Aug. 20, 1957 C. L. EDDLEBLUTE 2,803,012

CONTROL SYSTEM

Filed Dec. 29, 1955 3 Sheets-Sheet 1

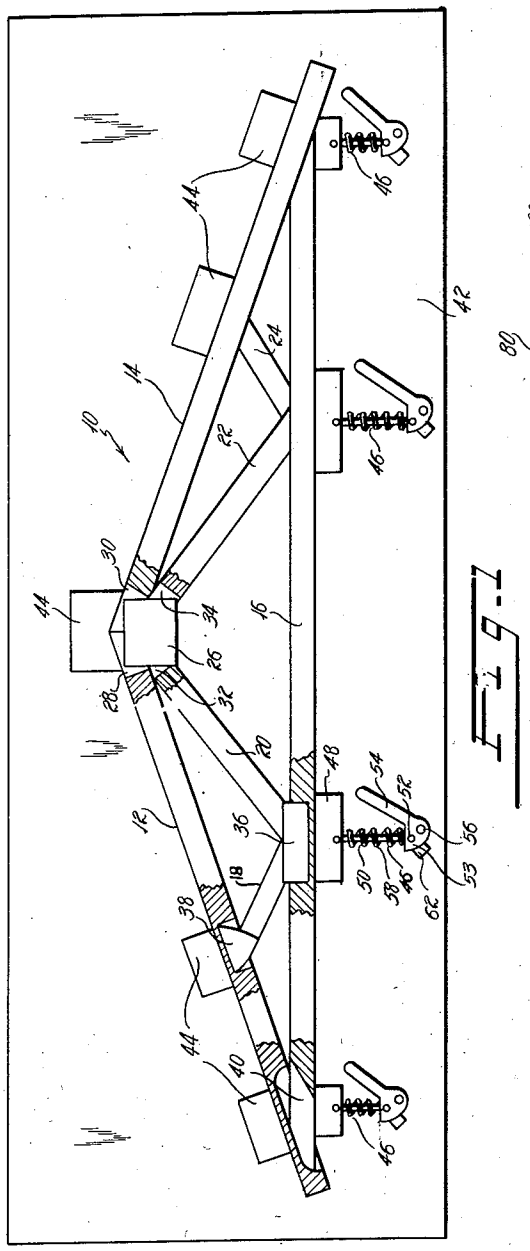


FIG. 1

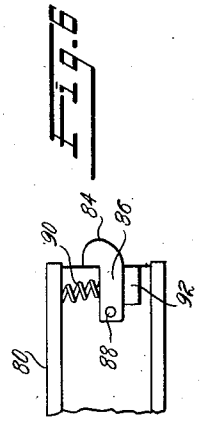


FIG. 3

FIG. 2

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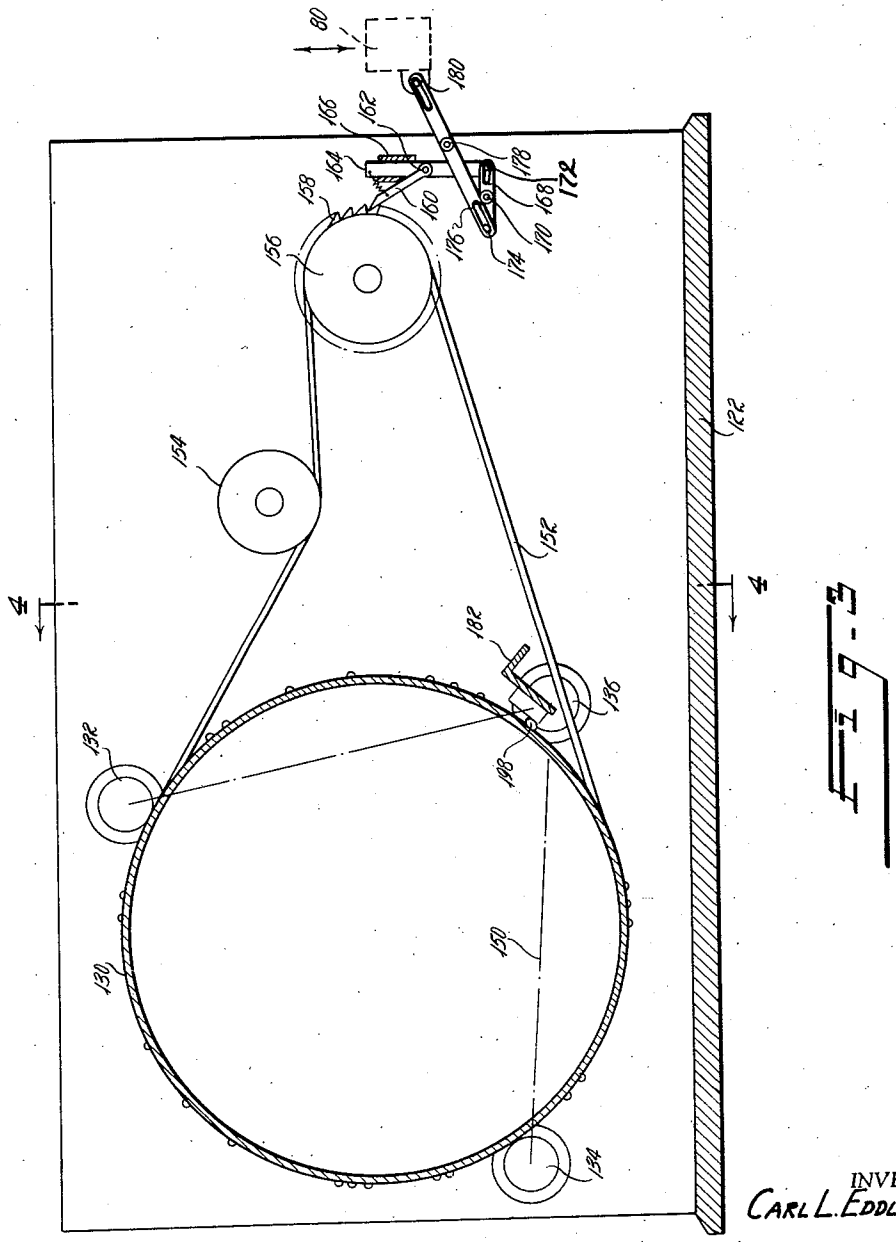


FIG. 3

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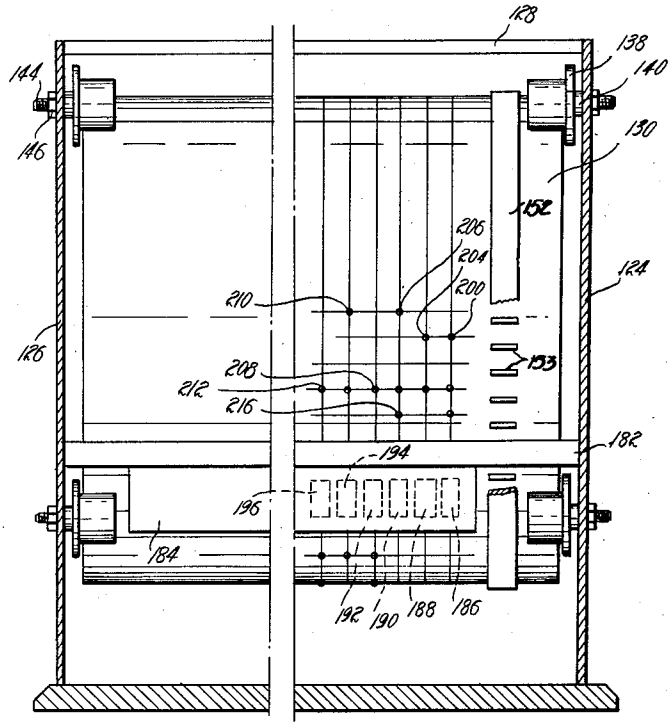
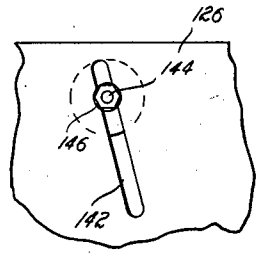


Fig. 4

Fig. 5



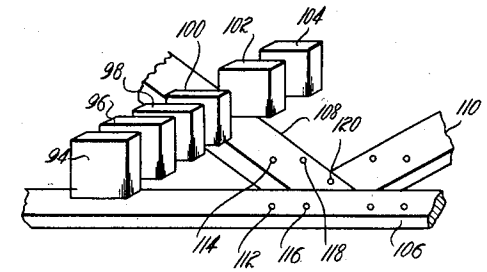


Fig. 7

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2,803,012

CONTROL SYSTEM

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Application December 29, 1955, Serial No. 556,341

15 Claims. (Cl. 1—1)

This invention relates to a machine for fabricating structural members and assemblies such as roof trusses, wall sections, floor sections, ceiling sections and other structures for use in the erection of prefabricated buildings, and more particularly relates to a system of controlling a generally conventional nailing machine for performing this work.

The construction of buildings and the manufacture of prefabricated building sections generally requires a great deal of manual labor in the asesmbly, nailing and other operations required. As a result of continual repetition of these operations even the most skillful workmen tend to become careless so that the sections are not always accurately constructed. While automatic machines have been developed for satisfactorily fabricating building sections, such as the type machine illustrated in United States Patent 2,574,163, these have been quite complex and costly and are often beyond the financial reach of small engineering and contracting organizations.

According to the present invention this expense problem is at least partially ameliorated through the provision of a control system which permits more or less conventional nailing machines to be utilized in the automatic fabrication of building sections or similar structural elements. The control equipment is simple and inexpensive so that any operator possessing a nailing machine of adequate size may convert that machine into an automatic device capable of performing the desired fabricating operation.

It is accordingly a primary object of the present invention to provide an improved automatic nailing system for fabricating building sections or similar structural elements.

It is another object of the invention to provide an improved control for a nailing machine to permit automatic fabrication of building sections and similar structural elements.

It is another object of the invention to provide a simple and inexpensive control system for a nailing machine whereby a large variety of different size and different shaped building sections and similar structural elements may be fabricated by means of simple and rapid adjustments of the control device.

Further objects and advantages of the invention will become apparent upon reference to the following specification and claims and appended drawings wherein:

Figure 1 is a plan view of a roof truss assembled on a pallet prior to nailing;

Figure 2 is a vertical elevation showing the pallet and roof truss of Figure 1 being fed through a nailing machine;

Figure 3 is a vertical cross section of a control device constructed according to the present invention;

Figure 4 is a vertical cross section taken along the lines 4—4 of Figure 3;

Figure 5 is a fragmentary vertical elevation showing the adjustable mounting of the rolls;

Figure 6 is a fragmentary detailed view of the control button on the nailing beam; and

Figure 7 is a perspective view showing a portion of a structural member advancing under the nailing chucks.

While this invention is suitable for use with any type of nailing operation it is particularly advantageous when utilized with the fabrication of building sections by means of sheet metal connectors and nails of the type described in my copending application Serial No. 492,840, filed March 8, 1955. Referring to Figure 1 of the drawings, a trussed rafter is shown generally at **10** and consists of rafters **12** and **14**, a joist **16** and trusses **18**, **20**, **22** and **24**. The rafters **12** and **14** are joined at the peak of the truss by means of a gusset plate **26** received in slots **28** and **30** in the ends of the rafters **12** and **14** and in slots **32** and **34** in trusses **20** and **22**. The remaining joints are similarly secured by means of gusset plates **36**, **38** and **40** as is more particularly described in my aforementioned copending application.

The trussed rafter **10** is assembled in this position on a jig pallet **42** and is held in an assembled position by means of stops **44** and toggle action clamps **46**. Clamps **46** may consist of a clamp block **48** pivotally connected to a bar **50** which is slidably received in a journal pivoted at **52** to a lug **53**. Lug **53** is carried by a lever **54** mounted on a pivot pin **56** which secures the lever to the pallet **42**. A spring **58** is mounted on the rod **50** and bears against the clamp block **48** and lug **53** on the lever **54** to urge the bottom side of the lug into engagement with a stop block **62** when the truss rafter is in a clamped position.

The pallet **42** is mounted upon a series of rollers **63** for rolling movement upon a suitable track **64** and is moved therealong by any suitable conveyor drive such as, for instance, a chain drive of the type shown in United States Patent No. 2,574,163. The conveyor system is driven by means of a conventional magnetic clutch-brake drive and the simultaneous energization of the drive and de-energization of the brake and vice versa is controlled by a pair of micro switches **66** and **68**.

The nailing machine may consist of a conventional nailing machine such as, for example, the type shown in United States Patent No. 2,232,725 as is shown in outline at **70** in Figure 2. The nailing machine includes a series of conventional nailing chucks **72** and **74** and each nailing chuck is provided with a conventional nailing punch **76** and with a flexible tube **78** which extends upwardly to the nail receiving funnels which are not shown. It will be understood that each of the nailing chucks **72** and **74** shown in the drawing represents a series of nailing chucks arranged in a line extending perpendicularly into Figure 2 of the drawing. The nailing punches **76** are actuated by means of conventional nail driving beams **80** which reciprocate in an up and down motion to perform the nailing operation.

Beneath pallet **42** is mounted a series of buttons **82** which, upon engaging micro switch **66**, de-energize the drive and apply the brake to bring the pallet to a halt with the button **82** depressing the switch **66**. The buttons **82** are so placed that the pallet is brought to a halt when the nailing chucks **72** and **74** are directly above positions on the truss rafter where nails are to be driven and the switch **66** also actuates the nail punch mechanism. Thus when the pallet comes to a halt with a button **82** depressing the micro switch **66** nails are automatically driven by the punches in a pattern determined by a control mechanism to be described in detail hereafter.

The nail driving beam **80** is provided with a button **84** which momentarily closes the micro switch **68** when the beam moves upwardly after driving the nails. This momentarily releases the brake and energizes the conveyor

mechanism to jog the pallet forward a small amount to allow button 82 to clear the switch 66. Once switch 66 is cleared the pallet moves forward under control of switch 66 until another button 82 is engaged.

In order to actuate switch 68 only on the upward stroke a movable button 84 is used as is shown in Figure 6. Where beam 80 is an I beam the button 84 is carried by a lever 86 pivoted to the web of the beam at 88. The lever is urged by a spring 90 into a stop 92. As the beam 80 moves upwardly the button 84 depresses the operating button on switch 68, while on downward movement the lever 86 pivots about the pin 88 and the button 84 does not actuate the switch 68.

When a pallet 42 is placed upon the conveyor 64 and the entire mechanism is turned on by an operator, the drive system moves the pallet to the left until the first button 82 actuates micro switch 66 to thereby de-energize the drive motor, actuate the brake and actuate the nailing mechanism. The beam 80 thereupon moves downwardly and the button 84 passes over the switch 68 without actuating the same. The beam 80 then moves upwardly on its return stroke whereupon the button 84 momentarily actuates switch 68 to release the brake and energize the drive system which moves the pallet forward to clear switch 66. Once switch 66 is cleared the pallet continues to move until another button 82 strikes the switch 66. It will be readily appreciated that by placing the buttons 82 at positions on the pallet where nails are desired a longitudinal placement of nails is effected. After the last button 82 on the pallet 42 clears the switch 66, the pallet continues to move until a button 82 on another pallet strikes the switch 66 to initiate another nailing operation.

Reference to the trussed rafter shown in Figure 1 will show that it is necessary to control not only the longitudinal but also the lateral spacing of nails in the structure. This is accomplished by means of a control mechanism shown in Figures 3, 4 and 5. Prior to running a series of trussed rafters or any other structure through the nailing machine the nailing chucks on the machine are positioned transversely of the rafter in such a manner that there is a nailing chuck at each transverse position that it is desired to drive a nail. The nailing chucks on conventional nailing machines, particularly the type shown in United States Patent No. 2,232,725, are normally adjustably mounted to facilitate such positioning as will be well understood by those skilled in the art.

Referring to Figure 7 there is shown a series of nailing chucks 94, 96, 98, 100, 102 and 104 arranged in preset transverse positions above a building structure consisting of joist 106 and trusses 108 and 110 which passes therebeneath. In order to drive nails at the positions 112, 114, 116 and 118, it is necessary to supply nails to chucks 94 and 98 when positions 112 and 114 are therebeneath, while at the same time withholding a supply of nails to the remaining chucks. The same chucks 94 and 98 are supplied with nails when the positions 116 and 118 are therebeneath, whereas when position 120 is reached only chuck 96 is supplied with a nail to be driven into the position 120. It will be readily apparent from this illustration that any satisfactory control system must be flexible so that the machines can easily handle building structures of different sizes and shapes.

Referring to Figures 3 and 4 there is shown a control system which satisfies these requirements. This unit comprises a base 122, end plates 124 and 126, and a cross brace 128. Mounted within the frame thus formed is a drum 130 which is supported in a centerless fashion upon three rollers 132, 134 and 136. Each roller is provided with a flange 138 for laterally positioning the drum 130 and the rollers are adjustably mounted by means of journals 140 received in end plates 124 and 126. In order to permit the rollers to receive and support different size drums, for a purpose presently to become apparent, journals 140 supporting rollers 132 and 134 are adjustably mounted in the end plates in slots 142 best seen in Figure 5. Each journal is clamped to the end plate by means of a screw 144 and nut 146 so that the rollers 132 and 134 are movable along lines 148 and 150 in Figure 3. This adjustability insures that drums of varying diameters are always mounted in the same positional relationship with respect to the fixed rollers 136. The drum 130 is driven by means of a toothed timing belt 152 which engages teeth 153 on drum 130 and which passes beneath an idler roller 154 and over a drive wheel 156.

The drive wheel 156 carries ratchet teeth 158 which are engaged by a ratchet lever 160 pivotally mounted at 162 upon an actuating bar 164 slidably mounted within a channel 166. The bar 164 is driven by the nail punch actuating beam 80 through a suitable cam or link mechanism so that the bar 164 moves upward each time that the beam 80 returns to its upper position. A linkage for accomplishing this is shown in Figure 3 and consists of a first link 168 centrally pivoted to a support at 170 and pivoted to the lower end of bar 164 by a pivot 172 passing through a slot in lever 168. The other end of link 168 is pivoted to a second link 176 by a pivot 174 which passes through a slot in lever 168. This second link is centrally pivoted to a support at 178 and to the beam 80 by a pivot 180 which passes through a slot in lever 176. Thus as the beam 80 moved upwardly the first link 168 is caused to rotate in a counterclockwise direction to force the bar 164 upwardly and thereby rotate the drive wheel 156 one increment. As the beam 80 moves downwardly the first link 168 rotates in a clockwise direction but does not move the drive wheel 156 since the ratchet lever 160 merely drags across the ratchet teeth 158.

The diameter of drum 130 is equal to the number of nailing operations times the circumferential increment of movement of drive wheel 156 caused by one upward movement of the nailing beam 80. Since the increment of movement of the drive wheel 156 is fixed, it will be seen that the diameter of the drum is dependent upon the number of nailing operations in a sequence. Thus, as an example, if it be assumed that in the fabrication of a given building structure there must be 100 actuations of the nailing punches, and if it is further assumed that each upward movement of the nailing beam 80 moves the periphery of the drive wheel 156 one inch, then the circumference of the drum 130 must be equal to 100 inches. Where a different type building structure is fabricated, utilizing, as an example, 50 nailing operations, the circumference of the drum must then be 50 inches.

The operation of changing drums is quite simple since it is merely necessary to loosen the nuts 146, remove the old drum, insert a new drum, and then move the rollers 132 and 134 into a position to support the new drum in the same relation to the stationary roller 136. The nuts 146 are thereupon tightened and the control mechanism is again ready for operation since the idler roller 154 takes up any increase slack in the timing belt 152.

Adjacent the stationary rollers 136 there is provided a support angle 182 having a switch support plate 184 extending between the rolls 136, as best seen in Figures 3 and 4. Mounted upon the support plate 184 are a number of micro switches 186—196 equal in number to the number of nailing chucks. The actuating buttons 198 on the micro switches are held in close proximity to or in light contact with the surface of the drum 130 and each micro switch cooperates with a circularly disposed series of buttons 200—212 which lies in a plane passing through the particular micro switch button 198. The surface of the drum 130 is divided by these planes into a grid 214 wherein the axial spacing between the planes is equal to the spacing between the actuating buttons 198 on adjacent micro switches 186—196 and wherein the vertical or circumferential spacing between axial button lines is equal to the peripheral increment of movement of the drive wheel 156 per reciprocation of the nailing beam

80. The buttons 200—212 may conveniently consist of headed pins frictionally held in equally spaced holes in the drum surface although other equivalent arrangements will be apparent to those skilled in the art.

Each micro switch 186—196 is connected in the circuit of a solenoid which controls the feed of nails to a nailing chuck and the nailing chuck is supplied a nail only when its corresponding micro switch is energized. In order to energize the desired micro switches circularly disposed series of buttons 200—212 are placed on the circumferential surface of the drum in the proper positions to actuate the desired micro switches and solenoids at any given position of the drum. Thus referring to Figure 4 it will be seen that when the buttons in horizontal or axial line 216 are opposite the control buttons 198 on the micro switches 186—196, micro switches 186 and 190 are energized whereas the remaining micro switches remain de-energized. Likewise when the following vertical or axial line of buttons 212 is in position adjacent the buttons 198 on the micro switches 186—196, each of the micro switches 186—196 is actuated. It will be apparent that the control buttons may either close or open the micro switches depending upon the particular solenoid arrangement used.

Referring to Figure 7 and remembering that for each nail chuck 94—104 shown there is a corresponding micro switch 186—196, it will be seen that in order to drive nails at positions 112 and 114 the micro switches corresponding to nailing chucks 94 and 98 must have drum buttons therebeneath when the nailing chucks 94 and 98 are vertically alined with positions 112 and 114. In order to drive a nail at position 120 there must be but one button on the drum in a position to actuate the micro switch corresponding to the nailing chuck 96.

It will be apparent from the foregoing that for the fabrication of any given structural member the size of the control drum is easily calculated and the position of the buttons thereon is easily determined from a knowledge of the nails to be driven at each forward advance of the structural member. The buttons on the drums may be readily movable so that a change in the nailing pattern is accomplished simply by removing or inserting buttons. Where different size or different shape structural members are to be fabricated different drums are provided and a stock of such drums may be maintained so that a change over from the fabrication of one structural member to another structural member is simple and quick and requires a minimum of equipment.

The overall operation of the device is as follows: A trussed rafter is assembled upon a pallet 42 and is clamped thereon by means of stops 44 and clamps 46. The pallet 42 is thereupon placed upon the conveyor 64 which is moving forward in predetermined increments under the control of the preceding pallet. At the end of the final nailing stroke on the preceding pallet the upward movement of the beam 80 rotates the drive wheel 156 in Figure 3 in a counterclockwise direction to bring the drum 130 to a start position wherein the proper micro switches 186—196 are actuated so as to insure that the proper nailing chucks will be supplied with nails during the next downward motion of the nailing beam 80. After the preceding pallet has cleared the nailing machine, the pallet 42 moves forward until the first button 82 engages the micro switch 66. This de-energizes the drive of conveyor 64, actuates the brake to bring the pallet to rest and simultaneously energizes the nailing beam 80 which thereupon moves downwardly to drive the nails present in the nailing chucks. As the nailing beam moves upwardly in its return stroke the ratchet lever 160 again advances drive wheel 156 one increment to place another row of buttons beneath micro switches 186—196 to control the placement of nails for the next downward movement of the beam. This upward movement of beam 80 also causes button 84 to momentarily close micro switch 68 to de-energize the brake and energize the conveyor

whereby the pallet 42 is jogged slightly to the left in Figure 2 so that button 82 clears switch 66. When this button clears switch 66 the driving mechanism is closed by switch 66 and continues in a driving condition until the next button 82 engages switch 66 to de-energize it. Nailing beam 80 is simultaneously driven downwardly to drive another set of nails. The pallet thus advances in stepwise fashion until the final button 82 clears the switch 66 whereupon the drum 130 is again in a starting position and remains in such a position until the first button 82 on a new pallet engages the switch 66.

Speed of operation is determined by the speed of the conveyor and by the rapidity with which the nailing machine 70 may be actuated. The control system is extremely simple and inexpensive and permits a complete flexibility of operation. The system is adapted to use with practically any conventional nailing machine which may be provided with a conveyor system and does not require expensive special purpose equipment.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. A control device for a plural chuck nailing machine having a reciprocating nail driving element and electrically controlled means for feeding nails to said chucks, comprising: a centerless mounted drum, a series of switches mounted in proximity to said drum and connected to control said means for feeding nails, spaced means on said drum cooperating with said switches for selectively actuating said switches on rotation of said drum, and means for rotating said drum one increment upon each reciprocation of said nail driving element.

2. A control device as set out in claim 1 wherein said means for rotating said drum comprises a drive wheel drivingly connected to said drum and a ratchet for moving said drive wheel.

3. A control device as set out in claim 1 wherein said drum is mounted upon at least two sets of rollers and is driven by means of a belt.

4. A control device as set out in claim 1 wherein said spaced means on said drum comprises circularly disposed groups of buttons arranged on the surface of said drum in spaced parallel planes normal to the drum axis and passing through the respective switches.

5. A control device as set out in claim 1 wherein said drum is mounted within at least three sets of rollers and wherein at least two of said sets are adjustable to receive drums of different diameters.

6. A control device as set out in claim 5 wherein one set of rollers is fixedly mounted, said switches being mounted adjacent the axis of said fixedly mounted rollers on a line parallel to said axis so that drums of varying diameter occupy similar positions with respect to said switches.

7. A control device as set out in claim 6 wherein said adjustable sets of rollers are adjustable along lines intersecting the axis of said fixed set of rollers.

8. A control device for a plural chuck nailing machine having a reciprocating nail driving element and electrically controlled means for feeding nails to said chucks, comprising: a frame including a pair of end plates, a first pair of rollers mounted on a single axis on the respective end plates, at least two additonal pairs of rollers mounted on spaced axes on the respective end plates, said two additional pairs of rollers being adjustable towards and away from said first pair of rollers, a drum rotatably supported by said rollers, a drive wheel rotatably

mounted and connected to said drum by means of a drive belt, ratchet teeth on said drive wheel, a ratchet member engaging said ratchet teeth, means for reciprocating said ratchet member under control of said reciprocating nail driving element to drive said drive wheel and said drum, a plurality of switches mounted in a line adjacent said drum and adjacent and parallel to the axis of said first pair of rollers, a plurality of circularly disposed groups of buttons mounted on the surface of said drum in planes passing through said switches normal to the axis of said drum, said buttons being of a size to actuate said switches when said buttons are rotated into juxtaposition with said switches, and said switches being connected to control said nail feeding means whereby a nailing pattern is controlled by said buttons.

9. An automatic nailing system comprising in combination, a plural chuck nailing machine having a reciprocating nail driving element and electrically controlled means for feeding nails to said chucks, a conveyor means passing beneath said chucks, a pallet mounted for propulsion on and by said conveyor means, means on said pallet for halting said conveyor means and energizing said nail driving element, means for selectively controlling the feed of nails to said chucks, said last named means including a plurality of switches respectively connected to said electrically controlled means for feeding nails to said chucks, a centerless mounted drum adjacent said switches, means for driving said drum one increment for each reciprocation of said nail driving element, and spaced means on said drum cooperating with said switches for selectively actuating said switches on rotation of said drum.

10. An automatic nailing system as set out in claim 9 wherein said means for driving said drum comprises a drive wheel belt connected to said drum and driven by a ratchet means actuated by reciprocation of said nail driving element.

11. An automatic nailing system as set out in claim 10 wherein said drum is mounted within at least three sets of rollers and wherein at least two of said sets are adjustable to receive drums of different diameters.

12. An automatic nailing system as set out in claim 11 wherein said spaced means on said drum comprises circularly disposed groups of buttons arranged on the surface of said drum in spaced parallel planes normal to the drum axis and passing through the respective switches.

13. A control device for a plural chuck nailing machine having a movable rail driving element and electrically controlled means for feeding nails to said chucks, comprising: a rotatably mounted drum, a series of switches mounted in proximity to said drum and connected to control said means for feeding nails, spaced means on said drum cooperating with said switches for selectively actuating said switches on rotation of said drum, and means for rotating said drum an increment of a turn upon each movement of said nail driving element.

14. A control device for a plural chuck nailing machine having a nail driving means and remotely controlled means for feeding nails to said chucks, comprising a rotatably mounted drum, a series of control devices mounted in proximity to said drum and connected to control said means for feeding nails, spaced means on said drum cooperating with said control devices for selectively actuating said control devices on rotation of said drum, and means for rotating said drum an increment of a turn each time said nail driving means is actuated.

15. A control device as set out in claim 14 in which said means for rotating said drum comprises a drive wheel having teeth, a ratchet member for engaging and advancing said drive wheel, and a belt connecting said drum and drive wheel.

No references cited.