Oct. 18, 1966 J. M. LAWSON 3,279,600

LUMBER SORTING AND STACKING APPARATUS

Filed April 3, 1964 6 Sheets-Sheet 1

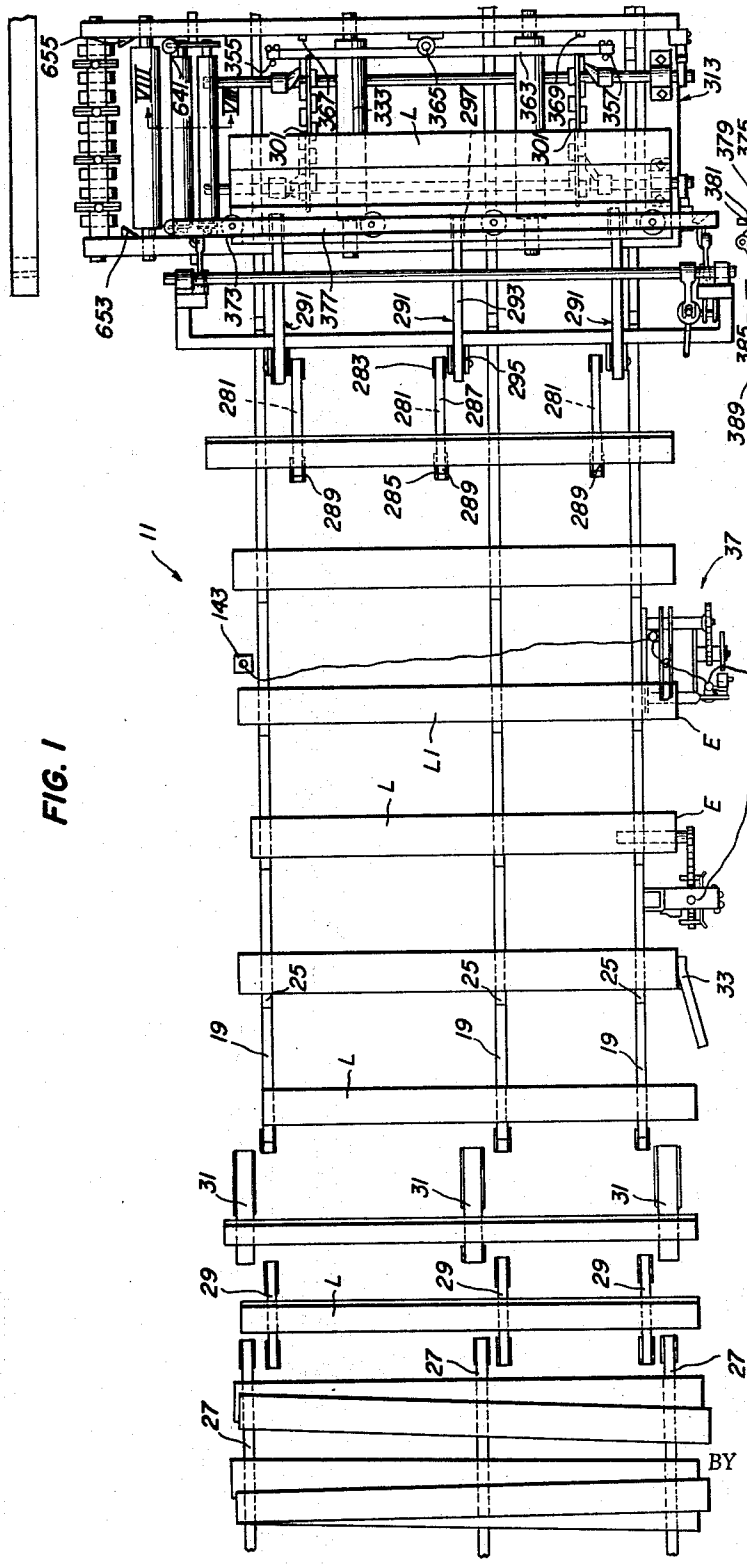


FIG. 1

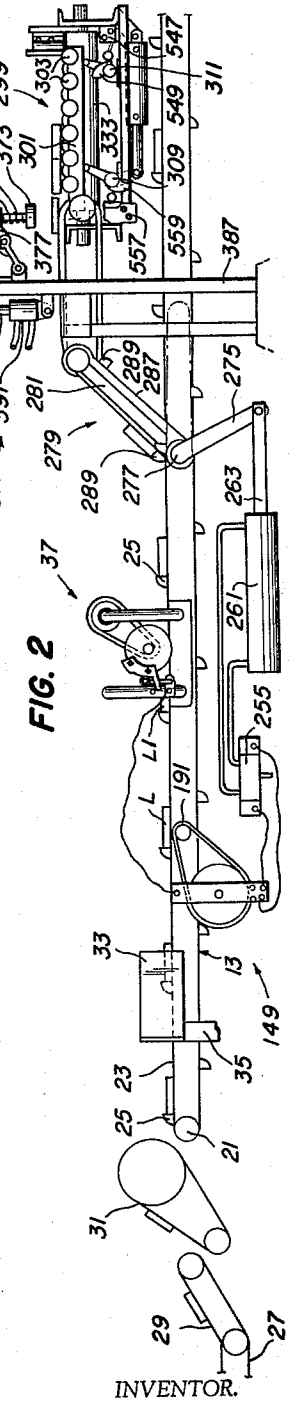


FIG. 2

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LUMBER SORTING AND STACKING APPARATUS

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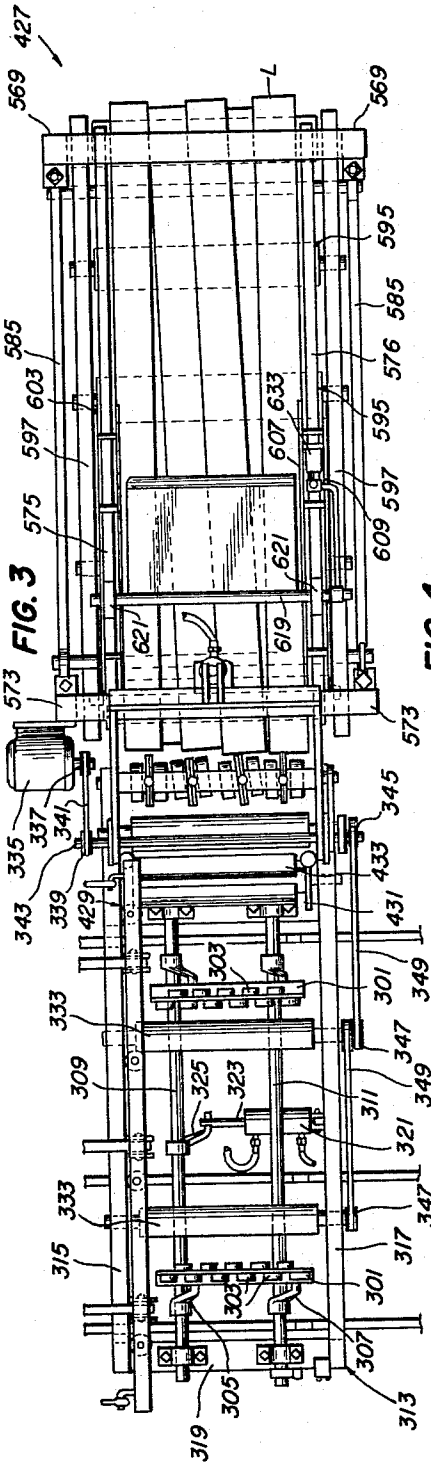


FIG. 3

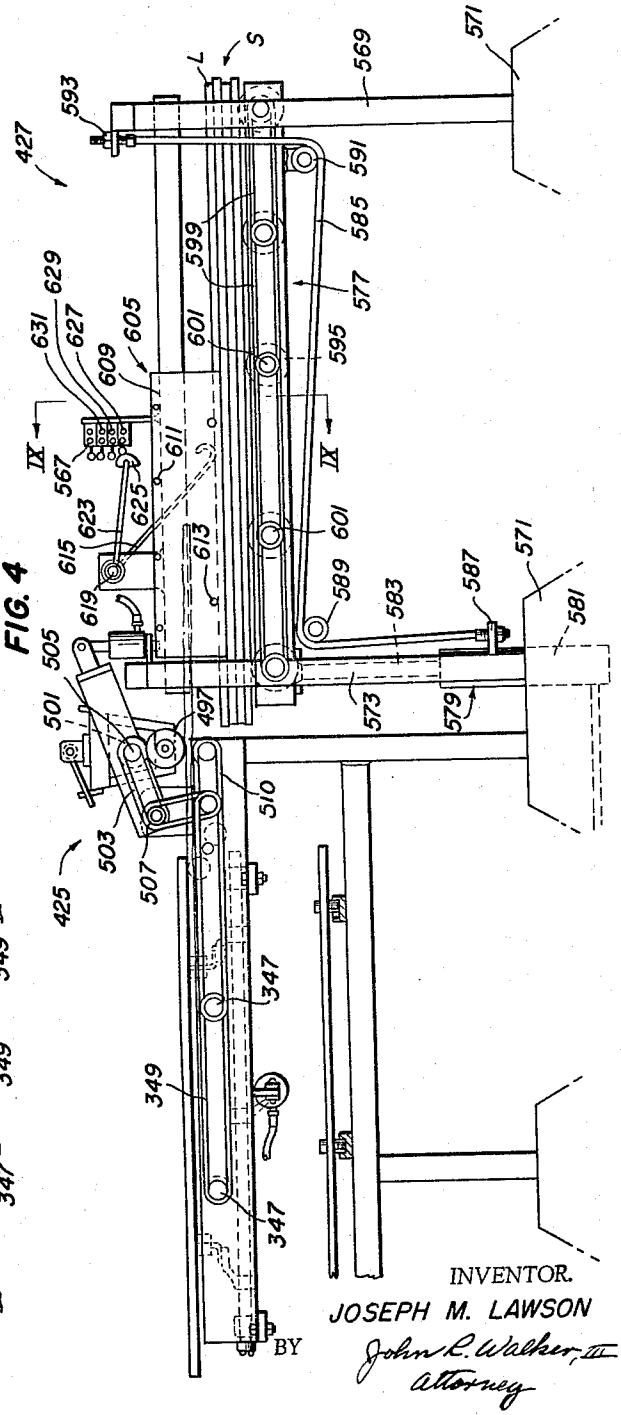


FIG. 4

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LUMBER SORTING AND STACKING APPARATUS

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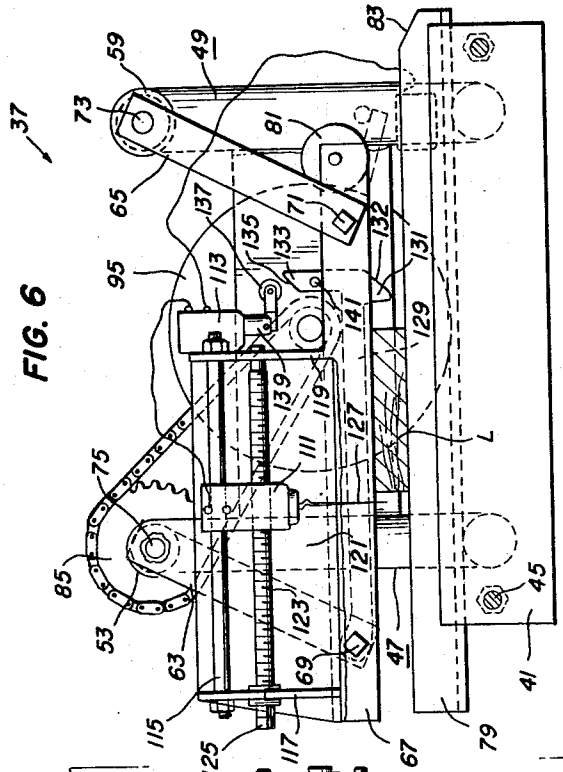


FIG. 6

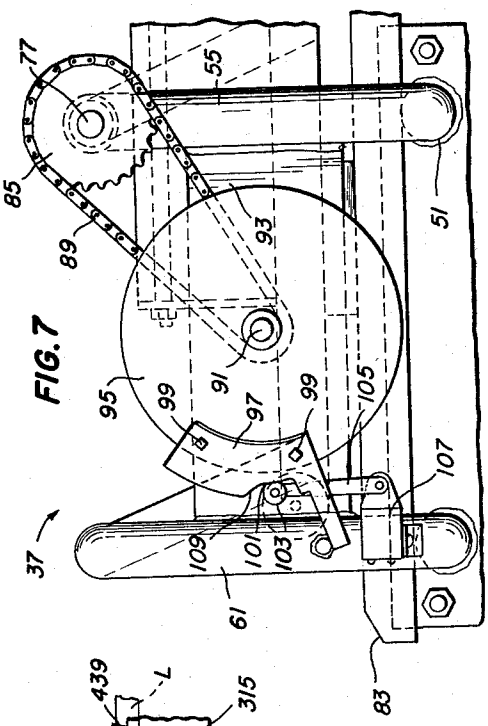


FIG. 7

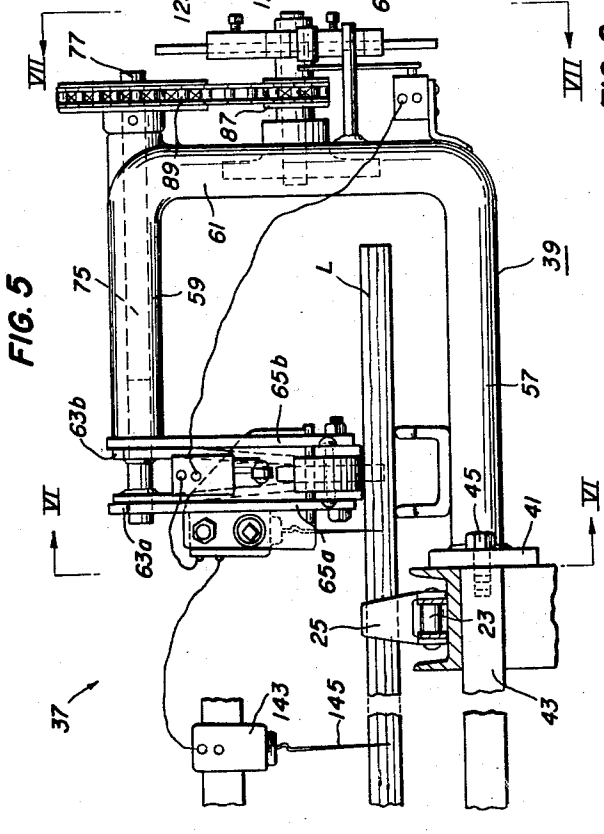


FIG. 5

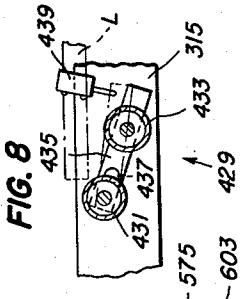


FIG. 8

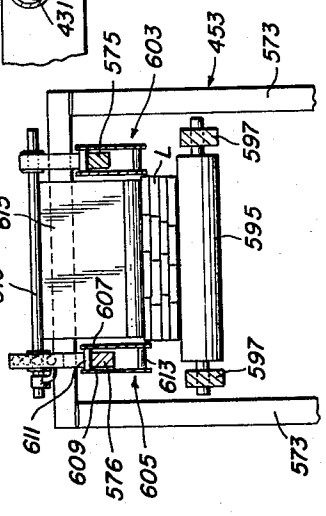


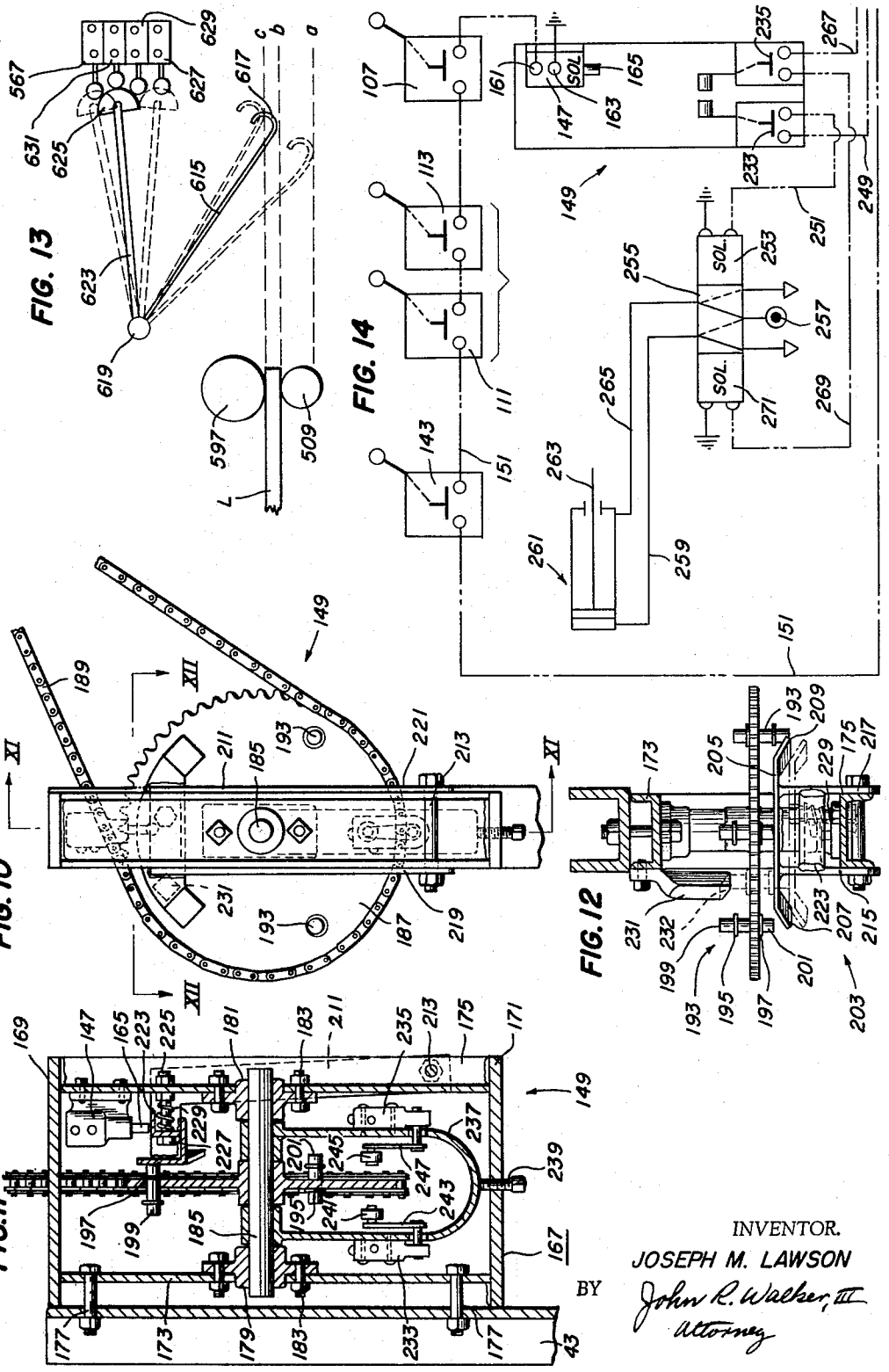
FIG. 9

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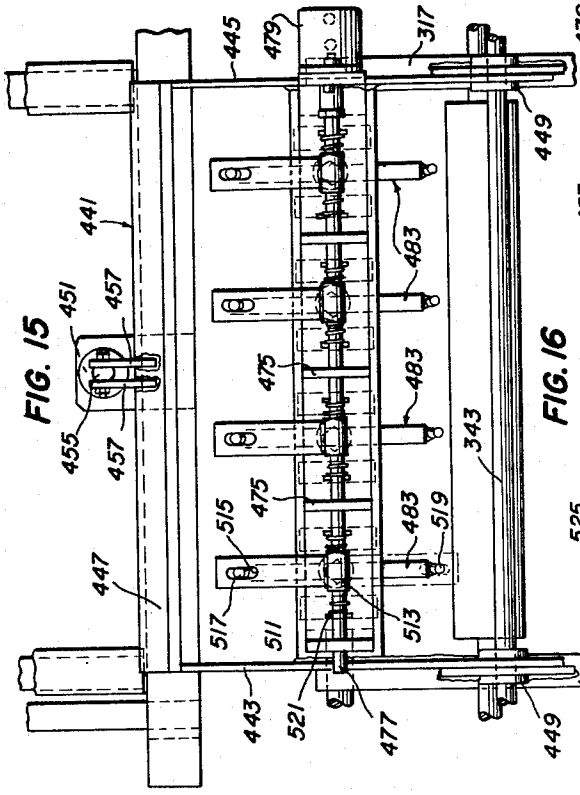


FIG. 15

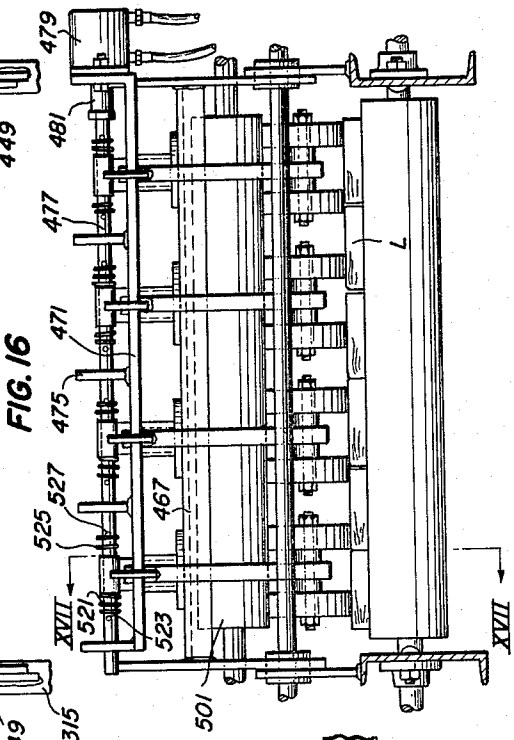


FIG. 16

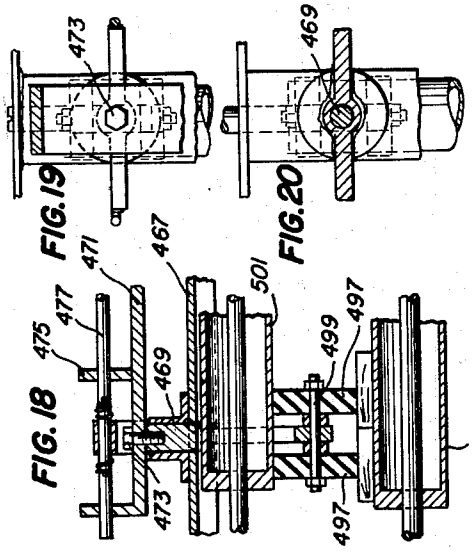


FIG. 19

FIG. 20

FIG. 18

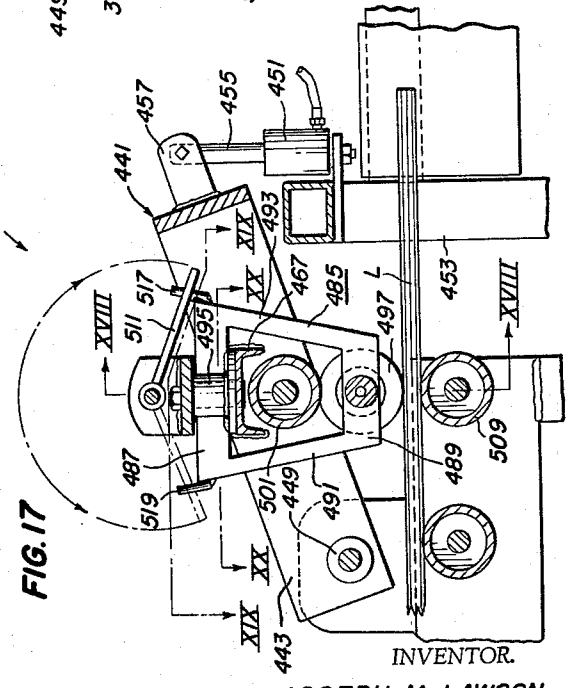


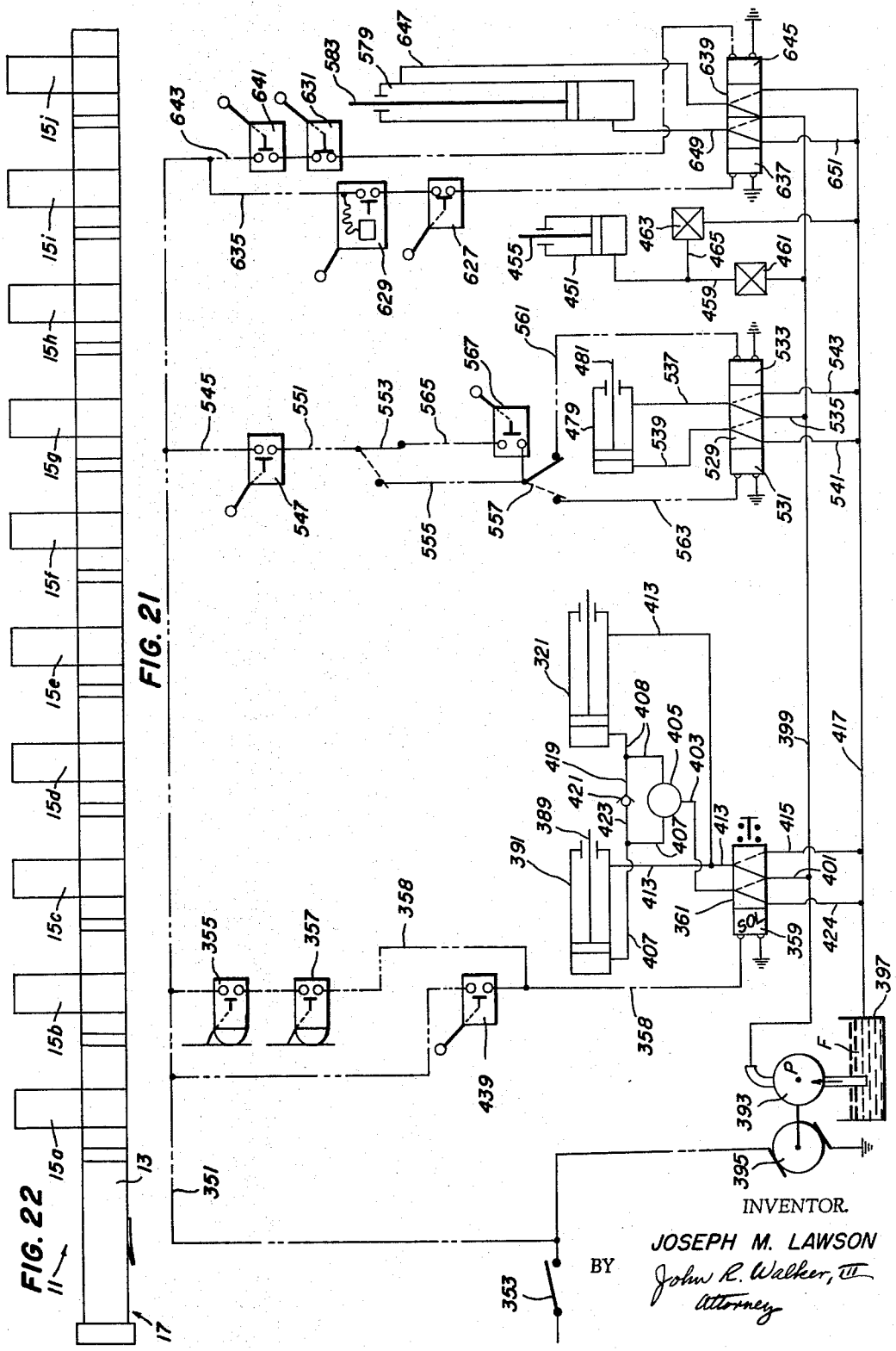
FIG. 17

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LUMBER SORTING AND STACKING APPARATUS

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United States Patent Office 3,279,600 Patented Oct. 18, 1966

3,279,600

LUMBER SORTING AND STACKING APPARATUS

Joseph M. Lawson, Memphis, Tenn., assignor, by mesne assignments, to Moore Dry Kiln Company, Jacksonville, Fla.

Filed Apr. 3, 1964, Ser. No. 357,065
13 Claims. (Cl. 209—74)

This invention relates to apparatus of the type for sorting lumber into desired categories or separations and stacking the separated lumber.

In apparatus of this type, the ultimate objectives should comprise three things, namely: (1) A correct decision or selection as to the category into which the lumber is to be placed or separated; (2) a separating or pulling off of the lumber from the main group or channel; and (3) a placing of the separated lumber into stacks that can be mechanically handled for the next operation. In previous years, there have been many attempts to provide equipment for sorting lumber into various categories, and some have done a good job of selecting and separating, but none have accomplished all three of the above-mentioned objectives. In other words, in the previous attempts, after the lumber was selected and ejected, it was necessary to handle the lumber board-by-board to get them grouped for shipping, etc.

The present invention is directed towards providing apparatus that accomplishes all three of the above-mentioned objectives.

Thus, one of the objects of the present invention is to provide apparatus which makes the correct decision as to the category into which the lumber is to be placed or separated, which separates the lumber from the main group, and which places the separated lumber into a stack that can be mechanically handled for the next operation.

A further object is to provide in such apparatus a very effective and improved means for correctly sensing the individual boards as to whether or not the individual boards should be separated from the main group and to subsequently remove the board if the decision has been made as to its selection.

A further object is to provide, in such apparatus, means for accumulating the selected and removed boards and for forming individual courses of boards from the boards accumulated.

A further object is to provide, in such apparatus, skewing means for moving the individual courses into a stack with the layers being arranged in a desired pattern, as, for example, into parallel and offset layers or criss-crossed layers.

A further object of such skewing means is to arrange each layer in such a manner that voids in random or mixed widths will not cause the stack to break down.

A further object is generally to improve the design and construction of apparatus for sorting and stacking lumber.

The means by which the foregoing and other objects of the present invention are accomplished and the manner of their accomplishment will be readily understood from the following specification upon reference to the accompanying drawings, in which:

FIG. 1 is a plan view of a portion of the apparatus of the present invention.

FIG. 2 is a somewhat diagrammatic view of that portion of the apparatus shown in FIG. 1, but viewed from the side thereof.

FIG. 3 is a fragmentary plan view showing other portions of the apparatus of the present invention, with parts removed for purposes of clarity.

FIG. 4 is a side elevational view of that portion of the apparatus shown in FIG. 3.

FIG. 5 is an enlarged fragmentary elevational view of the sensing device of the present invention.

FIG. 6 is a sectional view taken as on the line VI—VI of FIG. 5.

FIG. 7 is a view taken as on the line VII—VII of FIG. 5.

FIG. 8 is an enlarged fragmentary sectional view taken as on the line VIII—VIII of FIG. 1.

FIG. 9 is a sectional view taken as on the line IX—IX of FIG. 4.

FIG. 10 is an enlarged fragmentary view of the memory portion of the apparatus shown in FIG. 2.

FIG. 11 is a fragmentary sectional view taken as on the line XI—XI of FIG. 10.

FIG. 12 is a sectional view taken as on the line XII—XII of FIG. 10.

FIG. 13 is a somewhat diagrammatic view showing a portion of the hoist control mechanism.

FIG. 14 is a schematic view of the control portions of the sensing, memory and selection portions of the apparatus of the present invention.

FIG. 15 is an enlarged fragmentary plan view of the course skewing portion of the apparatus of the present invention.

FIG. 16 is an end elevational view of that portion shown in FIG. 15.

FIG. 17 is an enlarged fragmentary sectional view taken as on the line XVII—XVII of FIG. 16.

FIG. 18 is a fragmentary sectional view taken as on the line XVIII—XVIII of FIG. 17.

FIG. 19 is a fragmentary sectional view taken as on the line XIX—XIX of FIG. 17.

FIG. 20 is a fragmentary sectional view taken as on the line XX—XX of FIG. 17.

FIG. 21 is a schematic view of the electrical and hydraulic controls of the skewing portion, the course moving portion, and the stacking portion of the apparatus of the present invention.

FIG. 22 is a diagrammatic plan view of the apparatus of the present invention.

Referring now to the drawings in which the various parts are indicated by reference characters, the apparatus **11** of the present invention comprises, in general, a main conveyor **13** that carries the boards or pieces of lumber L to be sorted and stacked past a plurality of sorting and stacking stations **15**. For the purposes of clarity and understanding of the present invention, in FIG. 22 is illustrated a typical arrangement of the apparatus **11** of the present invention, and one example of the type of separation provided by the apparatus is given hereinbelow. In FIG. 22, the receiving end **17** of main conveyor **13** is that end to the left in this fig., where the boards are received, and they are carried to the right past the sorting and stacking stations **15**, which for purposes of clarity have been designated as **15***a* for the first station, **15***b* for the second station, and so on. For purposes of example and not limitation, the sensing devices at the various stations are set, in a manner to be described more fully in the detailed description to follow, so that boards having at least the following dimensions are separated or taken off at the following stations:

Station **15***a*—length, 16 feet; thickness, 2 inches.
Station **15***b*—length, 14 feet; thickness, 2 inches.
Station **15***c*—length, 12 feet; thickness, 2 inches.
Station **15***d*—length, 10 feet; thickness, 2 inches.
Station **15***e*—length, 8 feet; thickness, 2 inches.
Station **15***f*—length, 16 feet; thickness, 1 inch.
Station **15***g*—length, 14 feet; thickness, 1 inch.
Station **15***h*—length, 12 feet; thickness, 1 inch.

Station 15*i*—length, 10 feet; thickness, 1 inch.
Station 15*j*—length, 8 feet; thickness, 1 inch.

Thus, it will be understood that when the boards come to the first station 15*a*, all boards which are at least 2 inches thick and at least 16 feet long will be taken off, and the remainder will be taken down to station 15*b* where all boards that are at least 2 inches thick and at least 14 feet in length will be taken off, and so on. It will be understood that after the pieces of lumber L have gone through the apparatus 11, they will be in ten different separations or stacks. Then, after being dried, each stack or bundle of the lumber can be run through the apparatus 11 to separate the boards into ten different widths so that there will be a total of one hundred different separations, i.e., ten stacks separated into ten widths.

A detailed description of the various components of the apparatus 11 of the present invention follows:

MAIN CONVEYOR

The main conveyor 13 of the present invention preferably comprises a plurality of laterally spaced conveyor portions 19, each of which consists of a continuous elongated member such as a chain led over sprockets 21 and driven by suitable means so that the upper flight 23 moves to the right in FIGS. 1, 2 and 22, and the lumber L is carried thereby. Main conveyor 13 is provided with a plurality of lugs 25 which are arranged in groups of threes, with each of the groups being transversely aligned, with the individual lugs 25 of each group being respectively attached to the conveyor portions 19, and with the groups being equally spaced along the length of main conveyor 13. Thus, the main conveyor 13 is adapted to carry the pieces of lumber L with the pieces disposed substantially transversely of the direction of travel of the conveyor and substantially equally spaced apart.

Suitable means is provided for depositing the pieces of lumber L onto main conveyor 13 so that there is only one piece of lumber engaged by each group of lugs 25. Since any means known to those skilled in the art may be provided for depositing the pieces of lumber L on main conveyor 13, the following general description should suffice: A first conveyor 27 is provided for placing the lumber L to be sorted. First conveyor 27 moves the pieces of lumber L to the right, as viewed in FIGS. 1, 3 and 22, and onto inclined feed conveyor 29 which feeds the pieces onto suitable means, as a board dealer 31, that separates the boards and drops them one at a time in the proper place on main conveyor 13. An example of a preferred means for depositing one board at a time onto the main conveyor is shown in my co-pending application, Ser. No. 178,067, filed Mar. 7, 1962, Patent No. 3,162,292.

Adjacent the beginning of main conveyor 13 is provided an evener 33 for aligning the ends of pieces L. Evener 33 is formed of any suitable structure such as a piece of material that is attached to the frame 35 of main conveyor 13 and angled inwardly towards the boards so that as the boards are carried past evener 33, they are moved endwise until the ends contacted by evener 33 are in a given position relative to main conveyor 13. The purpose of evener 33 is so that the lengths of the boards can be gauged at the opposite ends thereof from evener 33, in a manner later to be described.

SELECTION AND REMOVAL PORTION

At each of the stations 15 there is provided a selection and removal portion that includes, among other things, a sensing mechanism 37, which will be first described. (See FIGS. 1, 2, 5, 6 and 7.) Sensing mechanism 37 comprises a frame 39 that includes a vertical plate 41 mounted on the framework 43 of main conveyor 13, as by means of bolts 45, and a pair of spaced substantially C-shaped members 47, 49 which are rigidly attached to vertical plate 41. C-shaped member 47 includes a lower horizontal portion 51, which is the part actually attached to vertical plate 41, an upper horizontal portion 53 spaced above portion 51, and an intermediate vertical portion 55 that integrally interconnects the outer ends of portions 51, 53. C-shaped member 49 is similarly constructed and includes lower horizontal portion 57, upper horizontal portion 59, and intermediate vertical portion 61, which respectively correspond to portions 51, 53 and 55.

A parallel linkage arrangement is pivotally mounted from upper portions 53, 59 and includes a pair of depending and spaced parallel arms 63, 65 respectively pivotally mounted adjacent the lower ends thereof to a horizontal and inverted channel-shaped member 67, as by fastening means 69, 71. The upper end of arm 65 is pivotally mounted at the end of upper portion 59 as at pivot point 73 by suitable means, and the upper end of arm 63 is pivotally mounted at the end of upper portion 53 by a spindle 75 to which the arm is fixedly attached and which spindle rotatably extends through upper portion 53 and out the opposite end thereof for a portion at 77, as best seen in FIG. 5. Arm 63 is preferably made in two spaced parts, 53*a* and 63*b*, which preferably have the lower ends thereof disposed on the interior of the upstanding flanges of horizontal member 67. Arm 65 is also preferably made in two spaced apart parts, 65*a* and 65*b*, which are preferably disposed on the outside of the upstanding flanges of horizontal member 67. A lower horizontal and channel-shaped member 79 is fixedly supported on frame 39 below horizontal member 67 so that the evened ends E of the pieces of lumber L pass between the members 67, 79 as they are carried along by main conveyor 13. At the receiving end, or end to the right as viewed in FIG. 6, of horizontal member 67 is provided a roller 81 which is positioned so that the ends E will engage the roller and cause the member 67 to swing upwardly to allow the ends E to pass between this member 67 and lower member 79. Also, the receiving end of lower horizontal member 79 is preferably beveled as at 83 to prevent the ends of the boards from catching thereon. It will be understood that without a piece of lumber L between the members 67, 79, the member 67 will normally be in a position closely adjacent lower member 79, but when a piece of lumber L passes therebetween, it will be understood that the upward swing of member 67 will cause arms 63, 65 to rotate clockwise, as viewed in FIG. 6. This clockwise rotation of arm 63 will cause spindle 75 to rotate clockwise, as viewed in FIG. 6, which, in turn, will cause clockwise rotation of a sprocket 85 fixedly attached to spindle 75 on portion 77 thereof. Sprocket 85 causes rotation of a sprocket 87 to which it is connected by means of a continuous chain 89. Sprocket 87 is mounted on an axle 91 which, in turn, is rotatably mounted from a vertical member 93 that extends between C-shaped members 47, 49 and forms a part of frame 39. A disc 95 is fixedly attached to axle 91 so that the heretofore described rotation of sprockets 85, 87 will cause rotation of disc 95, and it will be understood that this rotation will be in a counterclockwise direction, as viewed in FIG. 7. A cam member 97, which is substantially C-shaped in cross-section, embraces the edge of disc 95 and is adjustably held thereon as by means of set screws 99. Cam 97 includes a cam surface 101 that is engaged by a roller 103 on the end of the arm 105 of switch 107, which is normally open when there is no piece of lumber L between the members 67, 79 or when the piece of lumber is of an insufficient thickness, but is closed when a piece of lumber of sufficient thickness is disposed therebetween to cause the roller 103 to be disposed opposite the raised portion 109 of cam surface 101. It will be understood that by adjusting the position of cam member 97 on disc 95,

the thickness of the piece of lumber L which will cause closing of switch **107** can be selected.

There are two switches, namely, switch **111** and switch **113**, which are normally open, but which are closed when a piece of lumber L of at least a certain width is received in the sensing mechanism **37**. Switch **111** is adjustably mounted for adjustment along the direction of travel of the piece of lumber L. Thus, switch **111** is slidably mounted on a horizontal rod **115** which is mounted adjacent the opposite ends thereof from vertical members **117, 119** that are rigidly attached to and upstand from horizontal member **67**. A plate **121** also is upstanding from member **67** and disposed between vertical members **117, 119** in perpendicular relationship thereto. The body of switch **111** is threadedly mounted on a threaded member **123** which, inturn, is rotatably mounted from vertical members **117, 119** and is provided with a squared end **125** adapted to be engaged by a suitable tool for rotating the threaded member **123**. It will be understood that by rotating the threaded member **123**, the position of switch **111** can be adjusted along the length thereof. Switch **111** includes a depending finger **127** which extends below member **67** in the path of movement of the piece of lumber L so that when the leading edge of the piece of lumber contacts finger **127**, switch **111** is caused to close. A lever **129** is pivotally mounted from member **67**, as by fastening means **69**, and extends towards the receiving end of member **67** between the flanges thereof. Lever **129** is provided adjacent the distal end thereof with a depending lug **131** having a sloping face **132**, and an upstanding ear **133**, also having a sloping face **135**, which is adapted to contact a roller **137** on the arm **139** of switch **113**. A transverse pin **141** is mounted on upstanding ear **133** and engages the top of member **67** to limit downward movement of the lever **129** and hold it in a normal horizontal position, best seen in FIG. 6. Lever **129** is so arranged that when the piece of lumber L contacts lug **131**, it moves the lever upwardly to cause ear **133** to contact roller **137** and move arm **139** upwardly to close switch **113**. It will be understood that when the piece of lumber L is wide enough to bridge between lug **131** and finger **127**, both of the switches **111, 113** will be closed, and the piece of lumber of that width will be selected, depending upon other conditions existing as will be more apparent in the description to follow later in the specification.

A switch **143**, which concerns the length of the pieces of lumber L, forms part of the sensing mechanism **37** and is mounted adjacent the opposite side of main conveyor **13** from the evened ends E of the pieces of lumber so that when the pieces of lumber are of a sufficient length to be selected at the particular station, the switch **143** is caused to close when the lumber hits finger **145**.

All of the switches of sensing mechanism **37**, that is, switches **107, 111, 113** and **143**, are in a circuit (see FIG. 14) in series with one another and with a solenoid **147** in a timer or memory device **149** to be described in more detail later in the specification. Thus, switches **107, 111, 113** and **143** are interposed in an electrical lead **151** which leads from a suitable source of electricity, not shown, and which is connected to one terminal **161** of solenoid **147**. The other terminal **163** of solenoid **147** leads back to the source of electricity through ground, or through another lead, as desired. It will be understood that, in the above-described circuit, when all of the switches **107, 111, 113** and **143** are closed, solenoid **147** will be energized and the plunger **165** will be lifted upwardly for a purpose later to be described.

Timer **149** (see FIGS. 10, 11 and 12) comprises a base **167** preferably formed from spaced upper and lower plates **169, 171** rigidly interconnected by laterally spaced and upstanding channel members **173, 175**. Base **167** is attached to the side of framework **43** as by means of bolts **177**. A pair of bearings **179, 181**, which are mounted in horizontally aligned apertures respectively in channel

members **173, 175** by means of bolts **183**, rotatably carry the opposite ends of a shaft **185** upon which is mounted a sprocket or wheel **187**. Wheel **187** is driven in a clockwise direction, as viewed in FIG. 10, in synchronization with main conveyor **13** by suitable means, as a chain **189** which connects sprocket or wheel **187** to a sprocket **191** which is rotatably driven by suitable means from main conveyor **13**. A plurality of pins **193**, preferably three in number, are respectively slidably mounted in apertures extending transversely through wheel **187**. Each of pins **193** is provided with a pair of spaced stops **195, 197** disposed on opposite sides of wheel **187** to limit sliding movement of the pin. Also, each of pins **193** is provided with an accept end portion **199** and an opposite reject end portion **201**, and each pin is slidable between an accept position in which the accept end portion **199** is extended away from wheel **187**, and stop **197** is against the opposite side of the wheel, as best seen by the upper one of the pins in FIG. 11, and a reject position in which the reject end portion **201** is extended away from the wheel, and stop **195** is abutting the opposite side of the wheel, as best seen by the lower one of pins **193** in FIG. 11. In FIG. 12, the pin **193** to the right in this fig. is shown in a reject position, and the other two pins are shown in an accept position. The pins **193** are disposed on wheel **187** at substantially the same distances from the center of the wheel and are equally spaced apart at angles of 120 degrees.

An actuating device **203**, of which solenoid **147** is a part, is provided in timer **149** and comprises a segment or elongated actuating plate **205** that is disposed adjacent a portion of the path of movement of pins **193** on the side of wheel **187** adjacent reject end portions **201**. Actuating plate **205** is less than the width between any two of the pins **193**, that is, less than 120 degrees, so that no two of the pins will be directly opposite actuating plate **205** at the same time. Actuating plate **205** is preferably sloped at the opposite ends **207, 209** thereof to prevent breakage of parts in the event of malfunctioning. Actuating plate **205** is fixedly mounted on an arm **211** that, in turn, is pivotally mounted from base **167** for pivot about a horizontal axis as by means of bolt-nut assembly **213**. Arm **211** preferably includes a pair of spaced apart substantially horizontal members **215, 217** and a pair of spaced apart substantially vertical members **219, 221** that respectively depend from members **215, 217**. A transverse angle member **223** is rigidly interconnected between horizontal members **215, 217**. A fastening member **225** is fixedly attached to channel member **175** through an aperture therein and slidably extends through an aperture in angle member **223** with a head **227** being provided on the distal end thereof to limit inward pivot, or pivot counterclockwise as viewed in FIG. 11, of arm **211**. A compression spring **229** extends between channel member **175** and angle member **223** to urge arm **211** counterclockwise, as viewed in FIG. 11. An angular member or eraser **231**, having a sloped end face **232**, is mounted from channel member **173** with face **232** in the path of movement of the accept end portions **199** when they are in the accept position so that any pins **193** that are in the accept position will contact eraser **231** to move the pin into the reject position. Eraser **231** is located directly opposite actuating plate **205** adjacent the leading edge thereof, that is, the edge to the left as viewed in FIG. 10, and on the opposite side of wheel **187** from the actuating plate **205**. Movement of a pin **193** to the reject position by eraser **231**, as above-described, will cause actuating plate **205** to be moved from the tripped position, shown in solid lines in FIG. 12, to the cocked position, shown in dotted lines in this fig. When actuating plate **205** is moved into said cocked position, plunger **165** will drop under the force of gravity behind angle member **223** to hold the actuating plate **205** in the cocked position. Actuating plate **205** will remain in the cocked position until solenoid **147** is actuated, as heretofore described, by closing the switches **107, 111, 113** and **143**, which will

lift plunger **165**, whereupon actuating plate **205** will move to said tripped position and move the pin **193** which is adjacent the actuating plate **205** to said accept position. After leaving actuating plate **205**, a pin **193** will always be in the reject position unless solenoid **147** has been actuated. Next, the pin will pass, upon continued rotation of wheel **187**, down towards the bottom of the wheel where a pair of normally open switches **233**, **235** are mounted on opposite sides of wheel **187** on a yoke **237** which is pivotally mounted on shaft **185**. A set screw **239** extends through lower plate **171** and engages yoke **237** to hold it in a set position. Thus, it will be seen that the positions of switches **233**, **235** are adjustable. The roller **241** on the arm **243** of switch **233** is in the path of movement of accept end portions **199** when the pins **193** are in the accept positions so that the pins, when in the accept positions, will cause switch **233** to be momentarily closed. Similarly, the roller **245** on arm **247** of switch **235** is disposed in the path of movement of the reject end portions **201** of pins **193** when the pins are in the reject positions so that the pins, when in the reject positions, will cause momentary closure of switch **235**. The electrical circuits for switches **233**, **235** are best shown in FIG. 14 wherein it will be seen that a hot lead **249** extends from a suitable source of electricity, not shown, to switch **233**, and a lead **251** extends from the switch **233** to one terminal of the solenoid **253** of a two-position four-way double-solenoid valve **255**. The other terminal of solenoid **253** leads back to the source of electricity, as through ground. Thus, when switch **233** is closed, solenoid **253** is energized to cause valve **255** to move to the dotted line position, whereupon fluid, as hydraulic fluid, under pressure from a source **257** is allowed to pass through the valve and through conduit **259** to the rearward end of a piston-cylinder assembly **261**. This causes the piston rod **263** to be extended. It will be understood that during this movement of the piston rod, the hydraulic fluid will be dumped through the conduit **265**.

One terminal of switch **235** is connected to a suitable source of electricity by a lead **267**. The other terminal of switch **235** is connected by a lead **269** to one terminal of a solenoid **271** which forms part of valve **255**, and the other terminal of the solenoid is grounded. Thus, when switch **235** is closed, solenoid **271** will be energized and valve **255** will be in the position shown in solid lines in FIG. 14. Conduit **265** is connected to the front end of piston-cylinder assembly **261** so that when valve **255** is in the position shown in solid lines, as above-described, the piston rod **263** will be caused to retract.

Piston rod **263** is pivotally connected to a rocker arm **275** (see FIG. 2) attached to a rocker shaft **277** pivotally mounted from framework **43** for pivot about a horizontal axis transverse of main conveyor **13**. A relatively short bridge conveyor **279** is mounted on rocker shaft **277** and preferably comprises three laterally spaced portions, with each of the portions including an arm **281** fixedly attached at one end to rocker shaft **277**, a pair of sprockets **283**, **285** rotatably mounted from arm **281** in spaced relationship respectively adjacent the upper and lower ends thereof, and a continuous member, as a chain **287**, disposed around sprockets **283**, **285**. A plurality of lugs **289** are provided on chain **287**, with the lugs of each portion of bridge conveyor **279** being transversely aligned in a manner similar to lugs **25** on main conveyor **13**, so that the aligned lugs **289** on the three portions are arranged to contact the pieces of lumber L, as best seen in FIGS. 1 and 2. In addition, suitable means, not shown, is provided for driving chains **287** so that the upper flights thereof move to the right, as viewed in FIGS. 1 and 2, at the same speed as lugs **25**. Bridge conveyor **279** and piston-cylinder assembly **261** are arranged so that when piston rod **263** is extended, as heretofore described, the bridge conveyor **279** is in an up or closed position, shown in solid lines in FIG. 2, so that it spans the space between the main conveyor **13** and an accumulator conveyor **291**, which also is preferably in three portions. When the piston rod **263** is in a retracted position, bridge conveyor **279** is in a lowered or closed position, shown in dashed lines in FIG. 2, so that the pieces of lumber L will be carried down the main conveyor **13** to the next sorting and stacking station **15**. Lugs **289** should be synchronized with lugs **25** so that when the bridge conveyor **279** is in a closed position, one of the lugs **289** will be in such a position adjacent one of the lugs **25** that said one of the lugs **289** will come behind the piece of lumber L and push it up the bridge conveyor **279**, and when the bridge conveyor is in an open position, the lugs **289** are in alignment with the corresponding lugs **25** on the main conveyor **13**. The distance between the foot, or end to the left as viewed in FIG. 2, of bridge conveyor **279** and sensing mechanism **37** is important. Thus, this distance should correspond to the angular distance on wheel **187** between the actuation of a pin **193** by actuating device **203** and the pin's arrival at switches **233** or **235**. In other words, by the time the piece of lumber L1, which is shown in FIG. 2 just before being sensed by the sensing mechanism **37**, arrives at the foot of bridge conveyor **279**, the wheel **187** would have traveled one-half a revolution so that if this particular piece of lumber causes all of the switches **111**, **113**, **107** and **143** to be closed, which would mean that the board was to be accepted, then the bridge conveyor **279** would move to the closed position just as that board reached the foot of the conveyor so that the board would be carried up the bridge conveyor and onto the accumulator conveyor **291**. By the same token, if any of the switches **107**, **111**, **113** or **143** were not closed, which would indicate that the board was not acceptable, then when the board reached the foot of the bridge conveyor **279**, the bridge conveyor would remain in the down or open position and allow the board to continue on to the next station. In the adjustment of the timing, it will be understood that the chain **189** and sprockets **187**, **191** can be adjusted relative to one another so that timer **149** and sensing mechanism **37** are timed to coincide with the travel of lugs **25**, and that the position of yoke **237** can be adjusted so that sensing mechanism **37** is timed relative to bridge conveyor **279**. From the foregoing it can be seen that the bridge conveyor **279** is caused to move a minimum number of times. Thus, for example, if a number of consecutive pieces of lumber L, which are accepted, move through the sensing mechanism **37**, then the bridge conveyor **279** will remain in a closed position. Then, if a board comes along which should be rejected, the bridge conveyor **279** will move into an open position until the next acceptable board comes along, which will close the bridge conveyor. Also, it will be understood that when no boards L are passing through the sensing mechanism **37**, the bridge conveyor **279** will remain in the open position due to the action of eraser **231**.

COURSE MAKING PORTION

Accumulator conveyor **291**, which forms a part of the course making portion, preferably comprises a plurality of laterally spaced conveyor portions, each of which consists of a continuous elongated member or belt **293** led over pulleys **295**, **297** which are rotatably driven by suitable means, not shown, to carry the upper flight of elongated member **293** to the right, as viewed in FIGS. 1 and 2. Thus, the pieces of lumber L which are deposited on the accumulator conveyor **291** will be moved to the right, as viewed in these figures, and onto a course making conveyor **299**.

Course making conveyor **299** preferably includes a pair of spaced horizontal members **301** (see FIGS. 1, 2 and 3), with each of members **301** having a plurality of freely rotating wheels **303** rotatably mounted therefrom. Wheels **303** are arranged so that the upper surfaces thereof form an extension of accumulator conveyor **291**, and the accumulator conveyor will cause the boards L to move out in side-by-side relationship onto the course making

conveyor 299. Each of horizontal members 301 is supported by a pair of rocker arms 305, 307 which, in turn, are respectively fixedly attached to rocker shafts 309, 311 that extend transversely of apparatus 11 and which are respectively rockably supported from a suitable framework 313 of apparatus 11 that includes spaced transverse channel members 315, 317 interconnected by members 319.

A piston-cylinder assembly 321 is mounted on framework 313 and has the piston rod 323 thereof pivotally connected to an arm 325 which, in turn, is fixedly attached to rocker shaft 309. A plurality of rollers 333 are rotatably mounted between channel members 315, 317 so that the axes of rotation of the rollers are substantially perpendicular to the axes of rotation of wheels 303 and substantially parallel to the direction of movement of the pieces of lumber L along the main conveyor 13. Rollers 333 and course making conveyor 299 are so arranged that normally the upper surfaces of the wheels 303 are disposed above or at a higher level than the upper surfaces of rollers 333, as best seen in FIG. 2, so that the upper surfaces of wheels 303 are in alignment with the upper flight of accumulator conveyor 291 and so that the boards L on the course making conveyor 299 will not touch the rollers 333. For purposes of clarity, the above-described position of the course making conveyor will be referred to hereinafter as the normal or lifted position. When the course making conveyor 299 is in said lifted position, piston rod 323 will be in the retracted position. When piston rod 323 is extended, it will be understood that rocker shaft 309 will be caused to move clockwise, as viewed in FIG. 2, which will cause course making conveyor 299 to move to a lowered position wherein the upper surfaces of wheels 303 will move below the upper surfaces of rollers 333 so that the pieces of lumber L which were on course making conveyor 299 will be deposited on rollers 333. Rollers 333 are driven so that they rotate clockwise, as viewed in FIG. 4, to carry the pieces of lumber L off to the right, as viewed in FIGS. 3 and 4. The means for driving rollers 333 is preferably a motor 335 (see FIG. 3) having a pulley 337 which drives another pulley 339 through a belt 341 and which pulley 339 is mounted on a shaft 343 that is rotatably mounted from framework 313 by suitable means. Shaft 343 is provided with a pulley 345 which drives another pulley 347 on the shaft of one of rollers 333. The other rollers 333 have similar pulleys 347 which are driven as by the belts 349 in a manner well-known to those skilled in the art.

The electrical control circuit for causing piston-cylinder assembly 321 to be actuated for actuating the course making conveyor 299, as above-described, is best seen in FIG. 21. In this figure, it will be seen the numeral 351 designates the hot lead which is connected through switch 353 to a suitable source of electricity, not shown. A pair of micro-switches 355, 357 are interposed in series in a lead 358 that extends from lead 351 to one terminal of a solenoid 359 which forms a part of a single-solenoid spring-return four-way valve 361. The other terminal of solenoid 359 is grounded so that upon closure of normally open switches 355, 357, the solenoid 359 is energized to cause valve 361 to be moved into an actuated position, shown in dotted lines in FIG. 21. The solid line position of valve 361 is the normal position into which the valve is spring-actuated when solenoid 359 is de-energized. Switches 355, 357 are respectively disposed on the opposite ends of an elongated bar 363 (see FIG. 1) which is pivotally mounted from framework 313 for pivot about a vertical axis as at pivot point 365. Bar 363 is located adjacent the end of course making conveyor 299 and is limited in its pivot in both directions by means of stops 367, 369 which are contacted by the rearward side of bar 363. It will be understood that switches 355, 357 and bar 363 insure that there is a complete course of pieces of lumber L on course making conveyor 299 before piston-cylinder assembly 321 is actuated. This will be understood better when it is considered that both of the switches 355, 357 must be closed in order to actuate the course making conveyor, and both of these switches will only be closed when the first board L, or board to the right as viewed in FIG. 1, all along its length is flat against the bar 363 and the switches, and when the boards extend in correct transverse alignment across the course making conveyor 299. In other words, before the course making conveyor 299 fills up, the first board will in all likelihood be skewed somewhat and will only close one of the switches 355 or 357, but when the first board is pushed by the boards therebehind, it will cause correct transverse alignment of the boards and close the two switches, as heretofore described.

Closure of switches 355, 357 will also cause a pinch-off or stop device 371 (see FIG. 2) to be actuated to hold back the board which is after the last board on course making conveyor 299 to prevent it from going onto the course making conveyor and prevent it from being moved endwise on rollers 333 with the course that has been formed.

Stop device 371 includes a plurality of hold-down members 373 for engaging the board adjacent the forward end of accumulator conveyor 291. Each hold-down member 373 includes an enlarged circular board engaging portion adjacent the lower end thereof and a rod 375 slidably extending through transverse bar 377. Suitable means, not shown, is provided for limiting the downward movement of rod 375 relative to transverse bar 377. Each of the rods 375 is provided with a compression spring 379 urging hold-down member 373 downwardly so that when the hold-down member contacts the board, the hold-down member will yield somewhat, and the accumulator conveyor 291 can slip relative to the board being held down. Bar 377 is movably mounted by means of parallel links 381. One of the links 381 is fixedly mounted on a shaft 385 which, in turn, is rotatably mounted from upstanding support structure 387, and the end of the other link 381 is pivotally mounted from structure 387 by suitable means. The piston rod 389 of a piston-cylinder assembly 391 is coupled to one of links 381 by suitable means so that when piston-cylinder assembly 391 is actuated by closure of switches 355, 357, the piston rod 389 is extended to cause clockwise rotation of the links 381, as viewed in FIG. 2, and downward movement of hold-down members 373 to pinch off the board, as heretofore described.

The fluid system (see FIG. 21) for actuating piston-cylinder assemblies 321, 391 is preferably as follows: A pump 393, which is driven by an electrical motor 395, pumps the fluid, as hydraulic fluid F, from a tank 397 into a main conduit 399. From main conduit 399, fluid F under pressure is supplied to valve 361 through conduit 401. When valve 361 is in the position shown in dotted lines in FIG. 21, the fluid passes through the valve into the conduit 403 and into a sequencing valve 405 which allows the fluid to first pass to the rearward or lower end of the piston-cylinder assembly 391 through the conduit 407 and then, after a given pressure is reached, allows the fluid to pass also to the rearward end of piston-cylinder assembly 321 through the conduit 408. This sequence, as above-described, causes the pieces of lumber L to first be pinched off, as heretofore described, and then the course making conveyor 299 to be lowered, as heretofore described, after the lumber has been pinched off. When solenoid 359 is de-energized, the valve 361 will move to the position shown in solid lines in FIG. 21, so that the fluid F from pump 393 will flow through the conduit 401, through the valve 361, and into the conduit 413 which is divided and flows to the forward ends of the piston-cylinder assemblies 321, 391 causing the piston rods 323, 389 to retract, which causes the course making conveyor 299 to be moved to the normally raised position and the hold-down members 373 to be moved to the normally raised position. It will be understood that the

course making conveyor **299** will operate first, since it represents a small load. During the above-mentioned retraction of the piston rods **323, 389**, the fluid F from the rearward side of the piston of piston-cylinder assembly **391** will flow back to the tank **397** through conduit **407**, sequencing valve **405**, conduit **403**, conduit **424**, and main dump conduit **417**. The fluid F from the rearward side of the piston of piston-cylinder assembly **321** will flow back to the tank **397** through conduit **408**, conduit **419**, check valve **421**, conduit **423**, a portion of conduit **407**, sequencing valve **405**, conduit **403**, valve **361**, conduit **424**, and conduit **417**. It will be understood that the check valve **421** and the conduits **419, 423**, interposed between the conduits **407, 408**, must be provided since the sequencing valve **405** will not allow return flow therethrough from the conduit **408**.

When the course making conveyor **299** is lowered, as heretofore described, and the pieces of lumber L are transferred off to the right, as viewed in FIGS. 3 and 4, by rollers **333**, in a manner heretofore described, they move towards a feed mechanism **425** and then onto a hoist **427**, where the pieces are stacked in a manner later to be described. However, before the pieces of lumber L reach feed mechanism **425**, they pass over an off-balance switch mechanism **429** (see FIGS. 3 and 8) located before the feed mechanism and just before the last of the rollers **333**. Mechanism **429** comprises a pair of spaced rollers **431, 433** that are rotatably mounted at the opposite ends thereof by a pair of support bars **435** that, in turn, are respectively pivotally mounted by pins **437** from channel members **315, 317**. The pins **437** are off-center relative to support bars **435** so that normally when pieces of lumber L are not passing thereover, the mechanism **429** is in the position shown in solid lines in FIG. 8, in which position it will be seen the roller **431** is considerably above the level of roller **433**. A normally open switch **439** is mounted from channel member **315** in such a position that it is contacted by support bar **435** to close the switch when the pieces of lumber L pass over roller **431** and pivot the support bar counterclockwise to the broken line position shown in FIG. 8. Switch **439** is arranged in parallel across switches **355, 357** (see FIG. 21) so that the hold-down members **373** are kept in a downward position and course making conveyor **299** is kept in a downward position until the rearward ends of the pieces of lumber L pass over switch mechanism **429** and the rollers **431, 433** return to their normal positions.

FEED MECHANISM

The upper part of feed mechanism **425** comprises a rigid yoke **441** (see FIGS. 15 and 17) which includes a pair of spaced side arms **443, 445** rigidly interconnected adjacent the upper ends thereof by cross piece **447**. Yoke **441** is pivotally mounted from channel members **315, 317** as by shaft **343** rotatably extending through bearings **449** attached to side arms **443, 445** adjacent the lower ends thereof. Yoke **441** is held at a selected angle, as best seen in FIG. 17, as by means of a piston-cylinder assembly **451** that is mounted from the frame **453** of hoist **427**. It will be seen in FIGS. 15 and 17 that the piston arm **455** of assembly **451** is pivotally attached to lugs **457** which, in turn, are fixedly attached to cross piece **447** so that the angular position of the yoke can be adjusted by actuation of the piston-cylinder asembly. The fluid system of piston-cylinder assembly **451** is best shown in FIG. 21 wherein it will be seen a conduit **459** leads from main conduit **399** through a cut-off valve **461** to the lower end of the piston-cylinder assembly. Another cut-off valve **463** is provided in a conduit **465** that leads from conduit **459** into the conduit **417** so that the fluid can be returned to the tank **397**, if desired, to lower the piston arm **455**. It will be understood that both of the cut-off valves **461, 463** when closed will cause the yoke **441** to be held in a desired fixed position. It will be understood better in the description to follow that by varying the position of the yoke **441**, the pressure on the pieces of lumber L as they pass through the feed mechanism **425** may be changed to accommodate different types of wood, and to adjust the mechanism. A beam **467**, in the form of an inverted channel member, extends between side arm **443, 445** and is fixedly connected thereto. A plurality of stud-shafts **469** are fixedly attached to beam **467** in spaced apart relationship along the length thereof and upstand therefrom. An elongated plate **471** is supported on top of the stud-shafts **469** in spaced relationship above beam **467** and is anchored to the stud-shafts by means of bolts **473** respectively threadedly engaged in threaded sockets in the upper ends of stud-shafts **469**. A plurality of pieces **475** are fixedly attached on top of plate **471** in spaced relationship and upstand therefrom. Pieces **475** slidably support a rod **477** extending through aligned apertures in the pieces. A short-stroke piston-cylinder assembly **479** is attached to one of the end ones of pieces **475**, with the piston rod **481** thereof being coupled to rod **477** for shifting the rod **477** endwise.

A plurality of assemblies **483** are respectively provided in conjunction with stud-shafts **469**, and the following description of one of the assemblies **483** will suffice for all, since they are substantially identical:

Assembly **483** comprises a rigid and substantially trapezoidally-shaped support member **485** that includes a long upper member **487**, a shorter lower member **489** spaced therebelow, and two angularly disposed and spaced side members **491, 493** rigidly interconnecting the ends of the upper and lower members. In addition, support member **485** includes a collar **495** rigidly interposed in the middle of upper member **487** and pivotally mounted on stud-shaft **469** between beam **467** and plate **471**, so that the support member is adapted to pivot about the vertical axis of the stud-shaft. A pair of resilient wheels **497** are rotatably supported from support member **485** adjacent the lower end thereof by an axle **499**. A roller **501** frictionally contacts the top of wheels **497** and is rotatably mounted adjacent the opposite ends thereof from side arms **443, 445**. Roller **501** is driven in a clockwise direction, as viewed in FIGS. 4 and 17, by suitable means, as a belt **503** extending over a pulley **505** keyed to the axle of roller **501** and extending over a pulley **507** keyed to drive shaft **343**. It will be understood that clockwise drive of roller **501**, as above-described, will cause wheels **497** to be driven counterclockwise, as viewed in FIGS. 4 and 17. The wheels **497** are adapted to engage the top surfaces of the pieces of lumber L which pass between the wheels and a roller **509** located below the pieces of lumber so that they are fed to the right, as viewed in FIGS. 3, 4 and 17. Roller **509** is rotatably mounted from channel members **315, 317**, and is driven by means of a belt **510** and suitable pulleys. In addition, assembly **483** includes a lever **511** that is pivotally mounted from rod **477** by means of a collar **513** through which the rod extends and to which lever **511** is fixedly attached. Lever **511** is provided with a slot **515** therethrough adjacent the distal end thereof. Lever **511** is shiftable or pivotable, as by hand, into two positions, namely, a first position, shown in solid lines in FIGS. 15 and 17, in which position the lever is engaged with a pin **517** fixedly attached to support member **485** adjacent one end of upper member **487**, with the pin extending through slot **515**; and a second position, shown in in broken lines in FIGS. 15 and 17, in which position the lever is engaged with a pin **519** fixedly attached to support member **485** adjacent the opposite end of upper member **487** from pin **517**, with the pin **519** extending through slot **515**. A compression spring **521** is disposed around rod **477** between one side of collar **513** and a pin **523** fixedly attached to the rod, and another spring **525** is similarly arranged on the other side of collar **513** between said other side and a pin **527** attached to the rod. Within limits, collar **513** can shift lengthwise of rod **477**. Thus,

any shifting lengthwise of rod **477** is transmitted through one or the other of springs **521**, **525** to collar **513** and lever **511**, and any shock or the like due to irregularities of the pieces of lumber L, which are transmitted to the wheels **497**, will be taken up through the springs **521**, **525**.

In FIG. 15, rod **477** is shown in a central position so that lever **511** is in line with the vertical center line of stud-shaft **469** so that the wheels **497** will be in a straight line relative to the direction of travel of the pieces of lumber L. Assuming that the levers **511** are all in the same position, that is, over pins **517**, as best seen in solid lines in FIG. 15, it will be understood that when rod **477** is shifted in one direction, as, for example, to the left in this fig., the support members **485** will be caused to rotate in a counterclockwise direction, as viewed in this fig., so that the rollers will be skewed in a first position relative to the direction of travel of the pieces of lumber L and will cause the leading edge of the lumber to move over to the left, as viewed in this fig., and when the rod **477** is shifted in the opposite direction, or to the right, the wheels **497** will be skewed in the opposite direction in a second position and will cause the lumber to angle over to the right, as viewed in this fig. Then, if any of the levers **511** are shifted over to the other pin **519**, as shown by the lever in broken lines in FIG. 15, it will cause the wheels **497** to be skewed in just the opposite direction from that above-described. In other words, when lever **511** is over pin **519**, the wheels **497** corresponding to that lever will be skewed or angled in an opposite direction from those wheels corresponding to the levers **511** which are over pins **517**. Thus, various skew patterns may be provided. For example, the outside pairs of wheels **497** may be skewed outwardly or in diverging relationship to cause the outside boards to be moved outwardly, or the levers **511** may be all on the same side to cause other patterns, such as parallel patterns or criss-cross patterns, as will be more apparent in the details to follow later in the specification. Also, the relative surface speeds of wheels **497** as compared with roller **509** are preferably not the same, so that the skewing will be more pronounced with less pressure on the boards.

The fluid system for piston-cylinder assembly **479** is shown in FIG. 21, wherein it will be seen a two-position four-way valve **529** is provided which has a pair of opposing solenoids **531**, **533** for the actuation thereof. When solenoid **531** is energized, the valve **529** is in the position shown in solid lines in FIG. **21**, and in this position it will be seen that hydraulc fluid under pressure flows through conduit **535** to valve **529** and through the valve to conduit **537** which is connected to the forward end of piston-cylinder assembly **479**, which causes the piston rod **481** thereof to be retracted and shift rod **477** to the right, as viewed in FIGS. 15 and 16. It will be understood that the fluid will be exhausted from the rearward end of piston-cylinder assembly **479** through conduit **539**, through valve **529** and into conduit **417** through conduit **541**. Then, when solenoid **533** is energized and solenoid **531** is de-energized, the valve **529** will be actuated to the position shown in dotted lines in FIG. 21, whereupon the high pressure fluid will flow through conduit **535**, through the valve, and through conduit **539** to the rearward end of piston-cylinder assembly **479**, which will cause the piston rod **481** to extend and move the rod **477** to the left, as viewed in FIGS. 15 and 16. It will be understood that the fluid from the forward end of piston-cylinder assembly **479** will be exhausted through conduit **537**, through valve **529**, and through a conduit **543** that leads to conduit **417**.

The electrical system for piston-cylinder assembly **479** is also shown in FIG. 21, wherein it will be seen a lead **545** extends from the lead **351** to a normally open switch **547** (see FIG. 2) that is located adjacent rocker shaft **311** and is actuated by a cam **549** on the rocker shaft so that when course making conveyor **299** is actuated to a lowered position, as heretofore described, the switch **547** is closed. A lead **551** extends from the other contact of switch **547** to a hand selector switch **553** that is located in any convenient place and operable between a first position, shown in solid lines in FIG. 21, and a second position, shown in broken lines in this fig. A lead **555** extends from the contact of said second position of switch **553** to ratchet-type switch **557**. Switch **557** (see FIG. 2) is located adjacent rocker shaft **309** and is actuated by a cam **559** thereon which contacts the switch. Each time the course making conveyor **299** is lowered, the cam **559** contacts the switch **557** and causes it to be moved from one position to the next. The switch **557** is of the type well-known to those skilled in the art, which has two positions, namely, a first position shown in solid lines in FIG. 21 and a second position shown in dotted lines in FIG. 21. A lead **561** extends from the contact of the first position of switch **557** to solenoid **533**, and a lead **563** extends from the contact of the second position of switch **557** to solenoid **531**. A lead **565** extends from the first position contact of switch **553** to switch **557** and has interposed in series therein a normally open switch **567**, whose function and location will be described later in the specification.

HOIST AND CONTROLS

The frame **453** of hoist **427** (see FIGS. 3, 4 and 9) preferably comprises a forward pair of spaced posts **569** upstanding from a suitable base **571**, a second pair of spaced rearward posts **573** also upstanding from base **571**, and a pair of laterally spaced horizontal side members **575**, **576** rigidly interconnecting the forward posts **569** and rearward posts **573**. A vertically movable lift carriage **577** is mounted on top of an upstanding hydraulic jack **579** that has the cylinder **581** thereof embedded in base **571**, with the piston **583** thereof being attached at its upper end to lift carriage **577**. A pair of equalizing cables **585** are provided on the opposite sides of hoist **427**, and each has its lower end anchored to the rearward posts **573** as at **587**, and from there extends over a pulley **589** rotatably mounted from lift carriage **577** adjacent the rearward end thereof, and then extends below another pulley **591** rotatably mounted from lift carriage **577** adjacent the forward end thereof, from where the cable extends upwardly to a place of anchoring at **593** on forward post **569**. It will be understood that extension of piston rod **583** will cause the lift carriage **577** to raise, and retraction of the rod will cause the lift carriage to lower, and the cables **585** will cause the force to be distributed at either end of the lift carriage.

Lift carriage **577** additionally includes a plurality of transversely extending spaced rollers **595** that are rotatably mounted adjacent the opposite ends thereof from the side frame members **597** of the lift carriage **577**. For the purposes of removing the stack S of pieces of lumber L, the rollers **595** are preferably selectively driven by suitable means, as by the belts **599** which run over pulleys **601** respectively attached to the shafts of rollers **595** and which are rotatably driven by suitable means, as a motor or the like, not shown.

A pair of guide **603**, **605** are respectively mounted on horizontal members **575**, **576** so that they have limited vertical movement. Guides **603**, **605** are substantially identical, and the following description of guide **605** will suffice for both. Guide **605** preferably comprises a pair of vertical plates **607**, **609** that slidably extend on opposite sides of horizontal member **576** from adjacent one of the rearward posts **573** along a major portion of the length of the horizontal member **576**. A plurality of spaced upper fastening members **611** rigidly interconnect vertical plates **607**, **609** adjacent the upper edges thereof and extend over horizontal member **576**. In addition, a plurality of lower fastening members **613** interconnect vertical plates **607**, **609** adjacent the lower edges thereof and are normally spaced below horizontal member **576** when the lift carriage **577** is in a lowered position. Also, when

the lift carriage **577** is in a lowered position, the guide **605** will be supported from horizontal member **576** by engagement of upper fastening members **611** on top of the horizontal member. Guides **603, 605** are aranged above lift carriage **577** so that when the lift carriage is in upper positions during the loading of the first few layers of pieces of lumber L, the guides will ride on the lift carriage and travel up and down therewith, in a manner which will be better understood in the description to follow later in the specification.

A rigid and pivotable flap **615**, which preferably has an upturned rounded lower end as at **617**, extends between guides **603, 605** in spaced relationship thereto and angles upwardly and rearwardly from the lower end thereof to the upper end where it is fixedly attached to a shaft **619** that, in turn, is pivotally mounted at the opposite ends thereof respectively from horizontal members **575, 576** by brackets **621**. An arm **623** is also fixedly attached to shaft **619** and extends forwardly therefrom where it terminates in an enlarged end **625** that is adapted to successively contact switches **627, 629, 631** and **567** as arm **623** moves upwardly, or counterclockwise as viewed in FIGS. 4 and 13, when carried upwardly by the pieces of lumber L contacting flap **615**. It will be seen that the lower end of flap **615** is located in such a position that the pieces of lumber L will be substantially half-way out onto the stack S when the leading ends contact the flap. Switch **567** is normally open and is closed momentarily when contacted by arm **623**. Switches **627** and **631** are normally closed and are opened when contacted by arm **623**. Switch **629** is a delay type of switch which is normally open, but which closes a given number of seconds, as, for example, three seconds, after contact by arm **623**. Switches **567, 627, 629** and **631** are all mounted from horizontal member **576** on an upstanding bracket **633** fixedly supported on the horizontal member.

The electrical circuit in which switches **627, 629** and **631** are provided is shown in FIG. 21, wherein it will be seen switches **627, 629** are arranged in series and interposed in a lead **635** that extends between lead **351** and the solenoid **637** of the two-position four-way double-solenoid valve **639**, which has a center position wherein all ports are closed off and to which the valve returns when both solenoids are de-energized. Switch **631** and another switch **641** are arranged in series and interposed in a lead **643** that extends between lead **351** and the other solenoid **645** of valve **639**. Switch **641** is normally open and is located adjacent switch mechanism **429** so that when the pieces of lumber L run over the switch mechanism, switch **641** will be closed. When both switches **641** and **631** are closed, it will be understood that solenoid **645** will be energized, and the valve **639** will be moved to the position shown in dotted lines in FIG. 21. On the other hand, it will be understood that when switches **627** and **629** are closed, solenoid **637** will be energized, and the valve **639** will be in the position shown in solid lines, which will cause downward movement of the piston **583** of hydraulic jack **579** to lower the lift carriage **577**. The fluid system causing the above-mentioned actuation of hydraulic jack **579** is as follows: When the valve **639** is in the solid line position upon energization of solenoid **637**, hydraulic fluid will flow from main conduit **399** through the valve and through a conduit **647** to the upper end of jack **579**, and the fluid will be exhausted from the lower end of the jack through the conduit **649**, through the valve, and through the conduit **651** to the conduit **417**. Then, when the valve **639** is in the position shown in dotted lines in FIG. 21, the hydraulic fluid under pressure will be introduced from main conduit **399** through the valve and through conduit **649** to the lower end of the hydraulic jack **579** to cause lift carriage **577** to be lifted. The fluid will be exhausted from the upper end of the jack **579** through the conduit **647** and through the valve **639** to the conduit **417**. When both of the solenoids **637, 645** are de-energized, valve **639** will return to the center position, which is the closed position, and no fluid will flow, whereupon the jack **579** will stop.

In describing the combined operation of feed mechanism **425** and hoist **427**, it is assumed that the hoist is at a ready position, as shown in FIG. 4, in which position the hoist is shut off and stopped at its lower limit of travel by contact of arm **623** on switch **627**. This ready level is shown as at the line "*a*" in FIG. 13. It will be understood that the top surface of the top layer of boards will be even with the ready line "*a*" when there are boards stacked on the hoist **427**, or if the hoist is empty, the top of rollers **595** will be even with ready line "*a*." Also, for purposes of this description of the operation, it is assumed that a course of boards have been formed on course making conveyor **299** and that they are just starting off towards the hoist **427**. In addition, it is assumed that switch **553** is in the position shown in dotted lines in FIG. 21, and that switch **557** has just been actuated and is in the position shown in solid lines in this figure, which caused rollers **497** to be skewed to said first positions thereof. Also, it is assumed that levers **511** are in the positions shown in solid lines in FIG. 15. When the layer of boards starts towards the hoist **427**, the first thing that happens is that the leading edges thereof pass over switch mechanism **429**, which closes switch **439** and switch **641**. Closure of switch **439** will keep the course making conveyor **299** in the lowered position and stop device **371** actuated as long as the boards are passing over switch mechanism **429**. Closure of switch **641** will cause lift carriage **577** to start upwardly. The boards L will then move into feed mechanism **425** where they will be skewed towards guide **603**. In the meantime, before the oncoming course reaches the stack S, the hoist **427** will have carried the stack S upwardly until the upper surface of the top board on the stack has reached a receiving level, indicated as at line "*b*" in FIG. 13, whereupon the hoist will be cut off by opening of switch **631** by arm **623**. However, just before the arm **623** reaches switch **631**, it contacts switch **629** and starts the timing thereof. After the upper board has reached the receiving level "*b*," as above-described, the boards L will be moving outwardly onto the stack S, and when the leading edges are about half-way out on the stack, they will lift the lower end of flap **615** to the level "*c*" shown in FIG. 13 and will cause the arm **623** to be lifted into contact with switch **567**, which has no effect when switch **553** is in the dotted line position, but which does function when switch **553** is in the solid line position, as will be explained later in the specification. After the oncoming course has been received on top of stack S and after the time has elapsed for switch **629**, as, for example, three seconds, the switch is closed, which causes the lift carriage **577** to start downwardly and continue downwardly until the top of the course which has just been received reaches the ready level "*a*," at which time the hoist **427** is cut off and ready to receive another course.

It will be understood that by the time the above-mentioned actions have been taken place and the course is on the stack S, as above-described, the course making conveyor **299** and stop device **371** are in a raised position since switch **439** opened after the boards passed over switch mechanism **429**, and another course is starting to form on course making conveyor **299**. After this second course has formed, the switches are actuated as heretofore described, and the second course starts towards the hoist with the heretofore mentioned actuation of the switches taking place, except that it will be understood this time the switch **557** will be actuated to the dotted line position upon lowering of the course making conveyor, which will cause the rollers **497** to be skewed to said second positions, in which positions the rollers are angled towards guide **603** so that when the pieces of lumber L finally are in place on stack S, they are disposed over towards guide **605** with the board adjacent the guide

605 being in abutting relationship thereto all along the length thereof, and any spaces in the course being towards guide 605. Then, the next course will actuate switch 557 back to the solid line position so that the pieces of lumber L will be against guide 603. Thus, it will be seen that the boards will all be parallel, but successive layers will be offset first towards guide 603 and then towards guide 605, to form what is called an offset parallel skewing pattern. It has been found that a more pronounced and effective skewing can be accomplished by providing projections 653, 655 (see FIG. 1) which are located just before the feed mechanism 425 on either side thereof and projecting respectively inwardly from channel members 315, 317. These projections 653, 655 contact the trailing edges of the outside pieces of lumber L as they move through the feed mechanism 425 when the boards are being skewed.

For a different type of pattern for stack L, the switch 553 is moved to the solid line position shown in FIG. 21, whereupon the switch 567 is effective. The switch 567 will be closed when the course of boards is substantially half-way out on the hoist 427 and when the flap 615 is contacted, so that during the first part of the movement of the course out onto the hoist, the boards are skewed in one direction (that direction in which the skew wheels 497 have been left after the last course of boards passed through), and then during the last half of the movement of the boards onto the stack S, the wheels 497 are skewed in the opposite direction upon closure of switch 567 so that the rearward ends of the boards move in the opposite direction. This will cause the boards to be aligned somewhat diagonally across the stack, and then the next layer aligned in the opposite direction in a criss-cross pattern.

After the stack S has been completed in the desired type of pattern, the stack may then be moved off of hoist 427 as by actuation of the rollers 595.

From the foregoing description it will be seen that the apparatus of the present invention accomplishes all three of the ultimate objectives heretofore mentioned in an apparatus of the type for sorting lumber into desired categories or separations and stacking the separated lumber. In addition, it will be understood that such an apparatus is provided which does a very effective job in sensing the individual boards to see whether or not they should be separated, and subsequently accumulating selected boards. Then, the accumulated course is moved off automatically and stacked automatically into a stack having a desired pattern. Also, it will be understood that the arrangement or pattern of the stack can be varied into a number of different patterns, as, for example, by changing the switch 553 or by placing any desired combinations of the levers 511 either over pins 517 or pins 519. Also, it will be understood that more switches than switches 107, 111, 113 and 143 may be provided in series if other categories are desired, as, for example, for grading the boards, and it will further be understood that any of the switches may be closed or shunted if it is desired to disregard a particular category.

Although the invention has been described and illustrated with respect to a preferred embodiment thereof, it is to be understood that it is not to be so limited since changes and modifications may be made therein which are within the full intended scope of this invention as hereinafter claimed.

1. Apparatus for sorting and stacking lumber comprising main conveyor means adapted to convey boards of lumber with the length of said boards being disposed substantially transverse relative to the direction of travel of said main conveyor means, said main conveyor means including means for sequentially receiving and positioning the boards in substantially parallel and equally spaced relationship, a plurality of lumber sorting and stacking stations disposed along said main conveyor means; each of said sorting and stacking stations comprising an accumulator conveyor disposed above said main conveyor means, a pivotally mounted bridge conveyor movable between a closed position spanning said main conveyor means and said accumulator conveyor and a position open therefrom, said bridge conveyor in said open position being adapted to permit the passage of boards on said main conveyor means past said sorting and stacking station and when in said closed position to shunt or remove boards from said main conveyor means and onto said accumulator conveyor, means for actuating said bridge conveyor, a hoist disposed laterally of said main conveyor means, means operable at intervals for consecutively forming individual courses of boards from boards accumulated by said accumulator conveyor, and course transfer means sequentially operable with said course forming means for transferring each consecutively formed course of boards onto said hoist and for forming a stack of boards in courses.

2. The apparatus of claim 1 in which said means for actuating said bridge conveyor includes a powered mechanism operably coupled to said bridge conveyor and operable responsive to a signal for moving said bridge conveyor between open and closed positions, sensor means adjacent said main conveyor means for determining if a piece of lumber is in a pre-determined category and is to be removed from said main conveyor means and establishing a signal to that effect, said sensor means being positioned to sense each board a certain distance ahead of said bridge conveyor relative to the direction of travel of said main conveyor means; and timer means synchronized with said main conveyor means for receiving the signal from said sensor means, for holding the signal while said main conveyor means travels the above-mentioned certain distance, and for releasing the signal and actuating said powered mechanism at the appropriate moment if the piece of lumber is in said category to move said bridge conveyor to a closed position.

3. The apparatus of claim 2 in which said timer means comprises a frame, wheel means mounted from said frame, said wheel means including a plurality of shiftable pins equi-distantly spaced from and equi-angularly arranged about the axis of said wheel means, said pins respectively corresponding to pieces of lumber which are sensed by said sensor means, said pins and the pieces of lumber on said main conveyor means being so related that the time it takes a given number of successive pieces of lumber to pass by said sensor means is equivalent to the time it takes a corresponding number of said pins to pass by a fixed point adjacent said wheel means, each of said plurality of pins being shiftable toward one or the other of the sides of said wheel means, a pair of electrical switches, each of said switches being disposed at a respective side of said wheel means and respectively operably engageable with one or the other of the end portions of each of said plurality of pins, said pair of switches being connected with said powered mechanism for governing the up and down movement of said bridge conveyor and for the acceptance or the rejection of a board.

4. The apparatus of claim 3 in which each of said pins has an accept end portion and a reject end portion and each is slidable to and from one and the other side of said wheel means to a board reject or a board accept position, and in which said timer means includes solenoid means responsive to the signal from said sensor means, said solenoid means being operable to shift the appropriate one of said pins toward the accept side of said wheel means and to engage the accept switch of said pair of switches, and eraser means disposed ahead of said solenoid means relative to the rotation of said wheel means, said eraser means being effective to move each of said pins to a reject position prior to being acted on by said solenoid means.

5. Apparatus for sorting and stacking lumber comprising main conveyor means adapted to convey boards of lumber with the length of said boards being disposed substantially transverse relative to the direction of travel of

said main conveyor means, said main conveyor means including means for sequentially receiving and positioning the boards in substantially parallel and equally spaced relationship, a plurality of lumber sorting and stacking stations disposed along said main conveyor means; each of said sorting and stacking stations comprising an accumulator conveyor disposed above said main conveyor means and having a board departing end, a pivotally mounted bridge conveyor movable between a closed position spanning said main conveyor means and said accumulator conveyor and a position open therefrom, said bridge conveyor in said open position being adapted to permit the passage of boards on said main conveyor means past said sorting and stacking station and when in said closed position to shunt or remove boards from said main conveyor means onto said accumulator conveyor, means for actuating said bridge conveyor including sensor means for sensing the dimensions of each board entering said station and means resposive to said sensor means for moving said bridge conveyor between open and closed positions, a hoist disposed laterally of said main conveyor means, course forming means operable at intervals for consecutively forming individual courses of boards, said course forming means including a course making conveyor means adjacent said board departing end of said accumulator conveyor with said course making conveyor means being adapted to receive boards thereon from said accumulator conveyor, said course forming means also including intermittently operable stop means for limiting the travel of boards from said accumulator conveyor to said course making conveyor means, and course transfer means sequentially operable with said course forming means for transferring each consecutively formed course of boards onto said hoist thereby to form a stack of boards in courses.

6. The apparatus of claim **5** in which said course transfer means includes driven feed rollers rotatably mounted subjacent said course making conveyor means and in which said course making conveyor means is operable between a lifted position in which the boards thereon are held out of contact with said feed rollers and a lowered position in which the boards thereon will be moved into contact with said feed rollers to cause movement of the boards endwise.

7. The apparatus of claim **6** in which means is provided adjacent said course making conveyor means for determining when said course making conveyor means has a complete course thereon and for then initiating action of said course making conveyor means to said lowered position.

8. In lumber sorting and stacking apparatus including main conveyor means for conveying pieces of lumber in spaced apart relationship along a path of movement, means for selecting and removing pieces of lumber of a given category, means for accumulating the selected and removed pieces of lumber, means for forming individual courses of lumber from the pieces of lumber accumulated, hoist means, feed means for feeding the individual courses of lumber onto said hoist means for the stacking thereof; said feed means comprising a lower roller adapted to contact the lower side of said courses of lumber, at least one resilient wheel disposed over said lower roller adapted to contact the upper side of said courses of lumber, and means for skewing said wheel at an angle towards at least one side of said hoist means to cause movement of the board contacted thereby towards said one side of said hoist means.

9. The apparatus of claim **8** in which said hoist means includes a frame, a lift carriage, a jack supporting said lift carriage adjacent one end of said lift carriage for upward and downward movement thereof relative to said frame, a first pulley mounted on said lift carriage, adjacent said one end thereof, a second pulley mounted on said lift carriage adjacent the opposite end thereof from said one end, and an equalizing cable anchored adjacent one end to said frame; said cable extending upwardly from the place of anchoring over said first pulley and under said second pulley, and finally upwardly to a place of anchoring on the upper end of said frame.

10. In lumber sorting and stacking apparatus including main conveyor means for conveying pieces of lumber in spaced apart relationship along a path of movement, means for selecting and removing pieces of lumber of a given category, means for accumulating the selected and removed pieces of lumber, means for forming individual courses of lumber from the pieces of lumber accumulated, hoist means, feed means for feeding the individual courses of lumber onto said hoist means for the stacking thereof; said feed means comprising a lower roller adapted to contact the lower side of said courses of lumber, a plurality of assemblies disposed over said lower roller and each including at least one rotatably mounted resilient wheel adapted to contact the upper side of said courses of lumber, means contacting said wheel of each of said assemblies for the rotational drive thereof, means respectively pivotally mounting said assemblies for pivot of each of said assemblies to carry said wheel thereof into a first position in which said wheel is skewed at an angle towards one side of said hoist means and into a second position in which said wheel is skewed at an angle towards the opposite side of said hoist means, piston-cylinder means including a piston operable between an extended and a retracted position, coupling means coupled between said piston and said assemblies for moving said assemblies between said first and second positions thereof responsive to movement of said piston between said extended and retracted positions, control means operably coupled to said hoist means and said feed means for causing actuation of said piston-cylinder means and said hoist means at the proper time to cause stacking of the courses of lumber onto said hoist means in the desired pattern.

11. In lumber sorting and stacking apparatus including main conveyor means for conveying pieces of lumber in spaced apart relationship along a path of movement, means for selecting and removing pieces of lumber of a given category, means for accumulating the selected and removed pieces of lumber, means for forming individual courses of lumber from the pieces of lumber accumulated, hoist means, feed means for feeding the individual courses of lumber onto said hoist means for the stacking thereof; said feed means comprising a lower roller adapted to contact the lower side of said courses of lumber, a plurality of assemblies disposed over said lower roller and each including at least one rotatably mounted resilient wheel adapted to contact the upper side of said courses of lumber, means contacting said wheel of each of said assemblies for the rotational drive thereof, means respectively pivotally mounting said assemblies for pivot of each of said assemblies to carry said wheel thereof into a first position in which said wheel is skewed at an angle towards one side of said hoist means and into a second position in which said wheel is skewed at an angle towards the opposite side of said hoist means, piston-cylinder means including a piston operable between an extended and a retracted position, coupling means coupled between said piston and said assemblies for moving said assemblies between said first and second positions thereof responsive to movement of said piston between said extended and retracted positions, said coupling means including means respectively associated with said assemblies for selecting the positions into which the particular assembly is to be moved when said piston is in said extended and retracted positions, control means operably coupled to said hoist means and said feed means for causing actuation of said piston-cylinder means and said hoist means at the proper time to cause stacking of the courses of lumber onto said hoist means in the desired pattern.

12. In lumber sorting and stacking apparatus including conveyor means for conveying pieces of lumber in spaced

apart relationship along a path of movement, means for selecting and removing pieces of lumber of a given category, means for accumulating the selected and removed pieces of lumber, means for forming individual courses of lumber from the pieces of lumber accumulated, hoist means, feed means for feeding the individual courses of lumber onto said hoist means for the stacking thereof; said feed means comprising a lower roller adapted to contact the lower side of said courses of lumber, a plurality of assemblies disposed over said lower roller and each including at least one rotatably mounted resilient wheel adapted to contact the upper side of said courses of lumber, means contacting said wheel of each of said assemblies for the rotational drive thereof, means respectively pivotally mounting said assemblies for pivot of each of said assemblies to carry said wheel thereof into a first position in which said wheel is skewed at an angle towards one side of said hoist means and into a second position in which said wheel is skewed at an angle towards the opposite side of said hoist means, piston-cylinder means including a piston operable between an extended and a retracted position, coupling means coupled between said piston and said assemblies for moving said assemblies between said first and second positions thereof responsive to movement of said piston between said extended and retracted positions, said coupling means including means respectively associated with said assemblies for selecting the positions into which the particular assembly is to be moved when said piston is in said extended and retracted positions, control means operably coupled to said hoist means and said feed means for causing actuation of said piston-cylinder means and said hoist means at the proper time to cause stacking of the courses of lumber onto said hoist means in the desired pattern, and said control means including means for causing pivot of said assemblies into an opposite one of the positions thereof responsive to movement of a course substantially half-way out onto the stack.

13. In lumber apparatus including hoist means, feed means for feeding lumber onto said hoist means for the stacking thereof; said feed means comprising a lower roller adapted to contact the lower side of the lumber, a plurality of assemblies disposed over said lower roller and each including at least one rotatably mounted resilient wheel adapted to contact the upper side of the lumber, means contacting said wheel of each of said assemblies for the rotational drive thereof, means respectively pivotally mounting said assemblies for pivot of each of said assemblies to carry said wheel thereof into a first position in which said wheel is skewed at an angle towards one side of said hoist means and into a second position in which said wheel is skewed at an angle towards the opposite side of said hoist means, piston-cylinder means including a piston operable between an extended and a retracted position, coupling means coupled between said piston and said assemblies for moving said assemblies between said first and second positions thereof responsive to movement of said piston between said extended and retracted positions, said coupling means including means respectively associated with said assemblies for selecting the positions into which the particular assembly is to be moved when said piston is in said extended and retracted positions, control means operably coupled to said hoist means and said feed means for causing actuation of said piston-cylinder means and said hoist means at the proper time to cause stacking of the lumber onto said hoist means in the desired pattern, and said control means including means for causing pivot of said assemblies into an opposite one of the positions thereof responsive to movement of the lumber substantially half-way out onto the stack.

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