July 14, 1953 R. C. BLAIR 2,645,329

MECHANISM FOR HANDLING BOARDS

Filed Dec. 4, 1950 5 Sheets-Sheet 1

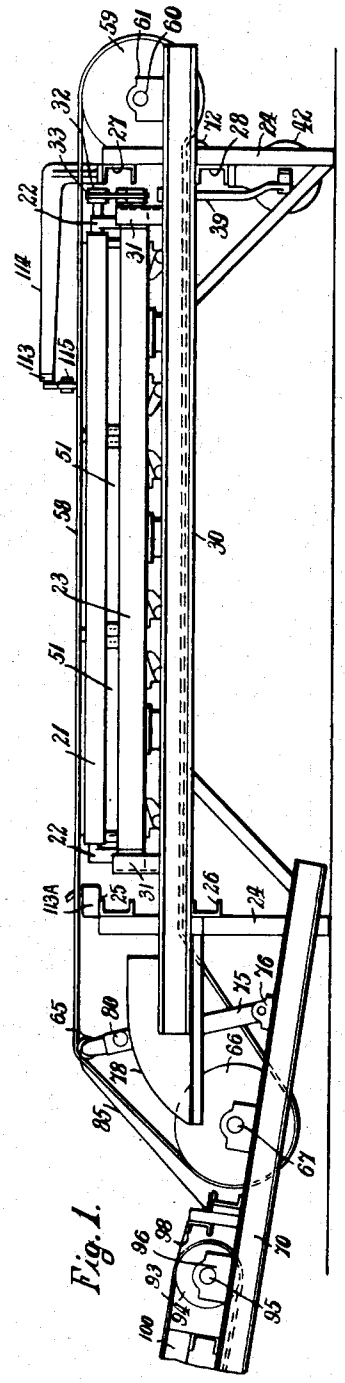


Fig. 1.

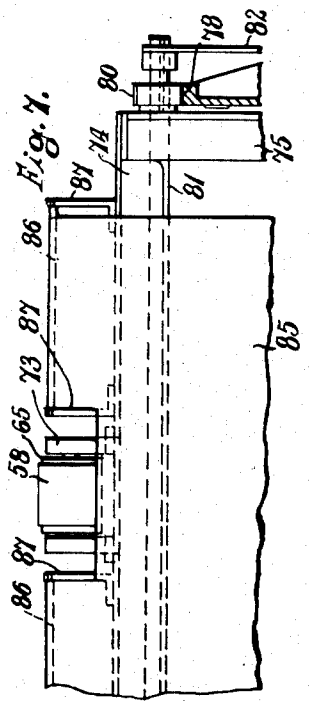


Fig. 1A.

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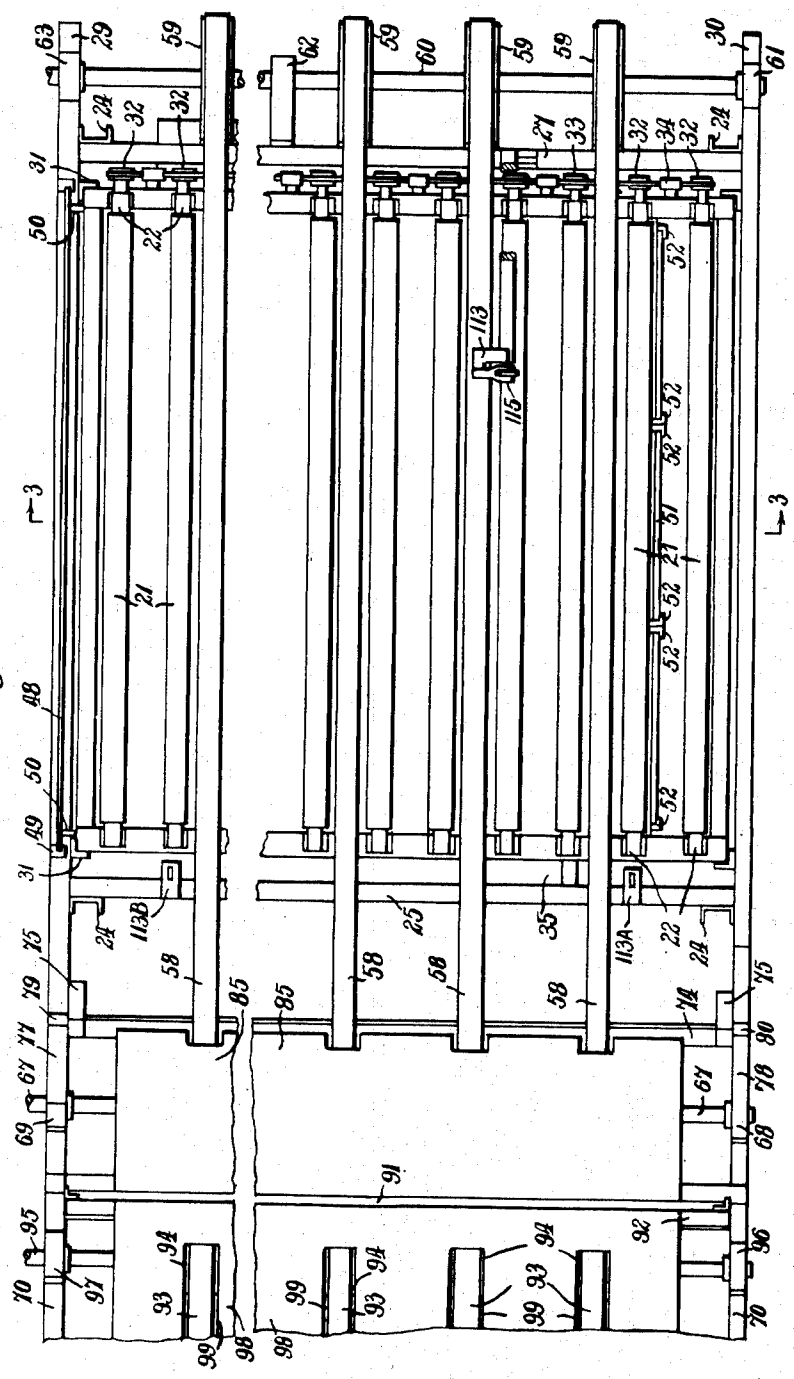


Fig. 2.

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MECHANISM FOR HANDLING BOARDS

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Fig. 3.

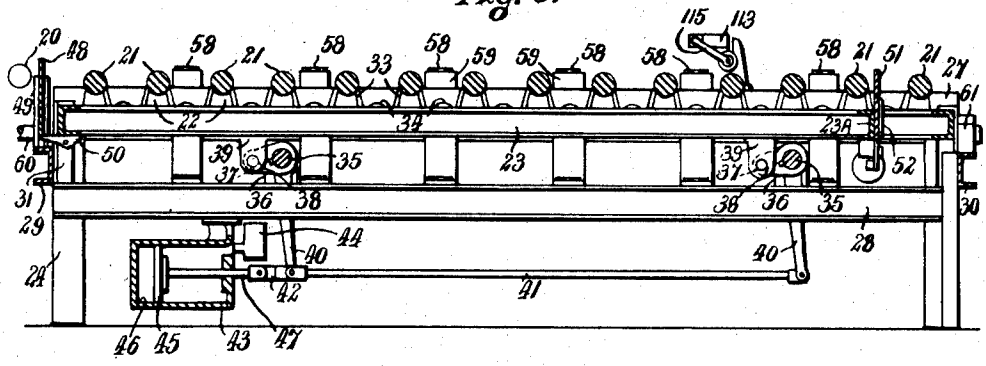


Fig. 5.

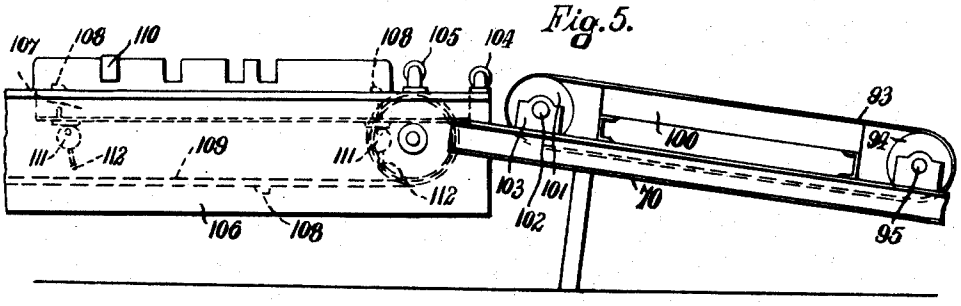
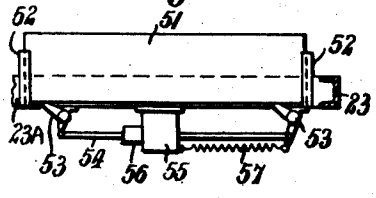


Fig. 4.



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MECHANISM FOR HANDLING BOARDS

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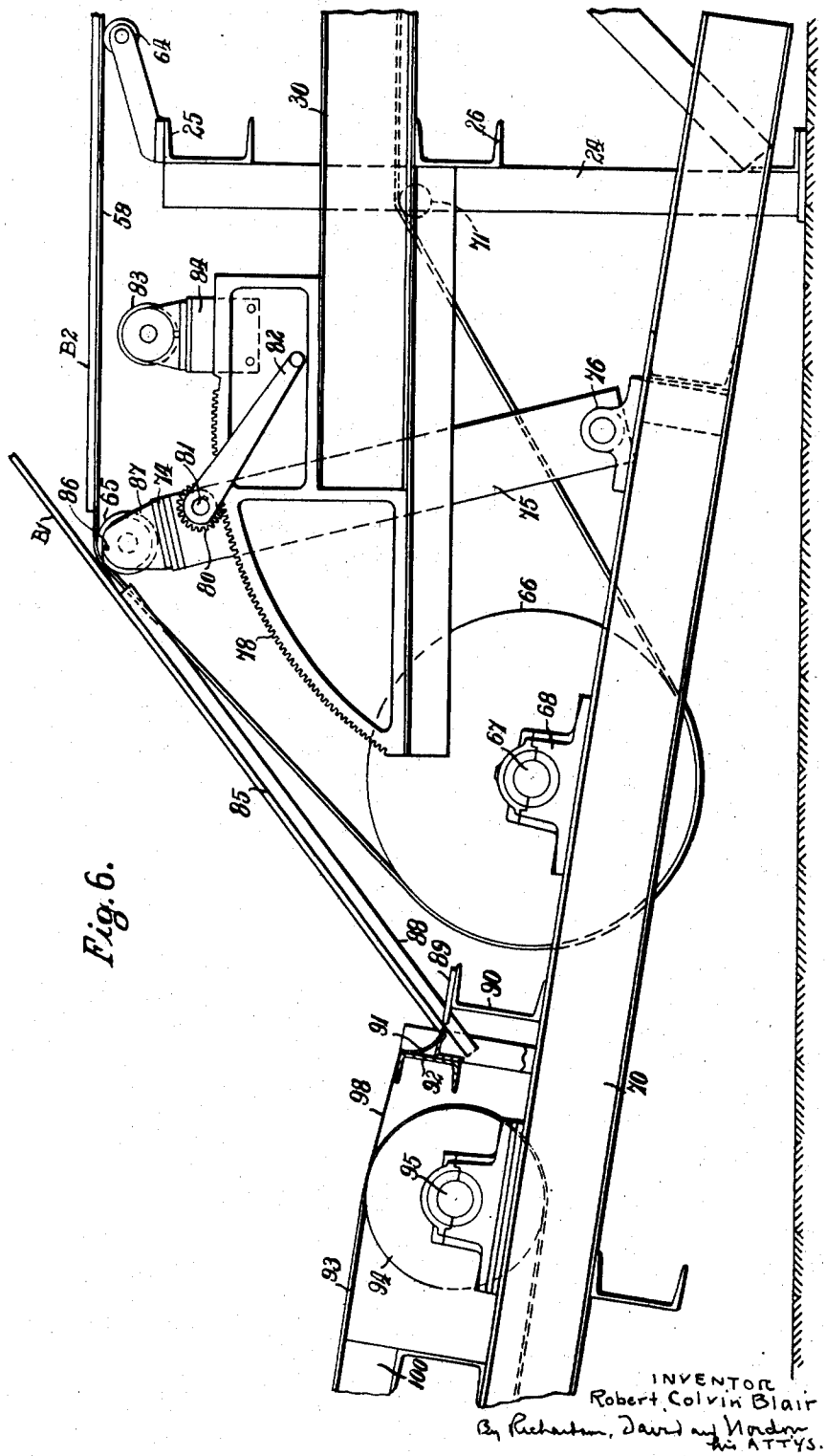


Fig. 6.

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MECHANISM FOR HANDLING BOARDS

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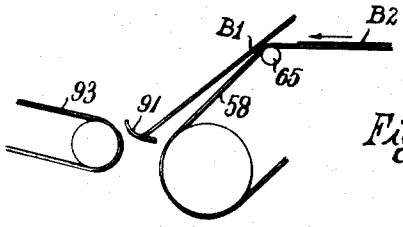


Fig. 8.

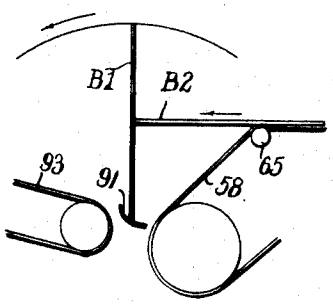


Fig. 9.

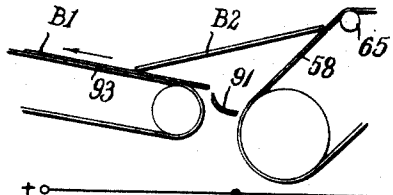


Fig. 10.

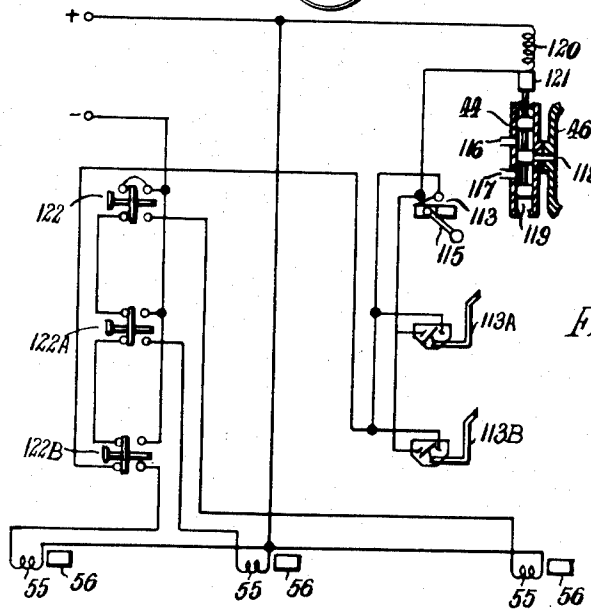


Fig. 11.

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Patented July 14, 1953

2,645,329

UNITED STATES PATENT OFFICE

2,645,329

MECHANISM FOR HANDLING BOARDS

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Application December 4, 1950, Serial No. 198,948
In Great Britain December 8, 1949

9 Claims. (Cl. 198—35)

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This invention relates to mechanism for handling boards such for example as plaster and other wall and ceiling boards for use in buildings.

Building boards, such as plaster boards, are often provided on one side with a surface of coarse texture, and on the other side with a smooth surface adapted to form an exposed panel face in a finished building. In order to protect the smooth faces of such boards from damage during transport and storage, it is usual to arrange the boards in pairs with the two smooth faces juxtaposed. The main object of this invention is to provide a convenient mechanism which, when fed with a sequence of such boards arranged with like faces up, will turn every other board over.

A further object of this invention is to provide a magazine for boards, means for delivering boards thereto and means for extracting boards therefrom in pairs or singly as required for subsequent operations to be carried out on the boards.

The main object hereinbefore referred to is attained, according to this invention, by apparatus including first conveying means adapted to carry a succession of boards placed like faces up, a stop member placed below and beyond the discharge end of the first conveying means in a position to be engaged by the leading edge of a board being discharged and to hold it leaning backwards towards that discharge end, and second conveying means having an entry end disposed beyond said stop in a position to engage a face of a board falling forwards about its edge on said stop and to carry the board beyond the stop, the arrangement being such that, when a first board is so engaged in the stop, the next succeeding board will overturn the first board against the second conveying means which will thereupon advance the two boards together.

The apparatus preferably includes a rest so placed as to support a board which has its leading edge engaged with the stop member and which is leaning backwards, so that the board is held clear of the first conveyors. The rest preferably comprises a plate so positioned as to cause the entrapment of air under a board falling against the stop.

The discharge end of the first conveying means preferably is adjustable in position relative to the stop member, in order to enable boards of different widths to be accommodated, or to enable the leading edge of a board to be delivered directly to the second conveying means instead of engaging the stop so the boards may be delivered for subsequent operations without being turned. The first conveying means preferably is constituted by a set of parallel belt conveyors the discharge end of which is defined by a line at which the upper runs of the conveyors are deflected downwards around deflecting rollers. These deflecting rollers preferably are mounted on an adjustable support to which the rest is connected. This rest preferably consists of a plate having its upper edge hingedly connected to the adjustable support.

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The second conveying means preferably are constituted by a set of parallel belt conveyors having a damper plate substantially in the plane of their upper runs.

The further object hereinbefore referred to is attained, according to a feature of this invention by the provision of means for turning over alternate boards fed to the apparatus, means for delivering the boards to a magazine of an edge grinding machine or the like and means for selecting and delivering one or a pair of boards from the said magazine.

The said magazine may be formed by rails adapted to support the boards and stops mounted above said rails at a height to allow the passage of one or a pair of boards only beneath them and means to withdraw a bottom board or a bottom pair of boards from the magazine.

The means for delivering the boards to the magazine may include one or more rollers disposed at the entrance to said magazine, said rollers being adapted to rotate at a substantially higher surface speed than the conveyor receiving boards from the turning-over means.

The means for withdrawing one or a pair of boards from the bottom of the said magazine may comprise chains or like driving members running beneath the magazine and parallel to, but below rails forming the bottom support for the boards in the magazine, and carriers mounted on the said chains and projecting above the said rails to engage one or a pair of boards as required. The rails may be vertically movable and means may be provided to adjust the height of the rails relative to the stops forming the front of the magazine and relative to the carriers on the chains.

The invention will be more fully described by way of example, and as applied to a plant for the continuous production of plaster boards having a smooth cream surface on one face and a coarse grey surface on the other.

On a first section of a continuous production line a continuous board is made from gypsum

slurry and paper "liners," allowed to set, and, while still travelling, cut into individual boards in known manner. The boards are transferred to a drier which forms the second section of the production line and through which the boards are conveyed in sets of two or more side by side. For convenience of description, each set will hereinafter be regarded as consisting of a pair of boards. The boards now have their narrower, cut edges transverse to the direction of travel, and their smoother faces directed downwards.

The pairs of boards pass from the drier to the third section of the production line where they are arranged in two's with smooth faces together and their cut edges are ground square and smooth. This third section which is constructed in accordance with this invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic side elevation of a transfer table and the overturning mechanism.

Figure 2 is a diagrammatic plan of the parts shown in Figure 1.

Figure 3 is a section of the transfer table taken generally on the line 3—3 in Figure 2.

Figure 4 is a diagrammatic elevation of a stop appearing in Figures 1 to 3.

Figure 5 is a diagrammatic side elevation of the magazine and a part of the apparatus that receives boards from the overturning mechanism.

Figure 6 is a side elevation to a larger scale of the overturning mechanism.

Figure 7 is an elevation of parts appearing in Figure 6 and as viewed from the left-hand side of Figure 6.

Figures 8, 9 and 10 are diagrams illustrating the action of the overturning mechanism.

Figure 11 is a diagram of electrical control mechanism.

The boards leaving the drier approach the transfer table from the top of Figure 2; the last roller of an approach conveyor is denoted by 20 in Figure 3. The transfer table includes a short roller input conveyor having rollers 21 rotatable in bearings 22 mounted on a rigid horizontal rectangular frame 23 which can be raised and lowered in a fixed frame comprising posts 24, longitudinal rails 25, 26, 27 and 28, and transverse rails 29 and 30. Four vertical angle bars 31 fixed to the rails 29 and 30 act as guides for the corners of the rising frame 23. Each roller 21 has a driving pulley or sprocket 32 co-operating with a common driving belt or chain 33 which is looped around idler pulleys or sprockets 34 and which forms a common connection between a driving motor (not shown) and all the rollers 21.

Mechanism for raising and lowering the roller-support frame 23 includes two lever shafts 35 (Figure 3) carried in bearings such as 36 on the fixed frame rails 26 and 28. Four levers 37 keyed to the shafts 35 support the roller frame 23 by engaging pivot pins 38 in lugs 39 mounted thereon. The shafts 35 are connected by levers 40 keyed to the shafts 35 and by links 41 and 42 to a pneumatic thruster 43 controlled by an electromagnetically actuated valve 44. The thruster has a piston 45 operating in a cylinder 46 and connected by a rod 47 to the link 42. In the condition shown in Figures 1 and 3, compressed air has been released from the cylinder 46 allowing the frame 23 to descend to its lowered position and move the piston 45 to the right. When compressed air is admitted to the cylinder 46, the piston 45 moves to the left and raises the frame 23 to a position in which the rollers 21 become level with the rollers of the approach conveyor.

A gate 48, vertically slidable in fixed guides 49, when in the operative position shown in Figure 3 prevents the passage of boards from the approach conveyor 20 to the roller conveyor 21 so long as the latter is out of its fully raised position. The gate 48 rests on tails of two levers 50 which are pivotally mounted respectively on the two supports 31 adjacent to the gate 48 and which co-operate with the frame 23. As this frame descends it rocks the levers 50 clockwise as viewed in Figure 3 and so causes them to raise the gate. As the frame rises again, the levers are released and the gate descends by gravity to its inoperative position.

Near the end of the transfer table opposite to the gate 48 are, in the case illustrated, three gates 51 placed side by side. Each gate 51 is vertically slidable in guides 52 fixed to a cross member 23A of the rising frame 23 (Figures 3 and 4). Each gate is operated by a pair of bell-crank levers 53 mounted on bearings on the cross member 23A and connected by a coupling link 54. A solenoid 55 fixed to the member 23A has its plunger 56 fast on the link 54. A tension spring 57 normally holds the gate 51 in its operative position. If the solenoid 55 is energised, the plunger 56 and link 54 are drawn to the right as seen in Figure 4 and the gate is thereby lowered.

The first conveyor of the overturning mechanism consists of six parallel and continuously running belt conveyors 58 having their upper runs parallel to and between every other adjacent two of the conveyor rollers 21. At their entry end the belts 58 are carried round pulleys 59 fixed to a shaft 60 rotatable in bearings 61, 62 and 63 in the fixed frame. The upper runs of the belts 58 run horizontally clear of the rollers 21, over an idler roller 64 (Figure 6), over a series of co-axial deflecting rollers 65 and around driving pulleys 66 fixed to a driving shaft 67 rotatable in bearings 68 and 69 on an inclined frame 70. The line of the deflecting rollers 65 defines the discharge end of the conveyor. The lower runs of the belts 58 run over jockey pulleys 71 and 72.

The deflecting rollers 65 are carried in bearings such as 73 (Figure 7) fixed to a beam 74 which is supported transversely below the upper runs of the belts 58 by two radius arms 75 pivoted to the frame 70 on bearings such as 76. Two toothed sectors 77 and 78 (Figure 2), fixed respectively to the rails 29 and 30, are engaged by pinions 79 and 80 fixed on a shaft 81 which is rotatable in the radius arms 75 by means of an adjusting crank handle 82. A series of idler rollers 83 is disposed below the upper runs of the belts 58 between the rollers 64 and 65, being carried by a stationary bridge piece 84 spanning between the two sectors 77 and 78.

A rest plate 85 is inclined downwards and forwards beyond the deflecting rollers 65. The upper border of the rest plate is gapped to accommodate these rollers and the upper edge of the plate is hingedly connected by pins 86 to brackets 87 on the beam 74. Fixed to the under surface of the rest plate 85 are longitudinal stiffeners such as 88 (Figure 6). The lower part of the rest plate is carried by a notched supporting plate 89 on a fixed transverse beam 90. A stop in the form of a transverse rubber plate 91 of arcuate section is fixed to a support beam 92 with its concave side facing upwards and rearwards and its lower edge spaced from the plate 89 by

a distance only sufficient to allow the rest plate 85 to slide freely between the parts 89 and 91.

Beyond the stop plate 91 is the second conveyor of the overturning system, consisting of six parallel and continuously running belt conveyors 93 having their upper runs inclined upwards at a small angle in the forward direction. At their entry end the belts 93 are carried round driving pulleys 94 fixed to a driving shaft 95 rotatable in bearings 96 and 97 on the inclined frame. The two conveyor driving shafts 67 and 95 are driven continuously by a motor (not shown), the linear speeds of the second conveyor preferably being slightly faster than that of the first conveyor. A damper plate 98 fixed to the stop support beam 92 is slotted at 99 to accommodate the belts 93 and extends forwards substantially in the plane of the upper runs of these belts, being carried by a series of parallel rails such as 100.

The delivery ends of the conveyors 93 are returned around pulleys 101 (Figure 5) on a shaft 102 carried by bearings such as 103 on the inclined frame 70. The conveyors 93 feed the boards over two driven feed rollers 104 and 105 into a magazine which is mounted on the feed end of an edge-grinding machine 106 of a known type. The rollers 104 and 105 preferably have a peripheral speed slightly in excess of the linear speed of the second conveyor. This magazine is provided with longitudinal rails 107 along which the boards are slid by the agency of carriers 108 projecting from conveyor chains 109 running adjacent to the rails. The rails 107 directly support the stack of boards in the magazine (which forms a floating reserve to ensure continuity of supply to the edge-grinding machine). The front wall of the magazine is formed by a stop bar 110 capable of being inserted in alternative notches in the side walls of the magazine to suit boards of different widths. The stop bar 110 can be spaced from the rails by a gap wide enough to allow the passage of one or two boards as required. In order to enable the plant to handle boards of different thicknesses, the rails 107 are adapted to be raised and lowered by cams 111 mounted on the main frame of the machine and rotatable by means of handles 112. For example, when the boards are ¼ in. thick, the rails 107 are raised by the cams 111 until the gap between them and the stop bar 110 is ⅝ in. When the boards are ⅜ in. thick, the rails 107 are lowered, leaving a gap of ⅞ in. between the main rails and the stop bar 110. These rails mask the carriers 108 and when they are raised they reduce the effective height of the carriers and vice versa. This arrangement avoids the necessity for adjusting the level of the front wall of the magazine and for fitting carriers of different heights to the conveyor chains.

The control mechanism of the transfer table includes a detector switch 113 (Figures 1 and 2) carried by a stationary arm 114 and having an actuating lever 115 terminating in a roller which depends in the path of boards being fed onto the table. The electromagnetically operated valve 44 (Figure 11) has a body provided with an inlet port 116 to be connected to a source of compressed air, an exhaust port 117 and a transfer port 118 leading to the cylinder 46 of the thruster 43. A valve piston 119 normally closes the exhaust port 117 and puts the cylinder 46 into communication with the inlet port 116. The valve is operated by a solenoid having a winding 120 and a plunger 121 coupled to the piston 119. When the winding is energised, the piston is raised, closing the inlet port 116 and putting the exhaust port 117 in communication with the cylinder 46. A control circuit leads from the positive terminal of a D. C. power source through the winding 120, the switch 113 and three normally closed, two-way hand operated switches 112, 122A and 122B to the negative source terminal. Two switches 113A and 113B (Figures 1 and 2) are connected in parallel with switch 113. The windings 55 of the operating solenoids of the gates 51 can be energised respectively through the three switches 122, 122A and 122B, each of which automatically opens the circuit through the electromagnetically-operated valve 43 so that the frame 23 cannot be lowered. Thus, if any of the boards discharged from the drier are faulty the operator can eject them by operating the required switch or switches 122, whereupon the respective gate or gates 51 are opened allowing the boards to pass through.

The turning mechanism according to this invention operates as follows. It has been pointed out that all boards leave the drier smoother face down and reach the end of the drier section with narrow cut edges leading. If a pair of boards happen to leave the drier prematurely, they will be arrested by the gate 48 and released automatically by the descent of this gate as soon as the transfer table is in condition to receive them. The pair of boards run over the rollers 21, and as the leading edge of one of the boards engages the switch arm 115 this arm rises and closes the switch 113. The thruster 43 thereupon operates to lower the rollers 21 until the boards are supported by the belt conveyors 58 which hold the boards clear of the rollers 21 and carry them to the left as seen in Figures 1 and 2. The boards now lie with their lengths transverse to the direction in which the belt conveyors 58 move, and the shorter, cut edges thherefore lie longitudinally. The switches 113A and 113B are arranged on the rails 25 in the path of the boards and are so operated by them that, when the second board of a pair has passed beyond the edge of the roller conveyor 21, the rollers are raised in readiness to receive the next pair of boards.

The first board B1 (Figures 6, 8, 9 and 10) of a production run that is transferred by the belt conveyors 58 of the overturning mechanism, on being discharged by these conveyors tilts forwards and downwards over the deflecting rollers 65 until its leading edge engages the arcuate stop 91, the board resting with its smoother under face against the rest plate 85, as in Figures 6 and 8. The leading edge of the next succeeding board B2, as it passes over the deflecting rollers 65, abuts against the smoother under face of the first board B1 and causes this board to tilt forwards about its lower edge, as shown in Figure 9, until it engages the second belt conveyor 93. The board B2 continues to press against the board B1 and assists the board B1 to fall forwards flat onto the second belt conveyor with its smooth face upwards. The board B2 is delayed in its fall by its frictional contact with the board B1 so that the leading edge of the board B2 falls beyond the arcuate stop. The trailing portion of the board B1, in swinging upwards, supports the loading edge of the board B2 and assists in preventing the leading edge from tilting forwards onto the arcuate stop 91; thus the board B2 passes onto the second belt conveyor section smooth face down. Thereafter, the third and fourth boards come onto the overturning mechanism and are treated exactly like the first two. Consequently boards

follow one another in succession, arranged with their smooth faces directed alternately upwards and downwards, and are stacked, in the order in which they arrive, in the magazine of the edge-grinding machine.

An advantage of the arrangement described is that the discarding of a faulty board as a result of inspection at the end of the drier does not interfere with the action of the overturning mechanism which operates equally well whether or not there are gaps in the series of boards fed to it.

Boards of different widths can be accommodated by appropriately adjusting the position of the deflecting rollers 65 by means of the sector-and-pinion mechanism operated by the crank 82. The fixed rollers 83 support the belts 58 when the rollers 65 are in a position suitable for narrow boards.

Important factors affecting the design of the overturning mechanism are (1) the coefficient of friction between the conveyor belts and the board faces, which should be high, e. g. as provided by rubber belts, (2) the coefficient of friction between board edges and board faces, and (3) the conveyor belt speed. These three factors determine the position of the arcuate stop 91 and the angle of rest of a board in the arcuate stop. The rest plate 85 and the damper plate 93 perform an important function in confining a body of air which cushions the fall of the boards. In the absence of such a cushioning effect relatively brittle boards, such as plaster boards, are liable to be damaged by the overturning mechanism. Figure 6 is drawn to scale and shows apparatus suitable for handling plaster boards ¼ in., ⅜ in., ½ in. and ¾ in. thick and having a width up to 4 ft., which is the width of the board B1 in Figure 6. The belt speed of the first conveying means is 145 ft. per minute.

In the case of ½ in. and ¾ in. thick boards it is not usual to turn them face to face as it is not convenient to handle a pair of such boards due to their great weight. If it is not desired to turn the boards the adjustable discharge end of the first conveying means is moved forward and downwards towards the arcutae stop so that the leading edges of boards being delivered by the first conveying means will fall beyond the arcuate stop directly on to the second conveying means and will proceed without being turned to the magazine of the edge-grinding machine. As already described such heavy boards can be withdrawn singly from the magazine to be ground and stacked one at a time.

I claim:

1. Apparatus which when fed with a sequence of boards turns every other board over, the apparatus including a first conveyor for carrying a succession of boards, a stop member placed below and beyond the discharge end of the said first conveyor in a position to be engaged by the leading edge of a board being discharged therefrom and to hold it leaning backwards towards that discharge end, and a second conveyor having an entry end disposed beyond said stop in a position to engage a face of a board falling forwards about its edge on said stop and to carry the board beyond the stop, the arrangement being such that, when a first board is so engaged on the stop, the next succeeding board will overturn the first board against the said second conveyor which will thereupon advance the two boards together.

2. Apparatus which when fed with a sequence of boards turns every other board over, the apparatus including a first conveyor for carrying a succession of boards, a stop member placed below and beyond the discharge end of the said first conveyor in a position to be engaged by the leading edge of a board being discharged therefrom and to hold it leaning backwards towards that discharge end, a second conveyor having an entry end disposed beyond said stop in a position to engage a face of a board falling forwards about its edge on said stop and to carry the board beyond the stop and a rest so placed as to support clear of the first conveyor the said board having its leading edge engaged with the stop member, the arrangement being such that, when a first board is so engaged on the stop, the next succeeding board will overturn the first board against the said second conveyor which will thereupon advance the two boards together.

3. Apparatus as claimed in claim 2, in which the said rest comprises a plate so positioned as to cause the entrapment of air under a board falling into engagement with the said stop.

4. Apparatus as claimed in claim 1 wherein the said discharge end of the said first conveyor is adjustable in position relative to said stop member.

5. Apparatus which when fed with a sequence of boards turns every other board over, the apparatus including a first conveyor for carrying a succession of boards and constituted by a set of parallel belt conveyors the discharge end of which is defined by a line at which the upper runs of the conveyors are deflected downwards around deflecting rollers, a stop member placed below and beyond the discharge end of the said first conveyor in a position to be engaged by the leading edge of a board being discharged therefrom and to hold it leaning backwards towards that discharge end, and a second conveyor having an entry end disposed beyond said stop in a position to engage a face of a board falling forwards about its edge on said stop and to carry the board beyond the stop, the arrangement being such that, when a first board is so engaged on the stop, the next succeeding board will overturn the first board against the said second conveyor which will thereupon advance the two boards together.

6. Apparatus as claimed in claim 5, wherein said deflecting rollers are mounted on an adjustable support to which the upper edge of the said rest plate is hingedly connected.

7. Apparatus as claimed in claim 6, wherein said deflecting rollers are mounted on a support which is capable of angular displacement about a transverse horizontal axis below the level of the deflecting rollers, so that the height and distance of the rollers from the stop can be selected to suit different widths of board.

8. Apparatus as claimed in claim 1, wherein the stop member is of trough section and of resilient material.

9. Apparatus which when fed with a sequence of boards turns every other board over, the apparatus including a first conveyor for carrying a succession of boards, a stop member placed below and beyond the discharge end of the said first conveyor in a position to be engaged by the leading edge of a board being discharged therefrom and to hold it leaning backwards towards that discharge end, and a second conveyor constituted by a set of parallel belt conveyors having a damper plate substantially in the plane of their upper runs, said second conveyor having an

entry end disposed beyond said stop in a position to engage a face of a board falling forwards about its edge on said stop and to carry the board beyond the stop, the arrangement being such that, when a first board is so engaged on the stop, the next succeeding board will overturn the first board against the said second conveyor which will thereupon advance the two boards together.

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