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MATERIAL HANDLING AND NAILING APPARATUS

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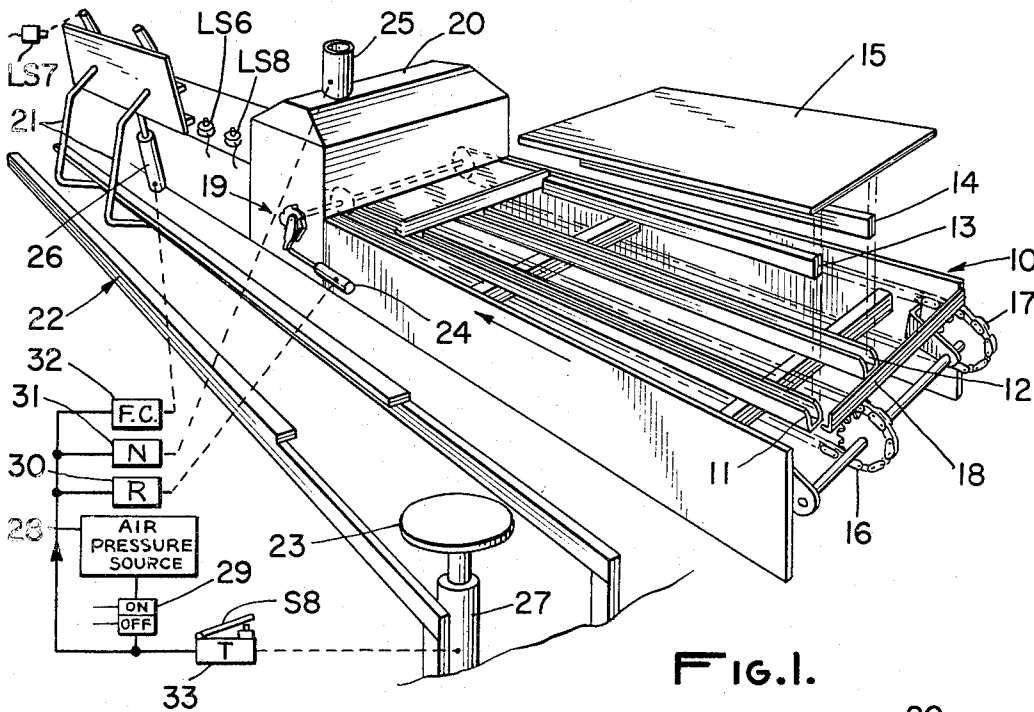


FIG. 1.

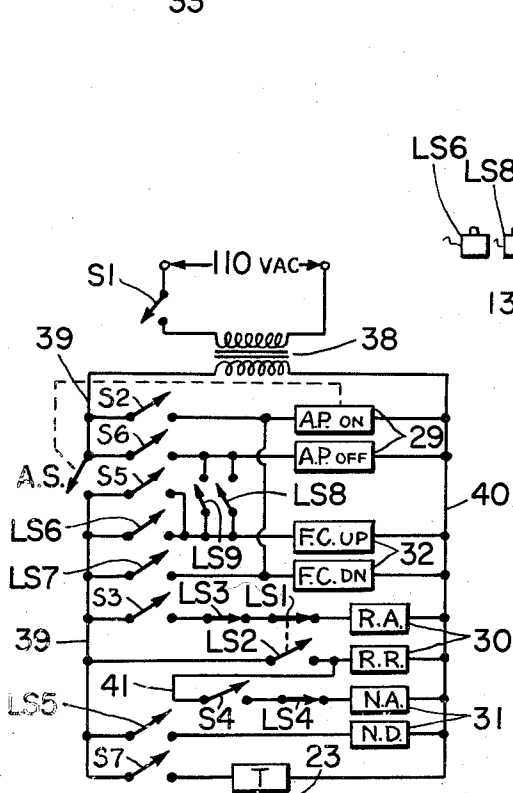


FIG. 3.

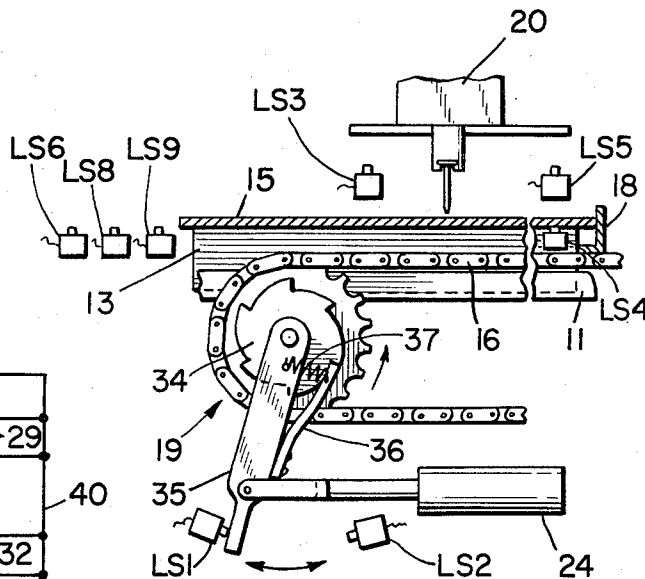


FIG. 2.

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MATERIAL HANDLING AND NAILING APPARATUS

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5 Claims

ABSTRACT OF THE DISCLOSURE

This disclosure relates to a structure for automatically conveying and nailing panels and rafters or runners together in a uniform and consistent manner to form prefabricated roofing sections. The panel and runners are simultaneously moved along a conveyor under a nailing machine which successively drives nails through the top of the panel into the runners at consistently spaced intervals. After the nailed members have reached the end of the conveyor, they are removed by a flipping conveyor, the arrangement being such that a continuous operation on a plurality of sets of members is automatically carried out. The apparatus also includes various safety features to prevent operation of the automatic nailer in the absence of any members to be nailed together and also suitable means for shutting down the system should a jam occur on the conveyor.

This invention relates generally to material handling apparatus and more particularly to a novel material handling and nailing apparatus in combination for providing prefabricated products employed in construction work.

It is now common practice in commercial construction of warehouses, storage buildings, and the like to prefabricate many of the components making up the structure. For example, the roofing for these structures generally includes plywood panels secured to suitable rafters (usually two-by-fours) which in turn are secured to main cross beams by metal brackets known as hangers. Roof panels of this type may very easily be prefabricated by nailing the plywood to the two-by-four runners or rafters in a central shop and securing the metal hangers to the corners or ends of the runners. Several such panels may be made up and then transported to the building site. The panels may then readily be installed.

The advantage of prefabricating the panels is that the nailing of the plywood to the rafters or runners can more easily be carried out. In this respect, it will be appreciated that constructing such panels on the job can be difficult since the rafters are hidden from a carpenter on the roof by the plywood and it is difficult for the carpenter to know exactly the proper placement of nails to be assured that the nail will pass into the two-by-four runners.

While a considerable savings is achieved by prefabricating the panels, there is still considerable material handling and labor problems involved in the prefabrication process itself.

With the foregoing in mind, it is a primary object of the present invention to provide a material handling and automatic nailing apparatus capable of nailing two or more members together such as a plywood panel and the cooperating two-by-four rafters all in an automatic manner to the end that greater efficiency insofar as cost and labor is concerned when prefabricating roof panels or similar products is realized.

More particularly, it is an object to provide a material handling and nailing apparatus which will automatically and successively preform roof panels with runners in a

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controlled manner so that the only labor required is simply to feed the apparatus from a supply of materials and thence remove the prefabricated products.

Another object is to provide means in combination with the material handling and nailing apparatus to facilitate the manual attachment of hangers to the prefabricated roof panels.

Briefly, these and other objects and advantages of this invention are attained by providing a basic conveyor means for moving the plywood panel and cooperating runners in a given direction. A nailing means in turn is provided for driving nails into the panel and runners when the same are positioned under the nailing means to receive the nails. In this respect, the conveyor is operated by a ratchet mechanism such that it will move given distances each time it is actuated. The nailing means in turn is arranged to drive one or more nails simultaneously each time it is actuated. A control means is provided interconnecting the conveyor means and nailing means such that the nailing means is automatically actuated in response to completion of movement of the members by the conveyor means and the conveyor means is automatically actuated in response to the completion of the nailing of a nail or nails by the nailing means such that the members may be automatically nailed together by nails evenly spaced along the members at the referred to given distance.

At the end of the conveyor means there is provided a flipping conveyor which will remove nailed members so that a continuous succession of sets of members may continue along the conveyor means in an uninterrupted manner.

The control means also includes suitable safety means for preventing operation of the nailing means in the absence of members to be nailed together in position under the nailing means and also for shutting down the entire system in the event that a jam is imminent.

The invention also contemplates the provision of a turntable for receiving the nailed panels after they have been removed by the flipping conveyor to facilitate proper positioning of the panels for manually securing metal hangers to the runners. This latter feature is optional since in many instances the turntable is unnecessary as two or more persons may simultaneously secure the hangers.

The entire apparatus is operated by air pressure, the control means including electrically operated solenoid valves for controlling the air pressure in a manner to actuate the various components in the desired sequence.

A better understanding of the invention will be had by now referring to a preferred embodiment thereof as illustrated in the accompanying drawings, in which:

FIGURE 1 is a highly schematic perspective view illustrating the basic material handling and nailing apparatus of this invention;

FIGURE 2 is a schematic side elevational view of a portion of the structure of FIGURE 1 showing some details of the automatic nailing means and ratchet mechanism for moving the main conveyor; and

FIGURE 3 is a schematic electrical ladder diagram of the control means for the apparatus useful in explaining the operation of the invention.

Referring first to FIGURE 1, there is provided a main conveyor means 10 including channels or troughs such as indicated at 11 and 12 for receiving suitable rafters or runners in the form of two-by-fours 13 and 14. A plywood panel illustrated at 15 above the rafters 13 and 14 is arranged to simply rest on top of these rafters when the same are received in the troughs or channels 11 and 12. In this respect, the conveyor 10 may include suitable side flanges for guiding movement of the rafters and plywood 15 along the conveyor.

As illustrated schematically in FIGURE 1, the driving means for the conveyor includes sprocket type chains 16 and 17 provided with cross push bars 18. Preferably, six such cross bars are provided in an actual embodiment. These cross bars will engage the upper edges of the two-by-four rafters 13 and 14 and the end edge of the panel 15 above the edges of the troughs 11 and 12 and it will be evident that movement of the chains will move the cross pieces 18 down the conveyor in such a manner that successive sets of members comprising the plywood panel 15 and runners 13 and 14 may be positioned on the conveyor to be engaged by the respective cross bars. In this respect, the chains for moving the cross bars are operated by a ratchet mechanism designated generally by the numeral 19 such that the panel members and runners will move through a given distance each time the ratchet mechanism is actuated.

As illustrated in FIGURE 1, there is provided an automatic nailing means 20 in a position such that the various plywood panel members and runners pass beneath suitable nailing heads in the nailer. This nailing means will drive one or more nails through the top of the plywood panel 10 into the corresponding rafters simultaneously. As the conveyor is moved through a given distance, the nailing means is again actuated to drive another set of nails through the plywood and this operation is continued so that a row of nails is provided evenly spaced.

The nailed members in the form of plywood and runners then pass to a flipping conveyor designated generally by the numeral 21 which removes the nailed members from the end of the main conveyor 10. In the particular embodiment illustrated, the flipped members are received on a gravity type conveyor 22 such that the same will roll down the conveyor to a turntable 23.

The turntable 23 simply permits a single worker standing adjacent to the table to manually nail hangers onto the ends of the runners of the plywood and then rotate the plywood one hundred and eighty degrees so that he can nail similar hangers on the opposite ends of the runners.

The conveyor means 10 itself is operated, as mentioned by the ratchet structure 19 and in this respect, there is provided an air cylinder 24 coupled to the ratchet means and arranged to reciprocate the ratchet means in a manner to move the cross bars 18 on the conveyor chains a given distance each time the air cylinder 24 is actuated.

Similarly, the nailing means 20 is actuated by one or more air cylinders depending upon the number of nailing structures provided. In the particular example illustrated, there would be two air cylinders which may be connected in parallel for simultaneous actuation for driving nails simultaneously into the rafters 13 and 14 respectively. For simplicity in describing the invention, only one nailing actuating air cylinder 25 is shown.

The flipping conveyor 21 is actuated by an air cylinder 26 and the turntable 23 is actuated by an air cylinder 27.

As indicated schematically in FIGURE 1, these cylinders are supplied from an air pressure source 28 indicated to the left of the drawing which passes through a main line incorporating an on-off air switch control 29. The air then passes through suitable solenoid control valves indicated schematically at 30, 31, and 32 for the ratchet structure of the conveyor, the nailing means, and the flipping conveyor. These solenoid valves are designated also by the letters R, N, and FC respectively. In addition, air from the air pressure source passes through a foot operated solenoid valve control 33 also designated T to actuate the air cylinder 27 for the turntable 23.

Referring now to FIGURE 2, details of the conveyor driving ratchet structure will be described. As shown, there is provided a main ratchet wheel 34 connected directly to the driving wheel for the chain 16. The shaft of this ratchet wheel pivotally supports a laterally extending bar 35 in turn supporting one end of a pawl structure 36. A spring 37 biases the pawl 36 such that the end of the

pawl will be received in one of the various ratchets of the ratchet wheel 34. The lower end of the bar 35 connects to the piston rod for the ratchet control cylinder 24.

With the foregoing arrangement, it will be evident that reciprocating action of the ratchet cylinder piston rod will swing the actuating bar 35 in such a manner that the pawl 36 can successively engage the ratchet wheel 34 to effect a forward motion of the chain 16 through discrete distances each time the cylinder 24 is actuated.

The various solenoid control valves for the air pressure system described in FIGURE 1 are electrically operated and are under the control of various limit switches. The physical positions of these limit switches are schematically illustrated in both FIGURES 1 and 2. For example, in FIGURE 2, there are shown at the lower end of the drawing two limit switches LS1 and LS2. These switches are so positioned that the switch LS1 will be engaged by the ratchet bar structure 35 when the ratchet is in one extreme position and the limit switch LS2 will be engaged when the ratchet is in its opposite extreme position; that is, after completion of movement of the conveyor chain 16 and thus the members by means of the cross bar 18, through a given distance.

As also illustrated in FIGURE 2, there is provided a limit switch LS3 which is engaged when the nailing means is in its down position or after a nail has been driven into the plywood 15 and associated runner 13. A limit switch LS4 in turn is positioned to be closed only when the members to be nailed are under the nailing means. A further control limit switch LS5 is positioned to also be engaged by the nailer 20 after the nail has been driven into the members to deactivate the nailer.

As illustrated in both FIGURES 1 and 2, there is provided a limit switch LS6 responsive to the presence of material at the end of the conveyor for actuating the flipping conveyor 21. In FIGURE 1, it will be noted that there is provided another limit switch LS7 positioned to be engaged by the flipping conveyor 21 when the same has completed its flipping of the members to an upside down position, which limit switch serves to return the flipping conveyor to its initial position preparatory to flipping another set of members when the same close the limit switch LS6.

Finally, there are provided limit switches LS8 and LS9 positioned between the nailing means 20 of FIGURE 1 and the flipping conveyor 21 of FIGURE 1 and responsive to the presence of a panel disposed between the nailer and the flipping conveyor to close down the system in the event that there is still a panel on the flipping conveyor which has not been removed. As will become clearer when the operation is described, these last switches prevent jamming of the successive sets of members as they pass down the conveyor line after being nailed together.

The interconnections of the various limit switches as well as further power switches constituting a control means for the conveyor, nailing means, flipping conveyor, and turntable will be understood by now referring to the electrical ladder diagram of FIGURE 3.

As shown in FIGURE 3, the control system is powered from a conventional 110 volt AC supply connected through a main power switch S1 to the primary of a step-down transformer 38. The secondary of the transformer 38 has two power lines designated 39 and 40 constituting the sides of the ladder diagram.

A suitable series of control switches are provided in addition to the main power switch S1. The first of these switches is illustrated at S2 and connects to the main air pressure supply on-off control 29 as described in conjunction with FIGURE 1. Energization of the air pressure on supply automatically closes an air supply switch AS in the power line 39.

The ratchet advance and ratchet retract mechanism control solenoids for the ratchet cylinder 24 to drive the conveyor are designated by the numeral 30 in FIGURE

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3. The ratchet advance control is energized by a switch S3 extending from the power line 39 in series with the limit switches LS3 and LS1 to the ratchet advance RA and power line 40. The limit switch LS2 connects between the power line 39 and the ratchet retract control solenoid RR to the line 40. A branch lead 41 following the limit switch LS2 passes through a switch S4 to the limit switch LS4 and then through the nailing actuating control 31 designated NA to the power line 40. The nailing deactuating control limit switch LS5 is shown extending from the line 39 through this control ND to the power line 40.

Referring to the upper portion of the ladder diagram, a switch S5 serves to connect energy from the line 39 through the flipping conveyor FC to enable manual raising of this flipping conveyor by means of this switch. Similarly, a switch S6 above the switch S5 connects from the line 39 through the air pressure control AP-off constituting part of the on-off controlling switches 29 for enabling manual shutting off of the air supply system.

Finally, at the bottom of the diagram there is provided a switch S7 which may be foot operated for raising the turntable 23 to an up position wherein the members resting thereon can readily be manually rotated.

The various other limit switches described in FIGURES 1 and 2 connect between the various power lines 39 and 40 in series and parallel with the various solenoid controls as illustrated in FIGURE 3.

With the overall description of the various components in mind, the entire operation of the material handling and nailing apparatus will now be described. Initially, a worker will position the runners 13 and 14 in the troughs or channels 11 and 12 and then position a plywood panel 15 on top of these rafters. The main power switch S1 of FIGURE 3 is then closed and thereafter the switch S2 is closed to energize the air pressure supply. Operation of this air pressure supply will close the air pressure switch AS shown in the power line 39.

If now the operator closes the switch S3, energy will pass from the power line 39 through the normally closed limit switch LS3 and the limit switch LS1 also shown in closed position to actuate the RA solenoid control for the ratchet cylinder 24.

With reference again to FIGURE 3, the operator will close the switch S4 to place the nailing means in a ready condition. When the limit switch LS2 is closed by the bar 35, energy can pass from the power line 39 through the closed limit switch LS2 which will then actuate the ratchet retract mechanism RR and return the pawl to the position illustrated in FIGURE 2. Also, current will pass through the limit switch LS2 and the branch line 41 through switch S4 and thence the limit switch LS4 to the nailer actuator NA. The presence of the plywood panel and runners under the nailer holds the switch LS4 closed as illustrated in FIGURE 2 so that the nailer will be actuated to drive nails into the materials. When a first set of nails has been driven, the limit switch LS5 is engaged and closed thereby permitting energy from the line 39, as illustrated in FIGURE 3, to pass through the nailer deactuating solenoid and thus raise the nailer heads preparatory to a subsequent nailing operation. By this time, the ratchet return has opened the limit switch LS2 which effectively prevents any further actuation of the nailer actuator NA and closed the limit switch LS1 to again actuate the ratchet advance cylinder 24 and move the members through a given distance. The foregoing cycle is then repeated and another set of nails is driven through the plywood to the rafters. Nails are thus evenly distributed longitudinally along the edges of the plywood into the rafters.

The foregoing process will continue until the limit switch LS4 automatically opens as a result of the end of the material leaving its position under the nailing head. The conveyor can continue to operate but the nailer will not operate until such time as the limit switch LS4 is

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again closed by a next set of members to be nailed together. The next set of members corresponding to the plywood 15 and runners 13 and 14 can be assembled on the conveyor while the first set is being nailed and this next set will then be conveyed under the nailer in succession by the next cross bar corresponding to the cross bar 18 in FIGURE 1.

The nailed members leaving the nailing means 20 then pass over the limit switches LS8 and LS9 closing these limit switches but as the conveyor keeps moving, the limit switches LS8 and LS9 will be left behind and thus will open again before the material reaches the limit switch LS6 for the flipping conveyor. Closing of this latter limit switch, again with reference to FIGURE 3, will result in energy from the line 39 passing through the closed limit switch LS6 and through the flipping conveyor up control to the line 40. The flipping conveyor 21 illustrated in FIGURE 1 will thus flip the nailed together members onto the return conveyor 22.

As described heretofore, the up position of the flipping conveyor closes the limit switch LS7 which, as illustrated in FIGURE 3, will then energize the down control FCDN for the cylinder 26 to move the flipping conveyor in the opposite direction and lower the same.

When the upside down members are received on the return conveyor 22, they fall by gravity to the turntable 23. An operator standing adjacent to this turntable may fix hangers to the ends of the runners at one end of the panel and then by his foot depress the switch S7 which will raise the turntable 23 by means of the air cylinder 27 and enable him to rotate the members one hundred and eighty degrees. He may then conveniently nail hangers on the opposite ends of the two-by-fours. The completed prefabricated members may then be removed from the turntable and the operator will release pressure on the switch S7 so that the turntable 23 will be lowered preparatory to receiving another panel.

In the event that the flipping conveyor 21 should not function properly to remove a set of nailed members from the end of the conveyor, the safety limit switches LS8 and LS9 as described and as shown in FIGURE 3 will prevent a jam by closing down the air supply system. Thus, assume that a panel is positioned between the nailer and the flipping conveyor to hold the switches LS8 or LS9 closed and there is also an unremoved panel on the flipping conveyor which is holding LS6 closed. In this case, current from the line 39 will pass directly through the closed limit switch LS6 and one or the other or both of the closed limit switches LS8 and LS9 to the air pressure off solenoid AP-off to the line 40 thereby turning off the air pressure supply. When the air pressure supply is turned off, the air switch AS opens this removing energy from the line 39 to the various other components of the system. Thus, the entire air pressure system is shut down and a jamming of the members at the end of the conveyor is avoided.

With the air pressure system shut down, the jamming members are removed and the switch S2 is then closed to energize the air pressure system again which action will close the air switch AS so that air is supplied to the structure. The flipping conveyor may be cleared by manually closing the switch S5 and then closing the other switches as required in accordance with the heretofore described sequence.

From the foregoing description, it will thus be evident that the present invention has provided a novel material handling and automatic nailing apparatus wherein a completely automatic operation is carried out for a succession of members to be nailed together to result in prefabricated products at the end of the conveyor system.

It should be noted that it is not possible for the nailing means 20 to be operated unless there is material to be nailed together present under the nailing means. Further, it will be evident that it is not possible for the conveyor to move during a nailing operation as a consequence

of opening of the limit switch LS3 when the nailing heads are in their down position. Thus, during a nailing operation, the ratchet advance and retract mechanism is de-energized and during a conveyor moving operation wherein the ratchet advance or ratchet retract is energized, the nailing apparatus cannot be operated. In another sense, the nailer is responsive to completion of movement of the conveyor, this completion resulting in the closing of the limit switch LS2 which supplies energy to the nailer. In the same sense, the ratchet mechanism is responsive to the completion of a nailing operation wherein the limit switch LS3 is permitted to return to its closed position.

It will be realized accordingly, that all of the various objects and advantages of this invention have been fully realized.

What is claimed is:

1. A material handling and nailing system comprising, in combination:

- (a) conveyor means for moving at least two overlapping members to be nailed together a given distance each time said conveyor means is actuated;
- (b) nailing means for driving at least one nail into said members each time said nailing means is actuated;
- (c) control means interconnected with said conveyor means and said nailing means is automatically actuated in response to completion of movement of said members by said conveyor means and said conveyor means is automatically actuated in response to the completion of the driving of a nail by said nailing means; and
- (d) a flipping conveyor positioned to receive said members after they have passed said nailing means and moved to a downstream station from said conveyor means, the flipping conveyor being responsive to the presence of said members to remove said members from said downstream station,

whereby a plurality of sets of members to be nailed may be successively placed on said conveyor means, automatically nailed together by nails evenly spaced along said members by said given distance, and, automatically removed by the flipping conveyor from said downstream station after the nailing of each set is completed.

2. The subject matter of claim 1, in which said control means includes means for preventing actuation of said nailing means in response to the absence of members on said conveyor means in a position to receive nails from said nailing means.

3. The subject matter of claim 1, in which said control means includes means responsive to the presence of a set of said members on said flipping conveyor and the simultaneous presence of a set of members between said nailing means and said flipping conveyor for automatically de-energizing said system so that said conveyor means and nailing means can no longer be actuated until said set of members on said flipping conveyor means is removed whereby jamming together of successive sets of members at the end of said conveyor means is avoided.

4. The subject matter of claim 1, in which said conveyor means and nailing means are powered by air pressure, said control means including solenoid valves electrically controlled by limit switches for controlling said air pressure to actuate said conveyor means and nailing means.

5. The subject matter of claim 1, including a gravity feed return conveyor for receiving members from said flipping conveyor; and a turntable positioned to receive members from said return conveyor, said control means including means for raising said turntable to enable a worker to rotate said members 180° and thereby facilitate fixing hangers to opposite ends of certain of said members.

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