United States Patent

[11] 3,591,067

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[21] Appl. No. **828,489**
[22] Filed **May 28, 1969**
[45] Patented **July 6, 1971**
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[54] **ASSEMBLY JIG FOR THE NAILING OF WOOD FRAME MEMBERS**
13 Claims, 17 Drawing Figs.

[52] **U.S. Cl.** **227/4,** 144/288, 227/100, 227/155
[51] **Int. Cl.** **B27f 7/22**
[50] **Field of Search** ..... 227/2, 3, 4, 27, 38, 40, 100, 101, 102, 150, 152, 154, 155; 144/288, 288-6; 269/321 F, 104, 105, 106, 229

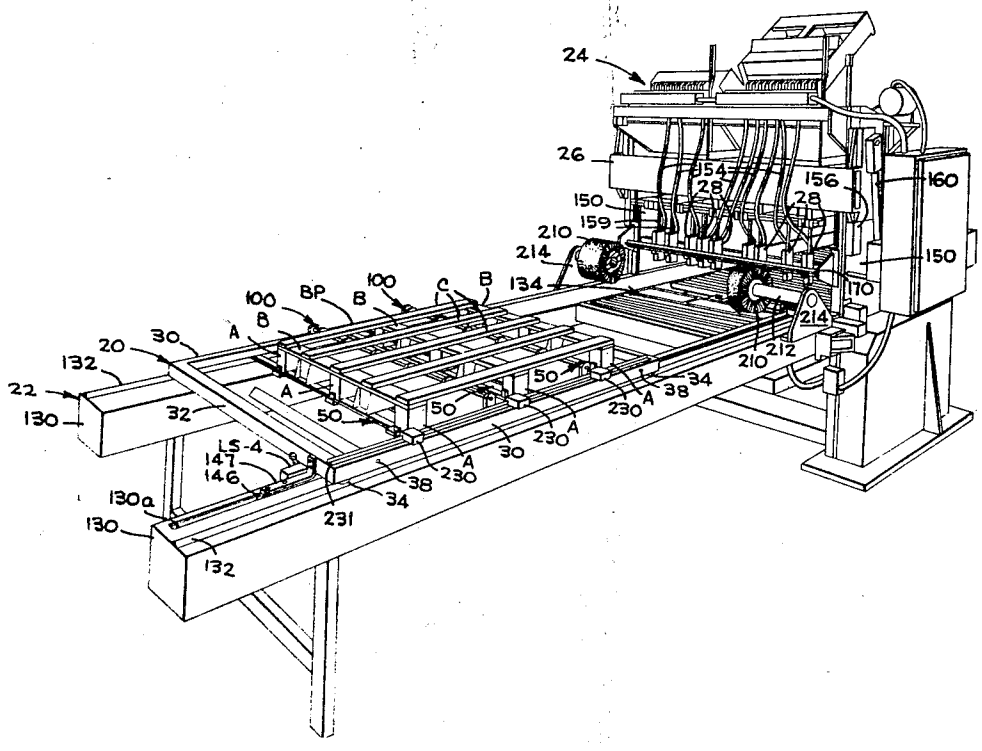
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Primary Examiner—Granville Y. Custer, Jr.
Attorneys—F. W. Anderson and C. E. Tripp

ABSTRACT: A jig for assembling wooden pallet members prior to nailing which jig comprises a rigid rectangular frame structure that is arranged upon a pair of parallel tracks for horizontal movement beneath an automatic nailing machine. Transversely extending and adjustably mounted support members are adapted to carry either the supporting blocks or the supporting stringers of the two basic types of pallets, and vertically yieldable plates are mounted upon said support members to underlie the overlapped top boards of the pallets and thereby allow nails to be driven through the boards to be clinched from beneath. As the assembled pallet structure passes beneath the nailing machine, a series of switches stop it at the proper locations for nailing and an overhead brush insures proper alignment of the overlying pallet members prior to nailing.



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SHEET 1 OF 9

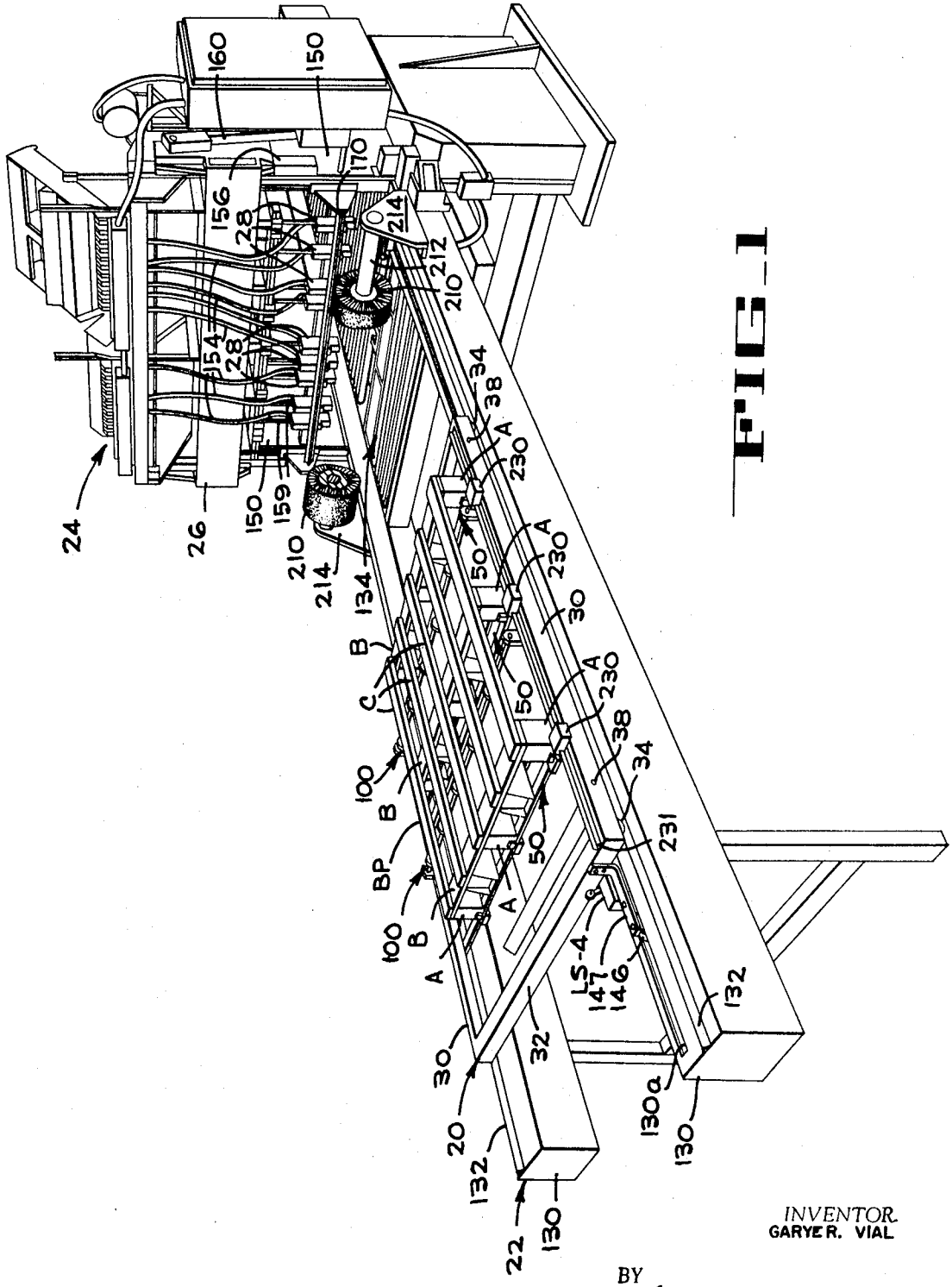


FIG. 1

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C. C. Tripp

ATTORNEYS

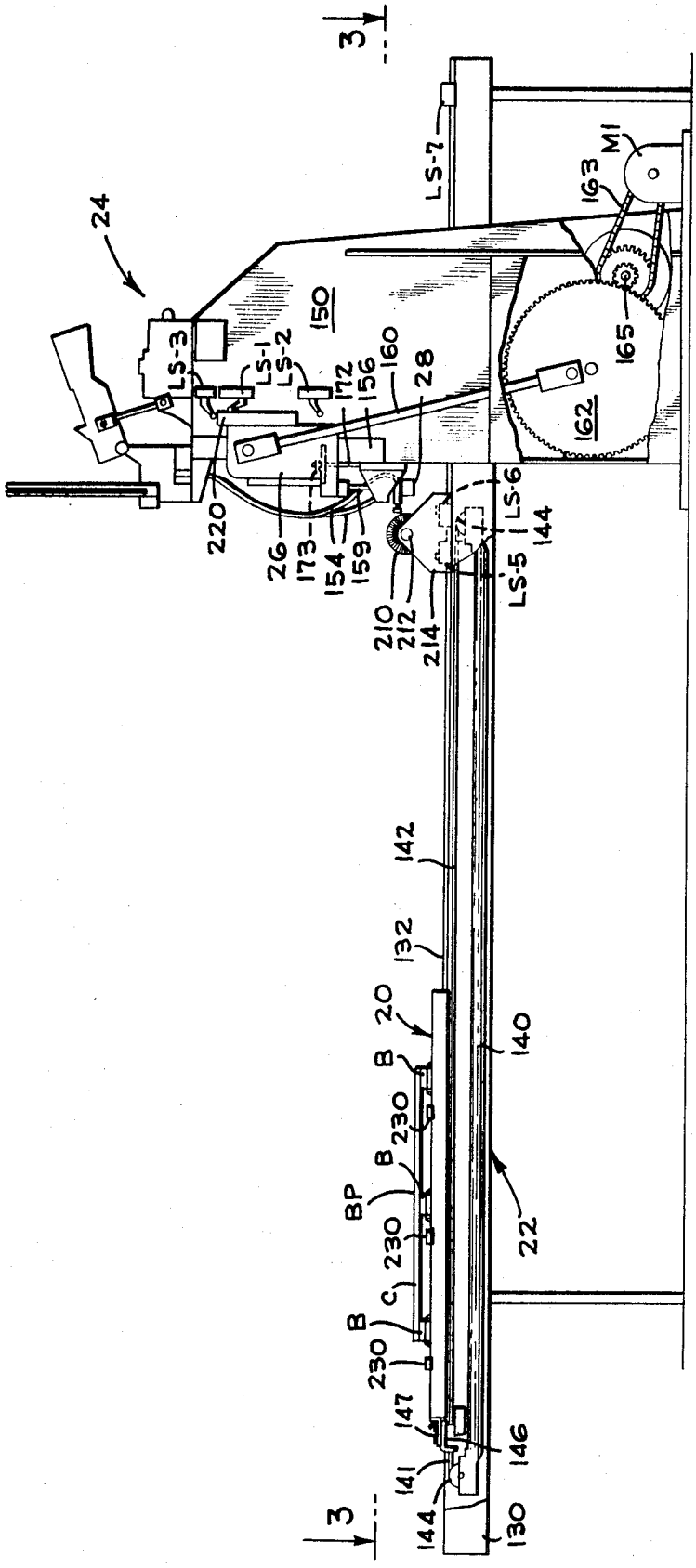

3
LS-7
M1
163
24
150
LS-3
LS-1
LS-2
172
156
160
28
165
162
220
26
173
154
159
LS-6
144
LS-5
210
212
214
142
132
20
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B
BP
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C
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230
147
141
144
146
130
140
22
3

FIG_2

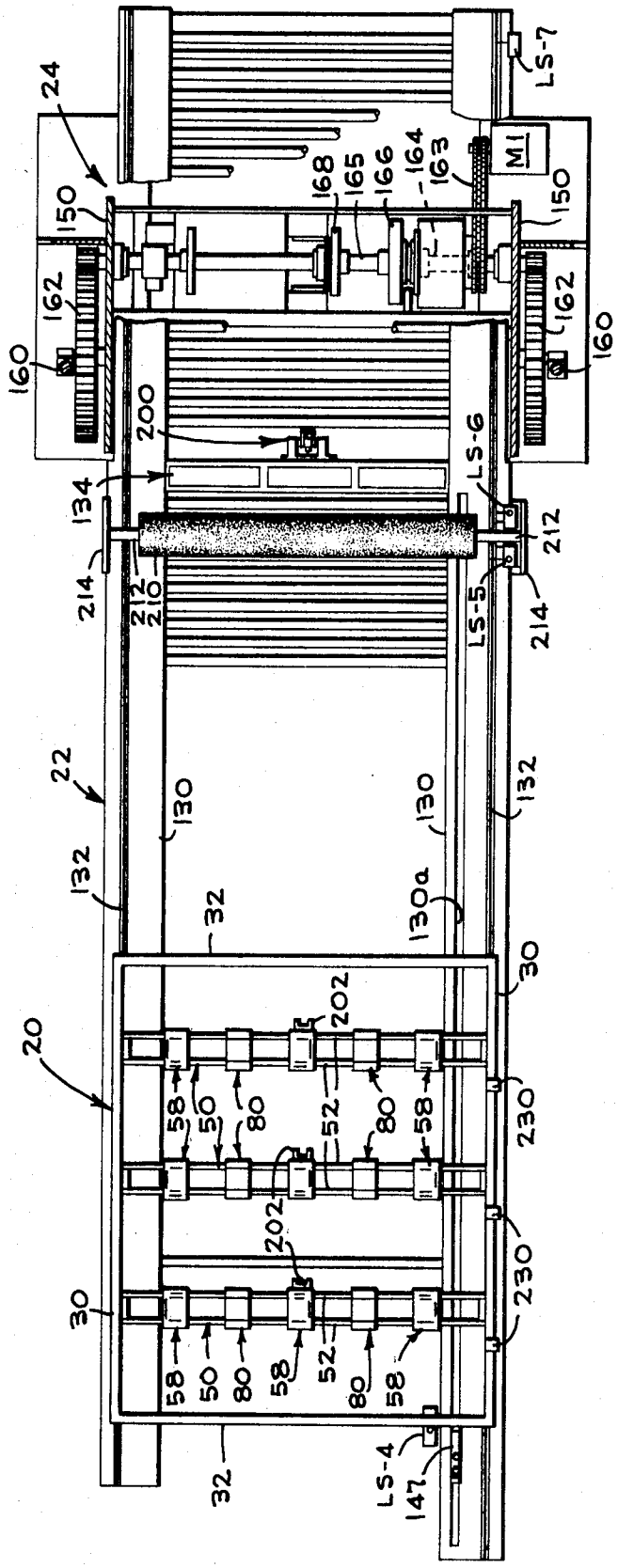

24
LS-7
M1
168
165
166
164
163
150
150
162
162
160
160
200
LS-6
134
212
214
212
210
214
LS-5
22
130
130
132
132
32
130a
30
20
202
58
50
80
52
80
58
230
202
230
30
58
50
80
58
52
80
58
32
LS-4
147

FIG. 3

FIG_4

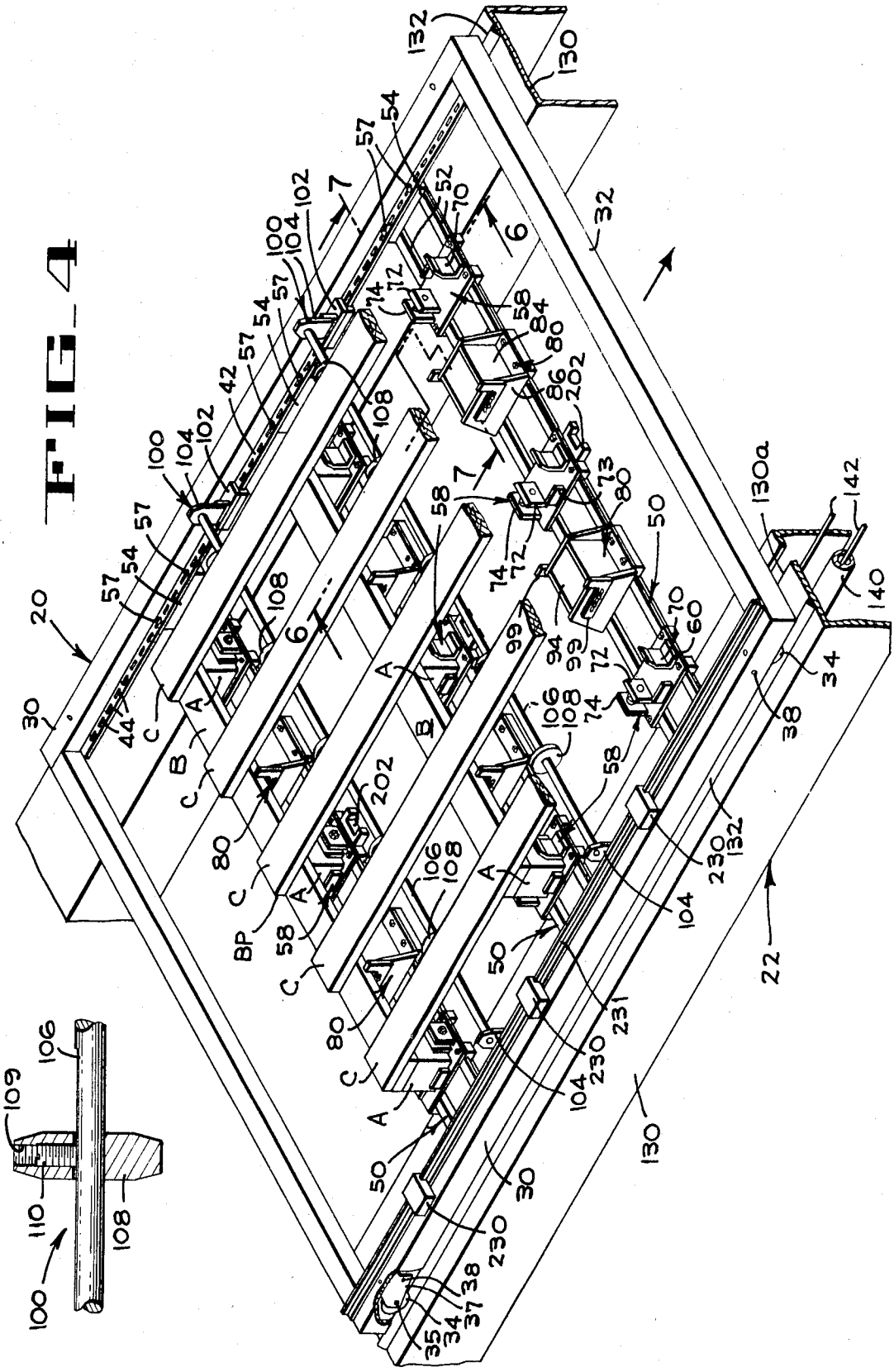


FIG_5

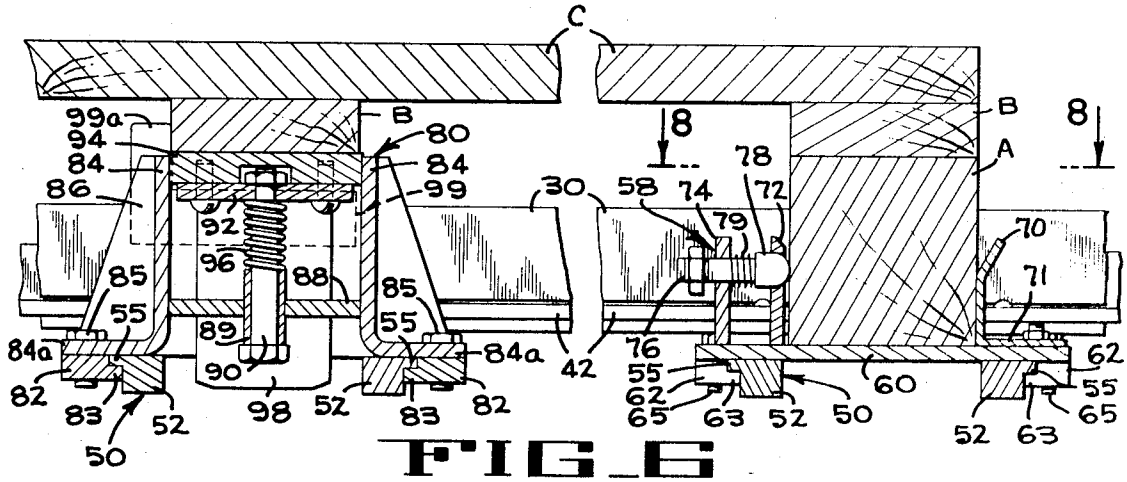


FIG_6

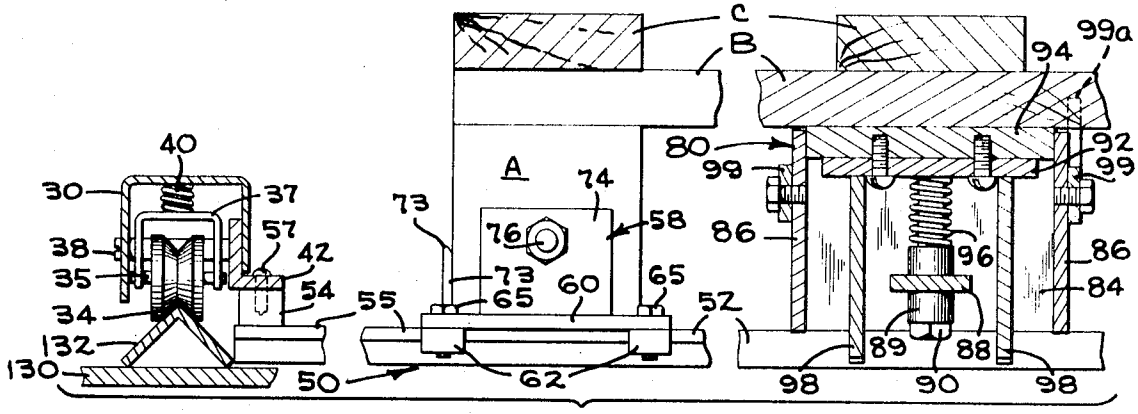


FIG_7

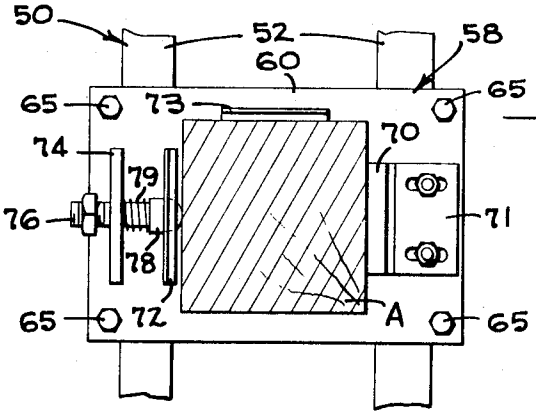


FIG_8

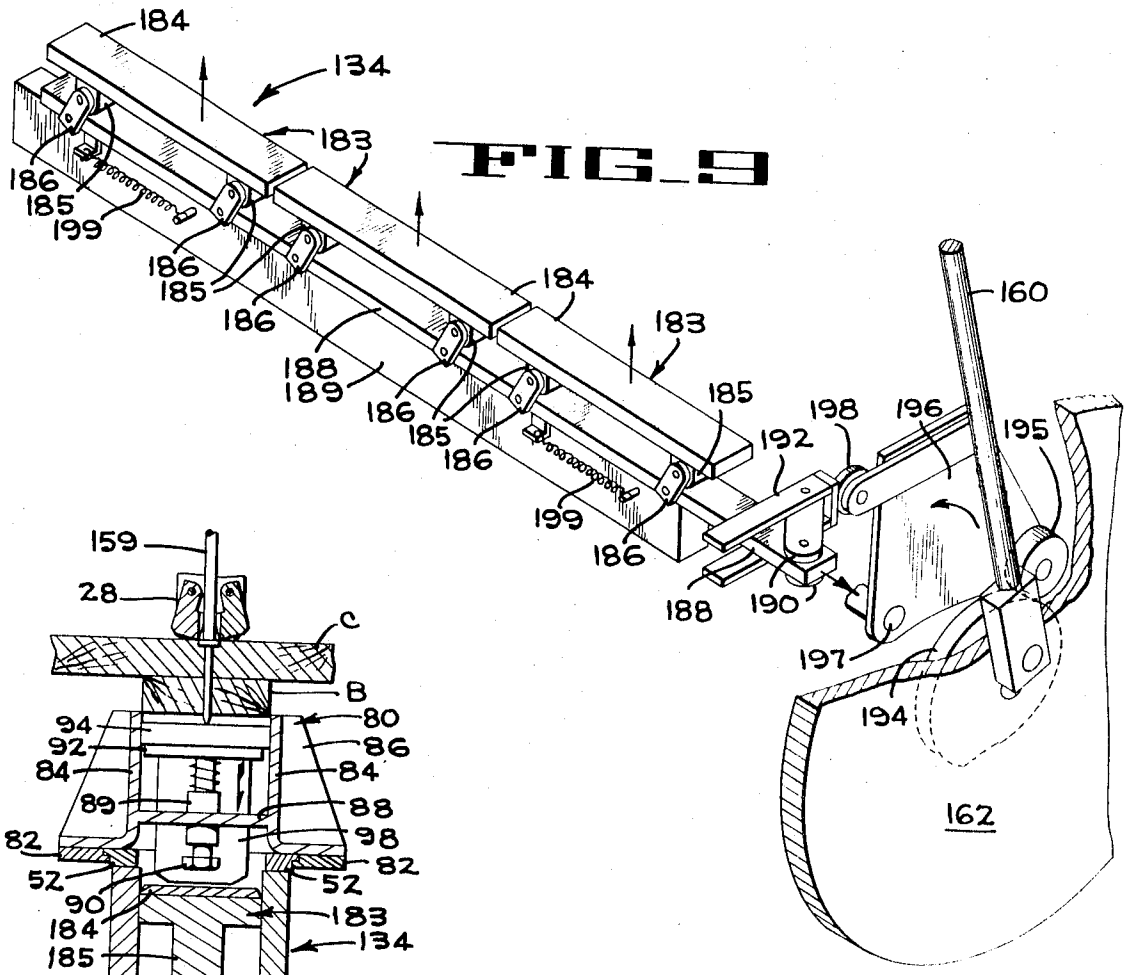


FIG_9

FIG_11

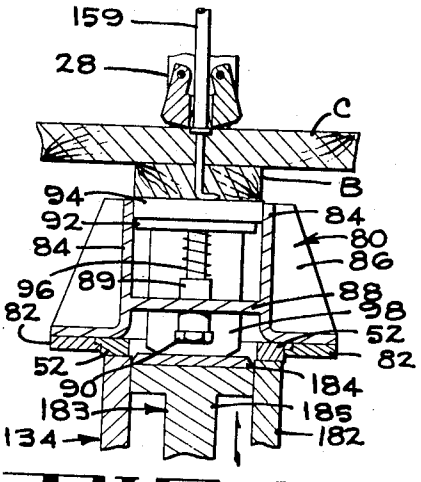


FIG_12

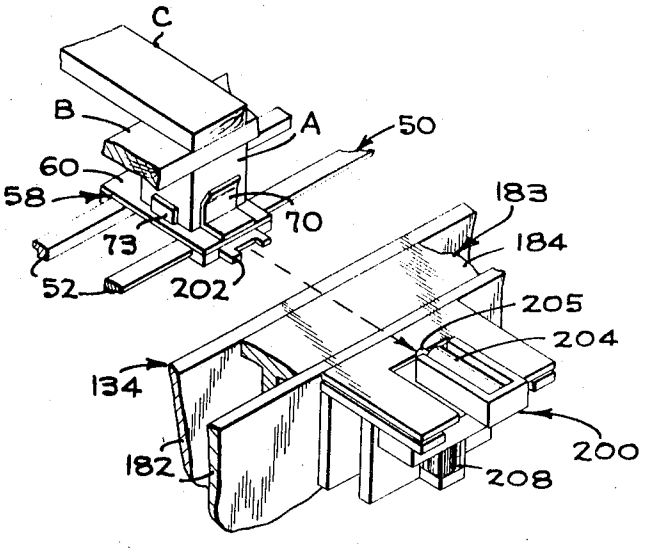


FIG_10

FIG. 13

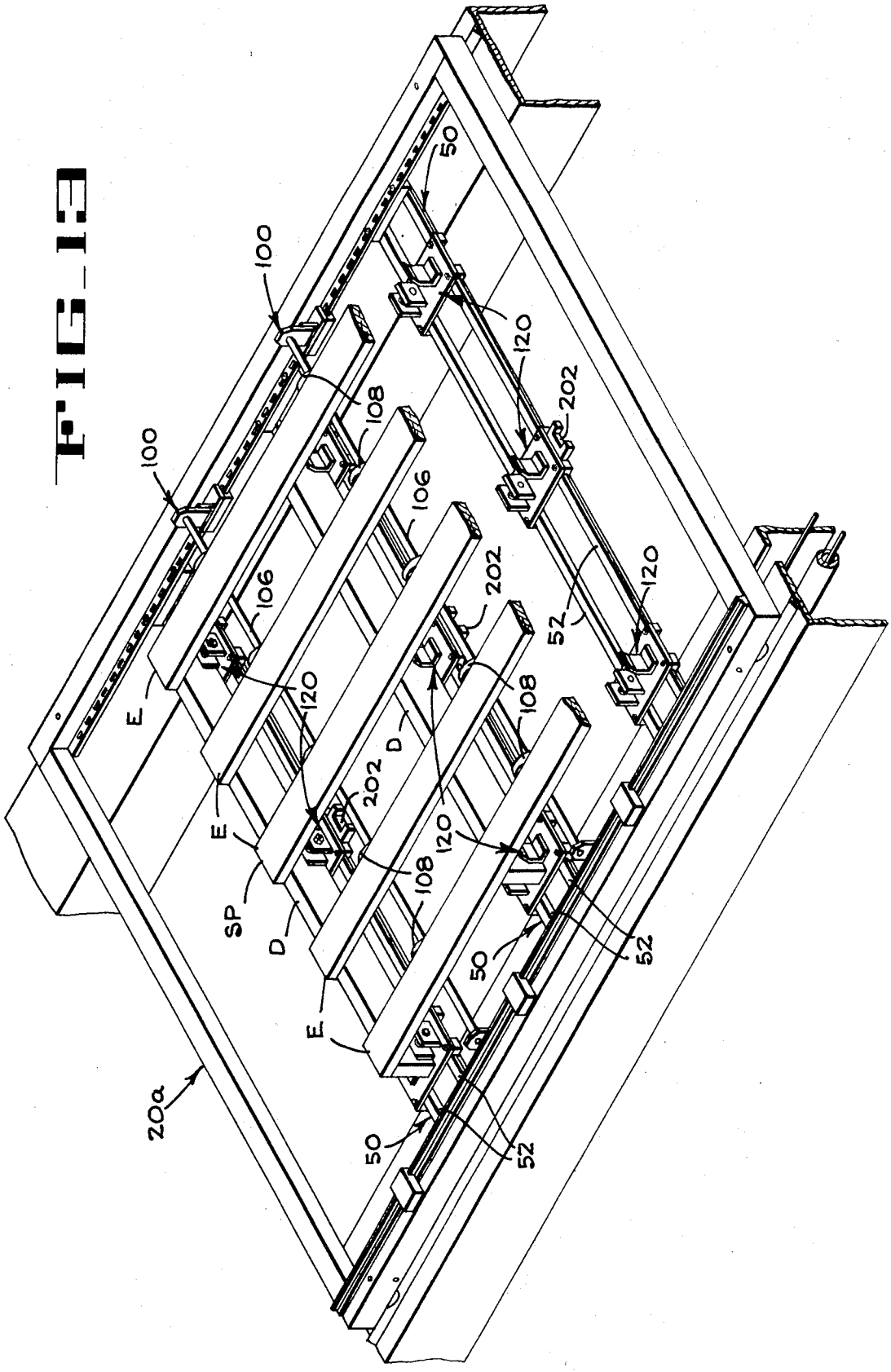
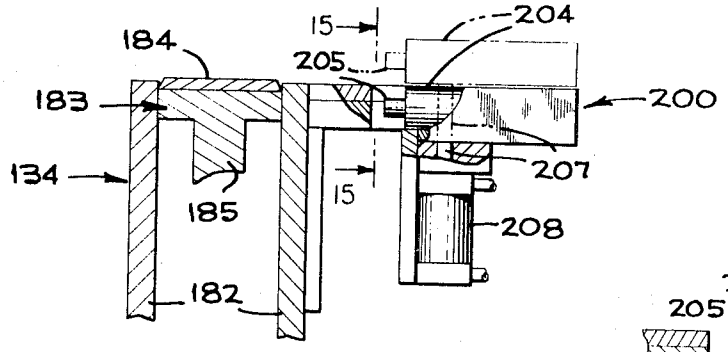

100
100
50
120
108
202
106
106
202
120
52
120
E
E
E
E
120
202
D
D
108
108
SP
108
120
50
52
50
52
20a

FIG_14



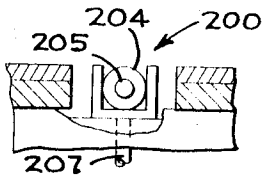


FIG_15

FIG_16

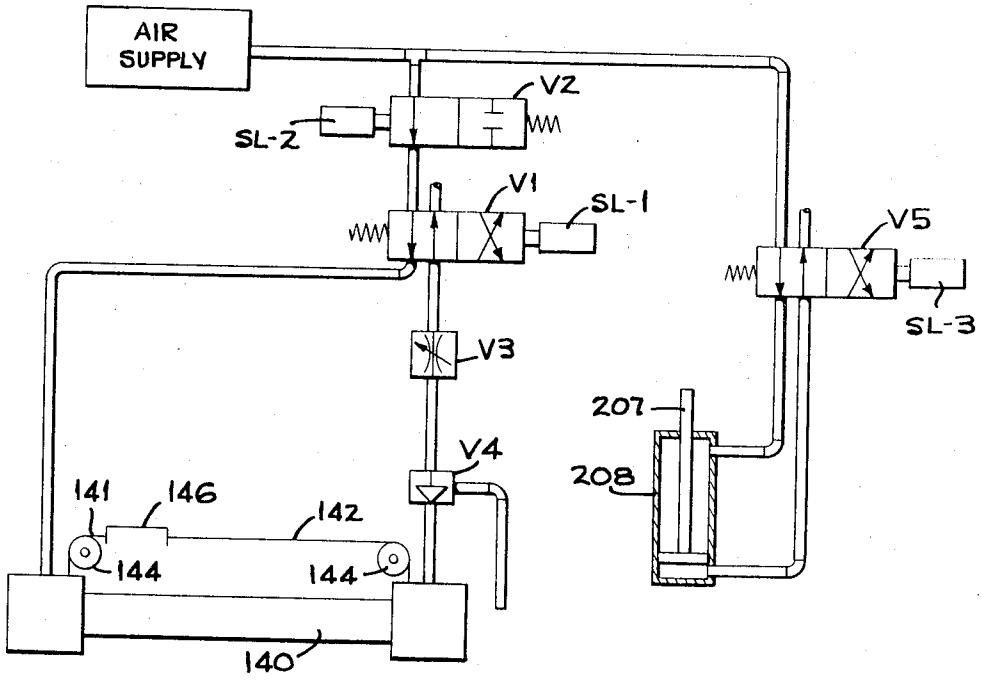
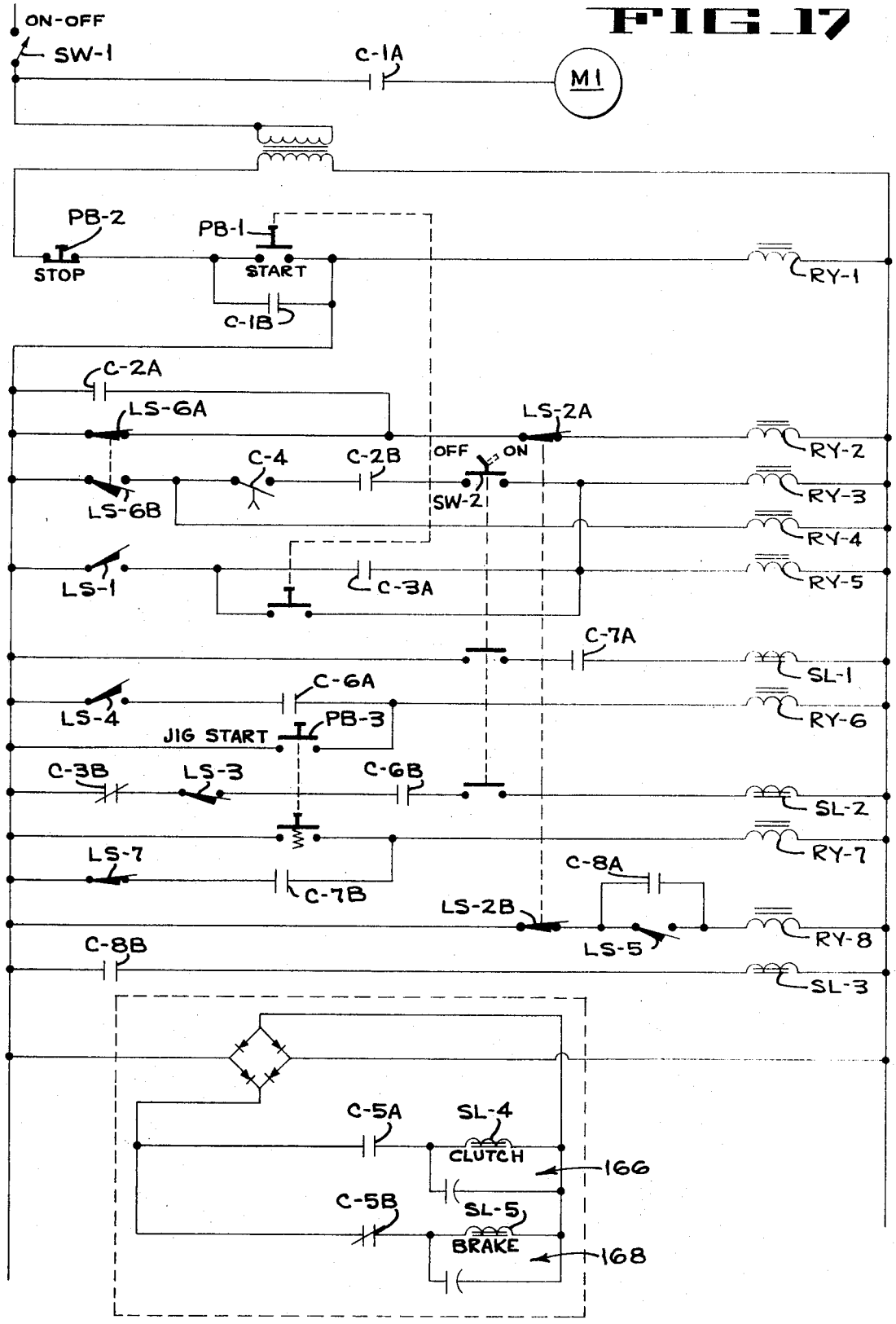


FIG 17


ON-OFF
SW-1
C-1A
M1
PB-2
STOP
PB-1
START
C-1B
RY-1
C-2A
LS-6A
LS-2A
RY-2
C-4
C-2B
OFF
ON
SW-2
RY-3
LS-6B
RY-4
LS-1
C-3A
RY-5
C-7A
SL-1
C-6A
LS-4
RY-6
JIG START
PB-3
C-3B
LS-3
C-6B
SL-2
RY-7
LS-7
C-7B
C-8A
LS-2B
LS-5
RY-8
C-8B
SL-3
C-5A
SL-4
CLUTCH
166
C-5B
SL-5
BRAKE
168

ASSEMBLY JIG FOR THE NAILING OF WOOD FRAME MEMBERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

In general, this invention pertains to that field of art concerned with apparatus for positioning wood frame members prior to the nailing thereof, and more particularly, it pertains to assembly jigs to aid in the proper positioning of the wood frame members of a pallet, or similar structure, and for the conveying of the same to automatic nailing machinery.

2. Description of the Prior Art

Since the advent of automatic nailing machinery, it has been well known that repetitive nailing operations could be carried out more rapidly and efficiently if specially designed apparatus were provided for holding the members to be nailed together and for conveying the assembled structure beneath the nailing machines. For example, the U.S. Pat. No. 690,416 to Fuller, which issued at the turn of the present century, discloses a travelling jig which is provided with workpiece holding members and which is arranged upon a generally horizontally extending conveyor track so that an assembled wood structure may be carried beneath a nailing machine structure for securing the individual wooden members together.

In the intervening years, many different types of assembly fixtures or jigs have been provided for the assembly of wood frame members to aid in the nailing thereof. Many of such devices have been provided with adjustable features so that they may be modified to handle different sized products, and some have been, in addition, provided with automatic features so that an assembled frame structure will be carried through a nailing machine automatically with each individual portion of the structure being automatically nailed as it passes the nail driving section of the machine. An example of an adjustable and automatically movable fixture for a wooden frame assembly is shown in the prior art U.S. Pat No. 3,207,403 to Stoddard et al.

The problem of making a suitable assembly jig which will be adjustable for different sizes or types of wooden structures has been found to be particularly troublesome. Obviously, the provision of a complex structure which has flexibility in all directions will necessarily require a costly device the expense of which would be difficult to justify for the typical user of such an apparatus which may, for example, be a wooden pallet manufacturer. For this reason, adjustable assembly jigs of the prior art have generally been limited to the assembly of particular structures and have lacked versatility. Furthermore, even with their limited range of adjustability, the special adjustment features have complicated the assembly process so that the prior art assembly jigs are frequently difficult and time consuming to load thereby rendering them inefficient for their intended purpose. Two adjustable assembly jigs of the type described which are representative of the prior art are the structures disclosed in the U.S. Pat. No 2,958,351 to Deamer et al. and the U.S. Pat. No. 3,277,939 to Scott.

A particular need for assembly jigs has arisen in the pallet making industry, and this need has been accentuated in recent years because of the greatly increased use of wooden pallets in the new automated material handling systems. Pallets have traditionally been assembled in jigs of makeshift design which are constructed with but a single type, and usually with but a single size, of pallet in mind. It should be here pointed out that there are two basic types of pallets in general use today, one being the stringer type which is constructed of a plurality of parallel stringers fastened together by a plurality of transversely extending deck boards and the other being the block type which is constructed of a plurality of spaced blocks secured together by a deck mat made up of deck boards and stringer boards extending at right angles to each other. In the past each of these basically different types of pallets have been assembled in entirely different jigs, and, in the case of block type pallets, the mats have been nailed together separately before they are fastened to the supporting blocks.

While adjustable jigs for the assembly of pallet members have been known, as shown in the aforementioned patent to Stoddard et al. for example, such structures have not been truly versatile in that they have not been designed to handle both the block type and the stringer type of pallet as has been pointed out. Furthermore, the range of adjustment of the prior art jigs has not been enough to permit a full scale commercial pallet making operation to be carried on with only the one basic jig. Additionally, the loading or other handling problems involved with the prior art assembly jigs have been aggravated by the adjustable features so that the jigs are not as efficient or time saving in a pallet nailing operation as they might otherwise be.

SUMMARY OF THE INVENTION

The present invention comprises an assembly jig for wood frame structures which is adjustable not only to permit different sized structures to be assembled therein but also to permit basically different types of structures to be assembled therein. For example, the same basic assembly jig of the present invention can be used to preassemble for nailing both the individual members of a stringer type pallet or the individual members of a block type pallet.

A very important feature of the present invention is the ability of the jig to provide for the members of a structure, such as a block type pallet, wherein overlapped cross members are provided at an elevation above the other members of the structure which cross members must be fastened together by a clinching operation. In the so-called clinching operation a nail is driven through the elevated overlapped boards and then bent flush against the lowermost surface of the lower board. The assembly jig of the present invention is provided with a workpiece holding member which supports the cross members and which has a yieldable support surface that is adapted to yield downwardly under the force of the driven nails and be engaged by and driven upwardly by conventional nail clinching mechanisms in order to effect the clinching operation.

Another important feature of the present invention is the means for readily adjusting the assembly jigs for different sizes and even different types of products. As will be seen from the description of the preferred embodiment of the invention, the adjustments to the assembly jig may be made readily by unskilled laborers so that the down time in product changeovers is a minimum. Furthermore, it will be seen that the adjustable features of the present invention do not hinder the loading of the jigs, and the efficiency of the jigs can therefore be kept at a maximum for good production results.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective of the assembly jig and the associated conveyor structure of the present invention particularly showing its utilization in connection with an automatic nailing machine.

FIG. 2 is a side elevation of the apparatus shown in FIG. 1 with portions thereof being broken away for the purpose of clarity.

FIG. 3 is a horizontal section taken substantially along the line 3–3 of FIG. 2 with portions thereof being broken away for the purpose of clarity.

FIG. 4 is an enlarged isometric view of the assembly jig shown in FIG. 1 and particularly illustrates the use of the jig in the assembly of a block type pallet, portions of which are broken away for the purpose of clarity.

FIG. 5 is an enlarged section through one of the adjustable deck board guide members shown in FIG. 4.

FIG. 6 is an enlarged section taken generally along the line 6–6 of FIG. 4.

FIG. 7 is an enlarged section taken generally along the line 7–7 of FIG. 4.

FIG. 8 is a section taken generally along the line 8–8 of FIG. 6.

FIG. 9 is an isometric view of the nail clinching mechanism of the automatic nailing machine shown in FIGS. 1 and 2.

FIG. 10 is an isometric view of the mechanism for stopping the travel of the jig.

FIG. 11 is an operational view of the yieldable clinching device of the present invention particularly illustrating its position after a nail has been driven through the overlying wooden members.

FIG. 12 is an operational view of the clinching device of the present invention similar to FIG. 11 but illustrating the position of the device at a time subsequent to that of FIG. 11 at the completion of the nail clinching operation.

FIG. 13 is an isometric view of the assembly jig, similar to FIG. 4, but illustrating the jig as modified to provide for the assembly of a stringer type pallet.

FIG. 14 is a transverse section through the anvil table of the nailing machine shown in FIGS. 1–3 and particularly illustrates, in side elevation, the stop member with the raised position of the member being shown in phantom line.

FIG. 15 is a section taken along the line 15–15 of FIG. 14.

FIG. 16 is a schematic diagram of the pneumatic circuitry of the present invention.

FIG. 17 is a schematic diagram of the electrical circuitry of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the preferred embodiment of the invention shown in FIG. 1, an assembly jig 20 is provided for operation upon a horizontally arranged conveyor structure 22 to take an assembled block type pallet structure BP beneath an automatic nailing machine 24 where the individual members of the pallet can be nailed together. When in the location shown in FIG. 1, the assembly jig is adapted to be manually loaded with the individual members of the pallet which members are placed in overlying relationship. A control system is then actuated to energize the conveyor structure and send the jig forwardly. The jig is automatically stopped as the leading portion of the assembled pallet comes to a location directly beneath a nailing head 26 and a transverse row of nail holding assemblies or chucks 28, and the head is lowered to drive a row of nails from the chucks into the overlapped pallet members. The jig is then automatically moved forwardly to reposition the assembled pallet and permit a second line of nails to be driven, and this process is repeated until the pallet has been completely nailed.

The assembly jig 20 is shown in detail in FIG. 4 and will be seen to generally comprise a rectangular frame structure of inverted channel members including a pair of side frame members 30 and a pair of end frame members 32 which are welded together at the ends thereof. The frame is mounted for horizontal movement by means of grooved wheels 34 with one wheel being provided at each of the four corners of the structure. Each of the wheels is rotatably mounted upon a pin 35 (FIG. 7) which is attached at one end of an inverted U-shaped support member 37. The opposite end of each support member is rotatably mounted upon a pivot pin 38 which is secured to the downwardly extending walls of the overlying side frame member. A compression spring 40 is secured between the undersurface of the side frame member and the top of the support member 37 to urge the free end of the support member and supported wheel downwardly and thereby provide a resilient support for the jig. As will be explained in greater detail hereinafter, the jig will thus be forced downwardly when the pallet members are engaged by the nail driving means until firm contact with an underlying support surface is achieved to permit the nailing operation to be accomplished.

Arranged along the inner side of each of the side frame members is an L-shaped support bracket 42 which is provided with a plurality of uniformly spaced and aligned apertures 44 in the face of the bracket which extends inwardly of the jig from the side frame member. The L-shaped support brackets are rigidly secured to the side frame members and they are adapted to carry therebetween a plurality of support members 50 extending transversely of the jig structure. In the assembly jig of FIG. 4 three such support members are shown. As best seen in FIGS. 6 and 7, each of the support members comprises a pair of parallel support rails 52 which are connected together at their ends by blocks 54 and each of which is provided with a short outwardly extending flange 55. The blocks 54, which are rigidly secured to the upper surfaces of the support rails are each attached to the jig frame structure by means of a pair of bolts 57 which extend within a selected pair of the apertures 44 in the adjacent support bracket 42. It will be recognized that the support members may be moved to various positions along the supporting side frame members of the jig if the pallet size is to be changed simply by removing the bolts 57, shifting the position of the support members, and reinserting the bolts in a different set of apertures in the support bracket.

The assembly jig which is shown in FIG. 4 is particularly arranged to support the individual members of a block-type pallet BP. In this form of pallet a plurality of blocks A are provided in three parallel rows of three blocks each. Each row of blocks is connected together by an overlying deck mat comprised of stringer boards B and deck boards C with the spaced stringer boards and deck boards resting on the blocks and extending crosswise to each other. In the arrangement of the assembly jig shown, it is the purpose of the support members 50 to not only provide support for the blocks of the pallet but also to provide a nailing surface for the overlapped stringer boards and deck boards where they are not supported by an underlying block.

Referring especially to FIGS. 6, 7 and 8, it will be seen that each of the blocks A of the pallet are supported upon an assembly 58 which comprises a flat support plate 60 that is secured to each of the underlying support rails 52 by means of a clamp member 62 which has a protruding flange 63 arranged to underlie and lock with the outwardly projecting flange 55 of the support rail. Bolts 65 extend through the corners of the support plates to bring the clamp members into tight engagement with the support rails. By loosening these bolts the support plate may be slid along the support rails to any position desired if the pallet configuration is to be changed. Positioned upon each support plate is an upright member 70 which has a mounting flange 71 that is adjustably secured to the face of the plate at one side thereof. Arranged in opposed relationship to the adjustable upright member 70 is a fixed upright member 72 which has its lower edge rigidly attached, as by welding, to the face of the plate. The uprights 70 and 72 are arranged in parallel relationship so as to form a pocket therebetween for the reception of the pallet block and a short guide plate 73 is positioned between the uprights to properly locate the block. Extending in parallel relationship to the fixed upright 72 is a mounting plate 74 which is apertured to slidably support a plunger 76 having an enlarged rounded nose portion 78 which protrudes through the aperture and is adapted to resiliently engage the side face of the pallet block and hold it within the pocket. A compression spring 79 fixed about the plunger between its nose portion and the mounting plate provides yieldable support for the plunger so that the block may be placed in and removed from the supporting assembly without undue difficulty. As shown in FIG. 4, three such block supporting assemblies are arranged along each support member 50 at equally spaced locations.

Each of the transversely extending support members 50 also carries a pair of clincher assemblies 80 (FIGS. 6 and 7) which are arranged between and uniformly spaced from the block supporting assemblies 58 and are adapted to aid in the nailing together of the overlapped deck boards C and stringer boards B. Each clincher assembly includes a pair of clamp members 82 having inwardly extending flanges 83, similar to the clamp members 62 of the block supporting assembly, for adjustably clamping the clincher assembly to the underlying support rails 52 and permitting sliding movement therebetween when it is desired to adjust the lateral position of the assembly. The structure of the clincher assembly generally comprises a pair of opposed upright members 84 having mounting flanges 84a which are attached by means of bolts 85 to the clamps 82. A

pair of trapezoidally shaped plates **86** are rigidly attached to the upright members **84** at each side thereof so as to form a boxlike structure. A support plate **88** extends between the inner faces of the upright members **84** and serves to mount at the center thereof a supporting sleeve **89** which sleeve is used to slidably secure the enlarged end of a shoulder bolt **90**. The uppermost threaded end of the shoulder bolt is secured to a reinforcing member **92** which is bolted into a flat clincher plate **94**, the outer edges of which closely parallel the walls of the pocket formed by the members **84** and plates **86**. A compression spring **96** is mounted between the upper edge of the supporting sleeve and the lower face of the reinforcing member **92** so as to urge the bolt and the clincher plate upwardly into the position shown in FIG. **6** where the top surface of the clincher plate is located just above the upper edges of the upright members **84** and plates **86** so that the wooden members to be nailed can be placed thereon. Depending from the reinforcing member **92** are a pair of vertical flanges **98** the lower ends of which are just slightly higher than the lower face of the support rails **52** when the clincher plate is in its raised position. A pair of L-shaped guides **99** are bolted to the outer faces of each of the upright plates **86** and are provided with upstanding arms **99***a* which are adapted to receive the side edges of the stringer boards B of the pallet and guide it into the proper position on the jig.

It will be noted that, when the clincher plate **94** is in its raised position, it is arranged to support the stringer board B of the block-type pallet illustrated. The clincher plate is adapted to yield when a nail is driven through the overlying boards B and C, and, by means to be disclosed hereinafter, a power member with an upward drive stroke is adapted to engage the lower ends of the depending flanges **98** once the nail has been driven completely through the overlying boards so as to bend the protruding end of the nail flat against the lowermost surface of the stringer board.

A pair of deck board alignment members **100** are also adjustably positioned upon the L-shaped support brackets **42** that extend along the side frame members **30** of the assembly jig. These alignment members include a mounting block **102** which is adjustably secured within selected apertures **44** of the support brackets, and each mounting block is provided with an upright flange **104** for detachably supporting a rod **106** that extends transversely across the jig. The rods **106** are each provided with a plurality of adjustably mounted discs **108** (FIG. **5**) which have radial threaded passages **109** for reception of a setscrew **110** to permit their attachment to a flattened portion of the support rod. As shown in FIG. **4**, the discs are secured to the support rods in spaced positions so that the deck boards C of the pallet may be precisely aligned by the loaders who stand at the side of the jig. Obviously, if a greater or lesser number of deck boards were to be used, the number of alignment discs could be accordingly increased or decreased by removing the rods **106**. Furthermore, the spacing of the discs can easily be adjusted by loosening of the setscrews **110** and sliding the discs along the rods.

In FIG. **13** there is shown a stringer-type pallet SP (the second basic type of pallet structure) and the modified form **20***a* of the assembly jig for assembling and retaining the members of this type of pallet prior to nailing. Each stringer-type pallet includes a plurality of transversely extending stringers D and a plurality of uniformly spaced deck boards E which overlie the stringers. The assembly jig **20***a* is basically the same as the assembly jig shown in FIG. **4** except that the workpiece holding members, i.e., the block supporting assemblies **58** and the clincher assemblies **80**, are replaced by stringer supporting assemblies **120**. Each of the stringer supporting assemblies is virtually identical to the block supporting assemblies **58** except that the spacing between the pocket-forming upright members has been decreased so as to accommodate the narrow width of the stringer D as compared to the relatively large width of the support blocks A. In a manner previously described, the stringer support member **120** can be adjustably slid along the support rails **52** of the support members **50**, and the support members may be adjusted longitudinally along the jig. The deck board alignment members **100** with their adjustable discs **108** are used to align the deck boards E of the stringer-type pallets in the same manner that the deck boards C of the block-type pallets were aligned.

The conveyor structure **22** for supporting and transporting the assembly jig **20** generally comprises a pair of horizontally arranged and laterally spaced support rails **130** of boxlike structure. Each of the rails is supported at an elevated position and is provided with an inverted angle track **132** extending along its upper surface for engagement with the grooved wheels **34** that support the assembly jig. The support rails extend from a loading station spaced from the nailing machine through the nailing machine structure to a downstream discharging location and are arranged at an elevation so as to bring the jig directly over a rigid anvil table **134** that is part of the nailing machine and upon which the nailing operation is accomplished. The drive means for the assembly jig is best shown in FIG. **2** and comprises a pneumatically operated cable cylinder **140** extending from the upstream end of one of the support rails to a position just short of the nailing machine. The cable cylinder includes a piston pneumatically movable within the cylindrical body portion and having a pair of cables **141** and **142** attached to each face thereof and extending out of the opposite ends of the body where they are trained over upright pulleys **144** as shown. Both of the cables are attached to a U-shaped bracket **146** which protrudes through an elongated slot **130***a* in one of the support members **130**. The bracket **146** in turn is rigidly secured to a strap **147** attached to the end frame member **32** at the trailing end of the jig. As air pressure is applied to one end of the cable cylinder and simultaneously exhausted from the opposite end, the piston will be caused to move toward the exhausting end of the cylinder and, by means of the cables, propel the assembly jig in the opposite direction along the conveyor tracks **132**. When the pressurizing and the exhausting relationship is reversed (by means to be described presently) in the cable cylinder, the direction of movement of the assembly jig will likewise be reversed.

The nailing machine **24** which is utilized with the assembly jig of the present invention may be any conventional industrial nailer wherein the workpiece to be nailed is conveyed horizontally through the machine and wherein plural nailing assemblies operate vertically over the workpiece, such as is shown in the U.S. Pat. No. 2,856,606 to Richards, for example. The nailing machine as shown in FIGS. **1** and **2** generally comprises a pair of upright side frame members **150** which straddle the jig conveyor structure **22** and mount for vertical movement a plurality of nail holding chucks **28**, each chuck being individually fed nails through overhead tubes **154**. The chucks are adjustably positioned laterally across the machine at properly spaced intervals so that an entire line of nails can be driven at the same time. The nails are forced out of the chucks and through the wood members on the jig by the vertically reciprocating, nailing head **26** which is slidably mounted upon track members **156** on the side frame members **150**. The nailing head carries a plurality of rodlike nail punches **159** which are each associated with a nail chuck and which reciprocate through the chuck to drive the nail therefrom. The nailing head is reciprocated vertically by means of a pivotally mounted drive arm **160** which is eccentrically mounted upon a large drive wheel **162** at the base of the machine. When it is desired to operate the nailing head the drive wheel is rotated through one revolution by means of a continuously operating drive motor M1, a drive chain **163**, and a continuously rotating tubular shaft **164** (FIG. **3**) which encloses a drive shaft **165** to which it is connected through a selectively energizable clutch mechanism **166** of conventional design. A brake mechanism **168** is provided to stop the drive shaft **165** when the drive wheel **162** has been rotated through one revolution.

Each of the nail-carrying chucks is supported upon a connecting bar **170** extending transversely across the machine, the connecting bar being also slidably supported upon the

nailing machine side frame members **150** in a manner of the nailing head **26**. The chuck connecting bar is supported from the nailing head by means of a pair of rods **172** at each side of the machine, the upper ends of which are slidably supported within the nailing head and include stop members **173**. When the nailing head moves downwardly the chucks will be carried with it until they strike the top of the structure to be nailed. The nailing head then continues its downward travel carrying the nail punches **159** through the chucks to drive the nails. The distance which the chucks will travel is just enough to allow ample clearance for the members in the jig, and in practicing the invention it is set at about three-fourths inches. For a further description of the structure and operation of the nailing machine, reference is made to the hereinbefore mentioned U.S. Pat. No. 2,856,606 to Richards.

The nailing machine **24** also includes the anvil table **134** which is located beneath the nail chucks **28** and between the conveyor frame members **130**. As best shown in FIG. **10**, the anvil table includes a pair of upright side plates **182** which are fixed in position. Between the side plates are mounted a plurality of vertically movable clincher heads **183** (FIG. **9**) each of the heads including abutment plates **184** and a pair of depending mounting arms **185** which are connected by pivot links **186** to a horizontally arranged slide bar **188**. The slide bar is arranged to be reciprocated horizontally along an axis extending transversely of the nailing machine and is supported for such movement upon a fixed frame member **189** which is rigid with the anvil table structure. A pair of pivot links **190** are rotatably attached to one end of the slide bar and are also rotatably connected to a rectangularly shaped slide box **192** which is also mounted for horizontal reciprocating movement in the nailing machine side frame structure in a direction at right angles to the slide bar.

It will be recognized that horizontal movement of the slide bar **188** in the direction shown by the arrow in FIG. **9** will cause the pivot links **186** to move into a more upright position and thereby raise the clincher heads **183**. In order to impart this movement to the slide bar a cam **194** is attached to the shaft carrying the main drive wheel **162** and is adapted to be rotated therewith as the drive wheel makes its single revolution during one of the nailing cycles. A cam follower **195** is arranged to ride upon the face of the cam and the follower is attached to a crank plate **196** which is mounted for pivotal movement about a fixed pin **197** attached to the adjacent machine frame structure. Crank plate **196** carries a second cam follower **198** which is arranged to engage the vertical face of the slide box **192**. It can be seen that the enlarged portion of the cam **194** will act upon the cam follower **195** to cause the crank plate **196** to rotate in a counterclockwise direction (as shown by the arrow in FIG. **9**) and thereby cause the cam follower **198** to shift the slide box **192**, which horizontal motion is transmitted to the slide bar **188** through the pivot links **190** to thereby raise the clincher heads. For a further description of the structure of the clincher heads and their operating mechanisms, reference is herein made to prior U.S. Pat. No. 2,686,911 to Richards.

The purpose of the powered clincher heads **183** is to activate the clincher assemblies **80** and to bend the lower ends of the nails which protrude through the deck mat flush with the lower stringer boards B of the block-type pallet assembly. This operation is shown somewhat diagrammatically in two steps in FIGS. **11** and **12**. After the pallet assembly has been moved into position directly beneath the nailing head **26** of the nailing machine, the chucks **28** are lowered to the upper surface of the deck boards C and the nails are driven out of the chucks by the descending nail punches **159**. Since the jig is mounted upon spring-loaded wheels **34**, the jig will be depressed by the force of the nailing head until the support rails **52** extending across the jig come into engagement with the side plates **182** of the anvil table as shown in FIGS. **11** and **12**. In practice the jig is depressed about one-sixteenth of an inch before the first engagement with the anvil table is made. Continued driving of the nails by the nail punches will force the nails through the overlying boards B and C and into engagement with the clincher plates **94** of the clincher assemblies **80**. The clincher plates and their depending flanges **98** are thereby lowered as shown in FIG. **11**. At the time when the nails are driven through the boards the clincher heads **183** on the nailing machine are adapted to be moved upwardly by the action of the rotating cam **194** as explained hereinbefore. The driven abutment plates **184** will then engage the depending flanges **98** and force the clincher plates **94** flat against the bottom face of the stringer board B as shown in FIG. **12**. The timing is such that the clincher heads are quickly raised during that portion of the operating cycle when the nail punches **159** are fully extended so that the nails will be held rigidly between the punches and the upwardly moving clincher heads and the protruding ends of the nails will be bent flat. As shown in FIG. **9**, a pair of return springs **199** are arranged between the fixed frame member **189** and the slide bar **188** so that the clincher heads will be returned to their lowered position upon the conclusion of the nailing cycle.

In order to accurately center the support members **50** of the jig under the nailing head **26**, a stop member **200** is provided (FIGS. **10**, **14** and **15**) which member is mounted for vertical extension so as to temporarily engage abutment members **202** that are provided upon the leading faces of the centrally located workpiece holding members **58** and **120** on the jig support members. The stop member is comprised of a shock absorber **204** having a retractable plunger **205** that extends into the path of the jig when the shock absorber is in its raised position as shown in phantom lines in FIG. **14**. The shock absorber is mounted upon a piston rod **207** which is received within an air cylinder **208**. By actuation of the pneumatic controls for the air cylinder (in a manner to be explained presently) one end thereof may be selectively pressurized and the shock absorber will be raised into the path of the jig. After the nailing operation is completed the pressurization of the cylinder **208** is reversed and the shock absorber will be lowered to allow the jig to resume its forward travel.

As the assembled pallet structure is propelled beneath the nailing machine **24** and under the fast moving nailing head **26** it has been found desirable to prevent the uppermost layer of boards from moving out of alignment as they are struck by the nailing head. For this purpose, a brush **210** is arranged to extend transversely of the nailing machine and just upstream thereof. The brush is mounted for free rotary movement upon a shaft **212** which is fixed to mounting plates **214** that are attached to the outer edges of the conveyor support rails **130**. The lower edge of the brush is set at an elevation such that it makes firm contact with the uppermost boards of the pallet structure to be nailed yet does not prevent the boards from moving into the nailing machine. By conventional means (not shown) the brush may be vertically adjusted so as to accommodate different sized pallets or other wood frame structures.

The pneumatic circuitry for operating the conveyor cable cylinder **140** and the jig stop member **200** is shown diagrammatically in FIG. **16**. The air supply to the cable cylinder is directed through a two-way supply valve V2 which is controlled by a solenoid SL–2 to either block the air or allow it to pass to the cylinder; the unenergized condition of solenoid SL–2 blocks the passage of air to the cylinder. A four-way valve V1 is also provided in the inlet line to the cable cylinder which valve is controlled by a solenoid SL–1; this valve permits air under pressure from the air supply to be introduced at a first end of the cable cylinder and exhausted from the second end, or it may reverse this arrangement and permit air to be introduced at the second end while it is exhausted from the first end. As shown in FIG. **16**, an adjustable flow control valve V3 is provided in one of the lines to the cable cylinder and it will be recognized that this line is the inlet or pressurizing line when the position of valve V1 is reversed from that shown in FIG. **16** wherein the cable **141** will be pulling the jig to the right; this condition of the pneumatic circuitry corresponds to the operating condition when the jig is being moved forwardly to the nailing machine. It will be recognized therefore that the

adjustable valve V3 can be used to control the forward speed of the jig. A dump valve V4 is also provided in series with the flow control valve V3 but in a position closer to the cable cylinder 140 so that the exhausting air from the cable cylinder may be dumped to atmosphere through the valve V4 rather than being discharged through valve V3. Consequently, when the jig is returned to the loading station it can be run at a much faster speed since both the pressurizing and exhausting lines will be free of restrictions. A separate air supply line is run through a four-way valve V5 controlled by a solenoid SL–3 to operate the pneumatic cylinder 208 which, in turn, actuates the piston rod 207 that controls the jig stop member 200. It can be seen that the position of the stop member will be determined by the energization or nonenergization of the controlling solenoid SL–3.

In describing the operation of the assembly jig of the present invention, reference is first made to the various switches and switch actuators which permit automatic operation. Limit switches LS–1, LS–2, and LS–3 are positioned upon one of the side frame members 150 of the nailing machine (FIG. 2) and are adapted to be actuated by a vertically reciprocating actuator 220 carried by the nailing head 26. In the upper, or normal, position of the nailing head, the upper switches LS–1 and LS–3 are engaged and the lower switch LS–2 is unenergized. A limit switch LS–4 is positioned at the loading station in a location to be engaged by the upstream end of the jig frame, as shown in FIGS. 1 and 3, and serves to stop the jig when it reaches the loading station during its rearward travel subsequent to the nailing operation. Limit switches LS–5 and LS–6 are positioned a short distance apart upon one of the brush mounting plates 214 at the side of the conveyor structure and are adapted to be actuated by switch actuators 230 which are situated upon and protrude laterally outwardly from one of the side frame members 30 of the jig. The switch actuators 230 are slidably mounted upon an angle member 231 on the top of the side frame member and are adjustably attached thereto (by means not shown). The limit switches LS–5 and LS–6 are used to control the operation of the stop member 200 and to initiate the nailing cycle, respectively. A final limit switch LS–7 is positioned at the discharge end of the conveyor structure in a position to be engaged by the leading end frame member 32 of the jig and serves to stop the jig and reverse its direction of movement to return it to the loading station upon the completion of the nailing operation.

Having physically located the various switches and switch actuating elements, the operation of the apparatus of the present invention will now be described particularly in connection with the electrical circuitry of FIG. 17. The numbers following the contacts "C" relate the contacts to the similarly numbered relays "RY" whose energization determines the position of the contacts—the contacts being shown in their "-normal" or unenergized condition.

Initially, the switch SW–1 is closed to provide electrical power for the circuit and the pushbutton switch P14 1 is depressed to energize relay RY–1 and actuate the drive motor M1 through the then closed contact C–1A. Holding contact C–1B will keep relay RY–1 energized throughout PB–operation of the apparatus so that the motor M1 will be continuously operated unless the stop pushbutton switch PB–2 is activated. Toggle switch SW–2 is also flipped to the "on" position so as to condition the nailing machine and the conveyor structure for operation.

Starting with the jig at the loading station, as shown in FIGS. 1, 2 or 3, it will be seen that the trailing end frame member 32 is in contact with the limit switch LS–4 to hold it open and to keep the relay RY–6 in its unenergized condition. During this quiescent period of indeterminate length the jig may be loaded from each side of the conveyor structure with the boards that make up the pallet assembly. After the jig has been loaded, the pushbutton PB–3 is actuated to close a circuit to the relay RY–6 which, in turn, closes the contact C–6B to complete a circuit through the solenoid SL–2. This shifts the blocking valve V2 to the right (as viewed in FIG. 16) and permits pressurizing air to be introduced to the conveyor cable cylinder 140. It will be noted that the closing of pushbutton PB–3 also completes a circuit through the relay RY–7 which closes the contact C–7A and completes a circuit to the relay SL–1 to shift the four-way valve V1 to the left (as viewed in FIG. 16) and thereby cause the pressurizing air to enter the cable cylinder from the right-hand end through the flow control valve V3; this moves the cable 142 to the right to pull the jig forwardly toward the nailing machine. When the pushbutton PB–3 is released after the jig starts its forward travel the holding contact C–6A will maintain the relay RY–6 energized through the now-closed limit switch LS–4 and the holding contact C–7B will maintain the circuit to the relay RY–7.

As the first of the transversely extending support members 50 on the jig approaches the nailing position above the anvil table 134, the first switch actuator 230 directly to the rear of that support member will be caused to engage first the limit switch LS–5 and, shortly thereafter, the limit switch LS–6. When the limit switch LS–5 is closed a circuit is completed to the relay RY–8 which closes contact C–8B to complete a circuit to solenoid SL–3. The solenoid SL–3 shifts the four-way valve V5 to the left (as viewed in FIG. 16) to reverse the direction of the air pressure within the cylinder 208 and move the piston rod 207 upwardly. This places the stop member 200 into position to be contacted by the abutment 202 on the support member 50 to thereby position the support member directly beneath the nailing head. At approximately the same time that the jig is stopped by the stop member 200, the limit switch LS–6 is actuated. Upon actuation of the limit switch LS–6 a contact LS–6B thereof will close to complete a circuit through the relay RY–4. This, in turn, closes time delay contact C–4 to complete a circuit to the relay RY–3 and the relay RY–5. With the energization of relay RY–5 the contact C–5A is closed to activate the clutch mechanism 166 through its control solenoid SL–4 and the contact C–5B is opened to deactivate the brake 168 through its control solenoid SL–5. The drive wheel 162 is now directly connected with the motor M1 and begins its single driving revolution to lower the nailing head 26 and the nail chucks 28 to accomplish the nailing operation as aforedescribed.

As the nailing head starts its downward stroke the uppermost limit switch LS–3 on the nailing machine is opened and the circuit to the solenoid SL–2 controlling the two-way air valve V2 is deenergized. This blocks air flow to the conveyor cable cylinder 140. The upper limit switch LS–1 on the nailing machine will be allowed to close as the nailing head moves downwardly to maintain the circuit to the relays RY–3 and RY–5 during the nailing cycle. When the nailing head reaches the lowermost position to drive the row of nails through the boards on the jig, the lower limit switch LS–2 on the machine frame is opened. A first contact of this switch LS–2A opens to break the circuit to relay RY–2 and condition relays RY–3 and RY–5 for deenergization although these relays will remain energized as long as the upper limit switch LS–1 remains closed. A second contact, LS–2B, of limit switch LS–2 also opens when the nailing head reaches its lowermost level to break the circuit to the relay RY–8. This opens contact C–8B and deenergizes solenoid SL–3 to shift the four-way pneumatic control valve V5 and lower the stop member 200 from its position in abutment with the jig.

As the drive wheel 162 completes its one revolution and the nailing head returns to its normal elevated position, the upper limit switch LS–1 is again opened to break the circuit to the relays RY–3 and RY–5. This opens contact C–5A and closes contact C–5B to deenergize the clutch mechanism through its control solenoid SL–4 and to energize the brake mechanism through its control solenoid SL–5 to bring the rotating drive shaft 165 to stop. The uppermost limit switch LS–3 is also closed to complete a circuit to the solenoid SL–2 which shifts the pneumatic control valve V2 and permits the conveyor to be again moved forwardly. The conveyor will move until the switch actuator 230 adjacent to the second support member 50 of the jig energizes the limit switches LS–5 and LS–6 at

which time the aforedescribed operation is repeated. It will be evident that the described operation will take place as each of the switch actuators 230, in turn, actuates the switches LS–5 and LS–6 to stop the conveyor and initiate one complete cycle of the nailing operation.

Upon the completion of the nailing of the pallet structure, the jig will travel under the nailing machine until the front or leading end frame member 32 engages and opens the limit switch LS–7. This causes the relay RY–7 to be deenergized and opens the contact C–7A breaking the circuit to the solenoid SL–1. With the deenergization of the solenoid SL–1, the four-way operating valve V1 for the cable cylinder is reversed in position so that pressurizing air will be provided at the left end of the cylinder (as viewed in FIG. 16) and will be exhausted from the right end of the cylinder to move the jig rearwardly back to the loading station. Since the dump valve V4 is provided in the exhausting line from the cable cylinder the rearward travel of the jig may be at a much faster rate than the forward travel.

The jig will move rearwardly until the end frame member 32 engages the limit switch LS–4 to open it and deenergize the relay RY–6. This opens the contact C–6B and deenergizers solenoid SL–2 which stops the movement of the conveyor by blocking the air flow to the cable cylinder as previously explained. The jig is now in a position to be unloaded and reloaded and awaits subsequent starting by depressing the push-button PB–1. If desired, the jig may be unloaded at the downstream end of the conveyor structure before returning to the loading station.

While the assembly jig of the present invention has been described in connection with the construction of a block-type or stringer-type pallet, it will be apparent that other wood frame structures of broadly similar design, such as bed spring frames, crates, prefabricated frame structures, etc., might also be assembled for nailing with the present invention.

From the foregoing description it will be apparent that the jig of the present invention is designed for a versatile operation wherein it can handle both a block-type pallet and a stringer-type pallet with but an easily accomplished change in the workpiece holding components. The basic assembly jig is readily adjustable for different sizes of structures without being complex or unwieldy. Furthermore, the nailing operation can be completed on a block-type pallet including a clinching of the nails through the deck mat which is unsupported by the blocks by means of the novel clinching assemblies which are arranged to operate with and be controlled by a standard clinching mechanism found in industrial nailing machines.

Although the best mode contemplated for carrying out the present invention as has been herein shown and described, it will be apparent that modification and variation may be made without departing from what is regarded to be the subject matter of the invention.

I claim:

1. An assembly jig for the positioning of overlying wood frame members prior to nailing, said jig comprising a rectangular frame structure; conveying means mounted upon the underside of said frame structure to adapt it for movement over a horizontally arranged conveying surface and beneath an automatic nailing machine; a plurality of support members extending transversely of said frame structure; means mounting the ends of said support members to said frame structure for adjustment longitudinally thereof; and a plurality of workpiece holding members mounted upon each of said support members for adjustment transversely of said frame structure, said workpiece holding members including clincher devices for yieldably supporting a pair of overlying wooden pieces and for permitting a nail to be driven through said wooden pieces from above and to be bent into flat engagement with the underside of the lowermost piece; said clincher devices comprising a fixed frame structure, a flat plate for engagement with the lowermost of said wooden pieces, and spring means yieldably supporting said plate within said fixed frame structure.

2. An assembly jig and conveyor structure for the positioning of the individual members of a wood frame assembly and the conveying of said assembly beneath an automatic nailing machine where it can be nailed together, said structure comprising a pair of elongate frame members extending in parallel spaced relationship, a track arranged along the upper side of each frame member, a rectangular jig frame structure, means for mounting said jig frame structure upon said tracks, a plurality of support members extending transversely of said frame structure, means mounting the ends of said support members to said jig frame structure for adjustment longitudinally thereof, a plurality of workpiece holding members mounted upon each of said support members for adjustment transversely of said frame structure, power means for propelling the jig along said tracks, switch means engageable with a portion of said jig for disengaging said power means from said jig in order to cause it to come to a stop when one of said support members is located directly beneath the nailing heads of said automatic nailing machine, a stop member, and means for elevating said stop member into the path of said jig for engagement with one of said support members to position it beneath said nailing heads, said elevating means being energized by said switch means.

3. An assembly jig and conveyor structure for the positioning of the individual members of a wood frame assembly and the conveying of said assembly beneath an automatic nailing machine where it can be nailed together, said structure comprising a pair of elongate frame members extending in parallel spaced relationship, a track arranged along the upper side of each frame member, a rectangular jig frame structure, means for mounting said jig frame structure upon said tracks including a plurality of track engaging elements and spring means for resiliently supporting each of said track engaging elements from said jig frame structure whereby said jig will be caused to lower under the impact of the nailing heads until it can be engaged by an anvil so that the nailing forces will not be transmitted through said track engaging elements to said elongate frame members, a plurality of support members extending transversely of said frame structure, means mounting the ends of said support members to said jig frame structure for adjustment longitudinally thereof, a plurality of workpiece holding members mounted upon each of said support members for adjustment transversely of said frame structure, power means for propelling the jig along said tracks, and switch means engageable with a portion of said jig for disengaging said power means from said jig in order to cause it to come to a stop when one of said support members is located directly beneath the nailing heads of said automatic nailing machine.

4. An assembly jig and conveyor structure for the positioning of the individual members of a wood frame assembly and the conveying of said assembly beneath an automatic nailing machine where it can be nailed together, said structure comprising a pair of elongate frame members extending in parallel spaced relationship, a track arranged along the upper side of each frame member, a rectangular jig frame structure, means for mounting said jig frame structure upon said tracks, a plurality of support members extending transversely of said frame structure, means mounting the ends of said support members to said jig frame structure for adjustment longitudinally thereof, a plurality of workpiece holding members mounted upon each of said support members for adjustment transversely of said frame structure, power means for propelling the jig along said tracks, switch means engageable with a portion of said jig for disengaging said power means from said jig in order to cause it to come to a stop when one of said support members is located directly beneath the nailing heads of said automatic nailing machine, and a rotatably mounted brush positioned above said tracks and transversely thereof slightly upstream of said nailing machine, said brush being engageable with said members of said wood frame assembly to hold them in place while they are being nailed together.

5. An assembly jig for the positioning of overlying wood frame members prior to nailing; said jig comprising a rectangular frame structure; conveying means mounted upon the un-

derside of said frame structure to adapt it for movement over a horizontally arranged conveying surface and beneath an automatic nailing machine; a plurality of support members extending transversely of said frame structure; means mounting the ends of said support members to said frame structure for adjustment longitudinally thereof; and a plurality of workpiece holding members mounted upon each of said support members for adjustment transversely of said frame structure, at least to of said workpiece holding members on each of said support members including a pair of opposed upright flanges for receiving a wood frame member therebetween that is extending in the direction of said support member.

6. An assembly jig as set forth in claim 1 wherein each of said workpiece holding members comprises a flat base portion, upright portions mounted upon said base portion to provide a pocket for reception of a wood frame member, a pair of flanges mounted in parallel relation to said base at the opposite side edges thereof, and means for clamping said support member between said base portion and said flanges, said last names means being releasable in order to permit said workpiece holding member to be slid along said support member to a new position when said jig is adjusted for handling a new wood frame structure.

7. An assembly jig as set forth in claim 1 including a rod extending transversely of said jig above and spaced from the plane of said support members, and a plurality of spacer members slidably adjustably mounted upon said rod for providing abutments for the top boards of said wood frame members to aid in their alignment upon said jig.

8. An assembly jig as set forth in claim 1 including a rigid flange depending vertically from said flat plate, the lowermost edge of said flange being at a lower elevation than said jig frame when said plate is depressed by the protruding lower end of a nail whereby said end of said flange is adapted to be engaged by an upwardly moving force producing member to bend said end of the nail flat against the lowermost of said wooden pieces.

9. An assembly jig as set forth in claim 8, said workpiece holding members also including upright gripping members for releasably holding a wooden block upon which said overlying wooden pieces are supported, said upright gripping members being spaced from and alternating with said clincher devices along the length of the associated support member.

10. An assembly jig for the positioning of overlying wood frame members prior to nailing, said jig comprising a frame structure, a plurality of support members extending in parallel relationship across said frame structure, each of said support members having a plurality of upright gripping members mounted thereon in spaced relationship for releasably holding wooden blocks, and clincher devices mounted upon said support members in spaced positions between said gripping members for supporting a pair of overlying wooden pieces which are also supported upon said blocks, each of said clincher devices being yieldably mounted upon its associated support member so that a nail which is driven through said overlying wooden pieces will be permitted to protrude through the lowermost of said pieces.

11. An assembly jig as set forth in claim 10 wherein each of said clincher devices comprises a fixed frame structure, a flat plate for engagement with the lowermost of said wooden pieces, and spring means yieldably supporting said plate within said fixed frame structure.

12. An assembly jig as set forth in claim 11 including a rigid flange depending vertically from said flat plate, the lowermost edge of said flange being at a lower elevation than said jig frame when said plate is depressed by the end of the nail which is driven through said wooden pieces whereby said end of said flange is adapted to be engaged by an upwardly moving force producing means to bend said end of the nail flat against the lowermost of said wooden pieces.

13. An assembly jig and conveyor structure as set forth in claim 2 wherein said switch means includes a first switch for disengaging said power means and a second switch spaced upstream from said first switch for energizing said elevating means.

PO-1050
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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,591,067 Dated July 6, 1971

Inventor(s) GARYE R. VIAL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 9, line 56, change "P141" to --PB-1--. Column 9, line 59, "PB-" should be --the--. Column 13, line 20, "names" should be --named--.

Signed and sealed this 4th day of July 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents