein the said generation is performed and wherein the features typical of the invention are included.

Like reference numerals refer to like parts and elements throughout the figures of the drawing.

Referring first to FIG. 1: the machine of the invention comprises a first belt-like rotary element generally indicated at 10, supported by and revolving about two spaced parallel pulleys 11 and 12, one of which, say pulley 12, may be driven by a suitable source of movement (not shown) drivingly connected to the shaft 13 thereof. Therefore, the said first element 10 includes two curved portions 14 and 15, where it bends about the said pulleys, and two linear or straight portions 16 and 17 spanning the space between said pulleys.

For simplicity sake, the said two pulleys have been shown as having like diameters. Such feature is however not critical of the invention. The diameter of pulley 11 should be selected in view of requirements of proper meshing of the members, as it will be explained below, and the diameter of pulley 12 being determined solely by the requirement of having the element 10 properly circulating.

On the outer face of said belt-like element 10 a plurality of evenly spaced first members 18 is firmly secured, the cross-sectional shape, height and thickness of and the intervals between the said members 18 being selected to correspond to and to mate with the interior of the cavities of the asymmetrically corrugated strip 19 to be produced.

Said cross-sectional shape of and intervals between said first members 18 are best illustrated in FIG. 2, wherein the said intervals, indicated at 20, are however exaggerated for clearness of showing. From a consideration of the accompanying drawing it will be readily understood that in the above described assembly the curved portions 14 and 15 constitute arcs of toothed gears having teeth which are remarkably thicker, longer and closer to each other than conventionally shaped teeth of current transmission gears are, and that the straight portions 16 and 17 of same assembly constitute toothed racks.

Owing to the narrowness and deepness of the cavities confined between the said first members 18, the direct meshing of said toothed curved and/or straight portion with a conventionally toothed rotary element has been found not possible. Therefore, it may be assumed that an assymetrical corrugation of the desired wave form considered (requiring a straight portion as indicated at 16 to carry the corrugated strip on the second conventional base strip 21 and forcing the corrugated strip thereon for glueing) may not be produced by direct generation between arcs of circular toothed elements, due to geometrical factors which prevent the meshing of circular toothed elements shaped as shown in the drawings.

According to the invention, such direct generation is made possible by combining the described first assembly including the said first element 10 with a second assembly including a second belt-like element, generally indicated at 22, supported by and revolving about two pulleys 23 and 24, and therefore including two arc or curved portions 25 and 26 and two linear or straight portions 27 and 28. The axis of shaft 30 of pulley 23 is offset with respect to the axis of shaft 29 of pulley 11 of the said first assembly, as indicated at B in FIG. 2.

The offsetting, the diameter and the location of said pulley 23 are selected, according to the teaching of the art of gear meshing, for permitting the "entrance" meshing of relatively thin and elongated second members 31, carried by and fixedly secured to the said second element 22 in the cavities defined between first members 18 of first element. It is known in the art that, upon proper offset-

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ting of gears, "entrance" meshing or "exit" meshing of not properly mating toothed gears may be made possible, but that it is not possible to obtain both the entrance and exit steps of a completed meshing relationship if the teeth of gears are made thinner and/or longer over certain well known limits.

According to the gist of the invention, the exit or getting off of said excessively elongated and thin second members 31 of second rotary element 22 is made possible by arranging the straight portion 27 of second member 22 at an angle A with respect to the straight portion 20 of first element 10, so that the said second members 31 may progressively slide off the cavities of the corrugated strip yet formed and carried adjacent to the first members of the first element, the said sliding off being performed along a rectilinear and not a circular path.

In general, the said angle A is small, for instance between 5° to 15° . Owing to the fact that the said straight portions 16 and 27 of the first and second rotary elements 10 and 22 are not parallel, but diverging, while the said first members 18 are secured at right angle (90°) with respect to their respective support, the said second members 31 may be secured to their respective second rotary element at an angle of $90^\circ + A$ (FIG. 2), so that said second thin members 31 may be located coplanar to the cavities defined between adjacent first members 18, while traveling along said straight diverging portions 16 and 27. Such feature facilitates the exit of said second members from their prior meshing relationship.

The pitch of said second assembly may be advantageously made slightly larger than the pitch of the first assembly, to compensate the said angle A. In other words, the intervals between the second members are selected to correspond, on the straight portion 27, to the intervals between the first members 18 on the straight portion 16.

In operation, the various rotary parts of the described structure are driven in direction C at a proper uniform rate. The strip 19a of sheet material, for instance cardboard, is fed at 32 between the arc portions 14 and 25 of first and second elements, respectively, at the point where the meshing process begins. The desired assymetrical corrugation is then generated and completed in its desired final wave form between the said members in mesh, its completion being attained as the said members 31 attain their deepest penetration between the mating pair of adjacent members 18. The strip thus corrugated is carried on, without relative movement to members 18, while members 31 progressively and successively slide off, to the subsequent portion of the apparatus, wherein a second base strip 21a is caused to be attached to the bottom of the corrugated strip, according to current knowledge, to produce the length 33 (FIG. 1) of the desired article of manufacture which may be cut in a plurality of single or multi-cell containers, as known in the art.

From the above and by a consideration of the accompanying drawing it will be appreciated that the novel mechanism of the invention does not include reciprocating or intermittently moving parts, and that any one of the elements and/or members thereof may be driven at uniform speed, thereby preventing and avoiding the known limitations and drawbacks of the devices heretofore proposed, and improving the operation and the ability of mass production of the means of manufacture.

In the form of embodiment shown, the first and second rotary elements 10 and 22 are shown as consisting of belt-like revolving structure. Obviously, said first and/or said second element may be constructed as a Caterpillar-like or chain-like structure, of properly selected and uniform pitch, and the said members 18 and 31 may be made of differing shape, according to the wave form to be produced. The said first members 18 may consist of cylindrical rods, if desired, owing to the fact that in effect their rounded outer or tip portions only operate on the

strip to be corrugated and applied to the second base strip.

While the invention has been heretofore described and shown but in one form of embodiment thereof, it is intended that the invention is not limited to the very details shown, and that said details should not be taken as restrictive of the invention, as it is obvious that various modifications in design may be resorted by those skilled in the art to which this invention appertains, without departing from the spirit and the scope of the invention, as defined in and by the appended claims.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various applications in rotary mechanisms of the type considered, without omitting features that, from the standpoint of prior art, fairly constitute characteristic of the invention and, therefore, such adaptations should and are intended to be comprehended within the range of equivalents thereof.

Having thus described the invention, what is claimed as new and desired to have protected by Letters Patent is:

1. In an apparatus for corrugating a continuous strip of pliable sheet material, in combination, combined means for transporting a first sheet of pliable sheet material at uniform speed in one direction from an entrance end portion toward an exit end portion of said apparatus, for bending said sheet into corrugations and for subsequently supporting said corrugations during further transportation of the corrugated sheet, said means comprising a first roll located in the region of said entrance end portion, a first elongated flexible carrier means partially wound about said roll and adapted to move in said one direction from said entrance to said exit end portion, a plurality of rigid first forming members arranged spaced from each other along said flexible carrier means at a predetermined fixed distance from each other and each fixedly secured in such position at one end portion thereof to said carrier means and projecting with the other free end portion thereof from said carrier means, means cooperating with said fixedly spaced rigid first forming members in the region of said entrance end portion and comprising a second roll mounted for turning movement about an axis substantially parallel to the axis of said first roll and located in the region of said entrance end portion forwardly offset with respect to said first roll, second elongated flexible carrier means partially wound about said second roll and adapted to move in a direction acutely inclined to the direction of movement of said first elongated flexible carrier means, a plurality of rigid second forming members arranged spaced from each other along said second flexible carrier means and each fixedly secured at one end portion thereof to said second carrier means and projecting with the free end portion from said second carrier means, said rigid second forming members in the region of said entrance end portion intermeshing with said rigid first forming members for pressing portions of said pliable first sheet against said free end portions and into the spaces between said fixedly spaced rigid first forming members so as to form said first pliable sheet into a corrugated sheet with the corrugations thereof supported by said free end portions of said fixedly spaced rigid first forming members which transport said corrugated sheet toward said exit end portion during the travel of said carrier means; and feeding means in the region of said exit end portion for feeding a second sheet of pliable sheet material against the crests of said corrugations supported by said end portions of said first forming members, said second sheet being adapted to be secured to said crests of said corrugations while they are still supported by said fixedly spaced rigid first forming members to thus maintain the spacing and shape of said corrugations.

2. In an apparatus for corrugating a continuous strip of pliable sheet material, in combination, combined means

for transporting a first sheet of pliable sheet material at uniform speed in one direction from an entrance end portion toward an exit end portion of said apparatus, for bending said sheet into corrugations and for subsequently supporting said corrugations during further transportation of the corrugated sheet, said means comprising a first roll located in the region of said entrance end portion, a first elongated flexible carrier means partially wound about said roll and having a portion located in one plane, said carrier means adapted to move in said plane in said one direction from said entrance to said exit end portion, a plurality of rigid first forming members arranged spaced from each other along said first flexible carrier means and each fixedly secured at one end portion thereof to said first carrier means and projecting with the other free end portion thereof from said first carrier means, means located in the region of said entrance end portion and cooperating with said rigid first forming members for forming said first pliable sheet into a corrugated sheet, said means including a second roll mounted for turning movement about an axis substantially parallel to the axis of said first roll and forwardly offset with respect to said first roll, second flexible carrier means having a portion adapted to move in a plane slightly inclined to said one plane in said one direction so that said two carrier means slowly diverge during the movement thereof in said one direction, a plurality of rigid second forming members arranged spaced from each other along said second flexible carrier means and each fixedly secured at one end portion thereof to said second carrier means and projecting with the free end portion from said second toward said first carrier means, said rigid second forming members in the region of said entrance end portion intermeshing with said rigid first forming members for pressing portions of said pliable first sheet against said free end portions of said rigid first forming members and into the spaces between said first forming members, so as to form said first pliable sheet into a corrugated sheet with the corrugations thereof supported by said free end portions of said first forming members which transport said corrugated sheet toward said exit end portion during the travel of said first carrier means, said second forming members due to the slight inclination of said planes of movement of said two carrier means withdrawing from the spaces between said first forming members substantially in a direction normal to said first carrier means, whereby the distance between said forming members is adapted to be a fraction of the height thereof; and feeding means in the region of said exit end portion for feeding a second sheet of pliable sheet material against the crests of said corrugations supported by said end portions of said first forming members, said second sheet being adapted to be secured to said crests of said corrugations while they are still supported by said first forming members to thus maintain the spacing and shape of said corrugations.

3. In an apparatus for forming a corrugated strip of pliable sheet material with forming members spaced a distance which is adapted to be a fraction of the height thereof, in combination, combined means for transporting a first sheet of pliable sheet material at uniform speed in one direction from an entrance end portion toward an exit end portion of said apparatus for bending said sheet into corrugations and for subsequently supporting said corrugations during further transportation of the corrugated sheet, said means comprising a pair of first rolls mounted spaced from each other turnable about substantially parallel axes, one of said rolls being located in the region of said entrance end portion and the other of said rolls being located in the region of said exit end portion, first endless flexible carrier means wound about said pair of first rolls so as to define between said pair of first rolls a first straight run adapted to move in said one direction during rotation of said pair of first rolls, a plurality of

rigid first forming members arranged spaced from each other along said first flexible carrier means and each fixedly secured at one end portion thereof to said first carrier means and projecting with the free end portion thereof substantially normal to said first carrier means, means located in the region of said entrance end portion and cooperating with said rigid first forming members for forming said first pliable sheet into a corrugated sheet, said means including a second pair of rolls mounted for turning movement about a pair of spaced axes substantially parallel to the axes of said first pair of rolls, one of said rolls of said second pair of rolls being located in the region of said entrance end portion and forwardly offset with respect to said one roll of said first pair of rolls and the other of said second pair of rolls being located between said entrance end and said exit end portion, and endless flexible second carrier means wound about said pair of second rolls so as to define between said pair of second rolls a second straight run adapted to move in said one direction during rotation of said second pair of rolls and being located in a plane including with said plane of said first straight run an acute angle so that said planes slowly diverge toward said exit end portion, a plurality of rigid second forming members arranged spaced from each other along said second flexible carrier means and each fixedly secured at one end portion thereof to said second carrier means and projecting with the free end portions thereof inclined to said second carrier means so that said rigid first and second forming members during the movement thereof along said straight runs are substantially parallel to each other, said rigid second form-

ing members in the region of said entrance end portion intermeshing with said rigid first forming members for pressing portions of said pliable first sheet against said free end portions of said rigid first forming members and into the spaces between said rigid first forming members so as to form said first pliable sheet into a corrugated sheet with the corrugations thereof supported by said free end portions of said rigid first forming members which transport said corrugated sheet toward said exit end portion during the travel of said carrier means, said second forming members, due to the slowly diverging planes of said straight runs, withdrawing from the spaces between said first forming members substantially in a direction normal to said first carrier means; and feeding means in the region of said exit end portion for feeding a second sheet of pliable sheet material against the crests of said corrugations supported by said end portion of said rigid first forming members, said second sheet being adapted to be secured to said crests of said corrugations while they are still supported by said rigid first forming members to thus maintain the spacing and shape of said corrugations.

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