July 31, 1945. J. U. FORBES 2,380,512

MACHINE FOR MAKING MULTI-PLY BOARDS

Filed July 18, 1942 5 Sheets-Sheet 1

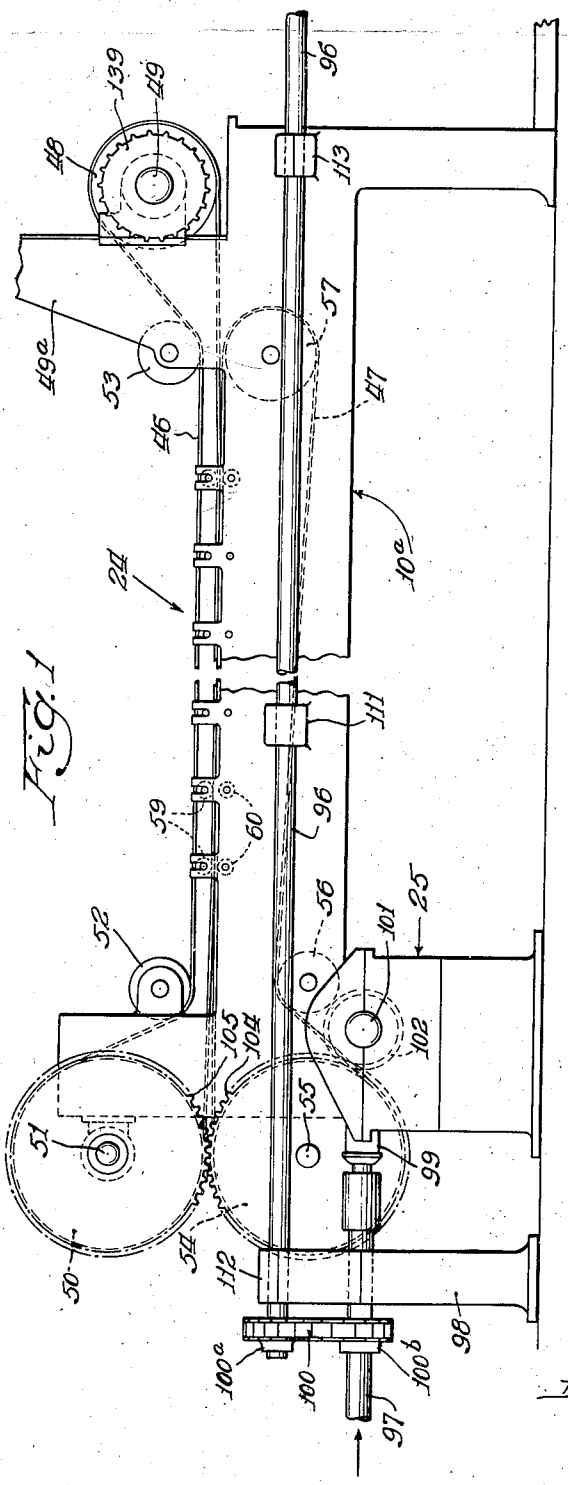


Fig. 1

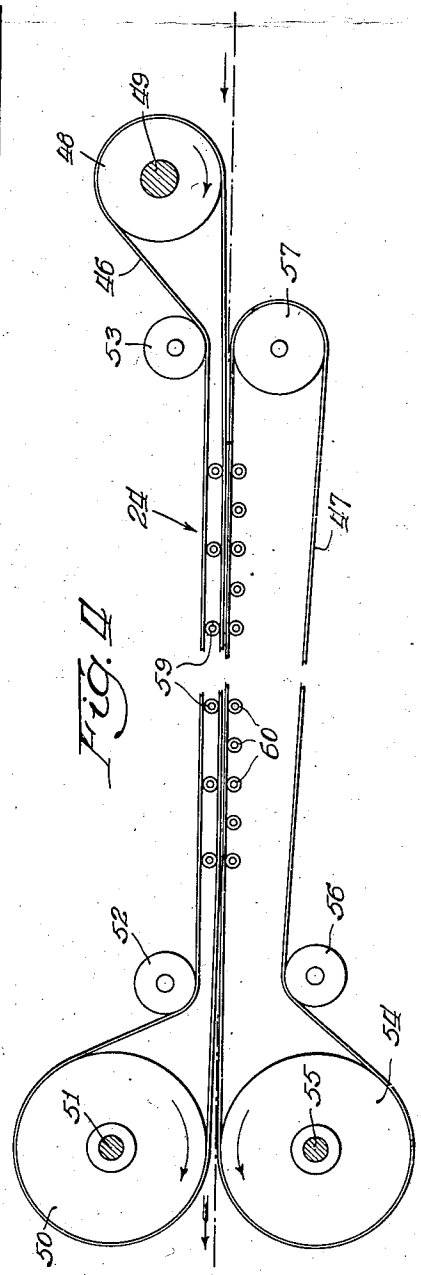


Fig. 2

Inventor:
Jerry U. Forbes
By: E. A. Wagonseller

July 31, 1945. J. U. FORBES 2,380,512

MACHINE FOR MAKING MULTI-PLY BOARDS

Filed July 18, 1942 5 Sheets-Sheet 2

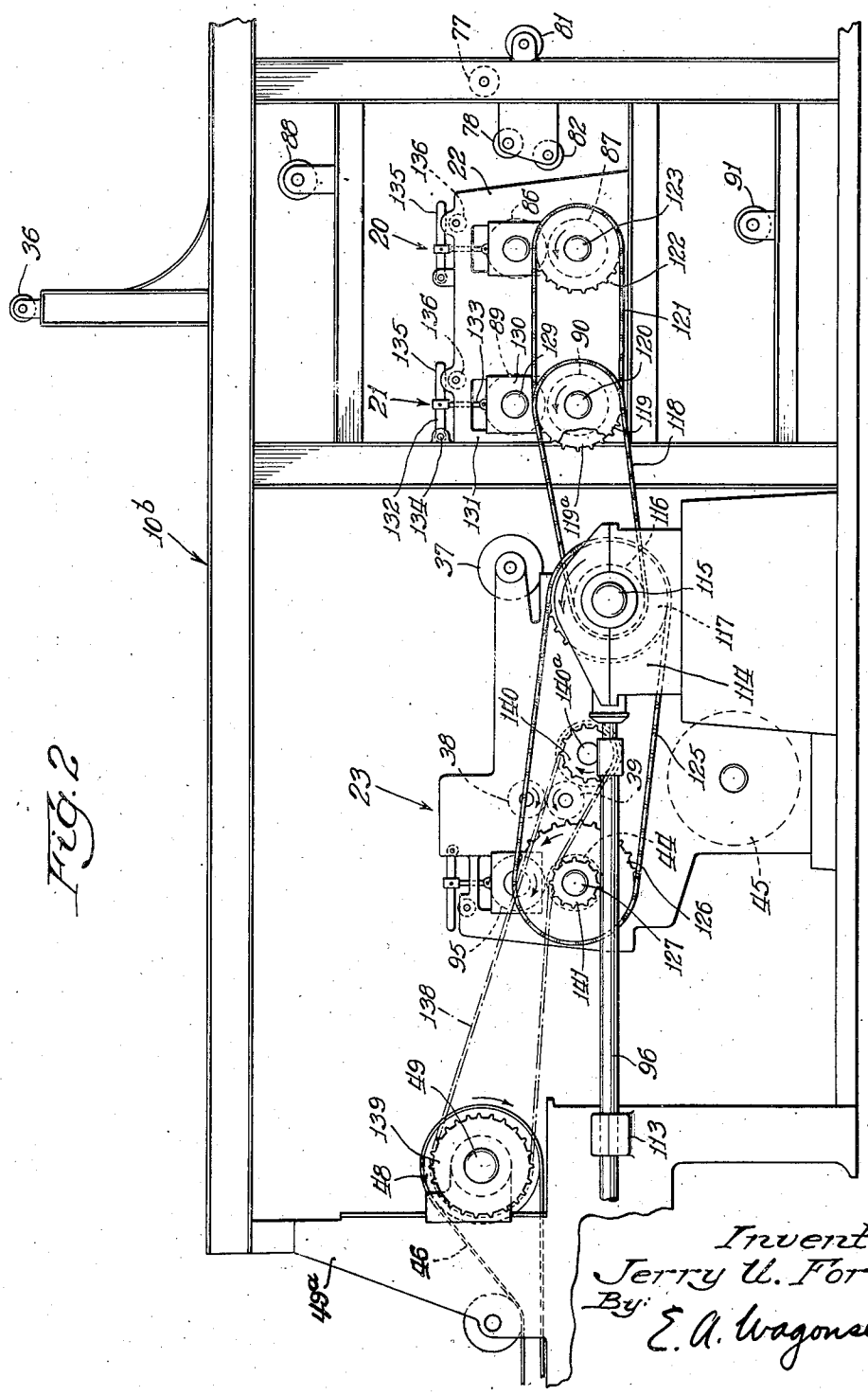


Fig. 2

Inventor:
Jerry U. Forbes
By: E. A. Wagonseller
Atty

July 31, 1945. J. U. FORBES 2,380,512

MACHINE FOR MAKING MULTI-PLY BOARDS

Filed July 18, 1942 5 Sheets-Sheet 3

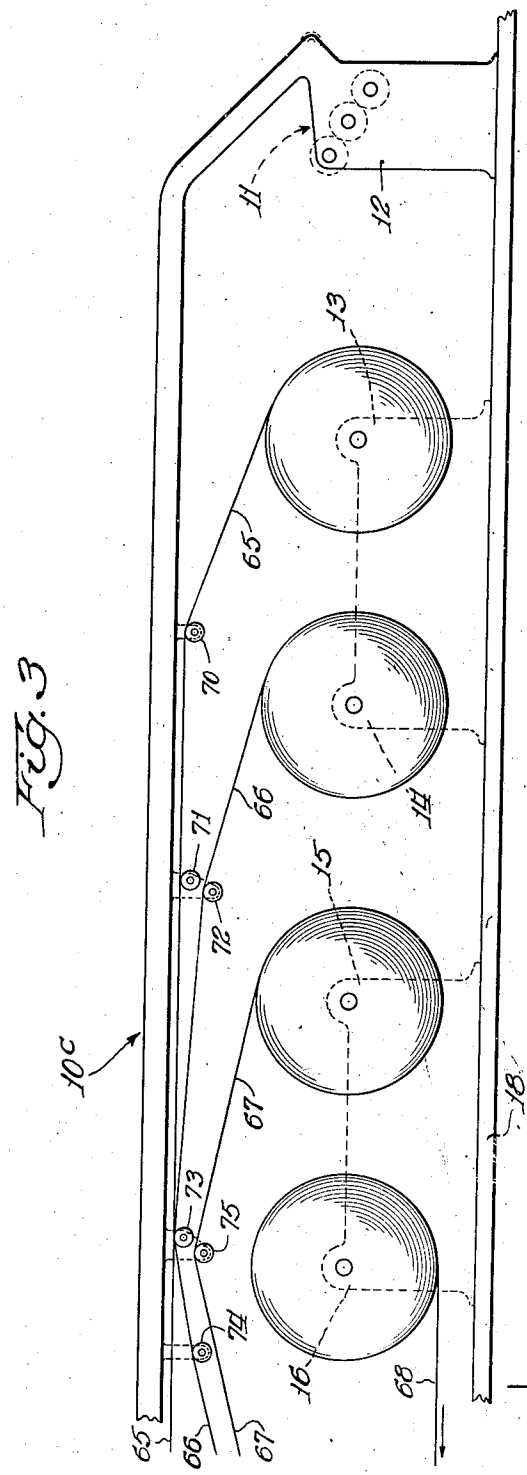


Fig. 3

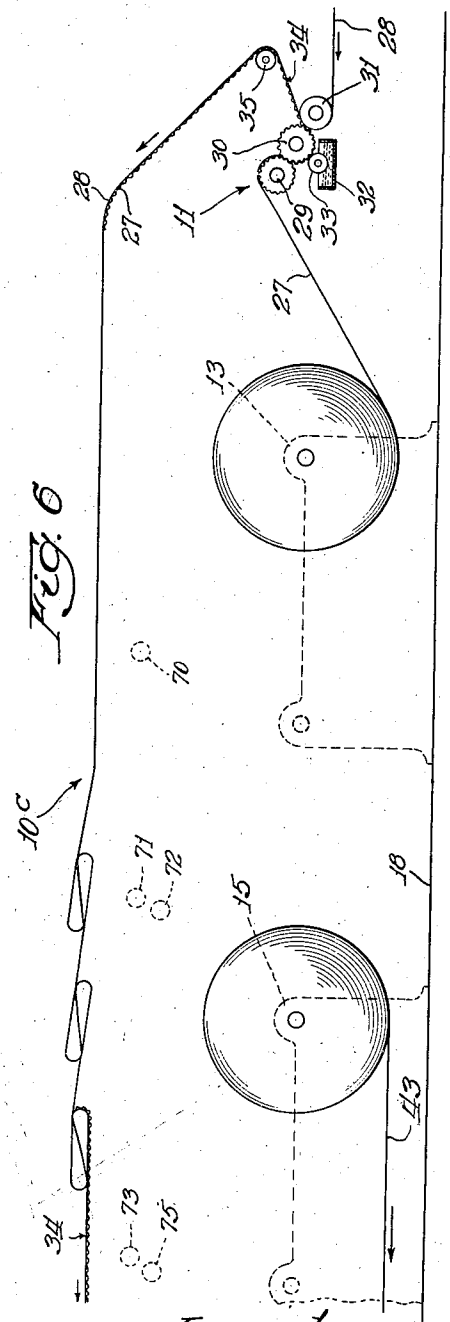


Fig. 6

Inventor:
Jerry U. Forbes
By: E. A. Wagonseller
Atty.

July 31, 1945. J. U. FORBES 2,380,512

MACHINE FOR MAKING MULTI-PLY BOARDS

Filed July 18, 1942 5 Sheets-Sheet 4

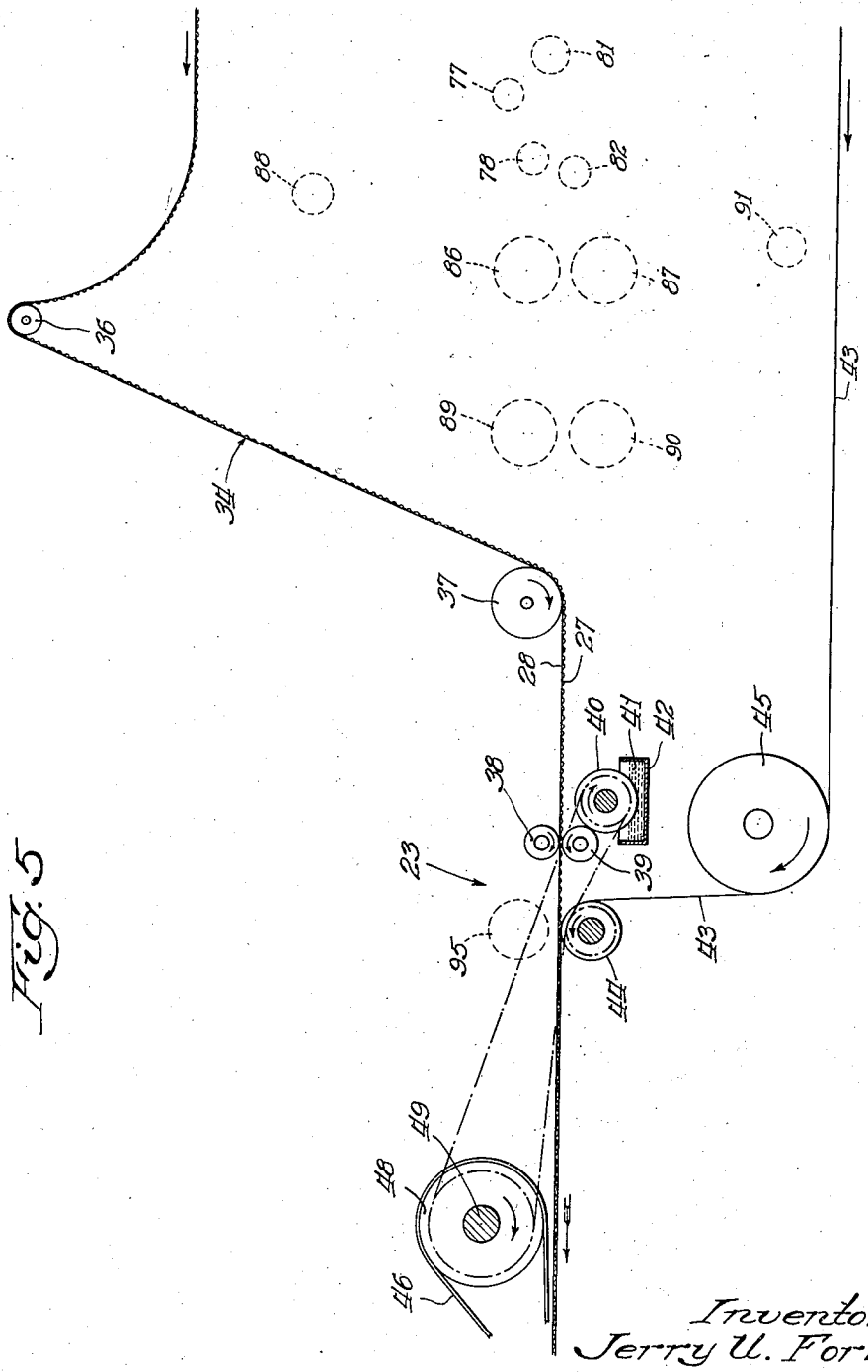


Fig. 5

Inventor:
Jerry U. Forbes
By: E. A. Wagonseller
Atty.

July 31, 1945. J. U. FORBES 2,380,512

MACHINE FOR MAKING MULTI-PLY BOARDS

Filed July 18, 1942 5 Sheets-Sheet 5

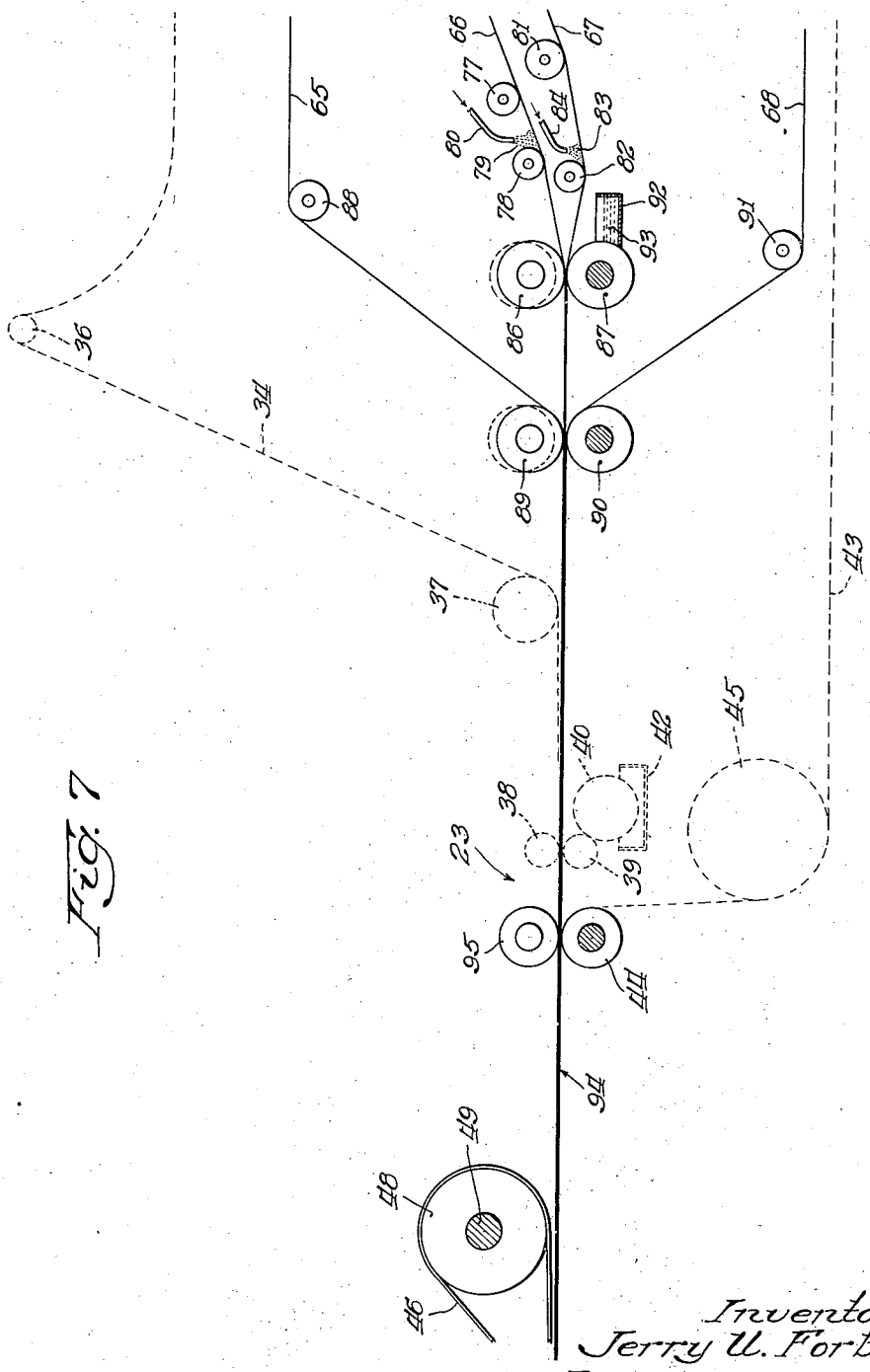


Fig. 7

Inventor:
Jerry U. Forbes
By: E. A. Wagonseller
Atty.

Patented July 31, 1945 2,380,512

UNITED STATES PATENT OFFICE

2,380,512

MACHINE FOR MAKING MULTIPLY BOARDS

Jerry U. Forbes, Cincinnati, Ohio, assignor to Container Corporation of America, Chicago, Ill., a corporation of Delaware

Application July 18, 1942, Serial No. 451,441

3 Claims. (Cl. 154—37)

The present invention relates to a method of and apparatus for the production of multi-ply sheet material and more particularly to the production of sheets of multi-ply corrugated paper board and solid fibre board.

A primary object of the present invention is to provide an apparatus for selectively forming an improved solid fibre board and a multi-ply corrugated paperboard, such apparatus being capable of being easily and rapidly converted for the production of either one form of material or the other.

Other objects of the present invention are generally to improve and simplify the mechanism and apparatus for the production of solid fibre board and corrugated paperboard, to utilize parts usually employed for one form of paperboard in the production of the other form of paperboard, the parts being assembled in a single, relatively compact unit whereby duplication of costly machine parts is avoided and valuable factory floor space is conserved.

Additional and more specific objects will become apparent as the description proceeds.

The machine which embodies the present invention is particularly useful in sheet fabricating plants in a locality in which there is a demand for only limited quantities of corrugated paperboard and solid fibre board, and where the demand is not great enough to justify the maintenance and operation of specialized machinery adapted solely for each of these types of paperboard. The disclosure made therein teaches how a standard, or conventional, form of double-face corrugated paperboard machine can readily be converted into a machine having a dual operating facility so that the machine when constructed can be prepared by a few simple changes and adjustments for the efficient production of solid fibre board.

In the drawings, illustrating a preferred embodiment of the present invention:

Fig. 1 is a side elevation of the discharge end of a combined corrugated and solid fibre pasting machine made in accordance with the present invention;

Fig. 2 is a side elevation of another portion of such machine, such portion being located immediately to the right of the portion illustrated in Fig. 1;

Fig. 3 is a side elevational view of a third portion of the machine, but on a somewhat smaller scale, such portion being located immediately to the right of the portion illustrated in Fig. 2;

Fig. 4 is a somewhat schematic side elevational view of the sheet conveying elements illustrated in Fig. 1 with the framework of this portion of the machine omitted;

Fig. 5 is a schematic side elevational view of a portion of the machine illustrated in Fig. 2 with the framework of the machine omitted, the parts being indicated as adjusted for the manufacture of three-ply or so-called double-face corrugated board;

Fig. 6 is a schematic side elevational view of the portion of the machine illustrated in Fig. 3 when this portion is used in the manufacture of three-ply or double-face corrugated board; and

Fig. 7 is a schematic side elevational view of the portion of the machine illustrated in Fig. 2 with the framework of the machine omitted, the parts of this portion of the machine being shown as adjusted for the manufacture of a continuous sheet of four-ply solid fibre board.

The machine embodying the present invention generally comprises: (*a*) a roll supporting section for supplying a plurality of continuous sheets or webs of paper or paperboard which are either to be made into multi-ply corrugated board or multi-ply solid fiber board; (*b*) a single-face corrugating unit; (*c*) a gluing and squeeze-roll section for joining the several sheets which are to be made up into a sheet of multi-ply solid fibre board; (*d*) a double-facer unit comprising adhesive applying elements for applying a liner sheet onto the single-face sheet; and (*e*) a conveying and drying section for carrying the double-face corrugated, or the solid fibre, sheet, whichever is being produced, away from the forming and assembling section whereby the composite sheet, being produced, has ample time for its adhesive to become set before it is cut into the desired lengths at the discharge end of the machine.

Referring more particularly to the drawings, the machine, as herein disclosed, is constructed on a suitable frame, the various parts of which, illustrated in Figs. 1, 2 and 3, are, for convenience of description, designated generally at 10*a*, 10*b* and 10*c*. The single-face corrugating unit is indicated generally at 11, being mounted in a portion 12 of the frame 10*c*.

A plurality of roll supporting members, herein designated at 13, 14, 15 and 16, are suitably mounted on the base member 18 of the machine portion 10*c*. As shown in Fig. 3, as many as four rolls can be supported on the roll-supporting members to form solid fibre board, but when it is desired to form three-ply corrugated board, only two of these roll supporting members will

usually be employed and a third roll supporting member, not shown, will be provided on the opposite side of the single face unit. The roll on the supporting member 13 will preferably be used to supply the inner corrugated sheet while the roll on the supporting member 15 will be used as the liner to be applied to the single face corrugated board at the double-facer unit.

The parts on the frame section 10b comprise essentially two squeeze-roll, or press-roll, units 20 and 21 located on the frame section 22 and designed for use with solid fibre board; a composite double-facer and squeeze-roll unit generally indicated at 23, for selectively applying the second liner sheet to complete the double face corrugated board and for applying smoothing-out pressure to the completed solid fibre board; and suitable driving and transmission mechanism which will be referred to in detail as the description proceeds.

The essential parts located on or associated with the frame section 10a are the sheet drying conveying mechanism 24, and a change-speed and reduction gear unit, indicated generally at 25, constituting a main driving means through which a motor (not shown) is connected to drive all the various parts except the single face corrugating unit.

The machine of the present invention is adapted to feed the completed sheet of corrugated or solid fibre board to a cut-off knife (not shown) which is located just beyond the discharge end of the drying conveyor 24 illustrated in Fig. 1. The specific problem which has been solved by the present invention is that of rapidly converting an efficient corrugated board machine into an equally efficient machine which will produce satisfactory multi-ply solid fibre board. The machine includes parts which are normally idle or inoperative when corrugated board is being produced and likewise includes other parts that remain idle or inoperative when solid fibre board is being produced. The advantage, as will be later more fully pointed out, is in being able alternately to manufacture either corrugated board or solid-fibre board along the same production line, using certain common items of equipment which must be employed, such as the usual cut-off knife, the motor for driving the various mechanisms, roll stands, supporting framework and other auxiliary parts.

For the purpose of a clear understanding of the machine, it will be described first from the standpoint of its use as a corrugating mechanism, and, thereafter from the standpoint of the solid fibre pasting mechanism.

In the manufacture of three-ply corrugated board, it is desirable to operate the single-facer independently of the double-facer and also to accumulate an excess supply of single-face board ahead of the duoble-facer unit where the second liner is applied. For this purpose the single-facer unit is preferably located in a position in advance of the roll-supporting members as indicated in Figs. 3 and 6. As this single-facer unit 11 is quite well known in the art, it is considered that a brief description will suffice. The web to be corrugated is indicated at 27 in Fig. 6, being in the form of a roll, located on the roll supporting member 13. The liner web to be applied to the corrugated web is indicated at 28 and is supplied from a roll, not shown. The web 27 passes between grooved or fluted rolls 29 and 30 which form the web into a series of corrugations. A motor (not shown) is connected to one or the other of the rolls 29 or 30 to drive the single-facer unit. The liner web 28 passes around roll 31 and is joined to the corrugated web by means of adhesive supplied from a pan 32 in which an adhesive-applying roll 33 is located in such a position as to carry adhesive from the pan to the crests of the corrugations of the corrugated web just prior to its leaving roll 30.

The single-face corrugated sheet, designated at 34, then passes up around a roll 35 to a belt conveyor (not shown) located in the frame 10c which carries the single-face sheet in the direction of the double-facer unit.

Referring now to Fig. 5, the single-face sheet, after it leaves the conveyor in frame 10c is directed over a roll 36 mounted on the frame 10b, thence downward below a guide roll 37, and thence horizontally between rolls 38 and 39 where adhesive is applied to the crests of the corrugations by means of a fountain roll 40 rotating in a supply of adhesive 41 in the pan 42. The single-face sheet, with adhesive upon the exposed crests of its corrugations, passes on to meet a liner sheet 43 as or somewhat after it passes over roll 44. The liner sheet 43 is preferably supplied from a roll supported on roll supporting member 15. This sheet is directed forwardly and passes under a preheater roll 45 after which it is directed upwardly to the roll 44.

The sheet, now in the form of double-face corrugated board, passes on to the sheet conveying mechanism 24. This conveying mechanism is preferably of a generally conventional form and comprises in the present instance upper and lower endless belts indicated, respectively, at 46 and 47. The upper belt 46 passes over a suitable roll 48 mounted on a shaft 49 supported by the upright portion 49a of frame section 10b. The roll 48 is arranged to rotate in a clockwise direction, as viewed in Figs 1, 2, 4 and 5, so that the lower reach of belt 46 will move toward the left. The arrangement is such that the lower reach of belt 46 will bear against the upper surface of the completed sheet. At its discharge end, the belt 46 passes around a driven roll 50 mounted on a shaft 51 which also rotates in a clockwise direction. The upper reach of the belt 46 is brought somewhat downwardly beneath rolls 52 and 53 from which it passes around the first mentioned roll 48.

The belt 47 passes around roll 54, mounted on shaft 55, journaled in the frame section 10a, and rotating in a counter-clockwise direction. After leaving roll 54 the belt passes over rolls 56 and 57. The upper surfaces of rolls 54 and 57 are so disposed as to bring the belt in contact with the lower surface of the double face sheet. Thus, the two belts, due to their passing around the driven rolls 50 and 54, engage the double-face corrugated sheet between them and draw the sheet toward the left as viewed in the figures of the drawings.

A plurality of upper rollers 59, 59 and lower rollers 60, 60 are mounted on shafts journaled in the frame 10a and are arranged to bear respectively against the upper surface of the lower reach of belt 46 and against the under surface of the upper reach of belt 47. When corrugated board is being conveyed through the conveyor 24, heat is preferably supplied by means of steam glands or boxes located intermediate the rollers 60, 60, thus applying heat to the corrugated board through the belt 47. In this manner the adhesive connecting the corrugated web with the

liner webs will be caused to become set in a shorter time than if heat was not supplied.

The means for driving the various parts of the corrugating mechanism will be described after the description of the solid fibre pasting mechanism which follows.

The solid fibre sheet may be composed of any convenient number of laminations but, in the present instance, the production of a sheet having four laminations is illustrated. For this purpose, there will be provided four webs 65, 66, 67 and 68 respectively, in the form of rolls, supported on the roll supporting members 13, 14, 15 and 16. Webs 65 and 68 are the two outer webs or the liners for the solid fibre sheet. In order to guide the webs 65, 66 and 67 to the adhesive-applying and squeeze-roll section, there is provided a suitable number of idler rolls, mounted on shafts, journaled in brackets depending from the under side of the frame section 10c. As illustrated, idler rolls 70 and 71 will support the web 65 for part of its movement; rolls 72, 73 and 74 support the web 66; and roll 75 supports the web 67. The web 65 may also be conveniently supported by contacting the web 66 at the point where this latter web runs over roll 73.

Referring now to Fig. 7, showing the webs entering the adhesive-applying and squeeze-roll section, one of the inner webs 66 is directed beneath spaced idler rolls 77 and 78, journaled on the frame section 10b, between which a coating of adhesive 79 is applied from a series of nozzles, one of which is indicated at 80. In a similar manner web 67 passes beneath idler roll 81 and adhesive spreading roll 82 located just beyond the point of application of another film of adhesive 83 supplied from a series of nozzles, one of which is indicated at 84. In each case the adhesive 79 and 83 is applied on the upper surfaces of the webs 66 and 67.

These two webs are then directed in between upper and lower squeeze rolls, or press rolls, 86 and 87, which are arranged, as will be presently described, to exert a considerable degree of pressure on the two webs 66 and 67 to bring them into close facial contact. It is to be noted that the adhesive 83 causes adherence between these two webs.

For the purpose of bringing the outer two webs 65 and 68 into adhering relation to the inner group of adhering webs, web 65 is directed over idler roll 88 and then downwardly between squeeze rolls 89 and 90. The web 68 is directed over idler roll 91 and thence upwardly between the same squeeze rolls.

The application of adhesive to the upper surface of web 66 has already been described. Adhesive is also applied to the lower surface of web 67 and for this purpose there is provided a pan 92 having a quantity of adhesive 93 therein. The edge of the pan is placed closely adjacent to the surface of roll 87 so that rotation of the roll, in contact with the liquid adhesive, will direct a continuous film of adhesive against the under surface of the web 67. Thus the assembled group of webs 66 and 67 will have adhesive on the upper and lower sides as the assembled webs pass through the first set of squeeze rolls 86 and 87.

The group 66 and 67 of assembled webs will next be directed in between the second pair of squeeze rolls 89 and 90 but as webs 65 and 68 are also directed in between these same rolls, the web group 66 and 67 will consequently pass in between the webs 65 and 68 to form a four-ply solid fibre sheet.

The completed solid fibre sheet, indicated at 94, passes beneath the roll 37 used in the corrugating equipment but does not contact such roll. It also passes in between rolls 38 and 39 of the double facer unit but as these rolls are spaced apart a greater distance than the thickness of the solid fibre sheet, they will not interfere with the movement of such sheet. The sheet continues on and passes between a third pair of squeeze rolls, one of which is the roll 44 already referred to and the other is a roll 95. The mounting, adjusting and driving mechanism for the rolls 95 and 44 as well as rolls 86, 87, 89 and 90 will presently be described in detail. The construction and manner of driving the rolls just mentioned is such that the surface speed of rolls 89 and 90 is very slightly in excess of the surface speed of rolls 86 and 87 whereby the sheet formed by the group of webs 66 and 67 will be maintained taut between the two pairs of rolls and there will also be produced a very slight slippage at the rolls 89 and 90. Likewise, rolls 44 and 95 are so constructed and driven as to have a surface speed very slightly in excess of the surface speed of rolls 89 and 90 whereby there is produced a slight degree of slippage, giving an ironing-out effect to the completed sheet 94 as it passes between these rolls.

The solid fibre sheet continues to travel to the left as illustrated in Figs. 4 and 7 and enters the conveying mechanism 24 where it is contacted both above and below by the respective conveyor belts 46 and 47. Passage of a sheet in between these belts also applies a degree of pressure to the sheet, keeping the laminations in firm contact until the adhesive has become set. While heat may be applied to the solid fibre sheet, it is considered preferable in most cases not to apply heat during the passage of the sheet through this conveyor. It is to be noted that the belts 46 and 47 may have considerable length. In practice, this length is from 40 to 60 feet, depending more or less upon the requirements of the corrugating mechanism.

The conveyor belts are actuated by means of the driven rolls 50 and 54. The driving mechanism for the rolls will later be described in detail but it is in order to point out that the speed of rotation of the rolls 50 and 54 is preferably such as to produce a surface speed in the conveyor belts 46 and 47 which is slightly in excess of the rate of speed of the completed solid-fibre sheet at the discharge end of the conveyor. Thus, the conveyor belt also produces somewhat of a smoothing or ironing-out effect on the sheet.

It is important that the movement of the conveyor belt, particularly in starting and stopping, is at all times accurately controlled with respect to the surface speed of the three pairs of squeeze rolls 86, 87; 89, 90; and 95, 44. For this purpose, means are provided for positively connecting the gearing for the belt drive and the gearing for the drive for the various pairs of squeeze rolls so that over-running of the squeeze rolls with respect to the conveyor drive will substantially be prevented. For this purpose a long, rigid shaft 96 is provided for connecting the gearing at the discharge end of the conveyor with gearing operating the three pairs of squeeze rolls.

The driving transmission mechanism for all of the parts and the arrangement of the shaft 96 with respect to the various driving mechanisms will now be described. Motive power for operating the conveyor and the squeeze rolls is applied in any suitable manner, as by means of an electric motor, not shown, geared to a jack shaft 97 (Fig.

1) journaled in frame element 98 and having its end connected at 99 with an intake or driven shaft in the reduction and change-speed gear box 25. A suitable sprocket chain 100 is arranged over sprockets 100a and 100b on the shafts 96 and 97 so that these shafts will rotate in a fixed ratio to each other and in a predetermined or selected ratio relative to the conveyor belt, the ratio being dependent upon the adjustment of change-speed gearing in the gear box 25. As belts 46 and 47 become worn, their rate of travel becomes slightly changed, and this can be compensated for by changing sprocket 100a or sprocket 100b or both so as to obtain a slightly different ratio between shafts 96 and 97. Extending from the gear box 25 is a driving shaft 101 having a pinion 102 fixed thereon which runs in mesh with a gear 104, fixed on shaft 55, on which is keyed the roll 54 for the lower conveyor belt 47. The gear 104 meshes with gear 105 on the top roll shaft 51 so that roll 50 and roll 54 are driven in synchronism. This forms a drive in which free play is reduced to a negligible value. It is thus apparent that rotation of driving shaft 97 drives the conveyor belts through the reduction and change-speed gear mechanism and through the other gears just described.

The shaft 96 is suitably journaled at 111, 112 and 113 on the frame sections 10a and 10b. This shaft is connected with an intake shaft in a second change-speed gear box 114. A shaft 115 driven by the gears within the gear box 114 has a small sprocket 116 and a larger sprocket 117 both keyed thereon. The sprocket 116 has a sprocket chain 118 running thereover, connecting it with a similar sprocket 119, which is keyed on shaft 120 on which lower squeeze roll 90 is keyed. A sprocket 119a adjacent and similar to sprocket 119 is connected by means of a sprocket chain 121 to sprocket 122, similar to sprocket 119a and keyed on shaft 123 on which the lower squeeze roll 87 is keyed.

In order to obtain a slight differential speed between the rolls 90 and 87 as above referred to, this may be done by providing a different number of sprocket teeth in one than in the other squeeze roll sprocket. In the present instance, however, the differential speed is obtained by a slight increase in the diameter of the roll 90 with respect to the diameter of the roll 87. Thus, when both rolls are driven at the same number of revolutions per unit time, the surface speed of the roll 90 slightly exceeds the surface speed of roll 87.

The sprocket 117, by means of a sprocket chain 125, drives a similar sprocket 126, keyed to shaft 127 on which lower squeeze roll 44 is mounted. The sprocket wheels 117 and 126 are preferably of the same size so that the shaft 127 will rotate the same number of revolutions per unit time as the shafts 120 and 122 on which the other two lower rolls are mounted. Roll 44 is driven at a surface speed slightly in excess of the speed of roll 90 and for this purpose the roll 44 is formed with a diameter slightly in excess of the diameter of roll 90.

The driving transmission for the belts 46 and 47 is so constructed as to cause the belts to operate at a speed slightly in excess of the surface speed of roll 44 so that the belt will tend to creep to a small degree upon the solid fibre sheet.

The upper squeeze rolls 86, 89 and 95, in the present instance, are not driven. Each of these rolls is so arranged that it may be lifted out of contact with the sheet or brought down into contact with the sheet to hold it with more or less pressure against its companion driven roll. As each of the rolls 86, 89 and 95 is mounted in a similar manner, a description of the mounting of one roll will suffice. Considering the mounting for roll 89, this roll is mounted on a shaft 129 journaled in a pair of movable blocks, one of which is indicated at 130, slidably mounted in guides in the frame member 131, and connected to a lever 132 by means of a link 133. The lever 132 is pivoted at 134 and has an end portion 135 bearing on a rotary cam 136 which, in one position, will permit the roll 89 to rest freely on the lower roll 90 and which, when moved to another position, will lift and support the roll 89 away from the roll 90. As is well understood, weights or other pressure applying means may be imposed on the end of lever arm 135 to increase the pressure exerted by the squeeze rolls on the sheet passing between them.

The description thus far completes the explanation of the gearing for the solid fiber pasting mechanism. It is to be noted that the sprocket chains 118, 121 and 125 that are employed for the solid fibre pasting operation are shown in full lines to distinguish them from the sprocket chains, now to be described, used for the corrugating operation.

When the mechanism herein described is to be employed to produce double-face corrugated board, the single-face unit will be set into operation and the liner sheet for the double facer unit will be brought in under the roll 45 and over the roll 44 as previously described. Each of the top squeeze rolls 86, 89 and 95 will be lifted by means of the cam element 136 and these rolls will be held in raised position during the time that the corrugated board is being produced. The next step is to remove sprocket chain 125 from the sprockets 117 and 126. A sprocket chain 138 is then applied leading from a sprocket 139, keyed on the shaft 49, to a sprocket 140 on shaft 140a carrying the adhesive applying roll 40. The lower reach of the sprocket chain 138 passes over a sprocket 141 keyed to shaft 127 for the purpose of rotating the roll 44 in a counter-clockwise direction which will cause its upper surface to move in the direction of the advancing corrugated sheet.

During the corrugating operation, the shaft 96 is disconnected from its drive and allowed to remain idle. This is accomplished in the present instance by removing the sprocket chain 100 which passes over the sprocket 100a and 100b on the shafts 96 and 97.

Due to the drive connection between the sprockets 139, 140 and 141, the roll 40 will be driven in a clockwise direction. This roll 40 serves to remove adhesive from the pan 42 and apply it to the sheet contacting roll 39 which, due to its contact with roll 40, will be caused to rotate in a clockwise direction, thus causing its upper surface to travel in the direction of the advancing sheet and applying adhesive to the downwardly presented corrugations of the corrugated sheet.

Due to the removal of the chains 125 and 100, and the application of chain 138, the rotational effect applied through the shaft 97 will pass through the reduction and change-speed gear within the gear box 25 and thence, from the drive shaft 101, the gear 104 will be caused to rotate which causes rotation of the rolls 54 and 50. The conveyor belt 46 acts as a driving transmission between shaft 51 and 49 to rotate the latter shaft with the sprocket 139 keyed thereto so that the sprocket chain 138 will drive

the rolls 40, 39 and 44. Due to this arrangement, it is to be understood that the liner sheet 43 and the single-face sheet 34 are pulled through the double-face unit 23 by means of the pair of belts 46 and 47. With the tension thus produced in the advancing end of the double-face corrugated sheet, there will be no tendency for the sheet to become buckled or wrinkled which might otherwise be caused if rolls 39, 40 and 44, rotated with a surface speed faster than the travel of the sheet.

When it is desired to again condition the machine for the production of solid fibre board, the sprocket chain 100 will be replaced on the sprockets 100*a* and 100*b* on the shafts 96 and 97 respectively. The sprocket chain 138 will then be removed from the sprockets 48, 140 and 141, after which sprocket chain 125 will be arranged over sprockets 117 and 126. According to this arrangement the belt 46 will no longer be employed as a power transmission, as nothing will be driven from the sprocket 139. The drive for the conveyor will be connected directly to the shaft 101 and the drive for the solid fibre squeeze rolls will be directed through shaft 115 which is connected by suitable gearing with the end of shaft 96.

When multi-ply solid fibre board is to be formed, the use of squeeze rolls such as the rolls indicated in the drawings is necessary for the production of a smooth, compact sheet with well adhering laminations. As a considerable degree of pressure is required to be applied on the squeeze rolls, it is not feasible to attempt to drive the squeeze rolls from the end of the conveyor belt 46, as there would be too much likelihood of slipping or overrunning of the parts at one point or another. It is also undesirable to attempt to drive the squeeze rolls from the conveyor belt for the additional reason that there is a relatively high degree of friction developed when these rolls are tightly pressed together.

By driving the belts 46 and 47 at their discharge end from a point close to the power shaft 97 and by driving the squeeze rolls from the end of the long, rigid shaft 96, the likelihood of slippage is reduced to an altogether negligible value.

From the foregoing it is apparent that the machine of the present invention is adapted equally well for the production of double face corrugated board and multi-ply solid fibre board.

In the production of double face corrugated board, a basic principle of operation is to handle the completed sheet without the application of heavy pressure at any point along the line of its formation, thus the drier belts 46 and 47 serve to draw the single face sheet and the liner sheet 43 through the double-facer unit, retaining the sheets under a moderate degree of pressure while the adhesive is allowed to set and finally delivering the finished sheet to the cut-off knife. The pressure of the conveyor belts on the sheet and the action of the belts in pulling the sheet through the double facer unit produces the necessary tension which provides a smooth, flat sheet.

Advantage is taken of the conveyor belts 46 and 47 in the production of solid fibre board due to the fact that the newly formed solid fibre sheet, with its adhesive still slightly wet, is received in between the conveyor belts and maintained under moderate or light pressure for a sufficient period of time to allow the adhesive to become thoroughly set. In order to insure this advantage from the use of the conveyor belts 46 and 47 it is important that the movement of the belts is so controlled at all times, both in starting and stopping, as well as in normal running operation, that the belts will never travel at a speed less than the speed of the sheet coming from the last pair of squeeze rolls 44 and 95.

Due to the long, rigid shaft 96, the travel of belts 46 and 47 will always be in exact timed relation with the operation of the three pairs of squeeze rolls. As there is preferably a slight differential speed between the successive groups of adjacent pairs of squeeze rolls and between the last pair of squeeze rolls and the conveyor belts whereby the surface speed of the squeeze rolls and the surface speed of the belt is slightly in excess of the speed of the sheet passing through these points, the laminations in the sheet will at all times be given a smoothing out action which will result in a smooth flat sheet, free from wrinkles.

While the present description sets forth a preferred embodiment of the invention, numerous changes may be made in the construction without departing from the spirit of the invention, and it is therefore desired that the present embodiment be considered in all respects as illustrative and not restrictive, reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

I claim:

1. A machine for the manufacture of multi-ply solid fibre board, comprising a frame, means associated with the frame for supplying at least two continuous webs of paper, a pair of cooperating squeeze rolls supported for rotation on the frame, driving means for at least one of said squeeze rolls, means for bodily adjusting one of said squeeze rolls toward and from the other whereby said squeeze rolls are adapted to engage and draw the webs in superposed, contacting arrangement therebetween, means for applying a film of adhesive between the superposed webs in advance of the point where the webs pass between said squeeze rolls, a conveyor comprising an endless belt arranged to receive the webs after passing between said squeeze rolls, a main driving means for the conveyor belt connected thereto by positive transmission means at its discharge end remote from said squeeze rolls, the driving transmission for said driven squeeze roll being also connected to the main driving means by means incapable of slippage, and the driving transmission for the conveyor belt being so related to the driving transmission for said driven squeeze roll as to cause the belt to travel at a surface speed slightly in excess of the surface speed of said driven squeeze roll whereby a smoothing-out effect is produced by the conveyor belt on the completed solid fibre sheet.

2. A machine for the manufacture of multi-ply solid fibre board, comprising a frame, means associated with the frame for supplying at least two continuous webs of paper, a pair of cooperating squeeze rolls supported for rotation on the frame, driving means for at least one of said squeeze rolls, means for bodily adjusting one of said squeeze rolls toward and from the other whereby said squeeze rolls are adapted to engage and draw the webs in superposed arrangement therebetween, means for applying a film of adhesive between the superposed webs in advance of the point where the webs pass between said squeeze rolls, a conveyor comprising a pair of endless

belts arranged to receive the webs therebetween after passing between said squeeze rolls, a main driving means, positive transmission means from the main driving means connected with said conveyor belts at their discharge end remote from said squeeze rolls, the driving means for said conveyor belts being so related to the driving means for said driven squeeze roll as to cause said belts to travel at a surface speed slightly in excess of the surface speed of said driven squeeze roll whereby a smoothing-out effect is produced by said conveyor belts on the completed multi-ply sheet, said driving means for said driven squeeze roll also being incapable of slippage and comprising a rigid shaft directly connected to the main driving means, whereby free play between said conveyor and said driven squeeze roll is prevented at all times.

3. Apparatus for making solid fibre board comprising means for feeding at least three webs from separate rolls to provide superposed layers, means for applying adhesive between the adjacent surfaces of said webs, a first pair of rotating squeeze rolls, means for passing two of said webs between said first pair of squeeze rolls, a second pair of squeeze rolls, means for passing the composite sheet formed from said two webs to said second pair of squeeze rolls, means for bringing at least one additional web into contact with said composite sheet and passing the newly formed composite sheet, formed from all of the webs, between said second pair of squeeze rolls, means for operating said second pair of squeeze rolls at a surface speed slightly in excess of the surface speed of said first pair of squeeze rolls, a pair of superposed belt conveyors having closely adjacent reaches arranged to travel in the same direction as said last-mentioned composite sheet, means for passing said last-mentioned composite sheet to and between said belt conveyors, and means for operating said belt conveyors at a speed slightly in excess of the surface speed of said second pair of squeeze rolls to produce a smoothing-out effect upon the newly formed composite sheet.

JERRY U. FORBES.