

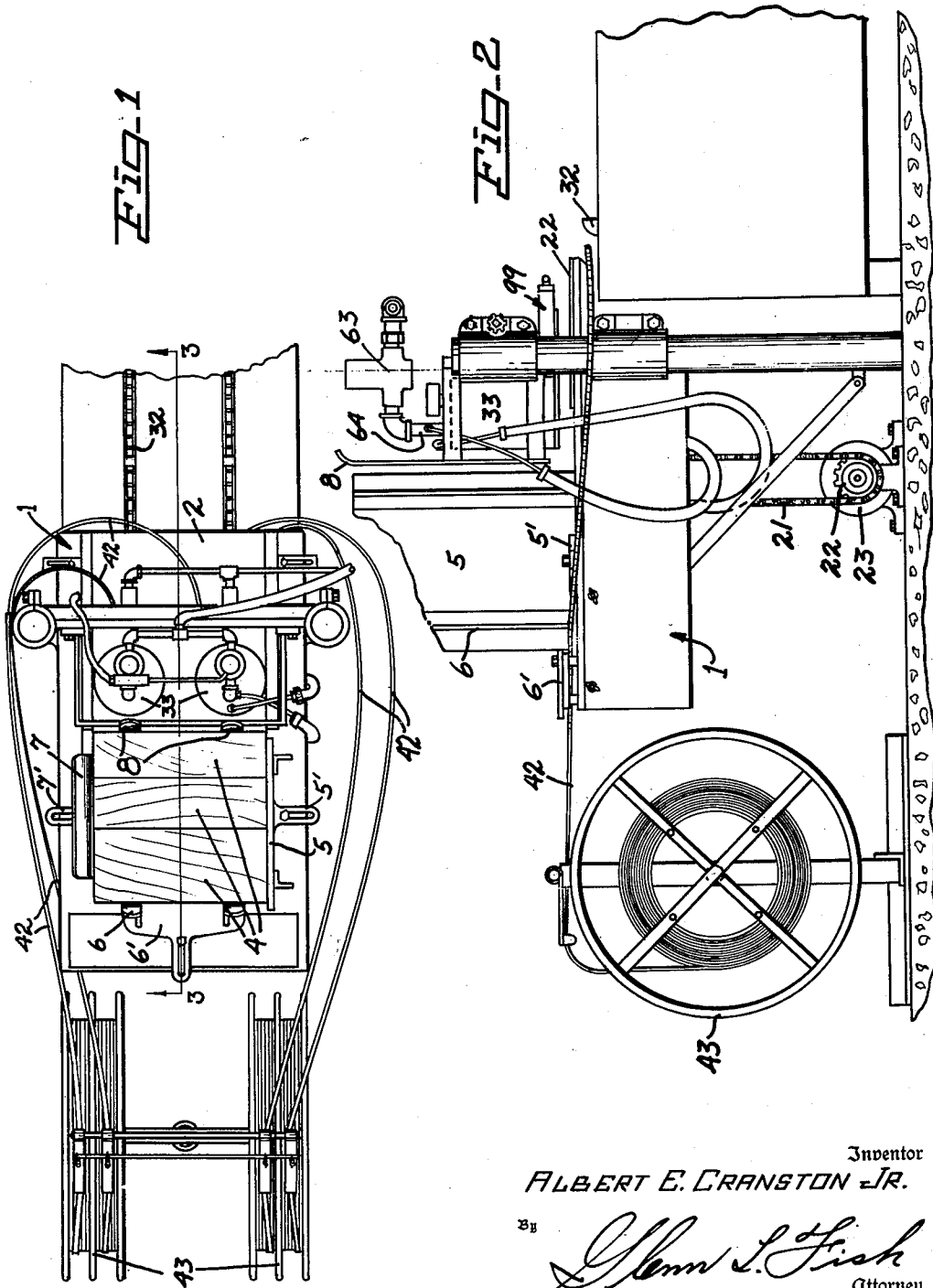
March 17, 1953

A. E. CRANSTON, JR
BOARD FASTENING MACHINE

2,631,283

Filed Nov. 15, 1947

6 Sheets-Sheet 1



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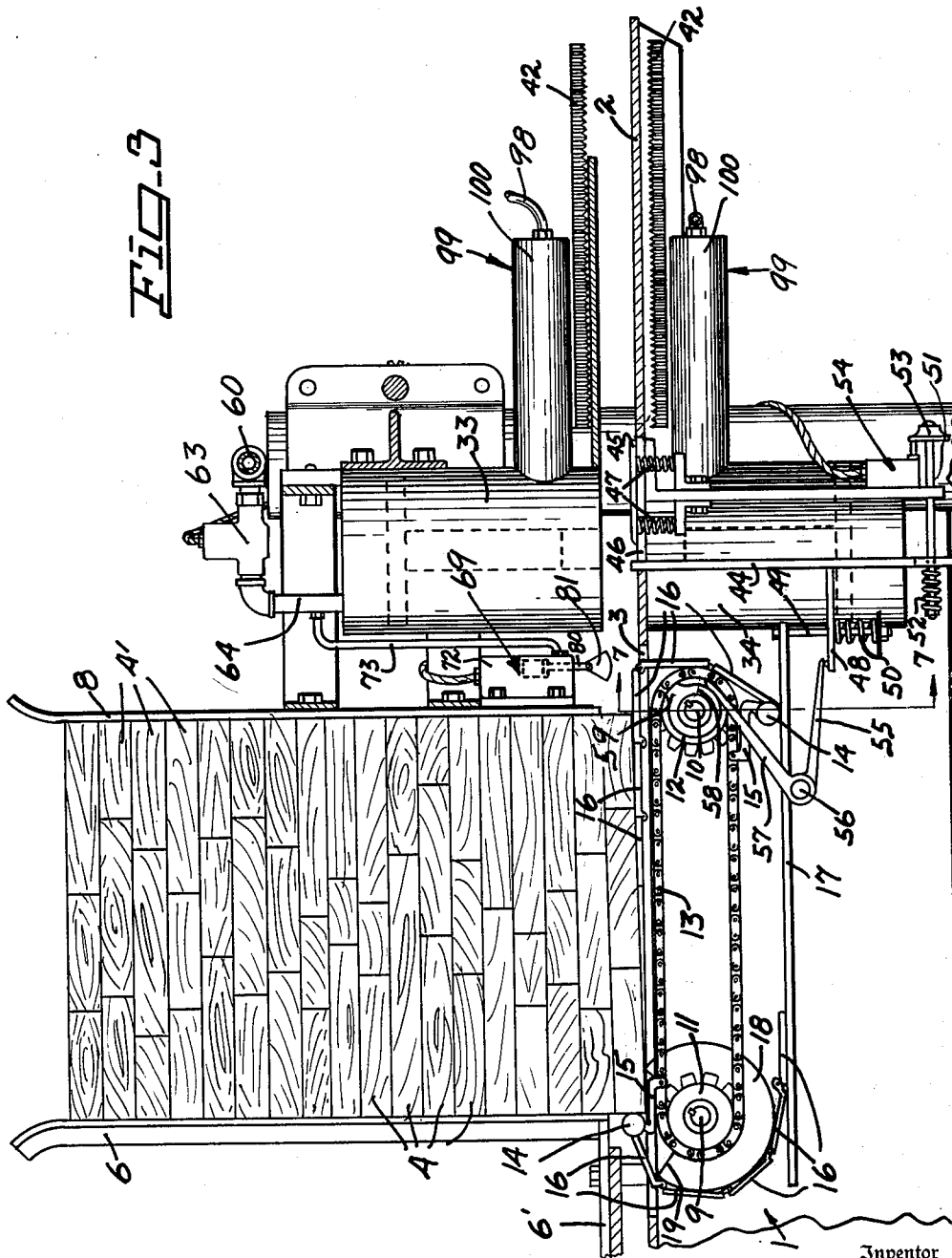
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6 Sheets-Sheet 2



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6 Sheets-Sheet 3

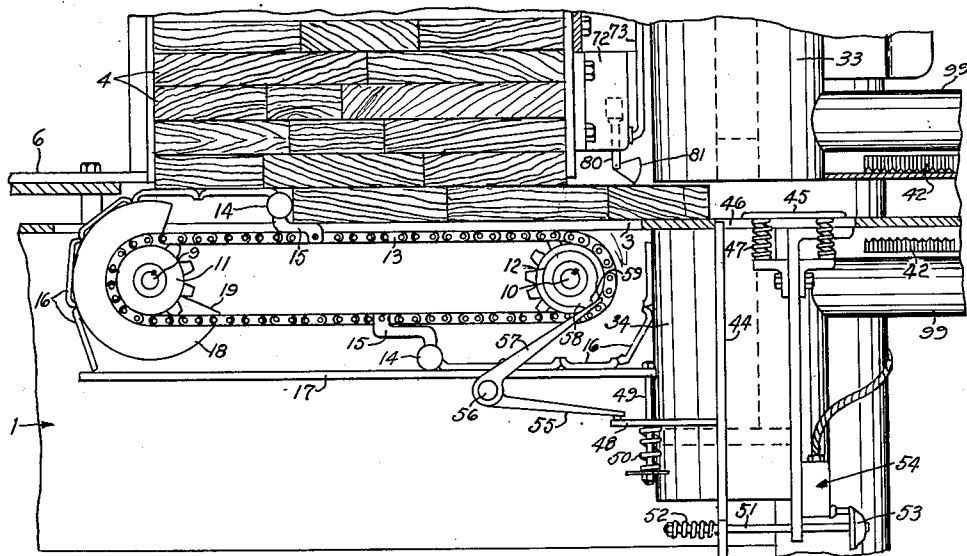


FIG. 3 a.

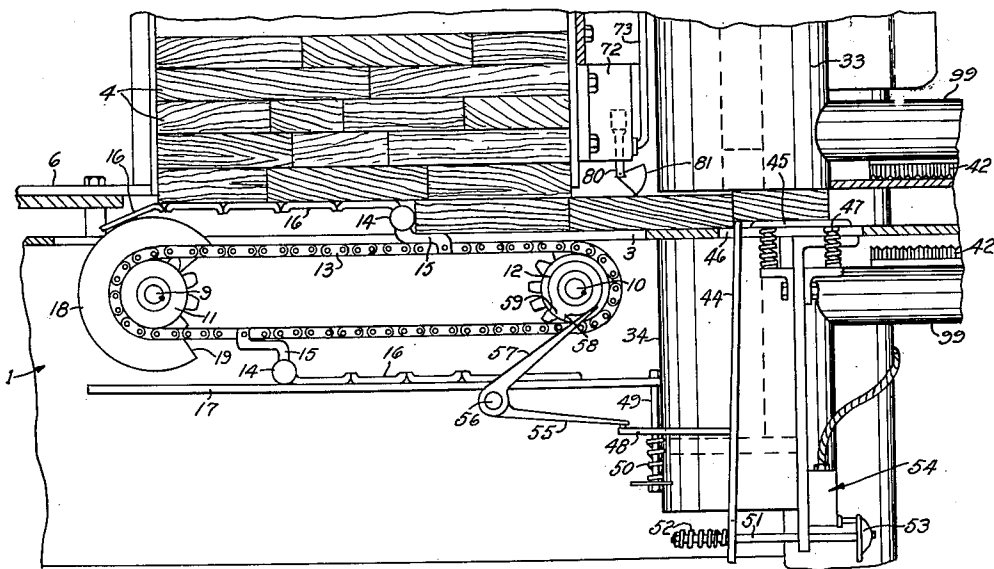


FIG. 3 b.

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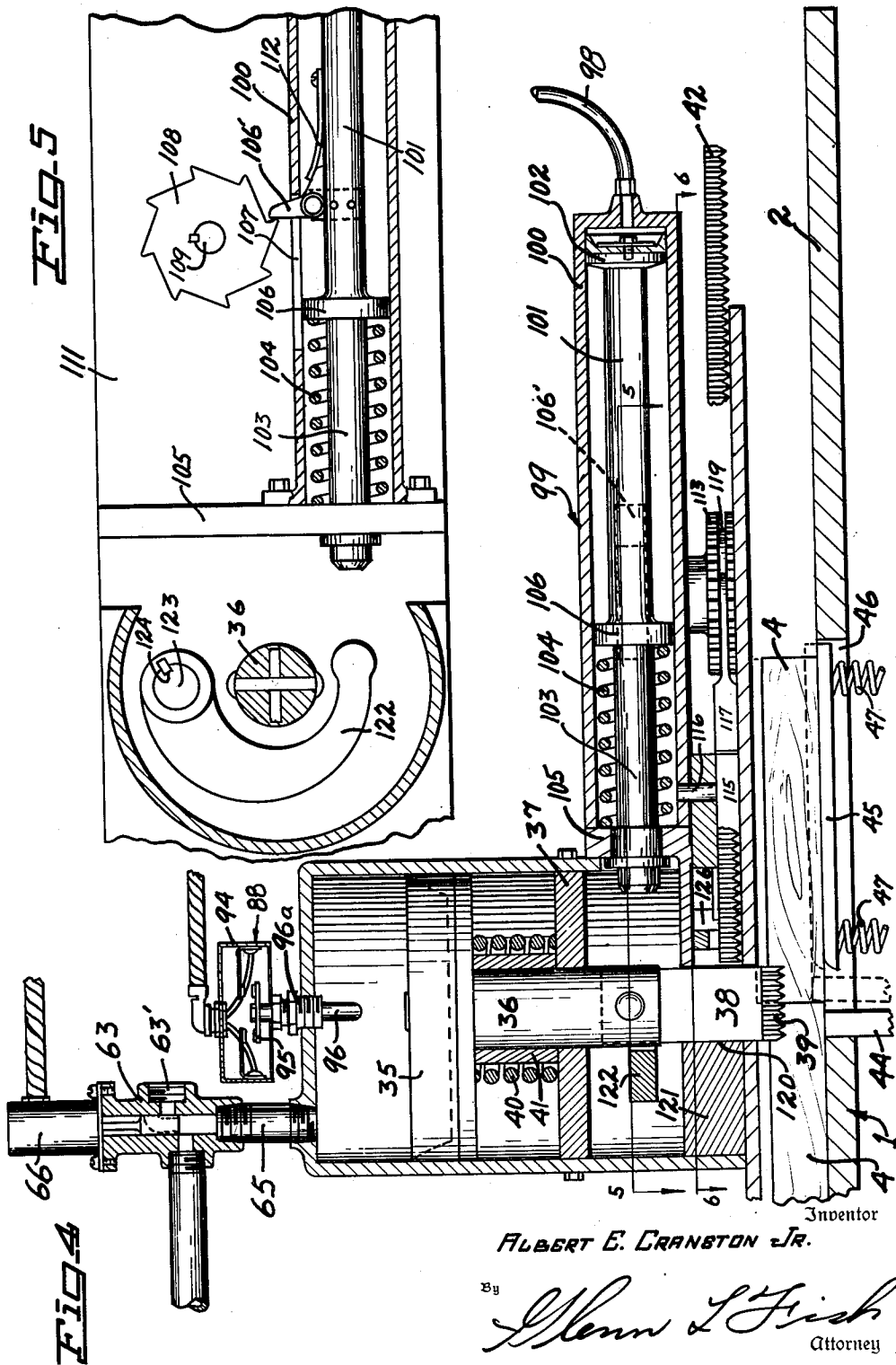
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FIG-6

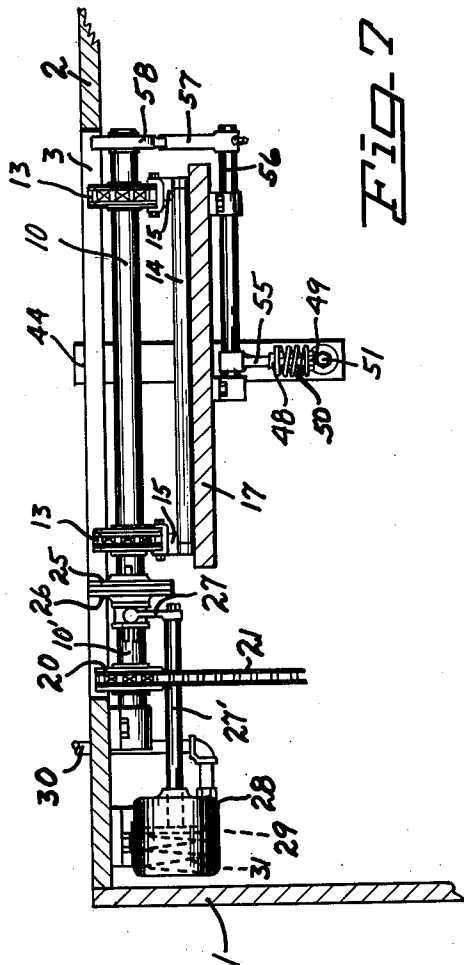
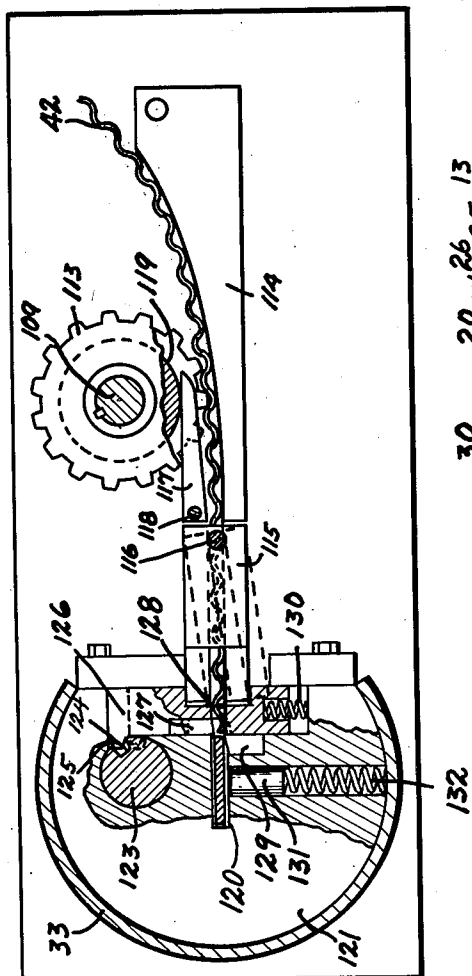


FIG-7

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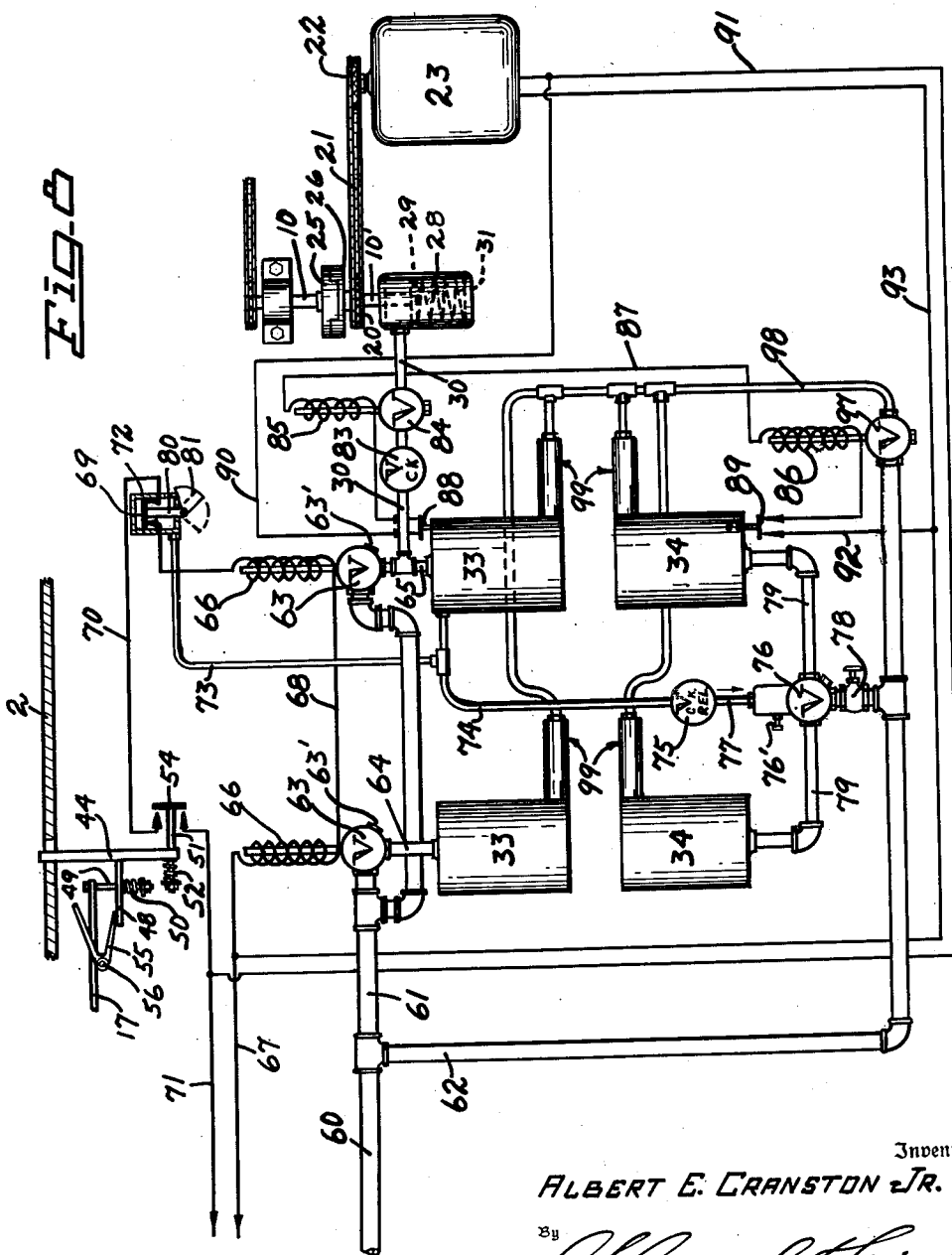
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UNITED STATES PATENT OFFICE

2,631,283

BOARD FASTENING MACHINE

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Application November 15, 1947, Serial No. 786,211

19 Claims. (Cl. 1—8.1)

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This invention relates to a board fastening machine and it is one object of the invention to provide a machine by means of which boards may be secured together and form boards of larger dimensions, for the manufacture of boxes, and the like.

At the present time, it is necessary to run boards longitudinally through a machine and use boards of predetermined width in order to permit fasteners to be properly placed. This makes it necessary to sort the boards which are to be used, and it is therefore one object of the invention to provide a fastening machine of such construction that boards of various dimensions may be used and fed transversely through the machine into position for application of fasteners, which bridge meeting side edges of the boards and secure the boards in abutting engagement with each other.

Another object of the invention is to provide a machine of such construction that as the boards of various widths are fed through the machine, the cracks between side edges of the boards will be automatically located and the fasteners applied in proper bridging relation to the abutting side edges of the boards.

Another object of the invention is to provide a board fastening machine, wherein the boards pass between upper and lower heads carrying hammers for driving fasteners into upper and lower surfaces of boards, the hammers being operated by fluid under pressure and means being provided for feeding strips of fasteners to the hammers and cutting the fasteners from strips of corrugated fastener material in proper timed relation to movement of the boards and the hammers.

Another object of the invention is to provide a board fastening machine wherein valves are provided for controlling the flow of fluid under pressure to the cylindrical heads in which pistons carrying the hammers are mounted, the valves being controlled by solenoids connected in circuits and automatically energized by electricity flowing through them when switches in the circuits are closed.

Another object of the invention is to provide a board fastening machine which is entirely automatic in operation and wherein boards are stacked in a hopper in layers or tiers resting one upon another, with the boards of each layer in edge to edge engagement with each other, the layers or tiers of boards successively moving downwardly onto a table from which they move into position for application of fasteners to the boards, in step by step movements of such length that abutting edge portions of the boards will always be brought into position for the staples to bridge cracks between the boards when applied.

Another object of the invention is to provide a board fastening machine which is automatic in operation, very rapid and efficient in opera-

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tion, and not liable to get out of order and fail to operate properly.

The invention is illustrated in the accompanying drawings wherein:

Fig. 1 is a top plan view of the improved board fastening machine.

Fig. 2 is a side elevation of the board fastening machine.

Fig. 3 is a view taken along the line 3—3 of Figure 1.

Fig. 3a is a fragmentary view similar to Fig. 3 but showing the operation of the cam mechanism for preventing the driving of fasteners in the leading edge of the first board in each layer of boards.

Fig. 3b is a view similar to Figs. 3 and 3a showing how the feeler bar is tripped by a joint to be fastened, to actuate the driving heads.

Fig. 4 is a sectional view upon an enlarged scale taken vertically through one of the hammer-carrying heads and the companion fastener feeding device.

Fig. 5 is a horizontal sectional view taken along the line 5—5 of Figure 4.

Fig. 6 is a sectional view taken along the line 6—6 of Figure 4.

Fig. 7 is a fragmentary view taken along the line 7—7 of Figure 3.

Fig. 8 is a diagram showing the pipes for fluid under pressure and the solenoids for operating valves of the pipes and the circuits for the solenoids and switches for the circuits.

Board feeding mechanism

This board fastening machine has a table 1, the top 2 of which is formed with an opening 3 as shown in Figure 3 over which boards 4 to be formed into ends for boxes and similar structures are stacked. The boards are arranged in layers or tiers, each of which is of a predetermined width, but as the boards are not of the same width, some tiers consist of more boards than others. The stack of boards is held upright by supports 5, 6, 7 and 8 and upon referring to Figures 1, 2 and 3, it will be seen that the supports 5, 6, and 7 have bases or brackets 5', 6' and 7' adjustably mounted upon the table while the supports 8 are stationary. This allows the supports 5 and 7 to be shifted towards and away from each other, so that boards of predetermined length may be fitted between them and also allows the support 6 to be shifted towards and away from the support 8, and accommodate boards of such width, that each tier or layer of boards will form a box end of desired height when the boards of the tier are stapled to each other. The support 7 is of less height than the other supports, thus allowing a new supply of boards to be easily thrust into the hopper or container formed by the supports when necessary.

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Shafts 9 and 10 are rotatably mounted under the table across ends of the opening 3 and carry sprocket wheels 11 and 12 about which chains 13 are trained. Cross bars 14 extend between the chains and are connected with them by arms or links 15 and with these cross bars are connected plates 16 which are hinged to each other in such manner that they may fold only in one direction. Therefore each series of hingedly connected plates forms a platform for receiving a tier or layer of boards to be fastened to each other. A shelf 17 supports the plates as they move from the shaft 10 towards the shaft 9 and in order to guide the plates upwardly from the platform through the opening 3 into position over the table, there have been provided disks 18, carried by the shaft 9, and formed with recesses 19 which accommodate the cross-bars 14. The plates serve to support the stack of boards above the lower tier or layer as this lower layer is shifted forwardly and the boards forming each layer will thus be held even with each other and each layer will be shifted forwardly as a unit during a fastening operation. This is accomplished by the action of one of the bars 14 engaging behind the lowermost layer as shown in Figure 3 to push the layer ahead of it as it moves from left to right in Figure 3. Subsequent positions of the layer are shown in Figures 3a and 3b. When the pusher bar 14 moves out from under the stack and starts to pass down and around the sprockets 12 the leading edge of the stack of boards then resting on the platform of plates 16 is thereby lowered to the level of the table top, the boards being longer than the width of opening 3 under the boards and the plates 16 being of less width than this opening. The rear edge of the stack is lowered simultaneously by the rearmost plate 16 riding down and off the discs 18. To effect this mode of operation, only the leading plate 16 of each of the two series of plates is connected to the conveyor, and the number of links in each chain 13 is equal to twice the number of teeth on the sprocket wheels.

The shaft 10 has an independently rotatable auxiliary unit 10' (Fig. 7) carrying a sprocket wheel 20, about which is trained a chain 21, and this chain extends downwardly from the table and is trained about a sprocket wheel 22 (Fig. 2), carried by the shaft of a motor 23 by means of which the machine is driven, as shown in Figures 7 and 8. A clutch member 25 is fixed on the shaft 10 for engagement by a movable clutch member 26. The member 26 is mounted on a splined portion of the unit 10' for sliding movement into and out of a driving engagement with the clutch member 25 and there has been provided a fork 27 carried by a rod 27', which is slidable into and out of a cylinder 28 and which at its inner end carries a piston 29. When air, or equivalent fluid under pressure is admitted to the cylinder through the pipe 30 and acts upon the piston, the rod will be shifted longitudinally and the shiftable clutch member moved out of engagement with the stationary clutch member to stop rotation of the shaft 10 and when the air is allowed to escape from the cylinder, the spring 31 returns the piston and the rod to the normal position in which the two clutch members are in driving engagement with each other. The boards will then be shifted along the table to a fastening position and a completed box wall will eventually be discharged onto the chains 32, as shown in Figure 1, which chains carry it to the discharge

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end of the table and may be driven in any desired manner.

Automatic locating mechanism

The fasteners are driven into meeting side edge portions of the boards, by upper and lower driving heads 33 and 34, mounted above and below the table top, and upon referring to Figures 1 and 3 it will be seen that the driving heads 33 are spaced from each other transversely of the table and located directly over the companion driving heads 34. Each driving head is of cylindrical formation and contains a piston 35, carried by a plunger 36, which slides through a partition 37 in the cylinder and at its outer end carries a hammer 38 for driving fasteners 39 into the boards, as shown in Figure 4. The piston and its plunger are urged towards a retracted position by a spring 40, fitting about a sleeve 41, which limits outward movement of the plunger during a fastening operation. The fasteners are cut from strips of fastening material 42, wound upon reels or spools 43, from which they are unwound and fed into the heads as shown in Figures 4 and 6.

A vertical rod or feeler bar 44 controls the operation of the driving heads and also movement of the boards between the driving heads 33 and 34 and onto a shoe 45, which is shiftable vertically through an opening 46, formed in the table and yieldably held in its raised position by springs 47, as shown in Figure 3. The leading edge of the first board of each layer to move across its upper end and onto the shoe without actuating the bar, and in order to effect this movement there has been provided an arm or strip 48 which projects horizontally from the bar and is formed with an opening through which a vertical rod 49 passes. The rod 49 extends downwardly from the shelf 17 and carries a spring 50 upon which the arm rests. The bar 44 passes through the opening 46 and is not only slidable vertically through this opening but also may be tilted upon the rod 49 and thus cause its lower end to be swung to the left in Figure 3. The lower end of the bar 44 is formed with an opening through which a rod 51 passes, the rod 51 carrying a spring 52 which is compressed when the lower end of the bar 44 moves to the left, so that the rod 51 may be shifted in the same direction and the head 53 at its front end brought into position to close the normally open switch 54. Downward movement of the bar 44 is effected by means of an arm 55 which projects from a shaft 56 rotatably mounted under the shelf 17, and in order to rotate this shaft there has been provided an arm 57, which projects from the shaft at an upward incline and is engaged by a cam 58 carried by the shaft 10.

Referring to Figures 3 and 8, it will be seen that as the shaft 10 turns, and the lower layer of boards is advanced towards the shoe 45, the arm 57 will be depressed by a lobe 59 on cam 58 and the shaft 56 rotated in a direction to swing the arm 55 downwardly. As this arm swings downwardly, pressure is applied to the arm 48, and the bar 44 will be shifted downwardly a sufficient distance to allow the front board to pass over it and onto the shoe 45. The bar 44 is then shifted upwardly by the spring 50 as the lobe 59 of the cam 58 moves out of engagement with the arm 57 of the shaft 56. The upper end of the bar 44 then engages the under face of the first board while the latter is elevated slightly by shoe 45 and as the front edge of the second board comes

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into contact with rear side edge face of the bar 44, pressure will be applied to tilt this bar and shift the rod 51 to the left to effect closing of the switch 54. Movement of the chains will then be brought to a stop, by means presently to be described, with contacting side edges of the first and second boards between the upper drive heads 33 and the lower driving heads 34.

The plungers of the driving heads 33 are then moved outwardly to impart driving force to the hammers and the fasteners will be driven into the meeting side edge portions of the boards on their top sides. The fact that the first board rests upon a shoe 45 which is yieldably held in a raised position by the springs 47, allows this board to be shifted downwardly against the lower driving heads 34 as the upper fasteners are driven into place and the two boards will have their surfaces flush with each other.

The driving heads

Movement of the pistons 35 and their plungers 36 is effected by fluid under pressure which is preferably air, but may be water or other liquids. This fluid, which will be referred to as compressed air, is supplied through a pipe 60 having branches 61 and 62, as shown in Figure 8, the branch 61 being connected with valves 63 which are connected with upper ends of the upper driving heads 33 by pipes 64 and 65. The valves 63 are normally closed and are moved to open positions by solenoids 66. When the valves 63 are open they admit air pressure from supply pipe 61 into the cylinders of driving heads 33 and when these valves are referred to as closed they shut off the air supply and exhaust the cylinders of the driving heads slowly through restricted ports 63'.

A power wire 67 leads to the coil of one solenoid which is connected with the coil of the other solenoid by a wire 68, and this solenoid coil is connected with a switch 69 which is connected with a contact of the switch 54 by a wire 70, the other contact of the switch 54 having connected thereto the second power wire 71. The switch 69 is housed in a cylinder 72 with which is connected pipes 73 and 74 leading from the cylinder of one of the driving heads 33.

The pipe 74 is also connected to a check or relief valve 75 which in its turn is connected by a pipe 77 to actuate a piston operated valve 76. The valve 76 is connected with the pipe 62 by a manually adjusted gate valve 78 and pipes 79 connect the valve 76, with lower ends of the cylinders of the driving heads 34. Valve 76 is normally closed to prevent communication between pipes 62 and 79, and is pressure operated by fluid pressure in pipe 77 to connect the driving heads with pipe 62. In its closed position this valve opens an exhaust port in communication with pipes 79.

The movable contact of the switch 69 has a depending plunger 80 carrying a pivoted shoe 81 which hangs at a lower level than the top surface of the bottom layer of boards when the pressure is relieved from cylinder 72 and there is no board beneath the shoe, as shown in Figure 3, in which condition the switch is closed. If the pressure in cylinder 72 is relieved when there is a board at rest under shoe 81, the shoe will rest on the board and hold the movable contact of switch 69 in raised or switch open position as indicated by the broken line position of shoe 81 in Figure 8. Movement of the boards will rock the shoe to its full line position, and in the

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absence of pressure in cylinder 72 plunger 80 and its movable contact will then be unsupported and will drop to closed position as indicated in Figures 3a and 3b. Shoe 81 constitutes a sector of a wheel and has sufficient arcuate length so that when it drops on a stationary board at the completion of a staple driving operation it will hold the switch 69 open until the boards move again for a sufficient distance to carry the driven staples beyond the driving heads.

When the machine is operating, this switch is normally closed, and from an inspection of Figure 8 it will be seen that when the switch 54 is also closed, current will flow through the solenoids 66 and energize them so that the valves 63 will be opened and air allowed to enter the cylinders of the upper driving heads. This incoming air forces the pistons 35 downwardly, so that fasteners will be driven into upper faces of the boards and air will also flow through the pipe 73 to enter the cylinder 72 and open the switch 69. When the switch 69 is opened the solenoids become inactive and the valves 63 start to close.

The valves 63 are a common type of delayed action valves which open quickly but close slowly after the solenoid is deenergized, thereby allowing sufficient time for the pistons 35 to make their driving stroke before their air supply is cut off. When these valves become closed the springs 40 raise the pistons exhausting the air slowly through restricted ports 63' and return the hammers to the retracted position.

When the compressed air flows through the valves 63 and enters the cylinders of the upper driving heads, a portion flows through the pipe 30 which has valves 83 and 84 therein, the valve 83 being a check valve and the valve 84 being operated by a solenoid 85. Valve 84 is closed by energization of its solenoid and opened by deenergization of the solenoid. The air upon entering the cylinder 28 from the pipe 30 acts upon the piston 29 and moves the clutch fork 27 longitudinally to shift the clutch section 26 out of engagement with the companion clutch section 25 and rotation of the shaft 10 will thus be stopped and movement of the chains 13 halted so that the boards resting upon the chains will be held stationary while fasteners are being driven into the boards. It will thus be seen that movement of the boards will be in timed relation to operation of the driving heads.

One end of the coil of the solenoid 85 is connected with an end of the coil of a solenoid 86 by a wire 87, the other ends of the coils for these solenoids being connected with stationary contacts of switches 88 and 89 carried by one of the upper driving heads and one of the lower driving heads. The other stationary contact of the switch 88 is connected with a wire 90 connected with a wire 91, which extends from the power wire 71 to the motor 23 and the corresponding stationary contact if the switch 89 has attached to it a wire 92 which connects it with a wire 93 extending from the power wire 67 to the motor. The switches 88 and 89 are of duplicate construction and each has a closed casing 94 as shown in Figure 4 in which is a movable contact 95, having a plunger 96, which slides through a fitting 96a into the casing of the driving head and protrudes into the driving head casing so that when the piston 35 is moved to its retracted position by the spring 40, the plunger 96 will be shifted inwardly of the switch casing and the movable contact 95 moved into position to bridge the stationary contacts and close the circuit.

Current will then flow through the coils of the solenoids 85 and 86. Energization of solenoid 85 closes the valve 84 to its source of air supply and opens an exhaust port to relieve the air pressure from cylinder 28. Energization of solenoid 86 opens the valve 97 to admit air to pipe 98 connected with the fastener feeders 99. The return of both pistons 35 to their retracted positions thereby actuates the fastener feeders and restarts the board conveyors 13, 14, 16.

The fastener feeders

The fastener feeders are of duplicate construction and each has an elongated cylinder 100, which projects radially from the companion driving head casing or cylinder below the partition 37 therein. A rod 101 is slidably mounted in the cylinder 100 and at its front end is provided with a piston 102 as shown in Figure 4, so that as air enters the front end of the cylinder the rod will be shifted rearwardly and its end portion 103 which constitutes an extension of the rod, will be shifted longitudinally towards the companion driving head. Spring 104 coiled about the plunger or rod extension between the bar 105 and the collar 106 urges the rod 101 to the right Figure 4 and yieldably holds it in its normal position. As the rod moves to the left Figure 4, a pawl 106' pivoted to the rod and projecting through a slot 107 in the cylinder acts upon a ratchet wheel 108 carried by a shaft 109 as shown in Figure 5, journaled vertically through a bearing carried by a plate 111. The pawl is yieldably held in an operative position by a spring 112, secured upon the rod and when the rod moves to the right Figure 4 the pawl will pass a tooth of the ratchet without turning the shaft. It will thus be seen that intermittent rotation will be imparted in step by step movements in the same direction to the shaft and a toothed feeding wheel 113 turned with the shaft 109 so that a fastener strip 42 engaged by teeth of the feeding wheel will be shifted longitudinally the length of one fastener. Each fastener strip moves along a guide 114 (Fig. 6) and to a companion guide 115 which is pivoted by a pin 116 and slotted longitudinally to receive the fastener strip, and upon referring to Figure 6 it will be seen that the portion of the fastener strip passing through the guide 115 is engaged by a rocker strip 117 which is pivoted by a pin 118 and has its forward end portion seated in a groove 119 extending about the toothed peripheral edge face of the feeding wheel 113. Normally the inner or rear end of guide 115 is aligned with a slot 120 formed in a block 121 to receive the hammer 38 and a fastener 39 cut from the fastener strip and as the fastener strip is advanced and a fastener cut therefrom, the cut fastener will be located in the slot 120 and disposed under the hammer so that as the hammer is actuated the fastener will be driven into abutting boards 4.

The fasteners are cut from the fastener strip by a cutter actuated by the rod 131 as it moved to the left Figure 4, and referring to Figure 5 it will be seen that as the rod moves to the left the rear portion or extension 103 of the rod moves into contact with the free end of a lever 122 carried by a shaft 123 which is disposed vertically in spaced relation to the plunger 36 and rotatably mounted through the block 121. A groove 124 is formed longitudinally of the shaft 123 and into this groove fits a lug 125 carried by a movable cutter head 126, as shown in Fig-

ure 6. This cutter head carries a blade 127 and even with the sharpened edge of this blade the cutter head is formed with a slot 128 through which the fastener strip passes. As the cutter head is shifted by action of the lug 125 during turning of the shaft 124 the blade 127 moves towards and across the sharpened edge of a stationary blade 129, so that the fastener strip will be severed to provide a fastener, the cutting taking place after the fastener strip has been shifted longitudinally a sufficient distance to dispose its end portion within the slot 120. As the pawl 106' moves out of engagement with the ratchet wheel 108 the extension 103 contacts lever 122 actuating the cutter mechanism. Upon opening of one of the switches 88, 89 to deenergize solenoid 83 the valve 97 is closed to its supply pipe 62 and opened to exhaust the air from cylinders 100. Spring 104 then shifts the rod 101 to the right Figure 5 to its initial position and a spring 130 (Fig. 6) will return the cutter head to its original position and cause the shaft 123 to be turned in a retrograde direction and the lever 122 returned to its original position. The guide 115 is pivotally mounted so that it may have swinging movement as the cutter head is reciprocated longitudinally. The fastener cut from the fastener strip is engaged by a plunger 131 which is pressed against a side face of the fastener by a spring 132 and the cut fastener will thus be held upright and accurately driven into the boards.

Operation

The operation of the improved board fastening machine is as follows.

A quantity of boards are stacked in the container or hopper and arranged in layers or tiers, each tier extending transversely of the table 2 and composed of a number of boards of such width that they fit snugly in side by side engagement with each other between the front and rear sides of supports 6 and 8 of the hopper, as shown in Figure 3. While some of the layers of boards have been shown consisting of three boards and others of two boards, it will be understood that the layers may each consist of any number of boards sufficient to form a box wall of the predetermined height provided for by the distance between the front and rear supports 6 and 8 of the hopper in which the boards are stacked.

The machine is first started in operation by energizing the electrical circuit 67, 71 and supplying compressed air to pipe 60 in Figure 8. Switch 69 would then be closed by the absence of pressure in pipe 73 and the absence of support for plunger 80 by shoe 81, as shown in Figure 3. Switch 54 is normally open, allowing valves 63 to remain closed to the supply pipe 61 but open at ports 63' to maintain atmospheric pressure in the cylinders of driving heads 33. Similarly, valve 76 is closed to the supply pipe 62, but its exhaust port is open to maintain atmospheric pressure in the cylinders of driving heads 34. The retracted positions of the pistons 35 in the driving heads hold switches 88 and 89 closed to energize the solenoids 85 and 86, the former solenoid thereby holding its valve 84 closed and the latter holding its valve 97 open. Thus the spring 28 holds the clutch 25, 26 engaged, and the motor 23 would immediately start feeding boards from the hopper.

The bottom layer of boards is moved forwardly by engagement of cross bar 14 behind

the rear edge of the rear board of the bottom layer. As the boards move forward they push pendulum shoe 81 aside without lifting plunger 80, to allow switch 69 to remain closed, and the cam lobe 59 presses the arm 57 downwardly to rotate shaft 56 and swing the arm 55 downwardly as shown in Figure 3a. This causes the feeler bar 44 to be depressed momentarily so that the leading edge of the front board of the advancing bottom layer is not engaged thereby to cause the driving of fasteners. As soon as cam lobe 59 rotates out of engagement with arm 57 the bar 44 is lifted by spring 50 to bear against the bottom surface of the boards.

Continued movement of the feed mechanism causes the front board of the advancing bottom layer to pass freely over the upper end of feeler bar 44 and onto the shoe 45 which raises the front board and allows the bar 44 to shift upwardly to extend slightly above the top surface of table 3. The leading edge of the second board then engages the rear side face of the protruding upper end portion of the bar 44 and tilts it about the rod 49 causing the rod 51 to be shifted to the left as shown in Figure 3b so that the head 53 closes the switch 54. Closing of the switch 54 energizes the solenoid 66 to open the valve 63 and admit air from pipe 61 into the cylinders of the upper driving heads. This air which is under pressure forces the pistons 35 downwardly and the hammers 38 carried by the plungers 36 drive fasteners into the top sides of abutting edge portions of the first and second boards in bridging relation to the boards. Air also flows into the cylinder 28 through the check valve 83 and through the valve 84 which is opened by deenergization of solenoid 85 as soon as initial movement of one of the pistons 35 has opened the switch 88. Air flowing into the cylinder 28 actuates the small piston 29 and the clutch forks are shifted in a direction to separate the clutch members 25 and 26 before the large pistons 35 have completed their stroke. Movement of the chains 13 is stopped abruptly by the friction of the boards and the boards are stationary at the instant the top fasteners are driven into them.

A portion of the air entering the casing or cylinder of one driving head 33 passes through the pipe 73 to cylinder 72 of the switch 69 and moves its movable contact upwardly to open this switch. Opening of the switch 69 interrupts the flow of current to solenoids 66 and the valves 63 close slowly by delayed action, allowing sufficient time for the driving stroke of the top pistons 35. When valves 63 are closed, they exhaust air slowly from the driving heads 33 through restricted ports 63'.

The air pressure in the top driving heads 33 which effects the driving of the top staples also flows through pipe 74 and check and relief valve 75 to the piston operator of valve 76. Check valve 75 opens automatically when subjected to a pressure of 50 pounds and recloses when the pressure in pipe 74 falls below 50 pounds, thus allowing the compressed air at a pressure greater than 50 pounds to open valve 76, and preventing loss of pressure from pipe 77 back through pipe 74 while the upper driving heads are exhausting. Valve 76 is thereby held open for a sufficient time to accomplish the actuation of the lower driving heads 34. When valve 76 is opened by pressure in pipe 77, air flows from pipes 60 and 62 through valves 78 and 76 to the cylinders of the lower driving heads 34 and raises their pistons to impart driving force to their hammers to drive

staples into the lower faces of the boards. Gate valve 78 is used to adjust the rate of air flow into driving heads 34 to retard their action and is timed to allow the upper pistons 35 to be retracted before lower hammers 38 drive the bottom fasteners. The action of the lower driving heads is also delayed because of the fact that the opening of check valve 75 does not occur until the pressure in pipe 74 has built up to the stated 50 pounds, by which time considerable movement of the upper pistons has already occurred. The pressure in pipe 77 is relieved slowly by needle valve 76', allowing valve 76 to shut off the pressure from pipe 62 and exhaust the lower driving heads.

As the air pressure is exhausted from the driving heads the springs 40 retract the pistons 35 until they engage plungers 96 and close the switches 88 and 89. Current then flows to the solenoid 85 to close valve 84 and also to the solenoid 86 to open the valve 97 as mentioned in connection with the starting of the machine. Opening the valve 97 allows air to flow through pipe 93 to the fastener feeders 99 causing their rods 101 to be moved to the left in Figures 4 and 5 to engage the pawl 106' of each rod with the companion ratchet wheel 103. Shafts 109 are thereby turned a partial revolution to shift the fastener strips longitudinally and move their free end portions into the slots 120. The rear ends of the rods engage the levers 122 and cause turning of the shafts 123 and as the shafts 123 are turned the movable cutter heads are shifted longitudinally in a direction to cause the blades 127 to move towards the stationary blades 129 and cut fasteners 39 from the fastener strips 42. Fasteners will thus be in position to be driven into both upper and lower surfaces of the boards when the driving heads are again actuated. In the next driving stroke of the lower driving heads the opening of switch 89 deenergizes solenoid 86 and allows valve 97 to return to its closed position which exhausts the pressure from the fastener feeding devices, allowing rods 101 to return by pressure from springs 104.

The clutch 25, 26 is not reengaged to restart the conveyor chains 13 until the pistons 35 in both upper and lower driving heads are fully retracted after all the fasteners in one joint are driven. Then the closing of series switches 88 and 89 energize the solenoid 85 as above mentioned to close valve 84 and open its exhaust port for cylinder 28 allowing spring 29 to move the clutch members together.

At the time when air is admitted to the upper driving heads and cylinder 72 the shoe 81 carried by the shank of the plunger 80 is lifted out of contact with the board under it, allowing the shoe to swing down to pendant position shown in broken lines in Figure 3. When the air is exhausted from the driving heads through restricted ports 63' the plunger 80 drops but the shoe 81 then comes to rest on a board and the switch 69 is thereby held open. The switch 69 will not reclose until the boards move sufficient distance to carry the newly driven fasteners away from the driving heads and rock shoe 81 out of alignment with plunger 80. This is a safety provision to prevent repeated operations of the fastener driving mechanism in quick succession which might drive one fastener upon another if the feeler bar 44 should be tripped at the wrong time by a crack or knothole close to the edge of the board. Fasteners cannot be driven while switch 69 is open. If the feeler bar is tripped by such a defect after the last driven

staples have passed beyond the driving heads new staples will be driven but no harm is done beyond wasting the staples.

As each board edge encounters the feeler bar 44 the above described cycle of operations is repeated in step by step movement to fasten each joint together regardless of the widths of the boards, except that cam lobe 59 will cause the staple driving mechanism to skip each joint between the last board of one layer and the first board of the next layer in the hopper. Were it not for cam lobe 59, all the boards in the hopper would be fastened together to form one continuous board.

In the fastening of each joint the leading board is initially supported upon the shoe 45 which is held in raised position by the springs 47. This board is shifted downwardly against the table top 2 as the top fasteners are driven into the boards, and then the springs return the shoe to its raised position to hold both boards flat against the upper driving heads while the bottom fasteners are driven. Thus the fastened boards have their top and bottom surfaces in the same planes and are readily pushed forward and out of the machine by the following boards when the conveyor chains are again set in motion.

The various references to delayed action, slow relief of pressure, and the like, are merely relative terms employed to account for the operations of different parts of the mechanism in predetermined sequence rather than simultaneously. The intervals of delayed action and pressure relief are actually very short in time and the whole cycle of operations is very quickly performed.

Having thus described the invention, what is claimed is:

1. A board fastening machine comprising a table, means for stacking boards in layers over the table, each layer consisting of a plurality of boards extending transversely of the table with side edges in face to face contact with each other, driving heads above and below said table, means for feeding fasteners to said driving heads, means for moving the bottom layer of boards along the table, means for stopping said movement of the bottom layer of boards, means for initiating operation of said driving heads, and a common means for actuating said stopping means and said initiating means when said contacting side edges of boards in said bottom layer are in position between said upper and lower driving heads to receive fasteners across the joint between said contacting edges.

2. A board fastening machine comprising means for supporting a stack of boards in layers with a plurality of boards in each layer and the side edges of all the boards transverse to a predetermined direction of movement, means for advancing said layers one after another in said direction of movement with the advancing boards in edge abutting relation, upper and lower driving heads spaced from said stack supporting means in said predetermined direction of movement for driving fasteners into top and bottom faces of the boards, and means actuated by leading edges of predetermined ones of the advancing boards to stop said advancing means and effect operation of said driving heads when predetermined joints arrive in fastening position relative to said driving heads, for fastening adjacent boards in each layer to each other.

3. A board fastening machine comprising a table, means for locating boards transversely across the table with their side edges in face to face contact with each other, driving heads

above and below the table for driving fasteners into upper and lower faces of the boards, means for moving the boards along the table between said driving heads, and means for stopping movement thereof when the boards are in position to receive fasteners across a joint between said contacting side edges.

4. A board fastening machine comprising a table, means for stacking upon the table layers of boards each consisting of a plurality of boards extending transversely of the table in side by side relation to each other, driving heads above and below the table, means for advancing the bottom layer of boards, means for stopping said advance when contacting side edges of adjoining boards are in predetermined position between the upper and lower heads, means for intermittently advancing fastener-strips towards the heads, and means for severing the fastener-strips after they are advanced to form fasteners within the heads in position to be driven into the boards.

5. A board fastening machine comprising a table, means for locating boards transversely across the table in side by side relation to each other, driving heads, means for moving the boards along the table, means for stopping such movement when contacting side edges of adjoining boards are in position to have fasteners driven therein by the heads across the joint between said edges, and means for feeding fasteners to the heads in timed relation to movement of the boards and operation of the heads.

6. A board fastening machine comprising a table, means for stacking upon the table layers of boards each consisting of a plurality of boards extending transversely of the table in side by side relation to each other, front and rear shafts rotatably mounted transversely of the table, sprocket wheels carried by said shafts, chains trained about the sprocket wheels, driving heads in advance of the stack of boards, an abutment bar shiftable vertically through the table, means mounting the bar for vertical sliding and tilting movement, a spring yieldably holding the bar in its raised position, a cam carried by said front shaft and operable to press said bar downwardly into position for movement of a front board across it and then release said bar to allow the bar to shift upwardly into position for engagement of the front edge face of a second board with the rear side of the bar and tilt the lower end of the bar rearwardly, a motor for driving said front shaft including a clutch member movable into and out of a driving position, means operated by fluid under pressure for shifting the movable clutch member from a normally operative position to an inoperative position, a pipe including a solenoid valve for delivering fluid to said clutch shifting means, a circuit for said solenoid having a normally open switch therein, arranged to be moved to a closed position when the said abutment bar is tilted to swing its lower end rearwardly, and a circuit for said motor having therein a switch actuated by fluid pressure in one of said driving heads.

7. A board fastening machine comprising a table, means for stacking upon the table layers of boards each consisting of a plurality of boards extending transversely of the table in side by side relation to each other, front and rear shafts rotatably mounted transversely of the table, sprocket wheels carried by said shafts, chains trained about the sprocket wheels, driving heads in advance of the stack of boards, cross bars car-

ried by said chains for engaging rear edges of the layers of boards and successively shifting layers of boards forwardly, plates carried by said cross bars for moving under boards back of a front board of a layer and supporting the stack as boards of the bottom layer are shifted forwardly, an abutment bar shiftable vertically through the table, a cam carried by the front shaft, means actuated by said cam for depressing the abutment bar as a front board moves across it and then releasing the abutment bar and allowing upward movement thereof into position for abutting engagement of its rear face by the front edge face of a second board as contacting side edges of the said boards move into operative relation to the driving heads, said abutment bar having a control movement responsive to said abutting engagement by the front edge of said second board, drive means for the front shaft including a fluid pressure operated clutch and a pipe line for delivering fluid under pressure to operate the clutch, a solenoid valve for the pipe line, a circuit for said solenoid having a switch therein, means operable by said control movement of said abutment bar to stop forward movement of the boards, and means for feeding fasteners to the driving heads in timed relation to the stopping of the boards and operation of the driving heads.

8. A board fastening machine comprising a table over which boards are stacked in layers each consisting of a plurality of boards extending across the table transversely thereof in side by side relation to each other, a conveyor for moving a layer of boards forwardly along the table, driving in advance of the stack of boards, a shoe yieldably held in a raised position above the table, an abutment rearwardly of said shoe shiftable vertically and yieldably held in a raised position, means actuated by said conveyor for shifting the abutment downwardly and allowing the first board of a layer to move across the abutment and onto said shoe while said shoe is in a raised position in front of a second board back of the front board, and mechanism for operating said conveyor and driving heads including a switch closed when the abutment bar is moved by engagement of the front edge of the second board of a layer with the rear face of the protruding upper end of the abutment bar and stopping forward movement of the boards while fasteners are driven into them.

9. A board fastening machine comprising means for advancing a plurality of boards in edge abutting relation with said abutting edges transverse to the direction of advancement, a plurality of driving heads arranged in side by side relation transverse to said direction of advancement to drive fasteners in said boards, and means actuated by the leading edges of predetermined boards of said plurality of boards to time the operation of said driving heads to drive fasteners into adjoining boards across the joints between said abutting edges.

10. A board fastening machine comprising a driving head, means for moving boards in transverse edge abutting relation past said driving head in position to receive a fastener from the head when the head is operated, means responsive to the movement of the boards to effect operation of the driving head when two boards move into position to receive a fastener across the joint between said abutting edges, and means to render said responsive means temporarily in-

effective at predetermined intervals in the movement of the boards.

11. A board fastening machine comprising a driving head, means for moving boards in transverse edge abutting relation past said driving head in position to receive a fastener from the head when the head is operated, and means projecting into the path of movement of the boards at predetermined intervals to be actuated by predetermined ones of the boards for timing the operation of the driving head to locate fasteners across predetermined joints between said abutting edges.

12. A board fastening machine comprising a driving head, means for moving boards in transverse edge abutting relation past said driving head in position to receive a fastener from the head when the head is operated, and means actuated by leading edges of predetermined ones of the boards to stop said moving means and initiate operation of the driving means.

13. A board fastening machine comprising means for stacking boards in layers with the side edges of the boards transverse to a path of movement, means for advancing said layers one after the other in said path of movement with all the boards in transverse edge abutting relation, a driving head arranged to drive fasteners in said boards, means actuated by the leading edges of the boards following the first board in each layer to initiate operation of said driving head to fasten together the boards of each layer, and means to prevent actuation of said last means by the leading board of each layer.

14. A board fastening machine comprising means for stacking boards in layers with the side edges of all the boards transverse to a path of movement, means for advancing said layers one after the other in said path of movement with all the boards in transverse edge abutting relation, means to fasten the adjacent boards in each layer to each other in said edge abutting relation, and means to render said fastening means inoperable to fasten the last board of each layer to the first board of the next layer.

15. A board fastening machine comprising a horizontal table, means for advancing boards in transverse edge abutting relation across said table, a driving head for driving fasteners into horizontal faces of said boards, a vertically and horizontally movable control member mounted for vertical projection into the path of boards approaching said driving head, and means operable by horizontal movement of said control member when it is engaged by the leading edge of a board to stop said advancing means and initiate operation of said driving head when the boards arrive in position to receive fasteners across predetermined joints between said abutting edges of the boards.

16. A board fastening machine comprising a table, means for advancing boards in transverse edge abutting relation across said table, a driving head above said table for driving fasteners into the top faces of said boards, a shoe projecting yieldably above the table beneath said driving head to engage said boards, a vertically and horizontally movable control bar mounted for projection above said table in front of said shoe relative to the direction of movement of the boards, means operable by said control bar when it is engaged by the leading edge of a board to stop said advancing means and initiate operation of said driving head for driving fasteners across predetermined joints between said abut-

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ting edges of the boards, means operable by said advancing means for depressing said control bar below the table top in predetermined positions of said advancing means, and means operable by said shoe to prevent repeated operation of said driving head until said boards have advanced a predetermined distance since the previous operation of the driving head.

17. In a board fastening machine, means for advancing a plurality of boards in edge abutting relation with said abutting edges transverse to the direction of advancement, a driving head mounted in position to drive fasteners across the joints between said abutting edges to fasten adjacent boards together, means actuated by leading edges of predetermined ones of the advancing boards to stop said advancing means and effect operation of said driving head when predetermined joints arrive in fastening position with respect to said driving head, and means responsive to advancement of the boards after each operation of the driving head to render said last means ineffective until a predetermined minimum advancement has occurred, to prevent the driving of one fastener on top of another.

18. A board fastening machine comprising means for stacking boards in layers with the side edges of all the boards transverse to a predetermined direction of movement, means for advancing said layers one after the other in said direction of movement with all the boards in transverse edge abutting relation, means to fasten the adjacent boards in each layer to each other in said edge abutting relation, and means responsive to advancement of the boards after each operation of said fastening means to render said

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fastening means ineffective until a predetermined minimum advancement has occurred.

19. In a board fastening machine, means for advancing a plurality of boards in edge abutting relation with said abutting edges transverse to the direction of advancement, a driving head mounted in position to drive fasteners across the joints between said abutting edges to fasten adjacent boards together, means actuated by leading edges of predetermined ones of the advancing boards to stop said advancing means and effect operation of said driving head when predetermined joints arrive in fastening position with respect to said driving head, and means to render said driving head inoperable to drive fasteners across joints other than said predetermined joints.

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