E. M. HAWKINS.

MACHINE FOR MAKING CORRUGATED PAPER BOARD.

APPLICATION FILED DEC. 28, 1915.

1,357,453.

Patented Nov. 2, 1920.

11 SHEETS—SHEET 1.

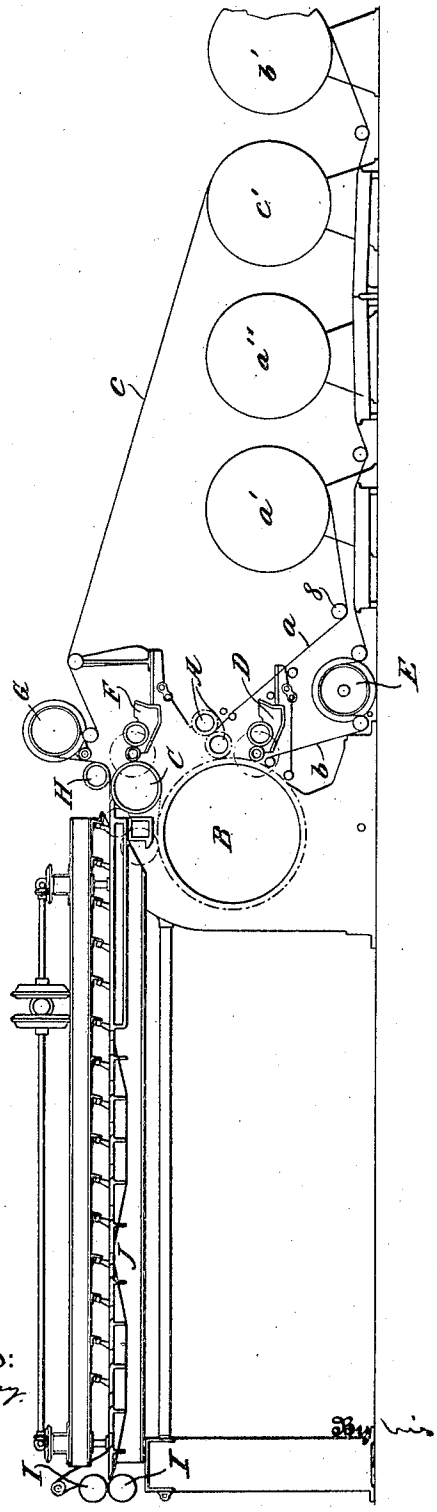


Fig. 1.

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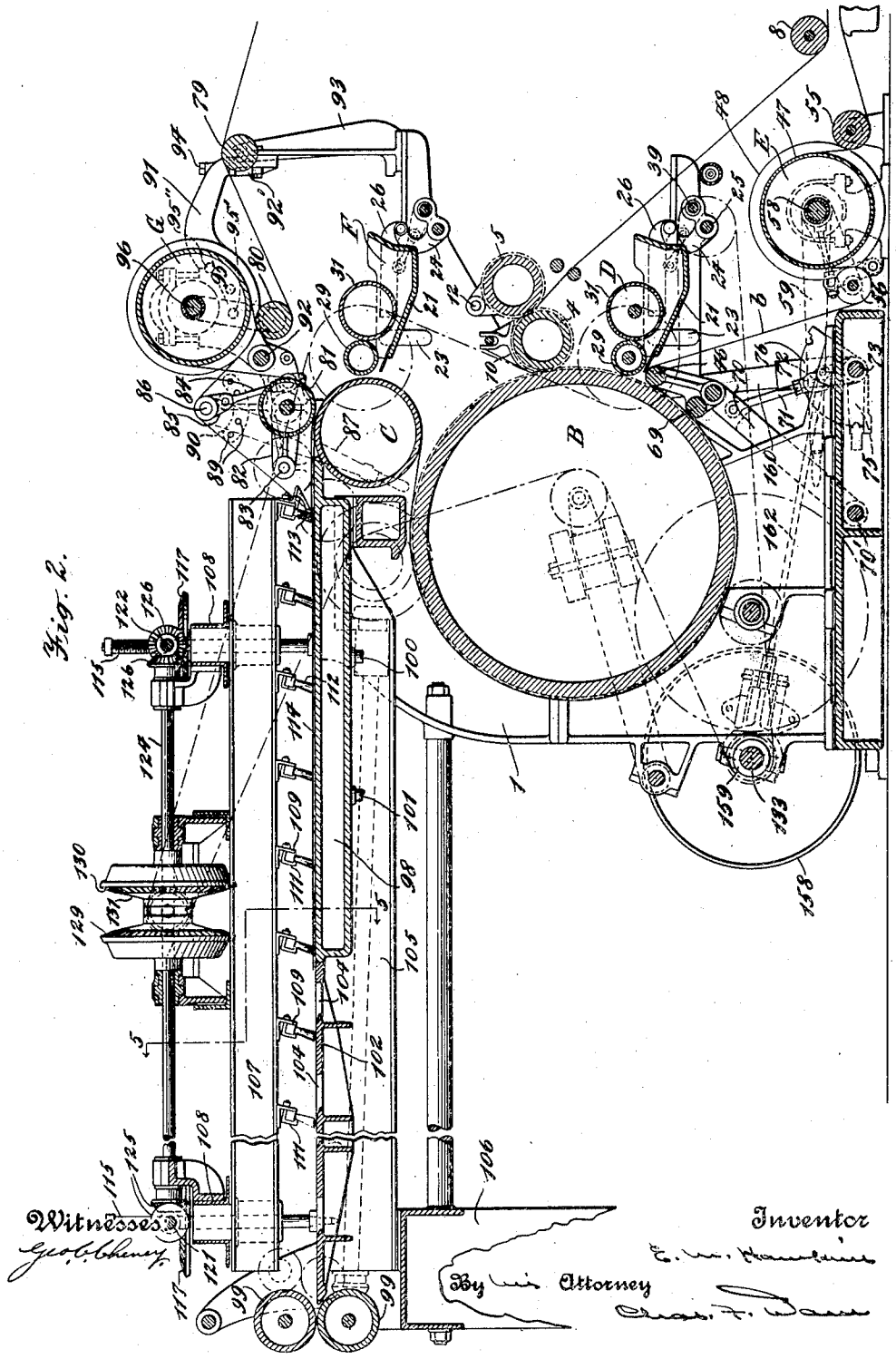


Fig. 2.

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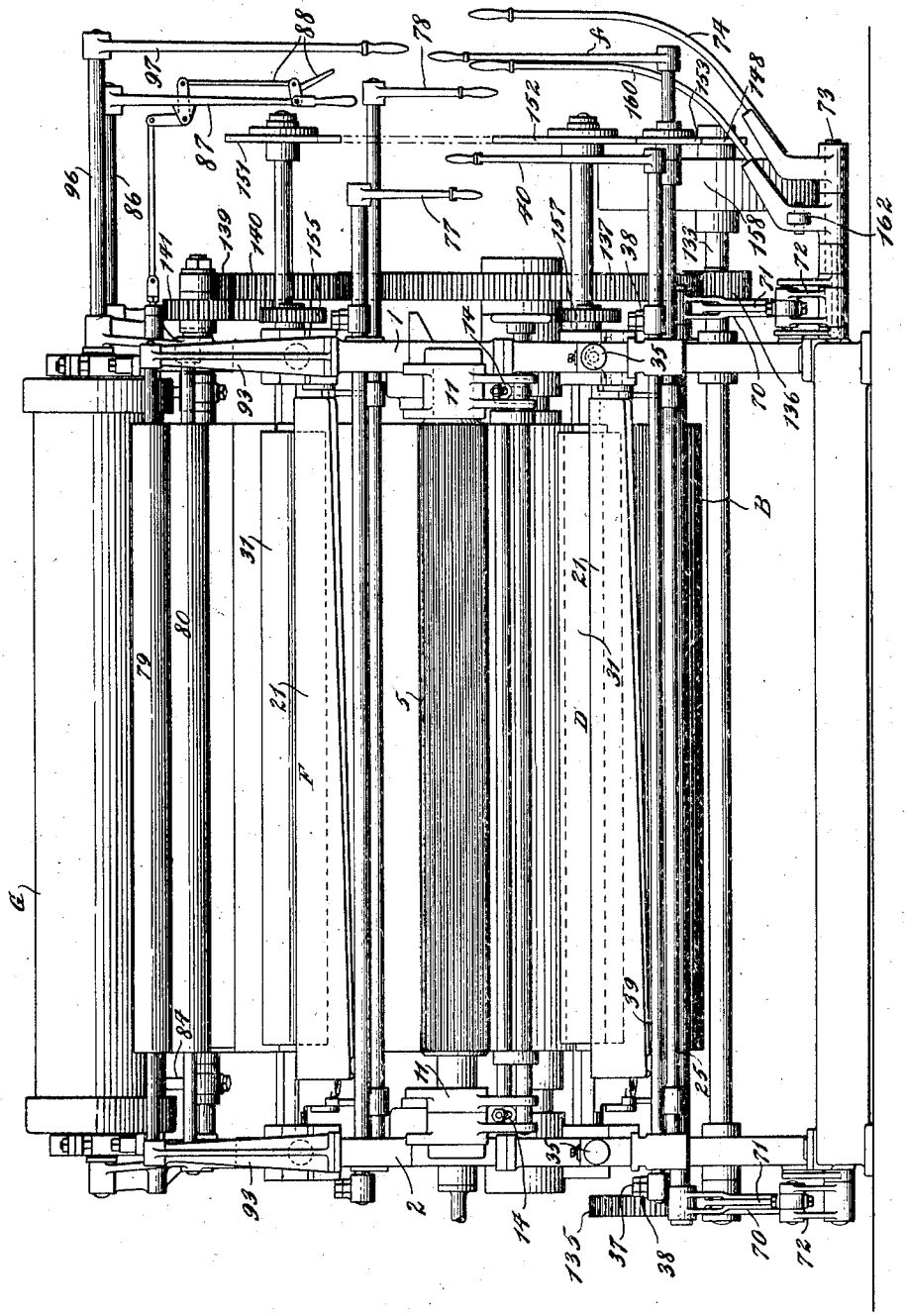


Fig. 3.

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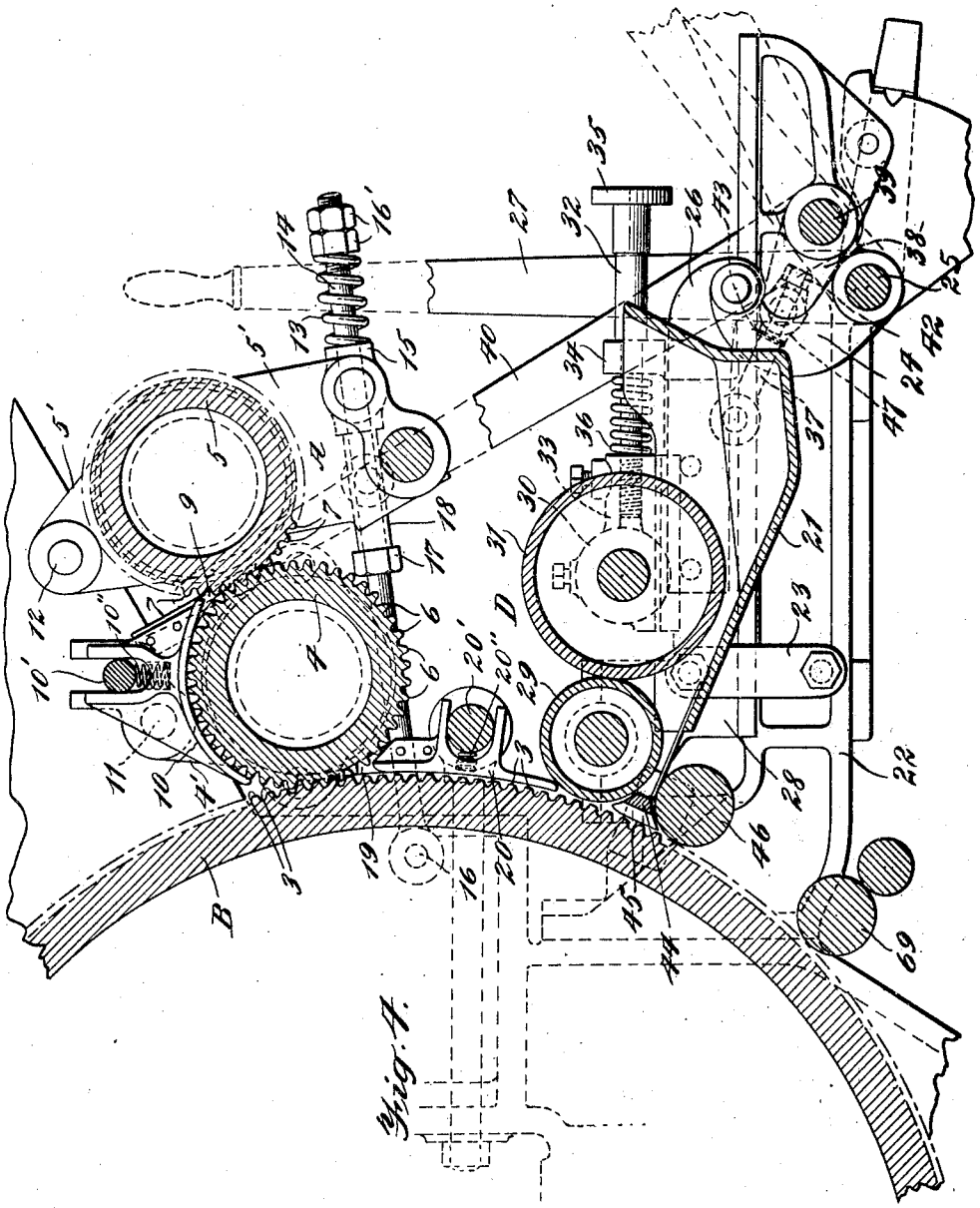


Fig. 4.

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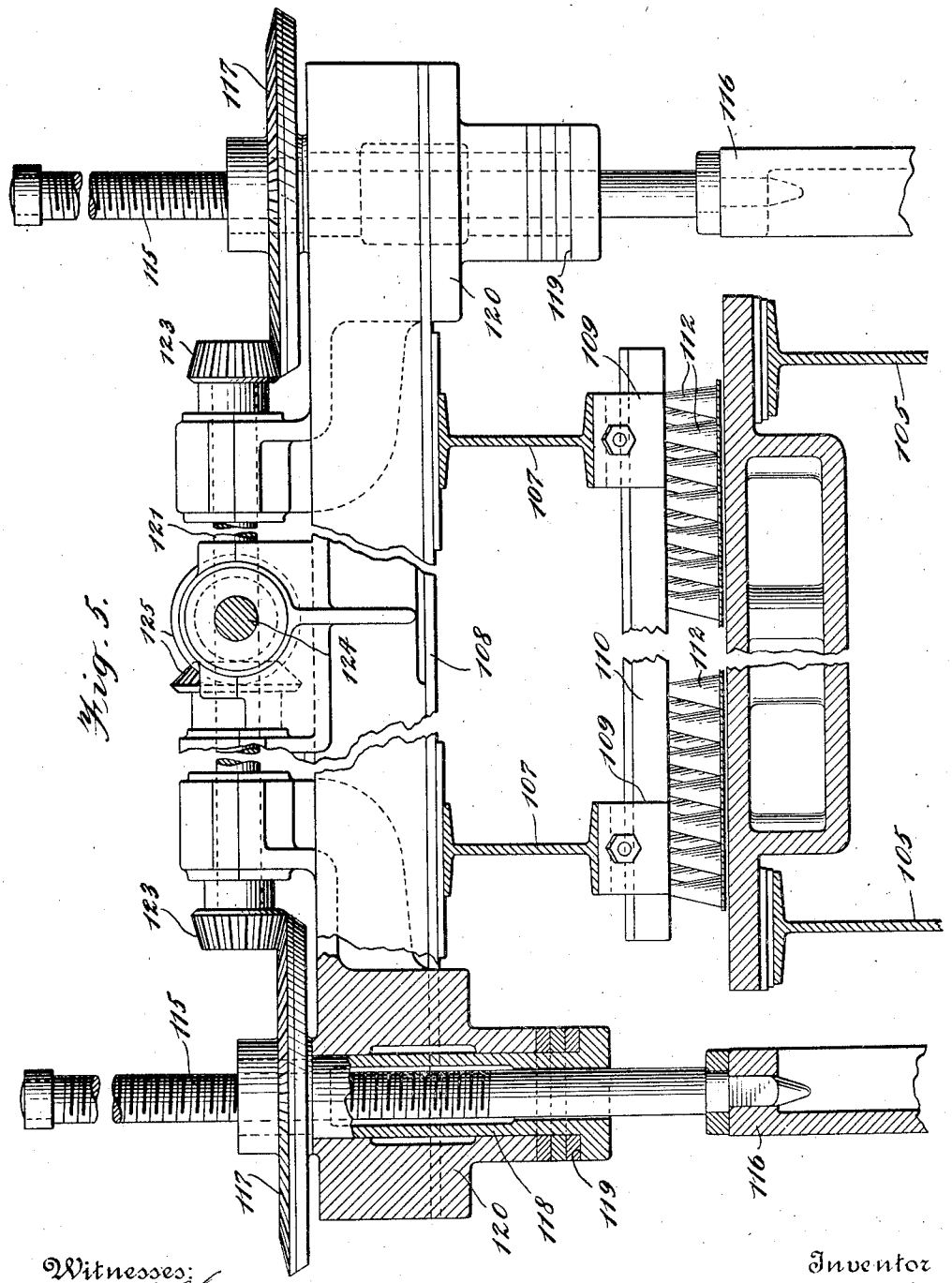


Fig. 5.

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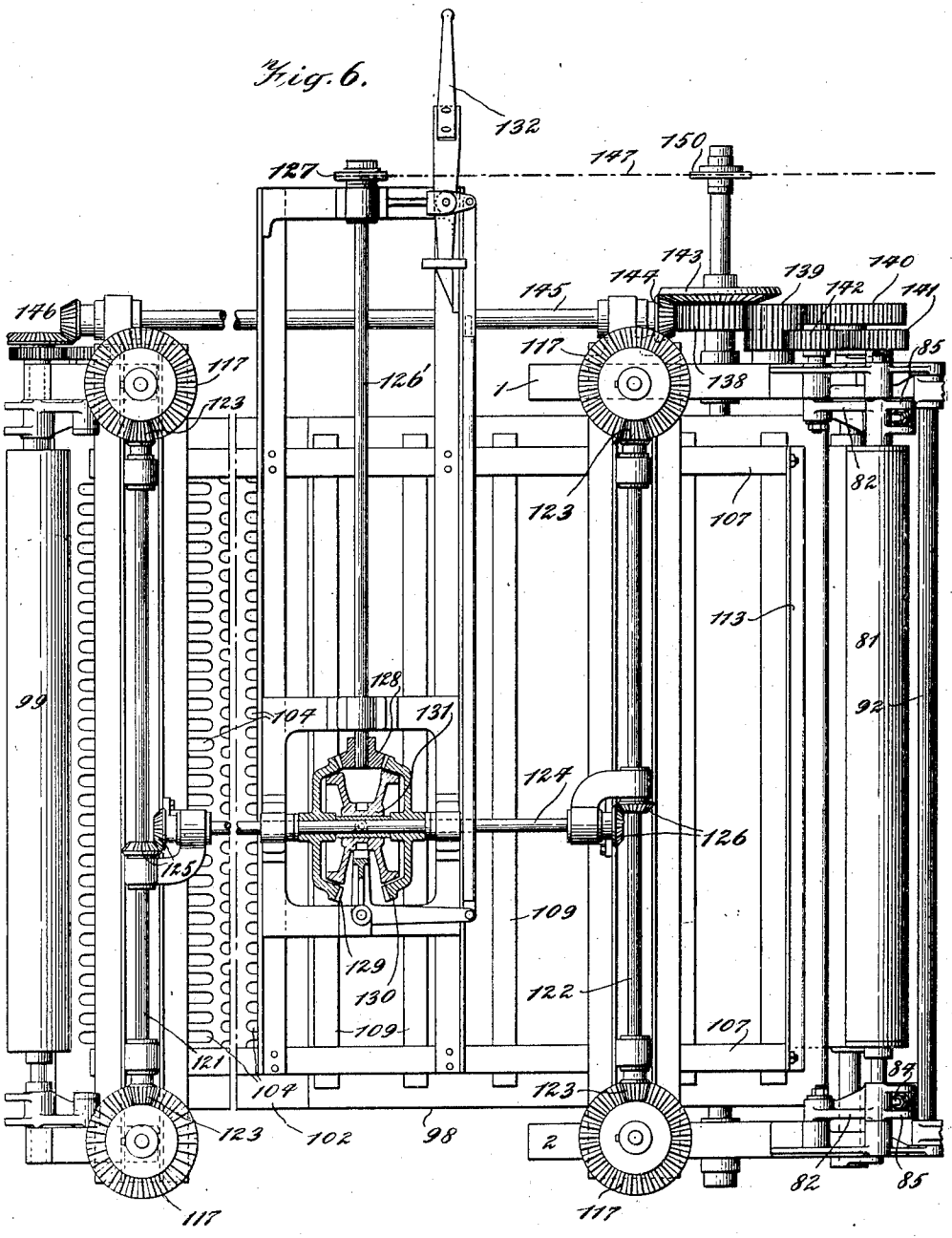
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11 SHEETS—SHEET 6.

Fig. 6.



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11 SHEETS—SHEET 7.

Fig. 7.

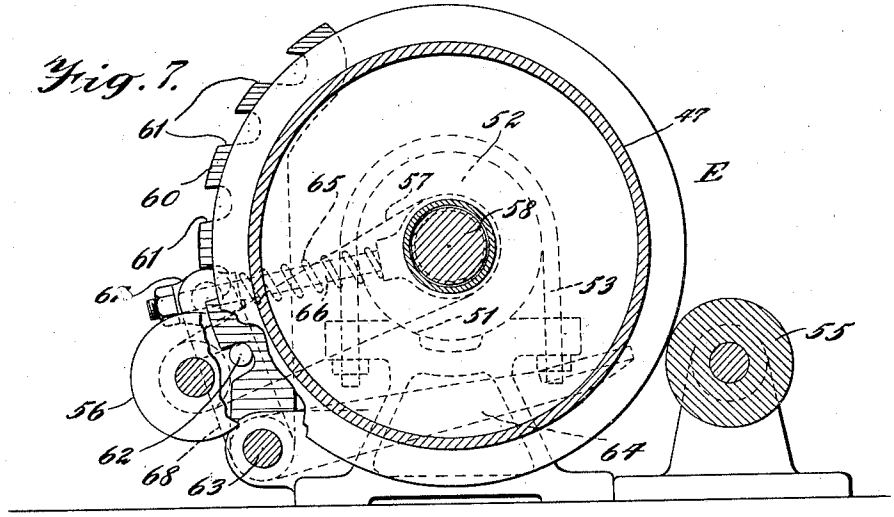
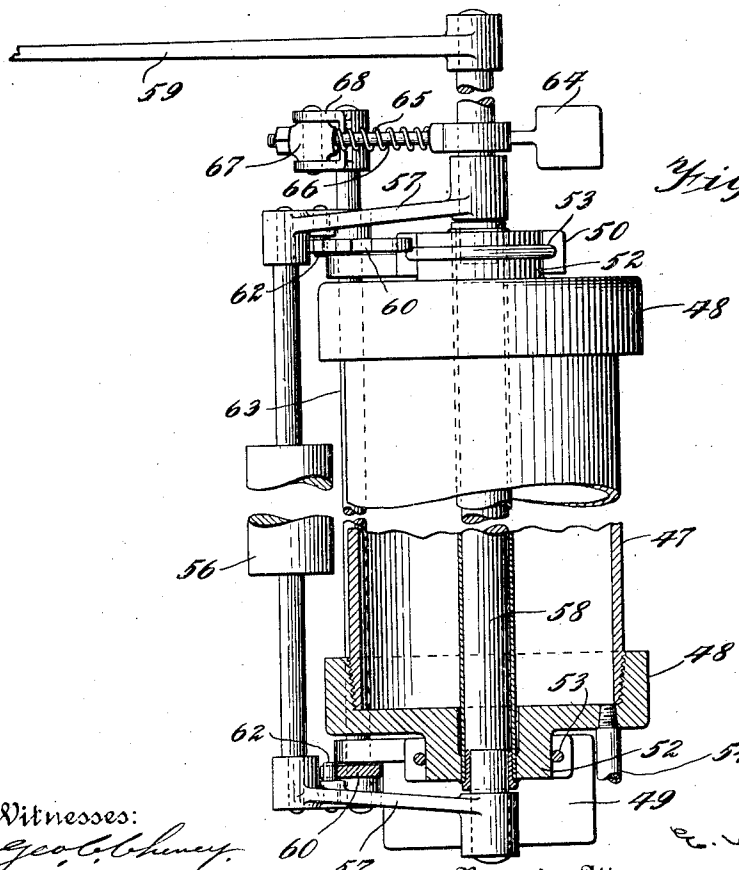


Fig. 8.



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APPLICATION FILED DEC. 28, 1915.

1,357,453. **Patented Nov. 2, 1920.**

11 SHEETS—SHEET 8.

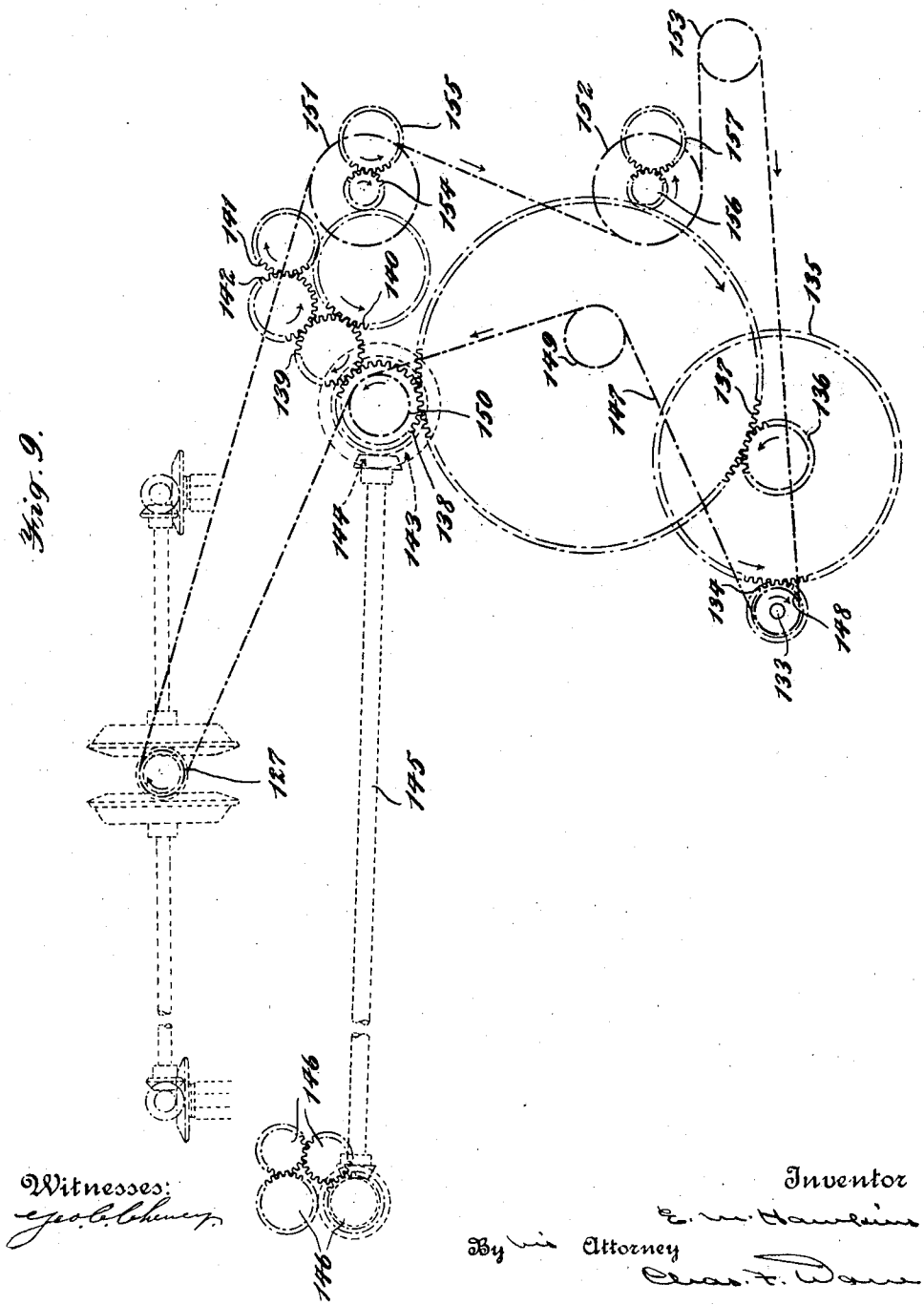


Fig. 9.

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APPLICATION FILED DEC. 28, 1915.

1,357,453. **Patented Nov. 2, 1920.**

11 SHEETS—SHEET 9.

Fig. 11.

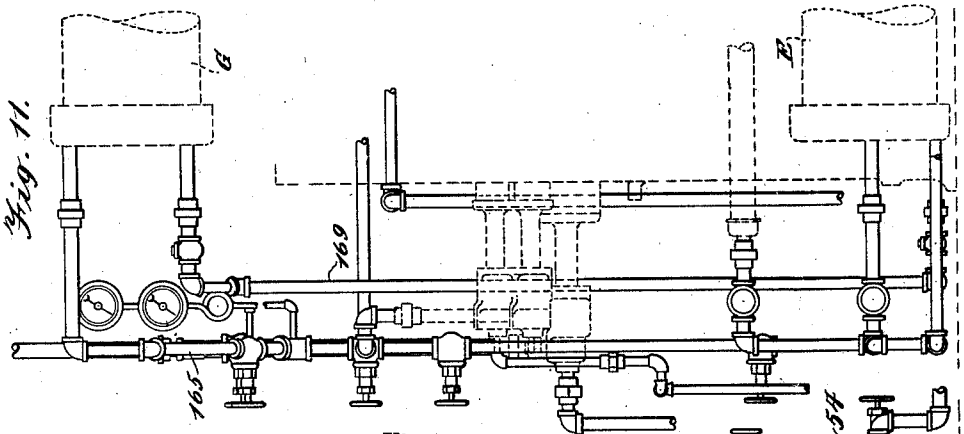
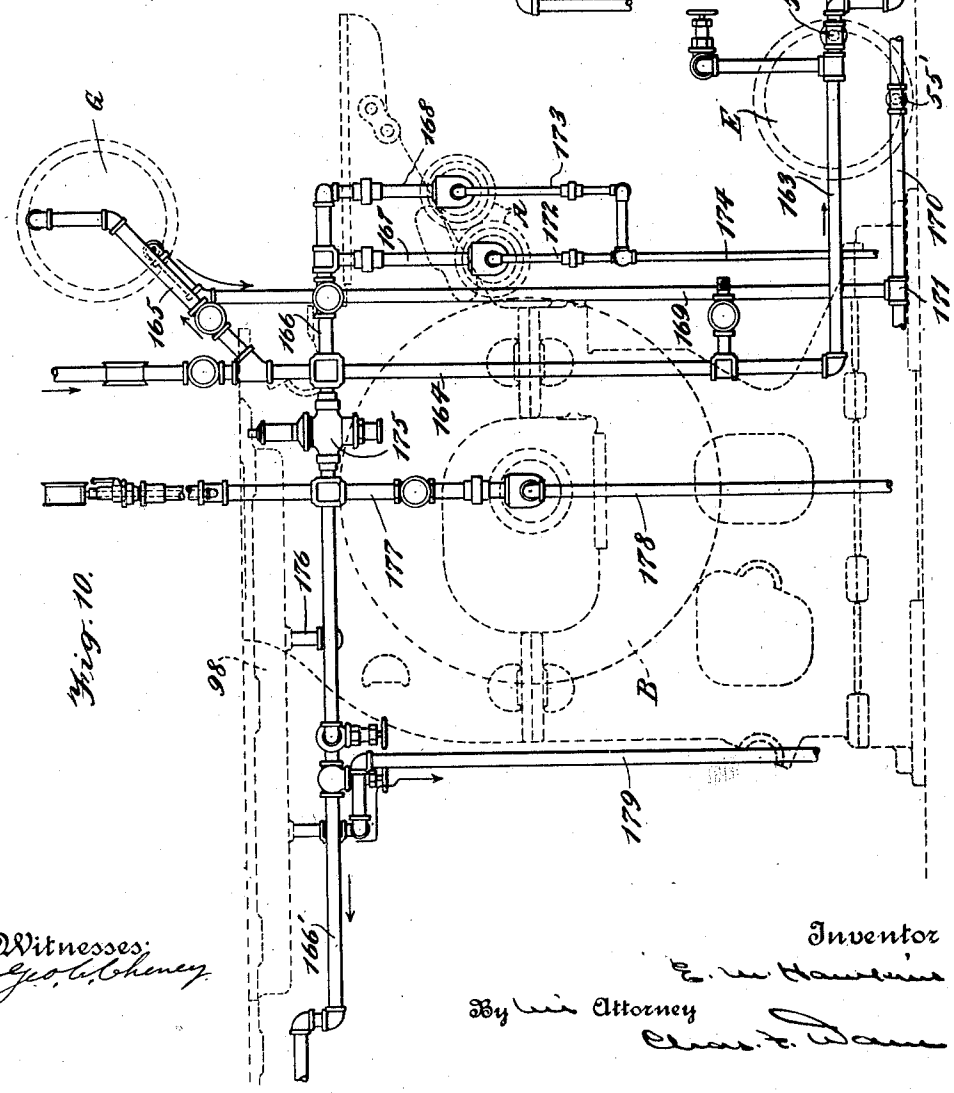


Fig. 10.



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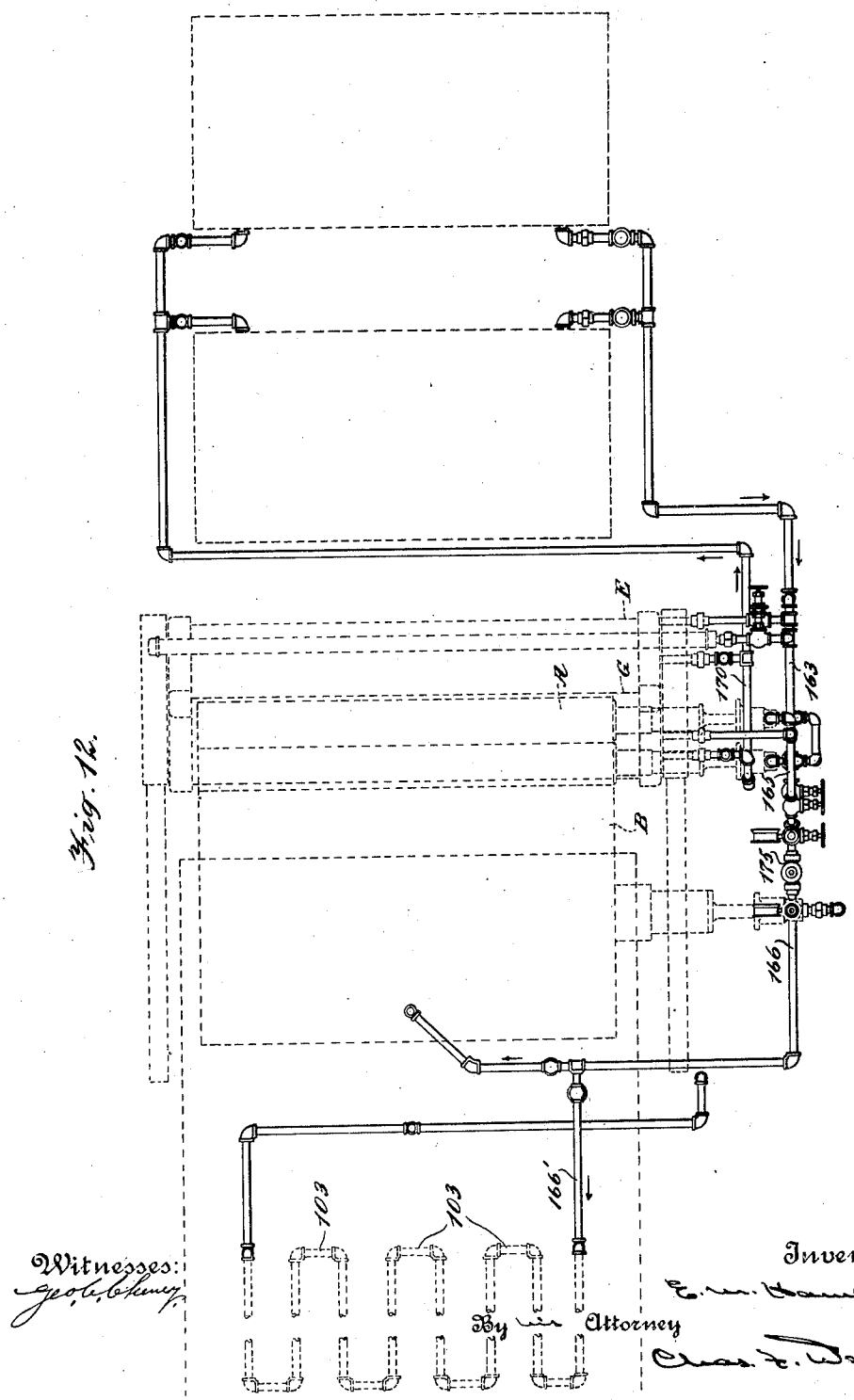
E. M. HAWKINS.

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11 SHEETS—SHEET 10.



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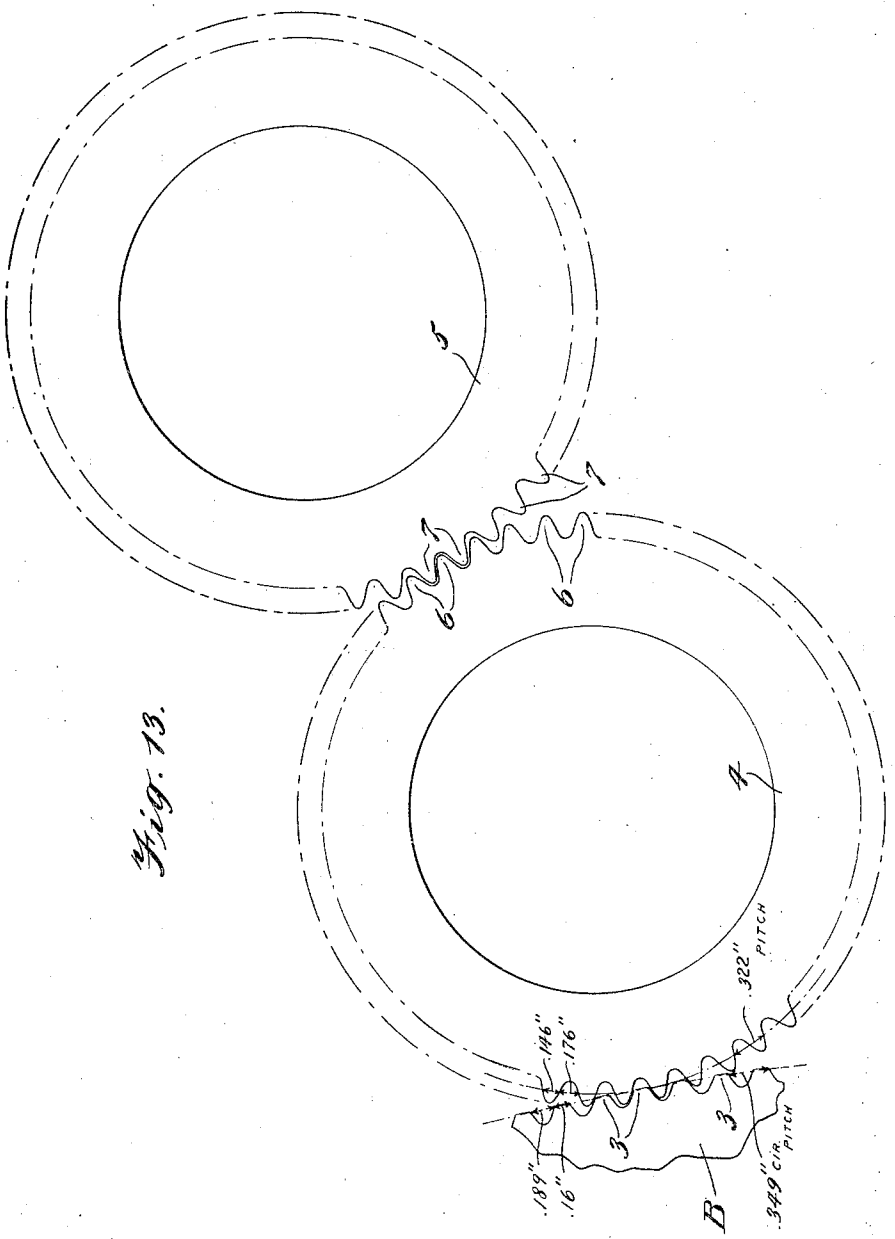


Fig. 13.

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UNITED STATES PATENT OFFICE.

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MACHINE FOR MAKING CORRUGATED PAPER-BOARD.

1,357,453. Specification of Letters Patent. Patented Nov. 2, 1920.

Application filed December 28, 1915. Serial No. 69,093.

To all whom it may concern:

Be it known that I, EDGAR M. HAWKINS, a citizen of the United States, and resident of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Machines for Making Corrugated Paper-Board, of which the following is a specification.

This invention relates to machines for manufacturing lined corrugated board, and has for its object to provide an improved machine, the various parts of which are constructed in a novel manner and coöperate to produce an efficient and well organized machine.

In its preferred form, the improved machine comprises a pair of corrugating rolls which corrugate the filler and transfer it to a rotary drum having corrugations adapted to receive and hold the corrugations formed on the filler. While the corrugated filler is being so moved on the surface of the drum, it has applied thereto a coating of adhesive by means of an adhesive-applying device capable of applying the adhesive to the ridges of the corrugations. The corrugated filler with its coating of adhesive then has applied thereto, a liner or facing which is conducted to the periphery of the drum by the mechanism hereinafter described. The corrugated filler then provided with one liner travels with the drum for a predetermined distance and is removed therefrom by a transfer roller in such a manner as to expose the unlined side of the corrugated filler. If double-faced corrugated board, or, in other words, corrugated board lined on both sides, is to be made, adhesive is then applied to the ridges of the corrugations on the unlined side of the filler and the other liner is subsequently applied by the mechanism to be hereinafter described. The filler then lined on both sides is passed under a pressure bed and over a heating bed to firmly unite the layers and dry the adhesive.

Before the two liners are applied to the corrugated filler, they are preferably preheated for the purpose of drying the same and rendering them more capable of absorbing the adhesive and capable of permitting the adhesive to dry quickly. Means is also provided for heating the corrugating rolls and the above-mentioned drum, as will hereinafter appear.

Certain of the pressure and other rolls employed in the machine are mounted for adjustments to permit the liners to be placed under the proper tension. Furthermore, the mechanism for applying the adhesive to the two sides of the filler is constructed in a novel manner to permit independent adjustments of the adhesive-applying rolls or adjustment of the set of rolls with respect to the corrugated filler without disturbing the relation between the rolls themselves. Either of these adjustments is independent of a hereinafter described adjustment of the adhesive pan which may be dropped down away from the adhesive rolls to facilitate cleaning.

In addition to the above mentioned features, there are other novel features which will appear as the specification proceeds.

The invention is illustrated in its preferred form in the accompanying drawings, in which:—

Figure 1 is a more or less diagrammatic side elevation of the machine showing the arrangement of the various parts thereof and the paths of travel taken by the filler and the two liners;

Fig. 2 is a central longitudinal and vertical section through the machine;

Fig. 3 is a front elevation of the machine;

Fig. 4 is a broken vertical section on an enlarged scale showing the details of the corrugating rolls and of one of the adhesive-applying devices;

Fig. 5 is a transverse vertical section through the pressure bed and the heating or drying bed, the section being taken on line 5—5 of Fig. 2;

Fig. 6 is a plan view, partly in section, of the pressure bed and heating or drying bed illustrating the mechanism for raising and lowering the pressure bed;

Fig. 7 is a transverse vertical section taken through the device for preheating the bottom liner;

Fig. 8 is a broken plan view, partly in section, of the device shown in Fig. 7;

Fig. 9 is a more or less diagrammatic view showing the driving mechanism for the various power-actuated parts of the machine;

Fig. 10 is a side elevation of the piping system used for conducting the heating medium to the various heated parts of the machine;

Fig. 11 is an end elevation of the structure shown in Fig. 10;

Fig. 12 is a plan view of the piping system illustrated in Figs. 10 and 11; and

Fig. 13 illustrates the difference in construction between the teeth of the drum and the teeth of the corrugating rolls.

Referring to the drawings, and particularly to Figs. 1 and 2, it will be seen that the filler *a* of straw-board or other suitable material to be corrugated and subsequently lined, is fed from a roll *a'* to the corrugating rolls, denoted generally by the reference character A. The filler is corrugated by means of these rolls and then transferred to a corrugated drum B, which carries the corrugated filler to a transfer roll or drum C by means of which the corrugated filler is removed from the drum.

Just after the corrugated filler has been gripped by the drum B, the adhesive-applying mechanism denoted generally by the reference character D, applies adhesive to the ridges of the corrugations. The corrugated board so coated with the adhesive then has applied thereto, the bottom liner *b* which is conducted to the periphery of the drum B from a supply roll *b'* over a preheating device, denoted generally by the reference character E. The bottom liner so brought into contact with the adhesive coated corrugated filler adheres thereto and is carried with the corrugated filler to the transfer roll C where the filler lined on one side is removed from the drum and reversed, so that the unlined side of the corrugated filler is exposed to the adhesive-applying mechanism, indicated at F. In this manner, the ridges of the corrugations on the unlined side of the filler have applied thereto, a coating of adhesive so that the second or top liner will adhere thereto. This second liner *c* is fed from a supply roll *c'* over a preheating device G similar to the preheating device E for the bottom liner. A pressure roller H brings the top liner into proper relation with the adhesive coated corrugations of the filler, thus causing the top liner to adhere to the corrugated filler.

A set of pull rolls I, between which the completed material passes, draws the lined corrugated filler over a pressure and drying bed, denoted generally by J.

In Fig. 1, it will be noted that four supply rolls of stock are shown, whereas only three supply rolls are needed at any one time for supplying the three layers of stock. The fourth supply roll, indicated at *a''* is a reserve roll of filler material, from which the filler stock may be taken when the roll *a'* is exhausted. Due to the fact that the filler is corrugated, substantially twice as much material will be needed for the filler, and hence the provision of the two supply rolls of filler stock.

The above description is for the purpose of giving a broad idea of the general arrangement of the parts of the machine, and the following description will set forth the detailed construction of each of the above-mentioned parts.

The drum B is rotatably mounted in the main standards 1 and 2 of the machine (Fig. 3), and is provided over its entire surface with a plurality of corrugations running longitudinally of the drum, as shown in Fig. 4 at 3. The corrugating mechanism A for corrugating the filler and from which the filler is transferred to the drum B comprises a pair of corrugating rolls 4 and 5, each provided over its entire surface with teeth or corrugations running longitudinally of the rolls. The teeth of the corrugating roll 4 are indicated at 6 and those on the roll 5 are indicated at 7. The teeth of the two rolls mesh so that the filler passed between the rolls is corrugated in the well known manner.

Before the filler *a* reaches the corrugating rolls 4 and 5, it passes under a guide roll shown at 8 in Figs. 1 and 2. After the filler is corrugated between the rolls 4 and 5, it is stripped from the roll 5 by means of the stripper fingers 9 and is then guided by means of the guide-shoes 10 and directed toward the periphery of the drum B. The teeth 6 of the roll 4 mesh with the teeth on the drum B, so that the corrugations on the filler board are positioned in the corrugations on the drum B. The teeth on the drum B cause the corrugated filler to move with the drum and maintain the spacing of the corrugations in the filler until secured by the liner to be adhesively applied thereto.

It is immaterial so far as the broad aspects of the invention are concerned, just how the corrugating rolls 4 and 5 are mounted, but preferably both rolls are mounted in movable bearings permitting of a yielding of the rolls relative to each other and to the drum whereby any foreign substance or additional thickness of material may pass through without injury to the roll teeth or other parts. This is accomplished by journaling the rolls in two pairs of brackets, one bracket of each pair being disposed at each side of the machine and the right hand bracket of each pair being shown at 4' and 5' in Fig. 4. These brackets 4' and 5' are respectively pivoted to the frame of the machine at 11 and 12, and are held with the rolls in yielding engagement with each other and with the drum, by means of a coil spring 13 encircling a stud 14 passing through a swivel block 15 on the bracket 5' and pivoted at 16 to the frame of the machine. The spring 13 reacts at one end against the adjusting nuts 16' on the stud 14, and at its other end against the bracket 5', and, therefore, as the stud 14 is free to slide in the swivel block 15, the rolls will be yieldingly held in proper relation to each

other and to the drum as stated. If so desired, the inward movement of the roll 5 may be positively limited by means of a nut 17 on the stud 14 between which and the swivel block 15, a sleeve 18 may be positioned. The extremity of the sleeve 18 adjacent the swivel block 15 will then act as a shoulder to limit the inward movement of the bracket 5′ and the roll 5.

The corrugated filler is stripped from the roll 4 by means of a plurality of stripper fingers 19 (Fig. 4) secured to guide-shoes 20. The stripper fingers 9 for removing the corrugated filler from the roll 5 and the stripper fingers 19 for removing the corrugated filler from the roll 4 operate in circumferential recesses provided in the rolls 5 and 4, respectively. The two sets of guide-shoes 10 and 20 which carry the said stripper fingers are respectively mounted on supporting cross-bars 10′ and 20′ and serve to retain the corrugated filler in the corrugations of the adjacent rolls until the corrugated filler is brought to the adhesive-applying mechanism D. These guide-shoes are mounted for transverse movement on their supporting bars as shown in order to permit of their yielding to any increased thickness of material passing through the machine as described in relation to the yielding support of the corrugating rolls, the same being yieldingly held to their normal position by means of suitable springs, 10″ and 20″, interposed between the shoes and their supporting bars as shown.

The mechanism D for applying the adhesive to the corrugated filler, in its preferred form, comprises an adhesive pan or trough, indicated at 21. It is mounted for raising and lowering movements upon brackets 22, which in turn, are secured to the machine frame. This is accomplished by mounting the pan 21 on the brackets 22 by means of the links 23 and 24. The links 23 are pivoted to the rear part of the adhesive pan and to the bracket 22, while the links 24 oscillate about the axis of a shaft 25 and are pivoted at their upper extremities to brackets 26 secured directly to the adhesive pan. A hand lever 27 secured to the shaft 25 is capable of oscillating the same and thereby rocking the links 24 to raise and lower the adhesive pan 21. Slidably mounted upon the bracket 22 is a casting 28 in which the adhesive-applying roll 29 is journaled. The casting 28 also carries the bearings 30 for the adhesive distributing roll 31, but the bearings 30 are slidably mounted upon the casting 28 and capable of adjustment thereon to vary the distance between the rolls 29 and 31. This adjustment of the roll 31 is accomplished by means of a rod 32 at each side of the machine, the extremity of which is threaded into a boss 33 of the corresponding bearing 30. The rod 32 passes through and is free to turn in an upstanding lug 34 carried by the casting 28. A shoulder on the rod 32, however, abuts against the outside surface of the lug 34, and, therefore, when the rods 32 are turned, such as by means of the thumb wheels 35, the bearings 30 may be made to slide back and forth upon the casting 28. A coil spring 36 is provided on each of the rods 32 and interposed between the lug 34 and the boss 33 to yieldingly hold the roll 31 in contact with the roll 29. By turning the thumb wheels 35, it is obvious that the space between the rolls 29 and 31 may be varied and that in all positions of the roll 31, the latter will be yieldingly held toward the roll 29, so as to yield if any foreign matter should pass between the rolls 29 and 31. This adjustment to vary the space between the rolls 29 and 31 is for the purpose of varying the amount of adhesive transmitted to the roll 29 from the roll 31.

When the machine is stopped, it may be desirable to move both rolls 29 and 31 away from the drum B without affecting the relation between the rolls. This is accomplished by pivoting a link 37 to the casting 28 and to a rocker arm 38 capable of oscillating about the axis of a shaft 39. A hand lever 40 also mounted to oscillate about the axis of the shaft 39 is capable of actuating the rocker arms 38 to shift the position of the casting 28 on the bracket 22. When the casting 28 is made to slide upon the bracket 22, both rolls 29 and 31 move with the casting 28, as they are both mounted thereon. The two rolls 29 and 31 may, therefore, be moved away from the drum B without disturbing the adjustment between the rolls. The dropping of the pan 21 by means of the hand lever 27 permits free access to the rolls and facilitates cleaning.

The position of the adhesive-applying roll 29 should be such that it comes in contact with the ridges of the corrugations on the filler. The roll 29 may be definitely located with respect to the drum B by inserting one or more washers at the connection between the link 37 and the rocker arm 38. As the link 37 passes through a swivel block 41 pivoted to the rocker arm 38, the washers may be conveniently inserted between the end of the swivel block and a shoulder on said link, as indicated at 43. When the handle 40 is in its extreme position to move the casting 28 rearwardly, the presence or absence of washers 43 will determine the distance between the adhesive-applying roll 29 and the drum B.

It will be noted that the teeth 3 on the drum B are flattened to a certain extent and are, therefore, of less height than the teeth 6 and 7 on the corrugating rolls 4 and 5. When the corrugated filler is being carried by the drum, the teeth of the drum, therefore, do not project all the way into the cor-

rugations of the filler. The roll 29 is adjusted so that the adhesive will be applied to the ridges of the corrugations of the filler and, therefore, if the filler does not intervene between the roll 29 and the drum, the adhesive will not be applied to the teeth of the drum. Furthermore, if any openings or holes occur in the filler, the adhesive will not be applied through said openings or holes on to the teeth of the drum, as the tops of the drum teeth are spaced from the roll 29.

Just below the adhesive-applying roll 29 is positioned a knife-bar 44, which runs transversely of the machine and is supported at its extremities on the brackets 22. The bar 44 is provided with a plurality of blades 45 which make line contact with the ridges of the corrugations in the filler to hold the corrugated filler in the corrugations of the drum. As the blades 45 make only line contact with the adhesive coated filler, they remove substantially no adhesive from the ridges of the filler corrugations.

Immediately below the knife-bar 44 is located a roll 46 over which the bottom liner passes and by which the liner is brought into contact with the adhesive coated corrugated filler carried by the drum. As above stated, the bottom liner is supplied to the roll 46 from a supply roll b'. Before reaching the roll 46, however, the bottom liner b is caused to pass over the preheating device E. This preheating device E is shown in detail in Figs. 7 and 8 and comprises a pipe 47 closed at its ends by means of the caps 48 screwed upon its extremities. The inclosed drum so formed is mounted upon two standards or pedestals, indicated at 49 and 50. Each pedestal is provided with a concaved bearing portion shown at 51 in Fig. 7 to receive a hub-like extension 52 on each of the caps 48. These hub-like extensions 52 on the caps are rigidly bolted to the pedestals by means of the yokes 53. Steam is admitted to the interior of the heating pipe through an inlet pipe 54 and discharged through the outlet pipe 55′ shown in Fig. 10.

The bottom liner b is first carried under a guide-roll 55 and then up over the periphery of the heating pipe. It then passes downwardly under a pressure roll 56 and then upwardly to the roll 46 above mentioned.

The pressure roll 56 is adjustable to place the proper tension on the liner passing over the heating pipe and to vary the distance over which the liner passes while in contact with the surface of the heating pipe. This is accomplished by mounting the pressure roll 56 in two arms 57 which are secured to a shaft 58 coaxially disposed with respect to the heating pipe and free to turn with respect thereto. A hand lever 59 also secured to the shaft 58 renders it possible to turn the shaft 58, and hence raise or lower the pressure roll 56. The pressure roll 56 is held in its adjusted position by means of a latch lever 60 at each end of the heating pipe. Each of the latch levers is provided with a plurality of notches or recesses 61 adapted to engage a stud or projection 62 carried by the arms 57 in which the pressure roll 56 is mounted. The latch levers 60 are secured to and oscillate about the axis of a shaft 63 and are actuated by means of a treadle 64 also secured to the shaft 63. When the treadle 64 is depressed, the latch lever 60 is drawn inwardly and permits adjustment of the roll 56 by means of the hand lever 59. The roll 56 is adjusted until the studs 62 register with one of the notches 61, and when pressure is released from the treadle 64, the latch levers 60 are returned by means of the coil spring 65 and support the pressure roll in its adjusted position. The spring 65 just mentioned is coaxially disposed on a rod 66 which swivels about the axis of the shaft 58. The spring 65 reacts against a swivel block 67 carried by an arm 68, which in turn, is secured to the shaft 63. The spring 65, therefore, tends to hold the treadle 64 in its raised position and the latch levers 60 in their operative positions.

When the roll 56 is made to assume one of its lower positions, it is obvious that the extent of the surface contact between the heating pipe 47 and the liner is relatively large whereas when the roll 56 is made to assume its higher positions, the extent of sub-surface contact is relatively small. In this way the heating of the liner, according to its contained moisture, may be regulated by changing the position of the roll 56.

As above stated, the bottom liner b is carried upwardly from the preheating device E just described, over the roll 46 which brings the bottom liner into contact with the corrugated filler on the surface of the drum. A roll 69 aids in bringing the bottom liner into contact with the corrugated filler and in pressing the liner against the filler. The rolls 46 and 69 are unitarily adjustable toward and away from the drum B, due to their being carried by arms 70 which are pivoted to the lower framework at 70′. The levers 70 are oscillated to raise and lower the rolls 46 and 69 by means of a link 71 pivoted to a rock arm 72, which oscillates about the axis of a shaft 73. The rock arm 72 is oscillated about the axis of the shaft 73 by means of a hand lever 74 (Fig. 3). A latch arm 75 moves unitarily with the rock arm 72 and coöperates with a quadrant 76 to lock the parts in their adjusted position. By actuating the hand lever 74, it is obvious that the oscillation of the rock arm 72 will cause the link 71 to raise or lower the rolls 46 and 69.

After leaving the rolls 46 and 69, the corrugated filler now supplied with the bot-

tom liner is carried with the drum until the transfer roll C is reached. The corrugated filler and bottom liner pass around the transfer roll C with the bottom liner adjacent to the surface of the roll C. The unlined side of the filler is, therefore, exposed in passing around the transfer roll C, thus giving an opportunity to apply adhesive to the ridges of the corrugations at the unlined side of the filler. This is done by means of the adhesive-applying mechanism F, which is similar in all respects to the adhesive-applying mechanism D for applying adhesive to the opposite side of the filler. The hand levers for adjusting the rolls toward and away from the transfer roll C and for lowering the adhesive pan are shown at 77 and 78, in Fig. 3, which hand levers correspond with the hand levers 40 and 27, respectively, of the previously described adhesive-applying mechanism.

The top liner *c*, in case the filler is to be lined on both sides, is applied to the corrugated filler as the latter reaches the upper part of the transfer roll C. The top liner is conducted to this point from the supply roll *c'*, over an idler roll 79, to and under an adjustable tension roll 80, and from thence over the periphery of the preheating device G, from which it passes under an adjustable pressure roll 81 to the filler on the transfer roll C. The said preheating device G and the tension roll 80 are substantially the same in construction and function as the preheating device E and the tension roll 56 about which the lower liner passes.

The preheating device or drum G is carried by castings 91 which are supported at one end on the rod 92 and at their opposite ends on brackets 92′ secured to other brackets 93 which serve to support the idler roll 79. As here shown, screws 94 are employed as a means to secure the outer ends of the castings 91 in connection with the brackets 92′.

The tension roll 80 is mounted in arms 95 which depend from and oscillate about the axis of a shaft 96 passing through the heating drum G. A hand lever 97 (Fig. 3) serves to swing the arms 95 about the shaft 96, and hence adjust the position of the roll 80. A latch pin 95′ (Fig. 2) on one of the arms 95, engaging the casting 91 in one of a series of holes 95″ therein, serves as a means to hold the roll 80 in adjusted position.

The pressure roll 81 above referred to, which directs the upper liner on to the filler passing over the transfer roll or drum C, is preferably supported with its axis slightly forward of the axis of the transfer roll C and sufficiently low to bring the top liner into contact with the filler before the filler reaches the highest point of the roll C, whereby a better union is effected between the filler and the top liner, since the top liner is applied to the filler while the filler is curved about the surface of the roll C. When the filler straightens out, there will be a slight relative movement between the filler and top liner, which will bring about a more intimate contact between the two and effect a better union.

The pressure roll 81 may be supported in any suitable or desired manner. As here shown, it is supported in a pair of swinging arms 82 each adapted to swing about an axis 83. These arms 82 are raised and lowered by means of links 84 pivoted at their lower ends to the arms 82 and at their upper ends to rock arms 85 adapted to be actuated about the axis of a shaft 86 by means of a hand lever 87. The hand lever 87 is provided with a latch device 88 (Fig. 3) which controls the insertion of a pin in and the removal of such pin from the perforations 89 provided in a quadrant 90. By adjusting the position of the hand lever 87, it is obvious that the pressure roll 81 may be swung about the axis 83 and be adjusted with respect to the transfer roll C whereby to vary the extent of relative movement between the liner and filler hereinbefore referred to.

The corrugated filler now lined on both sides is caused to pass between the pressure bed and the heating bed, denoted generally by the reference character J in Fig. 1. This part of the machine comprises a hollow casting 98 (Fig. 2), over which the lined corrugated filler is drawn by means of the pull rolls 99. Steam is admitted to the casting 98 through the inlet 100 and discharged through the outlet 101. At the rear of the casting 98 are located plates 102, over which the lined corrugated filler passes before the rolls 99 are reached and under which are placed a plurality of steam coils 103 (Fig. 12). The plates 102 are provided with openings or perforations 104 to permit the heat of the coils 103 to act directly upon the lined corrugated filler. The casting 98 and the plates 102 are supported upon I-beams 105 (Fig. 5), which run longitudinally of the machine and which are supported at their forward ends upon the main framework of the machine and at their rear ends upon a supporting structure 106.

The pressure bed above referred to is located above the casting 98 and the plates 102 and comprises an adjustable bed carrying a plurality of pressure devices, here shown in the form of brushes, which press against the lined filler as it passes over the heating bed 98 and the plates 102. In this manner, the liners are firmly pressed on the corrugated filler and the lined filler is brought into intimate contact with the heating bed and plates. The adjustable pressure bed is shown in Figs. 1, 2, 5 and 6 and com-

prises longitudinal I-beams 107, which are secured to the end cross pieces 108. The under surfaces of the I-beams 107 have secured thereto, a plurality of short angle irons 109 to which the extremities of transverse brush-carrying bars 110 are secured by means of the clips 111. (See Figs. 2 and 5). Each of the brush bars 110 carry a plurality of brushes 112.

Secured to the first pair of angle pieces 109 is a transverse angle bar 113, to which is secured a sheet of canvas or other flexible material 114 passing rearwardly under the brushes. The canvas intervening between the brushes and the lined filler evenly distributes the pressure of the brushes over the surface of the lined filler.

The pressure bed just described is supported at its four corners upon stationary threaded uprights 115. Each of these uprights is supported upon a stationary part 116 of the framework. A sleeve 118 having an internally threaded portion at its upper end rotates upon each of the threaded uprights 115. The forward pair of sleeves 118 support the extremities of the forward cross member 108 and the rear pair support the extremities of the rear cross member 108. This is accomplished by providing each sleeve at its lower end with a shoulder 119 which supports the extremity 120 of the corresponding cross member 108, in a manner clearly shown in Fig. 5.

The four sleeves 118 are each provided at its upper end with a beveled gear 117, and these four gears and attached sleeves (Fig. 6) are rotated in unison, due to the provision of a cross shaft 121 which rotates the two beveled gears 117 and attached sleeves of the rearmost pair and a cross shaft 122 which likewise rotates the two beveled gears 117 and attached sleeves of the forward pair. Each of the shafts 121 and 122 are provided at their extremities with beveled pinions 123 meshing with the corresponding beveled gear 117. The two cross shafts 121 and 122 are driven from a common connecting shaft 124 through the intermediary of two sets of meshing beveled gears 125 and 126. When the shaft 124 is rotated, it is obvious that all of the beveled gears 117 and attached sleeves will be rotated to raise and lower the cross members 108 and the pressure bed. The shaft 124 is rotated in either direction from a driving shaft 126′, which in turn, is driven from a sprocket 127. The shaft 126′ carries a beveled pinion 128 meshing with two crown gears 129 and 130. These gears are loosely mounted upon the shaft 124 and either of the same may be operatively connected with said shaft by means of a clutch member 131 operating between the crown gears 129 and 130. The clutch member 131 is keyed to the shaft 124 and may frictionally engage either the gear 129 or 130 to operatively connect the same with the shaft 124. The position of the clutch member 131 is controlled by means of a hand lever 132. When the clutch member 131 engages with one of the two crown gears, the pressure bed will be raised and when it engages with the other of the two crown gears, the pressure bed will be lowered.

As will be noted from Fig. 9, the drum B, the transfer roll C and the pressure roll 81 are positively driven from a drive shaft 133 through a train of gearing. A pinion 134 on the drive shaft drives a reducing gear 135. A pinion 136 rotating with the gear 135 meshes with the drum gear 137. The drum gear 137 drives the transfer roll C through the gears 138, 139 and the gear 140 secured to the transfer roll C. The pressure roll 81 has its gear 141 driven from the gear 139 through the intermediary of the intervening gear 142. As the gear 142 is coaxially disposed with respect to the stud 83 about which the pressure roll 81 oscillates, it is obvious that the adjustments of the pressure roll 81 will not throw the gears 141 and 142 out of mesh.

The gear 138 rotates unitarily with a beveled gear 143 which, in turn, drives a beveled gear 144 secured to a shaft 145 running back to the pull rolls 99. The pull rolls 99 are rotated from the shaft 145 by the train of gearing, denoted generally by the reference character 146.

The two rolls of each adhesive-applying mechanism are rotated from the drive shaft 133 by means of a chain 147 passing over the sprockets 148, 149, 150, 127, 151, 152 and 153. The sprockets 151 and 152 are associated with the upper and lower adhesive-applying mechanism, respectively. The upper sprocket 151 drives the two adhesive rolls through the intermediary of the gears 154 and 155 associated with the rolls, and the lower sprocket 152 drives the two rolls of the lower adhesive-applying mechanism through the intermediary of the gears 156 and 157 associated with the two rolls. The sprocket 127 also driven by means of the chain 147 serves to raise and lower the pressure bed in the manner above described. The drive shaft 133 is rotated by means of a drive pulley 158 (Fig. 3).

If so desired, clutch mechanism, denoted generally by the reference character 159, may be provided to connect the driving pulley 158 with the driving shaft 133 and to disconnect it therefrom. This clutch mechanism may be controlled from a hand lever 160 mounted to oscillate about the axis of the shaft 73, and having connection with the clutch mechanism by means of the link 162 (see Figs. 2 and 3). If so desired, the adhesive rollers of each adhesive-applying

mechanism may be provided with clutches to disconnect the same from the driving mechanism.

Not only are the preheating devices E and G supplied with steam, but means is provided for supplying the interior of the corrugating rolls and the drum with steam. Steam is also supplied to the heating bed and the heating coils under the pressure bed, as above stated. The steam may be supplied to all of these parts by any suitable system of piping, but preferably that disclosed in Figs. 10 to 12, inclusive, is employed. It will be noted from these figures that steam is supplied to the preheating devices E and G through pipes 163, 164 and 165 (see particularly Fig. 10). A branch pipe 166 conducts steam to the corrugating rolls through pipes 167 and 168. The drain pipe for the preheating device G is shown at 169 and joins the drain pipe 170 for the preheating device E at 171. The drain pipes for the corrugating rolls are shown at 172 and 173 and discharge into the common drain pipe 174. Before the steam is supplied to the drum and the heating bed by the pipe 166, it is caused to pass through a reducing valve 175 to reduce the pressure of the steam. After the steam passes through the reducing valve 175, part of the steam is supplied to the heating bed through the bed inlet pipe 176 and part of the steam is delivered to the drum through the drum supply pipe 177. The drain pipe for the drum is shown at 178 and the drain pipe for the heating bed is shown at 179. The heating coils 103 are supplied by means of a continuation 166′ of the pipe 166 and the drain from said coils is carried through the pipe 179, which also serves to drain the heating bed. The system may be provided with as many valves as necessary and pressure gages at various points, as indicated in the drawings.

It has been found in practice that if the corrugations formed on the filler are of the same size as the teeth on the drum which receive the corrugations, the corrguated filler in expanding, after being corrugated, tends to spring away from the drum. This may be avoided by making the corrugations on the filler of less pitch than the teeth on the receiving drum. By referring to Fig. 13, it will be seen that the teeth on the corrugating rolls may be so constructed with respect to the teeth on the receiving drum that the corrugations formed on the filler will be of less pitch than the pitch of the teeth on the receiving drum. The difference between the pitch of the corrugations on the filler and the pitch of the teeth on the receiving drum should be such that the expansion of the corrugated filler board will make the corrugations of substantially the same size as the teeth on the receiving drum. It may even be desirable to make the corrugations of the filler sufficiently small with respect to the size of the teeth on the drum to necessitate a slight stretching of the filler corrugations, in order to make them fit in the corrugations of the drum. There would then be no tendency for the corrugated filler to spring from the surface of the drum from the time it is received thereon to the time when it is held on to the surface of the drum by the bottom liner.

It will be noted from Fig. 13 that the pitch of the teeth on the drum B is greater than the pitch of the teeth on the corrugating rolls 4 and 5. The corrugations on the filler will, therefore, be of less pitch than the pitch of the teeth on the drum B, and when they expand will be of just sufficient size to be accommodated by the teeth of the drum or will have to be slightly stretched in order to be accommodated by the drum teeth. In either instance, the filler will not have a tendency to spring from the surface of the drum, as would be the case if the filler corrugations were the same size or pitch as the drum teeth and allowed to expand to a greater pitch.

The operation of the entire machine will be largely obvious from the foregoing description. Assuming that the three webs of material, that is, the straw-board or filler and the paper liners, have been properly threaded through the machine and that the machine has been set in operation, the various positively driven parts of the machine will feed the webs of material through the machine and the completed product will be discharged by the pull rolls 99 which draw the lined corrugated filler over the heating bed and under the pressure bed. The filler *a* in passing between the corrugating rolls 4 and 5 is corrugated and heated, and then the corrugated filler is transferred to the surface of the drum. The corrugations of the filler fit in the corrugations of the drum and the filler is, therefore, carried around with the drum to the transfer roll C. The adhesive applied to the ridges of the corrugations of the filler by the adhesive-applying mechanism D causes the bottom liner *b*, conducted to the drum by the mechanism above described, to adhere to the filler. As the filler and liner are both heated, they are substantially dry and in good condition to receive the adhesive. The bottom liner as above stated, is preheated by being passed over the preheating device E and is kept under proper tension while being passed over said device by the pressure roll 56. The various rolls over which the bottom liner passes keeps the liner under proper tension and draws the same against the corrugated filler on the surface of the drum. When the filler and bottom liner are re-

moved from the drum by the transfer roll C, adhesive is applied to the other side of the filler by the adhesive-applying mechanism F in the manner above described, if the filler is to receive a second liner, but if it is desired to make single-faced board, the adhesive-applying mechanism F may be rendered inoperative by withdrawing the adhesive rolls from operative relation with respect to the transfer roll C. The top liner *c*, in the event that one is used, is preheated by the preheating device G and then conducted to the transfer roll C and brought in contact with the filler by means of the adjustable pressure roll 81. The corrugated filler then lined on both sides is drawn under the pressure bed and over the heating bed. The pressure exerted upon the material as it passes over the heating bed may be regulated by means of the raising and lowering mechanism above described, which is thrown into and out of operation by the hand lever 132.

As above stated, the adjustment of the roll 81 permits the top liner to be applied to the filler while the filler is on the curved surface of the roll C, and, therefore, when the filler straightens out, a wiping action will take place between the filler and the top liner to effect a better union between the two.

The independent adjustments of the rolls of each adhesive-applying mechanism and the combined adjustment of the two rolls of each mechanism, together with the independent adjustment of the adhesive pan, permits the two rolls of each mechanism to be quickly withdrawn from the drum without affecting the adjustment between the two rolls of each pair and permits the pan to be dropped away from the rolls to facilitate inspection and cleaning. Furthermore, the means for adjusting the adhesive-distributing roll of each mechanism with respect to the adhesive-applying roll permits the proper amount of adhesive to be applied to the corrugated filler. Any foreign matter passing between the rolls will cause the distributing roll to yield, but it will return to its predetermined adjusted position with respect to the adhesive-applying roll. When both rolls are withdrawn from their operative position and returned, they will assume the same initial position, as the movement of the rolls toward the drum is positively limited and regulable. When the rolls are positioned in their proper relation with respect to the drum, the independent adjustment of the distributing roll does not affect the position of the adhesive-applying roll with respect to the drum.

It will be understood that the preheating of the liners may be dispensed with if they are sufficiently dry, as they will then readily absorb the adhesive and the heat of the drum and heating bed may be sufficient to dry and set the adhesive.

Although the machine has been described in its preferred form, it is obvious that numerous modifications and changes may be made in the details of construction, without departing from the spirit or scope of the invention, as defined in the accompanying claims.

What I claim is:—

1. In a corrugating machine, the combination of a corrugated drum, toothed corrugating rolls, means to transfer material corrugated by said rolls to the drum, the teeth on said corrugating rolls being of less circumferential pitch than the teeth on said drum, and means to operate upon the corrugations of the material during its passage about the drum.

2. In a corrugating machine, the combination of toothed corrugating means, corrugated means to receive the material corrugated by said corrugating means, the teeth on said corrugating means being of less pitch than the teeth on said corrugated receiving means, and means for operating upon the corrugations of said material during its passage over the receiving means.

3. In a corrugating machine, the combination of a grooved receiving member adapted to receive corrugated material, and corrugating means adapted to corrugate material with corrugations which are smaller than the size of the grooves in said receiving means, and means for operating upon the corrugations of said material during its passage over the receiving means.

4. In a machine of the kind described, the combination with means for corrugating material, of adhesive applying mechanism, means for receiving the corrugated material and for holding the same in proper relation with the adhesive applying mechanism, said adhesive applying mechanism including an applying roll and a distributing roll, means to adjust the distributing roll toward and away from the applying roll, means to positively limit the movement of the distributing roll toward the applying roll, and means to yieldingly hold the distributing roll in the extreme position determined by said limiting means.

5. In a machine of the kind described, the combination with means for corrugating material, an adhesive applying mechanism, means for holding the corrugated material to be treated in proper relation with the adhesive applying mechanism, said adhesive applying mechanism including an applying roll and a distributing roll, means to adjust the distributing roll toward and away from the adhesive applying roll, adjustable means to determine the limit of the movement of the distributing roll toward the adhesive roll, means to yieldingly hold the distribut-

ing roll in the extreme position determined by said limiting means, and means operable independent of the adjustment of the distributing roll to move both rolls unitarily away from said material holding means.

6. In a machine of the kind described, the combination of an adhesive-applying mechanism, a drum for moving the material to be coated with adhesive in proper relation with said mechanism, a roll positioned below said adhesive-applying mechanism for bringing a liner into contact with the adhesive-coated material on said drum, means for adjusting the parts of said adhesive-applying mechanism toward and away from said drum, and independent means for adjusting the position of said roll toward and away from said drum.

7. The combination with mechanism for lining a web of paper and the like, of a heating bed, a pressure bed between which and the heating bed the lined web passes, and a plurality of transversely arranged rows of pressure devices carried by said pressure bed, for the purpose described.

8. The combination with mechanism for lining a web of paper and the like, of a heating bed, a pressure bed between which and the heating bed the lined web passes, said pressure bed comprising a plurality of transversely arranged rows of pressure devices and being adjustable with respect to the heating bed, and a plurality of pressure devices carried by said pressure bed, for the purpose described.

Signed at Rochester, in the county of Monroe and State of New York, this 22d day of December, A. D. 1915.

EDGAR M. HAWKINS.

Witnesses:

F. A. Collins, Jr.,

Thos. D. Patton.