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Blakeslee

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[54] **AUTOMATIC FASTENING MACHINE**

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[73] Assignee: **Stacor Corporation,** Newark, N.J.

[22] Filed: **Apr. 26, 1972**

[21] Appl. No.: **247,524**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 109,769, Jan. 26, 1971, Pat. No. 3,681,842.

[52] **U.S. Cl.**..... **29/430,** 29/200 A, 29/211 D

[51] **Int. Cl.**..... **B23p 19/00,** B23q 7/10

[58] **Field of Search**..... 29/430, 200 A, 208 D, 29/211 D

[56] **References Cited**

UNITED STATES PATENTS

3,564,702	2/1971	Hurn et al.	29/430
3,574,920	4/1971	Stirling	29/200 A X
3,681,842	8/1972	Blakeslee	29/211 D X

Primary Examiner—Thomas H. Eager
Attorney—James W. Bock

[57] **ABSTRACT**

A method and machine for automatically assembling members into a frame and placing fasteners such as nails, staples or the like in a predetermined location includes means to collect the frame members into an assembly, means to move the assembly to be fastened to a work station where it is positioned against retractable stops, and means to position and drive a plurality of fasteners in a first location and to reposition and drive fasteners in at least one other location.

15 Claims, 6 Drawing Figures

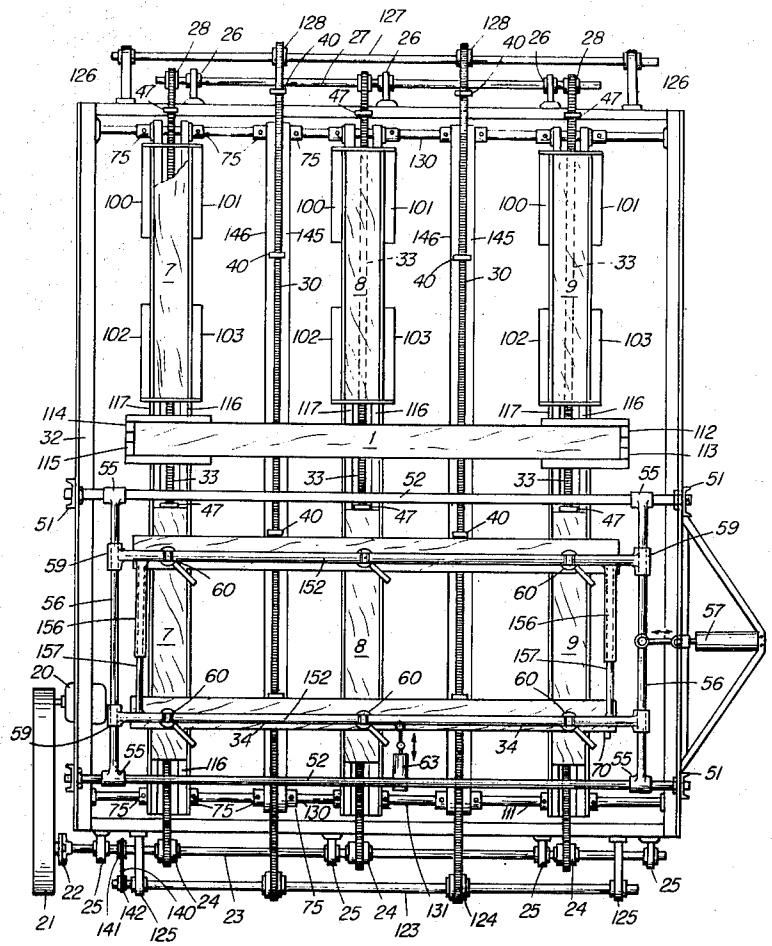


FIG. 1

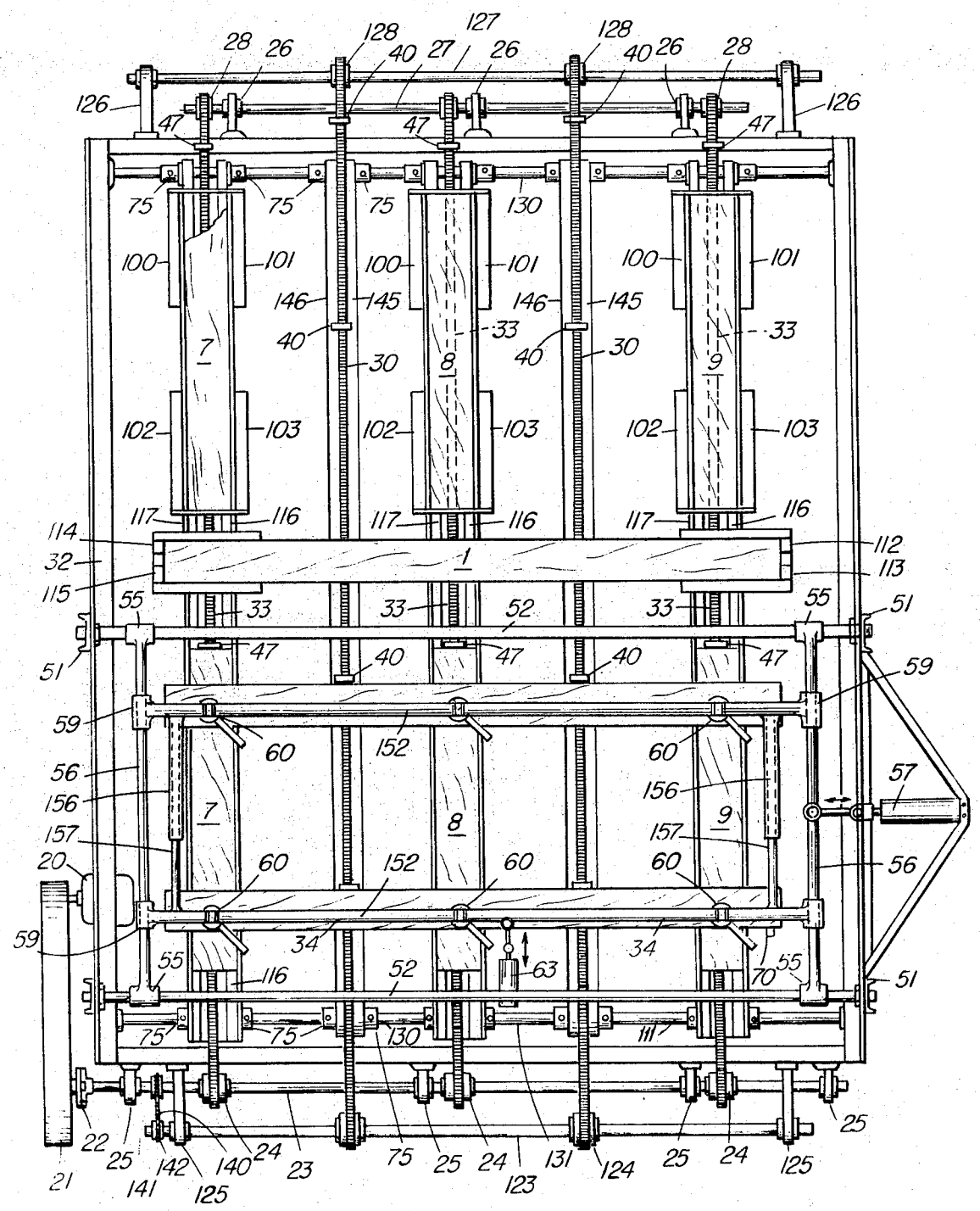
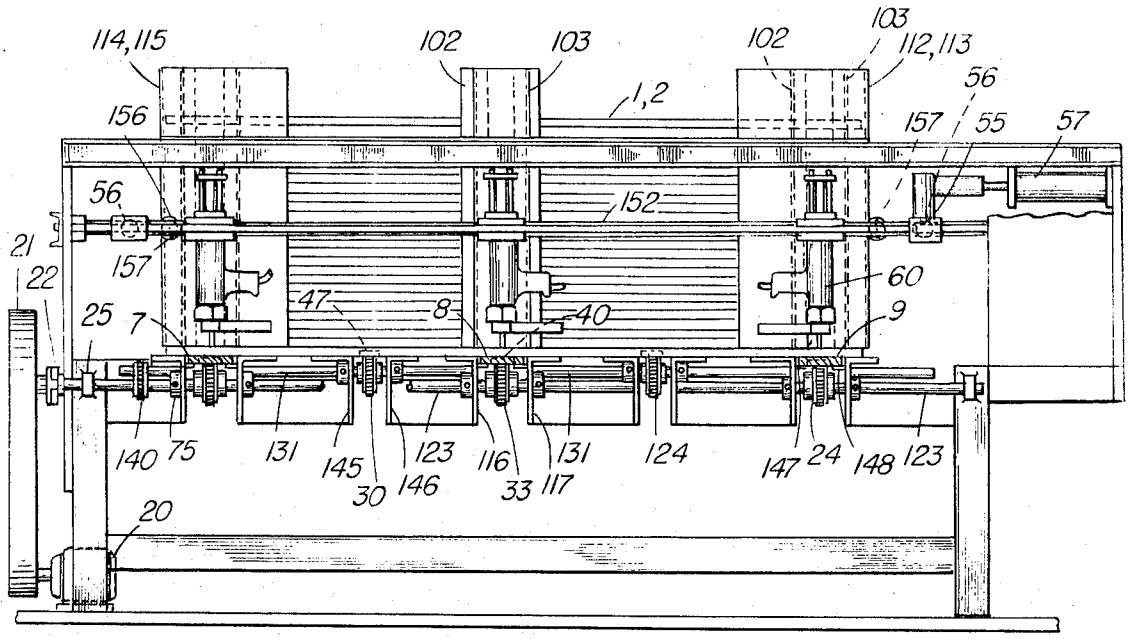

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152
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157
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152
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116
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63
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51
75
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130
111
22
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25
142
140
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23
75
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131
124
25
24
125
21
141
125
123

FIG. 2


114,115
102
103
102
103
112,113
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1,2
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157
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57
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152
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22
157
60
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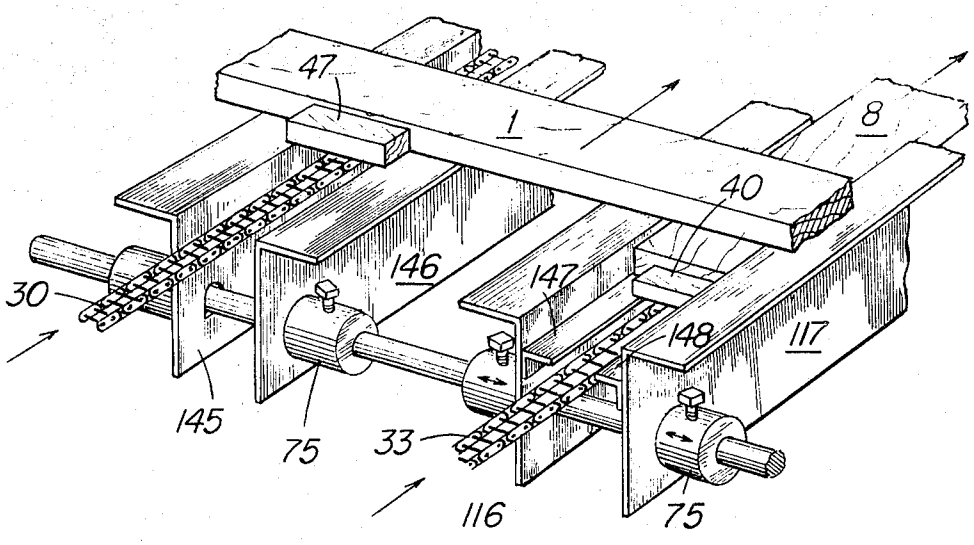

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148
117
145
75
33
116
75

FIG. 4

FIG. 3

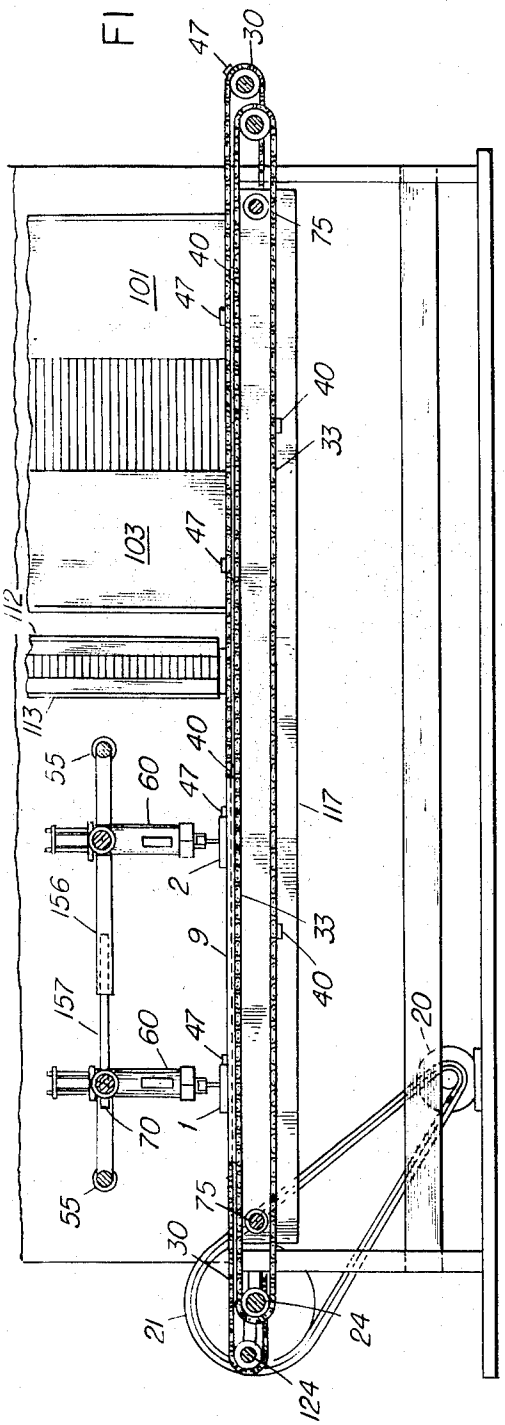


FIG. 6

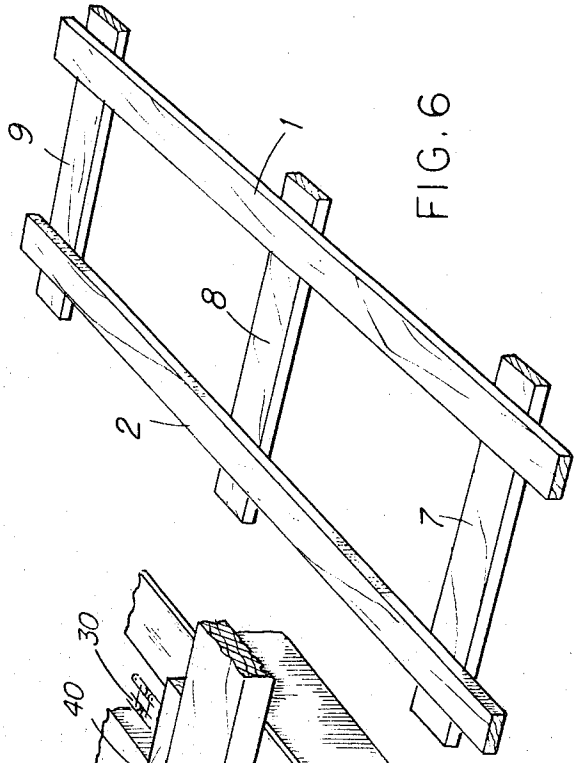
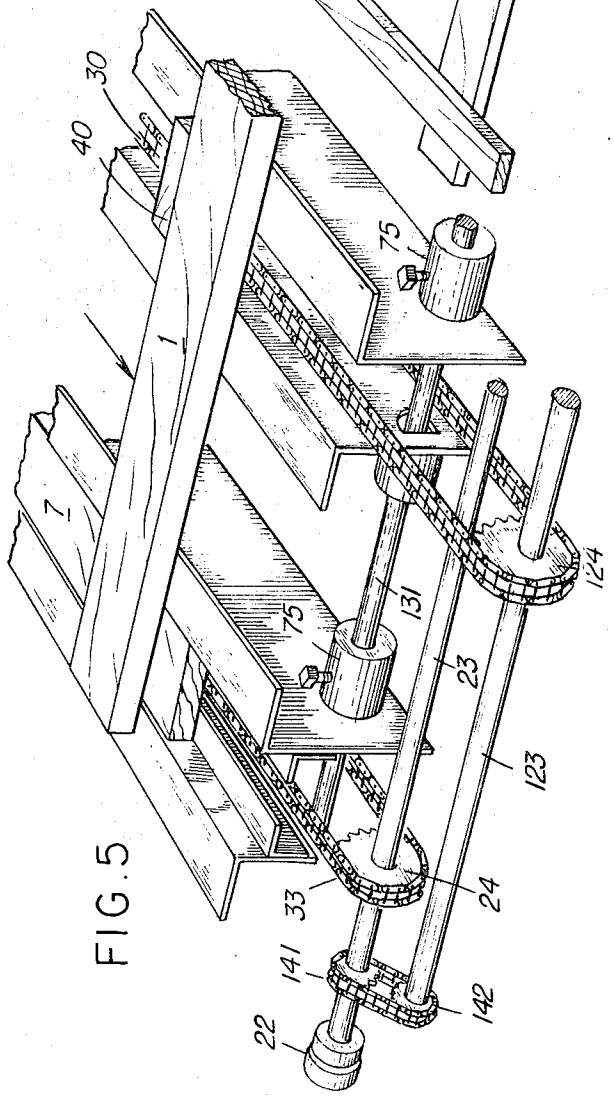


FIG. 5



AUTOMATIC FASTENING MACHINE

This application is a continuation-in-part of my copending application Ser. No. 109,769 filed Jan. 26, 1971, issued as U.S. Pat. No. 3,681,842.

The present invention is concerned with a method and machine for assembling and fastening with automatically driven fasteners such as nails or staples a plurality of longitudinal and transverse wooden boards into a frame or panel. The assembled frames are used as the walls of shipping crates or pallets. Frames of several sizes are combined to create a crate or pallet. The machine herein described in detail is adjustable to permit the assembly of frames of various sizes and of various numbers of longitudinal and transverse component boards. Operation of the machine is entirely automatic. When provided with a supply of approximately dimensioned board members and fasteners it produces finished frames therefrom without requiring a human operator. The machine replaces manual assembly and alignment of the boards and manual fastener insertion. The resulting frames are lower in labor cost and more uniform in dimensions than the hand assembled frames which they replace. The machine permits rapid fabrication of crates or pallets at a greatly reduced labor cost.

In The drawings:

FIG. 1 is a plan view of a machine in accordance with the present invention;

FIG. 2 is an elevational view of the front end of the machine of FIG. 1;

FIG. 3 is an elevational view of the right side of the machine;

FIG. 4 is a perspective view of a portion of the rear of the machine;

FIG. 5 is a perspective view of a portion of the front of the machine; and

FIG. 6 is a perspective view of a typical frame of the sort assembled by the machine in the present invention.

Referring now to the drawings, there is shown an embodiment of the machine of the present invention which has been set-up and adjusted to produce a frame of the form shown in FIG. 6. Such a frame can be used as one of the sides of a shipping crate. The other sides comprise similar frame units. The frame shown in FIG. 6 is composed of a pair of longitudinal members 1 and 2 and three transverse members 7, 8 and 9. This particular configuration of frame is but one of many such configurations capable of being assembled and fastened by the machine of the present invention. Frames can be made in other sizes, from other lumber sizes, in other proportions, and may have different numbers of longitudinal and transverse members. The five pieces of the typical frame shown in FIG. 6 are fastened together by means of conventional staples or nails driven at spaced locations in the overlapped intersections of the various board members.

The machine is in the form of open work support frame-work defining a horizontal plane. The supplies of the frame members 1, 2, 7, 8 and 9 are stored toward the rear of the machine in vertical stacks with their ends received in vertical channel hoppers or magazines 100–103 and 112–115. The forward portion of the horizontal plane of the machine constitutes a fastening station at which the members 1, 2, 7, 8 and 9 are joined with nails or staples 6 by means of pneumatic drive mechanisms 60. The drivers 60 are essentially conventional units available from such manufacturers as Bostitch Division of Textron, Inc. Carlstadt New Jersey.

The drivers 60 are arranged to be actuated when ever they contact a work piece by a contact trigger mechanism.

The horizontal plane of the machine is traversed from back to front by a group of parallel roller chains 30 travelling in the plane of the machine and a further group of parallel roller chains 33 travelling in guides below the plane of the machine. Chains 30 control the movement of longitudinal frame members 1 and 2 and chains 33 control the movement of transverse members 7, 8 and 9. FIGS. 4 and 5 illustrate the relative dispositions of chains 30 and 33. Chain 30 moves between drive members 145 and 146 and is disposed with its upper surface contiguous with the horizontal plane of the machine. Chain 33 is depressed below the horizontal plane of the machine and operates between a pair of guide members 116 and 117. Roller chains 33 are simultaneously driven by a plurality of drive sprockets 24 affixed to a drive shaft 23 which is supported in bearings 25. The rear end of each endless loop chain 30 is carried by sprockets 28 affixed to a back shaft 27 supported by bearings 26. The drive shaft 23 is driven by a motor 20 through a transmission such as a chain, belt or gear drive within a safety housing 21. The power is transmitted through a pneumatically disengageable clutch 22. Mechanical linkage, hydraulic, or electrical actuation could be employed through this clutch. Chains 30 are simultaneously driven by a plurality of drive sprockets 124 affixed to a drive shaft 123 supported in bearings 125. Drive shaft 123 is driven in synchronism with drive shaft 23 by means of a further chain drive 140–142. The rear end of each endless loop of chain 33 is carried by sprockets 128 affixed to a back shaft 127 supported by bearings 126.

Drive chains 30 and 33 include sets of mutually aligned pusher blocks 40 and 47 which may be short rectangular metal bars affixed to links of roller chains. The pusher blocks 40 move in unison to advance a longitudinal frame member 1 or 2 from the supply magazines 112–115 to the work station toward the front of the machine. Pusher blocks 40 are arranged on each chain 30 in pairs spaced apart by the distance that longitudinal members 1 and 2 are to be spaced apart when these frame members arrive at the work station. Pusher blocks 47 move on chains 33 in unison with each other and with blocks 40 to advance the plurality of transverse members 7, 8 and 9 along the channels defined by the pairs of guide members 116 and 117. Pusher blocks 47 are spaced along the length of each of the chains 33 by a distance greater than the length of the transverse members 7–9. Pusher blocks 47 move members 7–9 along the guide channels 116,117 to the fastening station at the front of the machine. The two groups of chains 30 and 33 are simultaneously driven and the pusher blocks 40 and 47 are relatively located along th chains 30 and 33 such that the members 1, 2, 7, 8 and 9 which form a set for a frame are taken from their respective supply magazines and carried forward to the fastening station of the machine in the relative positions which they occupy in the finished frame.

The supply magazines hold vertical stacks of boards which constitute frame members 1, 2, 7, 8 and 9 by confining the ends of the frame members within facing pairs of vertical channels 100, 101; 102,103; 112, 113; and 114, 115 such that longitudinal and lateral motion of the stacks of frame members is prevented but vertical downward movement of the members is permitted.

Each such facing pair of channels constitutes a magazine. The magazines for frame members 7–9 comprises a facing pair of channel members **100** and **101** at the rear end of the members 7–9 and a pair of hopper members **102** and **103** at the front end of the members 7–9. The magazine for longitudinal members **1** or **2** is constituted by the channel members **112–115.** The lowermost board in the magazines for frame members 7–9 rest in the channel formed between members **116, 117.** The lowermost board in the stack of longitudinal frame members **1** or **2** rests on top of the plane of the machine defined by the upper surfaces of members **116, 117** and **145, 146.** The lower ends of the magazines are spaced above the surfaces to which they deliver boards by a distance exceeding the thickness of a frame member board but less than the sum of the thickness of two frame member boards.

The frame members after being conveyed to the fastening stations are fastened together by fasteners **6** automatically driven by pneumatic drivers **60.** In the illustrated configuration of the machine there are six fastener drivers **60** secured to a carriage which is shiftable laterally by means of a linear actuator **57** and longitudinally by means of a linear actuator **63.** The fastener driver carriage is formed of a pair of lateral bars **152** and a pair of longitudinal bars **156, 157.** Longitudinal bars **156,157** are arranged telescopically to permit adjustment of the longitudinal spacing between the bars **152** which carry the fastener drivers **60.** Lateral bars **152** are supported by and are longitudinally slidable on bars **56.** Bars **56** in turn are supported by and are laterally slidable on bars **52.** The rectangular driver carriage comprising bars **152, 156** and **157** is positionable laterally of the machine by means of a linear actuator **57** which may be a pneumatic cylinder. The fastener carriage is free to slide laterally of the machine on bars **52.** Similarly, the fastener driver carriage is longitudinally positionable by means of a linear actuator **63.** The driver carriage is free to slide longitudinally along bars **56.** The ability to move the fastener carriage laterally and longitudinally permits the driving of fasteners at any predetermined location in the area of the overlap of the frame members which are being assembled. Thus, fasteners can be driven at one location in each joint area and then the carriage moved to a different position for the driving of a further fastener at a different location in each joint area.

The fastener drivers **60** are carried by vertically moveable pneumatic linear actuators **58** to lower the drivers **60** to the frame being assembled for driving a group of fasteners in a location in the frame determined by the position of the fastener driver carriage. Actuators **58** return the drivers **60** to a retracted condition during movement of the frame assembly into or out of the fastening station where fastening occurs. When the appropriate point in the cycle of operation of the machine is reached, the linear actuators **58** are operated to lower the fastener drivers **60** into contact with the frame being assembled. The fastener drivers include a trigger mechanism which causes the fastener drivers to actuate automatically when the drivers contact the work piece to drive the fasteners.

OPERATION

The following description of a machine operation cycle is directed to the machine when set up and adjusted in accordance with FIG. **1** to produce the frame of five members shown in FIG. **6.** The cycle begins by engaging clutch **22** to rotate drive sprocket shafts **23** and **123.** The drive sprockets **24** and **124** on these shafts cause the group of chains **30** and the groups of chains **33** to simultaneously move in the forward direction of the machine from the top to the bottom of FIG. **1.** Pusher blocks **47** affixed to chains **33** abut the lowermost transverse frame members **7–9** in the vertical stacks of such members in the magazines **100–103** located in the rear of the machine. Pusher blocks **47** cause the lowermost transverse frame members to slide forward from beneath their stacks in the magazines and to move forward of the machine. Pusher blocks **40** on chains **30** come to abut the lowermost board in the stack of longitudinal frame members **1** and **2** in the longitudinal member magazines **112–115** located in the approximate middle of the machine. A board which becomes longitudinal frame member **1** is pushed by the pair of pusher blocks **40** from beneath the stack in that magazine and is conveyed in unison with the transverse members **7–9.** A second pair of pusher blocks **40** is spaced from the first pusher blocks **40** by a distance equal to the desired spacing of the longitudinal frame members **1** and **2** in the finished frame. The second pusher blocks **40** come into abut ment with the next board in the longitudinal member stack which board will become longitudinal frame member **2,** and pushes that board from beneath the stack. All five frame members **1, 2** and **7–9** move in unison to the fastening station at the front of the machine. The frame members now constitute a set and are positioned in the relative positions desired in the finished frame. The set of frame members continues to advance until the leading edge of frame member **1** contacts edge detector switch **70.** Switch **70** provides a signal which is processed in the control system **80** described in detail in application Ser. No. 109,769. The control system causes disengagement of clutch **22** to terminate forward movement of the frame set. Stop members **34** are raised on command of the control system to form a positive stop against which the frame set is positioned with accuracy. The control system causes the fastener driver linear actuators **58** to lower the fastener drivers **60** into contact with the frame set resulting in automatic actuation of the fastener drivers to drive a first group of fasteners **6** in each of the overlapped joints of the frame set. The control system then causes the driver linear actuators to retract the drivers upwardly and also causes the driver carriage to shift laterally or longitudinally or both to a second position for driving a second group of fasteners at a location in the overlapped joints spaced from the first driven fasteners. The linear actuators are controlled to descend again to drive such second fasteners. The control system can be programmed to drive any desired number of fasteners in any desired pattern. It is usual to drive **2, 3** or **4** fasteners in each joint of the frame. At the conclusion of the fastener carriage positioning and fastener driving program the fastener drivers are retracted and the carriage is returned to the initial position. The stops **34** are retracted and the clutch **22** engaged to advance the now finished frame from the fastening station to the front output end of the machine. Simultaneous with the delivery of the finished frame from the machine, another set of pusher blocks **47** begins the cycle again by selecting a new group of transverse frame members **7** through **9.** The cycle repeats.

ADJUSTABILITY

The machine of the present invention is fully adjustable to accommodate a wide range of lumber sizes and lengths and to accommodate a wide range of sizes and configurations of finished frames. The number of transverse frame members, that is frame members which are aligned in the machine direction, can be changed by changing the number of drive chains **33** and the associated guide channels **116, 117** and supply magazines. The spacing between transverse frame members is adjustable as is the width and depth of the guide channels associated with roller chain **33.** As is perhaps best seen in FIG. **4** guide channel members **116** and **117** are attached to a pair of rods **130** which run transverse of the machine at the front and rear thereof. The guide channels are attached to the rods **130** with clamp members **75.** This manner of installation of the guide channel pairs **116** and **117** in the machine permits the guide channels to be both independently and collectively moved laterally. Collective movement of the guide channel pairs determines the relative spacing of the transverse frame members whereas the independent adjustability permits accommodation of boards of different widths. The supply magazines **100–103** for each of the transverse frame members are carried on the guide members **116** and **117** and move therewith. The drive sprockets **24** and the driven sprockets **28** for chains **33** can be positioned along their respective shafts **23** and **27.** The transverse frame member boards ride in the channel formed between members **116** and **117** with the upper surface of the transverse frame member boards flush with the horizontal flange of the guide channel members **116** and **117.** To accommodate lumber of a different thickness, channel floor members **147** and **148** attached to guide members **116** and **117** are vertically adjustable. Channel floor members **147** and **148** form the floor of the channel along which the transverse frame members slide. Sprocket shafts **23** and **28** are supported by bearings **25** and **26** respectively which bearings are vertically adjustable with respect to the machine frame to allow adjustment of the operating height of chains **33** in accordance with the adjustment selected for channel floor members **147** and **148.**

In similar fashion, guide members **145** and **146** for chains **30** are also laterally adjustable of the machine by means of clamps **75** which can be positioned on rods **130.** Vertical height adjustment need not be accommodated for chains **30** are intended to always operate in the plane of the machine. Pusher blocks **40** affixed to links of chain **30** determine the spacing of the longitudinal frame members **1** and **2.** Pusher blocks **40** can be positioned where desired along chains **30** to accommodate different spacings. For frames which require more than two longitudinal members more than two pusher blocks **40** are affixed at appropriate spacings along each of chains **30.**

Additional fastener drivers **60** can be attached to the fastener driver carriage at appropriate positions. The fastener drivers are clamped to carriage rods **152** and can be positioned where desired. The spacing between rods **152** is adjustable by virtue of the telescopic association of longitudinal carriage rods **156** and **157.** Thus, the number, the longitudinal spacing, and the lateral spacing of the drivers can be varied.

I claim:

1. A machine for assembling and fastening together a frame from a set of individual longitudinal and transverse frame members comprising;
- an adjustable work support including a fastening station,
- dispenser means for delivering to the work support the individual frame members of the set,
- means to properly space and move the delivered transverse members of the set to the fastening station,
- means to properly space and move the longitudinal members of the set to the fastening station in overlapping relationship with the transverse members, and
- fastener driving means at the fastening station arranged to drive at least one fastener to secure each of the transverse members to each of the longitudinal members.

2. The machine of claim **1** wherein the dispenser means comprise magazines for holding vertically stacked supplies of each frame member.

3. The machine of claim **2** wherein the means to space and move the transverse members comprise for each transverse member of the set a channel sized to accept the transverse member for longitudinal movement and an endless band traversing the length of the channel, the band including means to engage and propel the transverse member, the channels being separated by the spacing of transverse members of the frame.

4. The machine of claim **3** wherein the means to space and move the longitudinal members comprises at least one endless band including means separated by the spacing of the longitudinal members of the frame to engage and propel each longitudinal member.

5. The machine of claim **4** wherein the endless bands are sprocket driven roller chains.

6. The machine of claim **1** wherein the fastener driving means comprise a set of contact actuated automatic fastener drivers borne by a carriage which locates one such driver at each frame joint, and includes means to lower the drivers into contact with the set of frame members to actuate the drivers to drive first fasteners to fasten the frame joints, and means to traverse the carriage and drivers to a second position to there drive second fasteners to fasten the joints.

7. The machine of claim **6** wherein the means to traverse the carriage and driver includes means to move the carriage laterally of the machine and means to move the carriage longitudinally of the machine.

8. The machine of claim **7** wherein the automatic fastener drivers, the means to lower the drivers, and the means to traverse the carriage are pneumatic actuators.

9. The machine of claim **1** wherein the magazines each comprise pairs of facing vertical channels which receive the end portion of the stack of frame members.

10. A machine for assembling and fastening together a frame from a set of longitudinal and transverse frame members comprising;
- an adjustable work support including a fastening station,
- dispenser means comprising magazines for holding vertically stacked supplies of each frame member,
- means to space and move the transverse members comprising for each transverse member of the set a channel sized to accept the transverse member for longitudinal movement and sprocket driven

roller chain loops traversing the length of the channel, the chain including means to engage and propel the transverse member, the channels being separated by the spacing of transverse members of the frame,

means to space and move the longitudinal members comprising at least one endless band including means separated by the spacing of the longitudinal members of the frame and to engage and propel each longitudinal member,

fastener driving means comprising a set of contact actuated automatic fastener drivers borne by a carriage which locates one such driver at each frame joint, and includes means to lower the drivers into contact with the set of frame members to actuate the drivers to drive first fasteners to fasten the frame joints, and

means to move the carriage laterally of the machine and means to move the carriage longitudinally of the machine.

11. The machine of claim **10** wherein the channels are formed by a pair of guide members independently laterally positionable in the machine to accommodate transverse members of various widths and to permit adjustment of the relative spacing between transverse members.

12. The machine of claim **11** wherein the guide members which form the channels are provided with vertically positionable channel floor members to accommodate transverse members of various thickness.

13. The machine of claim **12** wherein the roller chain loops are laterally and vertically positionable.

14. The machine of claim **6** wherein the carriage comprises a rectangular frame of adjustable longitudinal dimension and the drivers are laterally positionable on the frame.

15. A method for assembling and fastening together a frame from a set of individual longitudinal and transverse frame members comprising;

delivering from supply magazines the transverse members of the frame,

moving the transverse members in unison,

delivering from a supply of longitudinal frame members and in overlapping relation to the transverse members a first longitudinal frame member,

continuing to move the transverse members and moving the first longitudinal member in unison,

delivering from a supply of longitudinal frame members and in overlapping relation to the transverse members a second longitudinal member in spaced relation to the first longitudinal member,

moving the now complete set of individual members of the frame in unison to a fastening station,

stopping the movement,

advancing plural automatic contact actuated fastener driving means into contact with the frame members at a first position for driving first fasteners to fasten the overlapping joints between frame members,

driving the fasteners,

retreating the fastener driving means from the frame,

advancing the fastener driving means into contact with the frame members at a second position for driving second fasteners to fasten the joints, and

retreating the fastener driving means.

* * * * *