Oct. 17, 1933. E. WATSON 1,931,365

MACHINE FOR FORMING DIAGONALLY CORRUGATED BOARD

Filed Dec. 5, 1931 4 Sheets-Sheet 1

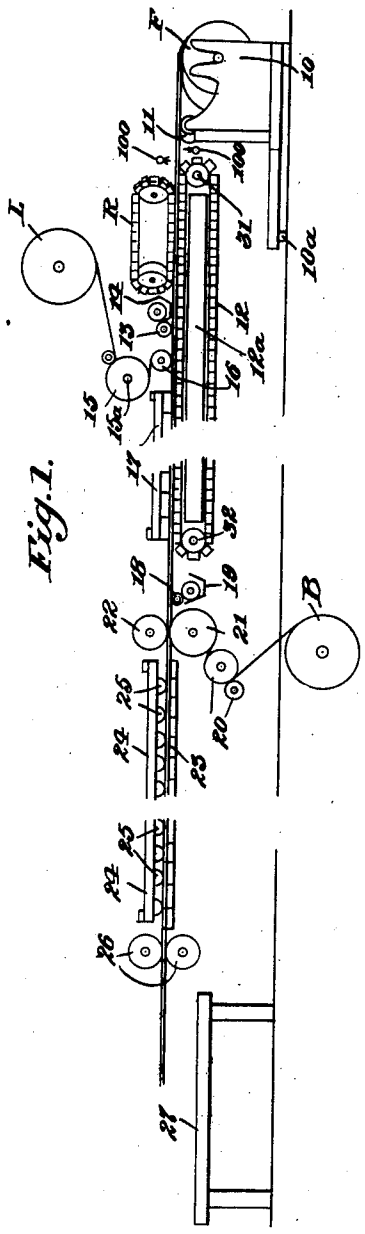

Fig. 1.

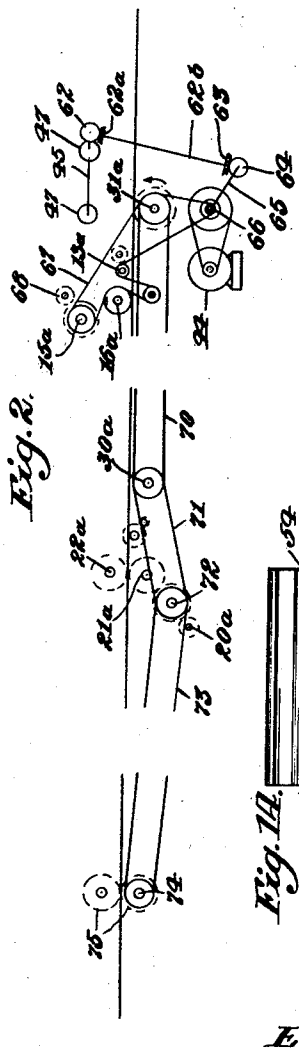

Fig. 2.

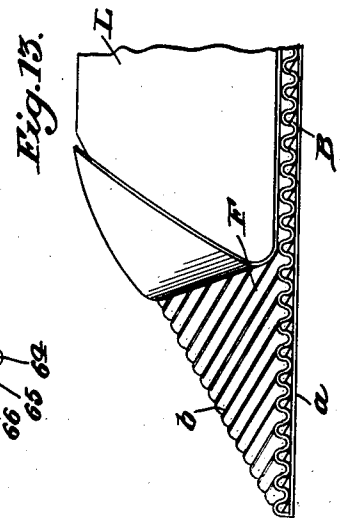

Fig. 13.

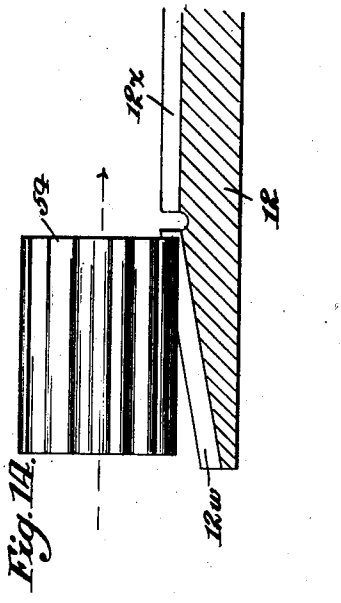

Fig. 14.

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Oct. 17, 1933. E. WATSON 1,931,365

MACHINE FOR FORMING DIAGONALLY CORRUGATED BOARD

Filed Dec. 5, 1931 4 Sheets-Sheet 2

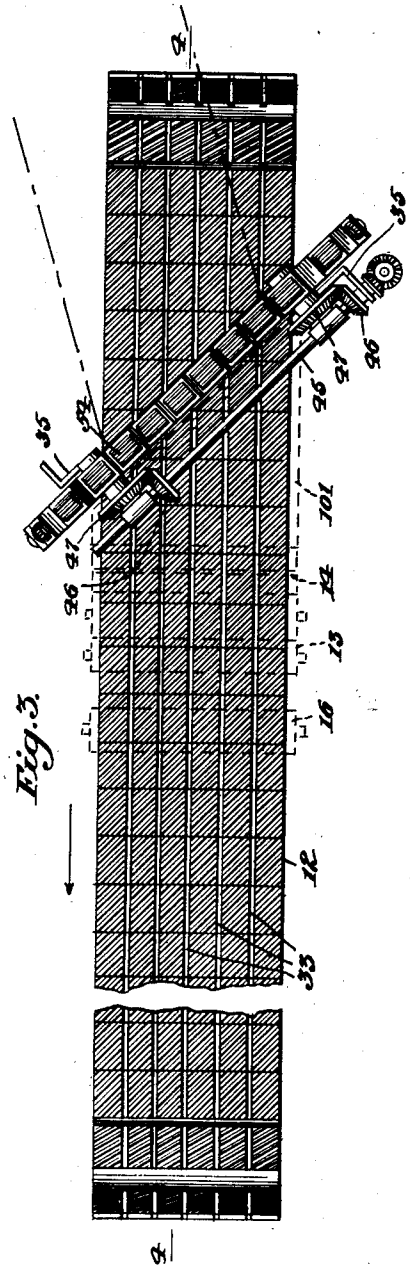

Fig. 3.

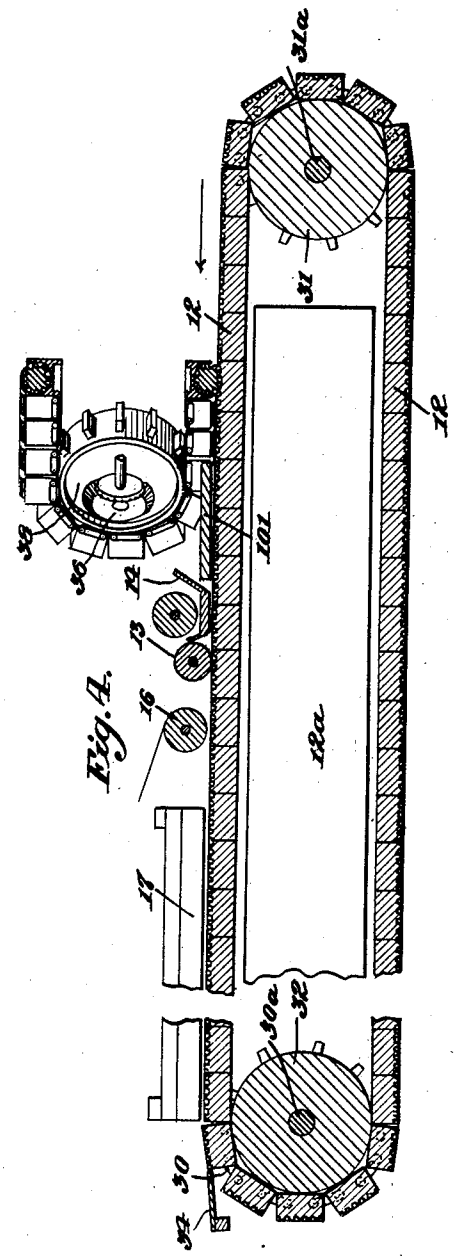

Fig. 4.

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Oct. 17, 1933. E. WATSON 1,931,365

MACHINE FOR FORMING DIAGONALLY CORRUGATED BOARD

Filed Dec. 5, 1931 4 Sheets-Sheet 3

Fig. 5.

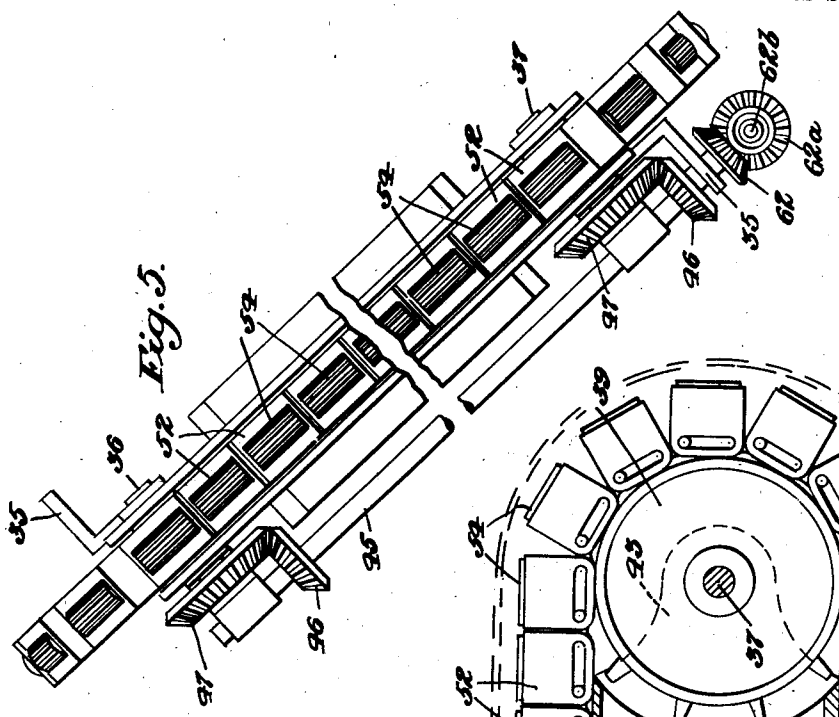


Fig. 6.

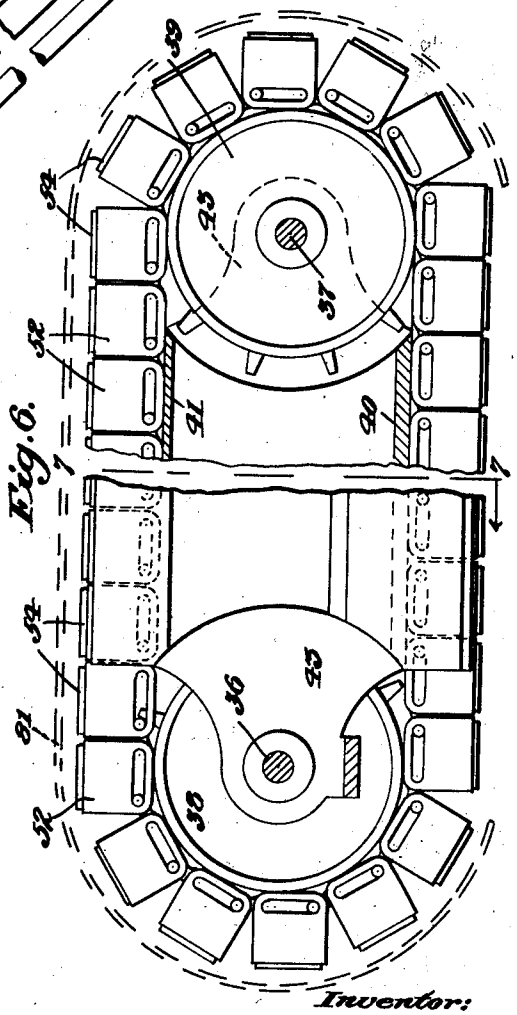
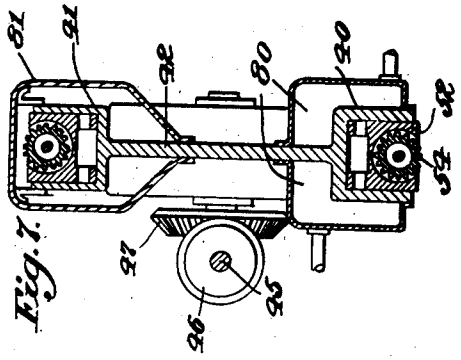


Fig. 7.



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Oct. 17, 1933. E. WATSON 1,931,365

MACHINE FOR FORMING DIAGONALLY CORRUGATED BOARD

Filed Dec. 5, 1931 4 Sheets-Sheet 4

Fig. 8.

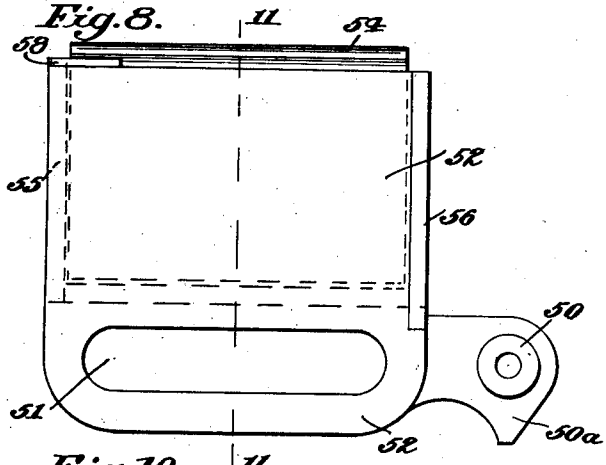


Fig. 9.

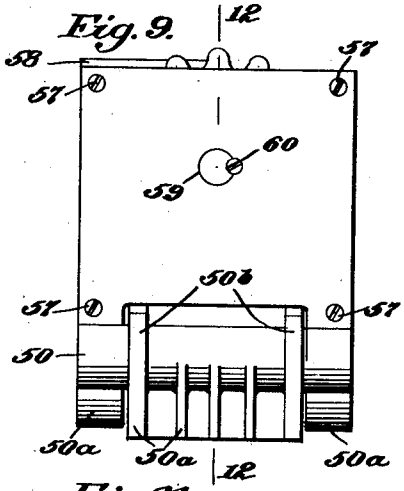


Fig. 10.

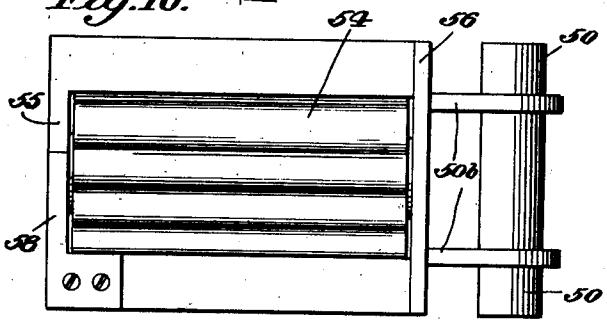


Fig. 11.

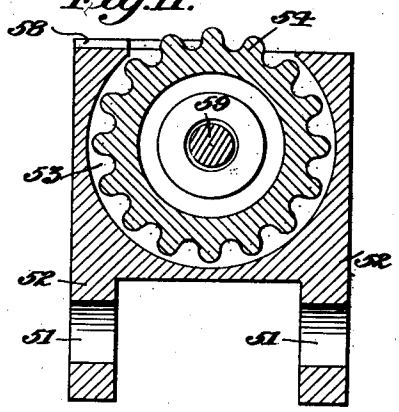
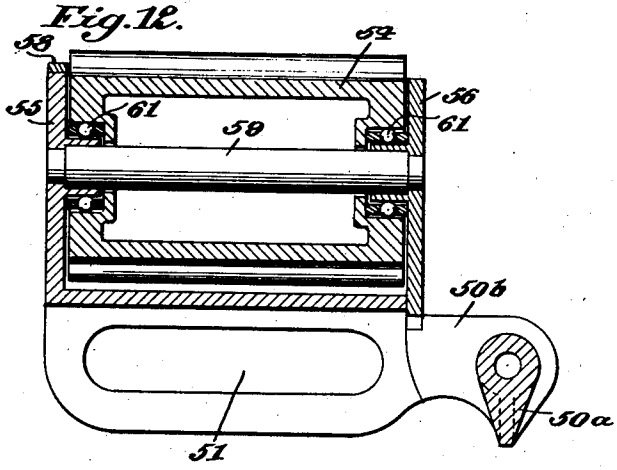


Fig. 12.



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Patented Oct. 17, 1933 1,931,365

UNITED STATES PATENT OFFICE

1,931,365

MACHINE FOR FORMING DIAGONALLY CORRUGATED BOARD

Edgar Watson, Towson, Md., assignor to The Lafayette Company, Baltimore, Md., a corporation of Maryland

Application December 5, 1931. Serial No. 579,322

13 Claims. (Cl. 154—30)

This invention relates to a method and an apparatus for the forming of diagonally corrugated board, e. g. comprising a corrugated filler having one or two liners secured to the crests of the corrugations, and in which the corrugations extend at an acute angle with respect to one or more sides of the finished sheet.

One of the features of the present invention is the provision of a mechanism including a receiving belt and traveling rollers which cooperate in forming the filler in a diagonally corrugated shape, ready for the application of a liner.

Another feature of the present invention is the provision of traveling rollers for the purpose aforesaid, which are in effect constituted of a plurality of independent elements which travel from side to side of the link belt during the movement of the latter.

Still another object of the invention is the provision of means whereby the independent roller elements are returned from one side of the belt to the other ready for a new traverse across the belt and the web thereon.

Other features of the invention will appear in the course of the following specification and claims, which set forth the invention in conjunction with an illustrative example of construction of an apparatus by which the method may be practiced, but it will be understood that this apparatus is not set forth as a limitation of the invention, since the invention may be employed in many other ways.

In these drawings:—

Figure 1 is a diagrammatic vertical longitudinal section showing the arrangement of the several parts.

Figure 2 is a similar view, showing the driving connections between the parts.

Figure 3 is a plan view of the belt and traveling roller structure, with other parts omitted for clearness.

Figure 4 is a vertical longitudinal section, on a larger scale, substantially on line 4—4 of Figure 3.

Figure 5 is a plan view of the traveling roller assembly, on a slightly larger scale.

Figure 6 is an elevation of the same.

Figure 7 is a sectional view substantially on line 7—7 of Figure 6.

Figure 8 is a side elevation of one link of the traveling roller assembly.

Figure 9 is an end view of the same.

Figure 10 is a plan view of the same.

Figure 11 is a section substantially on line 11—11 of Figure 8.

Figure 12 is a section substantially on line 12—12 of Figure 9.

Figure 13 is a perspective view showing a portion of the diagonally corrugated material produced.

Figure 14 is a vertical sectional view on a larger scale, showing the relationship of the edge of the link belt to a roller section.

In these drawings, a roll F of filler material is mounted on supporting brackets 10 and carried over a guide roller 11 onto the top of a traveling link belt 12, having a diagonally corrugated surface, and is pressed into the grooves of the surface by a traveling roller assembly R. The diagonally corrugated filler thus produced passes a cementing roll 13 provided with cement from a trough 14, and then receives a top liner from the liner roll L; this liner is carried around the guide and feed rolls 15 and over the liner applying roll 16. A heating box 12a may be provided between the upper and lower runs or flights of link belt 12. The top-lined board then passes beneath the heating or drying boxes 17 and is finally withdrawn from the link belt so that its lower surface may be brought in contact with a second cementing roll 18 which receives cement from a trough 19 and applies it to the lower surface of the corrugated board, which then receives a bottom liner from a roll B, this liner being guided by the guide rolls 20 and the liner applying roll 21 into engagement with the lower surface of the corrugated material. A counter-pressure roll 22 is provided above the roll 21 to support the material in its passage. The doubly lined, diagonally corrugated board now passes over the heating boxes 23 for drying the cement of this bottom liner. The board is held down against these boxes by a top frame 24 having a plurality of pressure rolls 25 thereon. Finally, the diagonally corrugated board issues between the delivery rollers 26, and may be cut off in suitable lengths and deposited on a table 27.

As shown in Figures 3 and 4 the link belt 12 may comprise a number of individual links which extend from side to side of the belt and are connected together as by the tension links 30 (Figure 4) to permit them to pass over the end sprocket drums 31, 32 of the driving system. These have diagonal ribs which are in alinement from side to side of the link belt. These links are provided with the stripper grooves 33 which cooperates with stripper fingers 34 (Figure 4) in facilitating the separation of the corrugated liner from the links.

Vertical standards 35 support the shafts 36, 37 of a pair of sprocket wheels 38, 39. Between these are provided the guide channels 40, 41 which are connected by a stiff web 42 having at its ends the cheek pieces 43 which engage over the shafts 36, 37 (Figs. 5–7) and are likewise supported by the standards 35, so that a rigid and stiff structure is provided. A driven shaft 45 connects the bevel gears 46 which mesh with the gears 47 mounted on the shafts 36, 37 whereby the sprockets are driven at a predetermined rate of speed.

A traveling roller assembly is provided, which is composed of a plurality of independent sections which are coupled together for traveling movement, but may be independently withdrawn from engagement with the link belt and returned from one side of the belt to the other.

In Figures 8 to 12, a traveling roller link is shown to comprise the laterally extending pivot pins 50 which are adapted to be received in the slots 51 of another link. The side walls 52 extend upwardly, but are provided with an intervening hollow space 53 (Figure 11) in which is received a roller section 54 having corrugations parallel to the axis in the illustrated form. One end wall 55 of the link is illustrated as integral, while the other end wall 56 is removable for the purpose of inserting and removing the roller section 54, but may be secured in position by screws 57 (Figure 9). A stripper finger 58 may be secured to the end wall 55 for operation between the roller sections to effect a proper stripping of the filler material, so that the latter is retained in the grooves of the link belt. A fixed shaft 59 is supported by inwardly extending bosses of the end plates 55, 56, and is held against rotation by a screw 60 (Figure 9.) It is preferred to provide ball bearings 61 between the shaft and the roller section 54.

A plurality of these individual traveling roller links are assembled together as shown in Figure 6 and are located in the channel guides 40, 41 and around the sprocket wheels 38, 39. The lower surfaces of the side walls 52 and the tips 50*a* of the pin webs 50*b* (Figures 8, 9 and 10) rest against the inner surfaces of the channels 40, 41 and thus when a traveling roller section is in its lower flight, within the channel 40, it is held down forcibly against the link belt, and is prevented from movement otherwise than as guided by the channel 40. After the individual section has passed to the end of the channel 40, it is returned in upper flight to the other side of the link belt ready for a further operation.

Preferably the lower channel 40 is surrounded by steam chests 80 for heating the roller sections during their operative movement, and insulating jackets 81 (Figures 6 and 7) may be provided to confine the heat.

In Figure 2, a general driving connection is shown for the link belt and associated parts. The shaft 45 carries a bevel gear 62 in mesh with a bevel gear 62*a* on a shaft 62*b* having a further bevel gear 63 driven by a bevel gear 64 on the shaft 65 which has a sprocket 66 connected by chains 67 with sprockets on the shaft 31*a* of the link belt sprocket 31, the shaft 15*a* of a liner guide roll 15, the shaft 16*a* of the liner applying roll 16, and the shaft 13*a* of the cementing roll 13. Shafts 15*a* and 13*a* are likewise provided with gears for driving gears 68 of the other liner guide roll 15 and a cement feeding roll in the trough 14. A driving connection illustrated as chain 70 also exists between the two sprockets 30, 31 of the link belt. The shaft 30*a* also is connected by a chain 71 with a shaft 72 which is in geared driving relationship with the shafts 21*a*, 22*a* of the applying and counter-pressure rolls 21 and 22, and is itself connected to one of the liner guide rolls 20, and is geared for driving the shaft 20*a* of the other roll 20. Finally a chain driving connection 73 is illustrated between the shaft 72 and the shaft 74 of the lower delivery roll 26, while the two rolls are connected together by gears 75. A motor 44 drives the shaft 65.

In operation, the sheet of filler material is introduced to the machine by passing over the guide roller 11 and entering upon the upper surface of the link belt 12 at an angle to the direction of travel of this belt as represented by dash and dot lines in Figure 3. This angle varies according to the angle which the finished corrugations form to the line of advancement of the link belt and to the actual loss of length in the filler stock occasioned by the bending to form the corrugations, and may be adjusted by moving the brackets 10 about the pivot 10*a*.

The link belt, roller sections, and other parts are then set in motion by actuating the motor 44. As the filler paper passes between the roller sections and the link belt, it is caused to assume corrugations corresponding to the grooves and ribs of the belt, while the belt travels in the direction shown by the arrow shown in Figure 3, and the individual roller sections turn in a clockwise direction as shown in Figure 4. Each corrugation is formed individually and simultaneously for its entire length. The strippers 58 operate to separate the corrugated filler from the roller sections and cause it to travel with the link belt, for which purpose also an apron 101 (Figs. 3 and 4) is preferably provided between the roller sections and the cement trough 14. As diagonally corrugated filler passes the cement-applying roll 13, the tops of the corrugations are coated with a suitable cement, and the filler then is brought into engagement with the top liner which is pressed on by the liner-applying roll 16 and the lined corrugated filler is passed beneath the heating box 17 where the cement is dried. The strippers 34 cause the lined corrugated material to separate from the link belt and to pass over the cement applying roll 18 and the bottom liner-applying roll 21 and thence into the second heating arrangement, so that ultimately a double-lined, diagonally corrugated board is produced. It is obvious that by omitting the cement-applying roll 18 and the subsequent parts of the machine, a single-lined board may be produced; and that where diagonally corrugated material only is desired, without liners, the cement-applying roll 13 and the liner-applying roll 16 may be omitted as well.

As the link belt travels beneath the sectional roller device, each roller tends to travel across the link belt, moving substantially at a right angle to the direction of the diagonal ribs on the link belt. This action occurs continuously and the roller sections succeed one another at close intervals, being preferably in compression relationship by the engagement of the end plates 55, 56 of the individual roller section units. After having passed from the upper edge of the link belt in Figure 3, the individual sections are returned to the lower edge of the link belt in Fig. 3 by the operation of the sprocket wheels

38, 39, and the upper guide channel 41. Thus there is no tendency for the roller sections to cause the filler stock to move laterally on the link belt, and hence no tearing of this stock occurs. It is preferred to positively drive the sprocket 39 by which the roller section units are delivered for operation with the link belt, whereby to produce a compression along the line of the units as aforesaid, and the other sprocket 38 may also be driven positively to relieve the sprocket 39 from draft strain in returning the sections to their initial position in the lower flight.

In Figure 13 the finished material is illustrated as comprising the upper liner L and the lower liner B with the intermediate diagonally corrugated filler F therebetween. In this figure the edges *a* and *b* are at right angles, and the lines or diagonal corrugation of the filler F extend substantially at 45° to the two edges *a* and *b*.

In Figure 14, the upper surface of the link belt 12 is shown to have a downward inclination in its upper flight at the edge to which the roller sections 54 are introduced. Thus, each roller section 54 in its gradual movement toward operative position engages with the inclined diagonal ribs 12*w* and hence its own longitudinal ribs are brought into alinement with those of the other roller sections which are then engaged with the diagonal ribs 12*x* of the horizontal portion of the link belt 12.

It will, therefore, be noted that the invention relates particularly to a method and apparatus for diagonally corrugating a sheet or web of material, with means for associating a liner or liners therewith if desired, by the interengagement of ribs on a roller and on a surface for receiving the sheet to be corrugated and maintaining it at least transitorily in its corrugated form.

It will be noted that a single source of power is illustrated for driving all parts of the mechanism, the individual elements being timed by proper gear and chain sprocket ratios, so that a uniform and regular movement occurs, from the moment that the devices first engage the filler stock until the stock issues from the machine.

It further will be understood that the usual means may be employed for moistening, steaming, drying and preheating the filler and liner stocks and finished material in their passage through the machine. For example, the rolls 15, 16, 20 and 21 may be heated in suitable manner as a means of pre-heating the liners before they are applied to the corrugated filler. Further, the apron 101 may similarly be heated to assist in drying the corrugated filler before the top liner is brought in contact therewith.

It is obvious that the invention is not limited solely to the form of construction shown, but that it may be modified in many ways within the scope of the appended claims.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent, is:—

1. In a machine for diagonally corrugating a flexible sheet, means for providing a surface for receiving said sheet and having ribs thereon extending diagonally to an edge of said sheet, a roller having longitudinal ribs interengaging with said diagonal ribs, and means for causing said surface and roller to travel bodily relative to one another in a direction at a right angle to said ribs.

2. In a machine for diagonally corrugating a flexible sheet, a belt having a plurality of diagonal ribs thereon, a roller having longitudinal ribs, and means for supporting the roller for rotation about its axis with said longitudinal ribs interengaged with said diagonal ribs and for permitting said roller to travel bodily transversely relative to the belt during movement of the latter.

3. In a machine for diagonally corrugating a flexible sheet, a belt having a plurality of diagonal ribs thereon, a plurality of roller sections having longitudinal ribs, and means for supporting the roller sections with said longitudinal ribs engaged in said diagonal ribs and for permitting the sections to travel bodily transversely relative to the belt during movement of the latter.

4. In a machine for diagonally corrugating a flexible sheet, a belt having a plurality of diagonal ribs thereon, a plurality of independent roller sections having longitudinal ribs, fixed guiding means extending parallel to said diagonal ribs, and independent section holders for said roller sections supported on said guiding means for movement therealong with said longitudinal and diagonal ribs interengaged.

5. In a machine for diagonally corrugating a flexible sheet, a belt having a plurality of diagonal ribs thereon, a plurality of roller sections having longitudinal ribs, fixed guiding means extending parallel to said diagonal ribs, section holders for said roller sections supported on said guiding means for movement therealong with said longitudinal and diagonal ribs interengaged, and means for connecting said holders in chain.

6. In a machine for diagonally corrugating a flexible sheet, a belt having a plurality of diagonal ribs thereon, a plurality of roller sections having longitudinal ribs, fixed guiding means extending parallel to said diagonal ribs, section holders for said roller sections supported on said guiding means for movement therealong with said longitudinal and diagonal ribs interengaged, means for connecting said holders in chain, and means for driving said chain.

7. In a machine for diagonally corrugating a flexible sheet, a belt having a plurality of diagonal ribs thereon, a plurality of roller sections having longitudinal ribs, fixed guiding means extending parallel to said diagonal ribs, section holders for said roller sections mounted for movement along said guiding means and located with said ribs in said grooves, means for connecting said holders in a loose chain, and means for individually engaging said section holders one at a time and moving them toward said belt, whereby said moved section may operate in compression upon other sections to advance the sections transversely relative to said belt.

8. In a machine for diagonally corrugating a flexible sheet, a belt having a plurality of diagonal grooves thereon, a plurality of roller sections having longitudinal ribs, fixed guiding means extending parallel to said diagonal grooves, section holders for said roller sections mounted for movement along said guiding means and located with said ribs in said grooves means for connecting said holders in chain, and means for moving said belt and said chain at predetermined relative speeds.

9. In a machine for diagonally corrugating a flexible sheet, a belt comprising a plurality of

links interconnected pivotally along axes transverse to the direction of movement of said belt, said links having alined diagonal rib sections extending from edge to edge of the belt, a roller having longitudinal ribs, and means for supporting the roller with said ribs interengaged and for permitting said roller to travel bodily transversely relative to the belt during movement of the latter.

10. In a machine for diagonally corrugating a flexible sheet, a belt having a plurality of diagonal ribs thereon, a roller having longitudinal ribs, driving means for advancing the belt, and co-ordinated driving means for moving said roller bodily relatively transverse to the belt.

11. In a machine for diagonally corrugating a flexible sheet, a frame, a traveling belt having a plurality of diagonal ribs thereon, guide channels fixed to said frame, sprockets, and a plurality of roller section assemblies connected in chain and supported by said sprockets and guide channels for movement parallel to said diagonal ribs, each said roller section assembly comprising a holder and a roller journaled thereon, each said roller having longitudinal ribs adapted to interengage said diagonal ribs, and heating means on the frame adjacent at least one of said channels for warming said roller sections.

12. In a machine for diagonally corrugating a flexible sheet, a belt having a plurality of diagonal ribs thereon; a plurality of roller section assemblies each comprising a base and end walls and interengaging means for connecting the assemblies in chain, a shaft mounted on said end walls, and a longitudinally ribbed roller journaled on said shaft; and means for supporting the assemblies with the longitudinal ribs of at least one roller interengaged with said diagonal ribs and for permitting the roller section assemblies to travel relatively transverse to the belt during movement of the latter.

13. A machine as in claim 12, in which each said holder includes side walls forming with said base and end walls a closed pocket, and said roller is located in said pocket with its longitudinal ribs projecting beyond said side and end walls and journal means are provided on said end walls for supporting the roller.

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