United States Patent

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[54] **SHEET DELIVERY APPARATUS**
7 Claims, 11 Drawing Figs.

[52] **U.S. Cl.** ..... **271/69,** 214/1 BD, 270/58, 271/79
[51] **Int. Cl.** **B65h 29/32,** B65h 29/40
[50] **Field of Search** ..... 270/58; 214/1 R, 1 B, 147 T; 156/556, 557, 559, 563; 271/69, 79

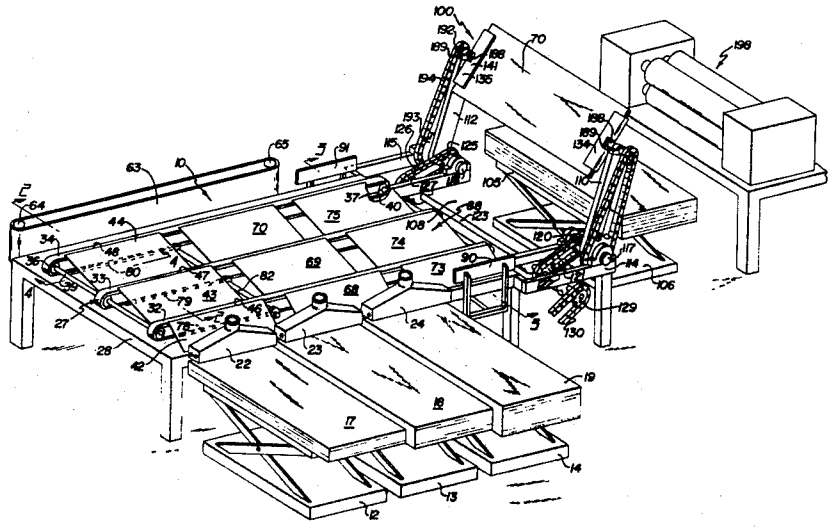
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ABSTRACT: There is described apparatus for delivering sheets to be laid up in multisheet panels. The apparatus includes means for gripping sheets, and particularly sheets that are strong in a longitudinal direction but relatively weak in a transverse direction, along opposite edges thereof and substantially throughout the length of said edges, and swinging said sheets over a layup table where they are released. The apparatus preferably includes conveyor means for delivering sheets to the gripping means.



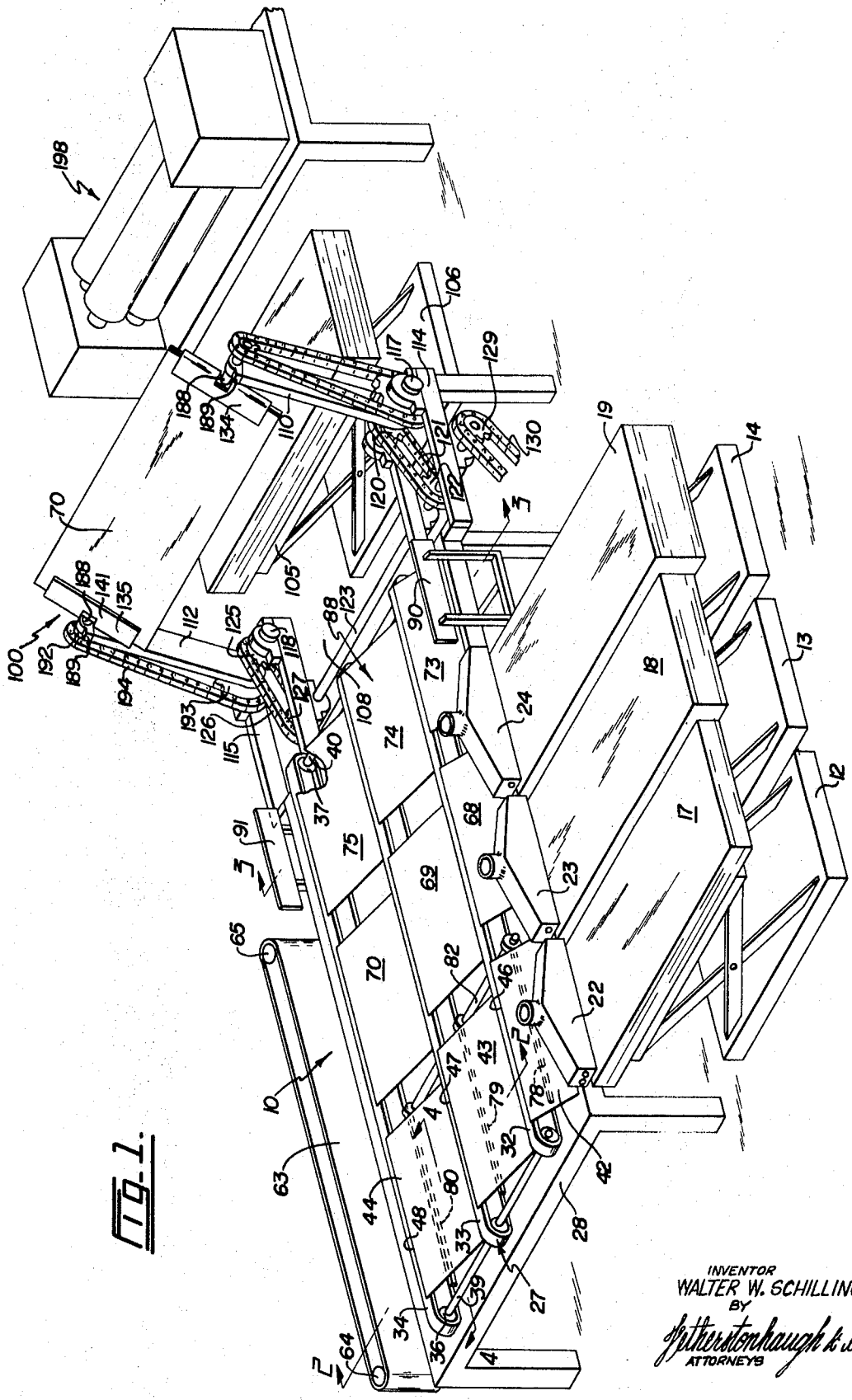
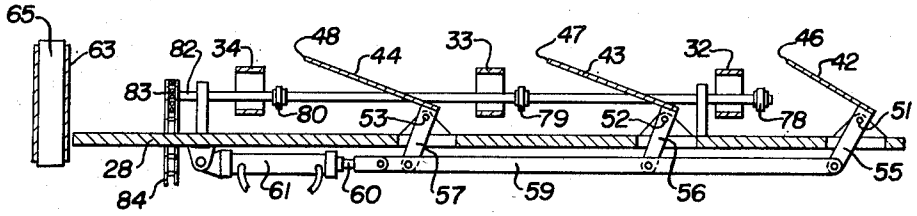


FIG. 1.

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Fig. 2.



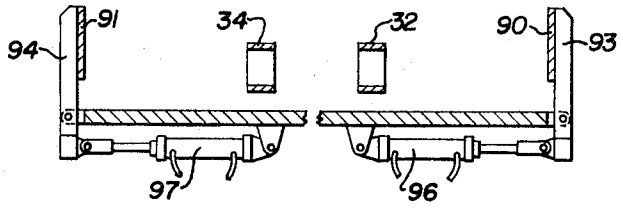


Fig. 3.

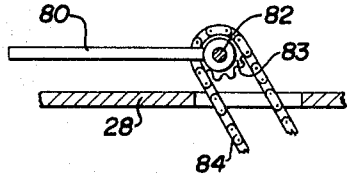
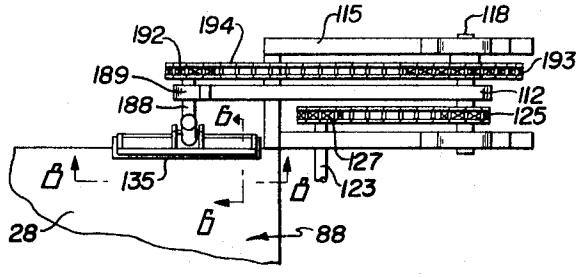


Fig. 4.

Fig. 5.



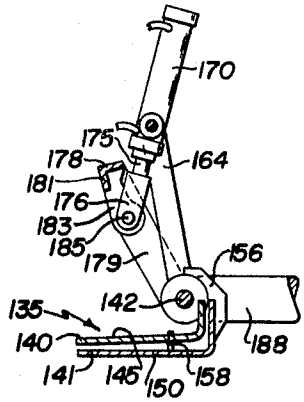


Fig. 6.

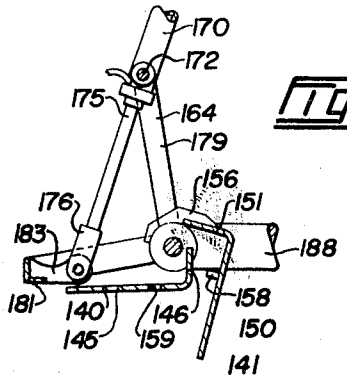
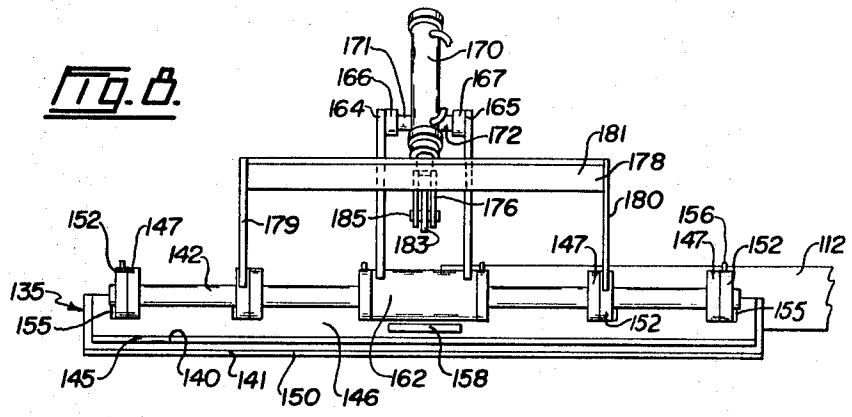


Fig. 7.

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Fig. 8.



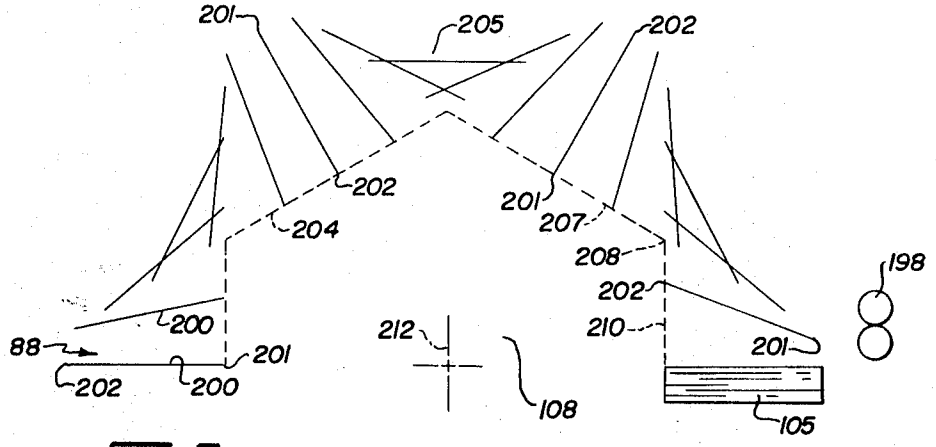


Fig. 9.

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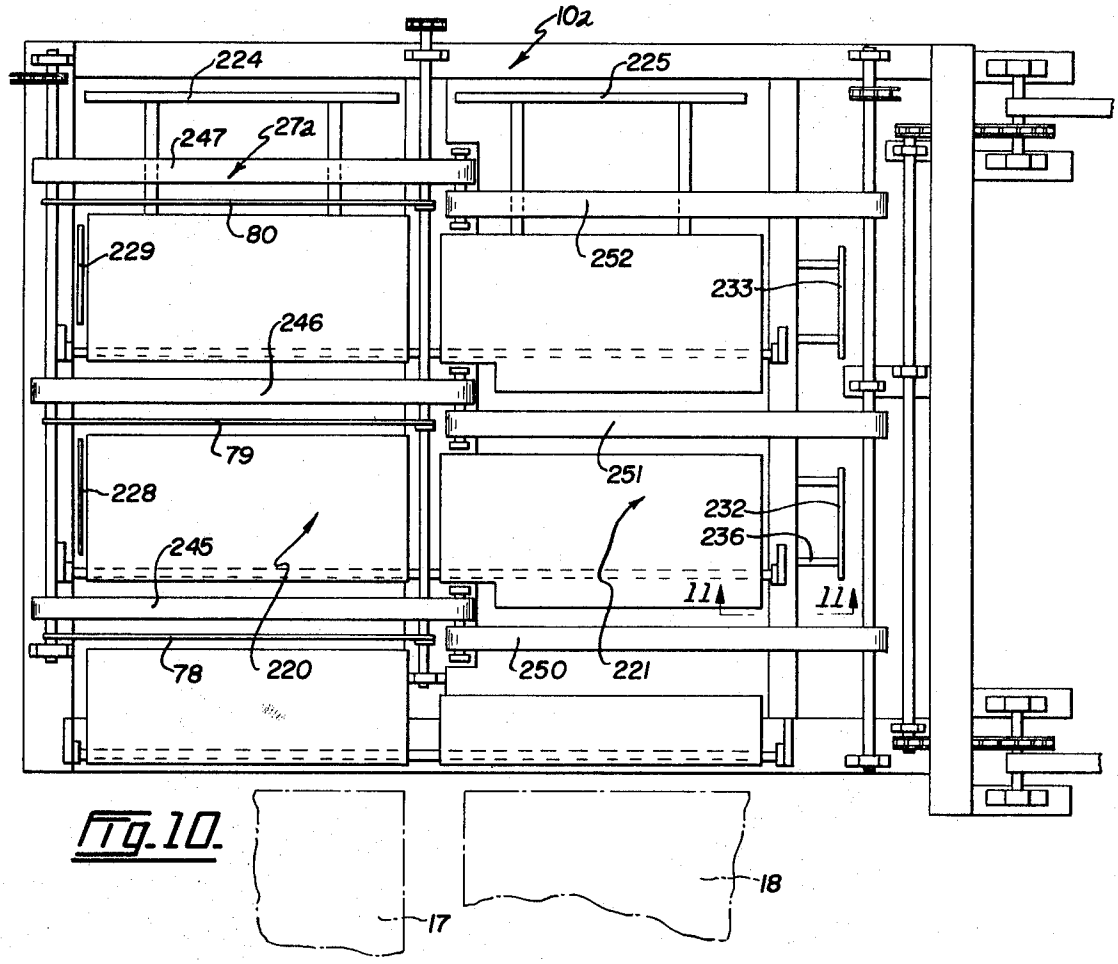


Fig. 10.

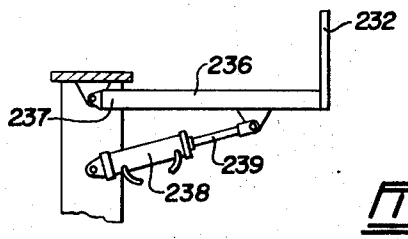


Fig. 11.

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SHEET DELIVERY APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to apparatus for delivering sheets to be laid up in multisheet panels, and particularly panels having face and back sheets, said face and back sheets having good or outer surfaces to form the outer surfaces of the panels.

Although this apparatus may be used for laying-up of sheets of any type of material, it is particularly designed for feeding and laying-up wood sheets or veneers during the manufacture of plywood, and for the sake of convenience it will be so described herein.

The outer sheets of plywood panels are commonly known as faces and backs, or face sheets and back sheets. The grain of the face and back sheets usually runs longitudinally of the panel, and each panel has at least one crossbanding or core layer, either in a single piece or sheet, or in two or more pieces positioned side by side. The grain of the crossbanding layer usually extends across the panel. A 30-ply panel includes face and back sheets and one core sheet. In 5-ply construction, there is a center sheet, a crossbanding or core layer on each face thereof, and the back and face sheets. If a panel having more plies is required, additional center sheets and core layers are added.

In most plants manufacturing plywood today, the face and back sheets, center sheets if required, and core sheets, single or multiple pieces, are laid up by hand. For example, one way of doing this is to lay a back sheet or veneer on a table, placing a core or crossbanding layer, in a single piece or multiple pieces, with glue applied to opposite faces thereof, on top of the back layer, and then placing the face sheet or veneer thereon for a 3-ply construction. If a panel of more than 3 plies is to be made, a center or veneer sheet is laid on the first core layer, and then a second core layer with glue applied thereto is laid on the center veneer, followed by a face veneer on the second core layer. The laid-up layers or sheets are then placed in a hot press in order to complete the formation of a plywood panel.

The flow of materials to the lay-up station is generally from two directions. The layup man stands directly in front of and facing a long side of the layup table. Core or crossbanding pieces or sheets are fed on to the layup table by a glue applicator which is located on the other side of the layup table. When a face or a back or a center sheet is required, two persons grip the desired sheet with their hands, one at each end, and carry it forward and deposit it on top of the stack of veneers resting on the layup table. As the sheet is being carried forward, it must be raised to clear the layup operator to avoid striking him. In practice, the layup operator will generally bend down while the sheet being carried is raised sufficiently to clear him. This is an unsatisfactory procedure in that there is always the danger of physical injury to the layup operator, and the lifting and bending actions are physically tiring. Furthermore, the sheet ends can be easily split or otherwise damaged by the stresses imposed thereon when they are lifted by hand. A further disadvantage resides in the fact that the speed of the layup operation is largely dependent upon the speed at which the face, back and veneer sheets are carried forward. Not only is this a tiring operation to the persons involved, but is is a waste of manpower to have two strong men standing ready to lift a veneer which has so little weight compared to its area. This manual procedure is relatively slow, inefficient and inconvenient.

The reason the veneers are directed over the head of the operator on to the table is that way has to be left at one end of the table for the removal of the stacked veneers, and this leaves only one end of the table for the feeding of the face and back veneers, and the center veneers when required. The face, back and center veneers are usually made from different stock or grades of wood, and may even have different thicknesses.

SUMMARY OF THE INVENTION

Apparatus according to the present invention feeds face and back sheets or veneers mechanically and automatically on to the layup station in a path which permits the layup operator to work in an erect and natural position at all times. If desired, the apparatus may be used to feed center veneers as well. It eliminates the need for the two men which previously lifted the sheet over the head of the operator on to the layup station. Furthermore, this apparatus grips each sheet or veneer throughout substantially the entire length of each end thereof, thereby eliminating physical damage to the sheets, and particularly the poor or weaker grades of veneer, it turns over the sheets or veneers to remove debris or foreign materials therefrom, and it can be used in the layup of 3-, 5- and 7-ply panels without any mechanical alteration or modification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic perspective view of one form of sheet delivery apparatus in accordance with the present invention,

FIG. 2 is a cross section taken on the line 2–2 of FIG. 1,

FIG. 3 is a cross section taken on the line 3–3 of FIG. 1,

FIG. 4 is a longitudinal section taken on the line 4–4 of FIG. 1,

FIG. 5 is a plan view of one side of the sheet transporting unit and its grippers which form part of this apparatus,

FIG. 6 is a section taken on the line 6–6 of FIG. 5, with the gripper jaws closed,

FIG. 7 is a view similar to FIG. 6 with the gripper jaws open,

FIG. 8 is an enlarged side elevation of one of the grippers, as viewed from line 8–8 of FIG. 5,

FIG. 9 is a diagram showing the course of movement of a sheet as it is rotated during transfer to the layup table,

FIG. 10 is a plan view of parts of an alternative apparatus in accordance with this invention, and

FIG. 11 is a section taken on the line 11–11 of FIG. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, sheet delivery apparatus **10** is set up so that it can be used to lay up face sheets and back sheets with or without center sheets. The apparatus includes a sheet transporting unit, and sheets may be supplied to this unit in any desired manner, and apparatus **10** includes a conveyor for this purpose.

The face, back and center sheets are selectively fed to apparatus **10** in any convenient manner. In this example, scissors hoists **12**, **13** and **14** have stacks of veneer face, back and center sheets **17**, **18** and **19** positioned thereon, respectively. These are well known self-levelling hoists. Vacuum feeders **22**, **23** and **24** are positioned above hoists **12**, **13** and **14**, respectively, and are adapted to lift sheets off the stacks on the hoists one at a time and to move them longitudinally over a suitable conveyor **27** mounted on and extending longitudinally of a support or frame **28**. This conveyor extends across the ends of the three hoists. As the vacuum feeders are known and do not form part of this invention, they do not need detailed description herein. Each feeder is such that a suction element is moved downwardly on to the upper surface of the uppermost sheet of a stack, and suction draws that sheet against powered rollers. The suction unit is raised, and the rollers are driven so as to cause the sheet to move longitudinally thereof on to conveyor **27**.

Although conveyor **27** may be any suitable type, it is preferably in the form of a plurality of laterally spaced belts, and in this example, there are three belts **32**, **33**, and **34**. These belts extend around pulleys **36** and **37** at their opposite ends which are mounted on shafts **39** and **40**, respectively. One of these shafts is driven by suitable source of power, not shown.

Depressible shear plates **42**, **43** and **44** are respectively mounted between feeder **22** and belt **32**, belt **32** and **33**, and belts **33** and **34**, and are aligned with hoist **12**. When these

plates are in their uppermost positions, they are inclined so that their respective upper edges 46, 47 and 48 are a little above the level of belts 32, 33 and 34. When these shear plates are depressed, their edges 46, 47 and 48 are below the level of the three conveyor belts.

These shear plates are moved between their upper and lower positions in any desired manner. One way of doing this is illustrated in FIG. 2. Plates 46, 47 and 48 are swingably mounted at lower edges thereof on shafts 51, 52 and 53, and connectors 55, 56 and 57 are secured to the plate and extend downwardly below the shafts. The connectors are connected at the lower ends thereof to a common bar 59, and one end thereof is pivotally connected to the piston rod 60 of a suitably mounted fluid-operated cylinder 61.

With this arrangement, when vacuum feeder 22 is operated, it directs the forward edge of a face veneer or sheet 17 on to and over inclined shear plates 42, 43 and 44, and these direct the veneer or sheet over conveyor belts 32, 33 and 34. The thrust of the rollers of vacuum feeder 22 drives the sheet against a guide belt 63 extending along the side of support 28 remote from hoist 12. This guide belt extends around rollers 64 and 65 at opposite ends thereof. The thrust of the feed rollers is sufficient to cause the sheet to clear plate 42, and when the three shear plates are depressed by the operation of cylinder 61, the sheet rests on conveyor belt 32, 33 and 34.

Shear plates 68, 69 and 70 are provided in line with hoist 13, while shear plates 73, 74 and 75 are provided in line with hoist 14. The shear plates 68, 69, 70 and 73, 74, 75 are similar to plates 42, 43 and 44, and are operated in the same manner.

Sheet turner arms 78, 79 and 80 are each fixedly mounted on a common shaft 82 which extends across support 28 in line with hoist 12 and near shear plates 42, 43 and 44. Arms 78, 79 and 80 normally lie in substantially horizontal plane below the upper surfaces of conveyor belts 32, 33 and 34, see FIGS. 2 and 4, but when shaft 82, is rotated by suitable power means, these arms swing upwardly to lift the face sheet 17 resting on the conveyor belts up and over on to a back sheet 18 positioned on said belts. Shaft 82 may be rotated in any suitable manner, such as by means of a sprocket 83 fixedly mounted thereon, and connected by chain 84 to a suitable power source, not shown. The turner arms swing through an arc of approximately 180°. After this action, the arms are returned to their normal horizontal positions.

In apparatus 10, conveyor belts 32, 33 and 34 are long enough to extend past shear plates 73, 74 and 75 into a pickup position 88 where they act as a holder or support for panels to be shifted on to the layup table. It will be understood, however, that these belts may be shortened, in which case the area in line with the center sheet stack becomes the pickup position.

Squaring bars 90 and 91 are located at opposite sides of the pickup position 88. These bars have a normal vertical position, as shown in FIG. 1, and preferably are shiftable out of this position in any convenient manner. FIG. 3 shows pivotally mounted arm 93 and 94 connected to and extending downwardly from bars 90 and 91, and the lower ends of these arms are respectively connected to the pistons of fluid-operated cylinders 96 and 97. These cylinders normally hold bars 90 and 91 in their vertical positions, and when the cylinders are operated, they swing the bars away from each other and out of their normal positions.

The apparatus described so far is one form of conveyor system which is used to direct veneers or sheets to the transporting unit, generally designated by the numeral 100. Although the apparatus can be used to deliver face sheets and back sheets alone to the transporting unit, it is preferably used to convey one of the sheets superimposed upon the other to the unit. For example, a face sheet 17 and a back sheet 18 are simultaneously shifted on to the belts of conveyor 27 in the manner described above. After the shear plates have been depressed, turner arms 78, 79 and 80 are operated to turn face sheet 17 over on top of back sheet 18. As this action takes place, the wind pressure against sheet 17 maintains it firmly against the turner arms until the latter stop moving, and the sheet drops down comparatively gently on to sheet 18 because of the air cushion therebetween. Then conveyor 27 is operated to shift the superimposed sheets into the pickup station 88 where they are ready for the transporting unit 100.

If a center sheet 19 is required, it is shifted out on to the belts of conveyor 27, and the latter is operated to shift this sheet into pickup position 88.

Transporting unit 100 is the main part of apparatus 10. It is to be understood that sheets, superimposed and/or singly, may be supplied to unit 100 in any convenient manner. However, the conveying system of apparatus 10 is very useful since it can be in operation superimposing and supplying sheets to the pickup position while the transporting unit is shifting a sheet or sheets on to a layup table 105. This table may be in any desired form, but in this example, it is illustrated as part of a scissors hoist 106.

Table 105 is spaced outwardly from the adjacent end of conveyor 27 or pickup position 88 to leave a space or station 108 for the machine operator.

Transporting unit 100 includes a pair of spaced arms 110 and 112 positioned at opposite sides of the operator's station 108. These arms are mounted on suitable supports 114 and 115 which, in this example, are extensions of support 28 on opposite sides of space 108. Arms 110 and 112 are fixedly mounted at one end thereof on shafts 117 and 118 located on a common axis and journaled in suitable bearings on supports 114 and 115. These arms are rotated back and forth by suitable means. Arm 110 is rotated by means of a sprocket 120 fixedly mounted on shaft 117 and a chain 121 extending around this sprocket and another sprocket 122 mounted on a shaft 123. Similarly, arm 112 is rotated by a sprocket 125 fixedly mounted on shaft 118, and a chain 126 extending around this sprocket and another sprocket 127 mounted on common shaft 123. This shaft is rotated back and forth in any suitable manner, such as by means of a sprocket 129 which is connected by a chain 130 to a suitable source of power, not shown.

Arms 110 and 112 have grippers 134 and 135 mounted for rotation on their outer ends. As these grippers are identical in construction and operation, only one, namely gripper 135, will now be described in detail, this gripper being shown in FIGS. 5 to 8.

Gripper 135 comprises a pair of elongated upper and lower jaws 140 and 14 mounted on a common shaft 142. Jaw 140 consists of a plate 145 with a strip 146 substantially normal thereto and extending along an edge thereof. A plurality of spaced and aligned sleeves 147 are secured to strip 146 and positioned so that shaft 142 extends therethrough. Jaw 141 includes a plate 150 having a strip 151 extending normal thereto along an edge thereof. This strip is provided with a plurality of spaced sleeves 152 which are positioned so that shaft 142 extends therethrough when jaw 141 is positioned beneath jaw 140, as clearly shown in FIGS. 6 and 7. Sleeves 152 project forwardly through notches 155 in upper jaw strip 146, and are connected to back strip 151 of the lower jaw by means of vertical braces 156.

FIG. 6 shows jaw plates 145 and 150 extending substantially parallel to each other, and this is their gripping position. A stop 158 projects upwardly from lower plate 150, and when the jaws are in the gripping position, this stop projects upwardly through a slot 159 in upper plate 145. Suitable means is provided for swinging the lower jaw downwardly and away from the upper jaw, and outwardly thereof, as shown in FIG. 7. For this purpose, an elongated sleeve 162 is mounted on back strip 146 substantially midway between the ends of jaw 140, and is aligned with sleeves 147 so that shaft 142 extends therethrough. A pair of arms 164 and 165 project upwardly from this sleeve, and have aligned bearings 166 and 167 at their upper ends. A fluid-operated cylinder 170 has trunnions 171 and 172 projecting laterally therefrom and journaled in bearings 166 and 167. This cylinder has a piston rod 175 projecting downwardly therefrom with a clevis 176 on its outer end.

A comparatively long yoke 178 has ends 179 and 180 connected to strip 151 of the lower jaw. In this example, ends 179 and 180 are fixedly connected to two of the sleeves 152. A crossbar 181 extends between these ends. Yoke 178 is positioned just in front of arms 164 and 165 of the upper jaw when the jaws are in the gripping position, see FIG. 6. A lug 183 is connected to crossbar 181 and depends therefrom substantially midway between ends 179 and 180. Lug 183 extends into clevis 176, and a pin 185 extends through the arms of the clevis and this lug. When piston rod 171 of cylinder 170 is retracted, jaws 140 and 141 are in the gripping position, as shown in FIG. 6, and when the piston rod is extended, as shown in FIG. 7, the jaws are opened, at which time plate 150 is positioned outwardly of upper plate 140 and hangs downwardly relative thereto.

Gripper 135 is rotatably mounted on arm 112 near the outer end thereof. In this example, a stub shaft 188 is journaled in a bearing 189 mounted on arm 112 and extends inwardly therefrom, the inner end of the shaft being fixedly secured to back strip 146 and sleeve 162 of upper jaw 140. With this arrangement, gripper 135 can be rotated relative to the transporting unit arm.

The rotation of gripper 135 is accomplished by means of a small sprocket 192 fixedly mounted on the outer end of stub shaft 188, and a large sprocket 193 mounted on the axis of shaft 118, but held against rotation in any suitable manner. A chain 194 extends around sprockets 192 and 193. If it is desired to rotate gripper 135 360° while arm 112 is swung through approximately 180°, the ratio of sprocket 193 to sprocket 192 is about 3 to 1.

As stated above, gripper 134 is the same as and is operated and rotated in the same manner as gripper 135. By referring to FIG. 1, it will be seen that the upper and lower plates of grippers 134 and 135 have a length which is substantially the same as the length of the ends of the face, back and center veneers.

A standard glue spreader 198 is positioned on the opposite side of table 105 from the operator's station 108. A part only of this spreader is shown in FIG. 1. As this is a standard glue spreader and is well known, it does not need complete illustration and description herein.

The operation of apparatus 10 is relatively simple. Starting with a pair of superimposed face and back sheets 17 and 18 located in pick-up position 88 after having been properly centered therein by squaring bars 90 and 91, arms 112 and 113 of transporting unit 100 are swung towards the pickup position with jaws 140 and 141 open. The upper plates 145 of the jaws come down on top of the superimposed sheets at the ends thereof while the lower plate moves downwardly outside and past said end. Then cylinder 170 is actuated to swing the lower jaws 141 upwardly underneath the sheets until the latter are gripped by jaws 140 and 141. Then the transporting arms are swung upwardly and over through approximately 180° to position the sheets over layup table 105. As this action takes place, chains 194 cause grippers 134 and 135 and the sheets gripped thereby to rotate 360°. Then cylinders 170 are actuated to swing the lower jaws downwardly to permit the sheets to drop on to the table.

The superimposed sheets are rotated 360° as they pass over the operator station 108. This permits any dirt on the surfaces of the sheets to drop from them. However, the most important reason for this action is in order to clear the head of the machine operator standing in station 108 and beside table 105 without the necessity of making the arms of the transportation unit so long that the apparatus takes up too much space in the plant in which it is operating.

FIG. 9 diagrammatically illustrates the motion of a sheet 200 which is gripped by grippers 134 and 135 and shifted from pickup position 88 to layup table 105. This sheet has a leading edge 201 and a trailing edge 202. It will be noted that during the first part of the swinging motion of the transporting arms, the leading edge of the sheet swings upwardly rather abruptly, and as the sheet is moved from over position 88, trailing edge 202 is in the lead and travels upwardly substantially along the line 204. As the sheet turns over in area 205, leading edge 201 moves downwardly substantially along the inclined line 207 until it reaches the point 208 above the edge of table 105. As the sheet continues to turn over, the trailing edge 201 moves downwardly along a substantially vertical line 210 from the point 208 to the front edge of the table. With this arrangement, the operator does not have to stand back from the table when the sheet is being transported over his head on to the table. He can remain quite close to the table because of the fact that trailing edge 201 moves almost straight down towards the table edge from point 208 which is located well above the table edge. The point 212 represents the axis of rotation of the transporter arms. The illustrated set of conditions apply when the arms are swung through an arc of 180°. The pickup position and the layup table do not have to be set in the same plane, one can be higher than the other, it only being necessary to adjust the degree of turn of the arms and the degree of rotation of the grippers and the gripped panels.

FIGS. 10 and 11 illustrate an alternate form of sheet delivery apparatus. In these FIGS., apparatus 10*a* includes a conveyor 27*a* which is made in two sections 220 and 221. Section 220 is located opposite the stack of face veneers 17, while the section 221 is located opposite the stack of veneers 18. The apparatus for a stack of center veneers 19 has been omitted. When sheets are directed into sections 220 and 221, they are moved against stop bars 224 and 225 which are at the side of the conveyor opposite the sheet stacks. These bars 224 and 225 can be swung out of the way in the same manner as bars 90 and 91, described above. Permanent stop bars 228 and 229 are located at one end of conveyor 27*a* so that face sheets directed into section 220 extend parallel to these bars. Similarly, depressible stop bars 232 and 233 are provided at the opposite end of the conveyor so that a back sheet directed into section 221 extends parallel to these bars when it engages stop 225. Bars 232 and 233 can be depressed in any suitable manner. FIG. 11 shows bar 232 mounted on the outer end of and projecting outwardly from an arm 236 which is pivotally mounted at its inner end 237. A fluid-operated cylinder 238 has a piston rod 239 connected to arm 236. When cylinder 238 is actuated to retract rod 239, bar 232 is drawn downwardly below the level of conveyor 27*a*.

Apparatus 27*a* includes the sheet turner arms 78, 79 and 80.

Conveyor 27*a* has belts 245, 246 and 247 in section 220, and belts 250, 251 and 252 in section 221. The belts of the two sections are moved independently of each other so that they can be moved in opposite directions or in the same direction, as desired.

When a face sheet 17 is positioned in conveyor section 220, and a back sheet 18 is positioned in conveyor section 221, stop bars 224 and 225 stop the sheets in their correct positions transversely of the apparatus. After bars 224 and 225 have been retracted, conveyor belts 245, 246, 247 and 250, 251, 252 are moved to shift the sheets away from each other so that the face sheet is moved against stops 228 and 229, and the back sheet against stops 232 and 233. This positions the edges of the two sheets at the opposite ends of conveyor 27*a* in their proper positions so that when the face sheet is swung over on top of the back sheet, the leading edges of the two sheets are aligned with each other. It will be noted that the section 221 of the the conveyor also acts as the pickup position of the apparatus.

The overall operation of the sheet delivery apparatus is apparent from the preceding description. The apparatus is started with a face veneer 17 with its good surface down on layup table 105. Then spreader 198 is operated to eject a core or crossbanding layer, either in a single piece or mulitple pieces, on to the veneer on the table. The core pieces have glue on opposite faces thereof. While this is taking place, a face veneer has been turned over on top of a back veneer on the conveyor 27. The good surface of the back veneer is uppermost at this time. Then the superimposed veneers or sheets, after being gripped along the opposite ends thereof by grippers 134 and 135, are transported over on to a table. The sheets make one complete revolution during this time so that

the back sheet rests on the core layer, with the face sheet uppermost. This action is continued until a desired number of sheets or veneers are stacked on the layup table, and they are then removed and taken to the press.

This action results in the production of 3-ply plywood panels. If five or more plies are required, center sheets can be fed in from the center feed stack in FIG. 1 in proper order to be placed on crossbanding layers on the table. If the apparatus of FIG. 10 is used, the center sheets will be placed in the stack on the layup table by other means.

I claim:

1. Delivery apparatus for thin flexible sheets to be laid up in multisheet panels, comprising a layup table, a support upon which a sheet can be laid spaced from an edge of the table, a station for an operator between the support and the table at said edge of the latter, a transporting unit including a pair of substantially parallel arms pivotally mounted near inner ends thereof near the station with the one arm on each side of said station, said arms being swingable between positions with outer ends thereof over the table and over the support, a gripper rotatably mounted on each arm near the outer end thereof and adapted to grip the sheet on the support along opposite ends of the sheet, power means connected to the transporting unit, to swing the arms to move the gripped sheet from the support to the layup table, said grippers being positioned on the respective arms so that the gripped sheet can clear the head of an operator at said station, and means for rotating the grippers so as to rotate the sheet gripped thereby around a substantially horizontal axis during the swinging movement of the arms to cause said sheet to clear the operator's head while being deposited on the table at said station.

2. Delivery apparatus as claimed in claim 1 in which said rotating means rotates the grippers and the sheet gripped thereby in the direction opposite the direction of movement of the transporting unit arms.

3. Delivery apparatus as claimed in claim 1 in which said rotating means rotates the grippers and the sheet gripped thereby through approximately 360° in the direction opposite to the direction of movement of the transporting unit arms.

4. Delivery apparatus as claimed in claim 1 in which each gripper comprises an elongated first jaw, means swingably connecting said jaw to the adjacent arm, a second jaw extending along the first jaw and pivotally mounted for movement between a gripping position beneath the first jaw and an open position extending downwardly therefrom, and power means connected to the second jaw for swinging the latter between the gripping and open positions.

5. Delivery apparatus as claimed in claim 1 including conveyor means for moving sheets on to said support.

6. Delivery apparatus for thin flexible sheets to be laid up in multisheet panels, comprising a layup table, a support upon which a sheet can be laid spaced outwardly from an edge of the table leaving a space therebetween for an operator, a transporting unit mounted between the table and said support, grippers mounted for rotation on said unit and positioned releasably to grip opposite ends of the sheet on the support, said grippers being long enough to grip substantial lengths of said sheet ends and adapted firmly to secure said ends against flexing, power means connected to the transporting unit to swing the latter to move the gripped sheet from the support to the layup table, said unit lifting the sheet up and over the head of an operator in said space, and means connected 360°the grippers for rotating the sheet gripped thereby approximately 360° around a substantially horizontal axis as said sheet is being moved from the support to the table, said gripper and sheet rotation being in the direction opposite to said movement.

7. Delivery apparatus for thin flexible sheets to be laid up in multisheet panels, comprising a layup table, a support upon which a sheet can be laid spaced outwardly from an edge of the table leaving a space therebetween for an operator, a transporting unit mounted between the table and said support, said transporting unit comprising supports positioned at opposite sides of said space and a pair of spaced arms swingably mounted on said supports on a first common axis, grippers mounted on said unit arms on a second common axis spaced outwardly from the first axis, said grippers being positioned on the arms releasably to grip opposite ends of the sheet on the support, said grippers being long enough to grip substantial lengths of said sheets ends and adapted firmly to secure said ends against flexing, a large sprocket on the first axis at each arm, a small sprocket rotatably mounted on each arm on the second axis, said small sprockets being connected to the adjacent grippers to rotate the latter, a chain extending around the large and small sprockets at each arm, the ratio of the large sprockets to the small sprockets being 3 to 1, power means connected to the transporting unit to swing the latter to move the gripped sheet from the support to the layup table, said unit lifting the sheet up and over the head of an operator in said space, and means for preventing the large sprockets from rotating during movement of the arms, whereby when the transporting unit is swung to move a sheet towards the layup table the grippers and said sheet are rotated approximately 360° in the direction opposite to the movement of the unit.

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